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Forecast of Contributions for December Issue

A first-hand report of the third Radio Conference at Washington is presented by the Editor, a member of the Conference.

Prof. C. M. Jansky, Jr., discusses radio-frequency amplifier circuits with untuned transformers. His general opinion is adverse, even in the case of reflex circuits of this type.

Many readers will welcome the fact that David P. Gibbons, in his funny left-handed Irwinese, takes a crack at the genus announcer. The title of his story, "Scratchi Outcasts Some Yellow Pearls", is indicative of this treatment.

Volney G. Mathison follows up this month's account of the careful processes that are sometimes followed in the manufacture of unlicensed tubes with a sensational exposé of the unscrupulous methods that others employ. "On the Trail of The Tube Sharks" is a most daring piece of writing.

L. F. N. du Treil, in an article on "The Generation and Measurement of Short Waves", gives suggestions for the construction of a 20-meter transmitter and wavemeter.

Alexander Maxwell has written an unusually complete account of how to build a low-loss C. W. transmitter. This is an excellent guide for the first-timer. Richard F. Shea also tells how to install a transmitter, giving practical directions for tuning a Hartley oscillator with a dummy antenna.

A. Gael Simson shows how to make a tape recorder.

In "Things Equal to the Same Thing" Harry A. Nickerson analyzes simplex receiving circuits into their simpler components.

Philip N. Emigh records his experiments in making a reflexed neutrodyne.

R. McGinnis explains how to build a speech amplifier for a transmitting set.

The fiction feature is "Station GFS" by R. W. Shirey. It combines radio with the spirit of Christmas.



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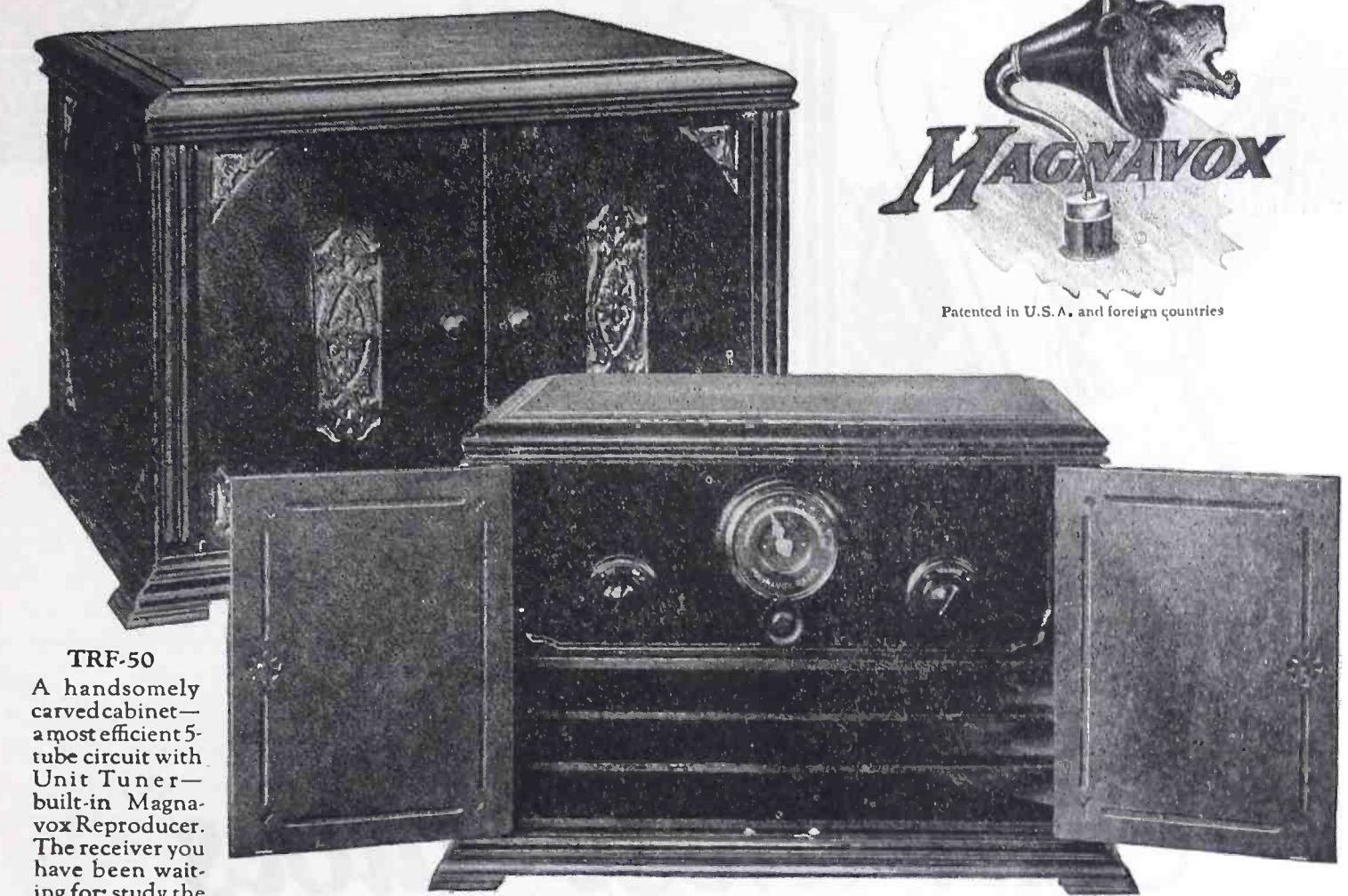
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3-LXL-9	100 A.H.	6	19.15	12-RB-2	4000 M.A.H.	24	10.00
3-LXL-11	125 A.H.	6	22.10	12-LR-2	6000 M.A.H.	24	12.00
3-LXL-13	150 A.H.	6	25.00	24-LR-2	6000 M.A.H.	48	23.30
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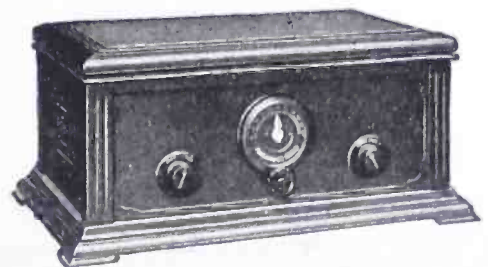
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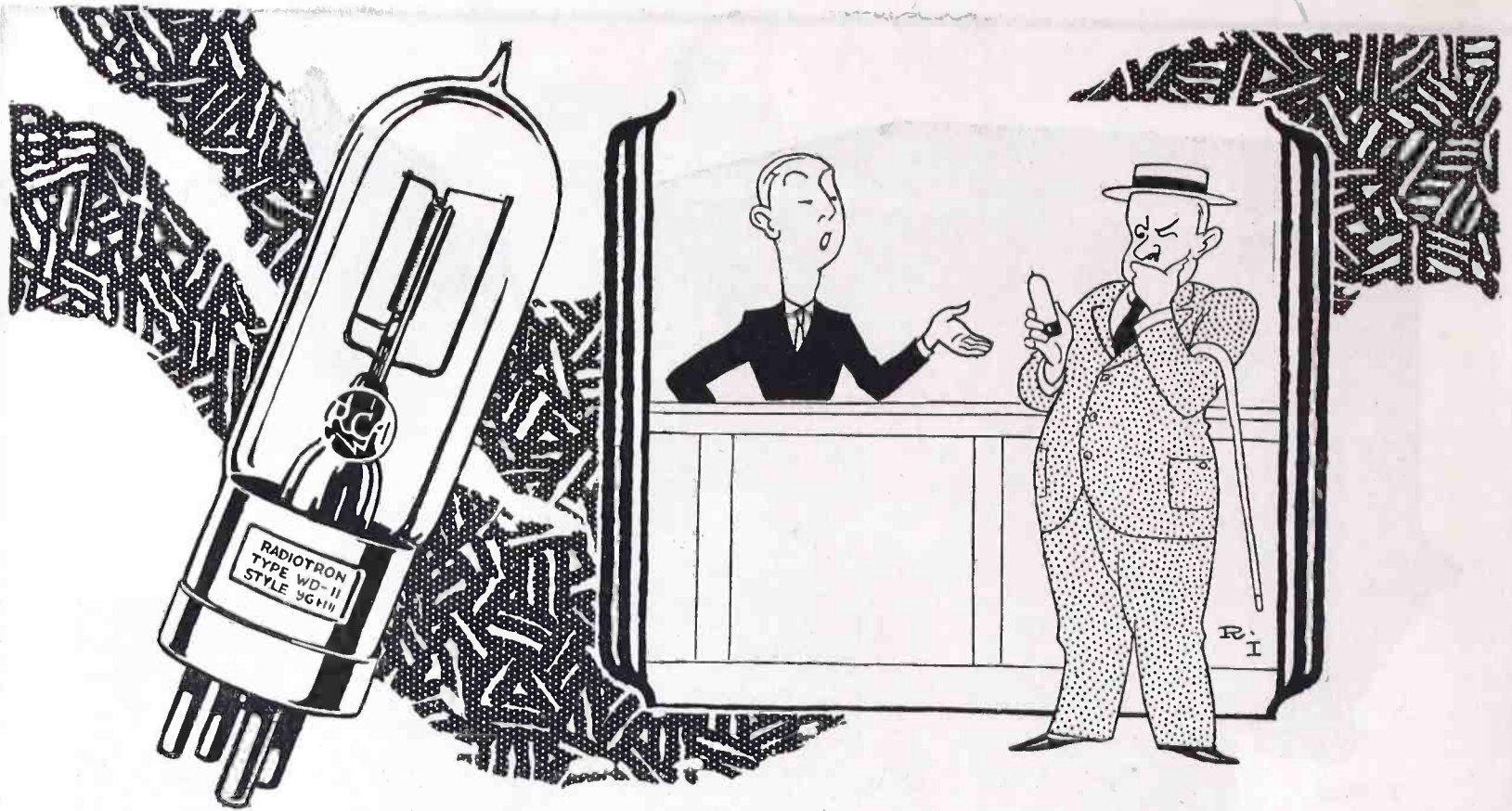
TRF-50 (as illustrated above)—is a 5-tube tuned radio frequency receiver with carved doors and built-in Magnavox Reproducer \$150.00



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Radiatorial Comment

ON the eve of the Washington Radio Conference, it is evident that the owners of 500-watt broadcast stations are likely to oppose the removal of the 1000-watt power limitation. On the other hand, manufacturers of 5000-watt equipment, as well as the concerns desiring to use these more powerful transmitters, are equally earnest in their desire to modify past restrictions. The 500-watters fear that they will be erased and the 5000-watters want to reach out further.

Thus does history repeat itself. Two years ago the 5-, 10- and 15-watters were fighting the 500-watters, and probably two years from now the 5000-watters will be opposing the 50,000-watters! Progress is rapid in radio and obsolescence more costly than depreciation.

The public is deeply interested in the outcome of this squabble, not so much from sympathy for those whose heavy investment may be somewhat lessened in value by the change, as from the kind of service they are likely to receive in the future. And it is the public viewpoint that both sides of the controversy seem to overlook. The public would rather have good programs from small stations with perfect modulation than poor programs from big stations with mediocre modulation. Radio has become so much of a public service that the people themselves are beginning to voice their opinions.

The most emphatic of these opinions is that the people want good day-time reception throughout the year. The receiving sets have been perfected to such a degree that they will pick up distant stations under adverse conditions. But their sensitivity is so great that they amplify static and other noises as well, so that there is no pleasure in listening to these distant stations. Their signal audibility is but slightly above the audibility of the disturbing noises.

The remedy is obvious. Since the noise level cannot be lowered, the signal level must be raised. This is the only practical means yet discovered for overcoming static. Strong indications from powerful transmitters may be slightly amplified without allowing static or other disturbances to be noticeable.

This, then, is the real argument in favor of the 5000-watters, and, no matter what the outcome of the conference recommendations, the governing consideration in Secretary Hoover's final ruling will undoubtedly be based upon that which will best serve the public.

WHAT, with the newspapers, magazines and moving pictures, the eye, until recently, threatened to make the ear almost as unnecessary as is man's rudimentary tail. But, with the advent of radio, the ear begins to assume its old-time position of importance. The lost art of oratory may yet be ruined.

When Mark Anthony asked the Romans to "lend me your ears" he was but anticipating the plea of the present writers to "lend us your eyes." Only a few of the ancient Romans could read and write. Indeed, it was not until after the invention of type and the printing press that this accomplishment became worth while for the average man and woman.

By this we do not mean that writing and reading is ever to be displaced by radio talks, which, at best, can only supplement the printed word. But, undoubtedly, the old-time influence of the minstrel, the reciter, and the town-crier, magnified a millionfold by radio, will again make the ear co-ordinate with the eye as a factor in the progress of a civilization based upon knowledge. Thus radio gives a new meaning to "lend me your ears", and incidentally a new means for saving the failing eyesight of the nation.

WHILE the improvement in transmitting equipment has been no more rapid than the improvement in radio receiving, its general adoption has. That is to say, many people are using obsolete receivers to listen to modern transmitters. By obsolete receivers are meant, primarily, those that are not selective enough to tune out what is not wanted when several local transmitters are on the air.

There is much talk about the obligation of the broadcaster to improve programs and transmitting facilities so as to justify the continuance of the ether franchise given by the government. But there is little attention paid to the reciprocal obligation of the listener to improve his receiving equipment as more and better stations come on the air, and, likewise, to make it "non-blooming" as more and more receiving sets are installed.

Short Wave Transmission

An Interesting Statement As To Its Possibilities In Military
And Civil Use

By Major General C. McK. Saltzman

Chief Signal Officer of the Army

IN considering the uses made of electrical energy in our busy world today, none of these uses is embodying more rapid development and change than radio. The keen, up-to-date experimenter hardly completes the ideal installation of the moment before an announcement from the laboratory or the discovery of an amateur makes the new set obsolete. One of the most interesting of these new developments, which bids fair to work a violent change in apparatus, is the use of short waves.

In this connection it is interesting to remember that in the early days of radio development, in the days when amateur experimenters and even noted scientists were commencing to fish in the mysterious pool of radio possibilities, experiments made use of comparatively short waves. The general trend, however, soon turned to the use of longer and longer waves, and the advantages which might have been utilized in the use of short waves were not taken advantage of. It appears today, however, that we are now to turn back to the "stone which the builders rejected" and to use even smaller ones.

It is quite true that, with all our study and experimentation, today we are



Major General C. McK. Saltzman, Chief Signal Officer U. S. Army

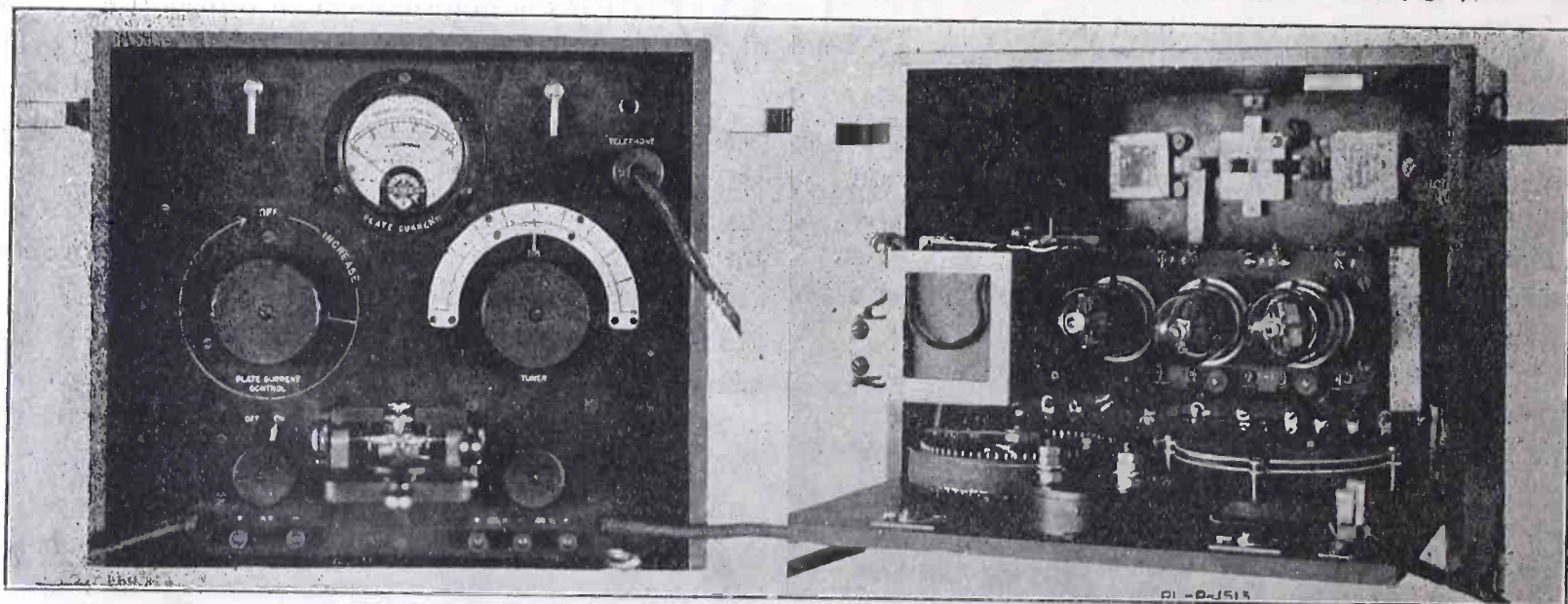
not capable of proving a satisfactory theory which shall cover all phenomena of radio transmission. We have endeavored to so mold these theories as to satisfactorily explain the present long

wave transmission, which has been the burden of thought for some years. In going back to short waves, it will be found that some of these molded theories will have to be remolded to explain results which are being obtained. However, the use of short waves is quite an established fact. The most eminent of our radio authorities are deep in the work of investigation, and amateurs are actually using them.

Comparing the two systems, it appears that many advantages are possible with the short waves. They undoubtedly will open up additional channels. If we establish 3000 cycles as the necessary frequency separation between telegraph channels, it will be seen that there will be an enormous gain in channels in the use of a small range of short wavelengths over a corresponding wide range of long wavelengths. It is probable that reflectors can be used, enabling directional effects to be utilized, which now are impracticable. This use of reflectors will open up the way not only to greater efficiency, but will permit a possible secrecy not now enjoyed. Such a use of reflectors will undoubtedly decrease interference difficulties.

In the design of radio apparatus for

Continued on page 72



Operating Panel of Army Short Wave Set
Note the simple means of adjustment, the large white dial being divided to provide ten channels of telegraphic communication over a wave band of less than 4 meters.

Interior View of Army Short Wave Set, Compact, Light and Accessible

The Locked Door Tube Factories

An Interesting Account of the Methods and Processes Employed
in the Manufacture and Repair of Unlicensed Vacuum Tubes

By Volney G. Mathison

“**B**LING-a-ling-a-ling!” goes a rapid electric bell, as we push the button alongside the locked door of Hidden Laboratories, Inc., somewhere-in-Newark, New Jersey. There is a distant sound of slamming inner doors, which somewhat muffles the whirring of motors and clicking of machines; and there is a clatter of steel filing cases being closed and locked; then half a dozen bolts slide back and the door opens about a foot.

“Who hails?”

“One from a land hungry for tubes.”

“Why hail you?”

“To watch the secret processes and improve my knowledge of manufacture.”

“Then you are a tube-outlet, I assume?”

“I am so recognized among the jobbers.”

“Advance with the passwords!”

“Vacuum.”

“And——”

“Thorium.”

“And——”

“Molybdenum.”

“And our aim?”

“Pump forever.”

“You are right. Pass in!”

I have found it indeed a difficult matter to gain admittance into any of the big unlicensed tube factories operating in Newark, but once inside, I soon felt amply repaid for all the trouble of getting there. Before attempting, however, to describe in detail what I found behind the locked doors, I think it will be best to outline briefly the genesis of these establishments.

Back in 1915, previous to the advent of the present type of based tube, there were two small unlicensed manufacturers of the old “audiotron,” an unmounted tubular device with two wires sticking out from each sealed end. After some costly patent litigation, these manufacturers were taken into the fold and transformed into distributors of a licensed product.

From that time until the sudden development of nation-wide music-broadcasting in 1922, really good unlicensed tubes were practically unobtainable. Plenty of bad ones were to be had, however; for some of the more observant of the glass-blowers employed about the large licensed lamp and tube works were quick to see the extraordinary profits being made in vacuum tubes, and they began clandestine manufacturing on a small scale in their cellars at home. The

more unscrupulous of these men did not hesitate to produce counterfeits, markings and all, of the standard licensed tubes on the market. A few others, more above board, did not manufacture, but confined their operations to attempts at small-scale repairing of burnt-out licensed tubes.

These products were of a wretched sort. They were made of bad materials, on crude machines, by glass-blowers totally ignorant of vacuum-tube engineering. These men knew that a tube consisted of an evacuated glass bulb containing a miniature filament, and a thing called a grid surrounded by another object called a plate. Once in a while they turned out a good tube, but this was accidental.

The stumbling operations of these glass-blowers quickly attracted the attention of other incandescent lamp and vacuum tube factory employes. Some of these went into partnership with the glass men and brought their fragmentary bits of knowledge into the business. The result was a slightly better, but still poor article, and somewhat less shrinkage.

With the coming of radiophone broadcasting, the demand for tubes suddenly became enormous; and here the unlicensed tube makers and repairers separated into two groups of two entirely different types of men, who are traveling widely divergent paths.

In one class were and are the crooks and fakirs and counterfeiters of trademarks, ignorant glass-blowers, men going it blind, still working in cellars and sheds with one-lung pumps and blowtorches; men without knowledge of vacuum tubes or their action; others with knowledge enough, but utterly unscrupulous; all intent solely upon cheating somebody with an inferior counterfeit or a wretched repair.

In the other and far more interesting class are those who have steadily taken better and better men away from the big licensed factories, and who have worked day and night to improve their plants and processes. Two or three of the larger independent plants have advanced to a point where the perfection of their equipment and the skill of their operatives is amazing. The inducement of high salaries and profit-sharing contracts offered to tube experts by the independent tube-makers, has caused the licensed factories to lose to their locked-door competitors some of their best men and most secret processes. As a result,

the equipment in use and quality of the finished product is sometimes identical.

The locked doors of these factories is purely a phase of the patent situation, as I shall explain later in more detail.

HARDLY anybody who has not spent some time in a tube factory, can have any conception of the intricate processes and remarkable scientific equipment necessary for the making of a good vacuum tube. Hard problems to solve begin at the raw materials; from there to the final testing-rack, the tube engineers meet with them, endlessly.

In the first place, there is the problem of purifying the metals used. All metals, as commercially reduced, contain various impurities, both solid and gaseous; whereas the elements of the vacuum tube must be absolutely pure. If they are not, gases will be given off and the tube will become soft.

The plate of a high-grade vacuum tube consists of pure nickel. This metal can be thoroughly purified and rendered gas free. The grid is made of molybdenum, a hard, silver-colored metal with a melting point above 2500 degrees Centigrade. It is extracted from molybdenite, a mineral with which many users of crystal detectors are familiar. Molybdenum wire or “molly wire” is used for vacuum tube grids because it will remain rigid at high temperatures; a grid of any other ordinary material would gradually sag when subjected to heat from the filament.

The basic metal of the filament of all the present popular types of tubes is tungsten. Tungsten is obtained from an ore called wolframite. This ore is crushed and reduced to a dirty-looking yellow powder, which is sometimes called tungstic acid. This compound is purified by a series of complicated chemical processes into pure powdered tungsten. In powerful hydraulic presses the tungsten powder is pressed into sticks. These are heated white hot in retorts filled with pure hydrogen gas to prevent oxidation; thereby sintering the sticks into slugs of pure solid metal. The slugs are worked hot into rods or wires less than 1/25 inch in diameter, and are then further reduced to the proper size, often less than .0009 inch, by hot drawing through a series of diamond dies.

Several formerly secret elements are drawn into the tungsten wire; the most important one is thorium, a rare and extremely costly metallic element. It is

gray in color, is heavier than lead or mercury, and is radio-active. Used in a radio vacuum tube, it is one of the most efficient emitters of electrons so far known. It has been found difficult to draw any large amount of thorium into the delicate tungsten wire used for tube filaments, particularly in the case of the wire used in the type-199 tubes. One of the latest processes, therefore, is to coat the tungsten wire with thorium by placing it in a retort filled with thorium vapor.

The electronic emission from a tube filament causes a disintegration of the thorium; this is the main reason why a good tube often becomes insensitive before burning out—the thorium in or on the tungsten has become exhausted. Any excessive heating of the filament tends to drive off the thorium, particularly if the plate current is on the tube. The overheating of a perfectly good type-199 tube for only a few moments will reduce its effective life to a fraction of what it would otherwise be.

The supporting wires upon which the grid, plate, and filament of a vacuum tube are mounted are made of pure nickel. It is astonishing what pains must be taken with such seemingly insignificant details as these supports. The pieces of nickel wire are "butt-welded" to other pieces of copper-clad wire. "Butt-weld" means a process whereby the two wires are welded end-to-end in a tiny tube or sleeve. The reddish-colored, copper-clad wire, which consists merely of pure iron coated with copper, is later sealed into the glass stem of the tube. Properly proportioned copper-clad wire has the same temperature co-

efficient as glass; that is, it expands and contracts at the same rate as glass. If it did not, the glass would break, or there would be a leak around the lead-in wires. This use of copper-clad wire is one of the most valuable developments in electric lamp and radio tube manufacture, as it has eliminated the costly

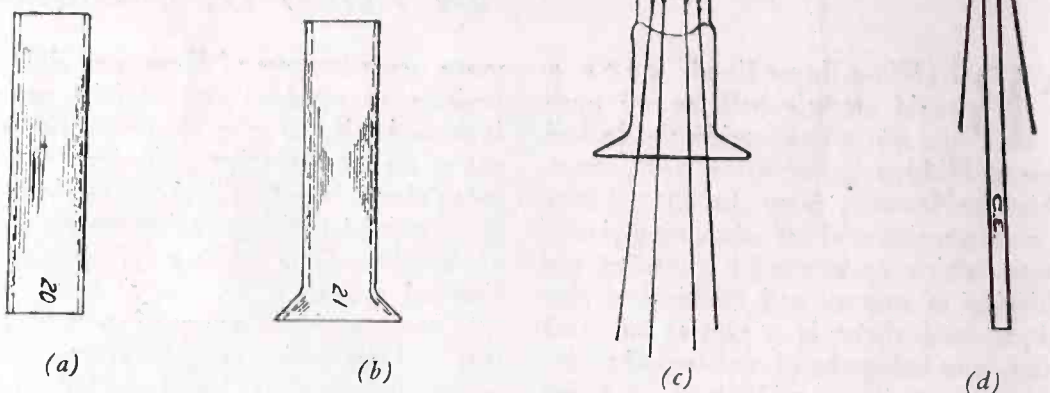


Fig. 1. The Beginning of a Radio Vacuum Tube
(a) Piece of cane-glass tubing. (b) Flared. (c) Stemmed. (d) Tipless stem, with filament.

platinum wires formerly necessary for sealing into the glass.

The nickel mounting wires, after being butt-welded to the copper leads, are placed in a silica tube about three ft. long and three or four in. in diameter. By means of electric heating coils or external gas-jets, the contents of the tube are heated red-hot; and they are then subjected to a stream of pure hydrogen gas. The nickel plates, which are stamped from pure sheet nickel on a die-stamping machine, are similarly treated. The hydrogen gas combines with the oxygen and other gases driven out of the hot nickel, and carries them off in an exhaust-pipe, in the form of water vapor. If a large flake of iron rust is placed in the hot tube filled with

hydrogen, the gas will combine with the rust, carry off the oxygen, and in a few moments you will have a piece of pure silvery iron! After having been purified with hydrogen, the nickel parts are stored in sealed containers and are used up as rapidly as possible.

The beginning of a radio vacuum tube is a piece of heavy glass tubing about $\frac{5}{8}$ in. in diameter and cut about 2 in. long, as shown in Fig. 1 (a). This piece of tubing is placed in a rotating chuck, heated in gas-jets until soft, and then flared out with a tool to the shape shown at (b).

The piece of glass tubing is now called a "flare." The flare, from which the tube-stem is to be made, is next placed on a complicated "stem-machine."

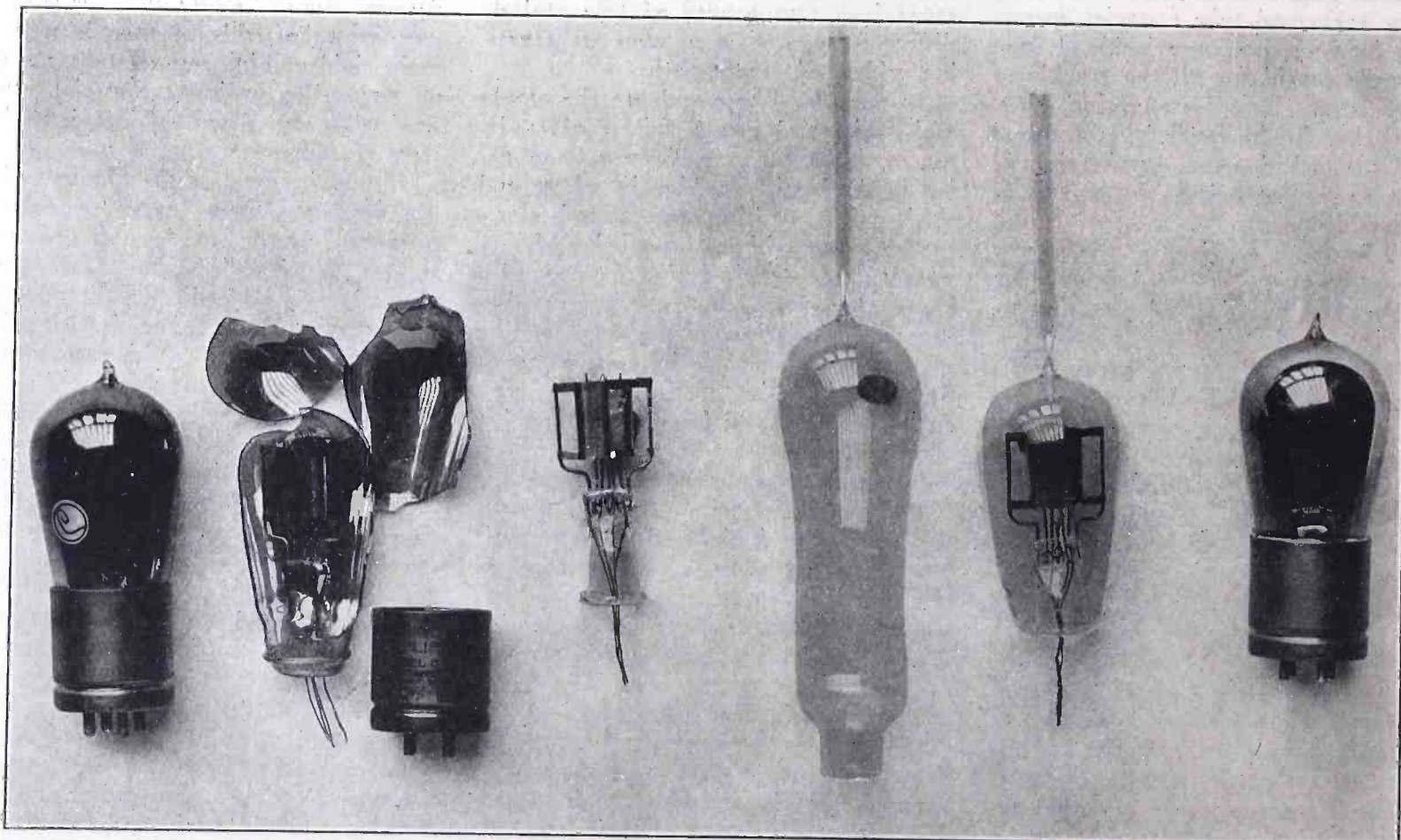


Fig. 3. Rejuvenating a Burnt-out Tube. (a) Burnt-out. (b) Broken down. (c) Old stem with new filament. (d) Molded glass bulb. (e) Sealed in. (f) Ready for testing.

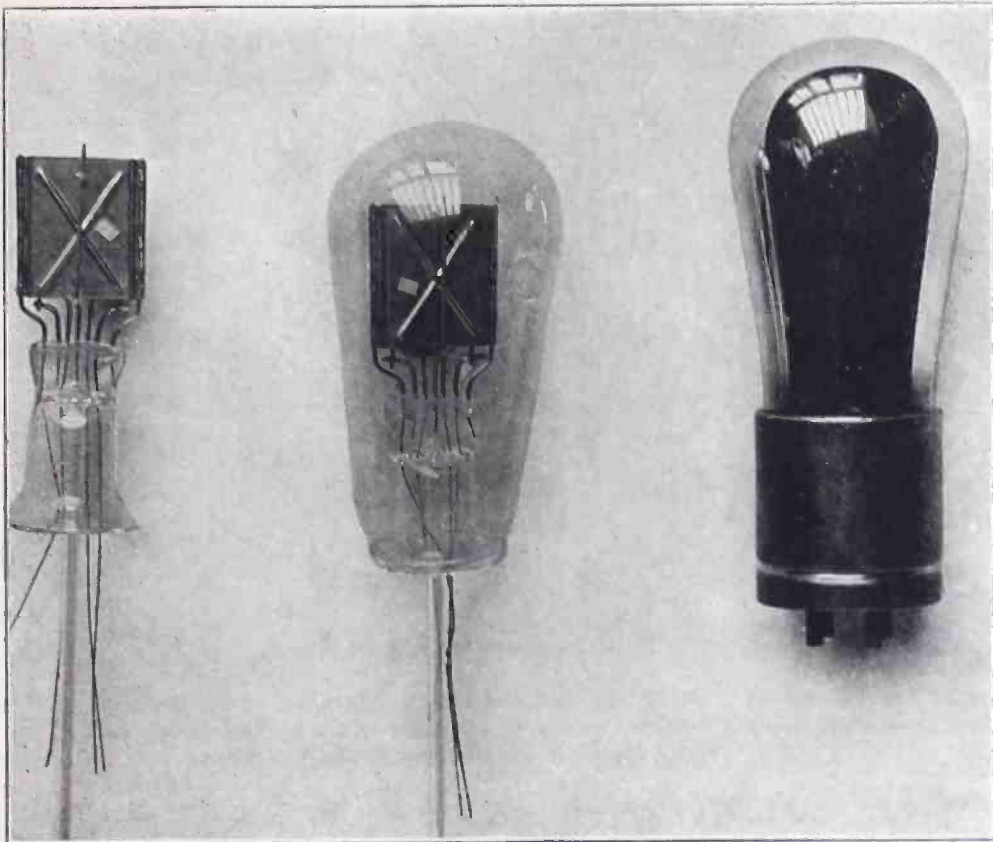


Fig. 2. A Tipless-Tube "Mount," Before and After Sealing In; and, to the Right, the Finished Tube. The tip is concealed in the base.

Here it is held vertically, with the un-flared end resting on a flat-topped lava cone. This cone contains six small holes, into which are stuck the six nickel mounting wires, with their copper-clad welds projecting up inside the

flare. In the case of a tipless tube, a small glass exhausting tube, about $\frac{1}{8}$ in. in diameter and 6 in. long is also dropped down inside the flare and allowed to rest on the lava cone, among the six mounting wires. All these parts

are then heated by batteries of gas-jets at the point where they rest on the lava cone. When the glass has been thoroughly softened, a pair of vise-like jaws come in against the glass tube or flare and press it in flat against the copper-clad lead-in wires and the small inner glass exhausting tube. The resulting object, now called a "stem," is shown in Fig. 1, (c), except that this cut does not show the inner exhausting tube. A tipless stem for an incandescent lamp is shown at (d). A radio tube tipless stem is identical, except that it has more wires sealed in. The copper-clad wires are treated with borax, to make them seal solidly into the glass.

The molybdenum wire grid is wound by machine around two short pieces of nickel wire, which are held the proper distance apart on a revolving flat mandrel. The grid wires are solidly welded to the nickel supports by a rolling electric spot-welder. The finished grids are next welded to the proper mounting wires on the glass stem; and the filament and plate are mounted. The plate goes on in two halves. All these parts are put together by electric spot-welding; that is, they are fused together by a low-voltage, high-amperage electric arc produced by a step-down transformer and certain mechanical devices.

We now have what is called a

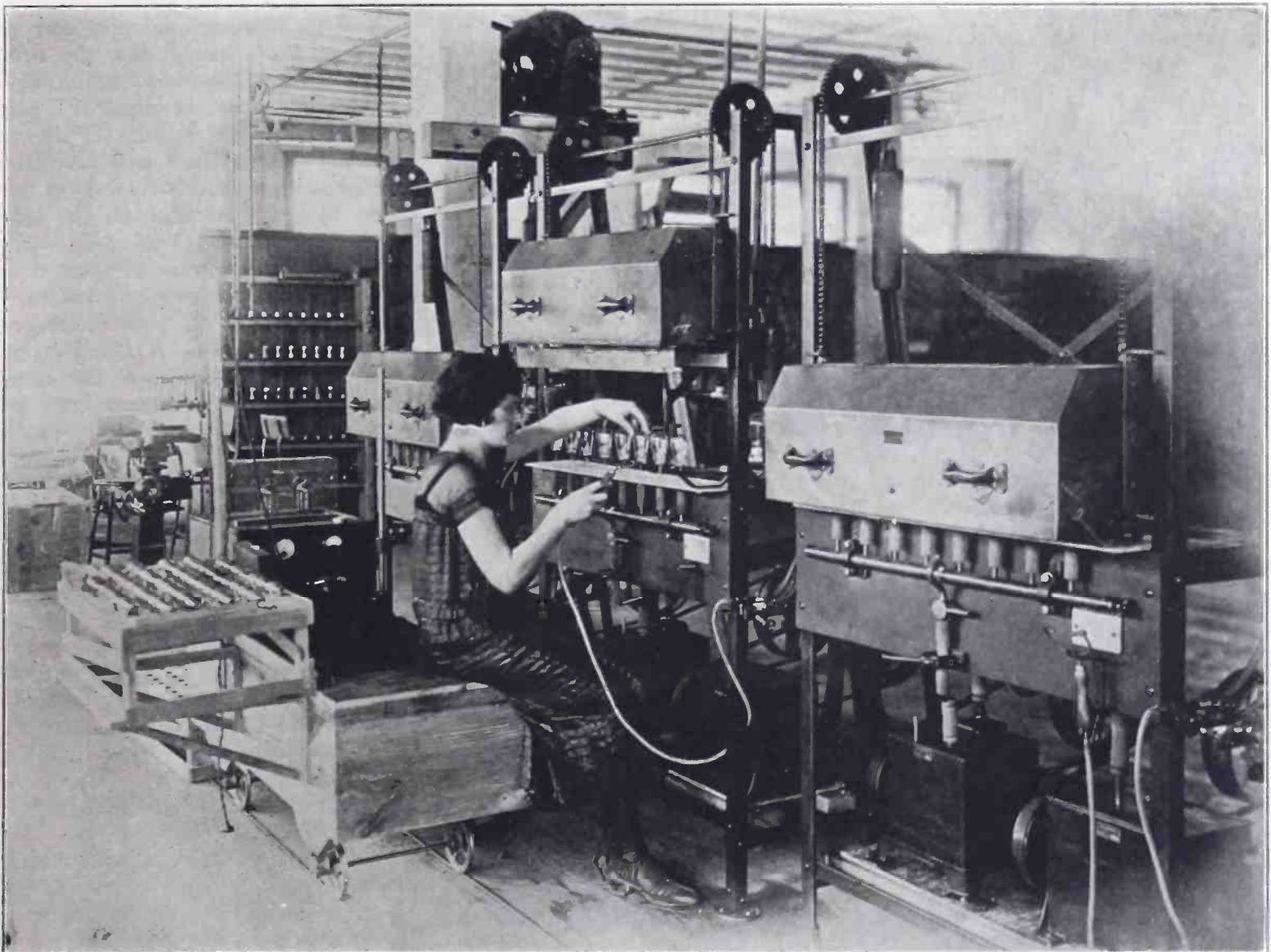


Fig. 4. The Heart of a Vacuum Tube Factory, the "Exhaust Positions" and "Bombarder." The young lady is not the bombarder; she is merely sealing-off a row of exhausted and bombarded tubes. An expert tube-man generally operates this machine.

"mount." The final operation at this stage of manufacture is to weld a small thin flat piece of pure metallic magnesium onto each outer side of the plate. One of these pieces may be seen on the plate in Fig. 2, and another on the repaired-tube plate in Fig. 3. This is the "vacuum-getter," or simply the "getter", as will be explained later.

A completed new mount is shown at the left in Fig. 2, and a UV-201A repaired mount in the center of Fig. 3. In the side of the stem, where the copper-clad wires are sealed in on the new mount in Fig. 2, will be noted a small hole which connects with the exhausting tube. This hole is obtained by blowing an air jet down the exhausting tube at the time the hot glass flare is pressed in around the lead-in wires, on the stem machine. Other jets of air are at the same time shot down around the outside of the exhausting tube, in order to make the pumping hole blow through in the right place.

The completed mount is next placed on an automatic sealing machine, and a molded glass bulb, open at the lower end, is dropped over it. The bulb and mount are rotated in a complicated battery of gas and air jets, and are thereby softened and fused together, producing the result shown in the center of Fig. 2. This bulb is now ready for pumping and bombarding.

The machine on which the bulbs are pumped out is called an "exhaust position." A "three-position exhaust" is shown in Fig. 1. This particular machine handles twenty-four tubes simultaneously. The small glass exhausting tubes of the radio bulbs are inserted in heavy rubber sleeves on the exhaust manifold. Castor oil is used in these rubber sleeves; it is found that this oil produces an absolutely "solid" seal.

The exhaust piping is connected to an

oil-sealed vacuum pump, which is usually backed by one or two other pumps and a rough-backer—in other words, a battery of three vacuum pumps operate in series, each pump pulling from one ahead. In the case of type-199 tubes, even this arrangement is inadequate to get a solid vacuum, and the final machine on the exhaust position is a Langmuir mercury-vapor pump.

This pump is the most nearly perfect vacuum-producing device at present known to science. It operates on the principle that molecules of gas will cling or adhere to heavy falling molecules of mercury vapor, and thereby may be carried down into a trap, whence the gas is withdrawn from the condensed mercury by means of a strong "backer" or ordinary vacuum-pump system. I have seen some powerful batteries of mercury-vapor pumps in operation, most of which have been imported from Germany.

When the radio tubes have been placed on the exhaust position and evacuation begun, a heavy asbestos-shielded cast-iron oven heated very hot by rows of internal gas-jets is lowered over the bulbs. Raising and lowering of the heavy iron ovens is made easy by use of balancing weights. The bulbs are heated almost to the caving-in point; this drives out any gases retained by the glass walls of the tube.

After thorough pumping and heating, the oven is raised and the tubes are tested for preliminary vacuum by applying to them one terminal of a grounded high-tension spark-coil. If the vacuum is not strong, there will be a blue discharge in the bulb. As soon as the bulbs no longer show blue on the spark-coil test, "bombarding" is begun.

The bombardment of a radio vacuum tube with properly-constructed equipment is one of the most interesting processes imaginable. A spiral copper coil or helix, consisting of ten or twelve turns three inches in diameter, carrying a heavy radio-frequency current, is held down over the bulb by means of an insulating handle about a foot in length. The high-frequency field produced by this coil causes an excitation of the molecules or electrons in the nickel plate and mounting wires; the resultant friction produces internal heat. In ten or twelve seconds all the metal parts of the tube come up quickly and smoothly to a glowing cherry-red heat. This cracks loose and expels all remaining oxygen, nitrogen, and other gases in the metal; and, since the tube is still on the vacuum pump, these gases are withdrawn down the exhaust.

