The Manufacture of a Tube

Why the Silver Coating Is Present — Filament Called the Most Important Part—It Is 19 Times Heavier Than Water and Melts at a Higher Temperature Than Any Other Metal.

By F. C. Kelley
Research Laboratory of the General Electric Company

DID you ever stop to think how this little product of research and scientific development, the vacuum tube, was evolved? Let us analyze this small bulb filled with metal parts and see how it is made.

The filament, which is the most important part in the tube, is made of tungsten, one of our rare metals. It is more than 19 times as heavy as an equal volume of water, and melts higher than any other metal. The tungsten is obtained in powder form after reduction from its oxide by pure hydrogen.

The pure powder, mixed with small percentages of thorium oxide and carbon, is first pressed under hydraulic pressure into bar form. If handled at this stage, the bar will break, so it is supported on a solid slab of tungsten and pushed into a hydrogen furnace where it is cintered at a white heat.

Reduced to Pure Thorium

It is then refired at a temperature just below the melting point in an atmosphere of hydrogen by passing a very heavy current through the bar. During this operation the bar is held at one end between the jaws of a tungsten-faced, water-cooled, copper clamp forming one terminal, and at the other end by a similar clamp forming the other terminal. The latter clamp hangs in a bath of water-cooled mercury.

The bar cinters or shrinks both in length and cross section while the carbon reduces the thorium oxide to pure thorium metal. The density of the bar is now about the same as that of pure tungsten which has been melted, and can be hammered hot by machines, called swaging machines, into round rods, and then into small wire. The wire, after reaching a certain diameter, is drawn down cold through diamond dies to filament size. This gives us the final filament material.

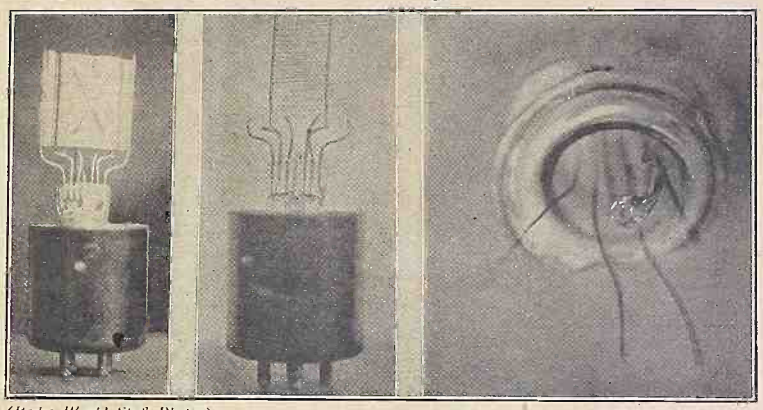
When the tungsten is heated to a high temperature in the vacuum tube, the thorium diffuses to the surface, covering it with a layer measured in atoms of thickness.

The metal thorium is used to give increased current from the filament to the plate. There is a critical temperature where the tube operates with the greatest efficiency and the thorium diffuses to the surface just fast enough to keep it covered.

Effect of Excesses

If the filament temperature is too low the thorium does not give so much plate current, and if it is too high the thorium evaporates from the filament faster than it can diffuse to the surface. The former condition produces low efficiency, and the latter causes deactivation of the filament resulting in still lower efficiency, and lower current from the filament to the plate.

There is still another change which occurs when the tungsten is heated to such a high temperature. It develops a crystalline structure, and upon the arrangement of these crystals in the filament depends the life of the tube. This crystal structure is controlled by the treatment of the wire in the making so that today we have tubes with long lives.



(*Radio World Staff Photos*)

FIGS. 1, 2 AND 3

The plate of a tube is shown at left, the view obtainable when the glass envelope is removed from the base. In the center is shown the grid, after the surrounding plate has been removed. At right is the flared end of the bulb, with terminal leads exposed. Note the point from which the exhausting is done and how it looks after being sealed.

Alloy Solves Problem

At one time all of the lead-in wires of our lamps and vacuum tubes were made of that rare, expensive metal, platinum. It was used because it was the only metal known that could be sealed into glass without cracking, and still give a vacuum tight joint. Then, no other metal with like properties was known. The increased demand for lamps, vacuum tubes, and the cost of platinum demanded a study of all the possible substitutes for this valuable metal. After a long investigation an alloy of nickel and iron was found which had the same coefficient of expansion as glass. It was necessary to produce this alloy wire with a thin copper coating to obtain a vacuum tight joint between the glass and the wire. The comparatively cheap copper-covered alloy wire today takes the place of the rare, expensive element, platinum, used in our early vacuum tubes. The alloy is used, then, only for the joint between the glass and the wire in that part of the tube known as the stem.

The stem consists of a small glass tube one end of which is flared so that it may be sealed into the bulb, and the other end contains the lead-in wires to the filament, grid and plate about which the glass is fused.

Constituents Explained

Small anchor wires are also sealed into the closed end of this stem and to them are welded nickel support wires for the filament, grid and plate. When completed, the stem carries the filament supported in the center of the plate with the grid correctly spaced between them.

The grid is made of fine tungsten wire wound around two nickel support wires in the form of a flattened spiral. Each point of contact between the spiral grid and support wires is welded.

The plate consists of a flattened cylinder of thin, sheet nickel, welded to nickel support wires.

Burning the Filament Too Low Causes Insufficient Plate Current, While an Overdose of Voltage Produces a Condition of Partial Paralysis—Alloy a Life-saver.

After the stem is made and the parts are mounted on it, the bulb is put down over it, and sealed to the flared end of the stem. The bulb is provided with one tube which is connected to the vacuum system for exhausting, and another which contains magnesium wrapped in sheet nickel.

The tube, after being sealed on the vacuum system, is exhausted, and then it is baked in an electric oven for a certain length of time, and at a definite temperature, in order to get rid of the water vapor or moisture in the glass. After this bake-out, the current is shut off from the oven, and the tube is allowed to cool.

Elimination of Gases

The metal anode, or plate, and the grid are now heated up to a temperature just below the melting point of nickel by a high frequency induction coil in order to get rid of the gas in the metals. The filament is heated to a very high temperature by passing a current through it in order to get rid of its gas. These gases are pumped out as fast as they are liberated. We have now a very high vacuum after pumping out all of the moisture in the glass and the gases in the metal parts, but still, we are not satisfied.

The magnesium, wrapped in a piece of thin nickel and held in the small side tube, is now heated by a high frequency induction coil until the magnesium vaporizes, and condenses in the bulb, giving it the appearance of a mirror. This metal reacts with the last traces of the more troublesome gases left in the tube, and cleans them up, giving us a still higher vacuum. The tube is now sealed off and based by automatic machinery. The filament, grid and plate wires are soldered to the insulated terminals in the base by an operator and we have the complete tube.

An Eliminator For Supers

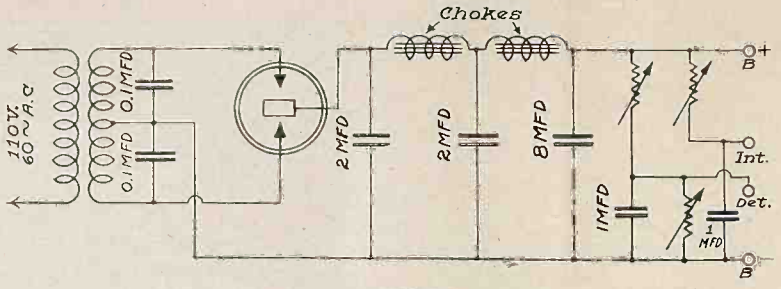


FIG. 1
The wiring diagram of the B eliminator

Raytheon Tube Is Employed in Conjunction With a General Radio 365 Transformer, Specially Suited to the Load-power Derived From 110-Volt 60-Cycle AC Main.

Limitation to 3 or 5-Tube Sets Removed by Providing a Device of Ample Capacity—No AC Hum Is Audible—"Final Silencers" Amply Take Care of This — Both Sides of Wave Rectified.

By H. G. Silbersdorff

WITHIN the past few months readers of RADIO WORLD were presented with several very fine articles on popular Super-Heterodyne models. I daresay those who closely followed instructions when building up any one of these models are more than satisfied with the results and feel, as I do, there is nothing like a Super, when you get one "hitting on all eight."

It is true some of the Supers described are very economical to operate due to their design, but many desire an everlasting source of B voltage.

The solution is a B eliminator that operates from the house lighting circuit. If it is well designed it will have ample reserve power and capacity to insure rich and clear reception. Unfortunately, however, this is not the case with all eliminators. Quite a few of them operate very well on 3- and 5-tube sets but when called upon to satisfy the needs of a real Super-Heterodyne they fall down miserably due to their low power and capacity. Because of this fact I will describe a unit which I know will fill the bill and prevent other 8-tube fans from wasting time and money on eliminators not capable of performing the necessary duties.

Used with Victoreen

The receiver I am using, because of its design, draws considerably less current from the batteries than do other similar sets which I have experimented with. In actual measurements it was found to draw only 19 milliamperes. It is a duplicate of the set described in RADIO WORLD under dates of February 20, 27, March 6 and 13 (the Victoreen), truly a remarkable receiver.

There are many requisites a B eliminator should have, and for the benefit of those contemplating the building of such a device I will name a few of prime importance. First it must have an output of about 60 milliamperes which will give one a large margin of safety, as it may be desirable to use several power tubes in the audio stages at a later date. It must be capable of doing this without passing any trace of alternating current hum. If tubes are used, they should have long life. This is another serious matter with some of the present-day eliminators using the standard -O1A type of tube as rectifiers. They must operate at an excessive overload and their life is usually a matter of a few months. Some eliminators will render certain tubes useless after a run of only one-half hour! To obtain results with minimum operating expense, full wave rectification is desirable, and this result with only one tube as rectifier, rather than two tubes.

Regardless of the type eliminator you build the condensers used in its filter system are of great importance. Until recently the only large capacity condensers which were available to the experimenter were of the ordinary by-pass type, primarily intended for use in receiving circuits. These condensers under no consideration were to be used in circuits opating at an A.C. potential. Consequently with nothing else to be had, home builders started building eliminators with these low voltage condensers, with the result that they blew rapidly. This proved to be costly experimenting. But times have changed and it is now possible to obtain high capacity condensers which are subjected to a 700-volt operating test, not merely a flash test. These condensers now have a safety factor of more than 300% and if correctly wired will cause no further trouble along this line.

The Choke Coils

Together with the filter circuit one or more chokes are usually used. These chokes must be designed especially for the job. Their resistance must be low to reduce to a minimum the voltage lost in them. Purely for the sake of appearance it is desirable to have both of these chokes, if two are used, housed in a metallic case (for shielding) which resembles in size and appearance that of the transformer.

This item is also an important one. The experimenter at last realizes that a rewound bell-ringing transformer cannot handle the job. The transformer, like all other transformers, must be designed especially for the work. The transformer I am using has its primary designed to operate from 110 volt 60 cycles. The high voltage secondary consists of two sections of 200 volts each. This makes it adaptable either to single or double wave rectifiers. It has an additional feature of terminals brought out from the primary which may be used to light the filament of a thermionic rectifier, or, in case the well-known Raytheon tube is used, it is possible to operate one stage of power amplification with unrectified filament supply.

A schematic circuit diagram is shown in Fig. 1. The two 0.1 mfd. condensers are used across the transformer output to absorb AC surges, to protect the windings of both the transformer and the choke coils, and to prevent too sudden cut-off in the tube. They also serve to eliminate high frequency disturbances from occasional discontinuities or changes in the character of the current supplied to the rectifier.

The Final Silencers

The two 2.0 mfd. condensers are a part of the filter. These function largely to improve the regulation of the Raytheon tube which is used and when there is a sudden draw upon it, they bolster up the voltage being delivered to the set, thus preserving the quality of the audio reproduction. The 8.0 mfd. condenser, which may be made up of two 4 mfd. condensers connected in parallel, completes the filter work and removes the last vestige of hum from the raw rectified AC.

The two 1.0 mfd. condensers, employed when there are intermediate voltage taps on the B eliminator for supplying the intermediate or radio frequency amplifiers and the detector plates, still further filter the residual hum, which is partly critical in the case of a detector tube. In short, they act as final silencers.

For the convenience of the novice, the Tobe Deutschmann Co. have incorporated all capacities with the exception of the two 0.1 mfd. condensers in a single housing. This compact arrangement considerably simplifies wiring and permits a neater and more compact arrangement of parts than when the individual condensers are used.

This B block, as it is called, is provided

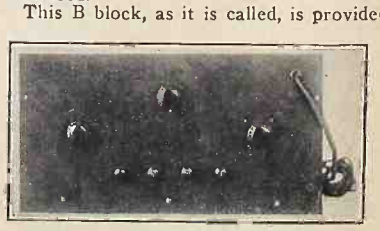


FIG. 2
The front panel view.

LIST OF PARTS

One General Radio Type 365 Rectifier Transformer.
One General Radio Type 366 Filter Choke.
One General Radio Type 156 Socket.
One Raytheon Rectifier tube.
One Tobe Deutschmann B block.
Two 0.1 Tobe Deutschmann condensers.
Three Bradleyohms No. 10.
Binding posts, wire, panel, cabinet and miscellaneous accessories.

It Passes 60 Milliamperes

Tips on How to Be Careful in Handling the Eliminator.

with six binding posts at its base, each plainly marked, signifying the capacity leading to each terminal.

The resistance R1, R2 and R3 are variable Bradleyohms No. 10 and have a range from 10,000 to 100,000 ohms. R2 may be fixed, provided it has a value of 10,000 ohms and is capable of passing at least 15 milliamperes.

Construction Advice

Of course the unit may be built on a breadboard and left exposed but the best way is to build it up on a board that will fit one of the standard size cabinets now on the market. I utilized a cabinet from a discarded 1-tube set. My baseboard measures 13x7½" and the cabinet measures 7" high. Such a cabinet requires a panel 7x14". All that is necessary to mount on the panel are the three variable resistors and the four output binding posts. It might be well to mount a bushing also to finish off the hole through which the 110-v AC lead passes. This will then permit the removal of the panel and baseboard as a unit without first removing the attachment plug cap, which would be necessary if this lead entered through the rear of the cabinet.

After the assembly is completed the eliminator may be placed into operation by connecting the transformer primary to the power supply and connecting its output to the receiver.

It will be noticed four binding posts are provided on the eliminator, whereas most Super-Heterodynes require only three for the B battery, namely B minus, B plus Det. (and intermediates) and B plus amplifier. The fourth post may remain open for the time being. Later on you might decide to use the eliminator on other sets. Then you will be glad you took time to to install the extra terminal.

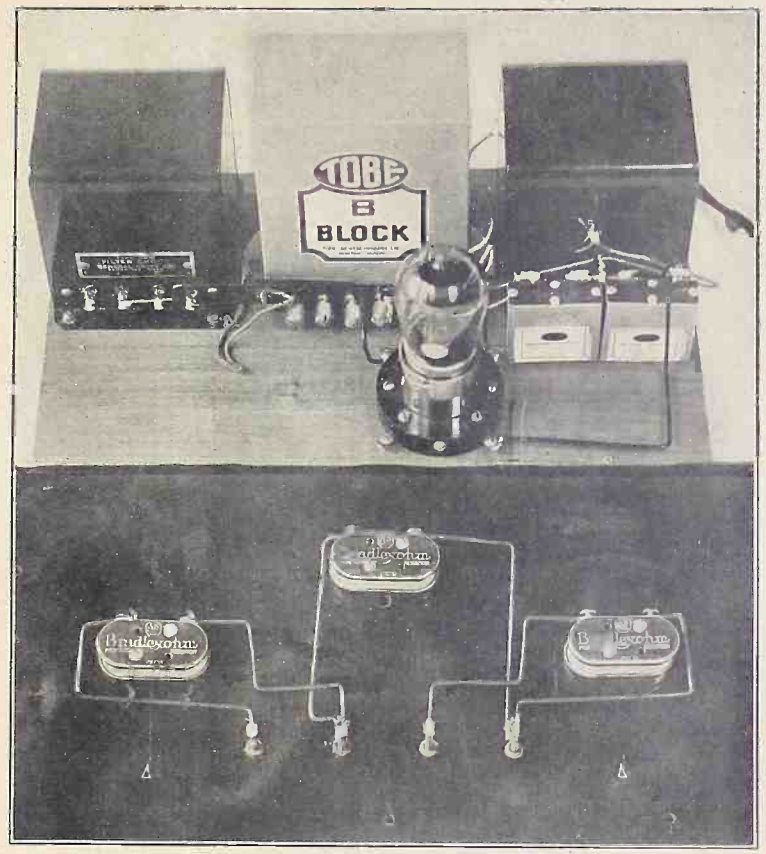
Detector Voltage Important

Voltages to the detectors and intermediate amplifier tubes are controlled by the variable resistances. After the eliminator is connected as described, the resistance knobs are turned until the proper plate voltages are obtained for the tubes of the set.

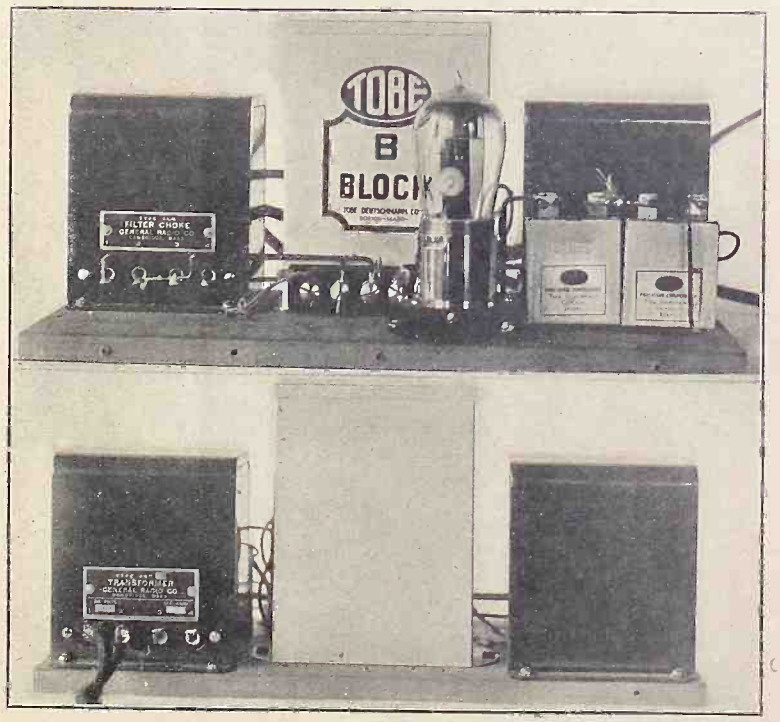
Care should be exercised in the operation of the eliminator. High voltages are being handled which are capable of giving one a bad shock if allowed to come in contact with the hand. Always make it a rule to turn off the power supply before touching any part except the detector adjustment. This adjustment will be found to be of great help in clearing up distant stations.

The voltage which the eliminator delivers is higher than that ordinarily employed, so the C battery voltage should be increased accordingly. It may be advisable to use two C batteries connected in series to take advantage of the higher plate voltage. Tone quality is improved.

The small pocket type voltmeter usually draws from 50 to 100 mils, which is too high to get correct output reading. A proper meter would be one drawing only a few mils. Such an instrument may easily be made by connecting a 100,000 ohm resistance in series with a 5 mil milliameter. The load is then only 1 mil for each 100 volts.



FIGS. 3 AND 4
An angular view of completed eliminator and the back of the panel are shown.



FIGS. 5 AND 6
The rear view, with parts arranged and tube in place, and a view of the other side.