The temperature of the nickel plate steadily rises, until it exceeds 900 degrees Centigrade or 1650 Fahrenheit. At this point the pieces of magnesium welded onto the plate "flash" or ex-

Continued on page 52

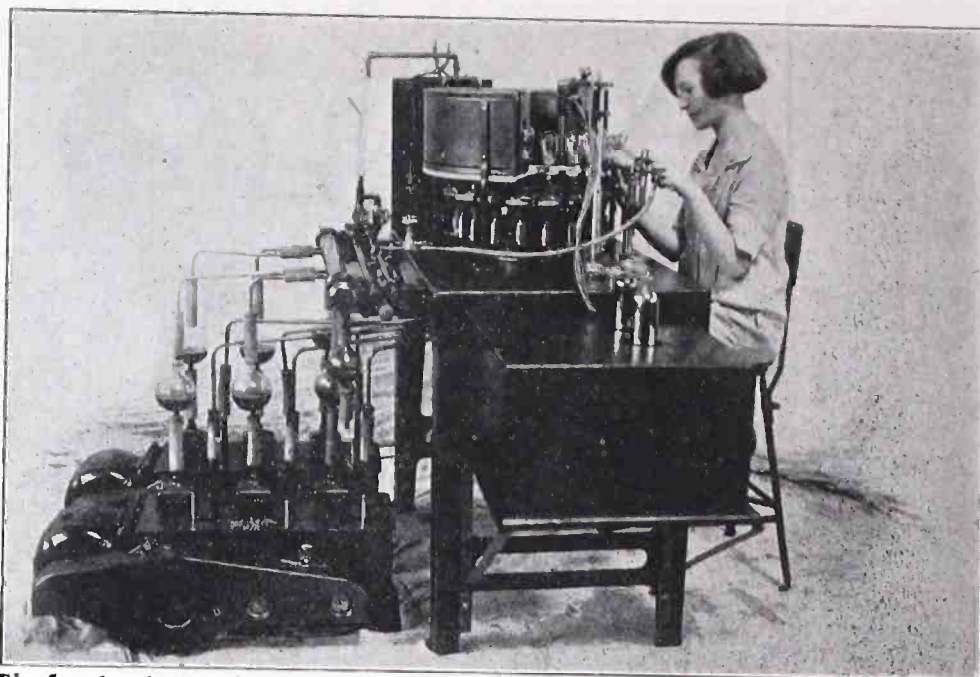


Fig. 5. An Automatic Bombarding and Exhausting Machine. This machine does the same work as the machine in Fig. 4, but most of the operations are automatic. Notice the C. W. bombarder in the foreground.

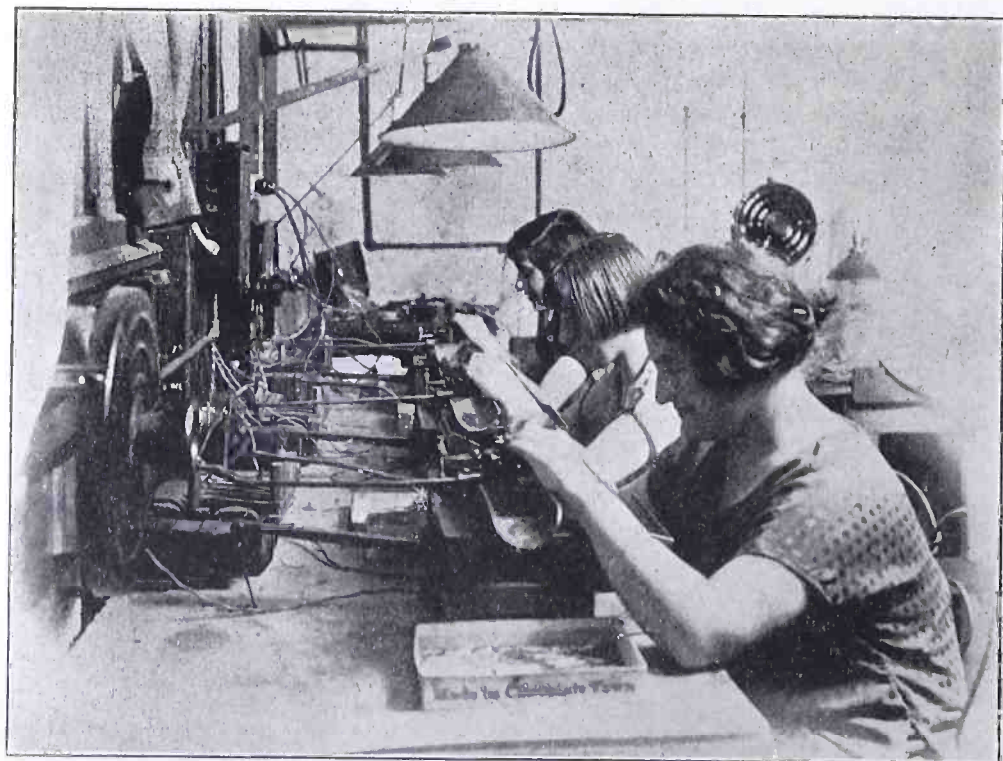


Fig. 6. Bob-haired Bandits Welding Nickel Plate and Grid Supports Onto Copper-clad Sealing-in Wires

Spiral Spring Tuned Inductances

A Unique Method of Tuning Without Variable Condensers
Especially Adapted to Short Waves

By Samuel G. McMeen

THE more turns in a coil the greater is its inductance, other things being equal. The greater the diameter of the coil, the greater its inductance, other things being equal. And the longer a coil, the smaller its inductance, the number of turns and the diameter remaining the same. Thus the inductance varies inversely as the length and directly as the square of the diameter and of the number of turns.

As a consequence of these facts, it is possible to tune a resonating circuit without varying the capacity. The condition of resonance is reached when the product of the inductance and its shunted capacity is of a certain value, that value depending on the frequency of the energy reaching the coil. In definite terms, the frequency to which a given coil and its shunted condenser are resonant is determinable by dividing the quantity 159,200 by the square root of the product of the inductance and the capacitance, the former being expressed in microhenries and the latter in microfarads.

If the resonant value is desired in terms of wavelength, that is available by dividing 300,000,000 by the frequency. Or it can be had at the outset by multiplying 1884 by the square root of the product of the inductance and capacitance, expressed as before.

In a variometer, half of the winding is arranged to react against the other half in such a way as to give a variability of inductance through a wide range, from a very low value to a maximum. The variometer thus becomes a valuable experimental device, apart from its use as a regularly utilized element of a receiving set.

The only drawback of the variometer as an element of inductance for use in experimental work is that it has no inherent power to tell what is the value of inductance for which it is set at any time. The only sure way to know the inductance for a setting is to keep the dial at the particular point and measure the value, and this is not always possible with the measuring devices at hand.

Of the three variable elements that control the inductance of a coil—the turns, the diameter and the length—the latter is capable of change more readily than either of the other two. Every spiral spring in the world stands ready to act as a variable inductance, and as you stretch it between your hands, it changes its inductance inversely as the

length. That is, the more it is pulled out, the less is the inductance, and the nearer it is closed up, the greater it is.

the coil is pulled out and adjusted to its circuit.

In Fig. 1 is shown an example of the application of such a spring inductance to the construction of a receiving set. This one involves the use of a spring of

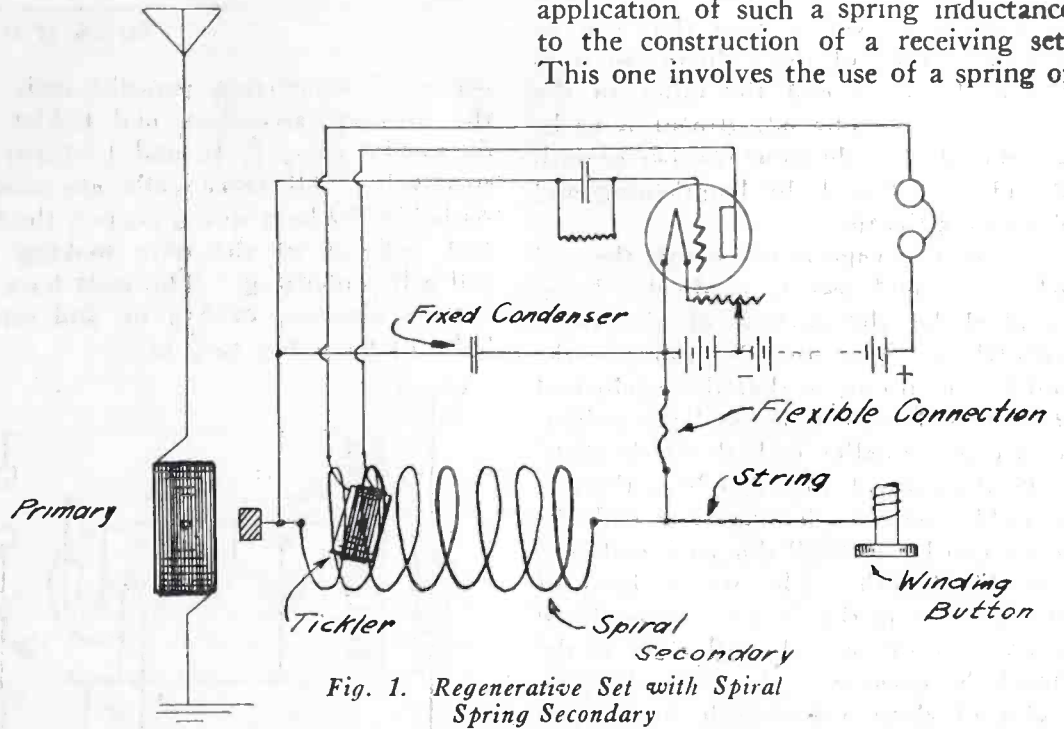


Fig. 1. Regenerative Set with Spiral Spring Secondary

When it is stretched out into a straight wire the inductance is almost zero.

By the use of a formula the inductance at any length may be known. This and its necessary table of values of a certain constant may be found in Circular 74 of the Bureau of Standards. In that formula the length of the coil enters as a quantity b in the denominator, and therefore divides the numerator quantities, which are the squared turns, the squared radius and the constants.

Thus with the spiral spring the numerator can be calculated as to the diameter and turns, and then treated in connection with the various lengths as

fair size, so as to admit the tickler. A good way to make such a secondary is to use a tool made for spring winding and to lay the turns with that device on a wooden form in a lathe. Spring brass wire gives the required resilience to the coil. If only copper wire is at hand, the required retractile force can be given by suspending the coil vertically and letting gravity tend to close the turns.

The primary winding in Fig. 1, shown at the left, should stand 2 in. or more from the secondary. It is surprising how far it may be removed and still function. No arrangement is made to tune the primary. The secondary is tuned by turning the button and winding or unwinding the string that is arranged to pull on the spiral.

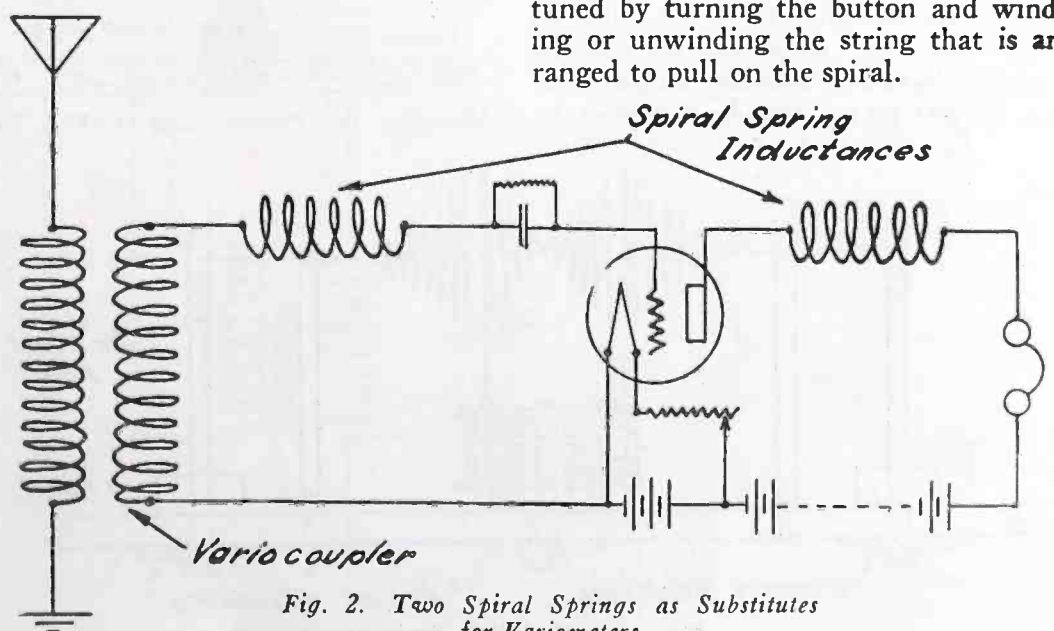


Fig. 2. Two Spiral Springs as Substitutes for Variometers

The condenser shunted across the secondary is fixed, as all the secondary tuning is done in the inductance. It may well be small, and can be a grid condenser or two pieces of sheet metal insulated from each other by celluloid, which is a convenient material for many insulations. Under certain conditions it is well to try omitting this fixed condenser entirely.

In Fig. 2 is shown the use of two springs instead of two variometers is a circuit that uses no condensers except that for the grid, and if the reception is at very short waves even that can be omitted. One of the inductances is in the grid circuit and the other in the plate circuit. The adjustment is to be accomplished in the same manner as with the plan of Fig. 1, by lengthening and shortening the spring.

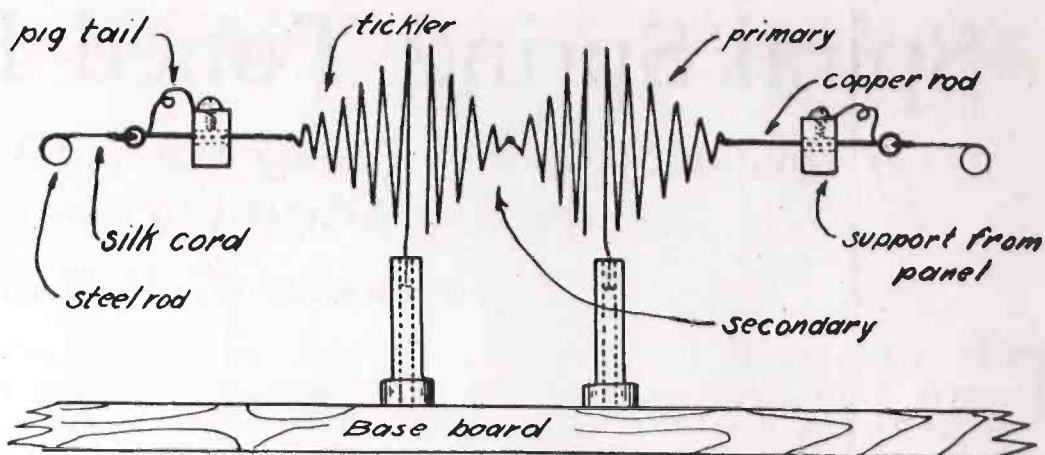
There is a capacitance across the coil when no condenser is used, this being supplied by the surface of the turns themselves. This, too, diminishes as the coil is drawn out, so that the product of the internal capacitance and the inductance grows smaller in both its elements.

In the case of Fig. 2, where there is no tickler rotor in the secondary coil, the latter can be of small diameter and considerable length. The widest kind of liberty exists in the choice of sizes. Even a diameter of an inch will serve if the length be great enough. For the new realm of short wavelengths now open to the amateur experimentalist, the low inductances needed may even be supplied by sections of coils from window-shade rollers. These contain long concentric springs made of steel, and while the resistance is higher than might be liked, the results will repay the trial. In the use of such long coils the excess over the amount to effect tuning should be cut off after trial has determined what is needed, to prevent dead turn losses.

A LOW LOSS RECEIVER FOR THE SHORT WAVES

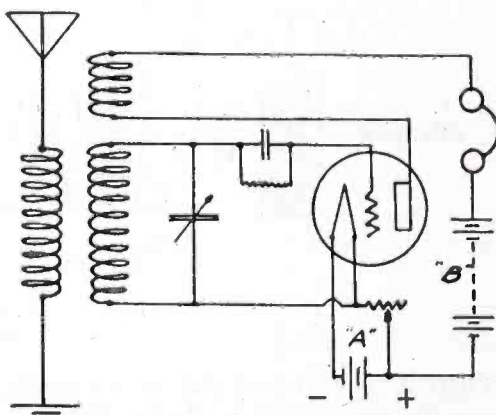
By H. N. SESSIONS

The regenerative receiver, with its great feed-back amplification, can be readily adapted to low-loss reception of the 94-100 meter broadcast waves by

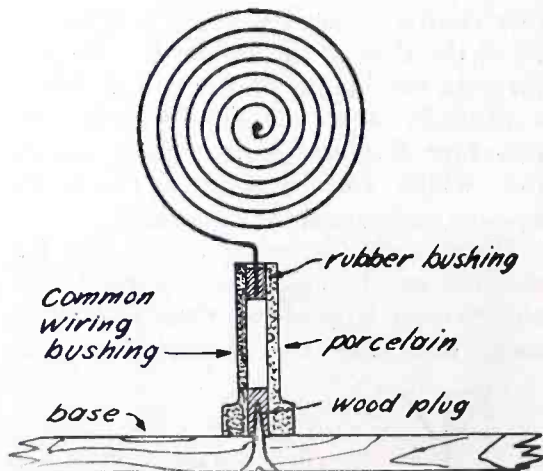


Section of Helical Coil Arrangement

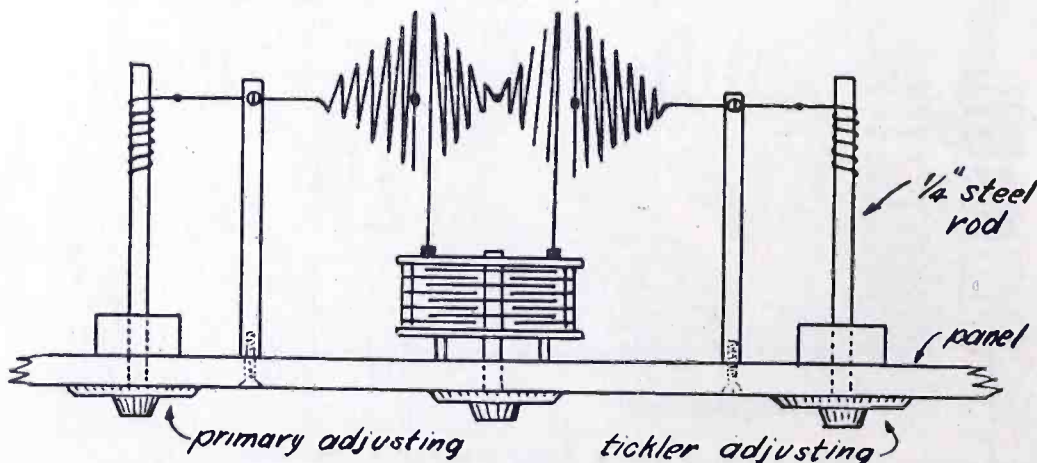
using self-supporting pancake coils for the primary, secondary and tickler inductances, using 7, 16 and 12 turns respectively. All three coils are wound with No. 10 bare spring copper, the size and stiffness of the wire making the coil self-supporting. The coils have an outside diameter of $4\frac{1}{2}$ in. and center holes of from $1\frac{1}{4}$ to 2 in.



Circuit Diagram for Low Wave Low Loss Receiver



Mounting for Primary and Tickler Tubes



Plan of Helical Coil Arrangement

The 16-turn secondary consists of two 8-turn coils wound in opposite directions with the center terminals connected so as to leave the face free from obstructions. The outside terminals are connected across an 11-plate low-loss condenser so that the secondary hangs free in the open air.

The primary and tickler coils are mounted with their lower fixed terminals in porcelain bushing standards. Their centers are attached to silk cords leading to control rods actuated by knobs on the panel so as to pull out the spirals into helices, thus giving a very fine adjustment of inductance and capacity. The coils have sufficient spring to go back into shape. The drawings show the method better than would words.

HANDY HINTS

By D. B. MCGOWN

When using a portable set with an antenna, a very good counterpoise can often be made by connecting the ground lead to the frame of the automobile. This is very well insulated by the rubber tires and will often work better than a rather indifferent, or poor ground that is usually available for portable use. If this is done, however, don't try to use the car's storage battery for a current supply, as you may run into trouble.

A very good "filler" for putting distilled water into small storage batteries, such as B batteries, can be made by using a small glass tube, about 6 in. long. Dip the tube into the distilled water, and allow the water to run up into the tube; then close the upper end with the finger. The water will remain in the tube, and just the right amount can be released into the cell, by carefully letting the air slip past the finger.

When in a hurry to use a receiving set, and no antenna is available, simply wind a piece of wire around a twin conductor lamp cord, connected to the lighting circuit, and you often will have a quite fair antenna system resulting. The capacity between the wire and the conductors in the cord forms a condenser, and connects the receiving set capacitively to the line wires, which form the antenna system.

Solving the Single Circuit Question

Easy Directions for Converting Your Old Blooper Into a Non-Radiating Reflex Receiver

By Keith LaBar

THE end is here for the single circuit tuner. The magazines herald it, the newspapers announce it, the gyp stores deny it, the public await it. The crying baby of radio, loved by its owner but not by the neighbors is gone; it is no more.

But long after its official departure there are evidences that it is still in our midst, taking up room in the ether with its moans. Why is this lengthy prolongation of visit after the "Welcome" on the doormat is changed to "Gone, but Not Forgotten." Ask the man who owns one. A sample of the varied answers would read as follows:

"What can I do with it? I sunk good money into it and can not afford to scrap it entirely." or

"The panel is ruined for anything else. The circle of holes left from the switch points would make it look like a sieve. So I will wait until some one solves the problem of making a new set without throwing away many parts and not buying more than a reasonable number of additional ones."

Hence this "I did it, you do it" article. We have not solved the problem completely. Far from it. But it is solved far enough for practical purposes.

Let us examine the anatomy of the single circuit tuner. It consists of relatively fewer parts than any other set using vacuum tube detector. There is a variable condenser, usually 23 plate, of approximately .0005 mfd. capacity. The inductance or coil element is supplied by a variocoupler or split variometer, the taps from which arriving by a more or less direct route to a number of switch points on the panel. At the right of the panel is the rheostat, behind which blinks the vacuum tube. A handful of wires connecting the parts and a number of binding posts scattered around completes the notorious single circuit regenerative set, alias "The Superdyne," "Newly-discovered Bunkoflex," etc.

Owing to the few parts most attempts to convert it into a respectable member of the radio family have involved the construction of an auxiliary unit. This unit and the original set herded together form a more elaborate set, which is harder to tune but is capable of greater distance if operated properly. This unit usually is a complete radio frequency amplifier employing a vacuum tube. It is placed between the aerial and the single circuit set, and, due to

the valve action of the vacuum tube, prevents back radiation into the aerial.

In some cases this unit is merely a few miscellaneous parts, mounted on a small panel and connected to the main set by a multitude of wires. It converts the set into a non-radiating receiver.

The first named unit is expensive, the second is a source of annoyance. It gets in the way and becomes disconnected at odd moments. If it sits on top of the cabinet, the cabinet is hard to open. If it sits beside the original cabinet, a new cabinet is required to house the unit to make it match up with the set, and matching a cabinet in small sizes is not an easy job.

So we must for these reasons of convenience and finance, do the best we can with the parts we have.

Merely rewiring the set, converting it into a non-regenerative set, is not the solution of the problem. Anyone who is accustomed to the relatively loud signals produced by the single circuit set, will not be satisfied with whispers.

The only set approaching and distancing the loudness of signals produced is the reflex. This is non-radiating, is easy to tune, and is pure in tone. Therefore a reflex we must have.

The most practical of the methods of doing this will be taken up in sufficient

detail to enable the average radio experimenter to go and do likewise. The first method is to add sufficient parts and utilize the circuit of Fig. 1. This circuit requires a potentiometer for the stabilization of the set and to prevent it from oscillation. If the panel of your set can stand the addition of a potentiometer without marring its fair beauty, all is well and good. Otherwise a second method, to be given later, must be employed.

The additional parts for the first method are a crystal detector, and audio-frequency transformer, a radio-frequency transformer, a potentiometer and two .002 mfd. fixed condensers.

A fixed crystal detector is preferable. Do not try to adjust it. If it is no good take it back. For those who must obey that impulse to see if it will make the signals "just a little better," there is the compact adjustable detector, usually very good. It may be mounted on the panel, although the better plan is to locate it in the back, so that the leads to it are not unnecessarily long.

The primary inductance is variable by steps, controlled by the switch on the panel. Tuning of the secondary circuit is accomplished by the variable condenser. If the longer wave lengths can not be reached, due to insufficient turns

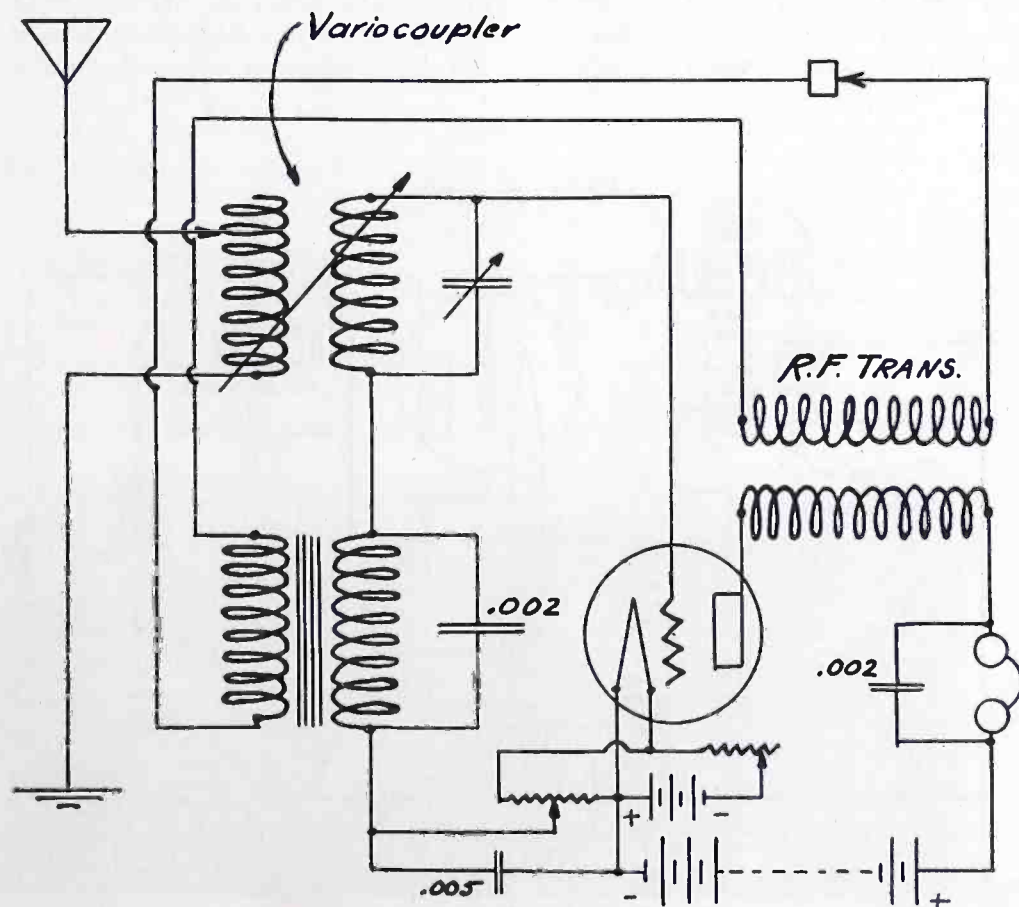


Fig. 1. Reflex With Potentiometer

on the rotary coil, and it is not convenient to add a few more turns, a very small mica fixed condenser should be permanently placed in shunt with the variable.

If your ex-grid condenser is of sufficient capacity and can be separated from its leak, it may be used in the place of the .002 condenser across the amplifying transformer and thereby save yourself the price of a movie. If not, it may be used as a watch charm.

Detailed instructions on How to Wire It Up are really not necessary and are rather difficult to give, due to the variation in the instruments used and their positions. Just follow the diagram. If it does not work and the connections are O. K., try reversing something. Try the crystal, or one side of the radio frequency transformer. Small things like this make a great deal of difference.

NOW for method number two. Fig. 3 shows the panel before and after rebuilding. The additional parts required are an audio-frequency transformer, a crystal detector, a C battery

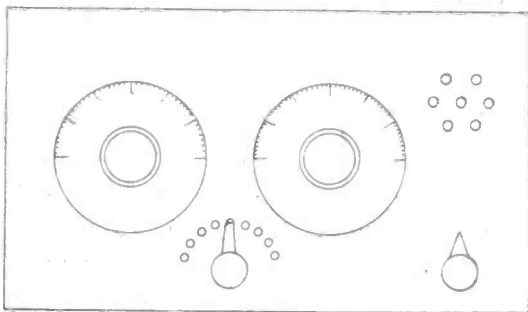


Fig. 3. Panel Before and After Changes

and a coupling coil which is wound on a cardboard or bakelite tube 3 in. in diameter and 2½ in. in length; secondary 60 turns No. 24; primary 15 turns wound directly over secondary with a

layer of empire cloth separating the two windings.

The coil is placed in such a position, preferably attached to the variable condenser, that it is not in inductive relation to the variocoupler; that is, the two windings must not be in the same plane nor close together.

It is necessary to wind a fixed primary for the aerial circuit over the former primary winding of the variocoupler. Owing to the fact that the taps running to the switch points prevent the easy winding of this layer, the wire for the primary, about 15 ft., will have to be threaded through the opening made by the taps and the panel. This is a job requiring a little patience. Of course the taps could be cut and the coupler removed from the panel, the primary wound, the coupler replaced, and then all taps soldered again, but who wants to do all that work. Be sure to put a layer of empire cloth between the two windings.

Owing to the fact that the switch cuts out part of the coupler at times, this primary must be over that part which is always in the circuit. This will mean the primary will be over one end of the coil.

The rotating element is connected in series with the tapped coil. It supplies the fine variation of tuning, while the switch supplies the coarse variation in tuning.

Theoretically this arrangement of inductance only is better than tuning the circuit with a variable condenser, due to the higher voltage built up, but in practice very little difference can be noticed unless something is wrong or the imagination is active. If you have followed the wiring diagram nothing much can be wrong, except perhaps for the

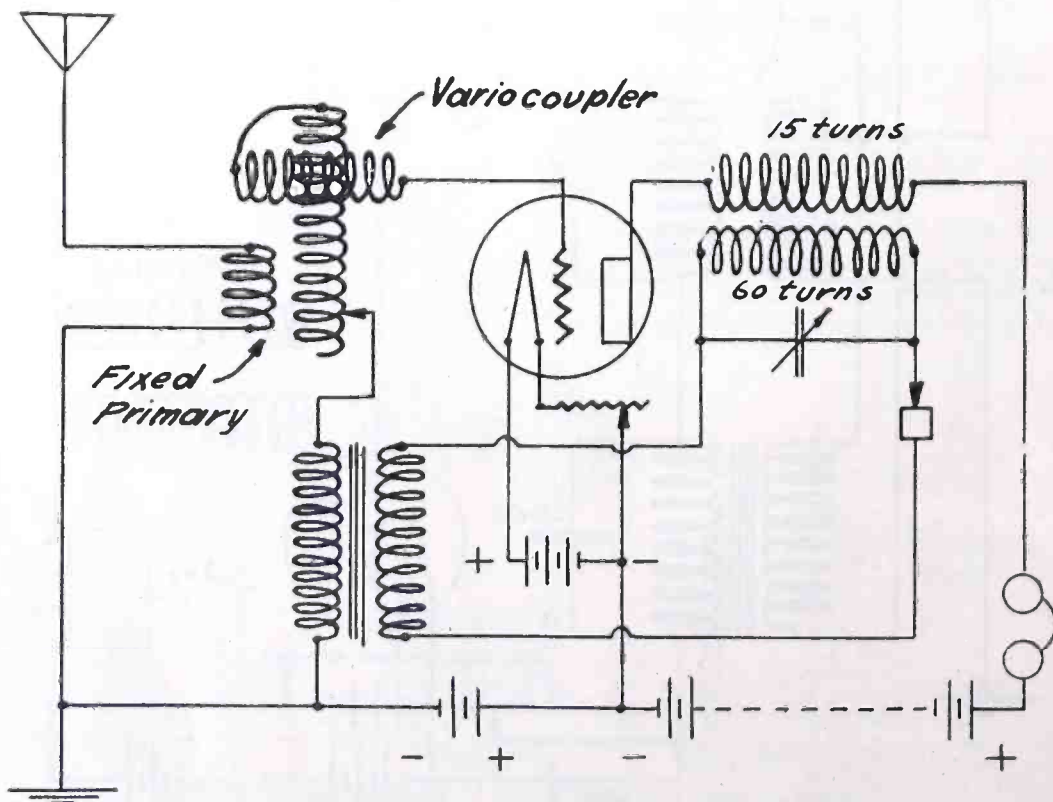


Fig. 2. Reflex With "C" Battery

same reason erasers are put on the ends of lead pencils.

With this circuit it is better to use a fairly large voltage on the plate and use a C battery. The tone is much better.

To fill up any unsightly holes on the panel this method is for use only if it is a bakelite panel, the family has gone for the day and you have not recently eaten a heavy meal or have a weak stomach. Here is the method used: Place the bakelite panel on a metal plate of some sort. If there is no metal plate handy, use a smooth brick. Fill up the hole with little chunks of hard rubber bitten out of a hard rubber panel. Go over the surface of the bakelite panel with a hot iron. If you have not too little or too much rubber, the iron is not too hot or cold, the rubber will melt and fill the hole flush. It looks fairly decent, too. If the panel is grained afterwards, the last clue to the missing holes is gone.

This may be described as being a laboratory exercise in practical radio. It shows to what lengths a radio ham will go in the line of doing a little salvaging.

In radio, as everything else, pride of accomplishment is everything. It is nice to have a factory built set sitting around but it is forgotten when Bill comes in to talk radio. The little home-made set, scorned by the family and left in the kitchen, is the object of the more attention. It is your own creation—your baby—and to the proud papa one's own child is the more beautiful.

SIXTH DISTRICT A. R. R. L. CONVENTION

The Sixth District A. R. R. L. Convention will be held at Modesto, Calif., November 7th, 8th, 9th. K. B. Warner, secretary and A. A. Herbert, treasurer of the American Radio Relay League will be present. Special railroad and hotel rates have been arranged.

The Southern California Radio Association has donated two beautiful silver cups to be awarded in a contest for the best operator in receiving and transmitting. The Modesto Radio Club will inaugurate its new perpetual trophy—the M. R. C. Wouff-Houng!!!! If you haven't heard about it come and find out. It is remarkable.

Prizes in apparatus, Government examinations for licenses will probably be held—fun galore—and on the last day (if the weather permits) an auto trip to the Don Pedro dam.

The program calls for a traffic meeting Friday afternoon, a business meeting in the evening, followed by stunts and R. O. W. H. initiation. On Saturday the morning will be devoted to contests, and the afternoon to technical papers on short wave transmission and reception, and the evening to a banquet and hamfest.

A Six-Tube Neutralized Receiver

Constructional Details for Home-Made Parts and Assembly
of Set Using Dry Battery Tubes

By Paul Oard

WHEN a new circuit, or what is claimed to be a new circuit, is made public, it is a fairly safe conclusion that for the first six or eight months after its introduction we will hear only of the good points of such a circuit. Then, gradually, as elaborations upon the original circuit begin to creep in, some of the bad points as well as the good ones are brought out in print, and, within a year or so after the introduction of a new circuit, the discerning reader will be able to make fairly accurate judgment of its good and bad points without the actual necessity of constructing an instrument embodying it.

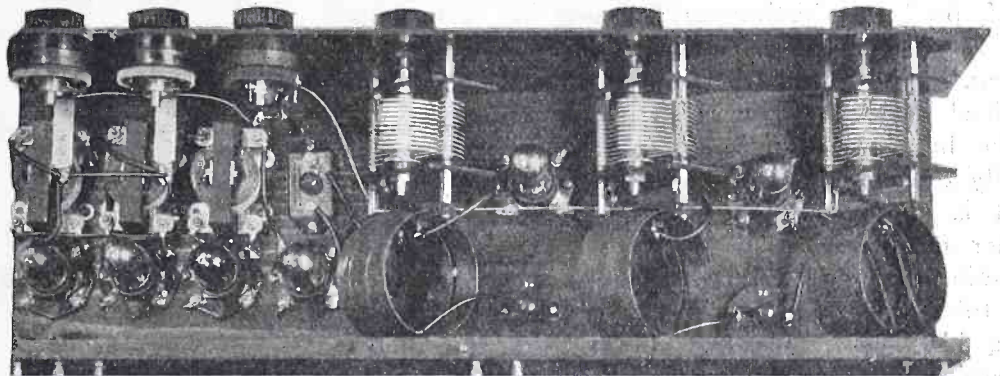
Thus when radio-frequency circuits began to engross the attention of the radio constructor, we heard only the good side of radio-frequency application. Much of this was pure theory — in actual practice it was found that there was much to be desired, especially in the reception of short wavelengths, within the broadcasting band. While the principle of regeneration, and its application to broadcast receivers was receiving the concentrated fire of radio writers, who, in the majority of cases, overlooked the fact that regeneration is one form of radio-frequency, very little was being said about the fact that the type of radio-frequency receiver employing amplification, before the detector tube, had drawbacks that made it in many respects as bad an offender as the straight regenerative circuit.

Constructors soon found that radio-frequency circuits could oscillate, squeal and whistle with all the vigor of an untamed single-circuit receiver of the regenerative type, and, furthermore, that the control of such a circuit was oftentimes a matter of some difficulty. Furthermore, while in an oscillating state, such a circuit oftentimes proved as annoying to

other broadcast listeners as the regenerative type. Not all the whistles and yells heard in the receiving set from outside bloopers came from the maligned regenerative receiver by any means.

The placing on the market of receiving sets embodying the Hazeltine method of controlling oscillation in radio-frequency circuits which embody amplification ahead of the detector tube

radio-frequency circuit, using the potentiometer method of control, may be made quite as efficient a receiver as a true Neutrodyne type, insofar as distance and volume are concerned, and, in the latter instance, it may safely be asserted that the "losser" control will oftentimes shade the Neutrodyne type in actual sound produced. However, the fact that different stations require quite



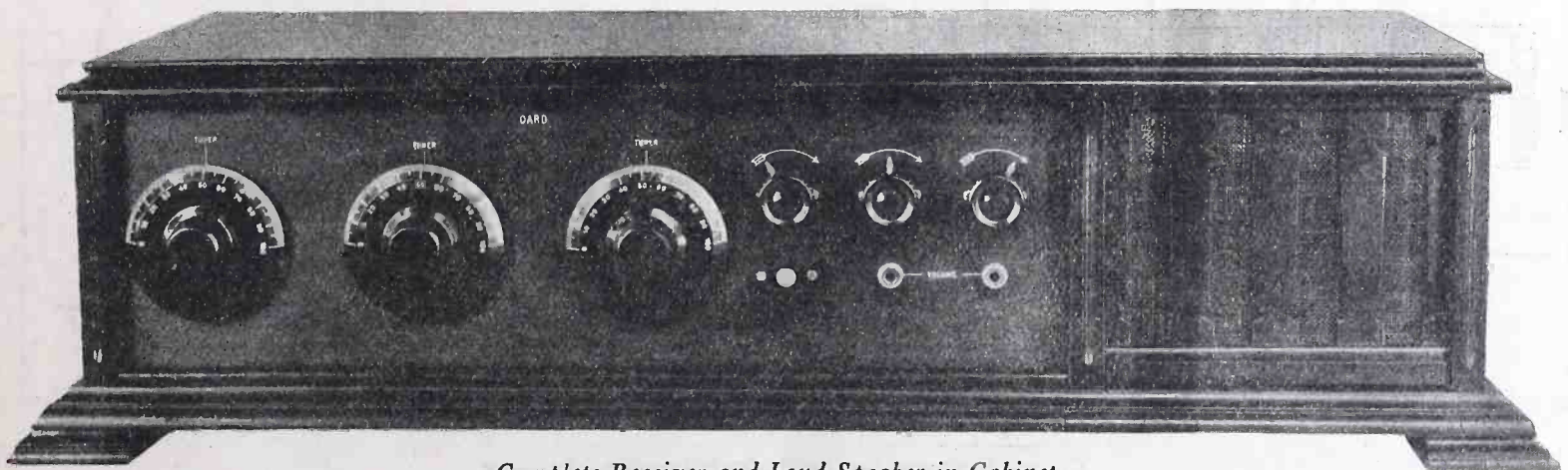
Rear View of Completed Set

marked the one big advance in the problem of handling such circuits in an efficient manner. It should be borne in mind by the radio constructor that the radio-frequency receiver which uses the Hazeltine method of control—in other words the *Neutrodyne*—uses the radio-frequency circuit pure and simple, and not a new form of circuit, but rather a practical method of controlling a circuit otherwise already developed, and which has been in use, more or less, for a period of several years.

Since the Neutrodyne type of radio-frequency control has come into vogue, it has become quite the custom to attack the other most popular form of control—the potentiometer—as being impractical. Common usage now refers to the potentiometer as a "losser" on account of the introduction of resistance in the grid circuit. As a matter of fact, a well-designed air-coupled transformer type

variable settings of the potentiometer in order to prevent over-oscillation, and that the setting for a given station at a definite point on the potentiometer may vary from hour to hour with the increase or decrease of signal strength as it is affected by atmospheric conditions and other factors, makes the potentiometer method of control not all that might be desired.

By the use of condensers of quite small capacities, in place of the potentiometer, in such a radio-frequency circuit, connected in the proper points, we establish what may be termed automatic control of such a circuit. Through their use, the tendency of the circuit to go into violent audible squalls is controlled, and the settings of the tuned radio-frequency transformers, instead of being dependent upon the position of the potentiometer control, remains in a definite place for each station. A prop-



Complete Receiver and Loud Speaker in Cabinet

erly neutralized receiver prevents any whistle from the carrier wave as a given station is tuned in.

In connection with this last sentence, it is well to here correct an impression that is quite widely held by those who are not familiar with neutralized receiver operation. While in tuning in a given station, no whistle is heard, should an oscillating receiver of the regenerative type, or the radio-frequency type controlled by potentiometer in close proximity, be tuning in on the same station, a whistle decidedly will be picked up—and oftentimes in no uncertain way. This is due to the heterodyning action between the oscillating receiver and the carrier of the transmitting station, producing an audible note, and the neutrodyne type will not prevent the reception of such a whistle. But it will not, in itself, produce whistling or blooping in nearby receivers, and, with all the receivers in the neighborhood of the neutralized type, we have a little bit of radio heaven—a condition of affairs highly desirable, but not always possible.

It is my purpose to present here a rather extensive article upon the construction of a neutrodyne type receiver. Six tubes are used—of the dry battery type, UV-199 or C-299. There is a general impression that such tubes are not practical in the neutrodyne type, many believing that it is difficult to neutralize such tubes. Proper construction of such a circuit shows this to be far from the truth. The six-tube dry cell neutrodyne type gives a trifle more volume than the standard five-tube type using storage battery tubes when equal plate voltages up to 90, the dry battery tube limit, are used. Two stages of tuned radio-frequency, detector, and three stages of audio-frequency amplification are used. The standard five-tube type makes use of two stages of audio-frequency amplification.

On three dry cells, under normal operating conditions, one may expect a conservative battery life of fifty *burning* hours with six of these tubes. Forty-five volts of *B* battery is used on all amplifier plates. Sufficient volume is provided on a loud speaker for any normal purpose, particularly where one

is after music and clarity rather than noise.

Properly constructed, this receiver is one that the owner may be proud of. Its ability to tune through local broadcasting stations, together with its freedom from internal squawks and squeals, and its definite settings for a given broadcasting station make it a pleasure to handle.

Standard practice in the construction of the instrument is followed, with a novel form of construction in the neutrodyne coils, and the neutralizing condensers. The instrument is responsive to wavelengths between 250 to 600 meters, covering the broadcasting band nicely, on the average antenna.

Materials for the construction of this instrument will be as follows:

- 1 Bakelite panel, 7x24x $\frac{1}{8}$ or $\frac{3}{16}$.
- 3 4-in. dials.
- 3 25 ohm rheostats.
- 1 filament switch.
- 1 open circuit single spring jack.
- 1 closed circuit, four-spring jack.
- 3 17 or 23 plate variable condensers.
- 3 Audio-frequency transformers.
- 6 199-299 type sockets.
- 1 Variable Grid Leak.
- 225 ft. No. 25 SCC Magnet wire.
- 2 Bakelite Discs $1\frac{1}{2}$ diameter x $\frac{1}{4}$ thick.
- 6 Bakelite strips $\frac{1}{2}$ x 3 x $\frac{1}{8}$.
- 3 Bakelite strips $\frac{1}{2}$ x $1\frac{1}{2}$ x $\frac{1}{8}$.
- 2 8/32 R H brass machine screws $1\frac{1}{2}$ long.
- 2 pcs brass rod, $\frac{1}{4}$ x $\frac{3}{8}$ drilled and tapped 6/32.
- 6 pcs brass rod $\frac{1}{4}$ x $\frac{3}{4}$ drilled and tapped 6/32.
- 7 binding posts.
- 1 Baseboard, 7x23x $\frac{3}{4}$.
- 1 Backboard 6x23x $\frac{1}{2}$.
- 2 small composition knobs, 8/32 thread.
- Spaghetti, bus bar, wood screws.

Assembly of Neutroformers

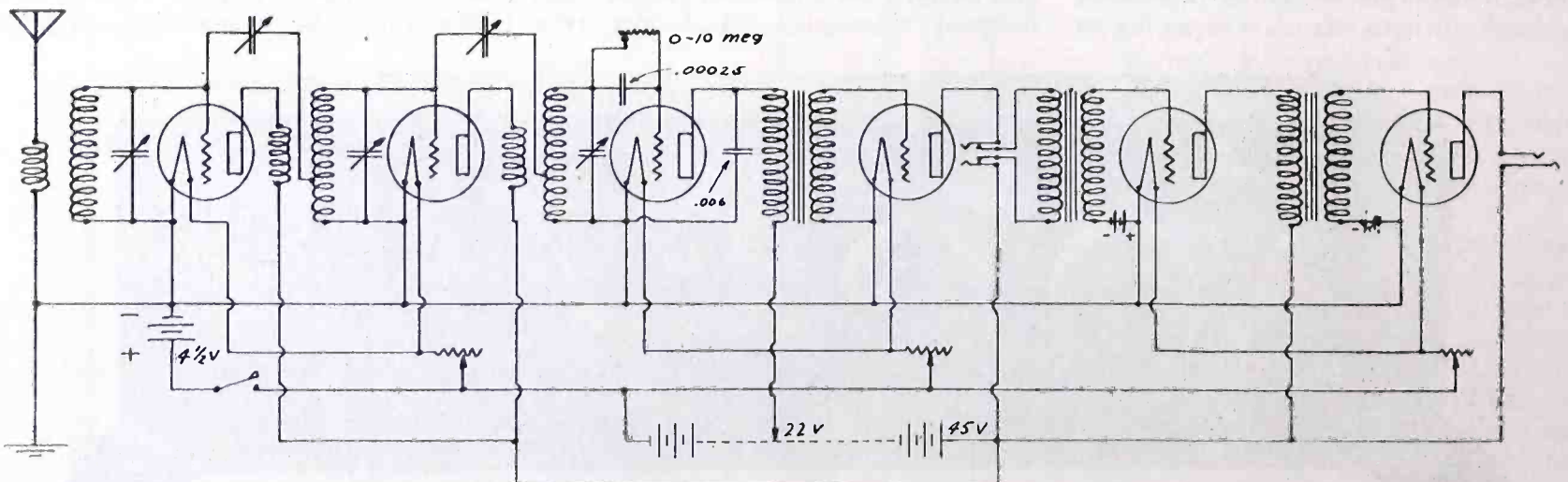
THE neutroformers, as they are called in the licensed Hazeltine Neutrodyne, constitute the radio-frequency tuning inductances. Three are required. The constructor will find the method here outlined a novel one, withal one that is thoroughly practical, as regards their construction. The ratio of the secondary winding to the primary winding is around four to one. Instead of being wound on a cardboard or bakelite tube, the windings are of the "self supporting" type, the coils being held together by collodion, and are sup-

ported on the condensers by bakelite strips. Theoretically, this form of construction is practically perfect, as the absence of solid material eliminates dielectric loss, but there may be some argument over the use of collodion, which in itself affords some capacity loss—also theoretical. The main point is that the experimenter saves nine inches of bakelite tubing, which is important. Once these coils have been made up, the constructor will have found a new method of making up coils which may be utilized in other jobs.

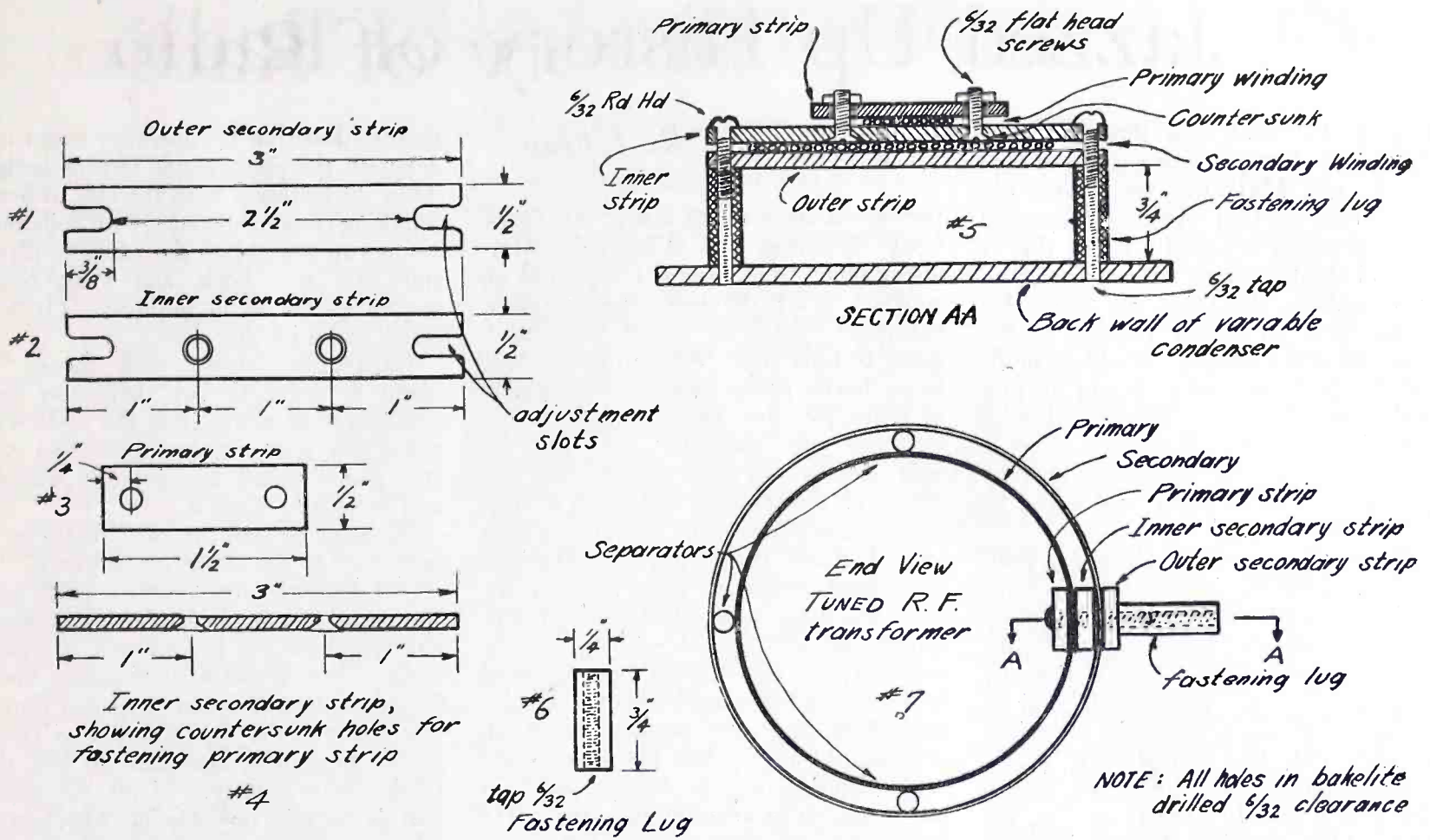
For the winding form, a 3 in. piece of cardboard or fibre tubing 3 in. in diameter is required. With a hacksaw, a cut is made lengthwise in the tube. Now, pressing the edges together until a couple of turns are in place, after which it will hold itself 65 turns of wire are wound evenly on the tube. The most convenient method of doing this is to lay out the wire in one long span, stretch it to take out any slight kinks, and then wind onto the tube by walking up on the wire. Clip the wire at 65 turns and fasten to prevent unraveling. Next give the winding a coat of collodion, which may be secured at drug stores. (A 25-cent bottle will be ample for the job.) Let this dry for about ten minutes. Release the fastened ends of the wire. Press in one edge of the split winding tube, and the winding will fall off the form intact. Wind up two more coils in the same manner.

Now cut off a half-inch of the winding tube along the length where it has already been split, spring the edges together again carefully, start the winding and wind on 15 turns. Wind up three of these 15 turn coils, treat in the same way as the first. Next, give all six completed coils another coating of collodion, this time on the *inside* of the coils. When dry, the coils are ready to fasten in place on the variable condensers.

A number of the variables on the market are so arranged that it is possible to place the $\frac{3}{4}$ in. fastening lugs directly upon the threaded rods which serve to hold the stator plates in position. In those makes where this procedure is not practical, it will be necessary to drill the end pieces of the condenser to take



Circuit Diagram for Six-Tube Neutralized Receiver



Tuner and R. F. Transformer Details

the fastening lugs. As the constructor must fit the job to the condenser on hand, no further detailed directions will be given in this particular.

The slots cut in the outer and inner secondary coil strips will serve to allow leeway for the different makes of condensers, insofar as the mounting is concerned. The inner secondary strip is drilled, 1 in. from each end, first with a 6/32 clearance hole, and then is countersunk with a drill that will allow a forced fit of the flat head of a 6/32 screw. These two flat-head screws are forced into the countersink, a 65 turn winding is placed between the inner and outer strips, and the two strips are in turn securely clamped to the fastening lugs, mounted on the variable condenser, using round-head machine screws, with a small washer under each head. Next, a 15 turn coil is placed midway between the two projecting screws on the inner secondary strip, and the 1 1/2-in. primary

strip is put in place, clamping it securely with hexagon nuts. As the two screws are held in place by the forced fit in the countersunk hole, they will not turn as the nuts are being screwed on.

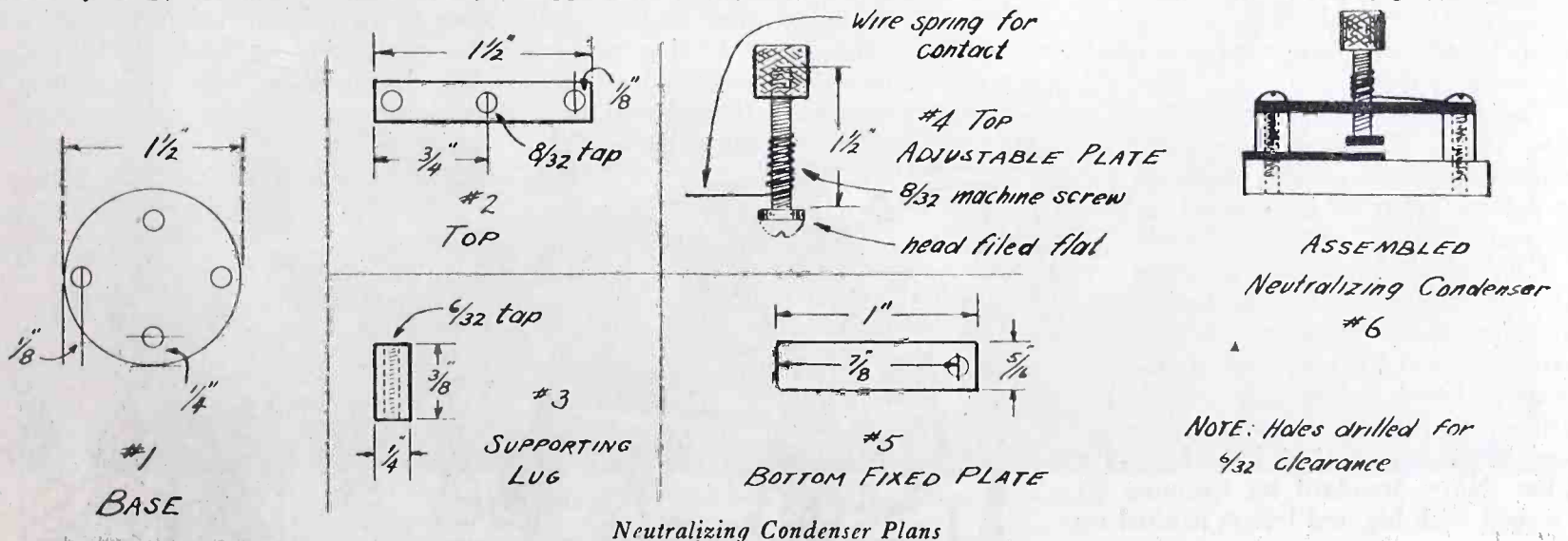
As a final part of the assembly, cut three 1/2-in. lengths of spaghetti and place them as shown in the end view of the completed transformer. A little dab of collodion will serve to hold them in place. These act as separators to hold the primary and secondary coils so that they will not touch each other. The two screws that hold the primary strip and coil in position are used as the terminal ends of the primary winding.

The completed transformer will be found to be remarkably rigid and strong. Under no conditions should a condenser be used that is not provided with a positive pig tail connection. Spring contacts will give more grief in a neutrodyne at critical adjustments than any supposed economy may warrant.

In the construction of the two neutralizing condensers, the top adjustable plate is made by filing down the head of a round-head machine screw. Where round bakelite discs can not be secured, a flat strip of bakelite may be substituted for the base. To make the wire spring contact for the adjustable plate bearing, the screw is held with a pair of pliers, and a few turns are made around it in the direction of the thread, with a short length of spring brass or phosphor bronze wire. This affords positive contact with the moving member.

The three radio-frequency transformers should be mounted on the panel at an angle of 60 degrees for the purpose of preventing inter-coupling as far as possible. The first two tubes should be mounted between the variable condensers, rather than between the coils, for the same purpose. The neutrodon condenser taps should be at 15 turns from

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Neutralizing Condenser Plans

A Jazzed Up History of Radio

By Monroe R. Upton

WIRELESS was thought up in the first place as a result of Guglielmo Markoney, an Italian, living in Italy by that name. It occurred to Markoney's wonderful mind that if it could think of some way to send messages without the poles and wires between them all of the expense of the poles and wires between would be obliterated. So he set out to invent on that solid economic base. Threatened with jails, ridicules, and all manner of other tortures, he kept on, supported only by his visions, love of truth, and a girl he had married.

One of the greatest problems was finding a name for his invention. He tried "Withoutwires" and "Nopolesbetween," but they didn't sound good when changed into Italian, which is a funny language anyway. How in the end he hit upon the right name is a curious anecdote. He had a small boy, an amateur, working for him named Lester, who was generally known as Les, for short. One morning the big inventor was making a birdcage out of wire, and, having been out with the boys the previous night, he wasn't quite in his best mind. When the cage was nearly finished, there wasn't enough wire and he yelled, "Wire-Les." Les brought him some wire alright, but that wasn't all he brought him. Invisibly he brought him the hitting on the right name for one of the best-liked inventions ever brought about. When Markoney realized this he was so excited and nervous that he dropped all of his tools and walked across the street to a well-known place there and proceeded to make triangles out of his right arm and neck so as to steady him. Geometry was always his best-liked subject at school anyway.

Markoney sent explorers to scour Africa for some substance that would make a good handle for galena detectors. It was two long and wearisome years before they brought back anything that pleased him at all. Meanwhile he was deciding on a good grade of ground wire, buying up old variable condensers, thinking up broadcasting programs, and winding honeycomb coils.

The aerial was a knotty problem to solve, too. He finally concluded it would be good advertising to use it, and he did so. History has proved he was right, for to this day they are used.

The day of the great experiment finally came and people brought their lunch for miles around, prepared to laugh as their ancestors had laughed at Galileo centuries before. But they laughed up their wrong sleeve. It is very interesting how Markoney worked it. He had a 2 kw. Navy Standard set mounted on a wagon with big, red letters painted on

the canvas sides which read: "All Questions Answered By Wireless." Markoney said: "Now, folks, I want you all to stand up a little closer, right up close, everybody, don't be afraid, nothing is going to hurt you. Now to prove there is no hokus pokus about this invention of mine, you just ask me any little old question you like and Les and me will endeavor to answer it." Les was sitting at the key of a little $\frac{1}{2}$ kw. over in the next town. An old lady with a ragged shawl completely covering her gray head, spoke up with tears in her eyes, and asked where her husband was. Markoney called and called, but he couldn't raise Les because Les was tired of searching for a weak spot on the carborundum and was outside the shack smoking a camel. But plenty of static was rolling in and he had 18 amps in the aerial, so he knew he was OK. He came out of the wagon and said: "Lady, your husband is in Detroit working for a fellow named Henry for five liras a day." This plunged the old lady into joy, for she thought he might be coming home. Other questions were answered just as satisfactorily, even more so, for Les got on the job, and the newspapers all pronounced the experiment a great success.

The first thing the authorities of all of the civilized nations did was to lock up the captains and put sets on ships. Operators were all ex-gunmen from Mott St. and they were given plenty of food and water in their rooms with them. But after a while the captains got used to not running their own ships and having them run from an office on shore. They ceased being sore and the gunmen were released for their old duties, being replaced by young boys from good families that wanted to get rid of them.

Along about that time Dr. De Forest thought up the lamp type of receiver in a box. It proved popular, so they used it to send with, too. Owing to new processes phonograph records were getting pretty cheap and they started sending them instead of dots and dashes. The

people liked that because they could understand the phonograph records better. They were pleased with the idea of hearing things from a distance with coils they wound up themselves according to directions out of a book, and a big boom started in the radio business. (It was called radio by that time).

Department stores with money to spend in order to buy their way into households as words, and the makers of radio gear sent out programs from central points called broadcasting stations and everybody liked it.

In point of size the radio industry is next door to the ice cream industry. If all of the wire on people's roofs was wound up on a big galvanized lead spool, and the spool put end to end, it would make a line a rod wide reaching from Broadway and One Hundred and Forty-first street on the North almost to Texas on the Southwest and back up into the Little Bear country. If all the paper that is used in one day on Manhattan Island alone to write about radio on was piled in one place and lit, it would make heat enough to fry 326,394 eggs (over), and the light could be seen 96 miles in flat country and 27 in hilly. If Markoney ever read $\frac{1}{10}$ of it he would commit suicide for having started it.

Barnum & Bailey is advertising for any male or female above three years of age that hasn't listened in on the radio and many thousands of dollars salary is offered for such a freak, but it looks like their side-show isn't going to have anything new. One man applied for the job and claimed he didn't know what radio was even, so how could he have listened in on it. Barnum & Bailey asked him right quick, "How many turns in the secondary?" The man said twenty before he thought, so they led him out.

According to the psychology experts, radio is billed to be a great social factor. Already it has just about horned out the weather as a topic of conversation. This is kind of hard on the people who have to listen in on their neighbors' sets, though looking at it on all its points, radio has probably been a great help to mankind and I refuse to say anything against it.



"Underground"

By George Sumner Albee

THE learned C. W. enthusiast and the learned Spark enthusiast who had been a ship operator, sat before a roaring fire in the latter's cosy cabin high in the Sierra Madres. The bitter wind which howled outside and blew sheets of rain against the heavy windows was not half as fierce as the battle of words they had waged, off and on, for years, and which they were waging even now. The moot question, "Resolved: That Spark beats C. W. all hollow," promised fair to be a never ending one, due to the learned Spark enthusiast's dogged obstinacy. As the hour grew late, the champion of Ye Contin'us Wayves threw up his hands in despair. "Let me tell you a story," he cried!

KURT ZEMKE bore his father's name according to good old Czech custom, for he was the eldest son and had reached his eighteenth birthday some months ago. He had three brothers and two sisters, but as yet only Kurt was old enough to work in the mine, and this added to his importance. The Zemkes measured the ages of their sons as did the other Czecho-Slovakian and Polish families in the grimy Pennsylva-

nian coal-mining settlement—they were either too young to work or were working. Daughters were unimportant. They simply grew to be fifteen or sixteen years old, when they were married by the Ruthenian priests and became the mothers of more begrimed and undernourished children.

Old Kurt and young Kurt rose every morning at 6:00 o'clock, gulped hot coffee and beans, took their tin dinner pails from the faded, always weary woman whom they called respectively, "wife" and "mother," and plodded off to work. Their clothes and shoes were as stiff and gritty as black emery paper, and were so impregnated with the anthracite dust that all attempts to clean them had long since been abandoned. Too, work in the mine was hard; the hours were long; home was a squalid, coal-filthy cottage; life seemed to be a matter of working to get food to give one strength to work and buy more food, and so on indefinitely, but old Kurt and young Kurt were happy. Young Kurt especially.

Perhaps it was because—and this is why Kurt's father kept a cautious hand on his elbow as the two walked to work each morning—he did not have to see

all the squalor about him, as did the others. He had been blind from birth, you see. Perhaps it was because he was naturally inclined toward cheerfulness; canary birds are sometimes blinded to improve their song. Perhaps it was because he was able to get away from it all, at least two or three nights a week, and call on his good friend, Judge Parker, with whom he shared a hobby. Anyway, Kurt was happy.

The boy felt that when he died and went to heaven, it would be much like going to Judge Parker's. The great white house on the hill 'cross town from the section to which the mine workers were restricted was as unlike anything Kurt had ever known as light is unlike dark. He could not see the house, any more than he could see the streets along which he hurried to get there at a gait, to be sure, almost equal to that of a normal man, so practiced had he become at making his way about, but he could sense what his eyes could not see. The quiet air of refinement, the cool cleanliness of the large rooms, the quiet which was always present in this finer residential district and which was never pres-

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"He Determined to Protect the Radio Set From Destruction"

Helpful Suggestions in Radio Reception

Some Hints on Trouble Shooting for the Guidance
of the Radiocast Listener

By Bernard Steinmetz

LET us first start from the antenna end. Long antennas are not always desirable, especially with regenerative tuners. The long antenna is very often the cause of broad tuning and consequent interference. The longer the antenna, the more difficult it is to tune it sharply to the incoming wave. If long enough it can extract enough energy from passing waves to which it is not tuned to cause considerable interference. Figuratively, a long antenna attracts waves of all frequencies, signals of all wavelengths just force themselves onto the long antenna. As a result, although signals may be somewhat louder there is no discrimination between different signals. If your antenna is long enough it may not even require any tuning, you can receive signals on it with no help from your tuning circuit. In such a case the interference would obviously be a maximum. The shorter antenna, on the other hand, actually requires considerable inductance and capacity to tune it to a given wavelength, hence tuning is bound to be sharper and interference less. So that the first expedient in reducing of interference is not to make the antenna too large.

In so doing the energy collected by the short antenna is less than that collected by the long antenna. In the case of regenerative receivers, however, this does not necessarily mean that signal strength is less. This is due to the fact that it is possible to regenerate more with the small antenna than with the long antenna. Users of regenerative receivers employing long antennas know that they can not bring the tickler coupling up very far or increase the plate inductance much before the set begins to squeal. In other words, the amplifying possibilities of the set by regenerating can not be used to maximum advantage because the set oscillates too soon when a long antenna is used. Thus although considerable voltage is set up in the long antenna, it is not amplified very much by regeneration. On the other hand with a short antenna, it is possible to increase the tickler coupling or plate inductance to greater values and thus realize more of the regenerative amplification of which the tube is capable before the set begins to oscillate. Thus, although the short antenna collects less energy than the longer one, the additional regenerative amplification obtained with the former may more than make up for the smaller received signal,

so that the ultimate signal strength may, in fact, be greater than that obtained on the large antenna.

One of the most selective receivers is the regenerative. The more it regenerates, the more selective it is. This is one of its chief virtues. Regeneration has the effect of reducing the effective resistance of the receiving circuit, and it is well known that the lower the resistance, the more selective the set. As a result any expedient which enables you to increase regeneration will also result in increasing the selectivity, thus helping to reduce interference. As pointed out above the short antenna allows greater regeneration than a long antenna and therefore makes the set more selective. So that from all angles very long antennas are not at all desirable with regenerative receivers. Work your receiver so that it regenerates as much as possible without oscillating.

Without the use of the most selective receivers, such as the superheterodyne, some interference can not be eliminated. This is due to the unfortunate location of the receiving station relative to the transmitting station. If you are situated so that one particular transmitter comes in like a ton of bricks all over your receiver scale no matter what you do, it is very likely a case of "force majeure." You either have to take the thing like a philosopher, if you want to live there, or else get a superheterodyne. If you can't do this, the next best thing to do is to move your domicile.

One of the most frequent causes of annoyance will be found in the different noises which are heard in the phones or loud speaker. Some of the causes for these noises have been dealt with often in the pages of this magazine and will therefore not be treated here, for example squeals due to oscillations of other regenerative receivers, which oscillations are radiated as from a transmitter. Those noises not usually dealt with will be here considered. They are most frequently found in regenerative receivers. In home-made receivers periodic noises such as clicks or thrumps occurring at different rates are often heard when adjusting the receiver. These noises will generally be found to be caused by incorrect values of grid leak and condenser. When the grid condenser charges up to a negative potential the grid is likewise at this negative potential and it therefore stops the plate current from flowing. If no means were

provided for this negative potential to leak off the tube would be inoperative because no plate current could flow. The grid leak provides a path over which the negative charge may leak off as it piles up on the grid condenser. Now if the values of leak and condenser are improperly chosen, the rate at which the charge on the condenser builds up and that at which it leaks off may be so different that this process may be heard in the phones. If the grid leak has too high a resistance the negative charge will leak off too slowly, and if it has too low a resistance, it may leak off too fast. There is a proper combination of values for grid leak and condenser for each tube and it is best to have a number of different values of leaks so that the best value may be found.

Such noises may also be traced to too tight tickler coupling which may cause periodic starting and stopping of oscillations, which will be accompanied by periodic charging and discharging of the grid condenser at an audible rate. This often happens when changing from one wavelength to another without altering the tickler coupling. Different wavelengths may require different tickler coupling. Care should therefore be taken to adjust tickler coupling whenever a change in wavelength has been made.

Amplifiers are good noise generators also. The causes are numerous, but the chief offenders will be here considered. A shrill squeal will often be found to be caused by one of the following: (1) Run down *B* batteries. For some reason or other when the battery runs down and develops a high resistance, this squealing sets in. A good *B* battery will immediately rectify this. (2) Open grid circuits in the a. f. amplifier. If the transformer secondary is open, or the lead to the biasing *C* battery is disconnected, or any other type of open grid circuit is had squealing will almost always be sure to take place. The remedy for this is obvious.

Audio-frequency amplifiers, if not properly built, are susceptible to howling, which is nothing more than the generation of audio-frequency oscillations. Any amplifier which amplifies enough will oscillate. Hence the tendency to howl is an indication that the amplifier really amplifies well, and it would be desirable to maintain all this amplification and stop the howling in some way

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Uses and Theory of the Loop Antenna

A Statement As To Its Advantages and
As To Why It Works

By Maurice Buchbinder

THE loop is undoubtedly the receiving antenna of the future. There is little exaggeration in stating that the ordinary indoor or outdoor antenna of the "open oscillator" type will in the course of time be considered obsolete. This will come with the more universal use of sensitive amplifying apparatus, and there are good reasons why it should be so.

Among the obvious reasons are these: The loop is small, it is portable and easily installed, it is not as unsightly as is the antenna equipment of the other variety, with its insulators, lead in wires, lightning arresters, ground connection and so on. It certainly strikes a false note to see a beautiful home, finely furnished and artistically arranged, with a radio equipment, handsome in itself, perhaps, but spoiled for aesthetic purposes by connections with the outside antenna by insulators and wires.

But it is because of its technical advantages that the loop will appeal chiefly to the enlightened broadcast listener. Although it is not an efficient device for picking up radio waves, absorbing less of a given wave than an ordinary antenna in the same locality, and therefore requiring more amplification to bring up the sound intensity to the required value, it contributes largely to the solution of three great problems of radio broadcasting, namely, (a) interference from nearby transmitters, both telegraph and broadcast; (b) interference from radiating receivers; (c) interference from static.

There are two important methods of selecting or weeding out undesired waves. The common one is by the process of tuning to the *wavelength*. Of this there are dozens of applications: Tuning by condensers, by variometers, by tapped inductances, tuning by one, two or more coupled circuits, by radio-frequency amplifiers, and so on through the whole range of equipment types. The other great method of selectivity is furnished by the loop selecting according to *directions*. In not making use of the loop antenna then, for receiving, we are disregarding one of the only two means we have for picking out what we want. Radiation is one of the serious troubles coincident with the popularizing of broadcast programs, especially in the cities. The loop, while by no means *non-radiating*, is far less efficient as a radiator than the ordinary antenna. Therefore, even if our receiving sets will continue

to be constructed of the radiating type, and we are at present far from the stage of eliminating this, we should minimize the amount of radiation by using loops. At the same time the directional powers of the loop enables us to avoid some of this minimum amount. Thus the loop is the golden rule antenna.

Interference from static seems at present to be the greatest problem in radio reception, and the one furthest from solution. Summertime reception of distant programs is greatly handicapped as a result. Yet the loop antenna contributes greatly to the solution of this problem also. It is well known that the loop antenna will pick up far less static in proportion to useful signal than will the ordinary antenna.

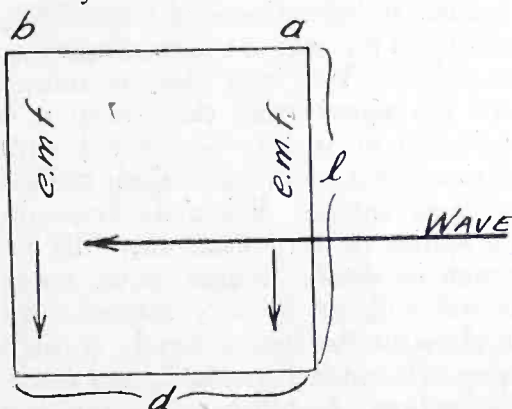


Fig. 1. Single-Turn Loop Parallel to Electro-Magnetic Wave

THE radio or electromagnetic wave progresses in a straight line from the transmitting station with the velocity of light, and at a frequency fixed by the tuning of the transmitter. At any point in the path of the wave there is an electric intensity alternating at the same frequency as the wave and as the current in the antenna which caused the wave. At a slight distance in advance of the wave the electric intensity is exactly the same except for a slight difference in phase, namely, corresponding to the time it has taken for the wave to traverse that distance.

To visualize matters, consider Fig. 1, which represents a single-turn loop placed directly in line with the advancing wave indicated by the arrow. At *a* the advancing wave causes an electromotive force proportional to *l*, the length of conductor exposed to the wave.

$$e_a = Al \sin \omega t$$

To obtain the value of electromotive in conductor *b* we must allow for the time it takes for the wave to travel through the distance *d*. Knowing the wave velocity, this time becomes

$$t_o = \frac{d}{v}$$

Therefore

$$e_b = Al \sin \left(\omega t - \omega \frac{d}{v} \right)$$

where $\frac{d}{v}$ is the phase difference.

The net electromotive force created in the loop is the difference between e_a and e_b or $e_r = Al \sin \omega t - Al \sin \left(\omega t - \frac{\omega d}{v} \right)$

It is not necessary to go into the mathematics which makes the expression e_r to simplify itself to the following value, when *d* is small compared with λ .

$$e_r = Al \frac{d}{\lambda} \cos \frac{2\pi v}{\lambda} t.$$

where *v* is the velocity of light.

If the loop has *n* turns

$$E_r = ne_r = \frac{dnAl}{\lambda} \cos \frac{2\pi v}{\lambda} t. \quad (A)$$

(*A*) incidentally depends solely upon the transmitter, namely how powerful, how far away, how good an antenna, and so on. A glance at the equation (*A*), which gives the value of induced electromotive force in a loop of *n* turns, height *l* and width *d* when pointed directly in line with the wave, reveals the following facts:

(a) The more turns a loop has the better it is. The number of turns is limited only by ability to tune to the required wavelength, just as the height and length of an ordinary antenna are limited.

(b) The greater the height and width of a loop, or the greater its *area*, the greater will be the induced electromotive force, subject to the same limitations as before.

(c) The lower the wavelength, the more efficient does loop reception become. Thus, if λ in equation (*A*) be reduced, the electromotive force will be increased.

So far we have not considered the directive qualities of the loop. In Fig. 2 we have a wave advancing at right angles to the plane of the loop. In this case the wave strikes both *a* and *b* simultaneously and the effects in the circuit cancel one another, and there is no electromotive force produced.

Considering now a case intermediate between the two extremes, we come to Fig. 3. This indicates the loop as making an angle θ with the advancing wave. It is evident that the phase difference,

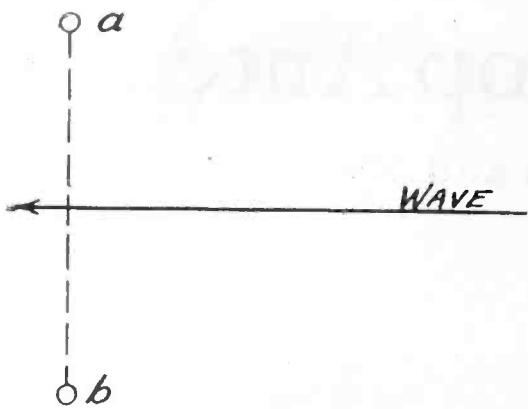


Fig. 2. Loop Perpendicular to Electro-Magnetic Wave

corresponding to the time it takes for the wave to travel from *a* to *b*, is proportional to the distance *k*, and not *d*, where $k = d \cos \theta$, θ being the angle between the line of the advancing wave and the plane of the loop, and *d*, as before, is the width of the loop.

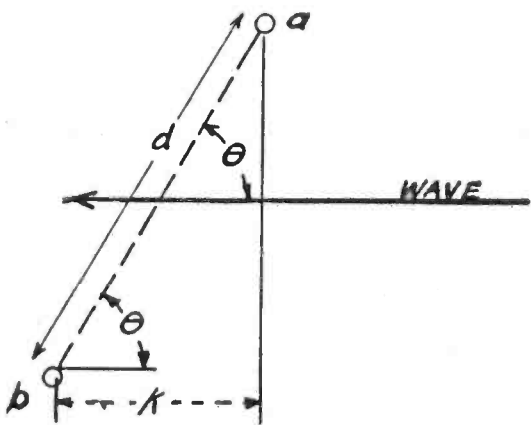


Fig. 3. Loop at Angle with Wave

Hence, if we rotate the loop, the electromotive force will depend upon the angle of its plane with the line of the advancing wave, or

$$e = E \cos \theta$$

If $\theta = 0$, then $e = E$, a maximum.

If $\theta = 90^\circ$, then $e = 0$, a minimum.

These are the two extremes possible.

We can get a good idea of the loop as an interference reducer and direction finder by plotting geometrically the angle θ against the induced electromotive force *E* (corresponding roughly with the loudness of the received signal). The graph resembles ∞ and is given in Fig. 4. It is seen that, as we turn through

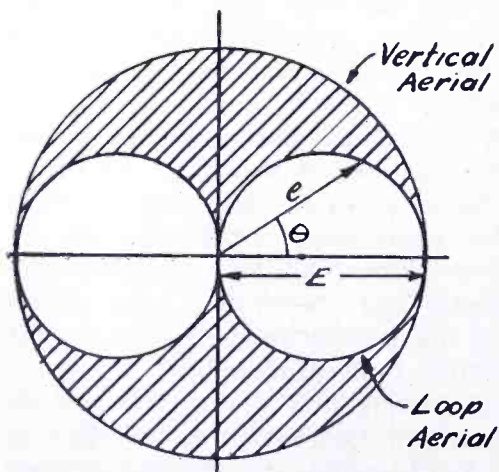


Fig. 4. Variation of Signal Intensity with Loop Direction

an angle of 360° , or completely around, we reach two points each of maximum and minimum intensity, namely for $\theta = 0$ and 180° , and for $\theta = 90^\circ$ and 270° . This is another way of stating that the loop does not differentiate between *N* or *S*, *E* or *W*—it merely indicates a given line, but not which extremity of that line.

The ordinary vertical antenna responds equally well in all directions. The plot of its response constructed along the same lines as before will be a circle, shown in Fig. 4. The difference in area between the two figures tells us graphically the advantages of the loop. It shows that, by just the amount of the shaded area, the loop will be silent to disturbing stations toward which it is not directed, while the vertical antenna will necessarily respond to them. In the single case where the loop must be directed exactly in line with a disturbing station, the loop has no advantage.

IN radio compass work the problem of designing a loop antenna is not quite so simple as for ordinary receiver purposes. The radio compass aims to point out the direction of a transmitting station. This may be accomplished in two ways. The loop may be rotated until the signal from the station is a maximum, or it may be rotated until the signal is a minimum. Each method has its advantage. When the transmitting station is very near, then the reduction in signal strength as we rotate the coil will not be very marked until the plane of the loop is nearly at right angles, when it will suddenly and markedly decline. In other words, this is a case with a very broad, indefinite maximum, hence the *minimum* signal point is used. On the other hand, if the station is very distant, it will not be heard until the plane of the loop points nearly at the station. Hence, this is a case for the use of a *maximum* signal point. In either case the aim of radio compass design is to make the maximum or minimum point as well defined and sharp as possible.

The sharpness of the minimum is reduced by one phenomenon known as antenna effect of the loop. The entire loop, being in effect a small elevated body, acts as a vertical antenna to some extent, producing a constant amount of

signal which cannot be eliminated no matter how the coil be rotated. This antenna effect is shown diagrammatically in Fig. 5.

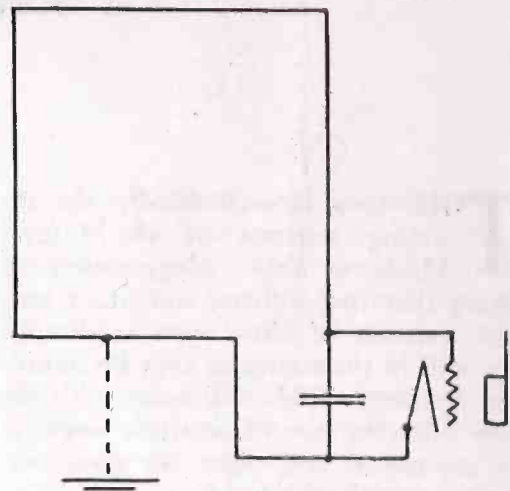


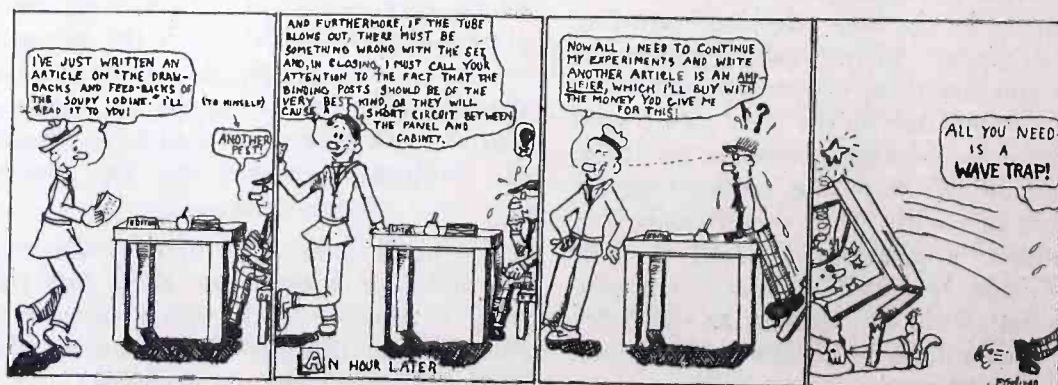
Fig. 5. Antenna Effect

The antenna effect may, however, be neutralized to a great extent by balancing condensers connected to the grid side of the loop which cause the disturbing signal to flow directly to ground without affecting the receiving apparatus.

Other factors affecting accuracy in radio compass work are not inherent in the loop, but in the properties of radio-waves themselves, and they may be corrected by calibration.

In conclusion, it is well to emphasize that the loop has become the most practical receiving antenna we have. It possesses technical advantages over the ordinary antenna, as well as advantages of convenience and appearance. The contemplating purchaser of a radio equipment should bear this in mind when he makes his selection and, if he is wise and can afford it, he will procure a highly-sensitive loop type of receiver. The experimenter and home builder can well afford to spend some time on loops and their uses.

When you are using a common type of high resistance telephone receiver as a loud-speaker unit, the rasping, or rattling noise can often be reduced, or even eliminated by putting a thin washer about the same thickness as the receiver case, between the diaphragm and the case. This holds the diaphragm away from the magnets, and keeps it from "chattering."



Simplifying a DX Regenerative Receiver

By A. Lewis Rockett

IN comparative tests with regenerative and radio-frequency receivers, the former held its own. It was a receiver of this type that brought in part of Senator Marconi's speech and musical numbers from 2LO, London, England, an airline distance of 5000 miles; the circuit diagram is shown in Fig. 1. *L*

The 22½-volt *B* battery tap is connected to the open end of *R*₁; the plate of the detector to the open end of *R*₂. Pigtail connections are used in each instance. This arrangement simplifies the control of regeneration. As a result, stations are tuned in easier by the voice, the small coil being used as a vernier,

- 2 lengths composition tubing (¼ in. preferred).
- 2 lengths 6/32-threaded brass rod.
- 2 4-in. tubes 1/16 in. thickness.
- 1 2¼-in. tube.
- 1 3-in. tube.
- 1 single-circuit jack.
- 1 two-circuit jack.
- 1 7x24 panel.
- 1 shield for condenser.
- 2 audio transformers.
- 2 back panel mounting switches.

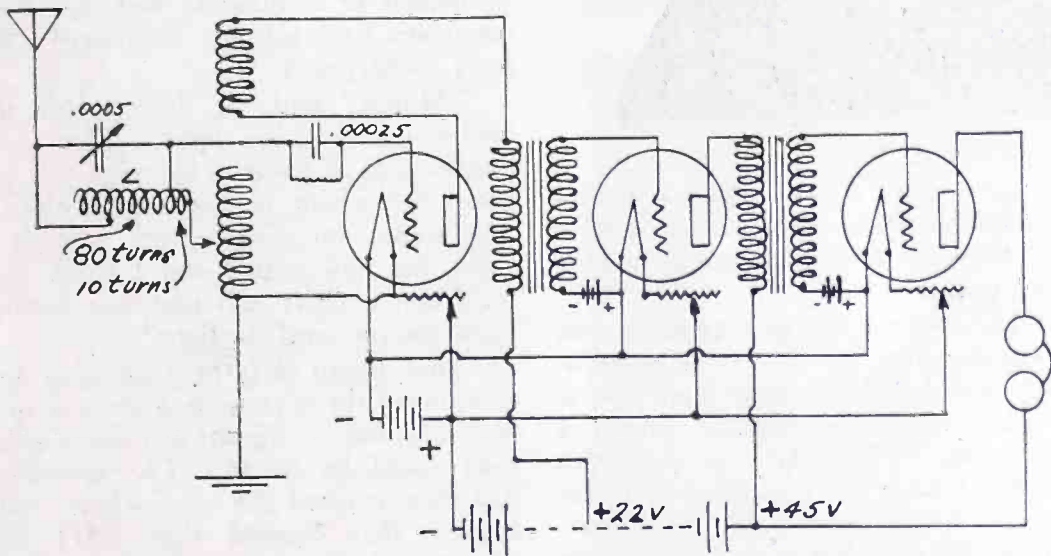


Fig. 1. Circuit Diagram of DX Regenerative Receiver

is wound on a 4-in. tube and should contain 90 turns of No. 24 dcc wire, tapped every ten turns. The first 80 are used as a wave trap coil shunted, through a switch, across the 23-plate condenser; the last ten turns form a small inductance in the aerial and grid circuits.

The receiver is simplified by using a special coupler, Fig. 2. Two rotors,

as there is not enough winding to tune as a variometer. The stator of the coupler is wound in the same direction, with the same size wire, and is tapped at the following turns: 30th, 35th, 40th, 50th and 60th—the end of the winding.