Vagaries of Radio Waves

Scientists Alone Must Conquer Great Barrier of Puzzling Behavior of Radiated Impulses, Says Dr. Dellinger—"Radio," He Adds, "Is a Sublime Manifestation of the Power of the Almighty And of the Higher Reaches of the Human Intellect."

By Dr. J. H. Dellinger

Chief of Radio Laboratory, U. S. Bureau of Standards

THE experiences of many persons with radio reception lead to a belief that there is nothing dependable about it. This belief is not surprising, for radio waves do have certain peculiarities which limit what radio can do. I am going to tell of some of these imperfections of radio. But the telling will not paint a dark picture nor justify anyone's belief that radio is now going to the bow-wows. On the contrary, there are times and conditions when radio gives a really superb service. When listening with a first-class receiving set to some of the fine musical programs broadcast from a local station with no other closer than a hundred miles to offer interference, you may have the thrill which comes only from perfection.

On such occasions you can participate at a distance in the excitement of a baseball series; or, again, all the majesty of the finest music art is actually brought to your own fireside. I am in entire sympathy with the belief that radio is a sublime manifestation of the power of the Almighty and of the higher reaches of the human intellect. This belief is increased, not diminished, when you know the difficutlies and limitations imposed by the materials with which we have to deal.

Worse Than Sopranos

One may well marvel that the radio engineer is able to deliver beautiful music and acceptable, even inspiring, radio programs from the transmitter to the repend on radio waves to convey the programs from the transmitter ot the recieving sets; for nothing has been discovered in the history of science quite so temperamental, variable, and erratic, as these same waves. Not even the temperamental sopranos who try the patience and strain the religion of the program director, are as hard to manage as the radio waves with which the radio engineer back of the scenes must struggle.

This is a new emphasis in radio. Until recently the problems and difficulties of radio were wrapped up with apparatus and currents. Now the chief limitation on progress is the erratic behavior of the waves. And just because of this, radio wave behavior is attracting widespread attention, for it is the unsolved problem, the difficult job, the frontier of conquest, which challenges people's interest.

The history of radio in our day turns on three major problems. The first was the problem of five years ago when broadcasting began. Everyone felt the crying need of improving the apparatus for receiving the broadcast programs. By and large, this ideal has been realized.

The second great problem of radio is today's problem of how to control or circumvent the vagaries of radio waves, and that will be the subject of this discourse.

The third great radio problem is one which waits for tomorrow for its solution, and that is the problem of the control and administration of broadcasting.

The first problem, that of yesterday, was a problem solved by the engineer. Today's problem of the radio wave vagaries is one for whose investigation we must look to the scientist; and I am sure I don't know who is going to solve the great human problem which I have indicated as belonging to tomorrow.

Progress in Wave Study

The subject of radio wave vagaries is of interest not only because it is timely but because noteworthy progress is being made in the understanding of their hitherto inexplicable mysteries. For instance, the unfavorable reception conditions of the past winter were notorious and stimulated universal inquiry. Some of the mysteries are now being cleared up. To be sure, the explanations cover a relatively small part of what is known for as the explanations develop the complexity and extent of the known radio phenomena increase still faster. It is therefore out of the fullness of my ignorance that I speak on this subject.

In a sense we know much less about the actual behavior of radio waves now than we did ten years ago. We then had a comfortable explanation of the known phenomena in terms of wave motion in the ether. The ether is a strictly homogeneous something filling all space, and its sole function is to transmit electrical actions. To be sure, Einstein and some other scientists declare that the ether doesn't exist, but the idea of its existence gives great help in understanding radio wave action just the same. And the ether has recently acquired the respectable status of legislative protection, for in an Act passed by the House of Representatives in March it was "declared and reaffirmed that the ether within the limits of the United States, its Territories and possessions, is the inalienable possession of the people thereof."

The vagaries to which radio reception is subject include: (1) intensity variation; (2) fading or fluctuation of received signal; (3) amtospherics or static; (4) variations of wave direction and polarization; (5) interference of various kinds. Interference is due to electrical apparatus and other man-made sources and is not included in this discussion. We are here concerned only with these vagaries arising between the transmitting station and the receiver. Not only are the wave vagaries I have listed very familiar and prevalent, but their effects are entirely different under different circumstances. It might seem entirely hopeless to find any regularity in their effects or to determine anything about their causes when you consider a list of the conditions upon which they vary.

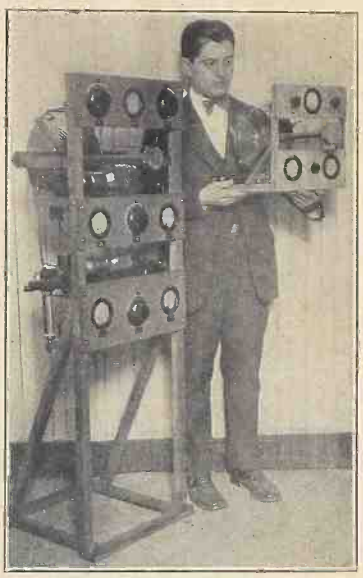
Intensity Varies Much

These conditions include frequency or wavelength, distance, place (land, sea, mountains, and different character of soil), time (day and night, summer and winter, sunset), occurrence of eclipses, solar activity (sunspots), aurora, atmospheric electricity, terrestrial magnetims, and weather. In spite of all this complexity, a number of facts have definitely emerged from the intensive studies which have been and are being made of radio phenomena by investigators all over the world. It will be most interesting and helpful to describe the known facts for various ranges of radio frequencies.

For frequencies from about 15 to 500 kilocycles (20,000 to 600 meters), the vagaries and difficulties of radio wave transmission are not as serious as at the higher frequencies. There is no perceptible variation for distances up to several hundred miles from the transmitting station. At greater distances there is noticeable variation of received wave intensity at different times of day and year. These changes of received intensity are progressively greater for higher frequencies in the frequency range here considered. Static, on the other hand, is greater the lower the frequency, and is somewhat more intense at night than in the day time.

The changes of received wave intensity at various times of day and year are present in more marked degree at the frequencis used for broadcasting, 500 to 1500 kilocycles (600 to 200 meters). In addition to these changes there occurs what is called fading, that is, irregular and rapid changes of the received signal, at times becoming so violent that the signal fades away entirely and then comes in again. These fluctuations are among the most baffling features of radio transmission. They occur particularly at night and at distances greater than about 50 miles from the transmitting station. In the daytime signals from broadcasting stations are rarely heard more than about 50 miles and they are, generally speaking, quite steady. At night the waves from the same stations may be received hundreds or even thousands of miles away, and are characterized by fading. The fading is more severe, with more rapid and intense

Likes Wood Panels



(Herbert Photos, Inc.)

JEROME GROSS, who built the two transmitters shown, used wood throughout for both panels and frames. He uses treated maple. He is shown holding a 7½-watt transmitter, the large one a 250-watter. Both transmitters have reached out to the same distance, approximately, 10,000 miles, on 20, 40 and 80 meters.

To-day's Greatest Problem

fluctuation, at about 100 miles from a transmitting station than at shorter or longer distances.

There is frequent mention of the existence of radio dead spots, that is, regions in which reception from particular stations is very difficult or impossible. This is tied in with the fact that radio transmission is better in some directions from a station than others. These differences can usually be explained in terms of topography of the land or presence of particular kind of obstacles.

The waves travel better and are less absorbed over water than over land, and hence tend to follow rivers. They are impeded by mountains which, so to speak, cast a shadow or cause something of a dead spot in the region beyond them. In special cases where a mountain or large cluster of tall steel buildings is nearer the transmitting set the shadows may be very marked indeed and may practically cut off all reception in regions beyond them. The largest cluster of tall buildings in New York creates dead areas in which reception from WEAF is very poor; these areas extend well into Connecticut and Long Island.

At frequencies above 1,500 kilocycles (below 200 meters) the peculiarities are still worse. As everyone knows, it has been discovered that the very high frequencies will travel immense distances with small transmitting power, but generally speaking, they are unreliable and subject to fluctuations of all sorts. Using very high frequencies radio reception has been achieved not only for the full distance of half way around the earth but even farther.

The Darkness Effect

This paradox is explained by the fact that the waves travel best over that half of the earth which is in darkness, and if a receiving point is in the daytime half of the earth near the boundary between day and night, it is actually found that a received wave travels around through the darkened hemisphere rather than over the somewhat shorter path through the light hemisphere. In receiving half way round the earth it is found that the signals are stronger at the antipodes than at intermediate points, apparently because of a convergence of the signals from many paths; and there are frequencies at which it is possible to receive at the antipodes throughout very nearly the whole 24 hours.

One of the most remarkable things about the very high frequencies is that there are distances or zones of alternate good and poor reception. Thus there is a so-called skip-distance over which radio signals may not be received at all while they come in very well at distances beyond. For instance, a 10,000 kilocycle (30 meter) signal will diminish with the distance and become inaudible at 70 miles and cannot be heard at all at distances beyond that until a distance of 500 miles is reached, at which it appears again. This skip-distance is different for different frequencies and furthermore varies with the time of day and time of year.

The fading effects as well as the received intensity also vary with time of day and year as well as distance. It is observed for instance that the fading at distances of several thousand miles is not as it is at distances from a fe whundred to a thousand miles. The fading is sometimes of very high speed, so much so that at times it spoils the quality of the received sounds because it is so rapid as to approach the frequency of sound waves.

The main conclusion to be reached from our knowledge of the radio wave vagaries is that their chief source and cause is in the higher regions of the earth's atmosphere. The vagaries are produced by electrical conditions in the atmosphere and these electrical conditions become more pronounced at higher levels in the atmosphere. There is little effect produced on the radio waves in the first 8 or 10 miles, however, conditions occur which determine the radio wave vagaries of which I have been speaking.

Globe Used As Aerial

(*Herbert Photos, Inc.*)

A LARGE BRASS globe may be used as an aerial. It is placed atop a six-foot pipe and the lead-in is connected to a binding post on the globe.

Experienced and theory both indicate that there is not a great deal of connection between radio phenomena and weather. Static consists of waves which are identical in character with the radio waves themselves but they come from natural electrical discharges in the air. Lightning is just one form of such discharges. These electrical discharges occur most frequently in the torid regions of the earth and in storm areas. Accordingly, the static actually comes principally from torrid regions and from storm areas, and is worse in the summer than in winter.

Northern Lights

There is no definite relation between radio transmission effects and aurora or magnetic storms. Aurora and magnetic storms usually come together. The northern lights or visible atmospheric discharges known as aurora, usually have no effect on radio reception one way or the other but have in some instances been known to diminish the intensity of received waves and in other cases to increase it. There does seem to be some effect of sunspots on radio reception, however. Sunspots throw out enormous eruptions of electrons and other electrical particles some of which may reach the earth's atmosphere.

When the sunspots are particularly intense, radio reception is apt to be disturbed and poor. This has not been conclusively proved but seems to be indicated by such observations as have been made. The sunspot cycle is 11 years, that is, there is a minimum of spots on the sun for a time after which they gradually increase and pass through a maximum and return to a minimum, the whole occupying a cycle of 11 years.

The last sunspot minimum was in 1922 and it would be inferred, therefore, that radio reception was at its best in 1922, should be progressively worse from 1922 to about 1928 and that in succeeding years reception conditions should improve and be at their best again in 1933. It will be interesting to see whether this occurs and whether future observations on sunspots will show a closer correlation with radio reception conditions.

The first suggestion that conditions very high up in the atmosphere might affect radio transmission was made by Professor A. E. Kennelly and by Oliver Heaviside. These physicists both suggested that at a great distance in the air, about 60 miles up, the ionization of the atmosphere is so great that above this height the atmosphere would be a very good conductor and that this would assist in the travel of radio waves.

An extensive study of fading led to a theory which unraveled many of the mysteries. This explanation was that the waves travel along the earth in the daytime and along the upper conducting surface of the atmosphere at night. This explained the fact that daytime distances of transmission are affected and determined by the absorption due to topography, and so forth, on the earth's surface, while at night the waves are free to go very great distances possible when free from this absorption.

Remarkable Effects

The waves are confined to traveling along the earth's surface in the daytime because they cannot penetrate high into the air which is ionized by the sunlight. Ionization is a condition produced by the sun in which the air is partly broken up into electrically charged particles which retard the passage of the radio waves. At night, the sun being absent, the air is no longer ionized and waves are able to get up to the upper conducting surface commonly known as the Heavenside surface, and travel along it and thus go to great distances. The Heaviside surface is, of course, not a perfectly smooth surface like a mirror but it is necessarily irregular as anything in our shifting atmosphere must be, and the effect of the irregularities along this surface is to produce the variations and fluctuations evidenced in a receiving set as fading.

The reason that the fading is not so bad at greater distances is that the wave transmitted directly along the ground becomes so weak as to die out altogether, and there is present at greater distances only the signal due to waves which have travelled along the Heavenside surface.

Remarkable effects of the very high frequencies have been discovered just recently, and numerous investigators are daily adding to the store of ascertained facts. The known effects and established theory are much more extensive and complicated than what I have been able to cover. For instance, I have said very little about the wave direction changes or the corkscrew motion of the waves which cause them.

It would be difficult now to imagine any explanation of radio wave transmission which did not include these elements: earth-bound waves with little or no fading for a limited region around the transmitting station, a region of interference and severe fading at night outside of that, and beyond that region a still greater one in which the signals are entirely due to waves transmitted along the Heaviside surface.

Very high frequencies differ from the lower in being able to penetrate up to the Heaviside surface in the daytime, and in the existence of a gap or skip-distance between the region close to the transmitting station in which the earthbound weave is effective and the further regions in which the upper-air wave is effective.

The only answer is that radio wave vagaries, like the weather, are phenomena of nature, and since we can't remove them we can only go around them.

An Audio Oscillator Helps An Experimenter

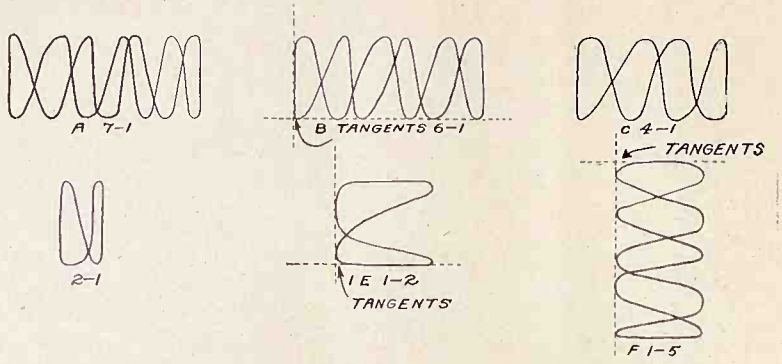


FIG. 7

[*You may start your own laboratory and at little expense have a fairly good one. First, build a radio frequency oscillator and audio frequency oscillator. The way to do this was described in part in the June 19 issue, the following being the completion of that article. Other construction work will be discussed in subsequent issues.*]

By John F. Rider

Member, Institute of Radio Engineers

PART II.

THE calibration of this unit unfortunately is limited to fans with certain equipment. But since the variations in constants of the original unit and those constructed by fans will not differ by any radical value, it will be possible to give calibrations of the laboratory unit, which calibrations may be used as standards. And since the calibration of an audio frequency unit is interesting, though tedious, it is thought that the method employed may be of interest to all readers.

The equipment utilized in addition to the regular audio oscillator to be calibrated consisted of a standard 1,000-cycle microphone hummer (tuning fork type 213 General Radio) and a Western Electric Cathode Ray oscillograph tube with its associated equipment. The method used is to apply the unknown frequency against the known frequency to the oscillograph tube and to determine the ratio existing between the two by means of the pattern which appears upon the oscillograph screen.

The principle of this oscillograph is an electronic stream which is caused to flow between two sets of square plates of non-magnetic material, which are placed one above the other and at right angles to each other, as shown in Fig. 6.

The Ratios Shown

When potentials are applied to these plates they cause the electronic stream to assume forms in accordance with the potentials applied to the respective sets of plates, and since the plates are at right angles to each other, the action of the potentials upon the stream is such as to cause the stream to spread out vertically and horizontally. The resultant image is visible on the screen, when the operations are carried out in a dark room. Now, when two frequencies are applied against each other, one frequency to each set of plates, a figure appears upon the screen, which figure is in motion when the two frequencies are not in some definite ratio to each other. But when some simple ratio is obtained, the patterns become stationary to form what is known as a Lissajous figure. By drawing tangents to two edges of this figure, and observing the number of lines which touch these

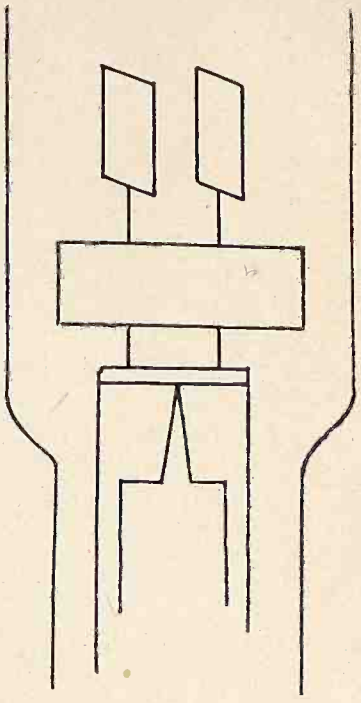


FIG. 6

tangents, the ratio is very easily computed.

Herewith are shown various Lissajous figures for various simple ratios. The standard frequency was obtained with the 1,000-cycle tuning fork hummer, and the various unknown frequencies to be calibrated, were obtained from the tube oscillators. Figures 7 A, B, C, D, E, and F show ratios of 7 to 1, 6 to 1, 4 to 1, 2 to 1, 1 to 2 and 1 to 5. The variance in the ratio, that is, above or below unity, is manifest by the shape of the Lissajous figure.

With respect to the calibrations of the audio oscillator, the exact values are at this time unnecessary, and will not be given, being reserved for the time when the audio oscillator is to be applied for measurement purposes, and various frequencies are required. However, the single calibration for the 2,000-cycle note remains intact.

[*The application of the RF and AF oscillators will be discussed in an early issue.*]

RESULTS LETTERS

RESULTS EDITOR:

Kindly extend my sincere thanks to Herman Bernard for his 1926 Model Diamond hookup. I have wired up one of these receivers and it is giving me all that a radio can give, e.g., volume, distance and tone. Stations, WBZ, KDKA, WJZ, WRC and others in the East; WSMB, WBAP, WFAA in the South, to KFI on the Pacific Coast, have all been received with great consistency. Each of these stations is more than 2,250 miles from here. We are located just north of the 60th parallel on the Slave River. This is a tributary to the McKenzie. Our nearest outside city is Edmonton, which is 600 miles south. A good radio set here is a godsend.

All the white people in this district, of which there are 48, have sets ranging from 3-tube factory type to Super-Heterodynes. There are several 5-tube sets, but I have yet to see which one of these can outdo mine, including the Supers.

HUBREY L. GRISWOLD,
RCCS Radio Station,
Fort Smith, North West Ter.,
Canada.

RESULTS EDITOR:

Having seen the large amount of applause letters on the Diamond of the Air in the many issues of RADIO WORLD, I thought that you might be interested in knowing that I have received a confirmation card of reception from OAX, Lima, Peru, on Jan. 24, during the International Tests. I received a 4-tube manufactured receiver as the reward for the best DX reception during these tests, from the "Cleveland Plain Dealer." At all times the Diamond was used.

R. S. ROLLINS,
Medina, O.

* * *

RESULTS EDITOR:

I would like to enter my Diamond of the Air in a contest wherein results are based upon the actual cost of material. I have logged several Chicago stations, all on the loud speaker. I can cut out the powerful General Electric station WGY, at any time. I have built many sets, but the Diamond is the best of all.

L. G. CASON,
97 Lancaster St.,
Albany, N. Y.

PATENTS GRANTED

The following patents were issued recently:

1,588,248—Antistatic System. David G. McCaa, Lancaster, Pa., assignor to The Electric Apparatus Co., Parksburg, Pa. Filed March 16, 1923.

1,587,520—Nonresonant System. Ralph V. L. Hartley, East Orange, N. J., assignor to Western Electric Company, Inc. Filed Feb. 3, 1919.

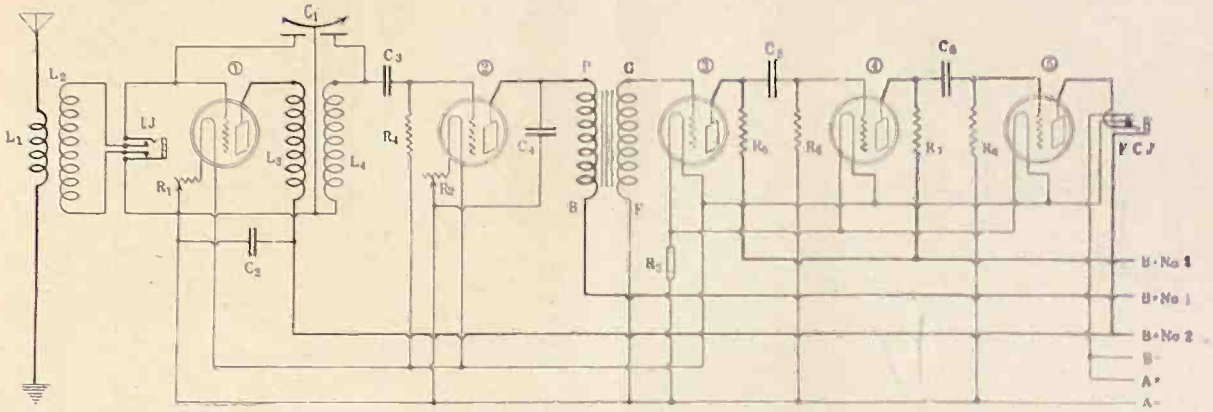
1,587,595—Telephony. Fritz Lowenstein, Brooklyn, N. Y.; John C. Wait, administrator of said Fritz Lowenstein, deceased, assignor, by mesne assignments, to Radio Patents Corporation. Filed Nov. 5, 1920.

1,587,657—Radio signaling system. Frederick A. Kolster, Burlingame, Calif., assignor to Federal Telegraph Company, San Francisco, Calif. Filed Dec. 5, 1921.

1,587,696 — Electrostatic Condenser. Alva J. Carter, Chicago, Ill., assignor to Carter Radio Company, Chicago. Filed March 14, 1924.

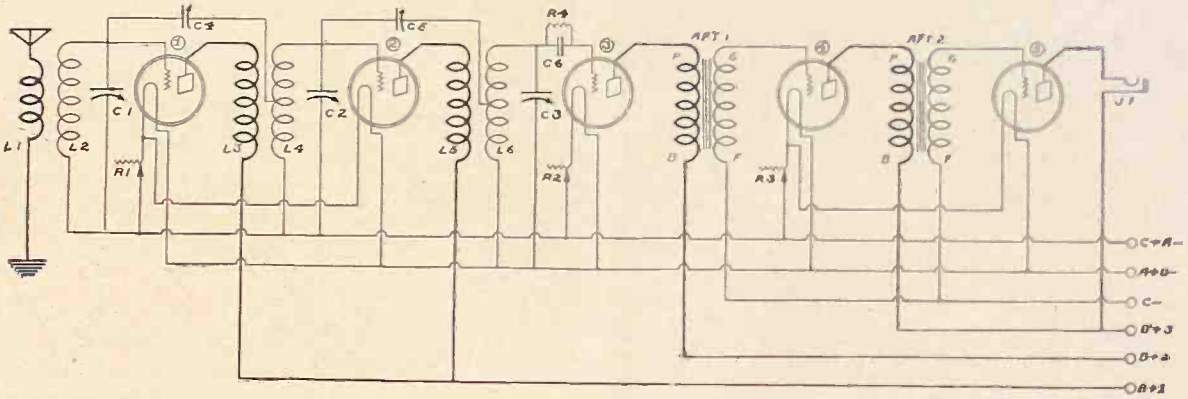
4 Flourishing Favorites

A 5-Tube Receiver Using One Control



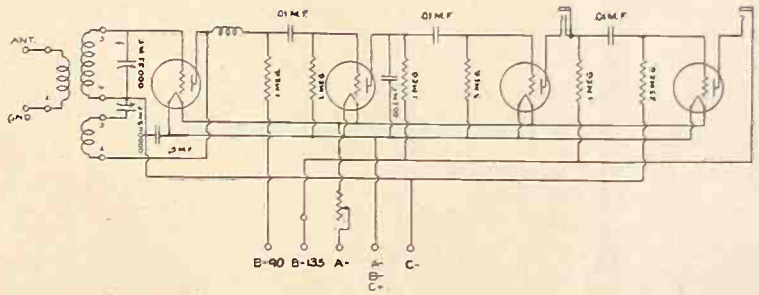
THE CIRCUIT diagram of a 1-control circuit described in the August 29, 1925, issue of Radio World. The filaments of the RF and the detector tubes are controlled by rheostats, while the filaments of the three audio tubes are controlled by a ¾-amper ballast resistor. The first stage of transformer coupled AF amplification produces fine volume, consistent with quality, while the two stages of resistance coupled AF amplification add to the volume while preserving quality of tone.

The Neutrodyne with Grid-Biased Audio



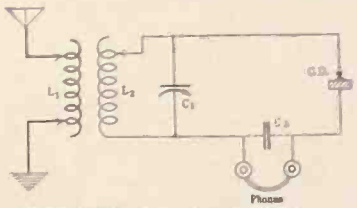
HERE WE have the circuit diagram of the 5-tube Neutrodyne. The TRFT used are standard neutroformers, their secondaries being wound to be shunted either by .00035 or .0005 mfd. variable condensers. The rheostat controlling the filaments in the AF stages may be supplanted by a ballast resistor of the ½-ampere type, if both AF tubes are of the—01A variety.

The All-Wave Regenerator



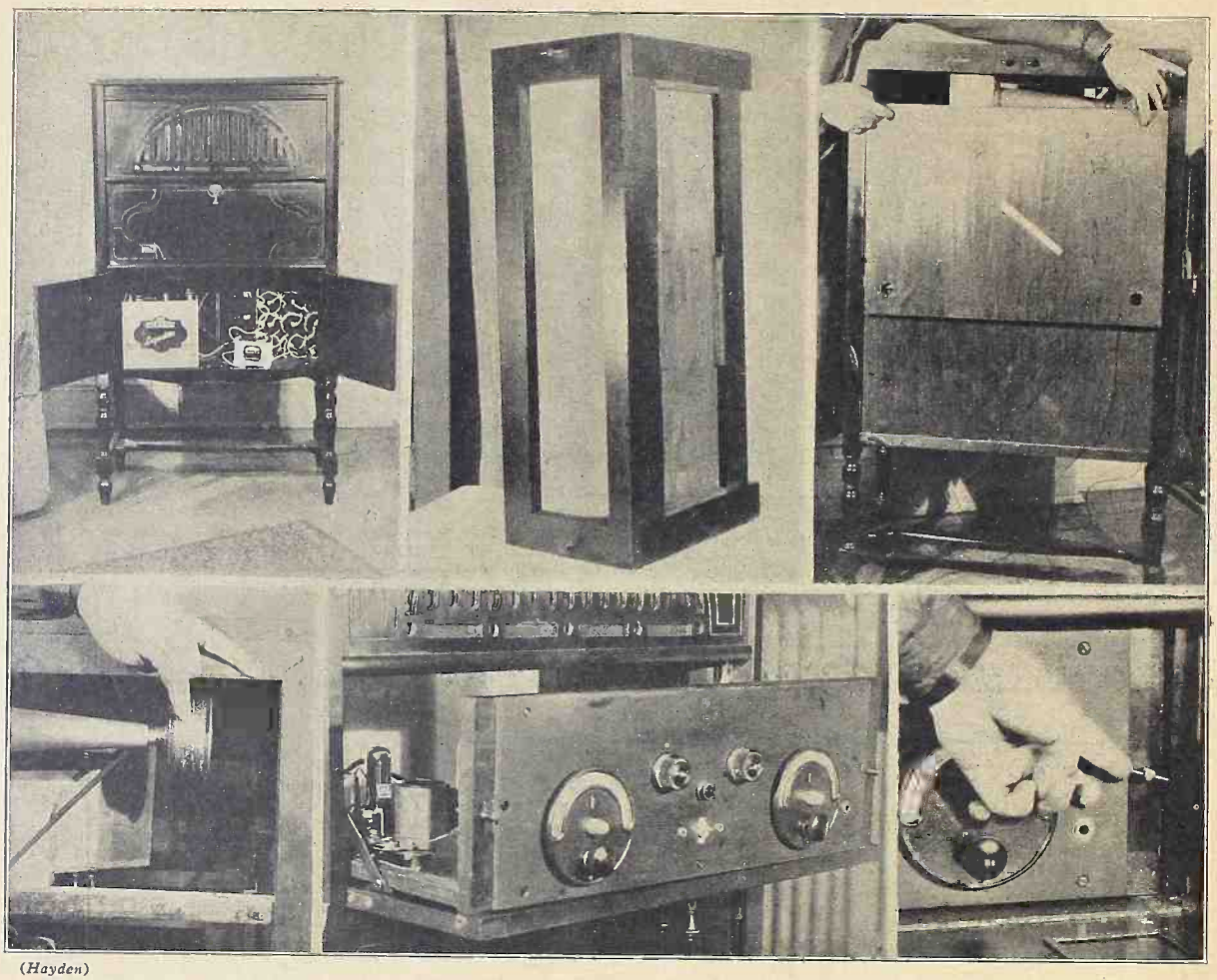
THE ELECTRICAL diagram of the All-Wave Regenerator, described in the March 27 issue of Radio World. The resistance in series with the plate of the detector tube, for best results due to coupling, should be a .1-megohm resistor. With a larger resistor a slight howl may develop.

Crystal Set



ABOVE WE have the circuit diagram of a very simple set, one of the most efficient of crystal receivers. The coupler used may be an old type vario-coupler or the primary and secondary windings of a 3-circuit tuner. With a 10 turn primary, taps should be made at every 2nd turn. Although the secondary is shown as being tapped, this is not absolutely essential.

A Console Installation



(Hayden)

THE USE OF A CONSOLE model cabinet to house set, batteries and loop is growing more and more popular. While these installations usually are in conjunction with factory-made sets, the home-constructed receiver may be similarly housed. How the batteries are placed is shown in the photo at top, left. The receiver is slid into the cabinet by means of the compartment (top center photo). At right, top, is shown the back of the removable cabinet. The lower strip depicts the location and housing of the built-in speaker, for which it is customary to supply one's own unit; the insertion of the set (front view), and the catch used to secure the sliding compart ment to the cabinet.

Rogers-Schudt Trouble Hints

By William A. Schudt, Jr.

Technical Radio Editor of The New York Telegram.

THOSE who followed instructions have encountered little difficulty with their Rogers-Schudt sets.

Chief difficulty so far has been encountered in the antenna tuning circuit, —synchronizing the dials without cutting down the signal intensity.

This situation is due, of course, to the wide divergence in antennas.

The set owner with a 125-foot antenna is up against an entirely different problem than the fellow with a thirty-five foot signal catcher.

With a conductively coupled primary one has his choice of three methods—the insertion of a fixed condenser of proper capacity in the antenna lead; tapping the coil at several points and a combination of both.

Use of capacities is bound to lessen the energy. For that reason the tapped coil system is strongly advised unless a .0001 or a .00005 mfd. proves sufficient to align the dials.

Probably one of the quickest and simplest methods to do away with the bad effects obtained with a long antenna is to insert a .0005 mfd. fixed capacity in the antenna lead before it reaches the movable arm of the inductance switch.

In some cases the use of a .0001 is recommended, especially when the antenna is very much longer than 100 feet. Usually the mid tap on the antenna inductance will be found the best operating point for this capacity with a long antenna.

The average antenna of between 35 and 50 feet was found by both Mr. Rogers and myself to give the best all around reception with almost perfect dial snychronism.

It has been found that in the majority of cases where a set failed to function in the proper manner it was the fault of the builder.

Not so long ago one man, who had made a set of this type, phoned me that it was absolutely inoperative and that he had gone over the wiring a dozen times. Furthermore he was sure that it was properly connected up. The set did not give a "peep."

We looked over his receiver and immediately found two grid leads "open" and one of the ends of his antenna inductance not making contact with the connecting lug. These we immediately altered and the set functioned beautifully.

Another incident: The builder followed out our instructions to the letter but the volume was very poor and almost inaudible on some low wavelength stations.

This gentleman overlooked one thing when checking his wiring. He did not look at the inductance switch. Had he done so he would have found that its movable arm was bent out of place, thereby causing poor contact on one peg and none at all on the three others.

Remedying this did the trick.

Wiring the Light 5 Portable

Textual Directions Are Completed for the Construction of the Economical 5-Tube Tuned Radio Frequency Set—Log Should Be Established Before Set Is Taken on Trips, to Facilitate Tuning In.

[*The following completes the article on how to construct the Light 5 Portable, an economical 5-tube tuned radio frequency set, fitted into a week-end carrying case. Parts I and II were published in the June 12 and 19 issues. Next week there will be a discussion of trouble shooting.*]

PART III

THE transformer mounting dimensions apply only to the Thordarson instrument, as designated in the list of parts, although the 3½-to-1 ratio may be used in one of the stages, if desired, preferably the first stage.

Coil Mounting

The coils are mounted on the frames of the condensers. These coils are the Bruno Light 5 series, consisting of one antenna coil, L1, and two radio-frequency transformers, L2L3 and L4L5. The coil forms have a 2" diameter and a 2¼" length. L1, the antenna coil, 60 turns of No. 24 SSC, tapped at 18th turn, is mounted at right angles to the front panel (but mounted on the back of the condenser C1). A brass angle is used, each arm ¾". Remove the nut from the frame at back of the condenser at that point of the frame where the milling of the rotor plates meets the stator plates completely, when the rotor plates are entirely enmeshed. Insert a right angle into this the bared screw and tighten the nut. Place the coil so that the free end of the angle passes into the core. A binding post (end of secondary nearer tap) is removed to mount the coil form. Fit the angle hole to the new hole in the coil form, to see that they coincide, although it is not yet necessary to reinsert the screw in the form hole. If they meet, then remove the angle from the condenser, tighten the angle to the coil form, which work can not be done well while the form is on the condenser, and finally restore the angle to the condenser frame and tighten the nut there. In mounting the coil form it will be advisable to have the screwhead on the outside of the form (reversing the usual method). Be careful to retain the hole utilized for mounting the coil form to the angle is the one which serves for the binding post at the ground end of secondary winding. This connection later will be made to ground, A minus and S1, because in the Bruno straight line frequency condenser the frame is grounded (grid return), the rotor plates going to grid. This is because the stator plates are connected to the frame, the clear amber Bakelite shaft of the condenser serving as the insulating device.

The last coil, L4L5, of the chain, is mounted next, because it is mounted in the same fashion as the first coil. Use the post at either end of the secondary.

The Central Coil

The central coil, L2L3, is mounted at right angles to the two others, but in a different mechanical fashion. To get the right angle mounting method it is necessary to use a brass angle that reverses the coil position. This is done by using a U-angle, comprised of two brass angles, each with ¾" arms, connecting one arm of one to the other arm of the other angle, to form a U. Not only should bolt and nut be used, the bolt being bent with pliers until the excess is deleted after the nut is on, but the whole joint should be soldered. Then one free terminal is connected to the now familiar mounting point on the condenser and the other point is secured to the nut and bolt used as one terminal of the secondary winding. Remember to preserve the connection between the secondary wire and the post when making any of these mounting connections.

As for the middle coil, the base of the U will have to point to the right as you are looking at the panel rear. By slight shift of the condenser C2 this coil may be placed so as to obtain zero coupling between it and the two others, a kink of great value, and rather novel.

Remove the screws from the condensers at those points where connection is to be made to the rotor. Do not remove the large double nut positioned in line with the condenser shaft for any reason. The nut meant is the one near it, occupying a position at the opposite one used when mounting the coils. Put tubes in the sockets and shake the sub-panel. See if the tubes strike the screws that protrude from the condensers for grid (rotor) connections. If so, with pliers snip off the protruding part of the screws, right close to the small hex nuts thereon. That will solve the problem completely.

Next remove the sub-panel from the brackets (hence from the front panel), as this is necessary for convenience in wiring the set.

Wiring Directions

The sub-panel should be removed, so that the filament and some other wiring may be done conveniently. Fig. 17 shows the isolated filament wiring, which should be tackled first. The A plus lead is connected to one side of the switch (the switch at right-hand side of the front panel, as you look at the dials, etc.), while the other side of the switch is connected to the F plus posts of all five sockets. A minus is connected from battery to one side of the rheostat R1 and to one side of each of the two Amperites, R2 and R3. The other side of the rheostat goes to three points—the F minus posts of the first and second RF and the detector sockets (1, 2 and 3). The other side of one of the Amperites goes to the F minus post of one of the audio sockets, while the other free end of an Amperite goes to the other F minus audio socket post. These sockets are 4 and 5. This completes the A battery wiring.

With virtually all variable condensers the rotor plates go to the grounded side, but with the Bruno condenser, because of the clear amber Bakelite shaft which constitutes the insulation, the rotor plates

(*Continued on page 26*)

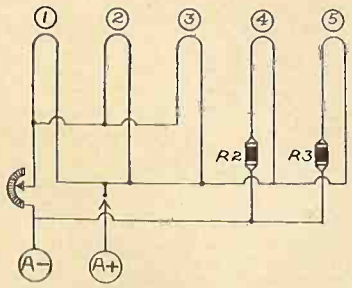


FIG. 17
The filament wiring. The rheostat R1 is at left. R2 and R3 are amperites. The Bruno switch is in the A plus leg

(*Radio World Staff Photos*)

FIGS. 9, 10 AND 11.
The way the batteries are placed, and the manner of accommodating the speaker, are shown in Fig. 9. Behind the curtain pocket is the reel aerial, secured to the lid by means of a threaded bolt and a wing nut. (Fig. 10). The batteries may be held taut by brass angles in a baseboard, aided by a strip of aluminum, bent to the shape of the battery block. (Fig. 11). The strip is bolted to the case.

Radio University

FREE Question and Answer Department conducted by RADIO WORLD for its yearly subscribers only, by its staff of Experts. Address Radio University, RADIO WORLD, 145 West 45th St., N. Y. City.

When writing for information give your Radio University subscription number.

I HAVE three fixed radio frequency transformers, which I wish to incorporate into a 6-tube receiver, employing two stages of transformer coupled audio frequency amplification. This set is to be used for portable purposes. The receiver should have only one major control. Please give wiring diagram and constants, etc.—Henry MacDonald, Pawtucket, R. I.