Parts used in construction are as follows:

- 1 23-plate condenser.
- 1 grid leak (Bradleyleak) ½ to 10 megohms.
- 1 UV-200 or C-300 detector tube.
- 2 UV-201A or C-301A amplifying tubes.
- 3 sockets.
- 3 rheostats.
- 1 .00025 grid condenser.
- 1 set binding posts.

A condenser with very little insulation is recommended. The grid leak is adjusted by turning to the position where signals are loudest. If the composition tubing for the shaft of *R*₂ is not available, it may be made by drilling a 5/16-in. rod (boring half way from each end) with a 3/32 drill and following through with a 9/64, and, if necessary, 5/32 drill, so the 6/32 shaft will turn freely. Fibre may be used. The drills can be purchased at any hardware store for 15c each and are a handy combination to have if not already in stock. The rotors are mounted so the center of the composition shaft is 3/8 in. above the stator winding. Holes for the shafts should be centered accurately. Jacks are used in the second and third stages.

In operating the receiver, *R*₂ is set at an angle of about 45° and *R*₁ at right angles to it. The rheostat is then turned until a click or hissing noise is heard; the desired position is just below this point. With the wave trap coil in or out of the circuit, the receiver is tuned in the same way. Its effectiveness is increased by using less of the winding and more of the coupler stator. In reaching the high wavelengths, practically all the windings of both coils are used. By using *R*₁ for the final tickler

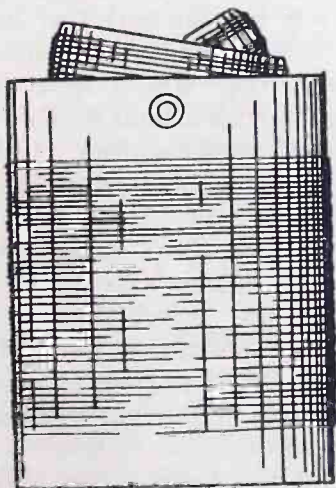


Fig. 2. Special Two-Rotor Coupler

*R*₁, 2¼ in., and *R*₂, 3 in. in diameter, are used; both rotate on separate shafts. The former is wound with 10 and the latter with 40 turns of No. 24 dcc wire, space being left in the centers for the shafts; the ends of *R*₁ are connected to a 6/32 threaded shaft. As shown in Fig. 3 the rotors are connected in series.

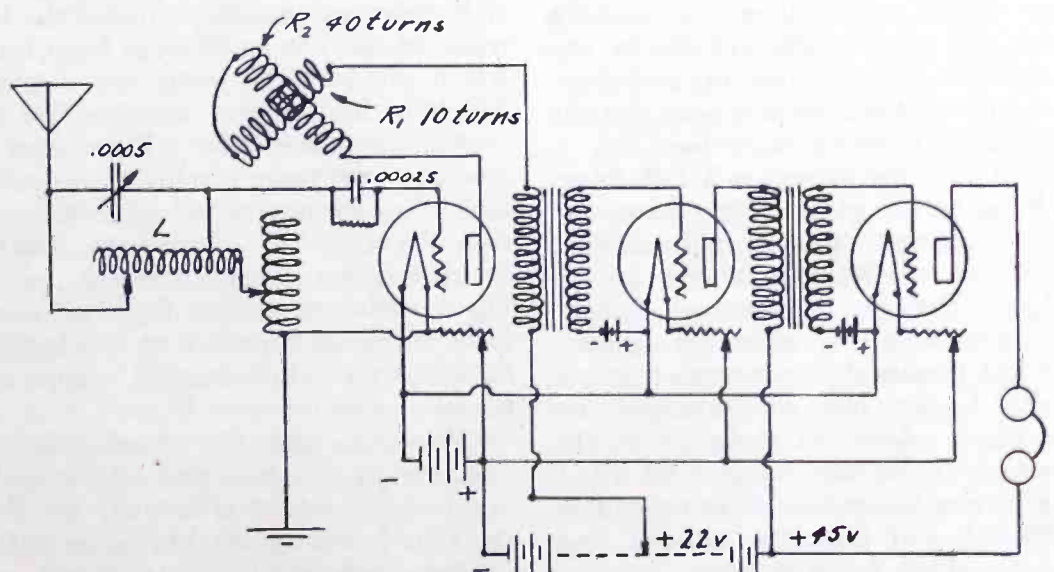
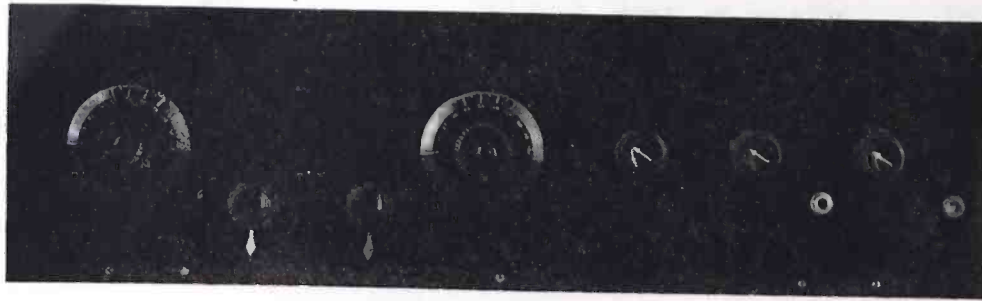
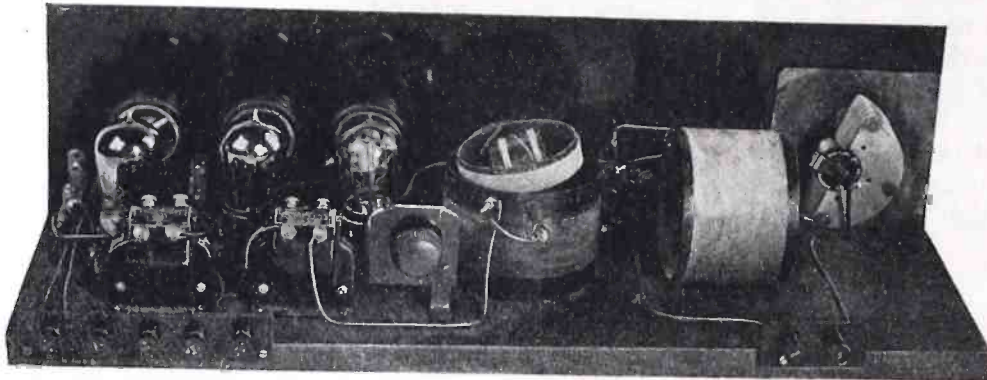


Fig. 3. Circuit Diagram of Simplified Receiver Using Two Rotors



Panel View of Completed Set



Rear View of Completed Set

adjustment, the volume may be increased to maximum without readjusting the condenser, the wavelength being affected very little by it. The open switch point on the wave trap switch is used to cut the coil out of the circuit when desired.

The set is selective, only one station coming in at a time. On several occasions DX stations operating on the same wavelength at the same time came in without interfering with each other. A vernier adjustment may be added to the condenser for further simplicity of tuning, though the set is not hard to operate without it. An outside aerial from 70 to 100 ft., not including lead-in, is preferred.

THE RADIO SPOOK OF SAN BERNARDINO MOUNTAINS

By COL. J. F. DILLON

THOSE engaged in the radio profession usually become hard boiled, as it were, and hence immune to supernatural thrills. However, when some normal person, whose reputation for veracity and judiciousness is well established, testifies in all seriousness to an extraordinary experience which can not be accounted for by any established scientific law or precedent, confidence in the immunity may, for the moment, be seriously jeopardized.

Soon after my arrival at a Los Angeles hotel on one of my recent inspection tours to the southern part of the district, I received a telephone request for an audience from one who stated that he desired to consult me regarding a matter that had perplexed him for more than a week. I gave him an immediate appointment. After an exchange of the customary courtesies, he glanced about in a furtive manner, as if fearing to be overheard, and appearing satisfied that we were alone, began his story.

"I presume," said he, "that you re-

ceive some very curious reports during your travels about the district, but it is doubtful if any of them are as strange as this one.

"Dr. X, who is a close personal friend of long standing, returned from an automobile tour last Wednesday and related his experience with what he termed a radio spook. Please keep in mind the fact that I have every confidence in the sanity and intelligence of the doctor, who, by the way, has never been known to perpetrate a practical joke or to spoof about things as many others do.

"He told me that one evening while encamped in a deep valley in the San Bernardino mountains, dinner had been dispatched and he was sitting beside the campfire thinking, when to his great astonishment, the low, soft strain of an aeolian harp mingled with the shrill squeak of the crickets and an occasional wah-hoo of the night owls. His immediate conclusion was that some camper had arrived in the near vicinity and had set up his radio with a loud speaker attached.

"Being in a sociable frame of mind, the doctor concluded to pay a friendly visit to the camp of his new neighbor, and with this thought in mind, he listened carefully in an effort to learn from which direction the music was coming. Much to his surprise, however, no direction was discernible. One minute it appeared to come from some point higher up in the ravine and the next from the hill in rear of the camp. Finally he instituted a systematic search, covering a radius of several hundred yards from his camp, but much to his chagrin, he found the valley deserted, except for his own camp.

"Pondering upon the situation, he returned to camp, where presently he again heard the strains of a familiar air, but this time it was rendered by an orchestra instead of a harp. Unwilling to rely entirely upon his own sense of hearing, he

called his wife from the tent nearby and asked her if she could hear anything unusual. After a moment she replied, 'yes, I hear an orchestra, and it is playing a selection from Chopin. Where is it coming from?' With a shake of his head, he replied, 'from out the clear blue.' 'Oh,' she exclaimed, 'do you think it could be coming from Mars? You know that all of these highbrow astronomers and wisenheimers are saying that Mars is inhabited just like our own planet! Wouldn't it be just wonderful if it really was some radio station up on Mars, and we are the first ones to hear it. And yet, it would be too extraordinary to imagine that the inhabitants of Mars have kept abreast of us in the development of civilization and that their composers have actually duplicated Chopin's masterpieces.'

"Madge," said the doctor, 'for the love of reason please desist. That lucid imagination of yours is carrying you beyond the realm of human possibility. The music, no matter from whence it came, has now ceased and I think that we'd better retire and postpone further investigation until daylight.'

"They began early next morning and scrutinized the surrounding ground very carefully, but no sign of any other occupant could be found. The following day they reached the city, where upon inquiry they learned that KHJ had transmitted the two selections which they heard, in the usual manner, which instead of relieving their minds, left them more perplexed than they were before. Now, sir, what the devil's the answer.'

"I would say, off hand, that the answer is somewhat difficult. If your estimate of the sanity and intelligence of your friends is to be relied upon, it would seem probable that the scope of their search for a radio station in their vicinity was too limited; that had they pursued their investigation further from their camp, they would have found a receiving set with a loud speaker attachment in good working order. Otherwise the opinion would obtain that the doctor and his good wife were victims of an acoustic delusion, for I can think of no other explanation which could be regarded with any degree of plausibility.

"It should be kept in mind that the wave energy emitted from telephone radiocast stations is purely electromagnetic and electrostatic in character. The function of the voice waves which act upon the diaphragm of the microphone, is to vary the volume or flow of current in the aerial circuit. This variation or modulation corresponds accurately to the energy of the sound waves created by the articular muscles of the throat during the process of speaking. While this radiated energy, as modulated by the action of the microphone, permeates all

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The Construction and Calibration of a Wavemeter and Heterodyne Oscillator

By D. B. McGown

NO radio station, either amateur or broadcast listener, is really complete without a reliable wavemeter. The amateur's transmitter must be accurately tuned so that it may comply with the requirements of the license and in order that other operators may know where to find it. In reception of any kind of signals, if the wavelength is known, it is a simple matter to adjust the receiving set.

Possibly the term, "wavemeter," should be abandoned, and the instrument referred to as a "frequency meter," owing to the fact that today the use of frequencies instead of wavelengths is becoming more and more common. A wavemeter is a tuned circuit so arranged that some indicating device shows when the circuit is tuned to the same wavelength as the circuit under measurement. The basic circuit as shown in Fig. 1,

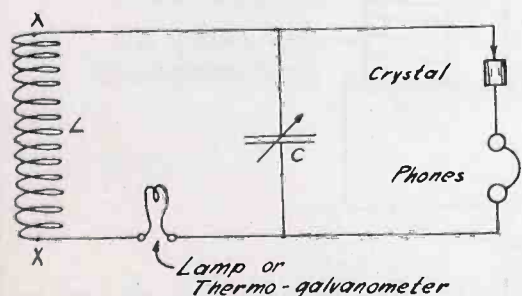


Fig. 1. Wavemeter Circuit

consists of a simple coil inductance shunted by a variable condenser, a lamp, a crystal detector and a pair of telephones, each of these forming an independent and separate resonance indicator. The use of these devices is almost self-evident. When the condenser C is varied, the lamp will flash up at the resonance point, if the whole instrument is coupled closely enough to the transmitter. If no flash can be obtained, the loudest signal in the phones is taken as resonance. Owing to the high resistance and unilateral conductivity of the crystal detector and the high impedance of the telephones, the radio-frequency component will not be affected by shunting these instruments across the circuit.

The lamp should be the low-voltage tungsten filament type used in flashlights—the lower the voltage the better. Although a fairly accurate resonance point can be found with the lamp, a more satisfactory scheme is to use a sensitive thermo-galvanometer, such as the Weston, Model 425, current-squared, thermo-couple instrument, which retails for about \$18. A hot-wire galvanometer makes a fair substitute.

The wavemeter shown in Fig. 2 was built by the author, using a current-

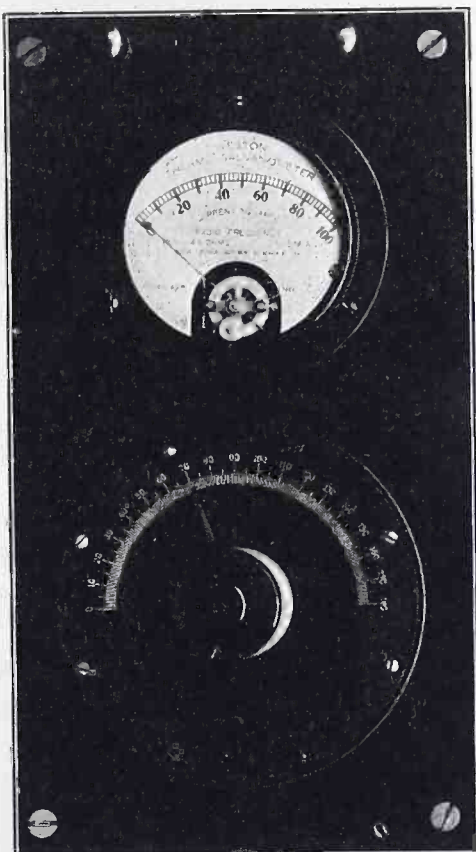
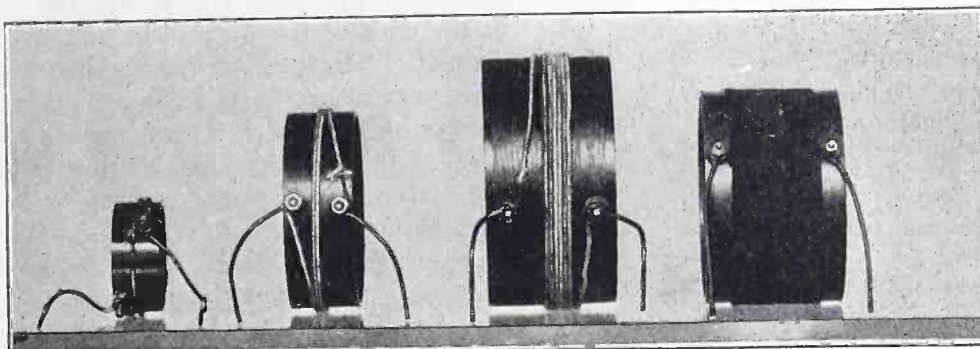


Fig. 2. Wave Meter and Coils

squared meter and a high-grade precision condenser of .001 mfd. capacity, completely enclosed in a metal shield. The two instruments were mounted on a bakelite panel, with two binding posts to permit the connection of various coils at points X-X in Fig. 1 to cover the particular wavelengths measured.

Calibration is best accomplished by means of the standard frequencies transmitted by WWV, the Bureau of Standards station at Washington, D. C., and 6XBM, at Stanford University, California. Another method is by means of the Class B broadcast stations, which seldom vary more than 2000 cycles from the assigned frequency, which is within the usual limit of measurement.

Although any receiving set may be calibrated by tuning in the station and marking the points where the loudest signals are obtained, it will be found that this is not accurate enough where precise measurements are desired. Fur-

thermore, this adjustment is not of much use in calibrating other instruments.

The accurate calibration of a wavemeter from the emitted waves from distant stations requires a sensitive receiving set, a vacuum tube oscillator, and the wavemeter to be calibrated. An oscillator to cover the broadcasting bands was made up by the writer from a Remler type 620 coupling unit, with the rotor winding left free. Fig. 3 shows the circuit diagram, which is the common

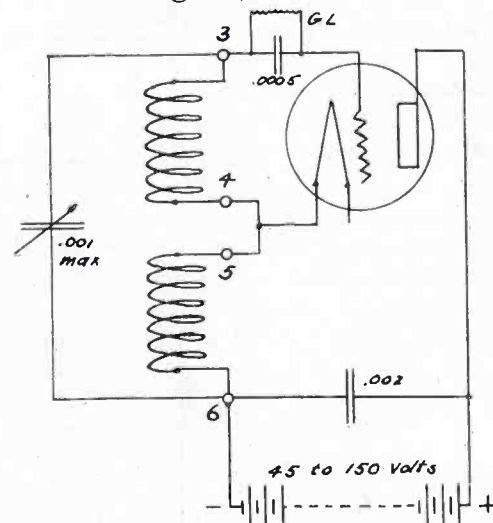


Fig. 3. Oscillator Circuit

Hartley circuit. A C-202 vacuum tube was used, with 130-volt B battery, although any similar tube would have served the purpose. A grid leak to suit the tube was used, and a .0005 mfd. grid condenser. The tuning condenser shunted across the terminals 3-6 was a common type, with a maximum capacity of .001, and need not be a "low-loss" condenser. The largest coil shown with the wavemeter, in Fig. 2, is used to check wavelengths in this band.

The method of operation is to first tune the receiving set to the desired signal so that it is reasonably loud, but not oscillating or regenerating. Then set the oscillator in operation and slowly swing the tuning condenser across the scale until it crosses the carrier wave, as denoted by the whistling note or "blooping." The oscillator will be in resonance with the carrier wave at the zero point

Continued on page 92

Pointers on Radio Construction

HOME-MADE LOUD SPEAKER

By F. L. ULRICH

No station is complete without a loud speaker; yet the high price is sometimes an obstacle that can be overcome only by home construction. The following parts are necessary:

- 1 good amplifying transformer.
- 1 UV-201 amplifying tube (a UV-202 5-watt transmitting tube will give better results).
- 1 pair of old relay or bell magnets.
- 2 6-ohm rheostats.
- 1 high resistance telephone receiver.
- 1 horn, any type.

First carefully cut off the bottom of the telephone receiver. Then separate the circular magnets from the pole pieces, leaving the two high resistance magnet windings with their small poles.

the bell and telephone magnets long enough to make the desired connections.

After testing out the windings of each pair of magnets, replace the receiver case back over the poles and secure the case to the ends of the fibre disks of the bell magnets. Before securing this case, make sure that the telephone poles will come within about 1/32 in. from the top edge of the receiver case, so that, when the diaphragm is placed on top, it will have enough room to vibrate without touching the pole pieces.

After this is all finished, it may be enclosed in a wooden case, allowing only the receiver case to extend out, as can be seen in Fig. 2. The horn is then attached to the receiver cap, either by

MAKING AN AMPLIFIER SUB-BASE AND PANEL

By H. W. ALLEN

The radio builder can rival the factory output in appearance and operation by using a sub-base and false panel for mounting his detector-amplifier unit. The only additional material required are two panels, one 6x9 in., 3/16 in. thick, to be used as the sub-base, and one 9x4 in., 1/8 in. thick, to be used as a

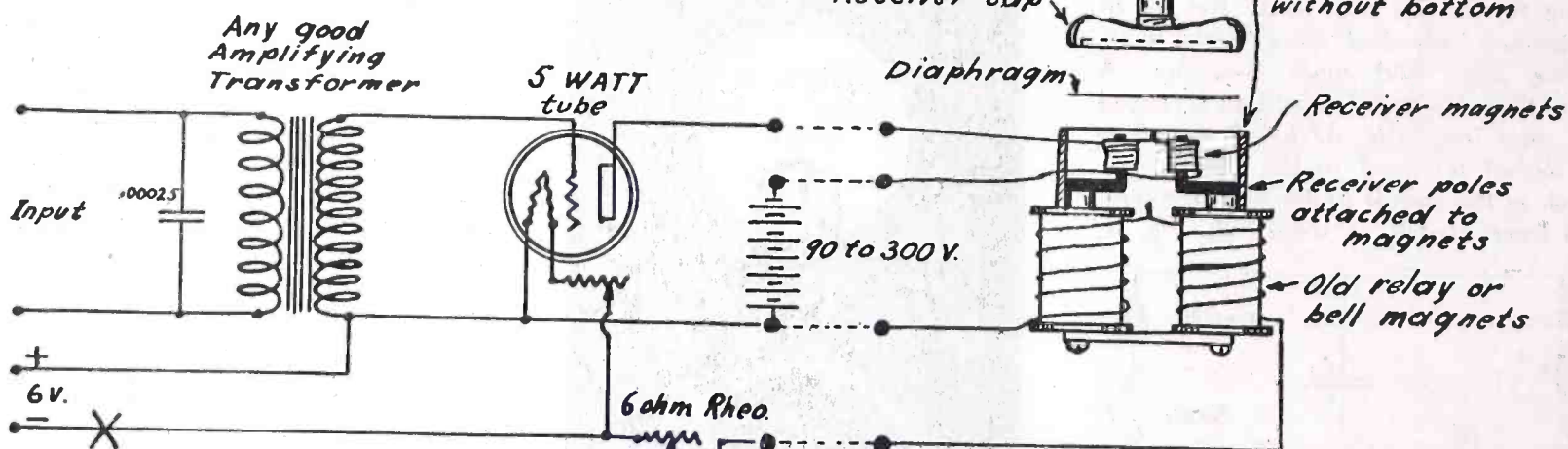


Fig. 1. Diagram of Connections for Home Made Loud Speaker

Next attach the two bell magnets to the telephone magnets, making sure that the right poles are brought together—as can be seen in Fig. 1. Then solder leads to

threads or by a special fitting which is screwed on to the receiver case. This completes the construction of the loud speaker, which is then mounted on a base, allowing enough room for the rest of the apparatus of the power amplifier.

The power amplifier, if mounted on the same base as the loud speaker, may be directly connected, making the connections permanent. Arrange the apparatus neatly on the base and then secure each piece with screws, following out carefully the connections as shown in the diagram. Binding posts should be used for connecting the batteries and input circuit to the loud speaker.

A single-pole, single-throw switch may be placed in the 6-volt line to disconnect the loud speaker, as can be seen in the diagram by the mark X. The loud speaker is then ready for operation.

false panel, together with a few screws, bolts and brass strip.

Fig. 1 shows the layout of the 6x9 sub-base, the dotted lines representing wires under the panel, and solid lines wires above the panel. Points marked X show where the wires pass through the panel. It is assumed that 6-volt tubes are used.

Any standard parts may be used except in the case of the sockets, which must be of the metal shell type. The insulating feet on the socket should be loosened and the contact screws either tightened in their original position or reversed so that the connections may be made from the bottom of the socket. All connections should be soldered.

Locate the rheostats in the correct position as shown in Fig. 1 and slot the sub-base to fit them as shown in Fig. 2.

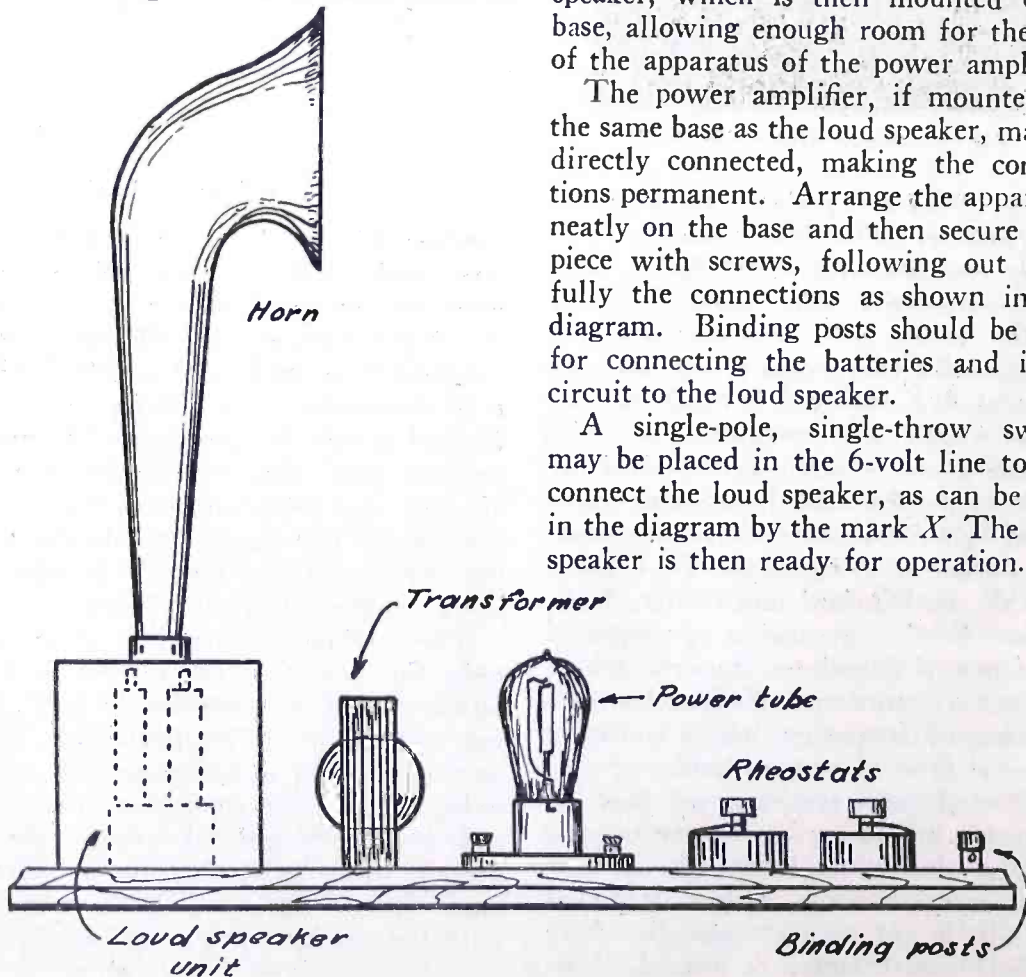


Fig. 2. Arrangement of Parts

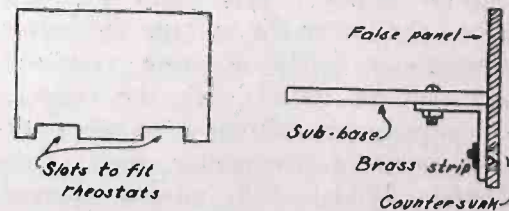


Fig. 2

Fig. 3

The 9x4 false panel is mounted on the sub-base with brass strip as in Fig. 3. On this false panel are mounted the rheostats, push-pull switch and jack.

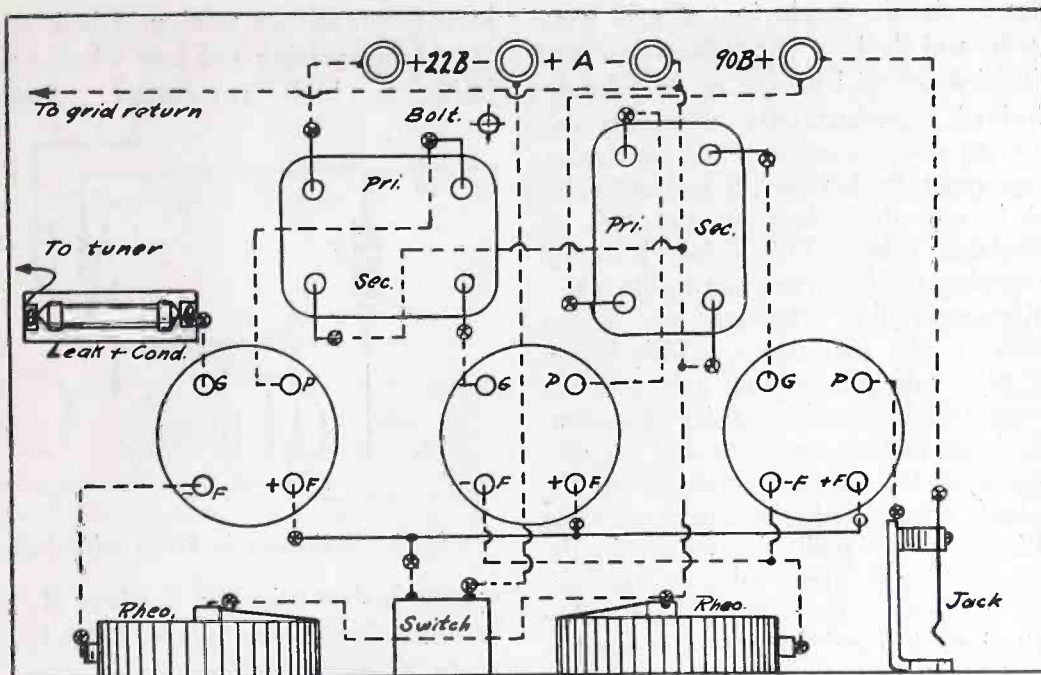
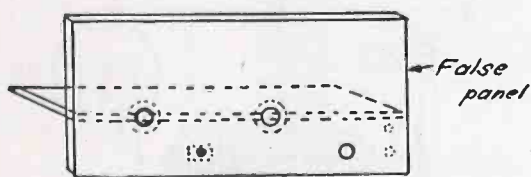


Fig. 1. Layout of Subbase



Dotted lines show positions of rheostats, jack, switch & sub-base

Fig. 4

Their relative positions are indicated in Fig. 4 and the general assembly in Fig. 5. All screws or bolt-heads should be countersunk.

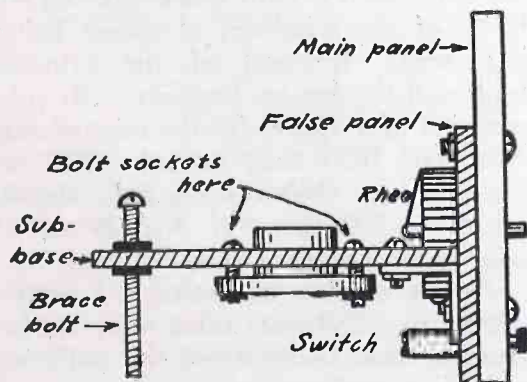


Fig. 5

As only the shells of the sockets protrude above the sub-base, there are few crossed wires. By disconnecting the tuner leads and loosening two bolts, the entire detector-amplifier unit may be lifted out for inspection or repair. It may also be used in any other type of receiver.

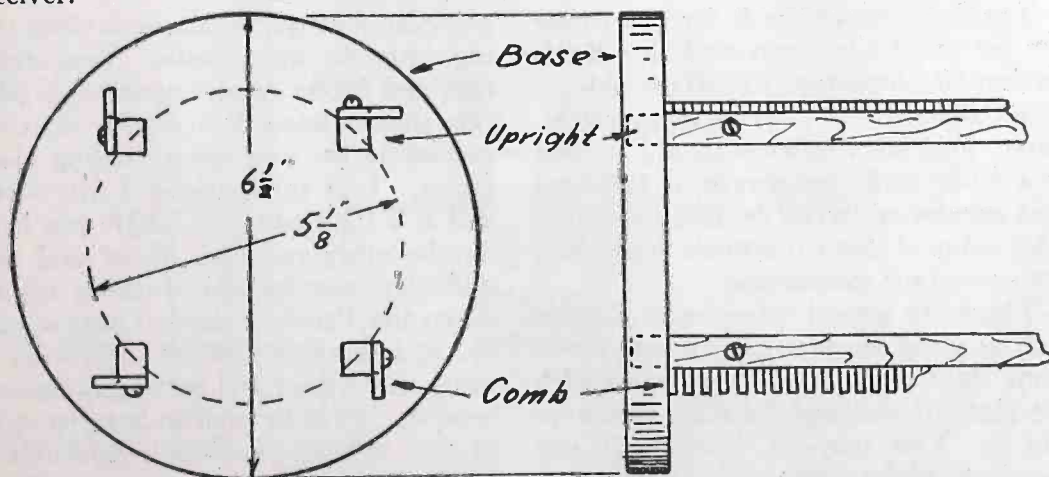


Fig. 6. Top View of Frame

HOW TO MAKE AN EFFICIENT C. W. INDUCTANCE

By MONROE H. MARTIN

In the various radio magazines there have appeared from time to time articles describing the construction of a C. W. inductance. In providing for the spacing of the turns, most of these require the slotting of a bakelite or hard rubber strip, a tedious and extremely difficult job.

This inductance consists of a coil wound upon hard rubber combs, which are fastened to wooden uprights, which, in turn, are wedged in holes drilled in a wooden base.

This base, which is circular in form, has a diameter of $6\frac{1}{2}$ in. and is 1 in. in thickness. On the base, by means of a compass, a circle $5\frac{1}{8}$ in. in diameter is described. At equal distances around the circumference of this circle four $\frac{3}{8}$ -in. holes are drilled to a depth of $\frac{3}{4}$ in. (Fig. 1).

The uprights are each $\frac{3}{8} \times \frac{3}{8} \times 4\frac{1}{2}$ in. These are preferably made from some soft wood. Using a rasp, the ends of the uprights are rounded for a length of $\frac{3}{4}$ in. (Fig. 2). This permits a snug fit of the uprights in the holes drilled in the base.

The spacing of the teeth of the hard rubber combs should permit the entrance of No. 14 wire. The combs (two are

necessary) are each cut into two parts, each part having 26 teeth. The parts are put into a vise, and, by means of a small-toothed saw, the teeth are cut

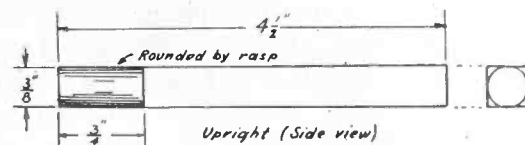


Fig. 2. Side View of Upright

down until only $\frac{5}{16}$ in. projects. In the handle of the comb two $\frac{3}{16}$ -in. holes are drilled, each $\frac{3}{4}$ in. from the end (Fig. 3).

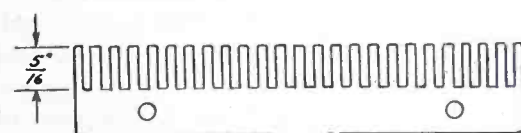


Fig. 3. Comb

The combs are then fastened to the upright by means of brass screws.

The uprights are inserted in the holes drilled in the base and adjusted so that each comb is perpendicular to the one immediately adjacent (Fig 1).

Wind 40 ft. of No. 14 copper wire on a form 4 in. in diameter. This gives the wire a tendency to contract and to fit snugly when wound on the combs. When the wire is removed, it retains the form of a coil spring. This coil is slipped over the combs and the turns fitted in their respective slots.

In using the unit, it will be found that 5 turns tune 186 meters, 10 turns tune 192 meters, 15 turns tune 200 meters, 20 turns tune 207 meters, and 25 turns tune 215 meters.

This inductance is very easy to make, and presents a pleasing appearance, if only a fraction of the time and labor ordinarily required is expended.

When out in dry country, where no trees are available for an antenna, quite good results can often be obtained by laying two lengths of wire out on the dry earth, using one as a ground, and the other as an antenna. When it rains, though, this type of antenna is rather worse than useless.

When making up a "cage" antenna, very fine hoops can be made up by taking an old edgewise wound inductance and cutting the turns off, one by one, and riveting or soldering the ends. Then drill holes through the rings thus formed, and thread the wires through them, and fasten with short-tie wires, and solder the whole securely.

Don't forget that a Tungar bulb can be made to last much longer if the filament supply circuit is opened on one side, after the tube has heated up. In this case the current flowing through the tube keeps the filament heated. This will reduce the current a trifle, but the tube life will often be increased three or four times.

AN IMPROVED TYPE OF GRID MODULATION

By F. C. JONES
6AJF

Most amateurs use phone or ICW for local work, and generally use loop modulation which is at best a make-shift scheme. A few use Heising modulation but that takes double the number of tubes, which is quite a drawback to most fellows financially, when the oscillators happen to be 50 or 250 watt tubes. The following deals with an improved system of grid modulation wherein the output of the set increases when modulating and only a small modulator tube is required.

Using a small tube as a grid leak and obtaining modulation by this scheme ordinarily causes distortion and decreased input to the antenna unless a resistance of proper value is shunted across the output of the modulator as shown in Fig. 1.

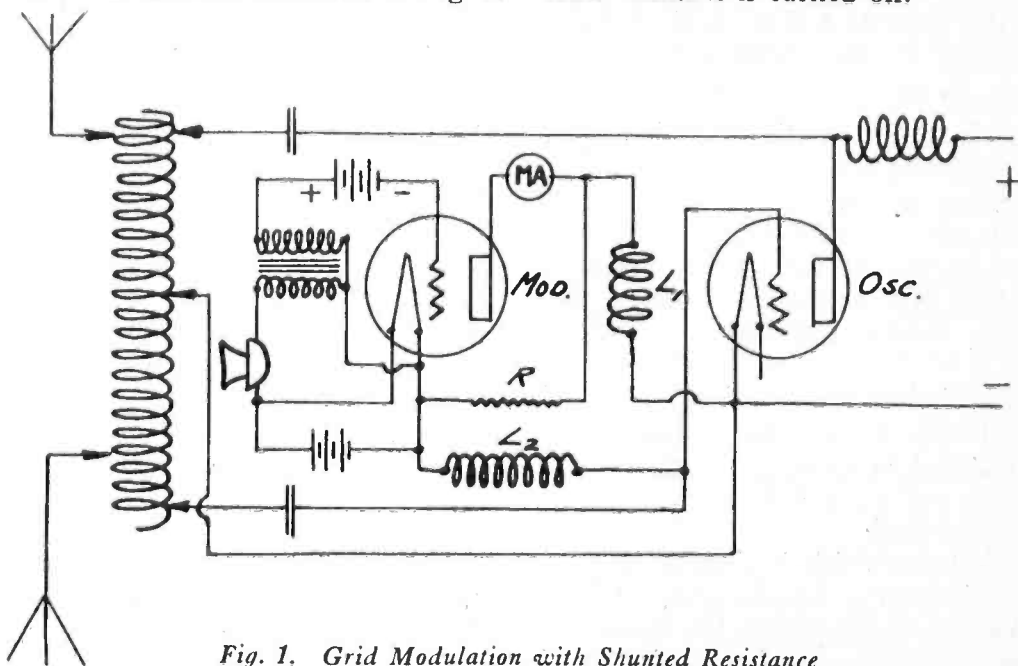


Fig. 1. Grid Modulation with Shunted Resistance

In this way there is always a small amount of grid current flowing, so that the oscillator still works at a reduced output due to small grid current which means a smaller plate current and small antenna input. Then when the microphone is spoken into, the grid of the modulator becomes more positive (as in Heising system) and the output impedance decreases, thereby lowering the total grid leak resistance. This causes an increase of oscillator grid current with the resultant increase of plate current and antenna input. Thus the voice modulates the antenna input.

One of the main drawbacks of the Heising system of modulation, is that the oscillator plate current is acted upon directly by the modulator, which has to be a tube of the same power rating while in the improved system of grid modulation the modulator acts on the grid of the oscillator and so only needs to be a small tube. Another thing is that in actual practice it seems to be able to modulate a greater percentage of antenna input than the Heising system without the corresponding distortion.

This scheme will work with any os-

cillator circuit employing a grid condenser and leak. The proper amount of modulator C battery can best be determined experimentally as it depends upon the power output of the oscillators, being generally between 0 and 45 volts, and is also dependent on the type of modulator tube. This value is found by varying the C battery until only a few milliamperes flow through the output circuit of the modulator. This brings the tube operation down towards the lower straight portion of its characteristic curve, so that an increase of current, when modulating, takes place along the straight portion of the curve. If no milliammeter is available for use in the plate of the modulator tube, an approximate value can be made by adjusting until there is practically no decrease of oscillator plate current when the modulator filament is turned off.

keep the resultant total grid leak resistance from getting too low when modulating a high percentage. Another

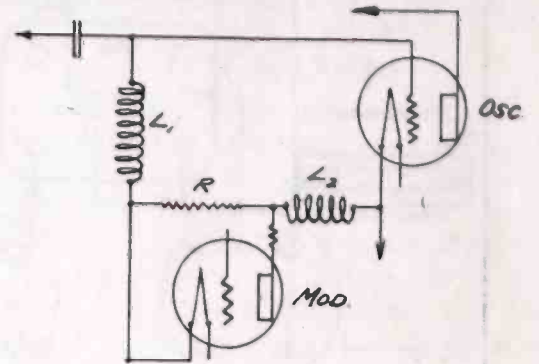


Fig. 2. Resistance in Series with Plate

scheme is shown in Fig. 3 where R_1 may be about 2500 ohms and R_2 from 10,000 up to 50,000.

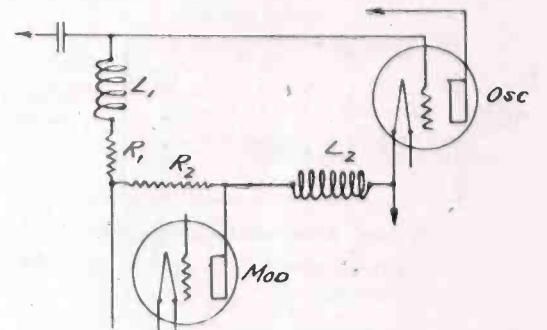


Fig. 3. Another Refinement

The modulation transformer may be any type, even a Ford spark-coil, the polarity of the windings of course being important. Reversal of the primary leads will fix that up, however. By substitution of a buzzer for the microphone very good ICW may be had. The radio-frequency chokes L_1 and L_2 should be about 200 turns of No. 28 to 32 wire on a cardboard tube.

Now a word as to results, at a nearby station two 250-watt tubes were modulated by one 5-watt tube, the radiation

The following are some values of resistance and types of modulator tubes which will work satisfactorily using the circuit shown in Fig. 1.

Value of shunt resistance R.	Oscillators No. used—type.	Modulator tube.
10,000 to 30,000 ohms.	1-4 C302 UV202	C301A, VT1, VT2 Any amp. tube.
10,000 to 20,000	1-2 C303 UV203	VT2 or C302 or C301A UV202
10,000 to 15,000	1-2 C304 UV204	C302, VT2 UV202

The shunt resistance R for low power sets, up to 50 watts, can well be a Bradleyohm 10 (resistance 10,000 variable up to 100,000). For larger sets several ordinary grid leaks in series should be used as a fairly large percentage of the total grid current is carried by this resistance. This value of shunt resistance determines the percentage modulation.

There are several refinements possible such as using an additional resistance of from 1000 to 5000 ohms in series with the plate of the modulator as shown in Fig. 2. This may be desirable if any speech amplifiers are used in order to

going up a couple of amperes when talking into the microphone. Less distortion and better results were obtained at this station using this system than was previously the case using Heising modulation. Last spring using 3 five-watters and a VT2 modulator 6AJF was heard on the other coast on phone and little difficulty was had in working up and down the Pacific Coast. Quite a number of fellows in Central California are using this system and getting fine results with it. Will be glad to hear from any of the fellows experiencing trouble or unusual results.

A Simple Break-In System

Several Practical Suggestions For Various Types of Continuous Wave Transmitters

By L. W. Hatry

ONE of the things that has been craved for a very long time is a simple, inexpensive and easily-installed break-in system. Fig. 1 shows the fundamentals of one for a low-

powered spark-coil C. W. set. The receiver, and lo, you hear—if the key is up. The choke RF_1 is the valve that keeps the received signal from running wild where you don't want it, leaving it only the path to the receiver, where it

insulated key is a necessity to avoid losses of received energy.

The choke RF_1 is composed of 250 turns of No. 18 d.c.c. wire on a 4-in. cardboard form paraffined. The wire must be heavy to pass the battery current without the resistance making the voltage too low, to actuate the spark-coil.