Fig. 352 shows the wiring diagram of such a receiver. The tubular object, shown at the lower left, may be a ballast resistor, of about 6 ohms resistance or part of an old 6-ohm rheostat mounting, used as a fixed resistance, or a plain 6 ohm rheostat mounted inside the set and kept at one fixed position at all times. The potentiometer, controls the oscillatory action of the RF tubes and the volume. The fixed resistor, heretofore discussed, controls the filament action off all the amplifier tubes. The filament of the detector tube is controlled by a rheostat. Either the 99 or the —01A type tubes may be used. A .0005 mfd. variable condenser is shunted across the loop terminals. This loop consists of 16 turns of No. 18 annunciator wire, wound on a 2-foot frame. If you wish to use a .00035 mfd. variable condenser, then increase the number of turns on the loop to 22. When winding the first type mentioned loop, space the turns every ¼". When wiring the latter type of loop, space the turns every ⅛". Although only the ratio of the first AFT is indicated as 5 to 1, the second AFT is of the same value. The .0005 mfd. fixed condenser, which shunts the primary winding of the first AFT, should be disconnected and connected in shunt to the plate-filament minus circuit of the same tube. It is not an absolute necessity, but may help to increase the volume. An antenna and ground may be used, if so desired. This can be done with the aid of a commercial antenna coupler, having a 10 turn primary and a 45 turn secondary wound on a tubing 3¼" in diameter with No. 22 double cotton covered wire, ¼" separation, prevailing between the primary and the secondary windings. The beginning of the primary winding is connected to the antenna post. The end of this winding is brought to the ground post. The beginning of the secondary winding is connected to the arm of the potentiometer. The end of this winding is brought to the grid post on this socket. The rotary plate connection of the variable condenser is brought to the beginning of the secondary winding or to the arm of the potentiometer. The number of turns specified

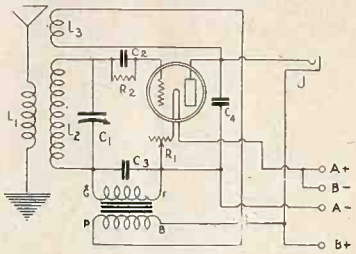


FIG. 353
The wiring diagram of the reflexed 1-tube regenerative set.

is for the .0005 mfd. variable condenser. If you wish to use the .00035 mfd. variable condenser, increase the number of turns on the secondary to 62. This complete set may be built in a week-end suitcase, such as used by Herman Bernard in his Light 5 Portable. The condenser potentiometer, rheostat and switch may be mounted on the front of the suitcase. That is, the portion, whereon the handle is attached.

* * *

I WOULD like to build a 1-tube regenerative set, employing a 3-circuit tuner, but reflexed. I realize that this set will be difficult to tune and get working successfully, but I would like to try it. The complete wiring directions, coil, condenser, etc., data and diagram of such a receiver would be very appreciated.—Michael Purrey, Davenport, Ia.

Fig. 353 shows the wiring diagram of this set. The primary, L1, consists of 10 turns wound on a 3¼" diameter tubing. The secondary, L2, is wound on the same tubing, it being separated ¼". This winding consists of 45 turns. No. 22 double cotton covered wire is used to make these windings. The tickler, L3, is wound on a 2¾" diameter tubing and consists of 36 turns. No. 26 single silk covered wire is used. The secondary contains that number of turns, that when shunted by a .0005 mfd. variable condenser, C1, the entire wavelength band of from 200 to 550 meters will be covered. The conventional grid leak-condenser, C2, R2, combination is used. C3 and C4 are .001 mfd. fixed condensers. The audio frequency transformer used is of the high ratio type of about 6 to 1. J, of course, is the single circuit jack. R1 is a 10 ohm rheostat. The —01A tube should be used for greatest success. Now as to the wiring. The beginning of the primary winding is brought to the antenna post on a strip. The end of this winding is brought to the ground post. The beginning of the secondary winding, L2, is brought to the rotary plate connection of C1 and to the G post connection on the AFT. The end of the secondary winding is brought to the stationary plate connection of C1 and to one terminal of the grid leak-condenser combination. The other terminal of this combination is brought to the G post on the socket. The F post on the AFT is brought to the terminal of R1, connecting with the arm and to one terminal of the fixed condenser, C3. The other terminal of this fixed condenser is brought to the rotary plate connection of C1. The other terminal of the rheostat, R1, is brought to the F minus post on the socket. The P post on the AFT is brought to the end of the tickler winding, L3. The beginning of this winding is brought to the plate post on the socket, to the top terminal of the single circuit jack and to one terminal of C4. The other terminal of this condenser is brought to the A minus post on the strip. The bottom terminal of the jack is brought to the B plus post on the AFT and to the B plus terminal on the strip. The F plus post on this socket is brought to the A plus B minus post.

* * *

PLEASE ADVISE me through the Radio University colums whether two stages of transformer coupled audio frequency amplification can be added to the 2-tube receiver shown in schematic form in Fig. 301 in the Radio University section of the April 24 issue of RADIO WORLD. If so, how? (2)—May No 22 double cotton covered wire be used to wind the coils?—William Bemhard, Jersey City, N. J.

(1)—Yes, this can be done with great ease. It is not known whether you wish to use a jack on the detector output or run the output directly to the audio frequency transformer. Therefore both methods will be described. Suppose the double circuit jack is used. Then the two inner terminals of the jack, go to the plate and the B plus posts, respectively. The top post of the jack is brought to the P post on the detector socket. The bottom terminal is brought to the B plus post. If the direct method is used, the plate post on the detector socket is brought to the P post on the AFT. The B plus post on this AFT is brought to the B plus post on the strip. The ratio of the AFT used here is of the 3-to-1 variety. The G post on this AFT is brought to the G post on the new socket. The F minus post on this AFT is brought to the F minus post on the second AFT, which is of the 3-to-1 variety, also. The P post on this AFT is brought to the P post on the first audio socket. The B post is brought to a new binding post on the strip, labelled, B plus 90. The G post

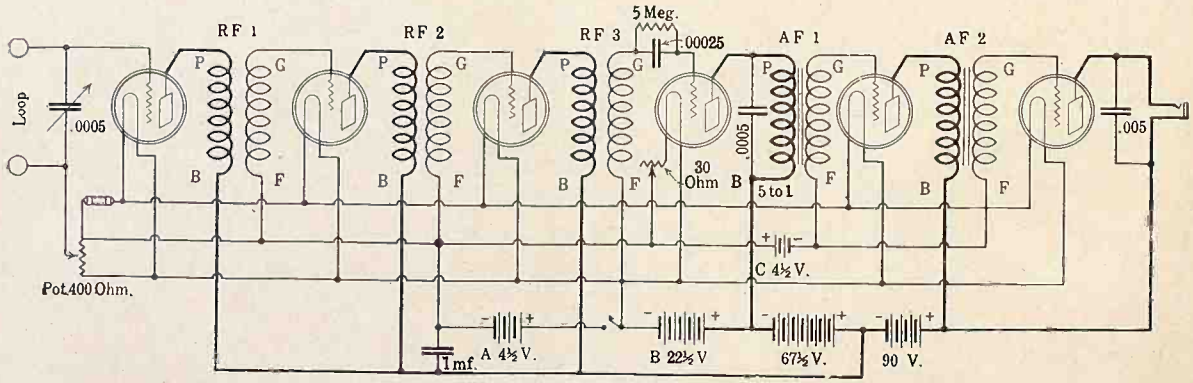


FIG. 352
The wiring diagram of a 6-tube portable.

on this AFT is brought to the G post on the last socket. The P post on this socket is brought to the top terminal of a single circuit jack. The bottom terminal of this jack is also brought to the B plus 90-volt post. Both the F minus posts of the sockets are connected together and thence to one terminal of a ½ ampere ballast resistor. The other terminal of this resistor is brought to the A minus post on the strip. The F plus posts of both sockets are connected to the F plus post of the detector and the RF sockets. A switch should be inserted in series with the A plus lead. (2)—Yes.

* * *

I HAVE built the Economical 4-tube Set, which was described in the March 27 issue of RADIO WORLD by Edgar T. Collins and cannot get the set oscillate over 350 meters. Please advise me how to remedy this trouble. (2)—How are the beginning and end of the coils wired?—J. McKlin, R. R. 1, Tomira, Wisc.

(1)—Use a larger honeycomb as tickler or a larger plate condenser. (2)—The end of the primary winding of the antenna coil is brought to the ground post. The beginning of the secondary winding of this same coil, is brought to the A minus post. The end of this winding is brought to the G post on the first socket. The beginning of the primary winding of the coupling coil is brought to the plate post on this same socket. The end of this winding is brought to the B plus post. The beginning of the secondary winding of this coupling coil, is brought to the A plus post, while the end is brought through the grid condenser-leak combination, to the grid post on the detector socket. It does not matter whether the beginning or the end of the plate winding is connected to the plate post of the detector tube or to the rotary plate connection of the variable condenser.

* * *

REFERRING TO Fig. 277 in the Radio University section of the March 20 issue of RADIO WORLD, the —01A type tubes are specified in the description. Can the wiring be altered so that —99 type tubes can be used and operated on dry batteries? I would also like to use a C battery if possible.—George L. Selwyn, 325 Jay St., Brooklyn, N. Y.

No change will have to be made in the wiring of the detector-filament circuit. The change will have to be made in the AF circuit. That is, you will have to use a separate 4-volt ballast resistor in series with each of the tubes, instead of the single ballast resistor, as per diagram. No change is to be made in any other portion of the wiring of the receiver. It is not necessary to use the C battery with the small tubes. However, if the larger tubes are to be employed, the C battery is placed in series with the grid return terminal of the grid resistance of the last tube. That is, the minus post is connected to the return terminal, while the plus post is brought to the A minus post on the strip.

* * *

I WOULD like to have the wiring diagram of a 2-tube receiver, using a regenerative RF tube, a crystal detector and a stage of transformer coupled audio frequency amplification. Please give the wiring directions, coil condenser, etc., data.—Samuel Graydon, Los Angeles, Cal.

Fig. 354, shows the wiring diagram. The primaries, L1 and L3, consist of 10 turns. The secondaries, L2 and L4, consist of 65 turns. These are wound on tubings 3" in diameter with No. 24 double cotton covered wire. The primary and secondary are each wound on a separate tubing. There is no need for there being any space left between the windings. The

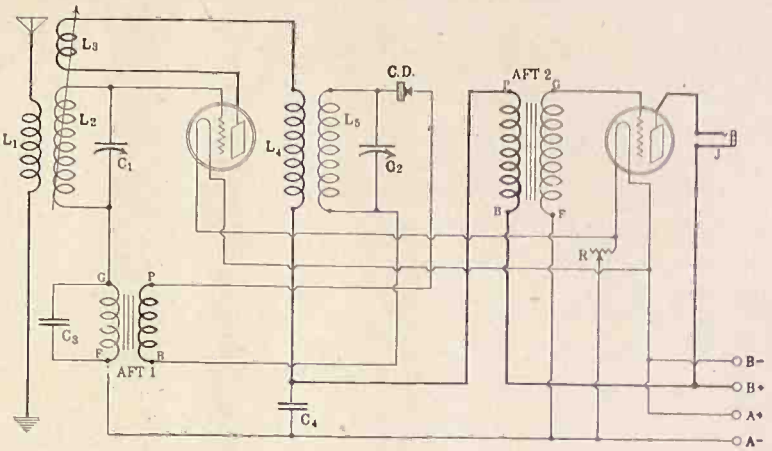


FIG. 354
The circuit diagram of the 2-tube reflex, requested by Samuel Graydon

tickler, L3, consists of 36 turns of No. 26 single silk covered wire, wound on a tubing 2½" in diameter. The tickler winding is placed near the secondary winding of the tuner. The audio frequency transformer, AFT1, in the reflex stage should be of the high ratio type, while the AFT, AFT2, in the regulation amplifier circuit should be of the low ratio type. C1 and C2 are .00035 mfd. variable condensers. C3 and C4 are .001 mfd. fixed condensers, R, the rheostat controlling the filaments of both the RF and AF amplifiers is a 10-ohm type. This should be so constructed that it will pass ½ amperes. The —01A tubes should be used. As to the wiring. The beginning of the primary winding, L1, is brought to the antenna post. The end of this winding is brought to the ground post. The beginning of the secondary winding, L2, is brought to the rotary plate connection of C1 and to the G post on the high ratio AFT. This same connection is continued to one terminal of C3. The end of this secondary winding is brought to the stationary plate connection of C1 and to the G post on the first socket. The beginning of the tickler winding, L3, is brought to the plate post on this socket. The end of this winding is brought to the beginning of the primary winding, L4. The end of this latter winding is brought to the P post on AFT2 and to one terminal of C4. The other terminal of C3 is brought to the F post on AFT1 and to the A minus post on the strip. The B post on this AFT is brought to the beginning of the secondary winding, L5, and to the rotary plate connection of C2. The P post on this AFT is brought to the high potential point on the crystal detector. The low potential point on the detector is brought to the stationary plate connection of C2 and to the end of the secondary winding, L5. The F minus posts of both sockets are connected together and to the resistance terminal of R. The other terminal of R is brought to the A minus post. Both the F plus posts are connected together and thence to the A plus post on the strip. The left off terminal of C4 is brought to the A minus post. The B post on AFT2 is brought to the B plus 45 volt post. The G post on this AFT is brought to the G post on the second and last socket. The F post on this AFT is brought to the A minus post. The plate post on this socket is brought to the top terminal of a single circuit jack. The bottom terminal of this jack is connected to the B plus 67½ or 90 volt post.

* * *

I HAVE just installed a —120 type tube in the last stage of audio-frequency amplification of my 5-tube Neutrodyne receiver. My B batteries were run down and since this tube operates best on 135 volts, I purchased three 45-volt batteries, as well as a 22½-volt C battery, which is necessary for this tube. Now, upon hooking up these batteries and installing the tube, although an increase in volume was noted, distortion was present. What could be the trouble?—Bill Jacksley, Utica, N. Y.

Your rated 45-volt batteries really had more than that, because of their freshness. Install an extra 4.5 volt C battery in series with the 22.5-volt battery.

Haste for Adjournment Perils Radio Legislation

WASHINGTON.

Senator Dill is optimistic as to the chances of his radio control bill for passage. He has made a thorough canvass of the Senate.

Considerable doubt exists as to whether the Dill bill, as framed at present, would be acceptable to the House and to President Coolidge. It has been made clear at the White House that the President is not favorably inclined toward the establishment of new commissions independent of executive authority, such as proposed in the Dill bill.

It is the hope that the differences between the Dill and White bills will be reconciled in conference between the House and Senate and that the final bill decided upon will meet with executive approval.

The chief handicap, it is said, is the time limit. Plans are to adjourn Congress just as soon as it can possibly be done, which means that the radio problem would have to be solved in short time if radio legislation is to be enacted at this session of Congress.

Senate Control Bill Is Twice Amended

The first of many additional amendments likely to come to the radio control bill now pending in the Senate came with two offered by Senator Dill of Washington State. One of these clarified the S.O.S provision and would provide that all radio stations on land or ships shall give absolute priority to calls from ships in distress.

The other would make more specific the provision that any broadcasting station which permits a political speech to be made shall give equal opportunity to all candidates. These speeches would go uncensored and the broadcasting station would be absolved from political or criminal responsibility resulting from such a speech.

Radio Helps Baseball, Says Rogers Hornsby

Rogers Hornsby, manager of the Cardinals and demon batsman, believes baseball is having its biggest year and credits radio with contributing to that end.

Writing to Eric H. Palmer of the Freed-Eisemann Radio Corporation, Brooklyn, N. Y., Hornsby remarks:

"While the attendance figures from all over the country indicate that baseball is experiencing one of its greatest years, it is my opinion that the radio has done considerable in maintaining interest in the national pastime. This is especially true in out-of-the-way places where the major league clubs do not appear.

"Through the radio, baseball is brought right to the homes of those not fortunate enough to be able to attend the games.

"I am a radio fan and enjoy listening to the reports of the games in which the Cardinals do not participate."

Hornsby owns two sets.

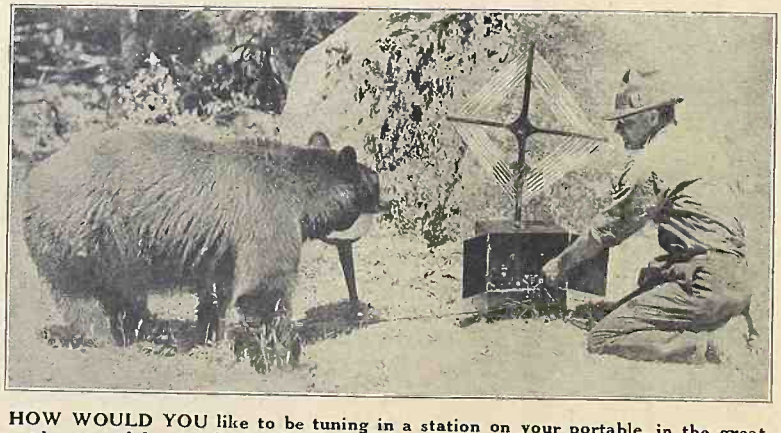
Wilbur Enthusiastic Devotee of Radio Art

Ever since the introduction of radio telephony and telegraphy, the United States military organizations have employed it extensively.

CURTIS D. WILBUR

A radio enthusiast is the Secretary of the Navy, Curtis D. Wilbur. Secretary Wilbur takes an active interest in the advancement of the design of radio transmitters and receivers, having made many valuable suggestions which were immediately used with great success. He has also shown much interest in the recent legislation of radio bills, etc., especially those now before the Congress.

Informal Visitor a Keen Listener



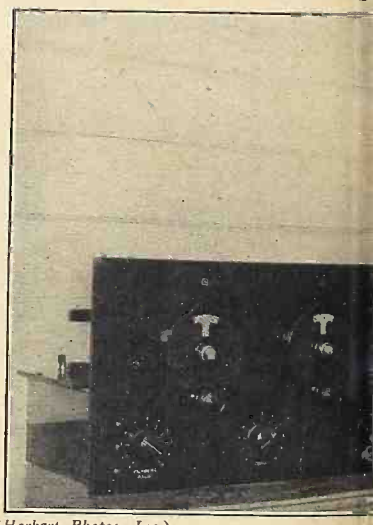
HOW WOULD YOU like to be tuning in a station on your portable, in the great outdoors, and have a brown bear browse into the picture and put his ear right beside the speaker? Notice that the bear absolutely is not chained to anything, for he is a contented member of the civilized Bruin colony of the Yosemite. The set operator is Albert H. Hottnauer, master mechanic, National Park Service.

Set Used In T

Underwood & Underwood

THE BUGLE BIRD is a native of the tr at Los Angeles, no one had succeeded Daughtrey, steward on the steamer, cap radio set tamed them so that they hop

Who Said Anything



(Herbert Photos, Inc.)

HERE is a set with five stages of tune one, two, three or six controls and with in programs with volume and quality. interesting feature is its change-over id efficiency of the various stages wh

Philharmonic Concert

WOR started a summer series of concerts by the Newark Philharmonic Concert Band Association by broadcasting from Branch Brook Park, commencing June 21 at 8 p. m. Dr. Edward Schaaf, founder and president of the Concert Association, and the Essex County Park Commission, are co-operating in the project. Sixteen more concerts will be sent out on the following dates: June 28, July 5, 7, 12, 14, 19, 21, 26 and 28, August 2, 4, 9, 11, 16, 18 and 23.

The facilities of station WOR, owned and controlled by L. Bamberger & Company, have been placed at the disposal of the Park Commission and the Band As-

ing a Rare Bird

and until the arrival of the S.S. Mongolia ming one of the wild creatures. Lewis two of the birds and with the aid of a nd the deck as fearlessly as the ship's

out Single Control?

io frequency. It can be operated on gle stage of audio frequency it brings ielding is used and perhaps its most hich enables the listener to test the ing any one or number of them.

ries Begins at WOR

ciation gratuitously. In the event of in, arrangements have been perfected to oadcast the musical organization from e WOR studio.

Joseph M. Barnett, director-baritone of OR, will be in charge of the micro- one throughout the series and it is ex- cted will interpolate several solos dur- g the summer.

On the occasion of the first broadcast iss Lucille Bethel, soprano, was fea- red as the soloist, presenting "Il Bacio" composition by Arditi, which is equally ll-known under the title of "The Kiss altz."

Miss Bethel is a gifted singer.

McQuhae, Tenor, Is Sued By His Teacher for $12,000

Allen McQuhae, tenor, recent Sunday evening soloist of the Atwater Kent program over WEAF, has been sued for breach of contract in the New York Supreme Court.

Felix Hughes, a music teacher, says he developed McQuhae's voice, paid for his first public recitals in Cleveland, O., and New York City, and although they entered into a managerial contract seven years ago, McQuhae, after he attained success and a name, signed a contract with the Musical League of America, Inc., and the Wolfson Musical Bureau, disregarding his preceptor.

Hughes claims McQuhae earned over $50,000 since he has been appearing in public. Under his alleged contract the teacher claims he is entitled to over $12,000.

Supreme Court Justice Erlanger granted motions of the two corporate defendants, the league and the bureau, to dismiss Hughes's complaint as far as they are concerned. In an opinion the court said it impressed him that Hughes had a contract with McQuhae and that he had better draw up an amended complaint suing the tenor alone.

Hughes asks for an accounting and the appointment of a receiver for his former protege's earnings.

Summer Dance Schedule Is Announced by WEAF

WEAF has arranged a schedule of evening dance music for the summer as follows:

Monday—8:00-8:30, Park Lane Restaurant; 11:00-12:00, B. A. Rolfe's Palais d'Or Orchestra.

Tuesday—10:30-11:30, Orchestras in this list alternate weekly; 11:30-12:00, the Buffalodians from the Monte Carlo.

Wednesday—11:00-12:00, Pelham Heath Inn Orchestra.

Thursday—7:30-8:00, Park Lane Restaurant; 11:00-12:00, the Buffalodians from the Monte Carlo.

Friday—10:30-11:00, Jack Albin's Orchestra from Marine Roof of Hotel Bossert; 11:00-12:00, Pelham Heath Inn Orchestra.

Saturday—10:00-11:00, Ben Bernie's Orchestra from Hotel Roosevelt.

Dance music in the hour from 11:00 to 12:00 up until Saturday, June 12, was furnished by Vincent Lopez's Orchestra under the direction of Irwin Abrams from the Casa Lopez, but as they have closed for the summer season it has not yet been definitely decided what orchestra will play during this hour.

Davies Is Announcer At Sesqui-Centennial

Edward A. Davies, director of WIP, Gimbel Brothers, in Philadelphia, and known all over the country for his announcing of all the important musical and sports events broadcast through WIP, assumed his official position as announcer-in-chief of the Municipal Stadium activities of the Sesqui-Centennial in Philadelphia when he announced to an audience of 70,000 through the public address system installed in the Stadium, the occasion being the Oriental Durbar given by Lulu Temple of Philadelphia as a fitting climax to the Shrine Convention held in that city.

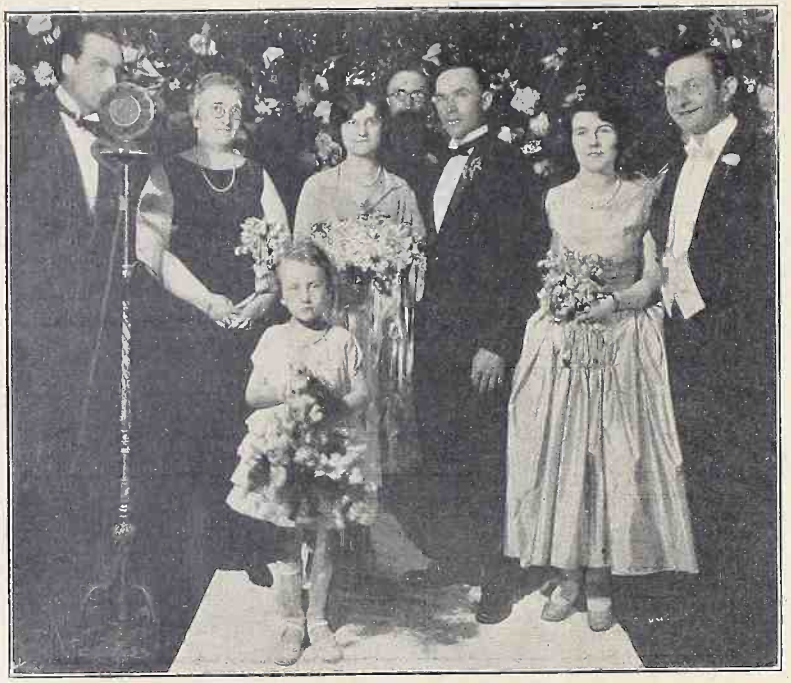
ARTISTS WILL BARNSTORM

As a further development of the hook-up which he declares he is forming between a number of independent stations, Norman Baker, of Muscatine, Iowa, president of the American Broadcasters' Association, announces that he is considering the advisability of organizing a company of artists which will travel from one station to another, booking a circuit of stations, the same as a circuit of vaudeville stations would be booked.

Childhood's Delight in an Open Boat

THE SEAS have no terrors, even for children (and much less have the placid lakes in a municipal park) when the youngsters' favorite set is left to their uncensored operation! The girl tuning the set is Norma E. Hayden.

June Wedding Broadcast As Thousands Tune In



THE FIRST June wedding staged at WHT, Chicago. The center couple are Mr. and Mrs. Charles Riddle, Tiosa, Indiana. Right, bridesmaid and best man. Left, announcer and bride's mother. This ceremony was heard by thousands of fans all over the United States.

Dan Cupid not only uses his shafts and quiver, but he turns to the radio to speed up and complete his work.

Miss Irma Schertz and Charles Riddle, both of Tiosa, Indiana, were married in the studio of station WHT, U.S.L. station in Chicago. The ceremony was transmitted and picked up by thousands.

The Rev. E. M. Riddle of Bryan, Ohio, brother to the bridegroom, conducted the ceremony.

Fine music preceded the marriage ceremony. A stringed quartet, vocal solos, and organ music added a realistic touch to the ceremony.

Following the ceremony the couple left for a honeymoon to Niagara Falls and a tour through the U. S. L. Storage Battery Plant. This trip was awarded as first prize in an entertainment contest staged by the U.S.L. Company.

The couple thanked the company.

Winner of Balloon Race Tells of His Debt to Radio

When William T. Van Orman, Pilot of the Goodyear IV captured the record for the greatest distance covered in the National Elimination Balloon Races held recently in the United States, he was enthusiastic in his praise for the mystery box which had accompanied him through the trials of the long contest. This was the fourth consecutive time in as many years that he had piloted a Goodyear Balloon to victory against the best in the country, and on the last three of these occasions his balloon was equipped with radio apparatus which served as the only connecting link between him and the rest of the world as he battled far above the clouds during his history-making flight.

Securely strapped to the tiny basket which carried him safely over mountains, rivers and the broad western plains, his little portable radio set annihilated the intervening space and brought to him the encouragement of his friends thousands of feet below, special weather bulletins and musical entertainment as well as news of other contestants.

This victory qualified him to represent the United States in the International Balloon Races which followed in Antwerp, Belgium. For this great air classic Van Orman retained the same proven mystery box, a portable Radiola receiver.

In this race Van Orman again outstripped the other contestants but without the jinx which attended him in the same event last year when he made a forced landing on the "Vaterland" at sea, which disqualified him, although he had navigated the greatest distance.

Upon receiving the joyful tidings of his victory at his landing, Van Orman immediately radiogrammed David Sarnoff, vice-president and general manager of the Radio Corporation of America, at New York, expressing his delight and thanks for the performance of the portable radio. This radiogram read:

"When all other methods navigation failed in severe twelve hour rain radio gave us bearings enabling us to fly Baltic to Sweden and victory even Madrid Spain was heard performance of set extraordinary.

"VAN ORMAN."

ARCTIC PARTY SEEKS SIGNALS

The 17,000 members of the American Radio Relay League are asked to be on the lookout from July until October, for signals from VOQ, the schooner Morrissey, which will carry the latest Arctic expedition of the American Museum, of New York, to within 700 miles of the North Pole.

In addition to seeking new and finer specimens of the narwhal, walrus, seal, musk ox and other Arctic denizens, and material for a special Arctic bird group, the expedition will undertake to solve some of the mysteries surrounding difficulties in polar radio communication. To assist in this work, A. Atwater Kent, Philadelphia, has financed the construction of a special short wave broadcasting outfit with which the expedition expects to keep in touch with stations in the United States and Canada throughout the entire trip.

This set, built in the physics laboratory at Marietta College, Marietta, O., under the supervision of Edward Manley, who will be in charge of its operation on the cruise, will use waves of 33 meters (9,985 kilocycles) and 20 meters (15,000 kilocycles). In the neighborhood of Etah, North Greenland, the farthest north for the expedition, waves below 18 meters will be used to pierce the daylight zone. One UV204 250-watt tube will supply the energy to the antenna.

To facilitate reception by amateurs who wish to establish contact with VOQ, Manley has worked out a definite schedule of hours that will be kept free for CQ calls. These are: 12:30 to 1 p. m., Eastern Standard Time, and 6:30 to 7 p. m., on 20 meters; 8:30 to 9 p. m., and 12 to 12:30 a. m., on 33 meters. International code will be used throughout.

A schedule with C-1AR, the station of J. J. Fassett, at Dartmouth, Nova Scotia, will be maintained at 10:30 to 11:30 a. m., on 20 meters, and 11 to 12 p. m., on 33 meters.

Manley suggests that many stations operating in the higher bands change to the 20 meter band this Summer, because of the greater distances that can be covered and because of the interesting things he promises to send through from the far North. A log of stations with which he establishes contact will be kept, and the operator scoring highest in this log will receive an interesting souvenir of his work, perhaps in the form of a polar bear skin or a set of walrus tusks.

NEW BOOKS

Elements of Radio Communication, a simplified technical radio book for the layman, student, amateur and engineer by Ellery W. Stone, Lieutenant U. S. N. R., Fellow, Royal Society of Arts; Member, Institute of Radio Engineers; Member, U. S. Naval Institute; Associate Member, American Institute of Electrical Engineers, published by D. Van Nostrand Co., 8 Warren St., N. Y. City. Price, $3.00.

This book will be found of great value to both the non-technical as well as the technical student. It was originally written for radio students in the Communication Service in the U. S. Navy. Therefore it may be used with great satisfaction in technical schools having special courses in radio, as well as being used in the home, in conjunction with correspondence courses. Only a knowledge of elementary physics and simple mathematics is necessary fully to grasp all in this book. The technical facts are so written that it is not a difficult matter to remember them. Designing data are also treated fully. This is a real good book for the radio student and enthusiast.

Pianorad, New Instrument, Has a Tube for Each Note

Simultaneous with the celebration of WRNY'S first anniversary, Hugo Gernsback, editor of "Radio News" and of "Science and Invention," demonstrated publicly at the station his new Pianorad. This instrument combines the piano and radio.

Listeners to WRNY are well acquainted with the Staccatone, which gives flutelike notes. The Staccatone was developed by Mr. Gernsback several years ago, and the same principles of this instrument, with certain fundamental changes, are now incorporated in the Pianorad.

The Pianorad has a keyboard like an ordinary piano, and there is a radio vacuum tube for each one of the keys. Every time a key is pressed, a radio oscillator circuit is energized, which gives rise to a pure, flutelike tone in the loud speaker. The musical notes produced by a vacuum tube with certain coils (inductances) for overtones, and for that reason the music produced by the Pianorad is of an exquisite pureness of tone, not realized with any other musical instrument. The quality is said to be better than that of the flute.

The notes are quite sharp and distinct, and the instrument can be readily distinguished from any other musical instruments. In the Pianorad there is a vacuum tube with certain coils (inductances) for each key, and whereas in the Staccatone arrangement, no chords can be played, it is possible with the Pianorad to sound any number of notes simultaneously, which can be sustained any length of time. On the ordinary piano you strike the key and the sound quickly dies away. In the Pianorad the sound remains as long as the keys are depressed.

The first Pianorad as constructed under Mr. Gernsback's supervision, has twenty-five keys, and therefore twenty-five notes. It is possible, however, to build a Pianorad with eighty-eight notes, which, of course, would require eighty-eight vacuum tubes. But for the purposes of demonstration, the twenty-five note Pianorad is quite satisfactory. The Pianorad at WRNY is usually accompanied by piano or violin, or both. Most pleasing combinations can be produced in this manner. The Pianorad at present uses a single stage of amplification—giving volume enough to more than fill the studio. By adding several stages of audio frequency amplification sufficient volume may be obtained to fill a large church or auditorium.

Couple's Marriage Follows His Proposal by Radio

Harold H. Funk of 1,836 West Eleventh Street, Brooklyn, was married to Miss Amelia M. Ferth of 213 De Kalb Avenue. Mr. Funk is production manager of the Freed-Eiseman Radio Corporation, and according to the announcement sent to magazines, the wedding is the result of a radio romance.

The couple were students together at Manual Training High School and began their interest in wireless then. Mr. Funk, said the announcement to the magazines, proposed by radio and got a "yes" the same way. A radio set is to accompany them on an automobile honeymoon.

DANES SLOW TO GET LICENSE

Thus far only about 27,000 of the 100,000 fans in Denmark have signified their intention of paying the Government license fee, but the situation may change as broadcasting gets under way there.

Goldman's Grand Opera Night a Big Feature

EDWIN FRANKO GOLDMAN, conductor of the famous Goldman Band, whose summer series of concerts is being broadcast by WEAF and its associated stations on Saturday, Sunday and Monday evenings.

WEAF and WGR will broadcast another of the popular concerts of the Goldman Band on Saturday evening, June 26, beginning at 8:30 o'clock.

"Grand Opera Night" will be observed on this occasion and all of the compositions with very few exceptions will be selected from noted operas. The soloist on this occasion will be Emily Day, coloratura soprano, who will be remembered as the vocal soloist on the evening of the first Goldman Band concert for this season. Miss Day is an artist who has scored a distinct success during the last three years in Europe and will fulfill many engagements in America during the next season.

The Goldman Band which numbers sixty pieces has been one of the most popular aggregations ever assembled and made a distinct "hit" with the radio audience last season.

GUNFIRE-PROOF TUBES

A feature of the radio receiving tube which fulfills specifications just issued for Government service is that it is not affected by the heavy vibration of passing trucks or even the jar of artillery-fire.

Russia to Harness Arctic Coast to Moscow Station

WASHINGTON.

At the beginning of the year there were upwards of 225,000 radio sets registered and in use in the Soviet Union, according to advices received by the Russian Information Bureau here. The number of sets in use increased since at the rate of 25,000 per month. Scores of thousands of sets, equipped with loud speakers, were being used in village reading rooms and in workers' clubs in the cities and each of these is patronized by hundreds of fans daily, particularly when the noon and evening radio newspapers are broadcast from Moscow and other cities. Several million persons listen in on the various programs every day.

The low current trust, which has virtually a monopoly in the manufacture of radio apparatus in the Soviet Union, is having difficulties keeping up with the demand. It plans to provide 1,300,000 receiving sets during the next few years. This year's program calls for an output of 27,000 tube sets, as against 6,500 produced last year, and 48,000 crystal sets, as against 30,000 last year.

Hook-up With Coast

The elaborate programs from the microphone in Moscow every day, including symphonic and chamber music, opera and drama, lectures and educational and newspaper material, are broadcast over a radius of 600 miles by a system of hook-ups in which stations in Leningrad, Kharkov and various provincial cities participate. This system of hook-ups will be greatly enlarged this year, so that natives on the Arctic coast and on the shores of the Black and Caspian seas will be able to get the Moscow programs simultaneously with the simplest sets.

New transmission stations have been opened in nine provincial cities this year. A new 25-kilowatt station is under construction in Moscow and a 10-kilowatt station in Leningrad. Other stations are being built in Dushembe and Samarkand in Central Asia.

A 100-kw Station

A plan for future radio construction has been worked out, which includes the building of a 100-kilowatt station in Moscow and 30-kilowatt stations in Novo-Sibirst and Tashkent.

Soviet radio fans are showing increasing interest in foreign programs, which they get without difficulty in many places. Not long ago the city of Tomsk, Siberia, heard the full program of the powerful Daventry station, England, more than 3,500 miles away. It appears that the reports that Soviet radio fans caught American stations during the International Radio Week was an error. What they heard was an orchestra in a Berlin hotel playing American jazz.

A THOUGHT FOR THE WEEK

"WHY do people like radio?" asks a writer in a more or less special story in a Sunday newspaper. Perhaps the questioner is first cousin of the man who called up a Columbia professor and asked him to explain over the phone just what electricity is.

RADIO WORLD

REG. U.S. PAT. OFF.

Radio World's Slogan: "A radio set for every home."

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(Dated Saturday of same week)
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SUBSCRIPTION RATES

Fifteen cents a copy. $6.00 a year. $3.00 for six months. $1.50 for three months. Add $1.00 a year extra for foreign postage. Canada, 50 cents.

Receipt by new subscribers of the first copy of RADIO WORLD mailed to them after sending in their order is automatic acknowledgment of their subscription order. Changes of address should be received at this office two weeks before date of publication. Always give old address; also state whether subscription is new or a renewal.

ADVERTISING RATES

General Advertising

1 Page, 7¼"x11"	462 lines	$800.00
½ Page, 7¼"x5½"	231 lines	150.00
½ Page, 8¼" D. C.	231 lines	150.00
¼ Page, 4½" D. C.	115 lines	75.00
1 Column, 2¼"x11"	154 lines	100.00
1 Inch		10.00
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52 consecutive issues	20%
26 times consecutively or E. O. W. one year	15%
4 consecutive issues	10%

WEEKLY, dated each Saturday, published Wednesday. Advertising forms close Tuesday, eleven days in advance of date of issue.

CLASSIFIED ADVERTISEMENTS

Ten cents per word. Minimum 10 words. Cash with order. Business Opportunities ten cents per word, $1.00 minimum.

Entered as second-class matter March 23, 1922, at the Post Office at New York, N. Y., under the Act of March 3, 1879.

JUNE 26, 1926

Woman Never Out of Pain Greatly Enjoys Broadcasts

Written evidence that the Happy Hours broadcast every day from WAAM really merit their name was received recently in a letter mailed to Mrs. Cora Morris, the soprano who assists the Rev. Merrill T. MacPherson and John A. Scott in the musical part of the programs.

"I have been in bed over twenty years," writes this correspondent, a woman, "never out of pain, so the radio is a wonderful treat. I hadn't heard a church service in over 22 years. Now I hear three on Sunday, and can hear one every day from the 'Happy Hour' if I listen. I love the hymns. My bed is by the window so I can see everything that passes."

Mrs. Cora Morris, who was the recipient of this letter, has sung at WAAM on an average of four times a week for the past two years, and has chosen her programs especially for the sick, afflicted and bedridden. She will continue to broadcast hymns for Happy Hour listeners on request.

Build a Portable Now

NOW is the time to build a portable receiver. Do not wait until next month, even if you are to take your vacation then, or indeed begin your vacation in August or September.

Before going on a vacation no doubt you will take short trips, and a portable is a very enjoyable piece of luggage. Now portables may be made more cheaply and more efficiently than ever before. Loop operation, small tubes, light batteries and compact cases all make for the greatest comfort. And, as has been said not too often, there is no joy quite like listening to your favorite station while you are lolling at your favorite seaside, lakeside or mountainside resort. There is a charm in the starry skies, the velvety wind, the moonlit waters and the broadcast music that makes romance stir even in wrinkled breasts.