Fig. 2 shows the familiar transmitter that uses an a.c. transformer as the source of high voltage with a separate transformer to light the filaments. The arrangements are similar to Fig. 1 and are based on the fact that one side of the a.c. supply line is always grounded, so that it is possible for you to get a completed 110-volt circuit through your ground connection. The objection to the system lies in the facts that: you get an a.c. hum in your receiver, only partially alleviated by the isolating condensers, C_1 and C_2 (Under no circumstances leave these condensers out); and that if you have any amount of power the arc at the key is very bad, although I have another system for the higher powers which will be described.

In Fig. 2 RF_1 is the same as it is in Fig. 1. The condensers C_1 and C_2 are, respectively, .006 Freshman and C_2 a size that gives minimum hum in your receiver as well as allowing good signal strength. This last must be experimented with, because your primary coil in your receiver partially determines the size necessary.

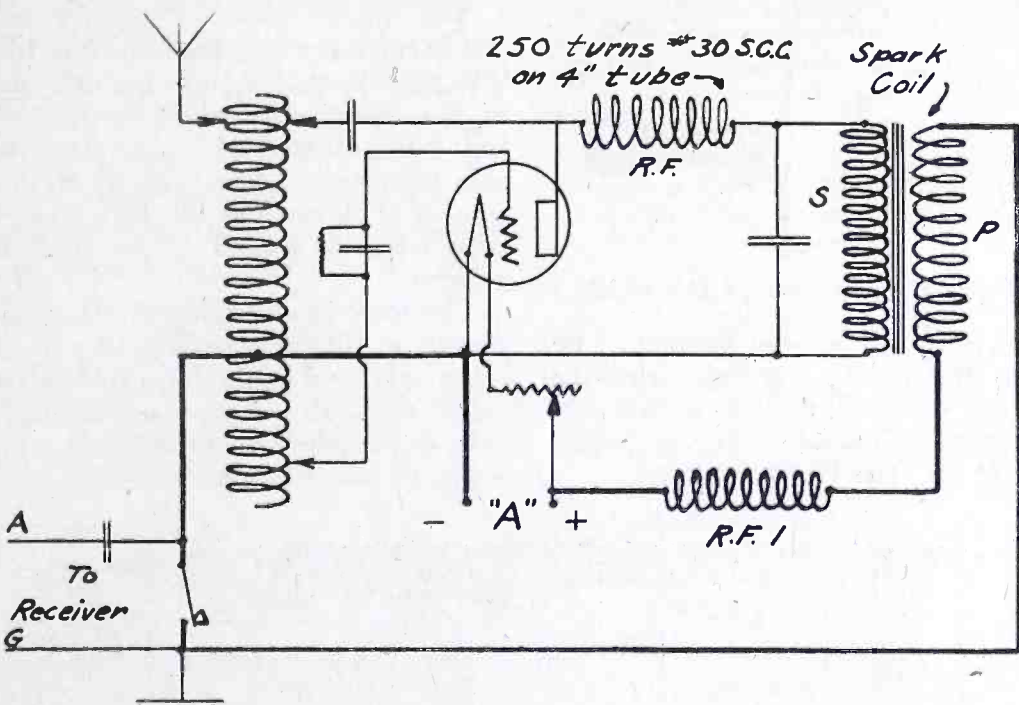


Fig. 1. Break-In System for Low-Powered Spark-Coil C. W. Set

powered sparks-coil C. W. set. The transmitter circuit is the usual Hartley, and for that reason does not attract your attention especially; but, placing the key where it is and connecting in the primary of the spark-coil in the manner shown along with the extra rf choke at RF_1 , produces a creditable and successful break-in.

The received signal chases its merry route down the antenna, through the helix, around the key through the re-

ceiver. So, you see, when the key is down the receiver is shorted and protected and when it is up you are receiving whatever is going on the air. In addition to everything else, you won't need an expensive antenna changeover switch, as the key does it all. In the spaces between the dots and dashes and between letters it is always possible for the fellow you are working to make a noise that you can hear, and thus avoid long repeats and delays. A well-

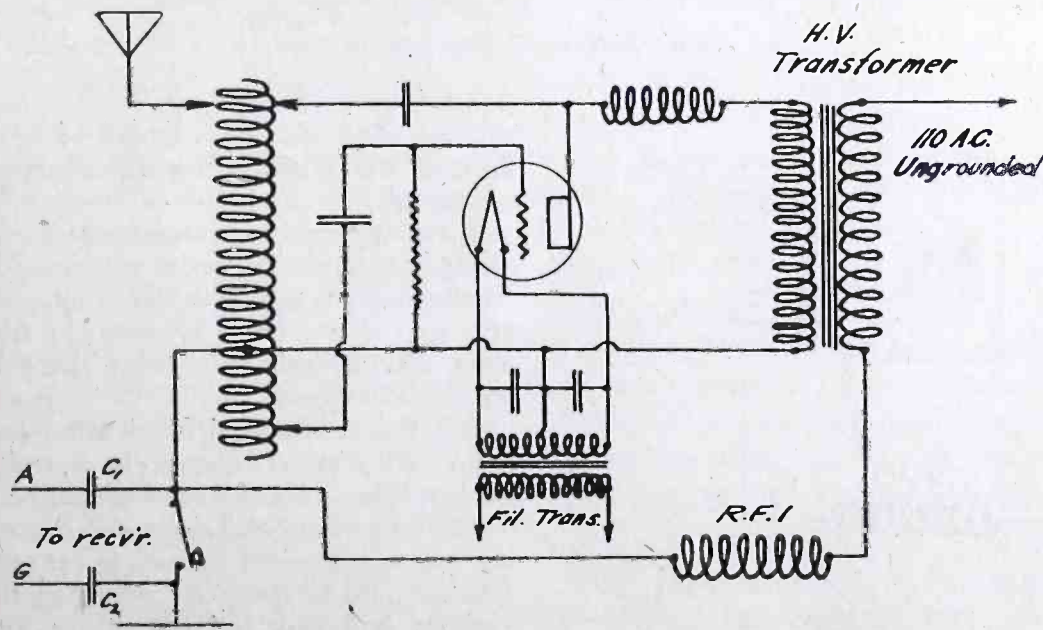


Fig. 2. Break-In System for A.C. Supply Transmitter

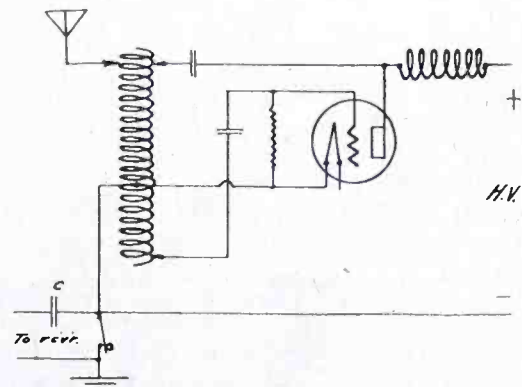


Fig. 3. Break-In System for Low Voltage Transmitter

Fig. 3 shows how the arrangement can be applied to any sort of low-power transmitter that doesn't use over about 250 volts on the plates of the vts: such as using B battery plate supply, low voltage d.c. generators, or small dynamos. This is particularly successful and gives a great deal of satisfaction. The condenser C is an .006 Freshman for the low voltages. A mica-insulated

condenser is always necessary at *C* and should be tested at somewhat over the plate voltage, so that you may be certain that it will not break down at an inconvenient time. A single-contact relay with a rather wide break can be used at *K* in place of the key and will permit of the use of higher voltages and powers.

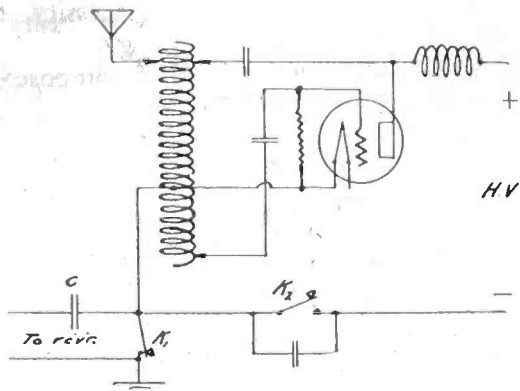


Fig. 4. Scheme for Higher Power

In Fig. 4 is shown the circuit necessary for the higher powers and it will handle quite a bit. The first necessity is a double-contact relay for *K*₁ and *K*₂. After you obtain it, it will be necessary to arrange it so that *K*₁ will close a little sooner and open a little later than *K*₂, as thus you will never put the load on your tubes and send the juice through your receiver. *K*₂ must be shunted by a rather heavy condenser, 1 or 2 mfd., so that no arc will occur across the contacts' points, and it must be set a little wide on the higher voltages. The condenser *C*, in this case, should be .002 and have a high voltage rating or else your receiver will not be adequately protected.

In Fig. 5 we have the solution for the high-powered set that utilizes a rectifier of any sort. Again the double-contact relay is employed and the directions for *K*₁ and *K*₂ are the same as in the foregoing paragraph. *C*, however, need not be such a high-powered condenser. It is also possible to insert *K*₂ at *X* instead of where it is inserted, in case you have a noisy rectifier of any sort and find it necessary to isolate it from possible connection with the receiver.

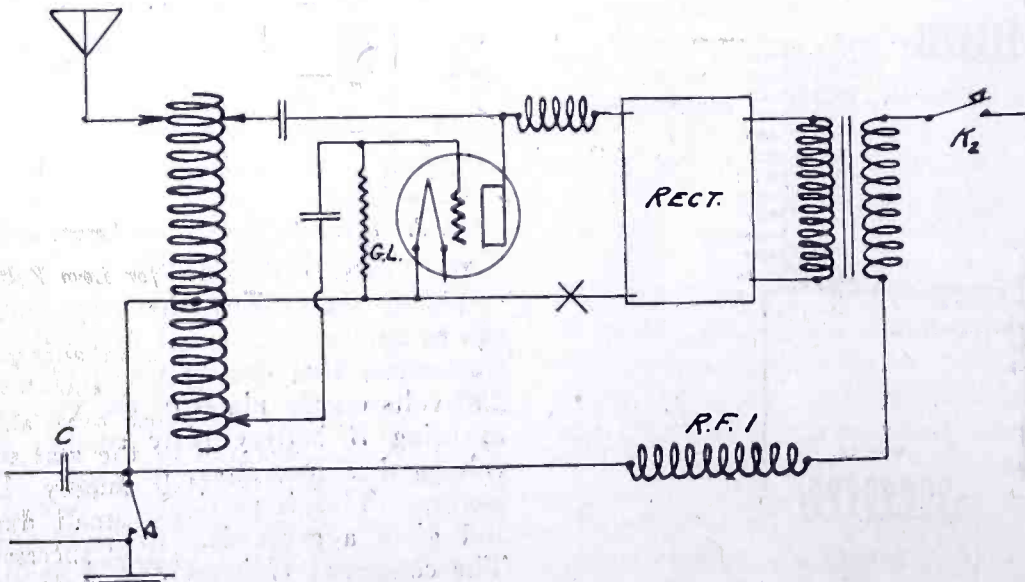


Fig. 5. System for High-Powered Set Using Rectifier

In finding the ungrounded side of the a.c. line, as is necessary in Figs. 2 and 5, the safest procedure is as follows: Procure a socket with a 110-volt lamp and a couple of clips. Clip one wire onto the ground after inserting the lamp in the socket, and clip the other clip to the 110-volt line; either side. If the lamp lights up, then you have the ungrounded side of the line; but be sure and test both sides. It should not light up on both sides of the line, but, if it does, you will have to ground one side

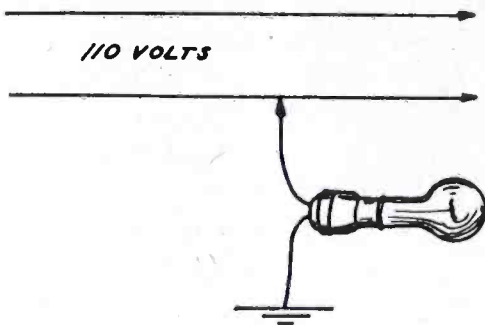


Fig. 6. Test for Ungrounded Side of Line

so that you can use the break-in. Be sure to ground the side that lights the lamp the least brilliantly if such a differentiation is possible. If not, either side will do. See Fig. 6.

A 50 to 200-METER DX RECEIVER

By F. L. ULRICH

The combination of an aerial in the primary circuit with a loop in series with the secondary, gives a receiving circuit that will oscillate as low as 50 meters. The loop is rotated until parallel with the transmitting antenna, so as to give the strongest signals.

Fig. 1 gives the antenna dimensions. The loop is 4 ft. square and is wound with 16 turns of No. 18 bell wire, and is equipped with a shaft and wheel so that it can be rotated.

The tuning coupler is made from a 3½ in. diameter bakelite tube 3 in. long. The primary winding consists of 2 turns of No. 16 wire placed ½ in. from the end, being shunted with a 43-plate variable condenser. The tickler winding consists of 30 turns of No. 20 c.c. copper wire which is wound ½ in. from the primary.

The secondary winding of the coupler consists of 30 turns of No. 18 c.c. copper wire wound in a wooden rotor placed inside the 3½ in. tube and fitting as close as possible without rubbing. This is placed in series with the loop and is

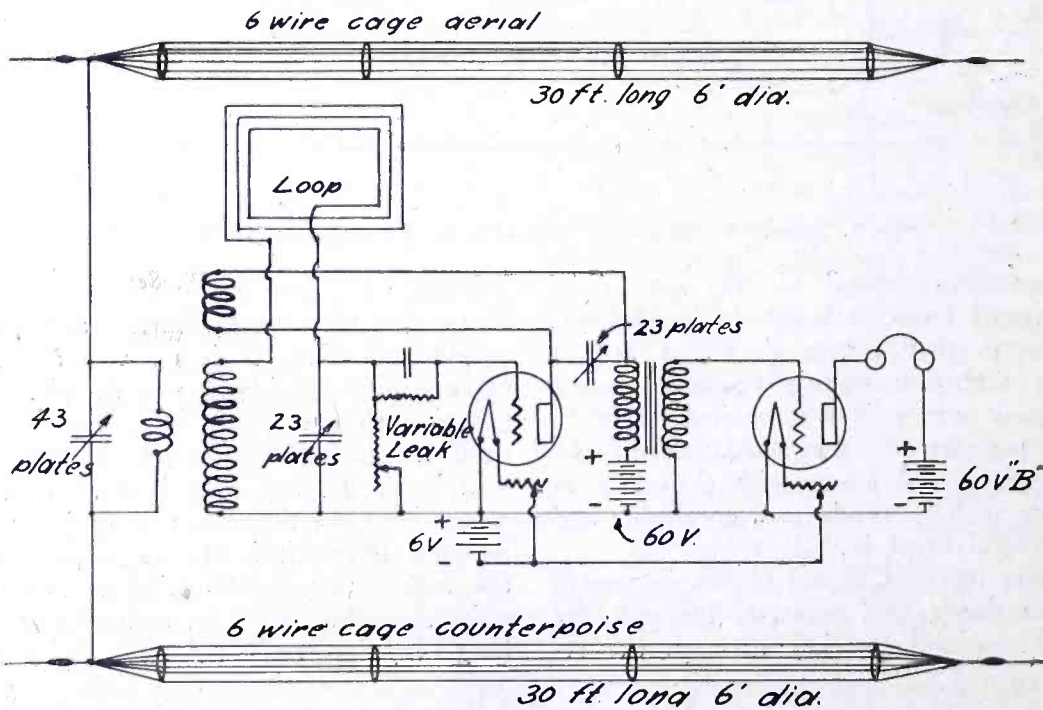


Fig. 1. Circuit Diagram for Short Wave Receiver

shunted by a 23-plate condenser. The rotating shaft is a 5 in. length of 3/16 in. brass tubing through which the leads are passed.

A variable grid leak consisting of a 1-megohm resistance in series with a semi-circular carbon against which a movable arm rubs is connected between the filament and the grid, this being the only critical adjustment.

A UV-200 was used for detector and a UV-201 with 60 volts on the plate for the amplifier. KDKA was often heard on 100 meters at San Diego, also numerous amateur stations operating between 100 and 200 meters. By adjusting the variable grid leak and the tickler con-

Continued on page 70

Improvements to Best's 45,000 Cycle Super-Heterodyne

DUE to the fact that letters containing suggestions for the improvement of the 45,000 cycle Super-Heterodyne described in the May issue of RADIO are still coming into this office in considerable quantity, final decision as to the best prize-winning suggestions over the entire period of six months will not be announced until the December issue. However, a number of worthwhile improvements to the circuit have been suggested during the month, and the judges of the contest have deemed it advis-

OCTOBER PRIZE WINNERS

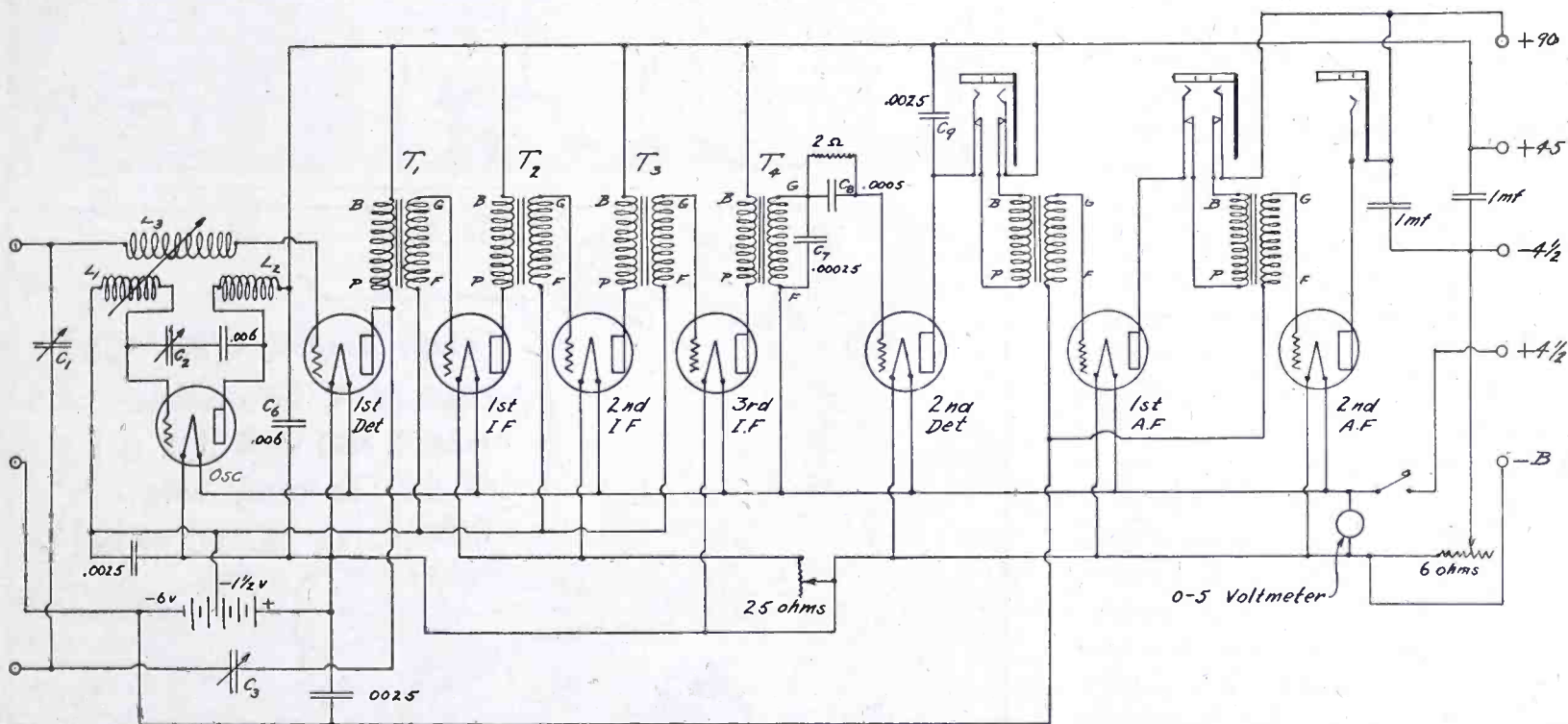
In Contest for Improving Best's Super-Heterodyne

1st prize—Chas T. Maloney, 36 Preston Street, Hartford, Conn. Protecting condenser in oscillator.

2nd prize—George Faulhaber, Portland, Maine. B Battery circuit change.

3rd prize—Robt. L. Park, 628 Montgomery Street, San Francisco, Calif. Changes in feedback condenser.

not have a straight line wavelength characteristic. This condenser would have to be cut out when the long waves are desired, and the .006 condenser substituted by means of a switch. It has been found that the Chelten Mid-get condenser, used as a feedback condenser from the plate of the first detector tube to the loop, has too many plates for most sets, and at the minimum setting of the condenser, with a well constructed loop made of heavy wire, the set would oscillate at the lower wavelengths. It has therefore been



able at the same time to revise the original circuit diagram, and incorporate the best improvements so far submitted, as well as several changes which the judges believe will improve the operation of the set.

The revised diagram is shown on this page, and should be used by anyone desiring to construct the set, in place of either the original diagram or subsequent ones, although any of the arrangements will give good results. The prize-winning suggestions this month were principally changes, the circuit apparently being satisfactory to most of those who have constructed the set. It will be noted that the first prize was awarded for suggesting the placing of a fixed condenser of .006 M. F. in series with the oscillator condenser.

Considerable trouble has been experienced with defective air condensers, the plates touching at certain points, causing the B battery to be short circuited through the filaments of the tubes, and thereby burning out all the tubes if the filament rheostat happened to be turned on. The fixed condenser will not affect the tuning of the oscillator coil, and in case the oscillator condenser plates should touch each other, there would be no B battery short circuit. A good grade of mica condenser should be used, such as the Dubilier Micadon. A condenser of .00025 might also be used, as was suggested, for spreading out the dial settings on the lower wavelengths, where they are usually very close together, with a condenser which does

suggested that two of the rotor plates be removed from the condenser, and more if necessary. It would also be desirable to mount this condenser on the panel, between the two air condensers, about an inch from the top, where ready adjustments can be made without having to lift up the lid of the cabinet. It is perfectly satisfactory to have the condenser inside the set, adjust it once and for all on some low wavelength station, and thereafter let it alone, but many people are very desirous of getting the greatest distance possible with their set, and of course the ease of adjustment of the condenser will be of importance. Another suggestion of merit concerns the connection of the negative B battery to the filament circuit. It has

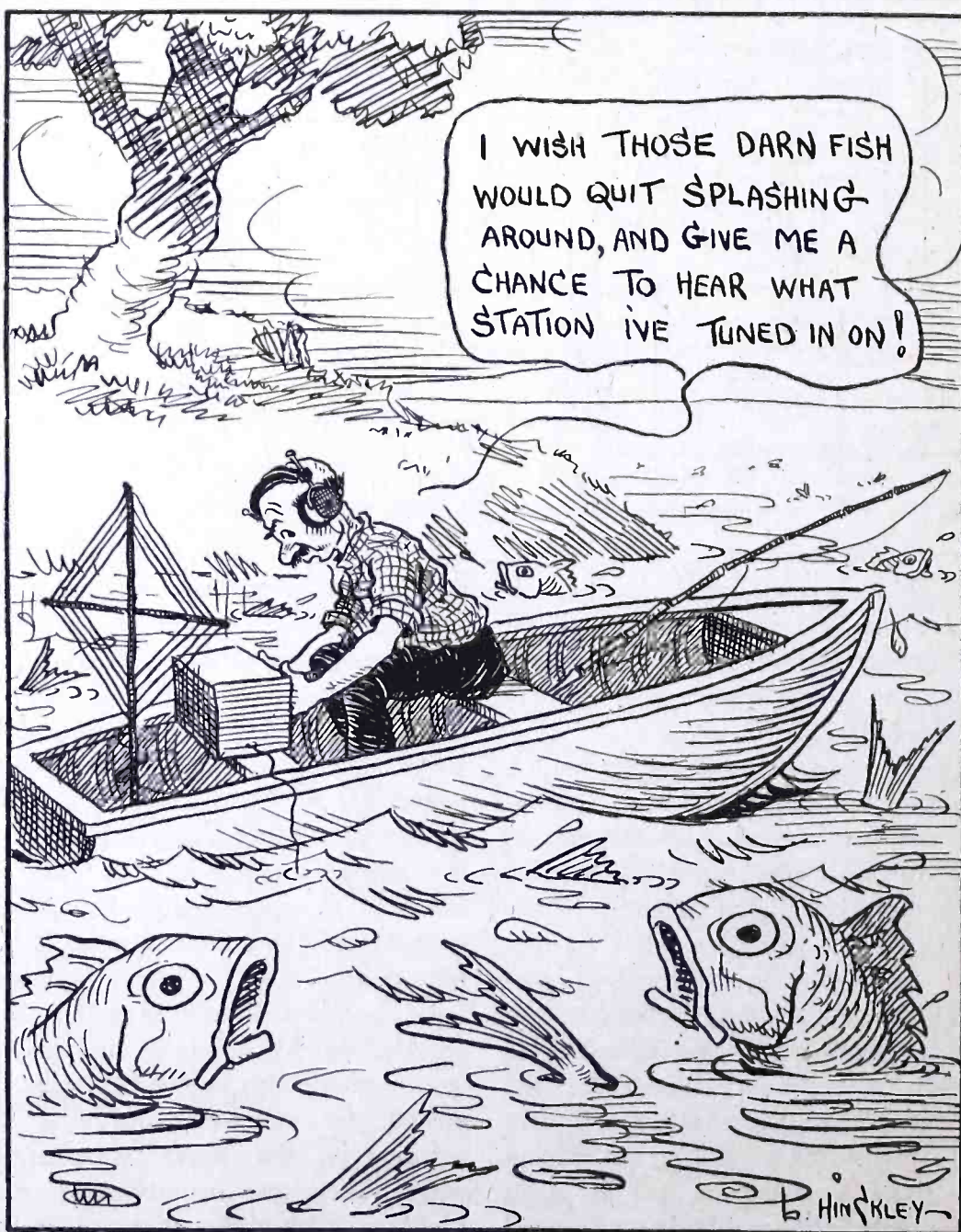
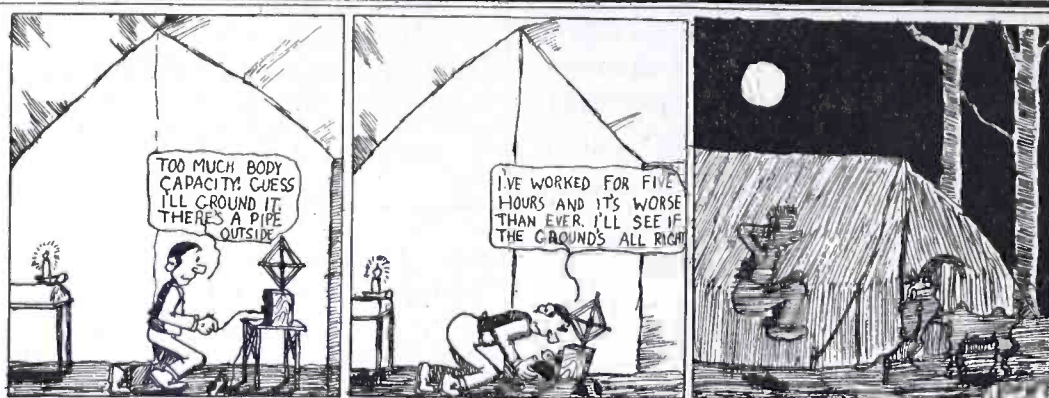
been the custom to connect the negative B return to the negative filament at the negative A battery binding post, and it is thought that providing a separate binding post for the negative B battery, connecting this binding post to a point between the main filament rheostat and the volume control rheostat will reduce the chance of burning out the tubes due to B battery being shorted in any part of the circuit.

It should be noted that the revised circuit uses a C battery. A considerable amount of trouble has been experienced by many experimenters who tried the suggestion in the August issue, where C potential was obtained by means of a biasing resistance in the B battery circuit. Most of the trouble has been caused by the use of resistances of incorrect value, wrong B battery, wrong tubes, and coupling between the resistance unit and the intermediate frequency amplifiers, due to close proximity. The resistance scheme will work if the directions are followed exactly, and the potentiometer kept away from the intermediate amplifiers, but it appears that the C battery is best understood by most people, and with improved batteries now obtainable, the cost of the batteries is immaterial as compared with other maintenance expenses. The manufacturers of the C-299 tube, in their data sheets, show a C potential of 6 volts, with 90 volts plate, obtained partly through a $4\frac{1}{2}$ volt C battery, and a $1\frac{1}{2}$ volt drop through the filament rheostat. This condition is true only when the A battery is $4\frac{1}{2}$ volts and in new condition, but is assumed to be the correct C potential for the UV-199 or C-299 tube with 90 volts plate. Hence, a 6 volt C battery is provided in place of the $4\frac{1}{2}$ volt battery, in order that a greater volume output from the audio frequency stages may be obtained. It has also been found that better quality results if the C battery on the 1st detector is increased to six volts, so that the same battery may be used for both purposes. The Burgess Company have recently introduced a new C battery of $7\frac{1}{2}$ volts, code number 5540, price 85 cents. The battery is particularly suitable in this circuit, as it has taps every $1\frac{1}{2}$ volts, enabling the user to obtain potentials of $1\frac{1}{2}$ for the radio frequency amplifier tubes, and 6 volts for the 1st detector and audio frequency stages.

Many have suggested substituting a variable condenser of some sort in place of the fixed condenser of .00025 Mfds. shunted across the secondary of the tuned stage. If the fixed condenser is within 5% of the correct value, no variable condenser is necessary, as we are informed by the manufacturer that the factory output is being very closely checked to insure uniformity of resonance with the standard capacity of .00025 Mfds. A check which was made on a number of condensers of various makes, all rated at .00025 Mfds. showed that 75% of them were at least 10% off, and some were as low as .0001

or as high as .0005 Mfds. If care is taken to buy a condenser which is guaranteed to be the correct capacity, no trouble with the tuned stage should be experienced, and it is only where such a condenser is unobtainable that the variable condenser should be resorted to.

Springs from old roller shade rollers make very good resistance units for anyone who wishes to charge storage batteries from 110 volts D. C. About five or six of such springs, stretched out so they will not touch between turns all in series will be about right for charging the average 3-cell A battery.





QUERIES *and* REPLIES



Questions submitted for answer in this department should be typewritten or in ink, written on one side of the paper. All answers of general interest will be published. Readers are invited to use this service without charge, except that 25c per question should be forwarded when personal answer by mail is wanted.

Please give diagram for using either a loop or outside antenna in connection with set described by Brainard Foote in August RADIO. I would like to be able to plug the loop into an ordinary jack, when desired.

N. F. G., Arcata, Calif.

A diagram showing the connections for a loop is shown in Fig. 1. It is not desirable to use a jack in a radio frequency circuit, due to the capacity of the springs of the jack, in shunt with the loop. It would be better to use an anti-capacity key such as is shown in the sketch.

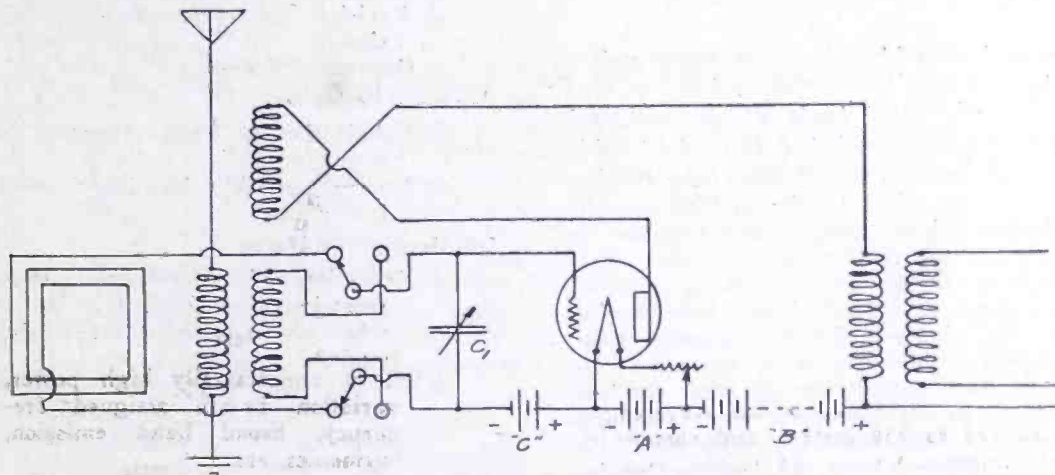


Fig. 1

connected in series with the grid leak, and is used to modulate the output of the oscillator tube to a limited extent. The percentage of modulation by this method is considerably below that of other well known systems, such as the Heising, and consequently is not often used in commercial practise, although it is a good method where only one vacuum tube is to be employed. Grid leak modulation in another sense is often used in amateur continuous wave telegraphy, where the output of the oscillator tube is interrupted to form dots and dashes, by opening and closing the grid leak with a telegraph key.

The voltmeter should be bridged across the points "A-B," and the voltage maintained at 5 volts, when the entire set is operated from a six volt source. The fixed resistances should be capable of adjustment, and the easiest method of adjustment is to place a voltmeter across the filament of one of the 3 volt tubes, varying the resistances until the voltage across the filament of the tube is exactly 3 volts. This measurement must be made with the filaments of all 3 and 5 volt tubes lighted, in order for the resistance setting to be of the correct value.

Shunting a condenser across the tune circuit terminals no doubt changed the frequency to which the intermediate amplifier was tuned, and since the original setting of the oscillator condenser for the particular station you were receiving was not at the critical point for resonance, a better position may have been found when the condenser was placed across the transformer and the intermediate frequency changed.

I would like to build a two-stage radio frequency amplifier to go ahead of my one tube reflex receiver. How can this be done without changing the connections on the reflex set, which is of the Harkness type?

—T. D. L., Toledo, Ohio.

The amplifier shown schematically in Fig. 3 will operate ahead of a single tube reflex receiver, provided that it is shielded from the reflex set. It would be wise to line the inside of the amplifier cabinet with sheet brass or

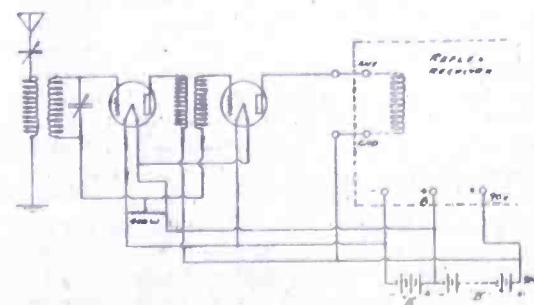


Fig. 3

What is the maximum allowable length of an antenna, in order to be able to transmit on a wavelength of 150 meters, as well as 100 meters?—H. N. W., Los Molinos, Calif.

Not over 90 feet, including the lead-in and ground lead.

In the 45,000 cycle Super-Heterodyne published in May RADIO, a condenser of .006 M. F. is shown in parallel with a 1 M. F. condenser. Is the former necessary and why?

—M. V. B., Jacksonville, Fla.

This condenser is in parallel with the 1 M. F. condenser across the 45 volt B battery, to be sure, but is intended to provide the oscillator plate with a low resistance path to the filament without passing through long leads to the 1 M. F. condenser, which is intended to protect the audio frequency circuit. If the oscillator plate return is forced to pass through several feet of wire, trouble from broad tuning results, which trouble is eliminated by the use of the .006 M. F. fixed condenser.

What is meant by "grid leak modulation," and who was the inventor of the system?

H. R. C., Ganonoque, Ont.

The "grid leak modulation system" was developed by Logwood, and is essentially a means of controlling the output of an oscillator by controlling the grid current. A microphone, through a suitable transformer, is con-

Kindly show how C-301-A tubes may be used in the audio frequency stages of a super-heterodyne employing dry cell tubes. Why is the volume increased approximately 50% by shunting a condenser between the plate lead of the tuned stage transformer and the positive B battery, in "Best's 45,000 cycle Super-Heterodyne."—H. J., Azusa, Calif.

In Fig. 2, the filament connections for six dry cell tubes requiring 3 volts at the filaments and two C-301-A tubes requiring 5 volts at the filament are shown, with the proper resistances in the three volt circuit.

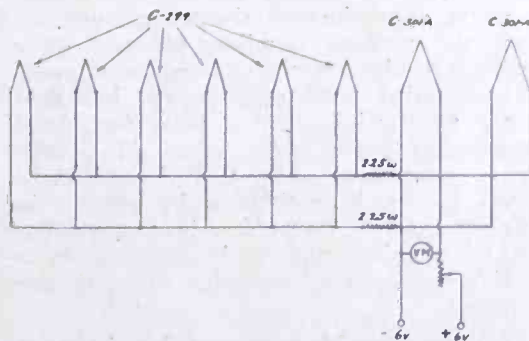


Fig. 2

If two separate sets of batteries are to be used, the negative leads of the two batteries can be tied together, to the negative B battery lead.

copper, grounding the shield, so that coupling between various parts of the circuit will not take place. The amplifier will add two extra controls to your tuning, but will provide good selectivity while receiving both local and long distance stations.

In a C. W. transmitter diagram recently shown in your columns, the filament rheostat for controlling the filament current of the two 5 watt tubes was shown in the primary circuit of the filament heating transformer. What kind of a rheostat should be used, and why should it be placed in the primary circuit?—E. B. K., Pueblo, Colo.

If the filament rheostat is placed in the secondary lead of the transformer, the filament circuit will be unbalanced unless the

rheostat can be divided in half, with exactly half of the resistance in each side. It is simpler to control the power input to the primary. If two 5 watt tubes drawing 2.5 amperes each, at 8 volts, are used, the power drain from the primary will be something over 40 watts, depending upon the efficiency of the transformer. Two 25 ohm receiving type filament rheostats, in parallel, will provide the necessary adjustment, and will carry the power without undue heating. If 50 watt tubes are to be used, the rheostat will have to be able to carry at least 1 ampere, so that the 6 ohm size will be needed.

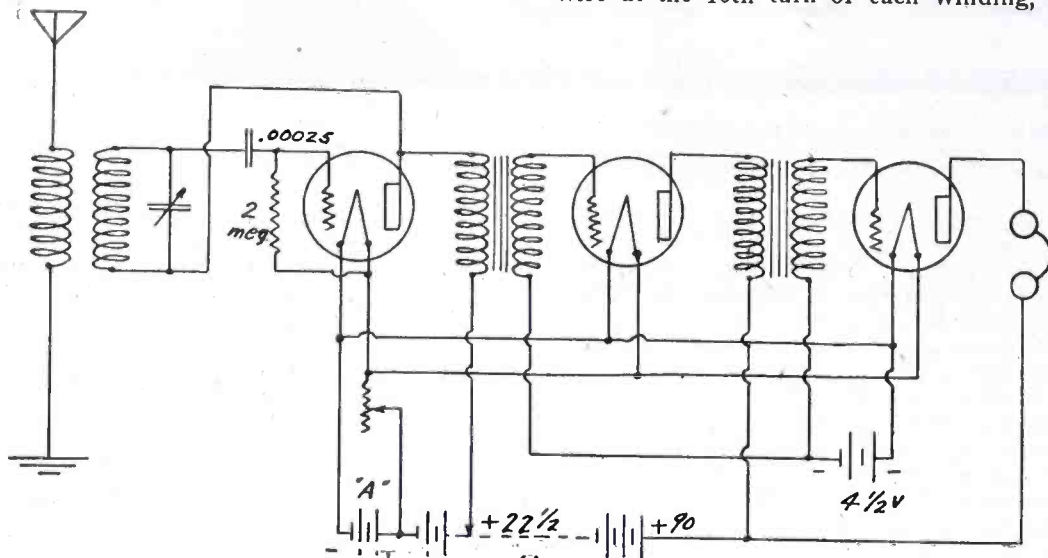


Fig. 4

Please publish the best hook-up to use in providing an audio frequency amplifier for the "Ultra-Audion" circuit shown on page 38 of August RADIO.—F. O. C., Hastings, Nebr.

A diagram giving the correct data for adding a two stage amplifier to a detector using the Ultra-Audion system is shown in Fig. 4. This sketch differs somewhat from the original, in that a grid leak of 2 megohms is shown, connected between the grid and the positive side of the filament.

What sort of a filter can I place in the antenna circuit of my receiver to cut out noise from a violet ray machine being operated in the same building with my set?—F. E. E., Youngstown, Ohio.

If the violet ray machine is very close to you, some of the interference might be coming into the set directly through the wiring. If your set is not shielded, this would be particularly true, and the best means of reducing the interference would be to thoroughly shield the inside of the box or cabinet in which your set is housed, with some sort of sheet metal, such as brass, copper or aluminum, connecting the shield to the ground. We know of no filter which will absolutely cut out interference coming in through the antenna-ground circuit. Some devices have proven of help in some cases, but often the interference comes in on the same identical wave with the station desired, and if the interference is filtered out by any means, the filter will also cut out the broadcasting station.

What are the best dimensions for a loop antenna, for receiving the very short waves, from 75 to 200 meters, for use in connection with a tuned radio frequency receiver?—J. R. P., Savanna, Ill.

The loop should be not more than 20 inches square, or if rectangular in shape, should not have an area of more than 400 square inches, for the specified number of turns. Five turns of wire, if the loop condenser is .0005 M. F. capacity, will enable you to tune low enough for all practical purposes. The wire may be any convenient form of stranded wire, common lamp cord being as good as anything on the market.

How can I adapt my Best's 45,000-cycle super-heterodyne for the very short waves?

This is best accomplished as follows:

The oscillator-coupler stator has two windings of 35 turns each. In order to cover a wavelength range of 75 to 250 meters, only 10 turns of each stator winding is needed, so a tap can be taken out ten turns each side of the midpoint of the coupler for the lower wavelength band. The insulation should be carefully scraped from the wire at the 10th turn of each winding, and

an extra lead soldered on. A small switch can be mounted inside the cabinet, so that the grid and plate leads of the oscillator tube can be easily switched from the outside ends of the coil to the 10-turn taps, making a total of 20 turns in the oscillator. The feed-back condenser can be used to make the 1st detector tube oscillate, and it will probably be necessary to use a one-plate condenser with a large dial, to facilitate heterodyning the C. W. signals. For the antenna tuner, the circuit is identical with that shown on page 34, July RADIO, except that the load coil should be 25 turns, for the wavelength range of 175 to 250 meters, and should be omitted altogether below 175 meters, leaving the 20-turn rotor and antenna series condenser in the antenna circuit. The stator should be used for the secondary coil, and should be tapped at the 10th turn of each winding in the same manner that the oscillator coil in the set was tapped. This will make the settings for the secondary and oscillator condensers fairly close together for a given wave, and will facilitate tuning. The tuner should be mounted on a small panel of the same height as the super-heterodyne panel, and it would be advisable to shield the back of the panel with sheet copper or brass, as well as the inside of the cabinet in which the tuner is mounted. This shield should be grounded.

In tuning, the oscillator condenser should be set at approximately the wavelength desired, the antenna coupling adjusted quite loosely, and the antenna and secondary condensers varied until resonance is indicated by the usual slight hissing noise and static disturbances which occur when all circuits are in resonance. The first detector tube should be set in oscillation by cutting in sufficient capacity in the feed-back condenser, and the C. W. stations heterodyned to a suitable audio-frequency with the oscillator condenser.

Can the new Magnavox tubes be used in the same circuits with UV-201A or similar tubes?—G. C. C., Carbondale, Pa.

Yes, in the same circuit with any six-volt tube.

SUBJECTS SUGGESTED FOR CONSIDERATION BY THIRD NATIONAL RADIO CONFERENCE

1. General Allocation of Frequency or Wavelength Bands.
 - a. Marine.
 - b. Broadcasting.
 - c. Aircraft.
 - d. Amateur.
 - e. Government, including Army, Navy, Post Office, Coast Guard, Lighthouse Service, etc.
 - f. Point-to-point.
 - g. Schools and experimental.
2. Allocation of Frequencies or Wavelengths to Broadcasting Stations.
 - a. Allocation to classes of stations.
 - b. Zoning.
3. General Problems of Radio Broadcasting.
 - a. Power requirements and limitations.
 - b. Revision of class requirements.
 - c. Operators' licenses.
 - d. Improvement of Programs.
4. Problems of Marine Communication.
 - a. Frequency or wavelength allocations to individual shore stations or groups of ships.
 - b. Types of waves or emissions permitted for various marine services.
 - c. Position or "TR" reports.
 - d. Revision of abbreviations "Q" signals.
 - e. Operators' licenses.
5. Amateur Problems.
 - a. Subdivision of band allocated for amateur use.
 - b. International identification of amateur calls.
6. Interference Problems.
 - a. Reduction of interference with radio reception from electrical devices other than radio transmitting stations.
 - b. Use of unnecessarily high power, variation from assigned frequency, broad band emission, harmonics, etc.
7. Interconnection.
 - a. Wire.
 - b. Radio.