—o—

Face to Face

THAT the music copyright problem is one close to the heart of the broadcast listener is proved every so often, to his utter satisfaction, as proof, but utter dissatisfaction as a listener. An orchestra may be broadcasting most enjoyable music. The announcer predicts the next number. It is indeed a prediction, rather than an announcement, for quite a few musical numbers are kept beyond the fold of broadcasting privileges. So some one else at the station, better versed in matters legal than the announcer is, simply shuts off the modulation. That means you hear nothing.

This recently happened most irksomely on a Thursday night when Harry Leonard's orchestra was broadcasting from the Hotel Astor roof, through WJZ, New York City. Milton Cross announced, or rather, predicted two certain numbers, at separate points on the program, but, alas, instead of them, the audience heard a quickly-made apology that the number was a prohibited one to broadcasters. And what do you suppose happened? The audience had nothing to listen to from that station until the prediction was made concerning the ensuing number! To have that happen twice in one night, from the same station, is quite disconcerting. What does a listener do under the circumstances? Tune in another station, perhaps.

For the convenience of listeners it would be well for stations to scrutinize the program of an orchestra, playing outside the studio (hooked up to the carrier wave by what is known as remote control) before the entertainment is begun. In the absence of gentlemanly conduct by both stations and composers, as the stepping stone toward a solution of the present music fees squabble, that extra burden of care upon the station is indeed necessary.

—o—

Practical Co-operation

CERTAIN stations seem not to be able to get rid of noises that are of studio origin. No reflection is intended upon discordant orchestras, but rather is meant such a nuisance as a generator or commutator hum.

When remote control work is being done, especially where the telephone wire carries the original voice or music a long distance to the carrier wave for modulation and transmission, one may expect a slight hum. But, when a station simply is sending a program from its own studio, and a fierce hum contributes an unceasing and exasperating obbligato, it is time to demand corrective measures.

One listener went to the pains to telephone to a certain station that was unwittingly sending out this racket along with its program, and, after explaining his grievance, put his radio receiver close to the telephone transmitter. Thus the man at the station was able to hear the hum, which was loud and annoying.

"Great guns!" exclaimed the station engineer. "So it's as bad as all that! We'll have to try right away to fix that up."

And try he did, with considerable success.

Such co-operation with a station is much to be commended. The best way to get what you want is to help the other fellow to give it to you. And in a case like this, a dually unselfish benefit accrues —in one case, to the station, in the other, to the listening public generally.

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Coincidental Music

A STATION in New York City recently broadcast an orchestra's rendition of "Katinka." At another station in the same city another orchestra was playing the same piece, at the same time, indeed, in the same time, musically speaking. One could turn his dials to tune in either station, and by doing this repeatedly and quickly, could create the impression that the same orchestra was being heard. However, toward the end of the rendition one of the orchestras speeded up its playing and finished first. No silver cup was awarded, for this was not a race. Indeed, it was an unwitting but entertaining coincidence for those who happened upon it.

This condition is likely to happen oftener as the radio listening public gets a more and more standard preference for popular music. For instance, songs like "Valencia," "Horses," "Animal Crackers," "At Peace With the World, With You," are raging favorites, and with many stations broadcasting orchestras at the same time, it is not unreasonable to expect to run into this new source of fun. However, to succeed wittingly still is quite a trick. Maybe it is better the day shall never arrive when the trick may be turned with sheer volition.

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Licenses for 7 Stations Requested By One Man

Although no licenses have been granted for many months, Ernest Walker Sawyer, who says he is a factory representative, of 824 East Seventh Street, Los Angeles, has asked the Department of Commerce for the privilege of broadcasting in seven cities: Los Angeles, San Francisco, San Diego, Spokane, Portland, Ore., Seattle, and Salt Lake City.

Others who applied were Henry J. Malarin, San Francisco; Oklahoma National Guard, McAlester, Okla.; Albert Henry Webb, Van Nuys, Calif.; Chamber of Commerce, Grand Junction, Colo.; J. E. Bute, Jr., Hastings, Nebr.; and Yonkers Broadcasting Association, Yonkers, N. Y.

Radio 10 Years From Now

Gernsback Predicts All Broadcasts Will Be Below 50 Meters, Where 4,000 Stations May Be Accommodated — Television to Have World-Wide Range — Cold Tubes, Operated From The Main, Will Function Gaseously — Single-Control Sets With Huge Speakers Forecast.

By Hugo Gernsback

WHEN it comes to predicting what radio will be in 1936, it is not necessary to make wild and improbable guesses, but by following certain laws and by building upon what has been accomplished for some years back, we can readily arrive at a result that will be fairly accurate.

At present there are more than 500 broadcast stations operating in this country, but we have only 150 channels in which to operate them. That means that some of the stations have to share time with others, to give them all a chance to get on the air, while some must be so far removed geographically as not to interfere with the others.

This is a very unsatisfactory state of affairs, and I have pointed out a number of times before that the only solution is to reduce the wavelength for all broadcast stations. It is my belief that in 1936 all broadcast stations will operate below 50 meters, possibly below 10 meters.

At such low wavelengths the frequency increases so rapidly that 4,000 stations can be separated 20 and more kilocycles without interfering with each other. The word "wavelength" will not be used in 1936. Rather, stations will all be known to operate under so many kilocycles, or perhaps, myriacycles (kilo meaning 1,000; myria, 10,000). Operating at 25 meters or below, we could immediately accommodate, even today, thousands of extra broadcast stations which would not interfere with each other in any way whatsoever. The reasons why it is not done at the present time are various.

A Gradual Change

Suppose one of our popular broadcast stations were suddenly to drop to 25 meters. No broadcast receiver made today could receive at such a low wavelength, because modern receivers are made to operate on wavelengths between 200 and 600 meters, or thereabouts. I make the prediction that during the next few years the popular broadcast receivers will be those which will be able to tune down lower and lower. Already broadcast stations are beginning to go down in the wave band.

Of course, this movement is gradual, as it should be. Such changes take time, which is a good thing, because if the changes were made overnight, all present broadcast receiving sets would be obsolete. By building better receivers to operate at lower and lower wavelengths, each year we shall show an improvement over the past one, and soon we shall have nothing but low-wave receivers.

At the same time the sensitivity of our sets will keep on increasing, as it has been during the past ten years. The greater amount of losses having been done away with, the efficiency having been increased, it stands to reason that the sensitivity of the set will be increased as well.

Prediction on Super-Power

While I believe in the present cycle of super-power, I do not believe that it will prevail in 1936, for the following simple reasons:

When Marconi first started sending across the Atlantic Ocean it took 50 kilowatts or 67 horsepower to accomplish the feat. Most of this energy was wasted, and only a very small fraction arrived at the other side of the ocean. Here we had wireless receiving instruments with fearful losses and the small amount of energy that came in was barely audible.

On the other hand, the amateurs of today are sending messages across the ocean regularly with an energy of 10 watts, which is exactly two-hundredths of one per cent. of the energy that Marconi took to do the same thing 25 years ago. In other words, with the energy inherent in a few small batteries that can be easily put into a small suitcase, and which can be readily carried about, it is now possible to transmit radio intelligence across the Atlantic Ocean. Again, if conditions are right, and the transmission and reception are efficient, there is no need for super power. In 1936 a 10-watt station will be heard around the entire world. Under such conditions, with ultra-sensitive apparatus, the super-power system would create havoc with receiving apparatus within a distance of a few miles, and for that reason it probably will not be used at that time.

The Miracle of Television

In 1936 we shall have radio television. It will be possible to see, as well as to hear, by radio. An explorer will take along with him a portable radio station and he will be able to give a lecture right on the spot in the jungle in darkest Africa or up in the unexplored regions—if such there be at that time—of the Amazon. He will explain everything he sees, and his projector will also be tuned at every angle so that the listeners 10,000 or 12,000 miles away will be able to see at the same time. This television apparatus, by the way, is almost within our grasp now, thanks to the wonderful work done by C. Francis Jenkins, of Washington, D. C., and Edouard Belin, of Paris, France. The actual transmission over short distances has already been accomplished, and it remains only to put on the finishing touches.

The Tubes of 1936

What tubes shall we use in 1936? The development of the vacuum tube since 1906 has been slow but steady. Since DeForest invented the audion, much improvement has been made. We are still using the same tube with a number of refinements. At the present time all tubes are run by batteries, or, if operated from the 110-volt house-lighting current, an intermediate circuit is used to step down the current to the right voltage.

Within the next few years we shall have a 110-volt tube, which will operate directly from the electric lighting mains, without any resistance whatever. This will be a great step forward, but to my mind this is not the final solution. Engineers are working towards a further goal, and that is a cold electronic tube; namely, no more heated filaments and no more A batteries. It is already possible to make an electrolytic tube such as was invented in Germany recently, where a colloidal liquid was used, and there is, of course, no heat in this. The electronic action is between plates and grids.

A cold tube will probably be used by 1936, this tube containing certain gases which may become luminous under the action of the current. These tubes will probably be used on either batteries or 110-volt current, but there will be no heating current, and such tubes, therefore, will be most economical. Even if five or six such tubes should be used, the consumption of current would be so small that it would not even be registered on the house current meter.

Controls

The control of the radio receiving outfit of 1936 will be simplicity itself. We are getting away from too many controls, knobs and other handles, which long before 1936 will be obsolete. It was I, by the way, who, in an editorial in the February, 1923, issue of "Radio News," was the first to advocate single control sets. It will have been noted that a few of these made themselves noticeable late in 1924, while 1926 will surely witness the advent of a great many single control sets, which seem to gain greater and greater favor with the public.

At present it is necessary to jump up whenever you wish to tune in another station or whenever an adjustment has to be made. This ties down the listener to the set, which is undesirable. We can have instead a device which by pressing a button, closes a circuit which automatically rotates the tuning controls very slowly or swiftly, depending upon the amount of pressure on the button. When the station desired is reached, the pointer on the dial revolves very slowly in the manner of a vernier until the station comes in loud and clear, at which the control is stopped. By touching a second button on the control, the operator can, at will, bring in either foreign stations, or the stations of his own country. It goes without saying that the single control regulates both the sounds from the station to be received and the television elements, both working in unison and automatically.

Loud Speakers

Naturally, most of our present-day loud speakers, which have as their basis the telephone receiver principle, are faulty and have helped, more than anything else, to bring radio into disfavor, due to the squawking and unnatural nasal sounds. In other words, the loud speaker today is the weakest part of a radio receiving set. The few loud speakers made which do not work on telephone receiver principles are, as a rule, much superior, but even the present-day loud speakers are not what we shall use in 1936. As a matter of fact, I predict with certainty that anything that has a small diaphragm, as have 85 per cent. of the loud speakers today, will not be used in 1936.

Imagine what happens to the iron disc, measuring 2⅛" in diameter, when called upon to reproduce transmitted sounds from a 50-piece orchestra. This little diaphragm has to be drum, violin, saxophone, oboe, flute, trombone, 'cello, cornet and piano all at the same time. Manifestly, it is impossible to get the one diaphragm to vibrate in such a fashion as to produce not only all the tone values, but all of the overtones simultaneously. As a matter of fact, it never happens. All we do get is an "average" of these sounds. Hence the distortion and squawky reproduction.

The loud speaker of 1936 will not have a diaphragm at all. It may be a talking, gaseous lamp, the sounds emanating from the glass walls of the luminous body of the lamp.

Too Much Is Given Free, Expert Advises the Trade

R. M. Klein, a well-known authority on radio merchandising, has analyzed the survey made by the N. Y. University Bureau of Business Research, published recently in RADIO WORLD, and points out the salient features and his views as follows:

"One hundred and eighteen brands of radio receiving sets all over New York City clearly indicate the confusion which must exist in the mind of a prospective purchaser who has no other source of information than the dealer's recommendation when endeavoring to make a purchase.

"It will be noted that electrical stores, hardware stores and auto supply stores average but three brands, which is certainly a most pleasing showing over what existed during the past two years and it is felt quite sure that three brands are ample for any high grade radio store to handle.

Time Payments Popular

"Also, it is noted that 71 per cent. of the stores make time payment sales and, we believe, this is a far higher percentage than exists in any other section of the country.

"Now, we look upon the time payment business as a very creditable phase of merchandising, providing that a reasonable charge is made for the accommodation and we certainly do not believe any dealer is justified in establishing time payment sales on a flat basis with cash sales.

"It will be noted that more than half of these stores making time payment sales make no extra charge over cash sales. This also we consider a serious error in business procedure.

8% Charge Upheld

"The average price of eight per cent. for time payment accommodation is believed reasonable.

"Note that 42 per cent. of those making time payment sales exact 25 per cent. down payment, and 27 per cent. exact a 33 1-3 per cent. down payment. This means that practically 70 per cent. of time payment sales are made on the basis of not less than 25 per cent. initial payment, and we believe that 25 per cent. should be the absolute minimum which any dealer should consider as an initial down payment.

"Note further the predominant time limit on time payment sales of six months. This we consider a very good factor, and do not recommend in any case that greater time than six months be allowed for completion of payments.

Trade-ins Are Light

"Trade-ins are not yet an appreciable factor, and we are at a loss to understand why dealers should allow as much as 25 per cent. on a trade-in set, and do not believe a successful business can be conducted on such a liberal allowance.

"Note further the relatively small number of firms who make installation charges. Here, again, we believe the merchants err in judgment, but no doubt are forced by highly competitive conditions to take this stand. We doubt if any other market throughout the country would necessitate as much free installation and service work as is now being rendered in New York.

Split Even in Service

"Note that 50 per cent. of the dealers maintain a service department. It is believed the trade would benefit were this increased to 100 per cent. and it will be found that in the majority of cases 'service' as rendered is of a character which justifies making a reasonable charge for same."

The number of brands per store, as developed by the survey, averaged 4.23, but this varied among different outlets.

A service department is maintained by 50 per cent., and 50 per cent. are without a service department. By far the majority of dealers give free service, but of those who charge for their work; 25 per cent. charge $2.50 an hour; 25 per cent. make a flat $2.50 charge per visit; 12 1-2 per cent. make a charge of $1.50 an hour; 12 1-2 per cent. make a flat charge of $2 per visit; 12 1-2 per cent. establish service charge of $10 a year; 12 1-2 per cent. have variable charges.

Manufactured Products $100,000,000 In 1925

WASHINGTON.

The total value of radio materials made in the United States during 1925 was $100,000,000, according to unofficial estimates compiled by the Statistical Division of the Department of Commerce. Of this some 10 per cent. went overseas. The 90 per cent. of this production which was finally sold to the ultimate consumer in the United States were purchased largely in October, November, December, January, February and March, the actual peak being in December. Factory production is lowest, in general, during the first half of the year.

Manufacturers of radio materials, knowing where the low points in their production curve are, and taking into consideration their ability to carry finished products in stock, and the time lag between receipt of order and shipment of goods, can determine in what part of the world sales effort should be made.

70,000 SETS IN DENMARK

WASHINGTON.

A recent survey of Denmark showed approximately 70,000 receiving sets in use, according to a report to the Department of Commerce.

Lively Interest Shown In Northwest Exposition

Fifty per cent. of the booth space already has been sold for the 1926 Pacific Northwest Radio Exposition, Public Auditorium, Portland, Ore., Sept. 20 to 25. The management is spending $10,000 for this show, which includes rental of auditorium, newspaper and billboard advertising, entertainment and the like, $7,500 of which is being raised from booth sales. The price of admission will be twenty-five cents. The attendance is expected to be 50,000, which represents 10 per cent. of the local population. Last year's show at the Multnomah Hotel was so successful that every evening during the three days people were turned away. There is increased space for this year's show.

Portland has a Listener's Association with nearly 2,000 members. It is estimated that there are 18,000 receiving sets where there should be 68,000. There is a splendid market for radio and the enterprising manufacturer can place his wares with some progressive local jobber and deliver his message in person to thousands of radio show attendants.

NEW CORPORATIONS

Rahem Horn Corp., N. Y. City, radio horns; H. A. Aaronson, R. Epstein, W. R. Morison. (Atty., A. Lipton, 160 B'way, N. Y. City).

COMING EVENTS

SHOWS

(Revised to date, corrections and additions solicited)

Aug. 21-28. Pacific Radio Exposition, Civic Auditorium, San Francisco. Pacific Radio Trade Association, 905 Mission Street, San Francisco, Cal.

Sept. 5-11. Los Angeles Radio Exposition, Ambassador Auditorium, Auspices Radio Trades Association of Southern California. A. G. Farquharson, Secretary, 515 Commercial Exchange Building, Los Angeles, Cal.

Sept. 10-17. National Radio Exposition, Grand Central Palace, New York City. Harold Bolster, Managing Director, Radio Exposition Corp., 1560 Broadway, New York City.

Sept. 13-18. Third Annual Radio World's Fair, New Madison Square Garden, New York City. Radio Manufacturers' Show Association, 611 Times Building, New York City.

Sept. 15-18. Akron Radio Show. Auspices Radio Dealers Association and "Times Press", George Missig, Secretary, "Times Press", Akron, O.

Sept. 20-25. Pacific Northwest Radio Exposition. Public Auditorium. George J. Thompson, Jr., Secretary, 411 Journal Building, Portland, Ore.

Sept. 20-26. Cleveland Radio Industries Exposition. Public Auditorium. George B. Bodenhoff, Manager, 511 Guarantee Title Building, Cleveland, O.

Sept. 25-29. Fourth Wisconsin Radio Exposition and Convention, Auditorium, Milwaukee, N. C. Beerend, Manager, P. O. Box 1005, Milwaukee, Wis.

Sept. 27-Oct. 2. Second Allied Radio Congress and National Radio Exposition, American Radio Exposition Palace, Chicago. Milo E. Westbrooke, Manager, 440 South Dearborn Street, Chicago, Ill.

Sept. 27-Oct. 2. Boston Radio Exposition, Mechanics Building. Shelden Fairbanks, Manager, 209 Massachusetts Avenue, Boston, Mass.

Sept. 27-Oct. 2. Northwest Radio Exposition, Kenwood Armory and Coliseum, Minneapolis. Harry H. Cory, Executive Secretary, 301 Tribune Annex, Minneapolis, Minn.

Oct. 4-9. Pittsburgh Radio Show. James A. Simpson, Managing Director, 420 Bessemer Building, Pittsburgh, Pa.

Oct. 11-16. Rochester Radio Show. Convention Hall. Auspices Rochester Radio Dealers Association, Rochester, N. Y.

Oct. 11-17. Fifth Annual Chicago Radio Show, Coliseum. Radio Manufacturers Show Association, 127 North Dearborn Street, Chicago, Ill.

Oct. 18-23, Second Southwest National Radio Show, New Coliseum, St. Louis. Auspices St. Louis Radio Trades Association. William P. Mackle, Executive Secretary, 1207 Syndicate Trust Building, St. Louis, Mo.

Oct. 25-31. Detroit Radio Show, Convention Hall. Auspices Radio Trade Association of Michigan. A. M. Edwards, Secretary, 4464 Cass Avenue, Detroit, Mich.

Oct. 25-30. Second Annual Indianapolis Radio Exposition, State Fair Grounds. Auspices Broadcast Listeners' Association. A. J. Allen, Secretary, 1406 Merchants' Bank Building, Indianapolis, Ind.

Oct. 26-29. Sioux Falls Radio Show. Coliseum. Auspices Civic Club. Roger S. Brown, Secretary, Sioux Falls, South Dakota.

Oct. 30-Nov. 6. Third annual Brooklyn Radio Exposition, 23rd Regiment Armory. Stephen T. Rogers, Managing Director. Suite 513, Albee Building, Brooklyn, N. Y.