MANANA

By C. V. BARTON

There is a busy man
Lives in a busy town;
He builds his radio up
And then he tears it down.

Now he has bought the parts
To make a super set;
He plays with them each night,
But hasn't built it yet.

He juggles all the parts,
His family sits around
Expectantly the while,
But hasn't heard a sound.

Transformers, sockets, tubes,
Condensers, knobs, and wire—
But where the music is,
One ceases to enquire.

This set is like the rest,
As any one can see—
It isn't working yet—
It's always going to be.

LETTERS TO THE EDITOR

Improving R. F. Selectivity

Sir: Since the appearance of my article, "Radio-Frequency With Single-Circuit Regenerative Receivers," in the September issue, I have received numerous requests for information as to increasing the selectivity of the circuit used. Those who are using loops or very short antennae are getting excellent results, but when the conventional size antenna formerly used on the regenerative set is connected, the selectivity is not quite satisfactory.

In this regard the following procedure is recommended, whereby any sized antenna can be used, and without any additional apparatus. A tap is taken off the honeycomb coil at the tenth turn from the ground connection and connected to the antennae, giving an untuned open circuit, the condenser C_2 being placed around the complete coil for tuning of the r. f. step. This gives a primary of ten turns direct coupled to a tune secondary of 50 turns, with no appreciable decrease in sensitiveness, and with no additional controls. The selectivity will be excellent.

For those who desire further improvements, and greater sensitiveness, a variocoupler, with tuned or semi-tuned primary, and a secondary of 75 turns shunted by a .0005-mfd. condenser is very good, at, of course, the expense of more controls. Very loose coupling must be used to obtain the maximum radio-frequency amplification.

626 Homer,
Palo Alto, Calif.

E. E. GRIFFIN

Program Pointers and Questions

Sir: Having broadcast talks from several New England radio stations, I have noted several points which might be of some interest to radio fans in general. Some stations review in detail the next day's program, when they sign off on the previous evening. Others have data for announcers written down exactly, so that everything goes off smoothly. Other stations take care to identify all artists and speakers, instead of merely giving their names. Most of the stations find that dignified and business-like announcements are better than alleged humorous skits.

Not all, however, succeed in eliminating a very amusing error: they permit innocent announcers to attempt to articulate titles and names meant for pronunciation by foreign tongues, exclusively.

It is also surprising that, in spite of all the bedtime stories (which are almost always listened to by a large number of unabashed adults), no special radio features are provided for young radio listeners-in, chiefly between the ages of 15 and 25. These young people constitute a very large section of the radio audience.

After a little investigation, I am also surprised by the fact that so many radio dealers in expensive ready-to-operate sets (who wonder why so many "build their own") succeed in selling a set to a customer ignorant of radio technique, and then refusing in every way to offer even suggestions. Now, the public in general is not going to keep on spending good money for a complex mechanism which is likely to remain idle for want of skill in operation.

The public, on the other hand, should be sceptical of many bargain sets. Value of sets is not wholly determined by the number of tubes it uses. I paid a rather high price for a one-tube set, but the results I get show that I was, after all, wise. Poor tuning is hindering many distance records. Good tuning means moving dials tenths of inches, instead of wobbling them back and forth by inches.

Radio fans should understand better the conditions under which the broadcasting artists work. They are in a hot, stuffy atmosphere, in an echoless padded room feeling

like a tomb, and in a silence as awesome as that at a funeral. They are nervous, being carefully watched, and frantically trying to remember many bits of advice.

As a radio speaker, I should like to know, through this magazine, if talks are really desired—and, if so, what kinds, and when. Slovenly enunciation, and voices with thin, weak volume or with stentorian bellowings, may partly account for some lack of interest in talks. No one likes to hear a sanctified monotone or a staccato, excited voice. Erratic reading, rapid delivery, and mumbling also contribute to the radio fan's disgust for talks.

Do you think that artists should ask for cards on their program? This seems to me an indirect compliment to oneself. Do you like programs secured by remote control? Do you favor giving artists frequent broadcasting dates, even though these artists may not be well known? Radio fans should remember that the artists, instead of broadcasting, might at that moment be earning money on lecture platform, stage, or concert floor.

I do not believe in allowing visitors or even waiting artists to be near the artist who is actually broadcasting. Disturbance is very likely to be caused by these people in the studio, and they make broadcasting much more nerve-wrecking.

I think that for concert pieces, announcements should include the name of the composers.

I think that some attempt should be made to balance programs. What can a lecturer do, if he goes on the air after an hour of light jazz?

Here is a point about ear-phones. They are necessary, but should be used wisely. A doctor has advised me that, for some people, they have caused, instead of relieved, deafness. After wearing them quite a while steady, you will note that you cannot for a moment hear very well. You will also note drops of moisture on the diaphragms, and you will feel the presence in your ears of an increased amount of larger moist ear-wax. Ear-phones, I repeat, are necessary and valuable, but use them wisely.

I wish also to remind radio fans that those stations using 100 watts, or less, have a larger following than is commonly supposed.

In sending cards to radio stations, the listener-in should mention *specific details*, if he wishes the card to be forwarded. Artist's name, title of his selection, and genuine criticism and constructive comment should be the policy, instead of flattering banalities.

In view of the importance of the above-mentioned points, I should like to know the opinions of fellow radio fans and especially of fellow radio speakers and broadcasting artists.

49 M. Street,
South Boston, Mass.

RICHARD K. MORTON.

Modesto Convention

Sir: I have a letter from the Modesto Radio Club with reference to the Convention, in which I am asked to notify you, for use in your mention of that affair, that the Modesto Hotel will be the Official League Headquarters. The charges will be:

Two in room, without bath....	\$2.50
Three in room, without bath....	3.50
Two in room, with bath.....	3.50
Three in room, with bath.....	5.00
Cots	1.00

The hotel lounge and the dining room will be turned over to the Convention, for its use. It is expected that the banquet charge will be not more than \$1.50. The tables will be arranged to seat four, so that it will be possible for couples to dine together should this be desired by those members who bring their wives.

The general program as laid down is:

First day, Friday, Nov. 7—Registration and general greetings up to 2 p.m., when the traffic meeting will be called. At 8 p.m. the evening meeting will be called to order, with talks by K. B. Warner, Secretary of the League; A. A. Hebert, Treasurer, both of whom are coming from Hartford for this meeting; followed by M. E. McCreery, Division Manager, and Colonel Dillon. All of these will talk on matters of general interest; those from Hartford chiefly with respect to the relations between the general headquarters and the districts; McCreery, with reference to his work as Manager. Colonel Dillon will discuss matters of general interest. I will preside as Pacific Division Director. Adjournment at or near 11 p.m. for the Royal Order of the Wouff-Hong initiation.

Saturday, Nov. 8—9 a.m., competitive tests for which two valuable cups have been given by a member of the Southern California Club, who wishes his name withheld.

Mr. Halloran took with him, I think, for the meeting at this office, notes on those who will give the papers at the technical session beginning at 1:30 p.m. Saturday, in which short-wave work will be discussed.

At 8 p.m. will be the banquet, followed by a hamfest that probably will last all night, after the usual fashion.

Very truly yours,
San Francisco. A. H. BABCOCK.

Resistance Coupling

Sir: Will you permit the writer, as one who has devoted considerable time and experimentation to the possibilities of resistance-coupled amplification, to take exception to remarks made by you in regard to the disadvantages of resistance-coupled amplification in your "Radiatorial Comment" in the July, 1924, issue of your excellent magazine?

I refer specifically to the following: "The added tubes and inserted high resistances that are necessary to give the amplification otherwise obtainable with transformers causes a tremendous drain on the batteries supplying plate potential. So that it is not only necessary to have more batteries to supply a higher voltage, but also necessary to renew the dead batteries oftener."

In the first place, the "drain" is generally taken as referring to current consumption. The extra *B* battery to which you refer is merely added until the unusual drop across the adventitious resistance is compensated for, at which point, as far as the tube is concerned, is being operated at the normal plate potential and drawing normal current. Then, it is quite evident that there is no unusual drain upon the *B* battery, necessitating its renewal at intervals more frequent than would be necessary for the transformer-coupled amplification.

I grant you that the purchase of an extra 45-volt *B* battery would be desirable (though not necessary). However, here enters another consideration, namely that when resistance-coupled amplification is functioning, *i.e.*, amplifying an impressed signal, the plate current modulates down, dropping to a fraction of its quiescent value. The signal impressed on the succeeding grids has the effect of a negative bias being applied at audio-frequencies. This greatly lessens the plate current consumption, increasing the life of the *B* battery, with the result that, even considering the extra potential and its added expense, the experimenter breaks about even as far as the maintenance of resistance-coupled amplification is concerned.

We would appreciate it should you find it politic to publish this letter or excerpts from it, thus remedying a false impression that you may have given to some of your readers.

Sincerely yours,
New York. ZEH BOUCK, Engineer.

WITH THE AMATEUR OPERATORS

A SUCCESSFUL LOOSE-COUPLED TRANSMITTING CIRCUIT

By F. BOWMAN, 6BUH

This transmitting circuit works so well that I am passing it on to the rest of the gang. The plate power is of the chemically "rectified" variety at 500 volts. 88 mills flow when two "5-watt" tubes are used at slightly

inductance in L_o and the part of L_p below the clip C should be electrically equal.

L_a is coupled rather closely to L_o and is variable. The coupling between the antenna circuit and the closed circuit is variable by the amount of inductance in L_a . The antenna tuning is done with the condenser V_2 . These two coils can be built like a Tesla coil, with strips of hard rubber or bakelite about an inch wide separating the windings, L_o being on

length within the tuning range of the two condensers, V_1 and V_2 , without changing any adjustment except the grid coupling. The short waves seem to be the best with this circuit, but the antenna coupling should be looser and the voltages are higher on V_1 .

This circuit has the following advantages, all of which may be had in other circuits, but which combine in this one:

1. Quick easy wave change without loss of efficiency.
2. Lack of signal swinging due to aerial swaying, as the closed circuit has a very marked stabilizing effect on the frequency.
3. No loss from antenna due to voltage node not at filament tap. (This, I believe, is the greatest loss of power in the amateur's transmitter. Ground the filament tap through a r.f. ammeter and watch your antenna current go down. The ammeter in the ground lead tells the story.)
4. Does not transmit key clicks and thumps strongly.
5. Easy on the tubes.
6. Emits a sharp wave comparatively free from harmonics. (Did you ever get out better with a little less antenna current than when adjusted differently to show more? Energy radiated as a harmonic is a dead loss as far as the working wave is concerned.)
7. Damage to antenna removes load from tubes.

It is very much to the interest of the amateur to consider these points in respect to his present transmitter, as it is for the general good to cause as little interference as possible, and, what seems to be most important to him, to get out as far as possible with a given tube rating, which simply means to put the energy into the ether via the antenna and not waste it in the house wiring or in burning holes in the plates.

Fig. 2 is an arrangement for loose coupling a Hartley circuit after this fashion. The original apparatus need not be altered, only the new part added. The same is true of the "reversed feed-back" circuit in Fig. 1, which is simply a variety of Fig. 2.

It will take a little more time to balance this circuit up than a conductively-coupled transmitter, but isn't that the fun O M?

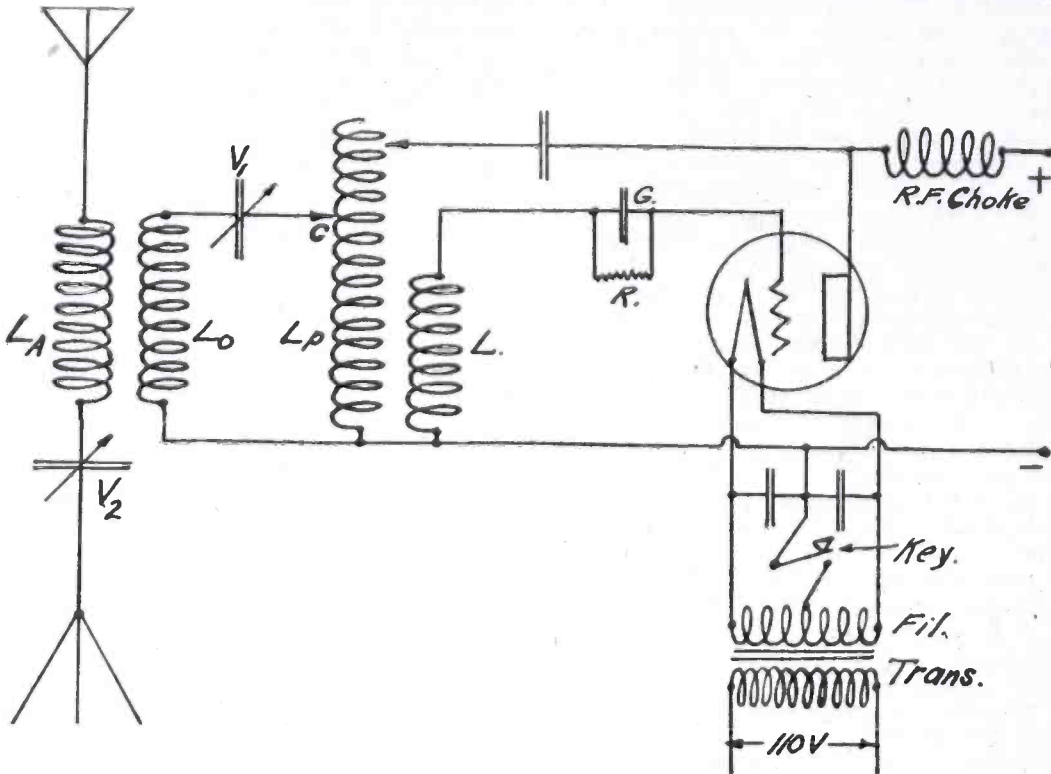


Fig. 1. Loose-Coupled Reversed Feed-back Circuit

below normal filament temperature. The power input is therefore 44 watts and the antenna current is 2.1 amperes. The antenna is a cage 60 ft. high, of about average resistance for an amateur aerial. This will give you an idea of the efficiency of conversion of the circuit.

The grid circuit G, L, R , Fig. 1, is of the conventional variety, except that the grid leak is of about 15,000 ohms resistance, and at this value the plates do not reach even a dull red heat when operated at the above power.

The filament is a.c. lighted and $\frac{1}{2}$ -mfd. condensers across each half of the winding are used to protect the filament transformer.

The plate-output circuit is different from the common amateur practice. The plate inductance L_p is the regular inductance used before loose coupling and is of No. 6 bare aluminum wire spaced $\frac{1}{4}$ in. and is 4 in. diameter with 25 turns. The output inductance L_o is the same size, etc., except with 8 turns. The condenser V_1 is variable and must be good. The one used here stands 5000 volts, but greater insulation than this is desirable, as a flashover will sometimes occur if only insulated for 5000 volts. The capacity should be in the neighborhood of .001 mfd. maximum; not smaller.

This condenser is connected as shown, and herein lies the hunch. This oscillating circuit is so proportioned that the zero voltage node is at the filament connection, and so there is much less tendency for the radio-frequency current to flow into the filament transformer and wiring, and the circuit acts in a push-and-pull manner, delivering its energy to the antenna and receiving it from the plate circuit at opposite half cycles in the sense that, as L_p is in the negative swing, L_o is in the positive; then vice versa and repeat. The the inside and L_a on the outside to facilitate changing the inductance in L_a .

When tuning the antenna to the closed circuit, L_o, V_1, L_p , it is necessary to not get the antenna exactly on the closed circuit wave, as instability will result. The best point is just before this condition is reached. Here radiation will be greatest with stability of operation. If this unstable band is too broad, the coupling is too close, or the grid coupling is too loose.

When the proper inductance values have been found, the wave can be changed to any

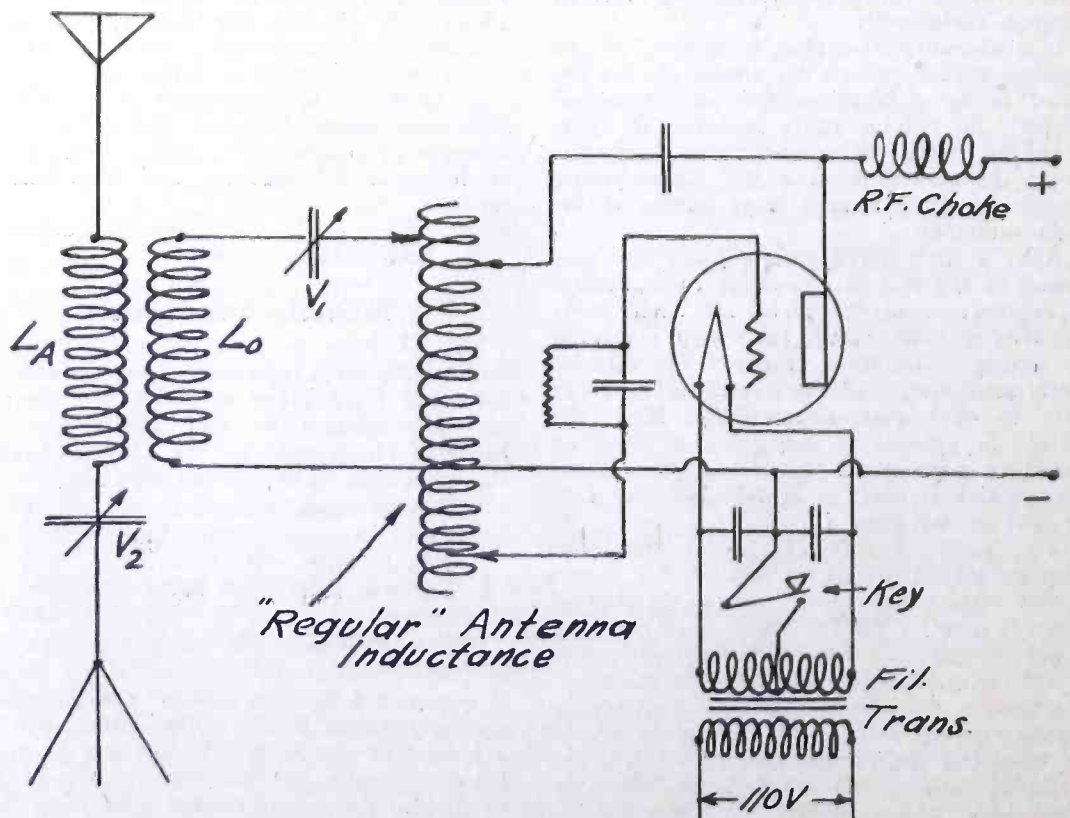


Fig. 2. Loose-Coupled Hartley Circuit

NEWS OF AMATEUR OPERATORS

9AMX has been assigned to Roy G. Walters, 713 Mound St., and 9CVL to M. L. Johnson, 938 S. 4th St., both of Atchison, Kansas.

6AFX, Richard Mortimer, has moved from 334 45th St. to 3782 Howe St., Oakland, Calif.

The call letters 600 have been re-assigned to the Pacific Radio School, 433 Call Building, San Francisco.

Qra of 9RT is now J. G. Smith, 325 East Parkway, Columbia, Missouri.

Call 8NT has been assigned to Stuart W. Farmer, 233 West Ferry Street, Buffalo, N. Y. Any reports of 8NT's signals will be appreciated and promptly acknowledged. This station was formerly licensed as 8AOX and 8BQN. A 20-watt transmitter is used, employing the 1DH circuit with 1000 volts at 250 mills on the plates. For receiving a type 1BGF tuner with one step of AF is used.

William J. Riley, operator in charge of 6RY in San Francisco, was recently elected president of the San Francisco Radio Club, Inc. R. K. Francis is the new secretary. C. Schomaker was elected sgt. at arms.

The call 6RP has been assigned to the RADIO PIONEERS of San Francisco. The equipment of 6RY is used by members of the organization.

3AD, Baltimore, Md., and 6RY, San Francisco, were in communication recently on 150 meters. This record was established with a 10-watt C. W. transmitter.

9CEC, Delbert R. Bartsch, 228 N. Main St., Galena, Ill. 50 watts, C. W. and fone. All crds answered.

Those who have been actively engaged in the radio art since and prior to 1913 are eligible to membership in the RADIO PIONEERS. The secretary, L. B. Loomis, 1380 Bush St. San Francisco, will be glad to hear from prospective members. Meetings are held every Tuesday evening.

Lawrence Mott, 6XAD, reports that he has communicated with 6CEU in Honolulu. Thus a new record is established, because Mott has, until the present time, been unable to carry on two-way communication with the Islands.

7FD of Seattle has been transmitting on 78 meters and works almost anywhere in the country with ease. 76P has been using the waves around 40 meters and finds them exceedingly efficient.

The amateurs are deeply interested in the radio conference called by Secretary Hoover. It is hoped that an adequate band of short waves will be made available for the development and expansion of amateur radio. It is expected that educational institutions of the country will be represented at the conference by Professor Cyril M. Jansky of the University of Minnesota.

7AV and 76V are two of the busiest stations in Portland.

7LR has returned from Alaska, where he served as commercial operator during the canning season.

DX AT 6XAD-6ZW DURING THE SUMMER MONTHS

By MAJOR LAWRENCE MOTT
Sig ORC, USA

As I have previously remarked in these columns, my radio effort—from June until October—amounts to but very little. One cannot spend one's days on the wind-dimpled, sun-caressed surfaces of the Pacific Ocean, hunting the splendid game fish of our waters, and fondle a brass key all night beside! The two pursuits are incompatible. I have, however, gone on the air several times, when QRN was not too vile, and I give herewith the summer list of stations reporting me and those worked.

Stations reporting 6XAD-6ZW: 10A, 1CU; T. J. Griggs, Brooklyn, N. Y.; 5KG, 5OS, 8DCW, 8BVD, 8CEI, 8CCT, 8AXF, 8DRJ; J. Heckler, Bucyrus, Ohio; 8DON, 8QB, 8DRJ, 9AKO, 9RQ, 9ABC, 9BMD, 9BAB, 9DNG, 1AJO, 1PY, 3HZ; T. Buzalski, Hillside, N. J.; 4OA, 7ACL, 7CH, 8CAB, 8DRJ, 8ATZ, 9DNG, 9EFX; W. James, Covington, Ky.

Stations worked: 1GV, 5GK, 5VO, 7VN, 7WM, 7ADP, 7ALI, 7AO, 7ACF, 8SF, 8BQI, 8BPA, 9AIM, 1GV, 7ACF, 7AO, 8BQI, 8SF, 8BPA, 9CLD.

Foreign Stations reporting 6XAD-6ZW: English 6LJ; English 6TM; 1AO, NZ; 1AC, NZ; 1AX, NZ; 4AH, NZ; 4AK, NZ; and 4AG, NZ. Also a report from the operator of the French oil tanker "MYRIAM" to the effect that he heard 6XAD "vy qsa" when 1530 miles S. E. of N. Y. (in July).

The sets to be used this winter are: 1. 500-watt WE on 178 meters, with a sharp "sink" note. Have installed a Stahl rectifier and am more than delighted with it. 2. 100-watt WE on 190 meters, ACCW. And a 3KW McCullough water-cooled tube. Shall have this transmitter on about 150 meters and ought to get very good radiation.

I extend greetings to all my old friends of the air and hope to hold chat with them during the '24-'25 radio season. All cards and communications will be promptly attended to, as is the custom at 6XAD-6ZW.

A record-making and -BREAKING winter to you all!

The station will be on the air Tuesday, Thursday and Saturday nights, 11 P. M. to daylight.

7NO of Aberdeen, Wash., works 7AEB of Alaska with ease. A good number of the message traffic between the states and Alaska has been handled by these two stations. 7LN, formerly of Nampa, Idaho, has moved his set to Kansas, where he plans to enter college. 7OB, Mr. Kenneth Norquest of Boise, is one of the most consistent stations in Idaho. 7YA is the call of the Boise High School. The transmitter is of 100 watts, using B battery plate supply.

7RQ has one of the finest stations in the West. He uses enameled aerial wire, glass insulators, low-loss coils, etc.

7SI is the only station in the seventh district owned by a young lady.

7FR is working on schedule with 6ALS of Hawaii every Saturday night. Many messages have been exchanged between the Island and the States.

CALLS HEARD



Readers are invited to send in lists of calls heard from stations distant 250 miles or more from their own station.

By 6BLM, John H. Caniff, Sebastopol, Calif.

4hf, 4my, 5za, 5zai, 5fn, 5oq, 5sg, 5acm, 5aiv, 7fr, 7gy, 7mf, 7no, 7nx, 7pj, 7pz, 7qc, 7ahs, 8rj, 8anm, 8apw, 8brc, 8chy, 8cpk, 8dgo, 8dhs, 9bm, 9hm, 9vc, 9zd, 9adr, 9ahz, 9amb, 9baz, 9bkj, 9beb, 9bpy, 9bzj, 9efi, 9cus, 9ddp, 9dkv, 9eam, 9elz, 9eky. 6BLM is on again, after being shut down for the summer. Will be glad to qsl traffic in all directions as usual. All reports on my 5-watt station will be appreciated. Also any one desiring a report on their sigs can have one by dropping me a card.

By 8CCI, 902 S. Elizabeth St., Lima, Ohio

(1aap), (1acr), (1ams), (1arf), (1asu), 1bak, (1gh), (gv), (pl), (2abt), (2brb), 2acs, (2byk), (2chg), (2cka), (2cjj), (2cyq), (2jc), (2kx), (2rb), (3cdk), (3cfc), (3cgc), (3ckl), (3hd), (3hv), (3qt), (3tf), (3zo), (4ai), (4eg), (4fg), (4ft), (4gw), (4hr), (4hz), (4io), (4jr), (4li), (4my), (4it), (4on), (4pv), (4qf), (4sh), (4ts), (4ua), (5aek), 5agn, (5agp), (5aiy), (5alz), (5amh), (5anf), (5aqp), 5ek, 5ek, 5mi, (5nj), (5nt), (5ka), 5ua, 5uk, 5vv, (5wi), 6avj, 6aws, (6awt), 6ebb, (6chl), 6cnl, 6emh, 6mh, 6pl, 6elp, (9bof), nkf, vdm, (July 7th). Wud appreciate reports on mi 50-watt C. W. All crds ansd. Tnx.

At 2CYX, 1104 Clay Ave., Bronx, N. Y.

(1abf), (1afa), (1ajo), 1ajx, (1ams), (1arf), 1aul, 1avg, (1axf), (1bbx), (1bcc), (1bgg), (1bkf), (1bkp), (1btt), (1bqf), 1cab, 1cue, (1cmx), (1df), (1gc), (1he), 1ka, (1fn), (1nc), 1pl, 1py, (1rf), 1rg, (1rw), (1se), 1xw, 1zo, (1vu), (3ahp), (3aot), (3auv), (3bva), (3cdn), 3eel, (3chg), (3cka), (3gc), 3fr, (3lg), (3ll), (3mf), 3nf, 3od, (3tf), (3tp), (3ue), 3zo, 4af, 4bx, 4cs, 4dx, 4fs, (4ft), 4ga, 4gw, 4hr, 4hw, 4io, 4ld, 4oa, 4ot, (4og), 4pv, 4ru, 4sw, 4un, (4mb), 4qf, 5agn, (5agv), 5aiy, 5amn, 5apc, 5arn, 5zao, 5uf, 5mi, 5fk, 5pu, 5uk, 5xa, 6as, 6awt, 6egw, 7bc, 7co, 7fd, 7it, 7no, (8ay), 8bn, (8bt), 8rt, (8sf), (8tt), (8uf), 8ut, (8vq), 8zz, 8aan, 8acm, (8add), 8aer, (8ajn), (8akk), 8ams, 8aqo, 8avl, 8avx, (8axf), 8bkh, (8bre), 8bsm, (8cci), (8cet), (8cdc), (8cei), (8clo), 8eni, 8enq, 8eud, 8cwu, 8daa, 8dat, 8dem, 8dgo, 8dkl, 8dmr, 8dmt, (8dnb), (8doq), 9aaw, 9ado, 9afk, 9aif, 9ako, (9aps), 9arf, 9arr, (9atn), 9avy, 9bec, 9beb, 9biw, 9bjo, 9bna, (9bmk), 9bmu, 9bpt, 9bsp, 9bty, 9hwp, 9bye, 9byt, 9ccf, 9ceh, 9ccw, 9cdv, 9cfi, 9cfk, 9cip, (9ekh), 9csg, 9cvf, 9dbj, 9del, 9dlw, 9dpx, 9dul, 9dvw, 9ebh, 9eky, 9elb, 9eld, 9eji, 9av, 9es, 9hr, 9pp, (9uc), 9tc. Can.—(2be), 2cg, (3bq), (3co), 3ni, (3vh). Qrk? All crds answered. Wud appreciate crds fm stations. wkd.

By 5JF, Marshall, Texas

2bse, 2cqz, 3zr, 4ai, 4cs, (4du), 4dv, (4dx), 4eq, 4fg, 4fs, 4ft, 4fx, 4gw, (4hz), 4ia, (4io), 4iz, 4nz, (4oa), 4p, 4sa, (4si), 4tj, 4ll, 4zb, 6adm, 6brf, 6cae, 6cgo, 6cgw, 6cng, 6cto, 6mh, (8aal), (8abm), 8atp, 8avx, (8bel), 8bhe, 8brc, 8cmc, (8cwp), 8cwu, 8dnu, 8doc, 8dom, 8dsn, 8hv, 8ry, 8xbh, 8zg, vdm, whu, nkf, kdka. Mex.—if.

By 6BLT, Ceres, Calif.

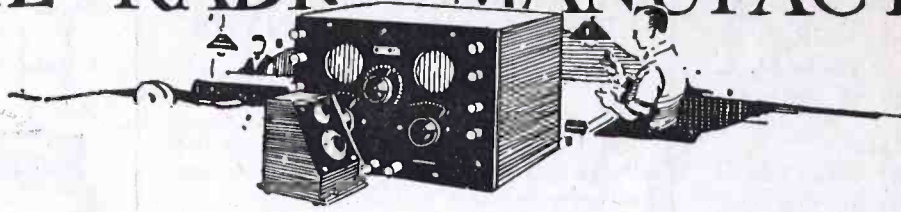
6ih, 6jp, 6cq, 6w, 6jj, 6ti, 6fa, 6abc, 6adu, 6afa, 6afg, 6afu, 6aja, 6ajh, 6akh, 6alw, 6amf, 6amv, 6aoa, 6apf, 6ard, 6asw, 6atf, 6atn, 6bam, 6bas, 6bbt, 6bbu, 6bef, 6bel, 6bdy, 6bdt, 6bgo, 6bls, 6blw, 6bny, 6brs, 6bts, 6bua, 6buy, 6bva, 6cde, 6cdg, 6ceez, 6cgu, 6chj, 6cka, 6cmu, 6cmm, 6eni, 6coi, 6cte, 7ca, 7cn, 7gv, 7gm, 7hk, 7qc, 7qy, 7ry, 7zu, 7zw, 9dk, 9ca.

At 6COU, 711 D Street, Oxnard, Calif.
(Sept. 1 to 19)

2rk, 3bva, 4my, 5amo, 5ce, 5gj, 5hp, 5ka, 5nj, 5pa, 5qh, 5rh, 7fa, 7mf, 7no, 7pz, 7qc, 8art, 8dea, 8gh, 8pz, 9aog, 9aou, 9bhs, 9bjk, 9bm, 9bmk, 9beb, 9ctr, 9ded, 9dng, 9dun, 9efy, 9ejn, 9eky, 9elb, 9ky, 9ze, 9zt, 9dxw, 9eky, 9hm, 9lv, 9rc, 9ss, 9vc, 9wu, 9zd, 9zt, nkf, nse. Foreign (?): RM (qra pse using intermediate "de") Wud like to have crds from ani above, also ani 6's who would like ck on sigs. All crds ans'd. Qrk mi 5-watter!

Continued on page 46

FROM THE RADIO MANUFACTURERS



The Fil-Ko-Leak is a hand-calibrated grid-leak showing the resistance in megohms through a peep-hole in the panel. It gives a smooth, gradual control of resistance so



that the correct potential can be maintained on the detector grid, and is guaranteed to be electrically and mechanically perfect. Each instrument is rigidly tested to insure accuracy.

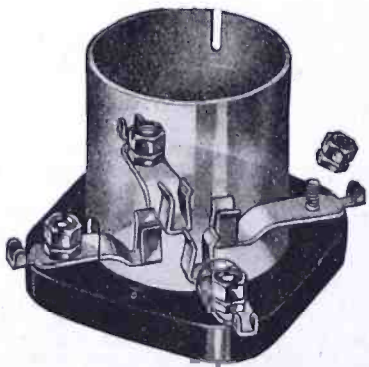
The France Super-charger is a new vibratory type for converting alternating into direct current for charging *A* and *B* batteries. It is nearly noiseless in operation and is rugged in construction. It charges

THE SILENT FRANCE MULTI-DUTY SUPER-CHARGER



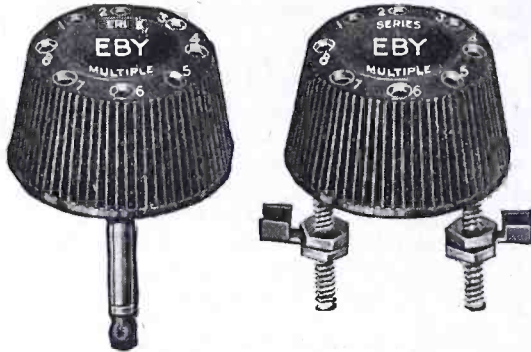
2, 4, 6 or 8-volt *A* batteries at a 5 to 7-ampere rate. *B* batteries up to 120 volts may be charged in series. It is furnished in an attractive metal case complete with meter, fuse plug, socket for lamp to vary *B* charging rate, attachment plug and wire.

The Cutler-Hammer Socket is of the one-piece contact construction. It has con-



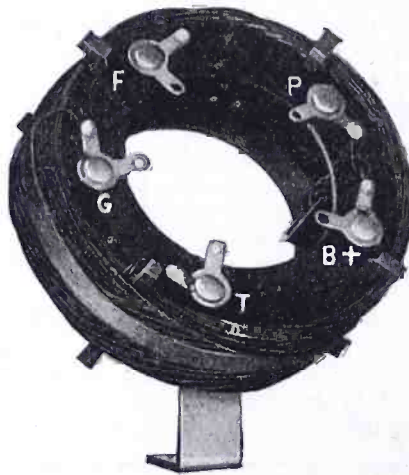
venient terminals for soldering. The metal parts are silver-plated.

The new Eby 4-phone plug is designed so that either series or parallel connection can be made for four phones. The tips are inserted in the holes on top of the plug and



are securely held by a phosphor-bronze spring. This plug is made in the two styles shown in the pictures. Its general appearance and finish is similar to that of the dials and knobs used in the better class of receivers.

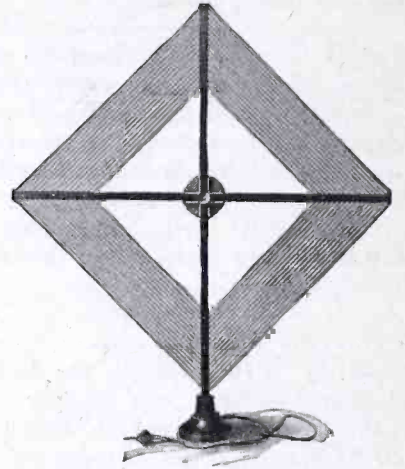
The Kellogg Radio Frequency Transformer is of the air core aperiodic type, suitable for sets in which radio-frequency is used. The primary has two terminals. A short or long antenna can be used. The



secondary is arranged with suitable taps for biasing features. High efficiency is claimed due to the method employed in winding the coils. Mounting brackets hold the transformer at the proper angle to insure best results.

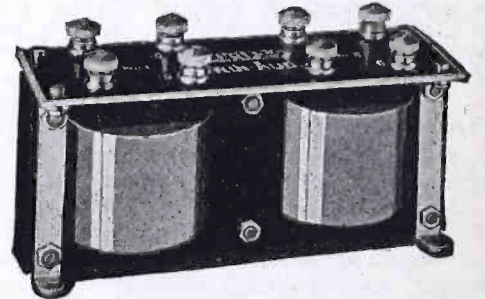
"The Super-Heterodyne" by John T. Boone is the title of a 64-page (6x9) pamphlet published by the J. T. Boone Radio Corporation of Detroit, Mich. After a brief explanation of its action, it discusses the detector and oscillator system, the intermediate frequency amplifier, filter and a.f. amplifiers, and the details of various complete types. He concludes with chapters on construction and operation. His treatment is simple and his explanations helpful to the constructors.

The Pacent folding loop has a spread of 28 in. when erected and folds into a package 13½x3 in. when collapsed. The arms are rigidly held in position by a large knurled screw. The base is indexed for 180 degrees



to facilitate direction finding and the loop swings through 360 degrees. The insulation is of hard rubber and the finish is in dark mahogany. It is designed to cover the entire broadcast band of wavelengths when used with a .0005 mfd. variable condenser.

The Peerless Twin-Aud consists of two audio transformers (1st and 2nd stages) combined as one unit encased in a metal shield. This gives a substantial and compact con-



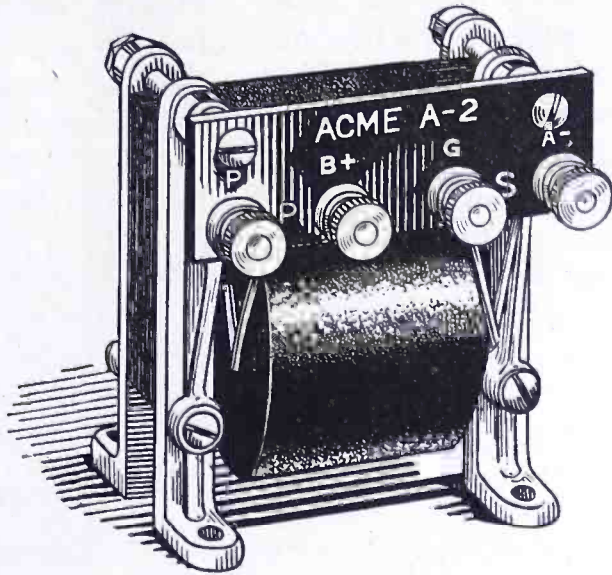
struction, easy to connect. It is claimed that howls due to inter-coupling have been eliminated and that maximum volume is secured without distortion.

Pennsylvania Harmonized Radio Phones are one of the new products carrying the "PENNSYLVANIA" trade-mark. A



closed metal base loud speaker, 24 inches high with a 12-inch bell completes the "PENNSYLVANIA" line.

Give your loudspeaker a chance!



ACME A-2
—for volume

NO MATTER what loudspeaker you have, it can't give you loud, clear reproduction unless you have proper audio amplifying transformers.

If your audio transformers don't deliver clear, strong, undistorted energy, you can't expect your loudspeaker to correct the faults for which your audio transformers are responsible.

The thing to do is to put ACME Audio Transformers in your set and *then* listen to your loudspeaker. ACME Audio Transformers will give your loudspeaker a chance to entertain you with all the thrills and enjoyment you expected and which you are entitled to.

Send 10 cents for 36-page book, "Amplification without Distortion," containing many practical wiring diagrams and many hints for getting the best out of your set.

ACME APPARATUS COMPANY
Dept. 83, Cambridge, Mass.
Transformer and Radio Engineers and Manufacturers

ACME

~ for amplification

ACME APPARATUS COMPANY,
Dept. 83, Cambridge, Mass.
Gentlemen: Enclosed find 10 cents for copy of
"Amplification without Distortion."

Name

Street

City

State

Touching the high spots of life

THERE is a wonderland of sport and adventure for either the expert or the new user in a radio instrument that is both fool-proof and capable of fine work.

You sit in your own library—you reach out into space with a simple turn of the dials and soon you have contact with—Boston or Schenectady or Pittsburgh, or perhaps some more distant point.

The thrill you get is a real one—it means another stage of amplification of man's contact with man. It means more than that to you; it means that you are bringing more and more of the world about that important centre—yourself. It means again that you are learning a new art—an art that you can carry into the finest technique if you are technically inclined, or that you can gradually improve on by merely the practice which repeated operation will give you.

Your pleasure increases with your skill

As you learn the habits of your instrument, you learn how to get satisfying results *every time* you try. You acquire skill in spite of yourself.

Almost any radio set can be made to work. There are several makes of good ones; and the one you should have is the one best suited to your personal requirements; but remember that for general excellence, surety and smoothness of results the De Forest D-12 stands pre-eminent.

The invention of the Audion tube by Dr. De Forest made the present high development of

radio apparatus possible. De Forest is the great name in radio. The De Forest Company has been the pioneer in simplifying the outfitting and use of radio. Our D-12 is a complete self-contained unit, with batteries, loud speaker, wires, tubes and antenna all ready for use the minute the battery wires are connected and the loop placed in position on top of the cabinet.

Without either outside antenna or ground wire it does its perfect work. With outside antenna and ground wire it may extend its range somewhat in special circumstances.

Its four tubes do the work of seven

It is built for convenience, and for exactness and economy of operation. Its four tubes do the work of seven, and do it better. It is easy on batteries, and above all, De Forest has won an outstanding reputation in the industry by years of notable performance. It is an instrument you will be proud to own and tell others that you own.

Every great industry has its great standardized product, known by the public for its efficiency, its reliability, and its honestly earned reputation. In the automobile field, the talking machine field, the piano field, there are such. You probably can name them. In the radio field its name is *De Forest*.

Economical to use

It is not a "cheap" instrument, because such standardized performance as the De Forest D-12 will give you is not a cheap thing, and the instrument is worthy of the attractive housing which it has; but it is most economical to use, because

DE FOREST D-12 RE-

Your receiver deserves De Forest Tubes

YOUR radio set is no better than its tubes—for volume and beauty of tone reproduction you must rely on them.

De Forest tubes satisfy the requirements of the most exacting set owner. They are the latest developments in the manufacture of tubes begun many years ago, when Dr. Lee De Forest invented the three-electrode

vacuum tube which makes present-day radio possible.

For volume and beauty of tone De Forest tubes are unsurpassed. They are non-microphonic—do not ring or sing or howl. They use little current, and last long.

For dry batteries use the De Forest DV-3. This tube is specially adapted for use on camping

trips, and for general use in locations where there is no electric power.

For storage batteries make sure you have the DV-2. With these tubes you can operate practically every circuit in use today.

The name De Forest on these tubes is a guarantee against de-

fects in material, character and workmanship. All De Forest tubes are inspected thoroughly during and after production and are tested. They are packed in individual cartons containing instructions for proper operation and connection. Sold only by authorized De Forest agents. Look for the name De Forest on each tube.

once adjusted it works most satisfactorily, and takes the minimum of current for operation. Though it is not "cheap," it is very low-priced in comparison with any other radio set that will give equal or approximately equal results.

This radio industry is beyond its "pin feather" or elementary experimental stage. The radio receiver was really invented when Dr. De Forest invented the Audion tube—although the world didn't know it for several years.

Good receiving sets today are standardized. You will no more throw away your radio after a year or so than you will throw away your good piano. The De Forest Radio is here, and here to stay.

There is much splendid broadcasting being done today—and it will be better tomorrow—but the so-called "latest word" in receiving sets does not differ in essential principles from that of several years ago—just as the automobile of today's purchase is in essentials the same as the car of the same name was several years ago. Don't be fooled on this. The De Forest Radiophone you buy now will be essentially up-to-date for years.

It is as simple as eating to use the De Forest D-12

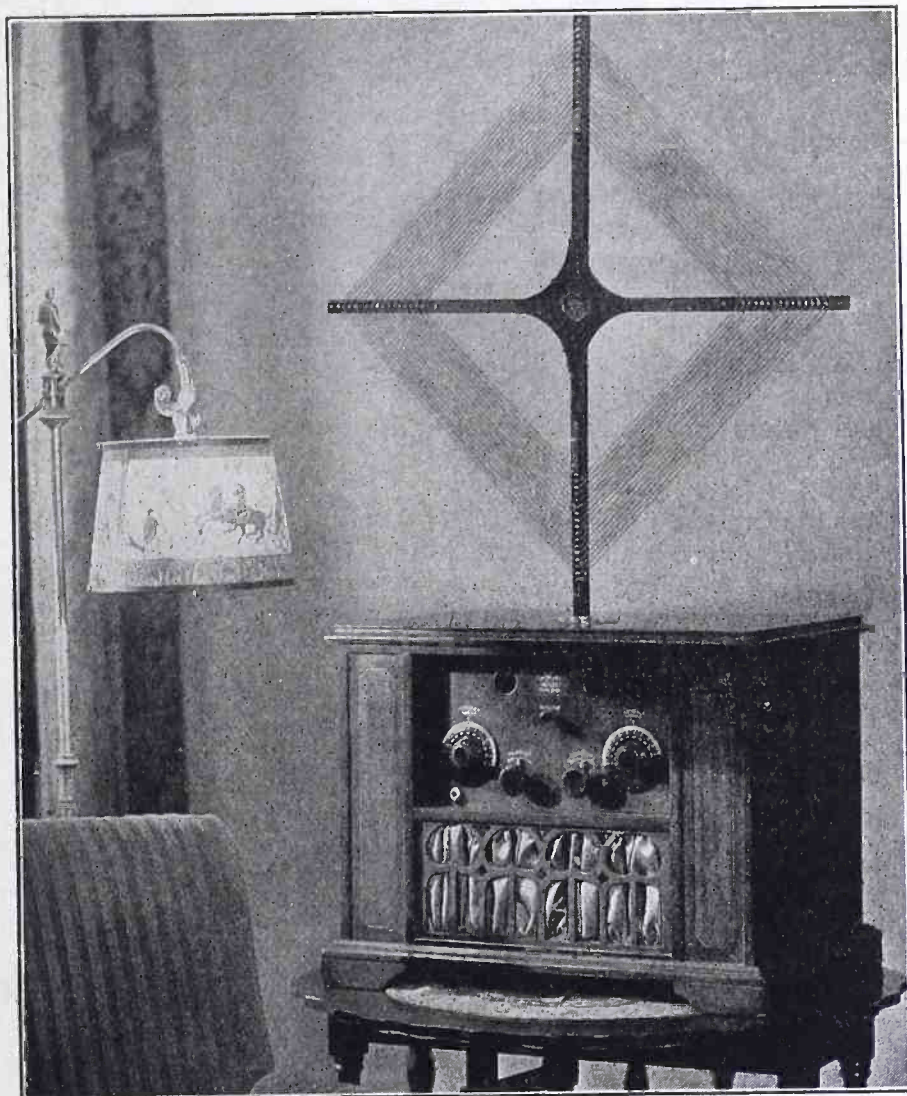
You learn how to catch the good things as you follow the broadcasting programs; that is fun. You learn how to get the reproduction clear and strong; that is fun. You learn the delicate art of picking up distant stations, and that is heaps of fun. You learn what radio *won't* do in the summer and what it will do in the winter. You learn its whims and whimsies. You learn it is as interesting as a beautiful girl; as temperamental as an artist, and you learn to be a master of its whims and temperaments.

You may do this with or without learning its mechanical and scientific principles. Suit yourself. It is fun either way.

Here are directions for using De Forest D-12:

Have your dealer deliver the instrument to you—put the loop into its place, turn the dials till you get your station (your dealer will show you how) and then your fun begins. Listen and change your stations to your heart's desire.

DE FOREST
RADIO TEL. & TEL. CO.
Jersey City, N. J.



FLEX RADIOPHONE

De Forest D-12 Reflex Radiophone

A four-tube, long distance indoor loop receiver, with self-contained batteries and loud speaker

1. **COMPACTNESS**—Completely self-contained in beautifully designed case with two foot antenna. No bothersome aerial and ground wires, or outside batteries or loud speaker.

2. **SIMPLICITY**—Controls simple enough for the veriest amateur, critical enough for the expert. Calibrated tuning chart with each set. Raising the cover makes all parts accessible.

3. **EFFICIENCY**—Six stages of amplification and one stage detector gives high selectivity on this four tube circuit. Tuned radio. Volume controllable from faint whisper to the crashing of a brass band, with perfect fidelity of tonal quality. Great distance range.

4. **ECONOMY**—This four tube reflex circuit cuts cost of tube replacement and battery upkeep. If more than five tubes

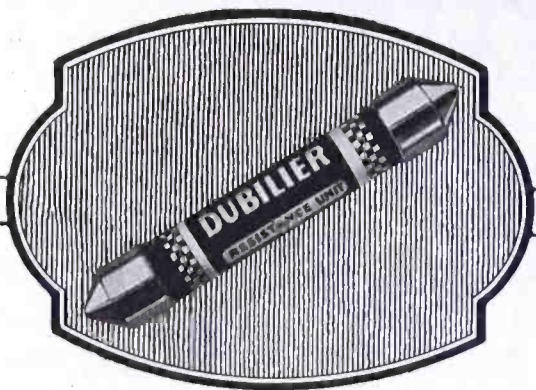
are used the "B" batteries are used up at ruinous rate.

5. **MOBILITY**—The D-12 is so light and compact you can easily move it from room to room and is so well built that this will not put it out of commission. Can easily be carried in the tonneau of your car. Some users install it on a tea-wagon. The leather covered set will not mar easily.

6. **BEAUTY**—This is the smartest and handsomest moderate priced set, in either its embossed two-toned leather or its piano finished two-toned mahogany case.

7. **Remarkably low price.** The De Forest D-12 Reflex Radiophone is several hundred dollars below any other set that compares with it in distance range, efficiency or beauty.

Tell them that you saw it in **RADIO**



Furnished in following
Resistance values:
.5 .75 1. 1.5 2. 2.5
3. 4. 5. megohms
Price 50c

The RESISTANCE UNIT

—Accurate and Efficient

A new Dubilier Product

The Dubilier engineers have perfected a resistance unit that is at once efficient, accurate *and constant*.

A good resistance unit will not change in resistance value with age. If it is marked 2 megohms it should have that same value to within commercial tolerance, after months of use.

It is easy to design a resistance unit, but it has taken us years to produce one that is right—quiet, efficient and constant.

You will find that the Dubilier Resistance Unit greatly increases the range and efficiency of your set.

For a descriptive folder, address 45 W. 4th St., New York

Dubilier

CONDENSER AND RADIO CORPORATION

SUPER-HETERODYNE 25c

Reprints from "RADIO" by G. M. BEST. Sent to any address for
25 cents.

PACIFIC RADIO PUB. CO.
Pacific Building—S. F., Cal.

Only a Few Left

CALLS HEARD

Continued from page 41
By 9DLM, 1107 Central Ave.,
Kansas City, Kansas

Calls heard between Sept. 5 and Sept. 20, '24:
1aac, 1all, 1are, 1bdx, 1bgo, 1bie, 1bsd, 1bvl,
1cpv, 2aar, 2afo, 2ajb, 2ana, 2anm, 2aok, 2atz,
2bck, 2bed, 2bgo, 2bkr, 2bnl, 2bpb, 2bqb, 2brb,
2buy, 2bck, 2cee, 2cjj, 2ckr, 2cnk, 2crp, 2cxy,
2mu, 2qd, 2rk, 2xq, 3abw, 3ach, 3adb, 3aeu,
3aoj, 3auv, 3bg, 3bge, 3bj, 3blp, 3blu, 3bmn,
3bpk, 3bpp, 3bsb, 3bta, 3btq, 3but, 3bvl, 3bwt,
3cbl, 3cdd, 3cg, 3cjin, 3co, 3cok, 3cvj, 3hm,
3kw, 3lg, 3mo, 3qw, 3rs, 3vh, 3xx, 3zo, 4ai,
4dx, 4ea, 4eg, 4eq, 4fg, 4gw, 4kk, 4ku, 4lp,
4me, 4mi, 4oa, 4of, 4on, 4qf, 4rr, 4si, 4tj, 4un,
4vl, 4xd, 6anb, 6ac, 6awt, 6bar, 6bqr, 6bwl,
6bwt, 6cfu, 6cgo, 6cgw, 6ne, 6pl, 6ry, 6vo, 6wt,
6xbn, 6zh, 7abb, 7ass, 7axo, 7bj, 7fd, 7fs, 7gk,
7mf, 7pj, 7qo, 7tj, 7zu.
Can.: 1ar, 2am, 2cg, 3ad, 3ef, 3fo, 3he, 3kq,
3ly, 3om, 3wv, 4cn, 4hh, 5go.

By 9DNG, Fergus McKeever, Lawrence, Kansas

1aac, 1aal, 1aan, 1aap, 1abi, 1aea, 1aeg, 1afa,
1aid, 1apy, 1amj, 1aox, 1akz, 1apc, 1aqi, 1are,
1arf, 1aua, 1aur, 1avj, 1awv, 1ayt, 1azr, 1bal,
1bes, 1bge, 1bgq, 1bqk, 1bu, 1bub, 1bvl, 1cab,
1ccx, 1ek, 1ekm, 1ck, 1cp, 1cpi, 1cpv, 1cqm,
1cue, 1da, 1dd, 1de, 1dip, 1fd, 1gv, 1ii, 1iq,
1iv, 1jf, 1er, 1axr, 1pe, 1pm, 1py, 1rf, 1se,
1sf, 1te, 1ud, 1vm, 1vk, 1vt, 1wm, 1xak, 1xam,
1xap, 1xas, 1xav, 1mw, (1zab), 1zz, 2abg,
2acs, 2add, 2ad, 2axf, 2by, (2bck), 2bir, 2bnz,
2brb, (2bqb), 2pd, 2rm, 2rk, 2buy, 2bxu, 2cja,
2cnk, 2ctq, 2cpx, 2cuk, 2cur, 2cu, 2cvu, 2cjj,
2cmk, 2li, 2dx, 2od, 2cyp, 2cyw, 2cxe, (2cee),
2evk, 2dz, 2fc, 2gk, 2agb, 2ju, 2kd, 2kv, 2kx,
2ctq, 2wc, (2wz), 2xbb, 2xbf, 2xs, 2ww, 3abm,
3abw, 3adb, 3adp, 3adv, 3ahp, 3ari, (3agf),
3bb, 3bdr, 3bfc, 3bfe, 3bna, 3bof, 3bpp, 3bob,
3bg, 3bqf, (3bva), 3bto, 3bve, 3bta, 3bt, 3bvl,
3bwt, 3bz, 3cba, 3cbp, 3cbl, 3cc, 3ccf, 3cev,
(3cdk), (3che), 3ckl, 3cta, 3cul, 3chg, 3auv,
3ek, 3ka, 3hs, 3lg, 3mb, 3on, 3oo, 3oq, 3qi,
3ti, 3tf, 3vn, 3zo, 3osn, 3na, 3rs, 3wf, 3lv,
4af, 4ai, 4bx, 4cl, 4du, 4dx, 4eq, 4ey, (4fz),
4ga, 4gv, 4hz, (4io), 4it, 4iz, 4fv, 4gp, 4js,
4ka, 4kk, 4mi, 4my, 4pb, 4pi, 4ru, 4sa, 4sb,
(4si), 4sh, 4t, 4tp, (4tj), 4on, 4xc, 4xe, 4xx,
4vn, 4zd, 6aib, 6agk, 6ano, 6ajf, 6apw, 6ase,
6bep, 6bjx, 6bqr, 6buf, 6bwl, (6cae), 6cae, 6cck,
6cfq, 6cfz, 6cel, 6cgw, 6els, (6crx), 6cto, 6cyo,
6gg, 6nt, 6nx, 6pl, 6rs, 6rx, 6ve, 6xad, 6xbn,
6vc, 7aci, 7ajt, 7co, 7fd, 7gk, 7gr, 7ho, 7mf,
(7pj), 7no, 7jb, 7sz, 7wm, 7zu.
Can.: 1ar, 2be, 2cf, 2fj, 2cg, 2ni, 3ad, 3bq,
3aa, 3fc, 3gg, 3kg, 3vh, 3wv, (3yv), 3ly, 4dy,
4cr, 4fz, 4io, 5bq, 5ds, 5fc, 9av. Cuba: 2by,
nkf, kdka. All who hear my sigs pse qsl; all
crds answered.

By 2BIR, Nutley, N. J.

(From Aug. 30 to Sept. 15)
(4ea), 4eg, 4fg, 4ft, 4ik, 4io, 4my, 4on, 4qf,
(4qw), 4rf, 4ru, (4rz), 4sb, 4sh, (4tn), 4tw,
4uk, 4un, 5aaj, 5aek, (5aaq), 5agl, 5agw, 5ahj,
5air, 5ajn, 5alz, 5amu, 5amw, 5anf, 5aqy, 5ari,
5ek, 5fm, 5fs, 5fv, 5gj, (5ka), 5mg, 5mz, 5nj,
5qk, 5ql, 5tq, 5uk, 5uo, 5vo, 6aao, 6awt, 6chl,
6pl, 9aal, 9aaw, (9abb), 9ado, 9adq, 9ahy,
9aif, 9atn, 9ayk, 9bbk, 9bcc, 9bcd, 9bdu, 9bgn,
9bhb, 9bie, (9bna), (9bqj), 9cee, 9cfi, 9cgr,
9cjc, 9cdo, 9ckh, 9cmf, 9cht, 9ctg, 9cvt,
(9cwk), 9cwz, (9del), 9dgb, (9dhl), 9dkk,
(9dlj), 9dnn, 9dmu, 9efz, 9ehs, 9eky, 9bk, 9bv,
(9ct), 9em, 9eo, 9fb, (9fj), (9hk), (9hl),
9hp, (9my), 9mf, (9pb), 9qr, 9rc, (9vc), 9vm,
9zb, 9zw. Any of above who hv hrd me pse
qsl by crd—tnx.

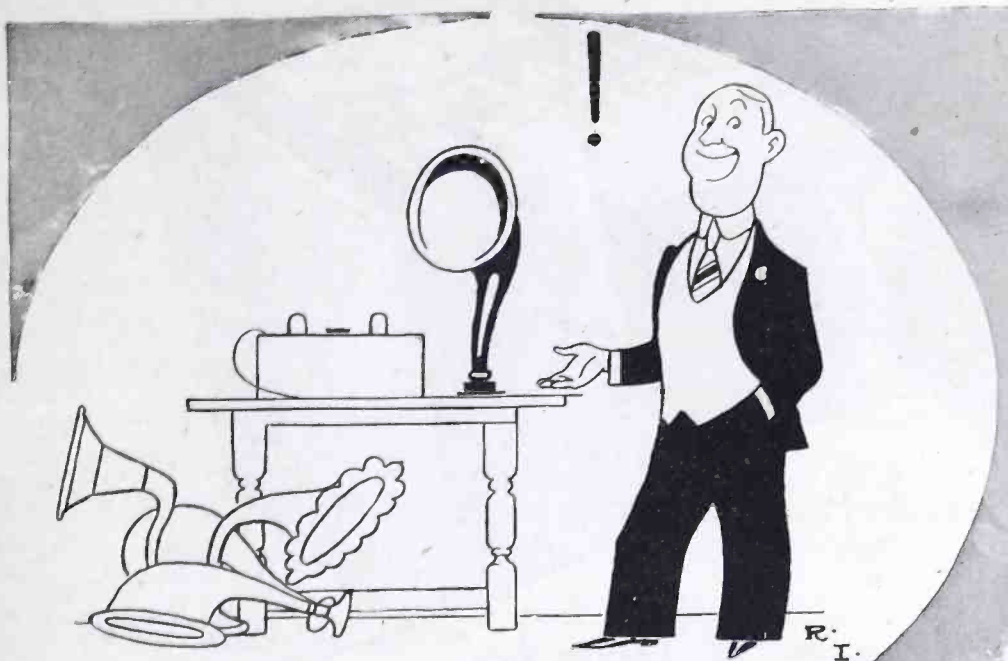
By 6BPQ, M. O. Smith, 504½ N. Adams,
Glendale, Calif.

1ael, 1bkr, 1bsd, 1ckp, 1cpv, 1cx, 1er, 1my,
1tb, 1xae, 1xax, 1xz, 2anm, 2brb, 2cil, 2cqz,
2sg, 2xi, 3aa, 3adb, 3adw, 3aec, 3bq, 3bsb,
3bta, 3btu, 3bva, 3bz, 3cbl, 3xw, 4ai, 4br, 4dq,
4fg, 4fs, 4ka, 4rr, 4sa, 4tg, 4tj, 4xw, 5aak,
5adv, 5aec, 5agn, 5ajj, 5ajh, 5ak, 5akd, 5ame,
5apz, 5bj, 5ck, 5et, 5fc, 5fm, 5gg, 5hq, 5ke,
5kq, 5li, 5oq, 5ox, 5oz, 5pn, 5se, 5sg, 5vo,
5xaz, 5xaw, 5zai, 7acf, 7aek, 7agz, 7aif, 7akk,
7alk, 7fd, 7gk, 7gr, 7gv, 7lg, 7lq, 7mf, 7mg,
7no, 7ok, 7pm, 7qc, 7rw, 7zn, 8ajn, 8apw,
8cdc, 8cdk, 8cyi, 8dgc, 8gz, 8hn, 8jy, 8vq, 8xs,
8zg, 9acs, 9aen, 9aey, 9ahz, 9aiu, 9aks, 9auw,
9axz, 9beb, 9bdu, 9bec, 9bm, 9bvz, 9byc, 9bye,
9ca, 9cfi, 9cfl, 9cfy, 9cht, 9cii, 9cjc, 9cjs, 9cjt,
9clq, 9clz, 9cpu, 9cro, 9ctr, 9evo, 9ewf, 9eyw,
9ddp, 9ded, 9dfz, 9djd, 9dkv, 9dqu, 9dvp, 9dvw,
9dxn, 9dxw, 9ea, 9eae, 9eam, 9efy, 9ejn, 9eli,
9er, 9ql, 9xl, 9xbl, 9xbn, 9zd.
Can.: 3bq, 4gt, 5as, 5cn, 5gf, 5go. Mex.:
bx. Porto Rico: 4sa.

By 8DKI, Warren, Pa.

6aak, 6aao, 6acu, 6afn, 6ahp, 6ajh, 6alg,
6ano, 6arb, 6atn, 6awe, 6awt, 6bcf, 6bev, 6bfi,
6bql, 6buy, 6ebb, 6ebd, 6cdy, 6efe, 6egs, 6egw,
6chl, 6oje, 6cnl, 6cqe, 6pl, 6rn, 6hj, 6zw, 7aa,
7acf, 7aiy, 7akk, 7ca, 7gr, 7gv, 7if, 7iu, 7pj,
7mf, 7qc, 7sf.
Can.: 4cr, 1el. Crds fr everyone. Qrk mi
5 watts.

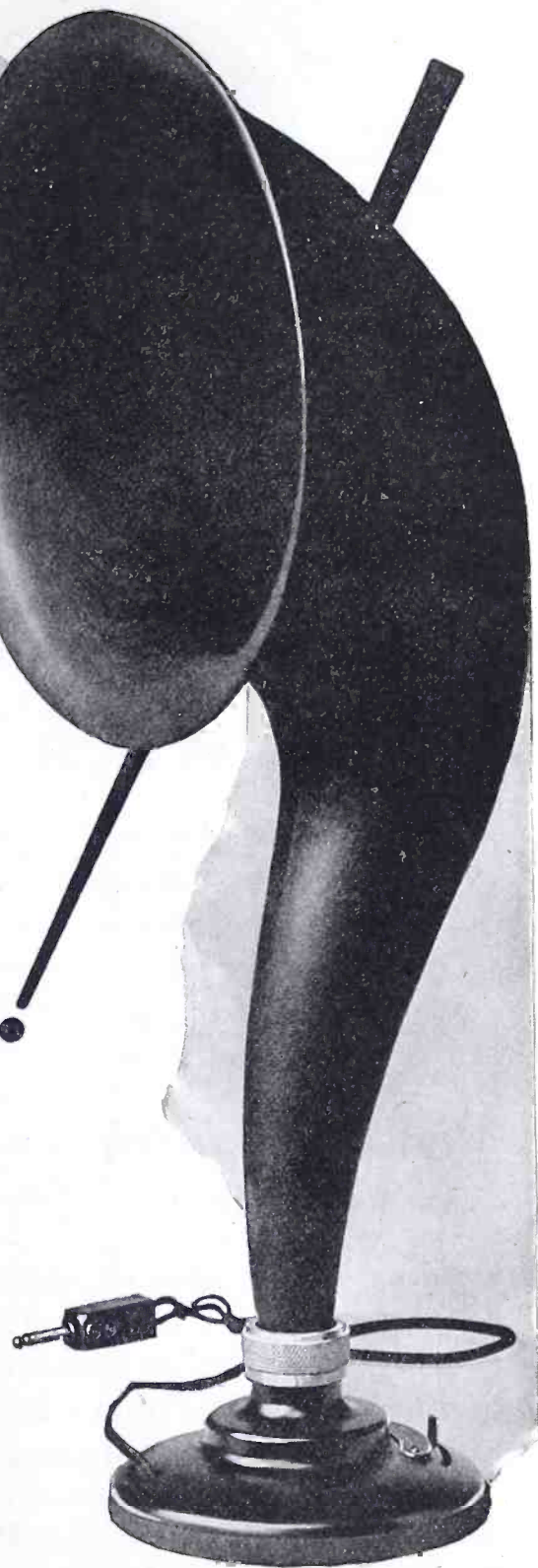
Continued on page 50



Hear the difference!

A loudspeaker is a critical thing. Any vibration in the horn adds sounds that nature never gave to the speaker's voice. And limited range thins down the tone to flat, unreal quality. Some people think that a near-real voice is the best that radio can give . . . but not after they have heard a Radiola Loudspeaker!

The difference is the result of elaborate experiment and extended scientific study. The Radiola Loudspeaker has an extraordinary range—gets the full richness of tone. And it adds no sound of its own. To know how clear—how mellow—how *real* your music can be—ask to hear a Radiola Loudspeaker.



Radiola Loudspeaker
Type UZ-1325
Now \$25.00

Radiola

REG. U. S. PAT. OFF.

LOUDSPEAKER

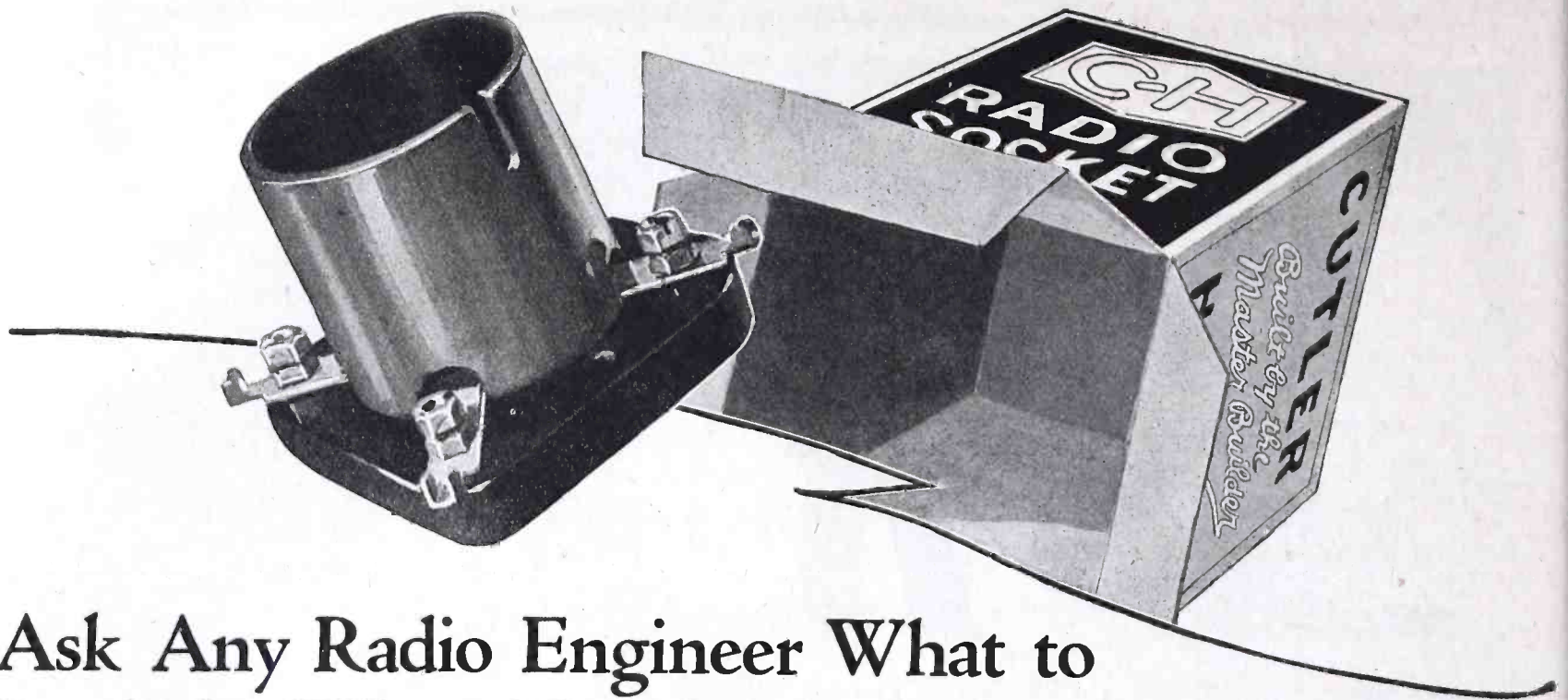
This symbol
of quality



is your
protection

RADIO CORPORATION
OF AMERICA

Sales Offices:
233 Broadway, New York
10 So. La Salle St., Chicago, Ill.
28 Geary St., San Francisco, Cal.



Ask Any Radio Engineer What to Look for When You Buy a Socket!

Radio experts are continually stressing the necessity of using good sockets. In some of the more sensitive circuits such as the Superheterodyne, poor sockets often completely destroy results. In fact, in thousands of sets today, with scores of different circuits, the so called "static" often mentioned, or "battery noises," are in reality merely the result of poor socket contacts—certain proof of dissipation of the feeble currents that we rely on for distant reception.

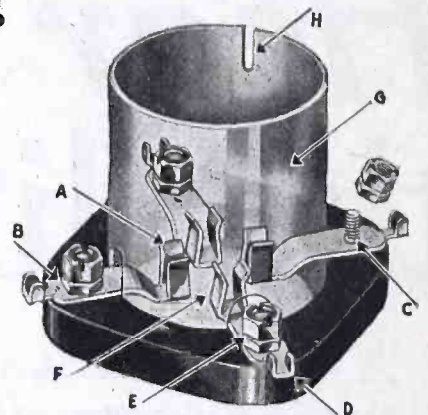
Minimum Dielectric Capacity

In the Cutler-Hammer Socket, designed by the same engineers whose precision rheostats and other radio current control apparatus have justly become world famous, every effort has been bent toward greatest efficiency. Custom has no consideration—and from its striking color scheme to its novel contact construction, the design is radically new.

It embodies a minimum of both insulation and metal; capacity absolutely minimized without sacrifice of mechanical strength. The insulation materials (shell of thin orange Bakelite and base of genuine Thermoplax) are ideal—high in quality and dielectric strength; low in dielectric capacity and losses. And all metal parts are widely separated, both in the insulation and in air to conserve every last bit of energy received.

Its contacts—the source of losses and noise in most sockets—are of entirely new construction. Each one is a springy clip

Maximum Dielectric Resistance



These Exclusive Features Assure Better Reception

- A Perfect contact. Both sides of tube prong cleaned when inserted—no contact or wear on soldered end.
- B All metal parts silver plated—perfect contact for the life of the set. Silver may tarnish but its contact resistance does not change.
- C One piece contact construction. The binding post is NOT a part of the circuit—the wire to the socket always touches the contact strip which carries the current direct to the tube prong—no joints to cause losses.
- D Convenient terminals for soldering—full length to allow bending down for under-wiring. Ears hold wire in place for soldering.
- E Extra handy binding posts—tight connections with either wrench or screw-driver. Lock washers hold terminals rigid.
- F Wide spacing of current carrying parts both in air and insulation—true low-loss construction.
- G A minimum of both metal and insulation for low capacity. Shell of thin Bakelite—the base of genuine Thermoplax.
- H The tube is held in place by merely a vertical motion—no twisting to separate bulb from base.

"Built by the



The Perfect

that clinches the tube prong without strain; yet cleans it bright whenever the tube is inserted or removed. These contacts are formed of phosphor bronze and *silver* plated—because the contact resistance of silver does not increase as it stands exposed to air. The area of contact is greater than that found in any other socket; and the construction is such that these feeble currents which mean so much in radio pass directly from the wire to the prong of the tube without meeting a single joint. (*In so many sockets the wiring is attached to a binding post to which the contact strip is in turn attached below. This presents a joint which causes noise and losses. The C-H Socket affords perfect connection even if the screw that holds the contact strip in place is entirely removed.*)

Silver Plated Phosphor Bronze Contacts

No Joints to Cause Noise or Losses

In this socket the tube is inserted and removed without turning—just pushed in and pulled out—to prevent twisting the bulb from its base. And the tube is held tight, absolutely rigid so that any vibration cannot cause contact noises. Its small size and convenient soldering terminals, too, mean a great deal in most sets for space is usually at a premium. The Thermoplax base is only $2\frac{1}{8}$ " square—scarcely more than the diameter of the tube, and the soldering terminals extend out far enough from the rounded corners that they may be turned down for under-wiring when this system is used. These terminals have handy ears which are bent up to hold the wire while the solder is being applied—adding much to the ease with which this work is accomplished. For temporary connection, or where soldering is not used, a slotted hex-nut is provided which securely clamps the wire against the contact spring with either wrench or screw-driver.

Convenient and Efficient Terminals

No Twisting to Damage Tube

In all it is as perfect a socket as engineering skill can devise. It offers maximum efficiency and ease of installation, coupled with an appearance that adds much to any set. And best of all you will like the price, 90c. *This socket that meets the specifications of the most exacting radio engineer costs no more than most of those on the market today!* If your dealer has not been stocked, you can be supplied direct from the factory at list price plus 10c for packing and postage.

THE CUTLER-HAMMER MFG. CO.

Member Radio Section, Associated Manufacturers of Electrical Supplies

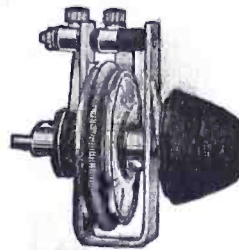
MILWAUKEE, WISCONSIN

Master Builder"

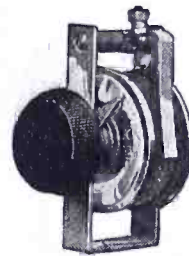
RADIO SOCKET



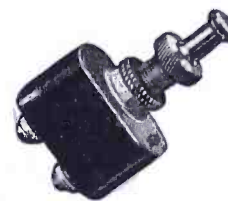
Instruments of Guaranteed
Quality Assure Success
in Radio



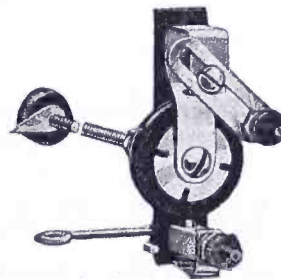
The C-H 4 Ohm Vernier Rheostat
Perfect detector tube control. Also furnished without vernier for amplifier tube control.



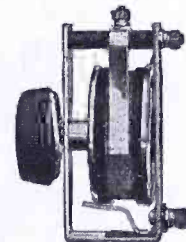
The C-H 30 Ohm Radio Rheostat
For control of the $\frac{1}{2}$ ampere, "UV201-A-C301-A" type receiving tubes and the "UV199-C299" type; also made in 125 ohm size.



The C-H Radio Switch
The switch with the perfect mechanism for providing easy control of the most delicate circuit without introducing microphonic noises—one hole mounting.



The C-H Variable Grid Leak
Mounted on the tube socket-panel controlled. Adjustable for all grid condensers.



The C-H Radio Potentiometer
The potentiometer with the resistance unit that does not wear and cannot be displaced under constant use.

ALL-AMERICAN

now
brings you

DISTANCE, VOLUME AND QUALITY with ONE TUBE

Self-Tuned Radio Frequency Transformers
—Wound to Suit the Tube

OUT of a year of many experiments and numerous failures to achieve in a practical instrument the theoretical possibilities of broad-tuned Radio Frequency Amplifiers, has come a simple but far-reaching discovery: Radio Frequency Transformers can and must be adapted to the characteristics of the particular vacuum tube whose grid voltage they supply. That truth—with All-American scientific research and All-American precision manufacturing—has made radio history.

SELF-TUNED RADIO FREQUENCY TRANSFORMERS have arrived—and All-American, naturally enough, has brought them. Never before has an instrument been built which will amplify so effectively, over the entire radiocast range, as will the new All-American Types R-199 and R-201A. Together with the new Type R-140 All-American Universal Coupler, they have made possible a new standard of efficiency in Radio Frequency and Reflex receivers.



As an example of this, we offer ALL-AMAX JUNIOR (1 Tube) and ALL-AMAX SENIOR (3 Tube). Both are All-American-coupled throughout, and both exemplify the new standard of performance.

Build an ALL-AMAX—using the complete panel scheme and wiring plan shown in your KEY BOOK—and you will never go back to an ordinary reflex set. Distance and power are yours!

All-Americans—Precision-Made for Reliability
Sold by all the Better Dealers

Audio Frequency Transformers "All-American for Reliability"

Ratio 3 to 1 R-12, \$4.50
Ratio 5 to 1 R-21, 4.75
Ratio 10 to 1 R-13, 4.75

Built by Precision Methods in a Modern Plant. All-American Audios are Unsurpassed at any price for Quality Reproduction and Dependable Service.

Long Wave Transformer

For High Amplification and no distortion of side bands at 4,000 to 20,000 meters (75 to 15 Kilocycles) . . . R-110, \$6.00

Power Transformers

For Tone Quality in a Third Stage, or for Loud Volume with Clearness.
Input Type R-30, \$6.00
Output Type R-31, 6.00

An absolutely new kind of book—immensely valuable to both beginner and expert.



ALL-AMAX JUNIOR and SENIOR; also many other good hook-ups.

Sent for 10 cents, coin or stamps.

RAULAND MFG. CO.
2654 Coyne St.
CHICAGO
Pioneers in the Industry

Radio Frequency Transformers
"Self-Tuned—Suited to the Tube"
Effectively amplifying all frequencies within the Radiocast Range.
For "199" Tubes R-199, \$5.00
For "201A" Tubes R-201A, 5.00

10,000 Meter Transformer
It gives superior results in beat reception, filtering out a 30 Kilocycle Frequency with high selectivity and no side-band distortion R-120, \$6.00

Radio Frequency Coupler
(Oscillator Coupler.) A uniform output at 150 to 650 meters R-130, \$5.00

Universal Coupler
Sets a new standard of efficiency as an antenna coupler. As a radio frequency transformer in tuned stages it is unsurpassed R-140, \$4.00

ALL-AMERICAN
TRADE MARK

Largest Selling Transformers in the World

Telmaco Acme Receiver

The Ideal Receiver for all Seasons



The Telmaco Acme Receiver is truly portable. May be instantly removed from handsome carrying case and inserted into beautiful two-tone mahogany case. No outside loop, no aerial, no ground required.

Size of Case 8" x 10" x 18". Weighs only 27 pounds complete. Easily Carried.



Acme 4-Tube Reflex Circuit Used

securing selectivity, distance and volume with minimum battery consumption.

Complete in itself. Easily carried from room to room in your home or to office, neighbors, etc. Take it along and have music, entertainment, speeches, news, market reports wherever you happen to be.

Instantly ready for use as it is. You can use external antenna and ground, loop and loud speaker if desired. 4 tubes (fully protected by shock absorber sockets)—equal to 7 tubes, due to reflexing and use of crystal detector.

Reasonably Priced Write for Free Illustrated circular fully describing Telmaco Acme Receiver.

Complete Telmaco 64 page catalog containing 20 circuits in blue and describing the best in radio sent postpaid for 10c.

Dealers! Catalog and Price List furnished to all bona fide dealers making request on their business stationery.



Quality Radio
Exclusively
Established 1918

Radio Division

TELEPHONE MAINTENANCE CO.
20 South Wells Street Dept. A Chicago, Illinois

TUBE FACTORIES

Continued from page 14

plode into a silvery vapor that adheres to the walls of the bulb. The magnesium has a tremendous affinity for oxygen and other gases; its vaporized molecules therefore tend to eat up or kill all gas particles still in the tube.

There are several very important problems met with in connection with this bombardment. If the high-frequency heating is too rapid, the magnesium will be flashed while comparatively large quantities of gases are yet streaming from the hot nickel. This is disastrous; for, if the vacuum is not very high when the "getter" flashes, it will be unable to "get" all the remaining gas. Furthermore, the magnesium will have a tendency merely to melt, instead of vaporizing. Under such conditions the tube will be a failure.

It is also essential that just the correct amount of magnesium be welded onto the nickel plates. If too little is used the vacuum will be poor; if too much, some of the magnesium vapor will condense on the stem of the tube and cause a high-resistance leak among the mounting wires. A good radio tube with magnesium or silver-colored getter will show a narrow black smoky fringe around the bottom part of the glass bulb close to the base.

The orange-colored tubes on the market are bombarded with red phosphorus instead of magnesium. Phosphorus, like magnesium, has a strong affinity for oxygen and other gases. The patch of white getter seen on the glass stems of some clear-walled tubes is cryolite, a sodium-aluminum fluoride.

The high-frequency current for the bombarding coil is produced by a device that is virtually a C. W. radio transmitter. In Fig. 4 a bombarder is mounted on the wheeled truck beside the operative. Two 50-watt power tubes are used; these can be seen, protected by a small wire caging, on top of the bombarder. The picture of an automatic exhaust machine also shows a C. W. bombarder in the foreground. A short-circuited copper helix is mounted, like a secondary, immediately around the bombarder coil; this helix draws energy from the primary spiral and intensifies the radio-frequency field in the vacuum tube.

After evacuation and bombardment, the tubes are sealed off; that is, the exhausting tubes from the bulbs are melted off with multi-tipped gas torches. The operative in Fig. 4 is sealing off. In the case of tipless bulbs, the exhausting tube is sealed off up in the flare and the remaining tip therefore is concealed in the base.

When the bulbs have cooled, they are "based." The four wires from inside the tube are threaded into the four

Continued on page 54



Type 201A

Airtron Radio Tubes

With the new highly developed dielectric moulded Bakelite base which eliminates all kinds of electrical losses.

AIRTRON TUBES

Speak for quality, volume, and all other characteristics demanded of a Radio Tube. Designed and manufactured to give the highest efficiency that a Tube at the present time can possess.

TYPE 200 —6 Volt. 1 Amp. Detector.

TYPE 201A—5 Volt. .25 Amp. Det. & Ampl.

TYPE WD12—1.5 Volt. .25 Amp. Det. & Ampl.

TYPE 199—3-4 Volt. .06 Amp. Det. & Ampl. Standard Base

EVERY TUBE GUARANTEED

LIST PRICE \$4.00

Sold by all Dealers, or shipped C.O.D. Direct by Parcel Post. When ordering, Mention Type.

DISCOUNT TO DEALERS

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NEWARK, N. J.

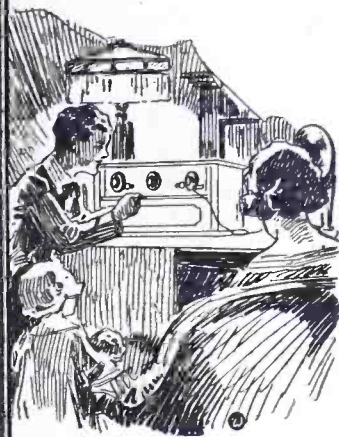
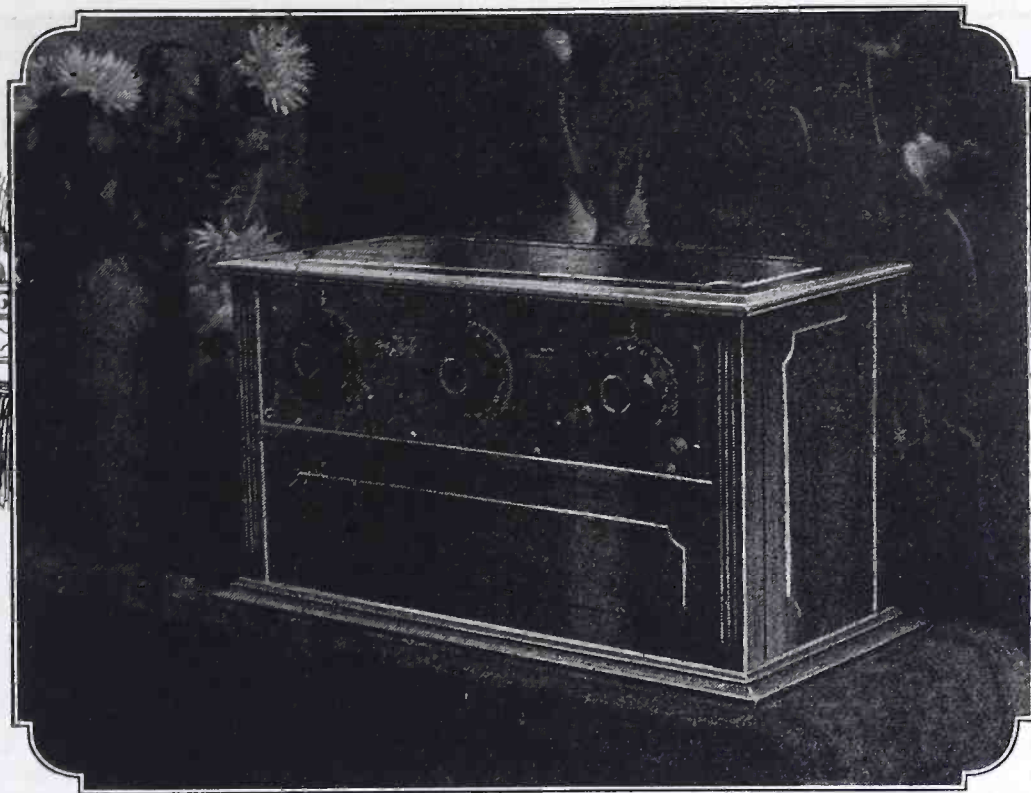
Western Representative:

LESTER'S RADIO SHOPPE, 140 South Spring Street, Los Angeles, Calif.

We are Still Repairing All
Types of Radio Tubes at \$2.50



Easy to Operate



Simple to Control



WHEN you own a Radiodyne you can tune in on broadcast programs without wasting time tinkering. The Radiodyne shuts out interference from nearby stations. By simply adjusting the dials as indicated on the Radiodyne chart you can select the stations you wish to hear. All batteries are enclosed in the beautiful two-tone mahogany cabinet.

Uses a 25 Foot Lamp Coil for Summer Reception



Wife Gets Good Results After Two Minutes Instruction

"We are getting constant reception this summer from stations 500 to 1000 miles away on loud speaker with a 25-foot length of lamp coil. I got Los Angeles, San Francisco and Cuba."

Bernard S. Slay, Minneapolis, Minn.

"I gave my wife two minutes instruction and left her alone with the set. When I came back she said that signals had been roaring in all evening and had a log to prove it."