CONVENTIONS

Sept. 27-28. Wisconsin Radio Trade convention. Auditorium. Milwaukee. N. C. Beerend, Manager, P. O. Box 1005, Milwaukee, Wis.

Oct. 18-23. Jobbers and Dealers Convention. Southwestern states. Auspices St. Louis Radio Trades Association. William P. Mackle, Executive Secretary, 1207 Syndicate Trust Building, St. Louis, Mo.

Oct. 25-31. State Radio Dealer Convention. Auspices Radio Trade Association of Michigan, Convention Hall, Detroit. A. M. Edwards, Secretary, 4464 Cass Avenue, Detroit, Mich.

Business Opportunities Radio and Electrical

Rates 10c per word; Minimum, $1.00; Cash with order

BATTERYLESS RADIO—Competent engineer is open for connection with concern desiring to manufacture radio working from light socket; no trickle charges or liquids; powerful natural reproduction; will demonstrate. Box C, Radio World.

MANUFACTURER OF ELECTRICAL equipment including complete line of battery eliminators, trickle charger and power amplifiers is looking for sales organization or executive with facilities for marketing. Box B, Radio World.

ELECTRICAL OR RADIO COMPANY—Electrical engineer seeks connection to develop new device or invention; have inventive ability and long electrical manufacturing experience; references. Box D, Radio World.

Transformers Improve, Steady Sales Prophesied

Taking into consideration the limitations of transformer-coupling, and allowing for the fact that it is the most efficient type as far as volume output goes, it is probable that the future will see as many transformers being sold as have been in the past. Of course, we can account for this statement by the suggestion that the transformer is rapidly approaching perfection in design.

This does not by any means infer that the other types will lose their popularity, for as pointed out previously, where the primary consideration is not direct cost, but quality, the other types stand much chance with the large number of radio enthusiasts who build their own. Again, the combination amplifier units, including transformers, resistances and choke coils are appearing in large numbers and seem to have won immediate favor. Thus, one stage of transformer-coupling, two of resistance and one of impedance, or any such similar arrangement, is coming into wide use.

Good quality is the rule to-day.

American Agenda Ready

WASHINGTON.

After several weeks of preparatory work, officials of the State Department working in cooperation with radio officials of the Department of Commerce, have practically completed the American agenda for the forthcoming international radio conference which is expected to be held in Washington next spring. The American proposals, it is said, will be similar to those submitted at the Mexican conference.

Freed Resigns as Head of Exhibition Corp.

Announcement was made at a meeting of stockholders of the Radio Exhibition Corporation that Joseph D. R. Freed, president of the Freed-Eisemann Radio Corporation, Brooklyn, has resigned as president and director.

Many of the stockholders are here to attend the convention of the radio apparatus section of the Associated Manufacturers of Electrical Supplies. Principal radio manufacturers formed the Radio Exhibition Corporation primarily for the purpose of achieving one annual exposition in New York to take the place of two simultaneously conducted competing wireless expositions.

Mr. Freed's resignation is due to pressure of responsibility as chief executive and chief engineer of Freed-Eisemann Radio Corporation.

Ruark Tells Story to Stress Unity Need

Possibly indicating future policy, was a story recently told to the Radio Manufacturers' Association by B. W. Ruark, of Chicago, its new Executive Secretary. Mr. Ruark said there was an old stage coach driver in the West who gained fame by the way he could clip off almost anything with his long blacksnake whip.

On a trip from Denver to Salt Lake a passenger said to him, "See that leaf! Can you cut that off?" The old driver did it with ease and pretty soon the passenger indicated a twig. This appeared easier than the leaf and finally the passenger pointed to a hornet's nest and said, "There's a hornet's nest! Let's see you pick that off."

Whereupon the driver swung his whip with a flourish but at the height of the gesture dropped the whip and turned to the passenger and said, "My friend, a leaf is a leaf, and a twig is a twig, but a hornet's nest is an organization and I'll be dog-goned if I'll be the one to disturb it!"

Mr. Ruark added rather significantly, "We don't want to have any stings in it if we can possibly avoid it but if we are going to be a power we must have an organization with a sting in it."

Exports in Four Years Totalled $22,281,000

WASHINGTON.

Total exports of radio materials from the United States during the four years 1922-1925 were valued at approximately $22,281,000, according to information compiled by the Electrical Division of the Department of Commerce.

Canada took during the four years a total of approximately $7,709,000 worth of radio materials or about 35 per cent.

Markets in Southern America took approximately 25 per cent. of all the radio products exported during the period. The principal purchasers were: Argentina, 11 per cent.; Australia, 8 per cent.; Brazil, 3 per cent.; New Zealand and British South Africa, each 1 per cent.

RADIO HOSPITAL FUND APPEALS

More than 7,000 bedridden patients in Washington hospitals and charitable institutions are appealing for modest contributions to recondition the hospital radio sets. Checks may be sent to Herbert T. Shannon, Colorado Building, Washington, D. C.

Set Aboard Great Liners Brings Thrill in Mid-Ocean

By Leon L. Adelman

The Chas. Freshman Co.

Many no doubt are contemplating a trip to Europe this summer and afraid they will miss the radio set.

"Gee, but I'll hate to leave that little humdinger of mine all alone," one says to himself.

Most of us will agree that a more interesting utility could not have been invented.

Now that radio is here to stay, we could not do without it. And so, the owners of the large trans-Atlantic liners are realizing the necessity of equipping their vessels with the latest broadcast receivers to insure comfort and entertainment for their passengers.

Let us go back further in history, before dwelling upon the almost miraculous changes that have marked our evolutionary progress. Suppose for a moment we had accompanied Columbus on his trip westward in search of a new gateway to India. How tedious and tiresome, how dull and monotonous, how fearful and unwilling would such a trip have been. Depending only upon the will of the winds and at the mercy of the seas, our pleasure trips would soon resolve themselves into the iron-bound motto, "See America First, Last and Always."

What Wireless Did

However, after a few trips to the west, the need for better sailing vessels became imperative and it remained for James Watt to invent the steam engine. With that great invention and its application to navigation a new era in ocean-going transportation sprang up and soon lanes of traffic were opened to the pleasure-seekers as well as to trade.

But it was not until the discovery and perfection of wireless that navigators and passengers felt at ease. For instead of dropping out of sight and communication with those at home, for a period extending over many weeks, the passengers were kept in constant touch with the rest of the world.

Then broadcasting came to increase pleasure at sea.

Most of the large liners, and for that matter many of the smaller coastwise steamers, have a broadcast receiving set which is placed at the disposal of the passengers. Not only does the set help to while away the time and make the voyage more pleasant, but it creates new radio enthusiasts.

Imagine yourself on the high seas, thousands of miles from home. Unless you have traveled extensively, your first journey may be a decidedly unpleasant sensation and you will have wished that you never had gone. But, after a while, you get used to it and go about to find amusement.

Down in the saloon tucked away in the corner, is a familiar-looking radio set, like the kind you left behind. A pull of the switch, a turn of a few knobs and a few moments of patient waiting and then —faint music.

Music Clear and Strong

A readjustment of the dials brings in the program strong and clear. Who can it be? Patiently you await the announcement and, realizing that you are more than 2,000 miles from home, wonder anew what station it is. Presently you hear, clearly and distinctly: "This is station WXYZ."

In the same manner in which some of our modern apartment houses are being equipped with complete radio installations, the staterooms of ocean liners are being wired for loud speaker reception of broadcast stations. Thus it is hoped ocean travel will be encouraged to a greater degree and that passengers will be able to obtain news and entertainment from home free of charge.

Some travelers are taking portable sets along with them and enjoy the programs until they are far out at sea. Then, when about half way across, the European stations begin to come in and French, German and other foreign stations can be tuned in with ease.

HE WILL BE

"So your husband has taken your radio all apart?" said Mrs. Suburbs. "Is he an expert?"

"Not yet," replied Mrs. Saylor. "He hasn't got it back together."—Life.

Rectification Preserves Both Sides of Audio Wave

Various illustrations of the methods of rectification of high frequency signals, and the effect of the rectification upon the signal wave form, have caused quite some misconception among radio fans. Questions are frequently asked about the reason for the two halves of a cycle for the signal voltage in the audio frequency circuit.

It is generally assumed that the signal voltage in its entirety is cut in two, that is, the negative half of the wave is chopped off in the rectification process. That, however, is a false idea, for it is necessary to differentiate between the modulated carrier wave and the audio frequency signal wave before considering the loss of the negative half of the modulated carrier wave during rectification.

The Wave Form Depicted

It is customary to show a radio frequency signal by means of an undamped wave as in Fig. 1. In Fig. 2 is shown the action of the rectifying element as chopping off the negative half of the signal wave. The cumulative effect of the various positive halves is then indicated as shown in Fig. 3. But this is not the real action taking place in the modern receiver when one is listening in.

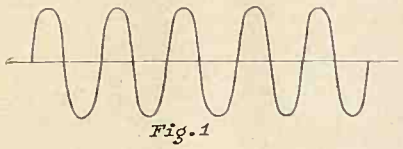


Fig. 1

Fig. 2

Fig. 3

The radio frequency carrier is modulated by an audio frequency signal. Now if we show the signal wave form of the unmodulated carrier as in Fig. 4, and the signal wave form of the audio signal as Fig. 5, the resultant modulated carrier wave will appear as a combination of both and we carefully observe that the entire audio signal wave form modulates both sides of the carrier.

Now, if we pass this modulated carrier through the same system which was used to rectify the signal wave form shown in Fig. 1, the resultant signal will appear only in audio form.

When the audio signal is passed from the rectifying element into the amplifier tube, the signal wave form has levelled itself back into its original shape shown in Fig. 5, since the wave form of the signal heard in the loud speaker should be of the same characteristics as that passed into the microphone, at the studio of the transmitter. So we see that while one-half of the modulated carrier is lost in the process of rectification, no effect is displayed upon the wave form of the audio or modulating signal, since this entire signal is impressed upon both halves of the carrier wave. The loss of any part of the audio signal wave form would mean distortion.

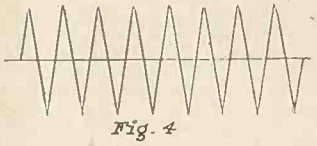


Fig. 4

Fig. 5

Completion of Wiring the Light 5 Portable

(*Concluded from page 13*)

go to grid, for they are connected to the frame, while the stator plates go to low potential —A minus in the case of the two RF tubes and A plus in the case of the detector tube. This fact should be borne in mind.

Use Flexible Wire

Flexible wire is used for making all the connections, for several reasons, including the reduced tendency to microphonic noises, many of which are caused by stiff busbar introducing its mechanical vibrations into the tube elements.

The grid leak-condenser combination, R4C4, is mounted between the grid post of the detector tube socket and the rotor plates of C3, to which also is connected one end of the secondary, L5. The busbar is carried upright from the G post of the socket, the condenser is soldered thereto, and the connection is continued from the other side of the grid condenser to the variable condenser rotor plates. Then the grid leak is pressed into place between the clips on the grid condenser.

The two F posts of the audio transformers are connected, this lead being brought out eventually to C minus, about 4½ volts being adequate biasing if 90 volts are used on the plates, as prescribed. The wiring of the baseboard mounted audio transformer may be completed also, at this time, but the other transformer, because panel mounted, must be wired later. Likewise the connections to the variable condensers, from sub-panel parts, must be deferred until the sub-panel is reconnected to the panel.

The Coil Wiring

This act may be done now, and the wiring of the coils completed. One end of each of the secondaries, L3 and L5, as well as one end of L1, has been connected to the proper variable condenser as a part of the mounting. This is to the stator plates, which go to A minus in two instances and to A plus in the third instance. In the case of L1, the end of the coil, that terminal nearer the tap, goes both to one side of the remaining switch and to the ground binding post on the front panel. The coil L1 consists of 60 turns of No. 24 wire, preferably SCC, if you can not get silk over cotton, while the tap is at the 18th turn. This tap is connected to the remaining free terminal of the switch. The open terminal of the coil goes to the aerial binding post on the front panel, to grid of the first socket and rotor plates of C1.

The remainder of the wiring is orthodox and needs no special advice. The coils L2L3 and L4L5 are wound alike, being, like the aerial coil, on forms 2" in diameter and 2¼" high. The secondaries have 72 turns of No. 24 wire, as previously used, while the primaries consist of 5 turns each, being wound in the center of the secondary, either over it, or, better alongside of and simultaneous with the secondary winding. Thus, to wind one of the coils, put on 32 turns, a part of the secondary, then cut a strip of wire, about 4 ft. long, and wind five turns of this while you continue winding the secondary. This brings to secondary turns to 32 plus 5, or 37, meaning that you need put on only 33 more turns to complete the secondary, indeed, the entire transformer. The excess wire on the primary is snipped off after you have determined just how great a length you need for making the wired connection. Of course, the coils should be wound before any of the set wiring is done, for the mounting of the panel parts, and the coils upon the condenser frames, is one of the first tasks.

After the sub-panel is fastened securely to the front panel and the uncompleted wiring is brought to a finish under those conditions, one still has to deal with the insertion of the receiver in the case. The panel and set is pushed into the case, so that the knobs of the dials are nearer the handle of the case. There are two angle brackets on the front panel, with holes on one of each of the two arms, and corresponding holes are drilled in the sides of the case. Bolts and nuts are used to secure the set to the case in this way. Wing nuts are handiest, being on the outside of the case, for then it is easy, if occasion should arise, to remove the receiver from the case.

The batteries are connected to the set.

(*Concluded on page 27*)

Good Back Numbers of RADIO WORLD

The following illustrated articles have appeared in recent issues of RADIO WORLD:

1925:

Aug. 29—A Set a Baby Can Build, by Herbert E. Hayden. A Fine Meter Switchboard, by Lewis Winner.

Sept. 12—An Oscillating Wavemeter, by J. E. Anderson. A 25-to-110 Meter Receiver, by Sidney B. Finkelstein. Spreading Out the Lower Waves, by Capt. P. V. O'Rourke.

Sept. 19—The 1-Dial, 2-Tube Speaker Set, by Percy Warren. Anderson's Theory of Fading. The Way of the Frequency Dial, by Capt. P. V. O'Rourke.

Oct. 24—The 3-in-1 RF Receiver, by Sidney B. Finkelstein. A Phonograph Cabinet Set, by Lewis Winner. How To Use Fixed Condensers, by J. E. Anderson.

Nov. 7—A 3-Tube Dry-Cell Circuit, by Capt. P. V. O'Rourke. One of the Best Crystal Sets, by Herbert E. Hayden. 1-Tube DX Set, Herman Bernard.

Nov. 28—The Zero Potential Loop, by Frank Freer. The 1-Tube Headset Receiver, by J. E. Anderson. A Discussion of AF Amplification, by Wm. Fortington.

Dec. 12—A Self-Contained Receiver, by H. E. Hayden (Part 1). B Battery Eliminator, by Lewis Winner (Holiday Gifts No.).

Dec. 26—The Regenerative Wave Trap, by John F. Elder. The 5-Tube Tuned RF Set, by Capt. P. V. O'Rourke.

1926:

Jan. 2—The 2-C Set for Simplicity, by Capt. P. V. O'Rourke.

Jan. 9—The 4-Tube DX Symphony Set, by A. Irving Witz. A Skillfully Made 1-Dial Set, by Herman Bernard.

Jan. 16—Anderson's 5-Tube Quality Receiver, The Raytheon B. Eliminator, by Lewis Winner.

Jan. 23—The 4-Tube Diamond of the Air, by Herman Bernard. B Batteries Last Six Months, by S. E. Finkelstein.

Jan. 30—An Individual AF Amplifier, by H. E. Hayden. The Antennatrol, by Herbert Hayden (Part 2). Trapping Out Super-Power in New Jersey, by Capt. P. V. O'Rourke.

Feb. 6—The Fenway (4 or 9 tubes), by Leo Fenway (Part 1). The Great 1-Tube DX Set, by Herman Bernard.

Feb. 13—Anderson's 5-Tube Economical Receiver. Trouble Shooting for Novices, by M. B. Strock. The Fenway, by Leo Fenway (Part 2).

Feb. 20—The 8-Tube Victoreen, by Herbert E. Hayden. The Fenway, by Leo Fenway (Part 3). Quality Stressed in 3-Tube Set, by Brainard Foote.

Feb. 27—The 4-Tube DX Dandy, by Herbert E. Hayden. Umbrella Aerial for DX, by Hugo Gernsback. Part 2 of The Victoreen.

Mar. 6—The 1-Tube Set, By Capt. O'Rourke. The Chemistry of Batteries, by A. R. Reid. The Victoreen Set (Part 3), by Herbert E. Hayden.

Mar. 13—The Non-Regenerative Browning-Drake Set, by M. B. Sleeper. The Tectron Eliminator (Part 1), by Lewis Winner. Curing Victoreen Trouble, by Herbert E. Hayden.

Mar. 20—The Super-Heterodyne, by J. E. Anderson. A 2-Tube Speaker Set, by Percy Warren. The Browning-Drake Set (Part 2), by M. B. Sleeper. A 2-Tube Eliminator, by Lewis Winner.

Mar. 27—An Economical 4-Tube Set, by Edgar T. Collins. A Practical B Battery, by Capt. P. V. O'Rourke. Tectron Trouble Shooting, by Lewis Winner.

April 3—The Bernard Portable, by Herman Bernard (Part 1). How to Get DX, by Capt. P. O'Rourke. A Compact B Supply, by Lewis Winner.

April 10—The Bernard Portable, by Herman Bernard (Part 2). Two Eliminators for DC, by Lewis Winner. A Super From An Old Set, by C. King.

April 17—The New 1-Dial Powertone, by Capt. P. V. O'Rourke. The Bernard Portable (Part 3), by Herman Bernard. The Action of Transformers, by Lewis Winner.

April 24—All Waves on One Set, by Capt. P. O'Rourke. Bernard's Portable (Conclusion). Control of Feedback, by Barney Feste.

May 1—New Multiple Tube, by Herman Bernard. The Aero All-Wave Set, by Capt. O'Rourke. Kilocycle-Meter Chart. Official List of Stations. An Analysis of Detection, by J. E. Anderson.

May 8—A study of Detection, by J. E. Anderson (Part 2). To Wind a Loop on a Cardboard Frame. How to Reflex Resistance AF, by Theo. Kerr.

May 15—Super-Heterodyne Results Brought Up to Maximum, by Herman Bernard. The Truth About Coil Fields, by J. E. Anderson.

May 22—A Built-In Speaker Set, by Herbert E. Hayden. The Powertone in Operation, by Capt. P. V. O'Rourke. Confessions of a Super Bug, by James H. Carroll.

May 29—Aerials in Ground and Water, by Lewis Winner. Economized Filaments, by J. E. Anderson. How to Get DX, by John F. Rider.

June 5—Five-Tube Compact Receiver, by J. E. Anderson. A Tester for Tube Circuits, by Spencer Hood. Problems of Portables, by Hugo Gernsback.

June 12—The Light 5-Tube Portable, by Herman Bernard (Part 1). The Rogers-Schudt Receiver, by Wm. A. Schudt, Jr. (Part 1). The Freshman Masterpiece, by A. W. Franklin.

June 19—Selectivity's Amazing Toll, by J. E. Anderson. The Light 5-Tube Portable Set, by Herman Bernard (Part 2). The 4-Tube Rogers-Schudt, by Wm. A. Schudt, Jr. (Part 2).

Any copy, 15c. Any 7 copies, $1.00. All these 33 copies for $4.50, or start subscription with any issue. RADIO WORLD, 145 W. 45th St., N. Y. C.

The 5-Tube Portable

(Concluded from page 26)

by means of flexible wire, which is bunched at one point, near the center, and introduced through a hole in the sub-panel to the required points in the set. These battery leads should be tagged with metal markers, so you will make no mistake in connections.

As a part of the outdoor utility of the set, and in consideration of tuning that otherwise would have to be done in the dark in many cases, it is well to provide one's self with a flashlight. It is advisable also, to record the dial settings for C2 and C3, so that you will know the positions of the dials for various wavelengths. The switch S1 caused a change in the settings of C1, but this dial may be logged, also, notation being made of the settings, for higher wavelengths, when the switch is off, and, for lower wavelengths, when the switch is on. But as one may use an emergency antenna, or one which will not be the same length all the time, the dial settings of C1, even under the attempted logging, may not be constant. However, when one knows the settings for C2 and C3 one has all the necessary information, as the tuning in on C1, with switch on or off, is only a moment's work.—H. B.

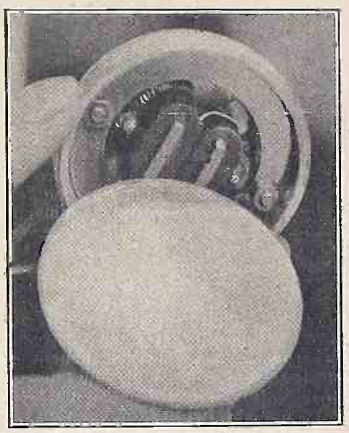
AVOIDS SETS IN CLUBS

That radio manufacturers are not enthusiastic about installing sets in clubs is reflected in the assertion recently of one of the foremost makers of the country that he would not hereafter sanction such installations. The reason given is that too many inexperienced persons fool with the dials.

COMPASS SUCCESS

Although not the first time used on airships, nevertheless the Lighthouse Service points out that the use of the radio compass for direction finding on Amundsen's Norge was probably the most convincing trial of the value of this instrument, which is now in general use in marine navigation.

Test For Phones



(Radio World Staff Photo)

IF YOU have dropped your phones and you imagine the magnets have lost their magnetism, because the signals are weak, unscrew the cap and take the thin diaphragm off, being sure not to bend it. Hold the phone unit down and run the diaphragm at right angles to the magnets. If the diaphragm is held in a semi-rigid state, that is, in such a position that it does not fall, the magnets are still strong, the weak signals being caused by trouble elsewhere. The diaphragm "holding on," is shown above.

Large Condensers Click Even When Not Shorted

A battery and phones may be successfully employed to test condensers for open or short circuits. With a large condenser, as soon as even a 1½-volt battery is connected in series with the phones, a pronounced click will be heard. This is due to charging the condenser and does not indicate that the condenser is bad. However, if immediately after this test, the test is repeated, nothing should be heard, as no charge is likely to be built up in such a short period. The smaller the condenser, the smaller the click.

(Radio World Staff Photo)

Hence one should distinguish with large condensers (.25 mfd. or higher) between the pronounced charging click and the loud short-circuit click.

Western Pennsylvania Far Ahead in Receivers

PITTSBURGH

There are more radio sets on farms in the 22 counties comprising the Western one-third of Pennsylvania than on farms in the forty-four counties (Philadelphia excluded) in the Eastern two-thirds of the State, and this notwithstanding that there are 50,000 more farmers in the Eastern two-thirds. This is attributed to the Western Pennsylvania farmers' appreciation of the value of the two weather forecasts and four market reports broadcast daily from KDKA for their benefit, and also the regular educational and entertainment programs for rural listeners. The service, inaugurated in 1922, has won great favor in the country districts.

As indicative of the benefits that radio service confers on the farmers a survey made by the National Farm Radio Council is illuminating. Reports were obtained from 44,550 farmers in forty-three states, and more than 46 per cent of them gave specific instances of money saved through the information that their receiving sets brought them.

It is of no little value to them to get market reports from 24 to 48 hours earlier than they would be obtainable without the use of wireless equipment. Warnings in regard to the weather or in regard to the spread of stock disease epidemics and insect plagues, enabling them to adopt measures to protect their crops and their stocks, have been helpful.

This the farmers appreciate.

Coolidge to Broadcast on Big Double Holiday

Putting off the celebration of Independence Day, which is also his birthday, until Monday, President Coolidge will address the assembled patriots in the stadium of the Sesqui-Centennial at Philadelphia on July 5. He will begin speaking at 2:30, E. S. T., 3:30 Daylight Saving Time, which Philadelphia is now using.

Already it is definitely known that the Philadelphia stations, WEAF in New York, WCAP in Washington, and others will broadcast the speech.

BASEBALL LISTENERS INCREASE

Crowds listening to play-by-play baseball radio reports are noticeably larger this year than last. It would seem that baseball fans are growing more accustomed to receiving returns in this way.

Bang and Pop of Fireworks to Be Broadcast July 5

The summer broadcasting will literally be inaugurated with a bang when WAAM broadcasts Independence Day fireworks direct from the Chamber of Commerce Fourth of July celebration at the South Orange Village Center. The broadcasting will be made oyer the special wire which the Chamber of Commerce has had installed for its official radio studio, which opened June 19.

Several microphones will be placed in advantageous positions for picking up the entire program with maximum effectiveness. Since the Fourth of July this year falls on Sunday, the celebration will take place on July 5.

The first part of the fireworks program will be the broadcasting of the Fourth of July exercises, including a band concert. Speeches by visiting celebrities will follow. Thomas A. Edison is expected to be present, and will be asked to speak a few words into the microphone.

The fireworks novelty broadcasting program will take place after the regular program is finished, and will be accompanied by a complete description from the announcer as to exactly how the displays look, while the microphones relay every splutter, pop and bang.

Research into records of past radio programs fails to disclose that any other fireworks broadcasting program has ever been put on the air.

QUARTZ GETTING SCARCE

Because of its newly discovered use in radio oscillators in frequency sets, there are signs of scarcity in quartz. Government officials said while plenty of crude quartz was available, the quality necessary for use in radio frequency sets appears to be unobtainable in sufficient quantities.

RADIO WORLD'S QUICK-ACTION CLASSIFIED ADS.

10 CENTS A WORD. 10 WORDS MINIMUM. CASH WITH ORDER

DISHES AND PLATES WILL DANCE. Makes everybody laugh. Lots of fun. Order now. Cooper's, Dept. 13, 1003 Main, Fort Worth, Texas.

A PAYING POSITION OPEN TO REPRESENTATIVES OF CHARACTER. Take orders shoes-hosiery direct to wearer. Good income. Permanent. Write now. Tanners Shoe Mfg. Co., 6-710 C Street, Boston, Mass.

DESIGN DATA FOR RADIO TRANSMITTERS AND RECEIVERS by M. B. Sleeper, sent on receipt of 75c. The Columbia Print, 145 W. 45th St., N. Y. C.

THE GREAT AID OF BY-PASS CONDENSERS, by John F. Rider, appeared in RADIO WORLD dated May 8. Sent on receipt of 15c, or start sub. with that number. RADIO WORLD, 145 W. 45th St., N. Y. C.

DETAILS OF WIRING THE DC B ELIMINATOR, Part II, by Lewis Winner, appeared in RADIO WORLD dated April 24. Sent on receipt of 15c, or start sub. with that issue. RADIO WORLD, 145 W. 45th St., N. Y. C.

A COMPLETE LIST OF BROADCASTING STATIONS appeared in our issue dated JUNE 6. Sent on receipt of 15c, or start sub. with that number. RADIO WORLD, 145 W. 45th St., N. Y. C.

CASH PAID FOR Dental Gold, False Teeth, Discarded Jewelry, Diamonds, Platinum. Mail, Florida Gold Refining Co., 21 Adams, Jacksonville, Fla.

SELL AND INSTALL RADIO SETS. With a $25 capital we can put you in the radio business and show you how to earn a hundred or two a week. For full details write Columbia Print, Radio Division, 143 West 45th St., New York City.

THE BERNARD PORTABLE SUPER-HETERODYNE appeared in RADIO WORLD dated April 3, 10, 17 and 24. Sent on receipt of 60c, or start your subscription with April 3 issue. RADIO WORLD, 145 West 45th St., N. Y. City.

WIRELESS IN THE HOME by Lee deForest, sent on receipt of 15c. The Columbia Print 145 W. 45th St., N. Y. C.

HERMAN BERNARD, managing editor of RADIO WORLD, broadcasts every Friday at 7 p. m., from WGBS, Gimbel Bros., N. Y. City. 315.6 meters. He discusses "What's Your Radio Problem?" Listen in!

A BUILT-IN SPEAKER SET, by Herbert E. Hayden, **POWERTONE IN OPERATION,** by Capt. P. V. O'Rourke, **THE NOVICE'S NOOK,** by James B. Scully, appeared in RADIO WORLD dated May 22. Sent on recipt of 15c, or start sub. with that number. RADIO WORLD, 145 W. 45th St., N. Y. C.

INVALID CHAIR, NEW. Willing to sell at a sacrifice. Strong, comfortable and easily moved around. Originally cost $65.00; will sell at half price. Call Telephone Bryant 0558 or write Box A., Radio World, 145 West 45th St., New York.

THE VACATION NUMBER OF RADIO WORLD DATED JUNE 12 contained many great features. The light 5-tube Portable, by Herman Bernard, The Freshman Masterpiece, by Albert W. Franklin, The Importance of C Batteries, by John F. Rider, etc. Sent on receipt of 15c, or start sub. with that number. RADIO WORLD, 145 W. 45th St., N. Y. C.

TO KEEP YOUR FILES COMPLETE, you can order your newsdealer to put a copy aside for you each week while on your vacation. Or, send $1.00 for RADIO WORLD from now until the end of August, and in this way you will not miss any copies. SUBSCRIPTION DEPT., RADIO WORLD, 145 W. 45th St., N. Y. C.

THE NEW 1-DIAL POWERTONE SET, by Capt. P. V. O'Rourke, appeared in RADIO WORLD dated April 17. Sent on receipt of 15c, or start sub. with that number. RADIO WORLD 145 W. 45th St., N. Y. C.

CONFESSIONS OF A SUPER BUG, by James H. Carroll, appeared in RADIO WORLD dated May 22. 15c per copy, or start sub. with that number. RADIO WORLD, 145 W. 45th St., N. Y. C.

Development of Speakers Traced From Its Inception

By Albert W. Franklin

Chief Engineer, Chas. Freshman Co., Inc.

Prof. Alexander Graham Bell's conception and invention of the telephone brought forth great exclamations of surprise and intense interest from all over the world. For, was it not the greatest step in scientific knowledge that had been made up until that time?

The invention of the telephone, its application to industry and its influence on our daily lives can not be over-estimated. Without it we would be at a distinct loss and fearful disadvantage. And so with our radio.

The strides that have been made in the development of radio have by far eclipsed those that have marked the progress of any other art or science. This is true, because it was necessary to overcome the many obstacles in the way, so that mankind could get the full benefit of what was destined to be its greatest asset. This necessity for development offered the inspiration, with the inevitable result that experimenters, research workers and engineers everywhere undertook the study.

Broadcasting Five Years

It is scarcely five years since the first broadcasting was done. Yet who can say truthfully that radio is not the greatest joy and blessing that was ever bestowed upon humanity? With the best entertainment of the world at one's command, what more could be desired? Education, travel, news, music, arts, sciences—all made possible by the radio—in everyone's home?

Radio engineering consists of a large number of important phases, and no one engineer can hope to attain success in all its branches. Thus, there is that branch which has to deal with tubes, the powerful three-electrode transmitting tubes, which function as voice amplifiers, modulators and oscillators. This alone requires specific knowledge and the greatest amount of minute detail work.

In radio telephone engineering, which has to do with the modulation, amplification and transmission of voice currents, there is a vast field of endeavor and only the most highly trained specialists are worth while.

Then, there is a multitude of minor and major divisions, such as transformer, motor-generator, loud speaker and circuit engineering, each of which constitutes a most important factor in the whole field. And, to make it more interesting, the field is divided into the two distinct and very different classes of transmitting and receiving.

One of the most important, because it has to do with the reproduction of sound, is that branch entailing the development of loud speakers.

The first telephone receivers were crude and ungainly. They served the purpose well, considering that the knowledge of electricity and its use in the transmission of intelligence was so small. The volume obtained with Bell's receiver was negligible. One had to jam the receiver tightly against his ear to make out the spoken words. Not until the invention of the carbon button transmitter by Edison was there any noted improvement. Even then, one had to keep the receiver close to the ear to hear. As far as loud speakers were considered, there simply weren't any.

Paper Cone Was First

As the art of radio progressed, the first loud speakers came into being. First, a paper cone placed over the mouth of the receiver served the purpose of the horn. This was replaced by other more appropriate horns of wood and metal in various sizes and shapes. Attention was then directed towards the telephone receiver or unit, and its windings were increased and decreased, the pole pieces were made larger and smaller, the diaphragm was made thicker and thinner, was made large and small, perforated and corrugated, alloyed and otherwise experimented with considerably.

In the search for something better, the floating armature type of reproducer was developed and as it has proved the best and most popular it is made the main topic for our consideration. This type is also known as the balanced armature reproducer and is incorporated in a number of speakers, notably in the new Freshman Master Speaker, a most novel and ingenious reproducer.

It remained for the Chas. Freshman Co. to conceive the method of reflexing the long air chamber into a short but highly efficient resonating air column having the property of taking capable care of both the lower and higher notes in the acoustic scale.

WHAT USERS OF THE BRETWOOD Variable Grid Leak *say:*

The Bretwood Grid Leak came with today's mail. It is now exactly 9:00 P.M. and the leak was installed about a half hour ago. This note is not only an expression of appreciation but also an attestation of the truth of your advertising. During the past half hour I have tuned in stations "ALL OVER THE DIALS" at leisure, and can adjust reception with the leak almost equal to a variable condenser.
I feel constrained to add that while waiting for reply and then receipt of leak from you, there has been on the set a fixed leak and condenser of well known and thoroughly reliable make, and fairly good reception has been enjoyed, but during this half-hour only test thus far the results are inexpressibly beyond expectation.
Have been a radio fan only about four years, but feel I have sufficient knowledge and experience to recognize a good thing upon fair trial. Your promptness and desire to satisfy your trade, in this case has won for you another "BRETWOOD BOOSTER." Thank you.

The Rev. WALTER G. BARLOW,
Bishopville, Ind.

Very many thanks for your kind letter of the 21st ult. and for the grid leak, which works perfectly. I have tried four different makes of grid leaks. The Bretwood "has 'em beat."

M. SAWYER,
Box 238, Los Gatos, Calif.

Received your grid leak and wish to say that none can compare with it when it comes to clearing up reception.

JOHN A. BLACKBURN,
5328 Warren Ave., Norwood, Ohio.

Enclosed find P. O. money-order for $3.00. Please send me two of your Variable Grid Leaks. I am using one and it works fine. Please mail them as soon as possible.

W. H. PERRY,
119 Congress St., Buffalo, N. Y.

Received your grid leak and many thanks. It is the best $1.50 that I have spent for radio equipment.

ED. JENKINS,
703 E. Main St., Louisville, Ky.

Enclosed herewith find check for $1.50 for one Bretwood Grid Leak. I am using your leak and find it far superior to any others. This is my third Bretwood.

J. C. WHITE,
422 W. Wooster St., Bowling Green, Ohio.

Will you please send me by return mail two Bretwood Variable Grid Leaks. I enclose herewith check for $3.25, the 25c. being for a special handling stamp, as these leaks are needed at once.
The leaks are the only satisfactory instrument on the market. I find them absolutely essential in the construction and operation of sensitive experimental receivers.

ED. J. WHITTIER,
The American Appraisal Co.,
Milwaukee, Wis.

I want to thank you for your leak, it makes the set 100% better. I was going to have a Diamond of the Air built, but since I have added your leak to my set I am now down in the dining room of the first floor and the set is on the second floor. I can hear the set just as plainly as if I were up there. I can hear every player in any band or music which is on air. The first night I gave the leak a very good test, and I got four stations in Chicago, one in Detroit, one in Canada, one in Atlanta, Ga., and several others without any noise. All were good and clear. It is going to make me spend more money, as I will have to get a good loud speaker. The horn I have now is a Manhattan Jr., and is good and clear, but as soon as your leak is installed the howling present when using three tubes is immediately stopped.

LEON E. COLE,
5816 Tilbert St., Philadelphia, Pa.

Grid Leak received and tested out, and find it is the only variable leak I ever used that is really variable. Enclosed find $1.50, for which please send me another one.

F. E. STAYTON,
Box 240, Ardmore, Okla.

Thank you for introducing me to the Bretwood Variable Grid Leak! I have installed one in my Three-Circuit Tuner, according to your instructions, and find that it does all you said it would—and more. I am now recommending the Bretwood to all my friends, and those who have used this wonder grid leak have nothing but high praise for it. The fact that it can be adapted for any hookup makes it invaluable to the experimenter.
Although I have only used the Bretwood leak for three weeks I have pulled in several of the weaker stations which were inaudible before, and the microphonic noises which were decidedly pronounced before have entirely disappeared.
Please accept my best wishes for your continued success and also for the Bretwood Grid Leak.

S. R. HUBBS,
180 Quincy St., Brooklyn, N. Y.

Let me say that the Bretwood Grid Leak improves the set 100%.

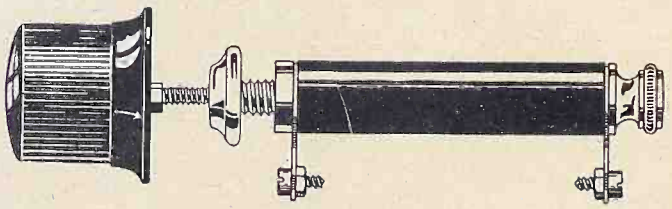
J. E. McGINNISS,
27 Lenox Rd., Brooklyn, N. Y.

I wish to take this occasion to thank you for your courtesy in furnishing me with your very excellent Grid Leaks. I have installed one with your Condenser on my own personal radio set, and am delighted with the results.

R. W. DeMOTT,
Experimenter Pub. Co.,
53 Park Place, N. Y. C.

I have received the Grid Leak you sent me and it is perfect. It is surely wonderful the way it works. Please send me another by return mail for a friend.

J. F. COOPER,
1029 Courtlandt St.,
Cincinnati, Ohio.



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In order to acquaint the readers of this magazine with these great publications, we are making, for a limited time, a special reduced rate and are also giving FREE one complete VALET Auto-Strop Razor.

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This shaving outfit consists of a highly polished, nickel-plated, self-stropping Razor; one blade, leather strop especially prepared. The razor case is of metal, finished in maroon, crystallized effect. Lined throughout with velvet, harmonizing with the pleasing color scheme of the entire package.

The only razor in the world that sharpens its own blades.

RADIO NEWS is the largest radio magazine published. It is the outstanding authority in the radio field, carrying more new developments, more hook-ups and more news than any other radio magazine.

RADIO NEWS has been radio's greatest magazine since the very beginning of radio broadcasting.

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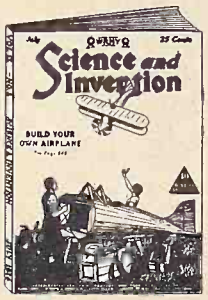

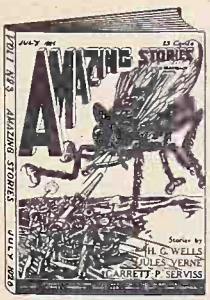

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WBBR, Rossville, N. Y..16	WMAK, Lockport, N.Y..14
WEBH, Chicago, Ill....49	WMSG, New York City..11
WHT, Deerfield, Ill.....55	WOC, Davenport, Ia....85
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WSB, Atlanta, Ga.....66	

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