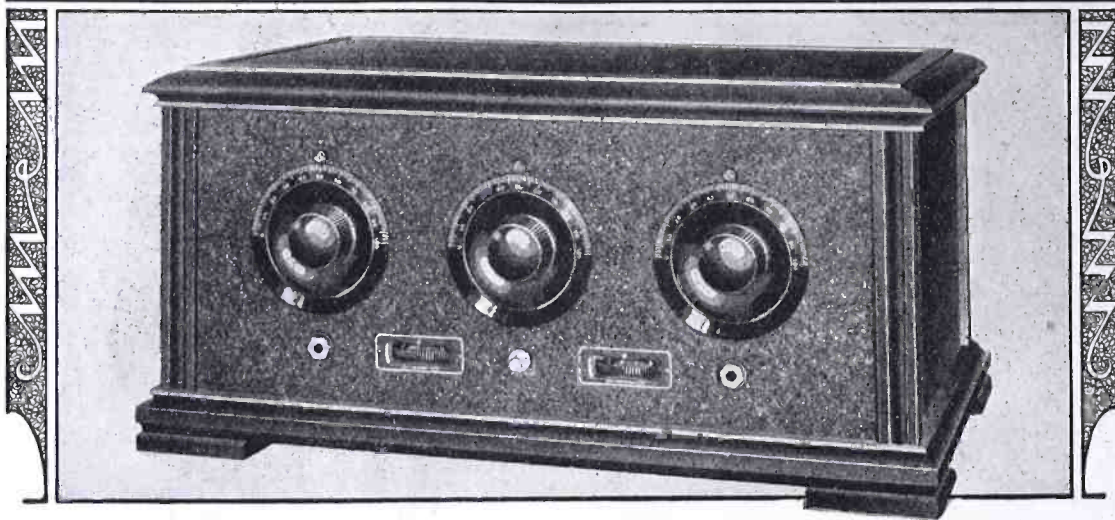
Robert Seldon Rose, Marquette, Mich.

Write for illustrated folder which describes the Radiodyne in detail. If you buy a radio before you have a demonstration of the Radiodyne you will surely regret it

Western Coil & Electrical Co., 311 Fifth St., Racine, Wis.

EISEMANN

ELECTRICAL EQUIPMENT



The Measure of True Worth

SPECIFICATIONS

Circuit: Two stages of tuned radio frequency amplification, detector and two stages of audio frequency amplification. Non-oscillating.

Tubes: Five in all. Jacks provided for either five or four tube operation.

Batteries: Either storage or dry-cells.

Cables: Complete set supplied for "A" and "B" batteries.

Wave lengths: 200 to 600 meters, with uniform efficiency of reception.

Aerial: 75 to 125 feet, single wire.

Panel: Aluminum, with attractive crystal black finish. A perfect body capacity shield.

Dials: Sunken design. Shaped to fit the hand and permit a natural position in tuning.

Rheostats: Adequate resistance for all standard base commercial tubes.

Condensers: Single bearing, low leakage losses.

Sockets: Suspended on cushion springs which absorb vibrations.

Cabinet: Mahogany, with distinctive lines and high finish. Ample space provided for "B" batteries.

EFFICIENT performance, attractive appearance and moderate price are the three basic elements that comprise value in a receiving set, as in any other article. Trick names and catch phrases, used to designate circuits, mean little and often confuse the buyer.

All three essentials are combined in the Type 6-D Receiver.

Performance: Extraordinary selectivity widens the choice of programs. In close proximity to powerful stations, the sharpness of tuning is marked. Far distant points are received with unusual clarity and volume. Tuning is very simple. The three dials are closely matched at all wave lengths, and settings are easily memorized.

Appearance: The substantial mahogany cabinet, with distinctive lines and high finish, is a fitting addition to the living room or library. The symmetrical panel layout and interior construction bear the imprint of advanced thought and skilled workmanship.

Price: \$125.00, without tubes and batteries, creates a new standard of value.



EISEMANN · MAGNETO · CORPORATION
 General Offices: 165 Broadway, New York
 DETROIT · SAN FRANCISCO · CHICAGO

Continued from page 52

socket prongs in the base, which are really small brass tubes; and the bases are then baked onto the bulbs in a machine, with a bakelite or resinous cement. The next operation is to solder the four leading wires firmly into the prongs; this accounts for the solder you find on your prong tips. A loose prong, while not particularly desirable, has no effect on the vacuum or operation of a radio tube.

The final process of tube manufacture, previous to testing, is "aging." Tubes are placed in rows of sockets on a rack, the filaments lighted to full normal heat, and plate voltage applied. 100 volts is applied to type 201A and type 199 tubes. Part of an aging rack may be seen in the background of Fig. 4.

The aging serves to bring the thorium on the filament into an active condition. If the tubes are aged properly, they will have to stay on the rack at least an hour. The aging time can be much shortened by increasing the filament current. The more careful tube makers and repairers, however, adhere as closely as possible to normal filament current and age from twelve to fifteen hours, thereby combining the aging process with an endurance test. A tube that passes curve tests and that has stood twelve or more hours of full filament current and plate voltage without going down is pretty sure to be a good long-lived product.

The foregoing description has dealt almost entirely with the manufacture of new tubes. In the case of repairs, all the processes are exactly the same, except that the "mount" is taken from a burnt-out tube. In repairing a tube the bulb is removed from the base by heating; the tip broken off to relieve the vacuum; then the bulb is cracked with a hammer and broken down until nothing remains but the plate, grid and stem, as shown in the center of Fig. 3.

The new filament is cut to the proper length and welded at each end onto a piece of nickel wire about 1/4 in. long. The filament is then fished into place and the two nickel end pieces spot-welded onto the old filament mounts. Pieces of magnesium are welded onto the plate, the mount is then sealed into a new glass bulb, as shown in Fig. 3, and, from here on, all the remaining processes, bombarding and so forth, are exactly the same as in the manufacture of a new tube. It should be understood that this applies to good repaired tubes; not fraudulent ones. Repaired tubes are sometimes reset in original bases, if these are in good condition.

There is no difference in the operation of tipped and tipless radio tubes. Tubes are made tipless because of appearance, less liability of breakage, and elimination of the sharp glass tips that sometimes hurt young ladies' delicate palms.

The reader will now be in a position to realize what the high-grade manu-

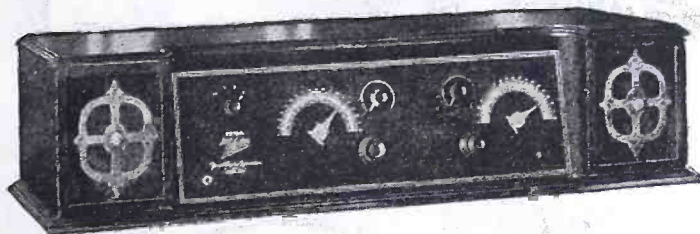
Continued on page 56



Super-Zenith X

New and exclusive Zenith features—including Super-Zenith Duo-Loud Speakers and Zenith Battery Eliminator—make this model supreme in the field of Radio.

Price (exclusive of tubes) \$550



Super-Zenith VII

(Not regenerative)—6 tubes—2 stages tuned frequency amplification—detector and 3 stages audio frequency amplification. Installed in a beautifully finished cabinet of solid mahogany—44 3/8 inches long, 16 3/4 inches wide, 10 3/4 inches high. Door panels inlaid. Slanting panel of sheet bronze, mahogany finish, with scales and indicators in metallic relief. Gold plated pointers, to prevent tarnish. Compartments at either end for dry batteries. Can be operated on either wet or dry batteries. Either inside or outside antenna.

Price (exclusive of tubes and batteries) \$230

Super-Zenith VIII

Same as VII except—built with mahogany legs of well-proportioned appropriate design, converting model into console type.

Price (exclusive of tubes and batteries) \$250

Super-Zenith IX

Same as VII except—built with legs and additional compartments containing built-in Zenith loud speaker on the one side and generous storage battery space on the other.

Price (exclusive of tubes and batteries) \$300



It Tunes Through *Everything* The New SUPER-ZENITH

The new Super-Zenith is NOT regenerative. It is a six-tube set in four different models ranging from \$230 to \$550, with a new, unique and really different patented circuit controlled exclusively by the Zenith Radio Corporation. Amplification is always at a maximum in each stage for any wavelength. *The Super-Zenith line is not affected by moisture.* For the first time, you have here a set that—

- 1—tunes through *everything* and selects the station you really want.
- 2—requires only *two* hands—not *three*—to operate.
- 3—brings in each station *at only one point on the dial.*
- 4—affords such mathematical precision and simplicity that you can run over the entire dial in 1 1/2 minutes and pick up *more* stations with greater clarity and volume than any other set on the market. Direct comparisons invited. The new Super-Zenith was perfected in Zenith's laboratories in the center of the eleven powerful Chicago broadcasting stations. Even under these extremely adverse conditions the new Super-Zenith tunes through everything and "gets the outside" on loop, inside, or outside antenna.
- 5—produces not only the seemingly impossible in perfect selectivity, but also possesses such artistry of design, such finished craftsmanship, that it lends distinction and exclusiveness to any living-room or library.

Write for the name of the nearest dealer from whom you can obtain a demonstration of this outstanding marvel of the radio world.

Dealers and Jobbers: Write or wire for our exclusive territorial franchise.

ZENITH RADIO CORPORATION

Branch Office:
1269 Broadway, New York

General Offices:
332 South Michigan Avenue, Chicago



**Super-Zenith X
Exclusive Features**

Contains two new features superseding all receivers. 1st—Built-in, patented, Super-Zenith Duo-Loud Speakers (harmonically synchronized twin speakers and horns) designed to reproduce both high and low pitch tones otherwise impossible with single-unit speakers. 2nd—Zenith Battery Eliminator, distinctly a Zenith achievement. Requires no A or B batteries or charger.

Zenith Radio Corporation
Dept. 11-H
332 S. Michigan Ave., Chicago, Ill.
Gentlemen: Please send me illustrated literature giving full details of the Super-Zenith.

Name.....
Address.....
.....

ZENITH—the exclusive choice of MacMillan for his North Pole Expedition. Holder of the Berengaria record.

BAKELITE

TRADE MARK U. S. PAT. OFF.



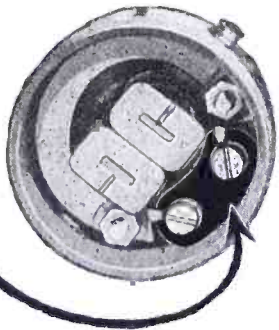
Western Electric and Bakelite

In each of these Western Electric Telephone Head Sets is a molded Bakelite terminal block.

The use of Bakelite by this company, with its years of experience in the manufacture of electrical communication apparatus, is evidence of its value as an insulating material.

Bakelite dials, panels, variometers and other parts are standard radio equipment. Mechanically strong, unaffected by atmospheric changes, and beautiful in appearance, they may be depended upon to render years of good service.

Send for our Booklet "S"



Send for our Radio Map

The Bakelite Radio Map lists the call letters, wave length and location of every broadcasting station in the world. Enclose 10 cents to cover the cost and we will send you this map. Address Map Department.



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Chicago Office: 636 West 22d Street

ELECTRICAL SPECIALTY CO.

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"ROLLS-ROYCE" RADIO TUBES



Like their name, significant of quality. Durable and powerful. Bring in distance with a maximum of volume and clearness.

Type 200... 5 Volts, 1 Ampere Detector Tube.

Type 201A... 5 Volts, .25 Ampere Amplifier and Detector.

Type 199... 3-4 Volts, .06 Ampere Amplifier and Detector.

Type 199... 3-4 Volts, .06 Ampere With Standard Base.

Type 12... 1 1/2 Volts, .25 Ampere Platinum Filament.

Amplifier and Detector

"The Rolls-Royce of Radio Tubes." ALL TYPES... \$2.50

Type 202... 5 Watt, Transmitters, \$3.00

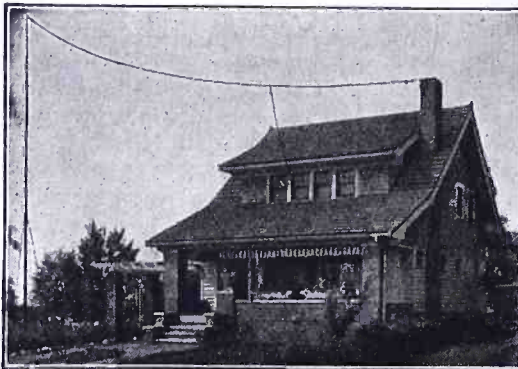
ALL TUBES GUARANTEED

to work in Radio Frequency. Especially adapted for Neutrodyne, Reflex and Super-Heterodyne Sets.

Shipped Parcel Post C. O. D.

When Ordering Mention Type

ROLLS-ROYCE TUBE CO. 21 Norwood St. (Dept. R) NEWARK, N. J.



The HERCULES steel Aerial Mast means greater range and better results. Neat, substantial construction. 20 ft. Mast \$10. 40 ft. Mast \$25. 60 ft. Mast \$45.

Write for FREE FREIGHT offer and latest literature. S. W. Hull & Co., Dept. G 2048 E. 79th St., Cleveland, O.

6 MONTHS FOR \$1.00
"RADIO" - San Francisco

facturing and repairing of radio vacuum tubes requires in the way of equipment, knowledge and skill. A good tube plant cannot be set up for less than \$25,000; yet there are pikers and fakirs operating with equipment that is not worth the price of a second-hand lizzie. These down-cellar repairers have small oil-sealed vacuum pumps and no mercury-vapor pump at all—yet nothing but a mercury-vapor pump will get a vacuum on a type-199 tube. They have no C. W. bombarder, or anything that looks like one. They bombard by heating the filament to twice the normal temperature and applying 500 volts to the plate while the tube is on the air pump. This causes sufficient heating of the plate to flash the magnesium; but the filament is left brittle, lifeless, and completely devoid of thorium—if it ever had any.

Most of the piker outfits buy their filament wire from a notorious Doctor Zak, Zik, or Zip, a fat, flabby East-Side New York junk dealer up in a garret, who operates a clearinghouse for tube sharks, and who buys all the wreckage and cast-off trash from the big tube plants. The large tube makers and repairers, on the other hand, sometimes go as far as to the German national laboratories for filament analysis, and buy remarkably good filament materials in that country.

As already stated, the secrecy of these tube plants is a result of the patent situation. Once a factory gets careless and forgets to lock its doors, it generally comes to grief. All employees are selected with great care and are paid high wages. These factories operate as private "electrochemical laboratories," or "electrical production-research laboratories." Those are some of the names on the doors, but the doors are locked. A stranger cannot get in, even to ask a question.

It seems to me, however, that the corporations holding the tube patents do not get after the independent factories anything like so vigorously as they probably could if they wanted to. As long as the independent factory does not become too prominent or does not attempt to appropriate a nationally-advertised trade-mark, the corporations are apparently rather inclined to let it alone. But, if a plant grows too big, it generally gets jumped on—hard.

The first step in putting an independent factory out of business is to get a "blind" to buy a shipment of the unlicensed product and obtain an invoice from the manufacturer showing the goods furnished. This invoice is photographed; samples of the infringing product are dismembered in the laboratory and the filaments analyzed; then an injunction is obtained. At this point, the officers of the infringing company

Continued on page 58

The
**“SECOND ANNUAL NATIONAL
RADIO EXPOSITION”**

Dec. 2nd to 7th, inclusive

at the

AMBASSADOR ARENA

Los Angeles, California

*An advance showing of the latest
developments in the Radio and
Phono-Radio Industries*

Under the Auspices of

**Radio Trade Associations
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For Space Reservations apply to:

Second Annual National Radio Exposition

603-604 Commercial Exchange Bldg.

Los Angeles, Calif.

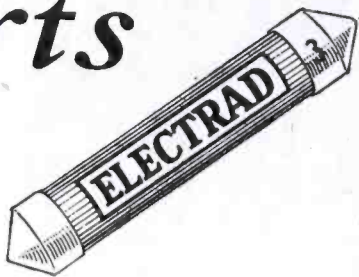
“Profit Sharing with Exhibitors”

ELECTRAD INC.

Parts

of Guaranteed Dependability

CERTIFIED LEAK. The most dependable grid leak made. Absolutely correctly calibrated. Each one tested and permanently set. Price 50c

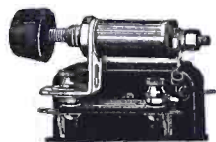


DON'T take chances. Insist on getting Electrad parts and protect yourself by using them. They are the trade-marked products of one of the oldest and largest radio laboratories.

VARIOHM. A scientific variable grid leak. Any resistance from 1/4 to 30 megohms by turning the knob. Guaranteed to increase your distance. Price 75c. Mounted\$1.00



Electrad parts are precise, scientific instruments for radio reception, the finest product of skilled craftsmen.



AUDIOHM. Just try one across the secondary of your transformer. \$1.50 with adjustable bracket.

They cost no more, frequently less. If your dealer cannot supply you, send us his name and the purchase price indicated and we will see that you are supplied.

ELECTRAD, INC.

Dept. E, 428 Broadway, New York

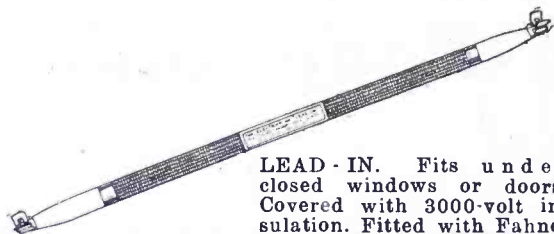
Makers of

Hydrogrounds, Glass Grid Leaks, Variable Grid Leak and Condenser Combined, Grid Leak Mountings, Aerial Outfits, Fixed Resistance Units, Indorarial, Resistance Coupled Amplifier Kits, Verni Tuner.

LIGHTNING ARRESTER. If fire should occur, you can't collect insurance if you haven't a lightning arrester. Get an Electrad. Model passed by the National Board of Fire Underwriters. Price 50c



LAMP SOCKET ANTENNA. Simplest, and most effective antenna. Price 75c.



LEAD-IN. Fits under closed windows or doors. Covered with 3000-volt insulation. Fitted with Fahnestock Clips, soldered connections. Beware of imitations. Price..... 40c

promptly put into effect certain brief legal procedures; the plant is shut down, all machinery is taken up at night, loaded into big motor trucks, and is carried away, to be buried deep in the interior of some huge storage warehouse. Few of the tube machines weigh as much as 1500 pounds, and these can usually be dismantled into lighter sections. When the suing corporation comes to look the place over, it finds the "factory" as bare as a hay barn in the spring.

When the storm has blown over, the tube machinery, if not already out of date, is dragged out of storage, set up on another location, and is soon going again, full blast. The biggest direct loss the tube makers suffer when they are forced to move out is their electric wiring and gas and air piping systems. The power wiring and air and gas piping of a good tube factory alone costs about \$3000, and there is not always time to tear this out. Even if there is time, the material is damaged and re-installation is costly. One ex-manufacturer of unlicensed nitre-gas incandescent electric lamps, an Irishman, showed me a sad-looking pile of torn-up armored cable and battered outlet boxes. This depressing wreckage, he feelingly declared, was all he had left of "livenhundred" dollars' worth of wiring. He had been careless with his door locks and invoices.

The viewpoint of the independent tube makers seems to be that the licensed factories are making immense profits behind the shelter of two or three disputed patents; they feel that as long as they are producing a quality article and giving everybody a fair deal their business is all right. This may be an erroneous attitude; I am not quite sure about it, either way, but everybody sees things from different angles. Unlicensed tube factories must either operate clandestinely or fight about patents in the courts. The endless delays and terrific cost of the latter procedure is apparent to anybody who has followed the still-unsettled legal battles over vacuum tube patents.

The independent tube makers are, at any rate, interesting fellows. They do not hesitate to throw out a five thousand-dollar machine to put in a slightly better one, or to go to Germany to get a filament analysis and buy a new type of mercury-vapor pump. They scrap stuff by the barrel, especially while adjusting new machines. They are completely wrapped up in tubes and tube problems; they will talk curves and grids and getter and electrons by the mile; and I have been in one plant which actually maintains a well-equipped laboratory and a staff of chemists carrying on vacuum tube research—all behind the locked door.

14-inch Bell
Polished Pyralin

Burns

A Speaker of Distinctive Lines

Full volume without sacrifice of clearness or naturalness. The true tones of voice or music are reproduced. Equal to hearing the original.

No. 100 Speaker Unit supplied for phonograph use—fits any make.

No. 205B—Polished black flare....\$22.50

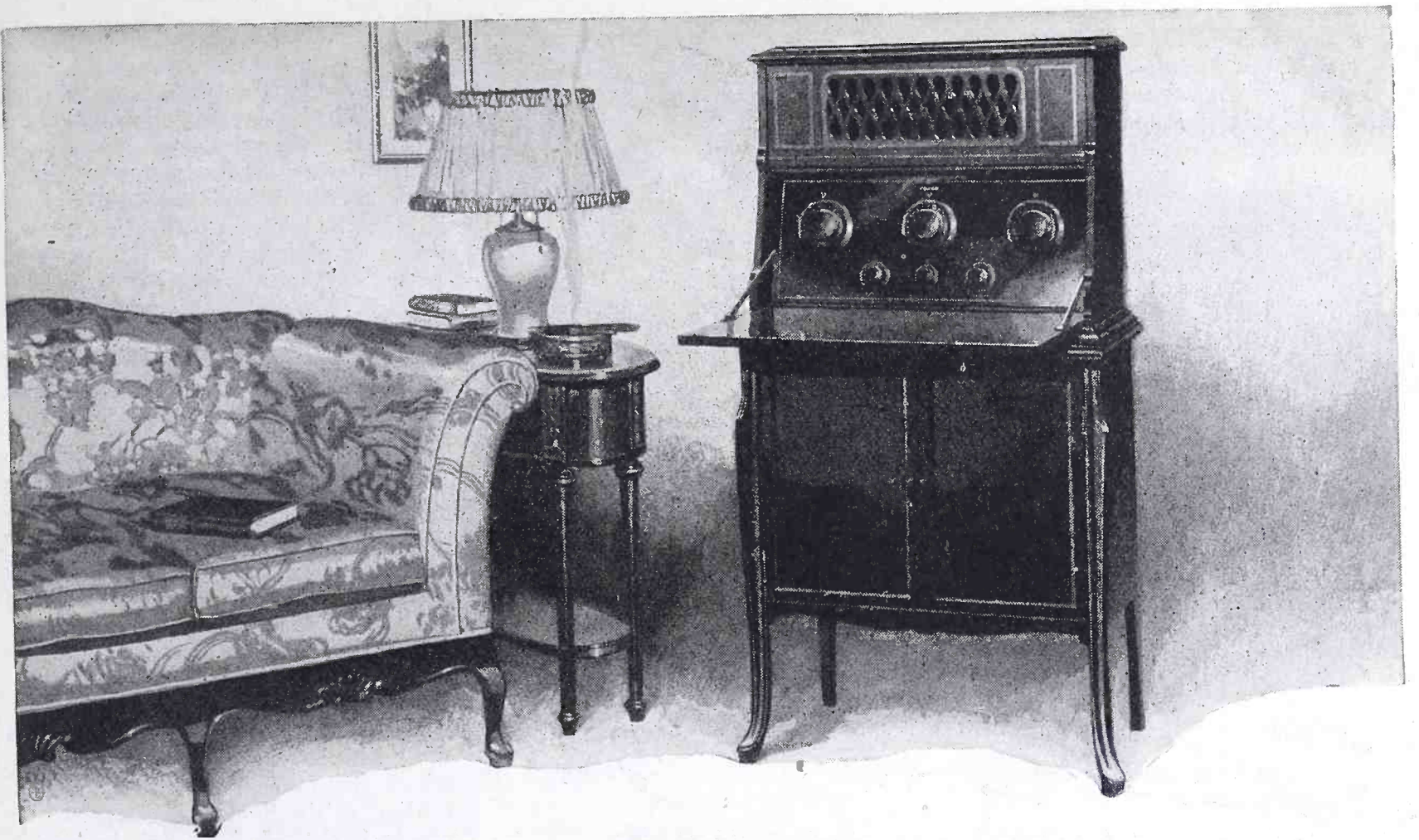
No. 205D—Shell pyralin flare.... 25.00

No. 100 —For phonograph use... 10.00

American Electric Company

State and 64th Streets, Chicago





The FADA Neutrola Grand

new beauty, new perfection in Radio

AN EXQUISITE instrument. Encased in beautifully finished genuine mahogany. A gem of the cabinet designer's art. A piece of furniture that will adorn any home.

Here in this new FADA Neutrodyne is a real achievement in receiving beyond anything you ever heard. Wonderful naturalness of tone. The high C of the coloratura soprano and the lowest bass of the human voice are reproduced precisely as sung. In selectivity the FADA Neutrola is remarkable.



FADA Neutrola Grand

The deluxe five-tube FADA Neutrodyne, with self-contained loud speaker. Receiver and cabinet in genuine mahogany, artistically decorated with wooden inlay. Ample space for all batteries and charger. Drop desk lid that hides receiver when not in use. Price, exclusive of tubes and batteries, \$295.

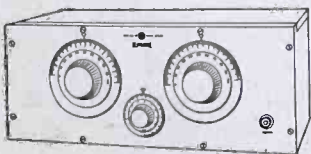
Ease and simplicity of tuning make it the ideal receiver for all the family.

The FADA Neutrola Grand is the finest of the

complete line of FADA Neutrodynes, which includes a model to suit every taste, every radio requirement, every pocketbook. Three, four and five tube FADA Neutrodyne receivers in plain or de luxe cabinets are now available at your dealer's. See them today and make your selection. You will never regret buying a FADA.

You have a range from \$75 to \$295 from which to select — six models, each extraordinary in results; each a remarkable value.

F. A. D. ANDREA, INC.
1581 Jerome Avenue, New York

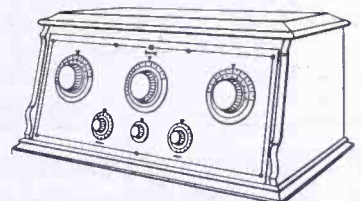
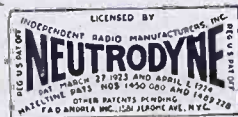


FADA Neutro Junior
No. 195

Three-tube Neutrodyne. A wonderful performer. Price (less tubes, batteries, etc.) \$75.

FADA

Radio



FADA Neutroceiver
No. 175-A

Mahogany cabinet. Inclined panel and roomy battery shelf. Five tubes. Price (less tubes, batteries, etc.) \$160.

Tell them that you saw it in RADIO

Here with a Loaf of Bread beneath the Bough
A Flask of Wine, A Book of Verse—and Thou
Besides me singing in the Wilderness—
And Wilderness is Paradise enow.

OMAR KHAYYAM



MELCO SUPREME RECEIVER

Tuned Radio Frequency

A five-tube receiver that embodies every feature demanded by the most discriminating enthusiast for perfect radio reception. The Melco Supreme really amazes in its performance any time and any place.

Your dealer will be glad to demonstrate. Ask for our literature. It's interesting.



AMSCO PRODUCTS INC.
Broome & Lafayette Sts. New York City.



Western Office, 447 Pacific Bldg., San Francisco, California

"B" BATTERIES

AN

EVEREADY

PRODUCT

At Standard Prices

43V. Batteries, tapped
22½V. Batteries, Navy Type
22½V. Batteries, Commercial Type

Latter two types especially adapted to
Cunningham and Radiotron Tubes.

Postage Prepaid Anywhere in U. S.

ETS-HOKIN & GALVIN

Wireless Engineers

10 Mission Street

San Francisco

Used Radio Apparatus
For Sale at Low Prices

Read the "RADIOADS"
On Page 111

S. HAMMER RADIO CO.

305 Atkins Ave.

Brooklyn, New York

Special!!

**5 TUBE NEW COCKADAY
4 CIRCUIT TUNER WITH KIT**

FREE GENUINE BAKELITE PANEL
Drilled and engraved, worth \$8.00,
with all orders for this Kit received
up to January 1st.

PARTS In this Kit are exactly as specified and
recommended by Mr. Cockaday in the
October issue of Popular Radio, also featured in our new
catalog

WIRED This set wired complete in
genuine mahogany cabinet **\$85.00**
We Specialize in Cockaday Kits

WRITE FOR OUR NEW CATALOG
containing 28 pages, unexcelled bargains in standard
nationally advertised radio accessories parts sets-kits.

Orders over \$5.00 Shipped Prepaid, Money Orders or
C. O. D. One-third must accompany all C. O. D. orders.
Not insured unless insurance charges included.

UNDERGROUND

Continued from page 23

ent "down by the tracks" where Kurt lived, all had a soothing effect upon him, though they seemed strange. And jovial Judge Parker, scholar and true gentleman, knew this and hoped in time to awaken the boy to a realization of finer things in life than coal mining, with coffee and beans. At present he was satisfied to teach the boy the intricacies of the hobby which he, himself, had followed since the days of coherer and crashing helix-enclosed straight gap. Radio!

IT was 9:00 o'clock Saturday evening. Tomorrow the mines would be closed; tonight was the one night in the week when Kurt could sit up for "DX." He was due in a few minutes. The judge, smoking in his snug study, smiled as he heard the garden gate slam. Kurt's shrill whistle floated up to him in imitation of a 500-cycle I. C. W.: "KZ. Hi!"

By humming and clicking his tongue as he whistled, he even managed to duplicate the familiar backwash and the rattling of the headset diaphragms. It was perfect; the judge's smile broke into a roaring laugh as the door opened and Kurt entered. "Good evening, son," he beamed, noting the scrubbed face and clean clothes. "How goes it?"

"Fine, thanks, sir. How's the bottle-smasher?" Mrs. Parker had gotten the boy, in spite of his meagre schooling, to speaking creditable English with little or no accent, but he and the judge relapsed into the slang of the air when they were alone.

"Better'n ever, KZ. I fooled with her a while this evening and the ammeter says eight amps. Like to go up to the radio room right away?"

"You bet. Gosh, sir, I'll bet you work every six between Oregon and Mexico tonight."

"I?" laughed the judge. "Say, boy, if you can shoot the stuff as fast with the bug as you whistled it tonight I won't be chief operator much longer. You know as much about the set as I do, anyway; you might as well operate it. From now on I'll be chief spectator. What say?"

Kurt's nostrils twitched excitedly. He, a poor miner's son, to have the privilege of operating the huge affair of shining metal and bakelite which he knew had cost the judge something in four figures. Of course he had been at the key several times, but for the most part the judge had been content to give him lessons on a buzzer-practice set. He held open the door of the copper gauze-shielded operating room for the older man to enter, then followed, shot home the master switch above the door and slipped into the comfortable Morris chair before the operating table. "What

Continued on page 62

Another step ahead!

ULTRADYNE

The Improved
SUPER-HETERODYNE
MODEL L-2

"Modulation System"-Plus Regeneration

THE new Ultradyne, Model L-2 surpasses all conceptions of sensitivity and selectivity—represents the peak of Super-Heterodyne engineering skill.

To the "Modulation System" which has previously made the Ultradyne famous, regeneration is added in Model L-2. The result is ultra-sensitivity, never before thought possible. The regeneration of infinitely weak signals produces tremendous amplification.

Selectivity is so high and amplification so strong that distant stations can be tuned in through local stations and put on the loud speaker.

This use of regeneration is the latest development of R. E. Lacault, A.M.I.R.E., Consulting Engineer of this Company, and formerly Radio Research Engineer with the French Signal Corps Laboratories, since his perfection of the "Modulation System" which is used exclusively in the Ultradyne Receiver.

The Model L-2 Ultradyne compels so complete a revolution in all previous ideas of Super-Heterodyne performance, that you can only comprehend its unusual selectivity, sensitivity, volume and range by operating this wonderful receiver.



Send for 32-page illustrated book giving latest authentic information on drilling, wiring, assembling, and tuning the Model L-2 Ultradyne Receiver.

50c

Write for descriptive circular

PHENIX RADIO CORP., 9 Beekman St., New York

Ultradyne Kit

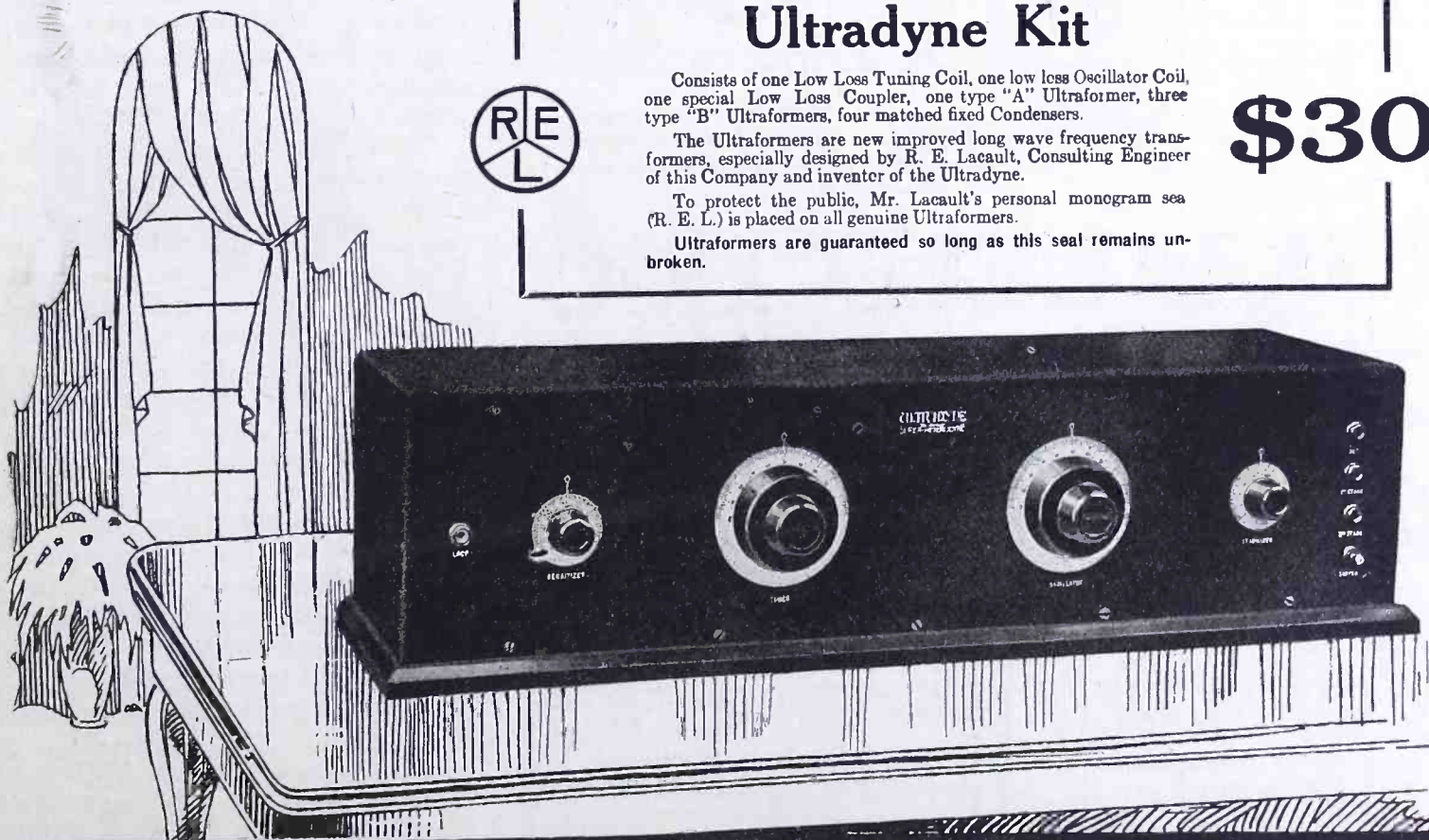
Consists of one Low Loss Tuning Coil, one low loss Oscillator Coil, one special Low Loss Coupler, one type "A" Ultraformer, three type "B" Ultraformers, four matched fixed Condensers.

The Ultraformers are new improved long wave frequency transformers, especially designed by R. E. Lacault, Consulting Engineer of this Company and inventor of the Ultradyne.

To protect the public, Mr. Lacault's personal monogram seal (R. E. L.) is placed on all genuine Ultraformers.

Ultraformers are guaranteed so long as this seal remains unbroken.

\$30



Tell them that you saw it in RADIO



So little to do—such great results

Never has there been entertainment, so much and so fine, that was so little trouble and expense as with radio.

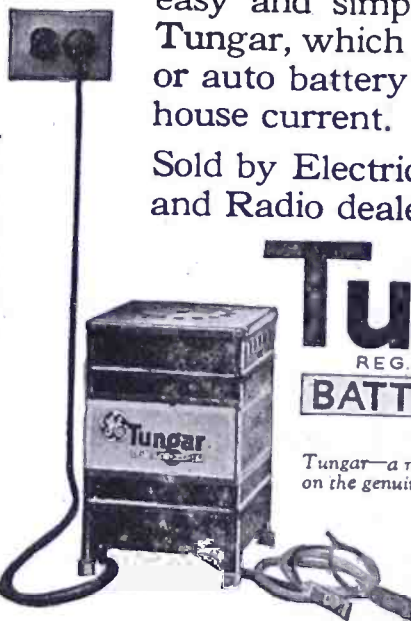
Good programs without limit when that storage battery of yours is fully charged and ready. Perfectly easy and simple if you have the Tungar, which recharges the radio or auto battery overnight from the house current.

Sold by Electrical, Auto-accessory and Radio dealers.



Tungar is one of the many scientific achievements contributed by the G-E Research Laboratories toward the wonderful development of electricity in America.

Tungar Battery Charger operates on Alternating Current. Prices, east of the Rockies (60 cycle Outfits)—2 ampere complete, \$18.00; 5 ampere complete, \$28.00. Special attachment for charging 12 or 24 cell "B" Storage Battery \$3.00. Special attachment for charging 2 or 4 volt "A" Storage Battery \$1.25. Both attachments fit either Tungar.



Tungar

REG. U.S. PAT. OFF.

BATTERY CHARGER

Tungar—a registered trade mark—is found only on the genuine. Look for it on the name plate.

Merchandise Department
General Electric Company
Bridgeport, Connecticut

GENERAL ELECTRIC

48E-12

CLARK & TILSON INC.

Wholesale Distributors of Nationally Known

RADIO SUPPLIES

Since 1921

DEALERS send for price list and discount sheet

554-A Seventh Ave.
New York City

FARAWAY RADIO

\$29.50

Gets stations Far and near Loud and Clear

FARAWAY Radio Sets are amazing values at bargain prices. Users get stations from New York to Frisco—loud and clear. Operate with either dry cells or storage batteries. Beautiful cabinet finished in mahogany with new platinum-finished panel. SATISFACTION GUARANTEED. Don't pay \$100 to \$150. Write for our money-saving plan and literature.

2-Tube Set - \$29.50
4-Tube Set - 59.50

Dealers - Agents: Biggest possibilities you ever heard of. Write for plan and territory quickly.

THE FARAWAY RADIO CO. 659 W. THIRD ST., CINCINNATI, O.

does the milliammeter read now, judge? You know—I can hardly thank you enough for letting me be your 'op.'—but—this set is surely going to be cared for like an only child."

"Er—that's all right, Kurt," said the judge, as he bent forward to look more closely at the meters on the instrument panel. Gratitude always embarrassed him. For the moment he had forgotten that Kurt could not read the milliammeter with his own eyes, so well had the boy found his way about the room, and so easily had he adjusted the dials, his ears telling him their correct positions which his eyes could not see.

Kurt listened carefully for a few moments to see if the air was clear, then gave a long preliminary dash and called a Los Angeles station which he knew the judge had worked. Judge Parker, reclining lazily in the armchair in which Kurt had sat as a pupil, closed his eyes dreamily and smiled as he followed the rapid clicking of the boy's precise sending. He was satisfied now that he could entrust to his protege a really important part in the work which he was carrying on. But it was not until after 1:00 o'clock in the morning when Kurt, jubilant at having worked every district, pulled the power switch and jumped up from his chair to stretch his cramped body, that the judge spoke what had been in his mind.

"Kurt." The voice was serious now. "Yes, judge?"

"I have a portable receiver and transmitter that you have never seen. It was built to my specifications in New York and arrived here only this morning, so I have hardly seen it myself. Do you think you can learn to operate it, and more than that, to really know it and analyze its operation well enough to take notes on its action under very peculiar conditions and later help me to chart 'em?"

"Make charts of the reception and transmission characteristics, you mean? With curves of the voltages, and all that? Why, I think so, judge; I think I can do that alright, but—it's hard for me to follow out a complicated hookup. These eyes, you know—"

"Yes, I know, Kurt. That's all right. The receiver is an improved super-heterodyne—I can tell you that much—but it's tremendously simplified, so it won't trouble you. The transmitter is low-powered—just a single fifty watt using a loop of heavy copper tubing like the Signal Corps sets. The whole outfit fits into a suit case, with binding posts for external current supply. I don't believe you will have any difficulty, if you decide to do me a great favor and take the job."

"I'll do my best, Judge Parker."

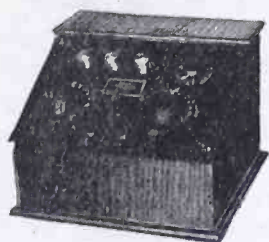
"I'm sure you will, Kurt, always. Now, what I want you to do is this. I

Continued on page 64

Ware NEUTRODYNE Receivers

The popularity of Ware Neutrodyne Receivers is evidenced on every hand by the justifiable pride of their owners—pride in the name, beautiful appearance, and their remarkable performance. To own a Ware is to have at your command the best that radio has to offer.

And there are good reasons for Ware supremacy—a well organized, well financed company; radio engineers of exceptional ability; exclusive inventions; the use of the best materials available; and craftsmanship of the highest order.



Type T

Mahogany cabinet, 10 $\frac{3}{4}$ " high, 14" wide, 13 $\frac{1}{2}$ " deep. Dry cell "A" and "B" batteries enclosed in cabinet. Reflex Neutrodyne circuit. Three dry cell tubes, one reflexed; equivalent to four tube circuit; one stage tuned radio frequency amplification, detector, two stages audio. Operates loud speaker. Outside antenna.

\$65.00 without accessories



Type X

Walnut cabinet, 8 $\frac{1}{2}$ " high, 21 $\frac{1}{2}$ " wide, 10 $\frac{3}{4}$ " deep. Dry cell "A" and "B" batteries enclosed in cabinet. Reflex Neutrodyne circuit. Four dry cell tubes, one reflexed; two stages tuned radio frequency amplification, detector, two stages audio, equivalent to five tube circuit. Double-scaled voltmeter indicates voltages of "A" and "B" batteries. Indoor or outdoor antenna.

\$150.00 without accessories



Type W

Walnut cabinet, 8 $\frac{1}{2}$ " high, 21 $\frac{1}{2}$ " wide, 10 $\frac{3}{4}$ " deep. Neutrodyne, not reflexed, using five vacuum tubes—two radio, detector, two audio—and storage battery. "B" batteries enclosed in cabinet. Double-scaled voltmeter indicates voltages of "A" and "B" batteries. Indoor or outdoor antenna.

\$175.00 without accessories

Send for catalog

Progressive Musical Instrument Corp., New York, N. Y.

Dalrymple-Whitney Radio Corp., New York, N. Y.

Cohen & Hughes, Inc., Philadelphia, Pa., Pittsburgh, Pa., Baltimore, Md., Washington, D. C.

DISTRIBUTORS

Illinois Phonograph Co., Chicago, Ill.

Yahr & Lange Drug Co., Milwaukee, Wis.

Ohio Musical Sales Co., Cleveland, Ohio

Lucker Sales Co., Minneapolis, Minn.

New England Phonograph Distributing Co., Boston, Mass.

Commercial Associates, Inc., Los Angeles, Calif.

D. H. Holmes, Co., Ltd., New Orleans, La.

C. A. Richards, Inc. (Foreign Distributor), New York, N. Y.

THERE are three types of Neutrodyne Receivers now being marketed by the Ware Radio Corporation, described in detail underneath the illustrations on this page. The beautiful tone quality is the same in each type.

Type T is the first three tube reflexed Neutrodyne, and the first Neutrodyne to be operated on dry cell tubes. It is sold at a very moderate price, but its performance is so remarkable in every way that it will more than meet every requirement of most radio users, except that of extreme distance.

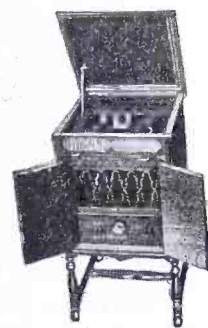
Type X is a four tube reflexed Neutrodyne, also operating on dry cell tubes. This instrument has a greater range than the three tube receiver.

Type W is designed for those who desire the maximum of sensitivity and selectivity, and greater volume than can be obtained with dry cell tubes. It is operated with a six-volt storage battery. This instrument has won an enviable reputation for all-round efficiency, and represents the highest development in radio reception.

Types TU, XU and WU are the same circuits as described above, contained in handsome cabinets with built-in loud speakers.

Investigate the various receivers on the market, but be sure to hear the Ware before reaching a decision. Send for catalog.

Ware
RADIO CORPORATION
529-549 WEST 42nd STREET
NEW YORK



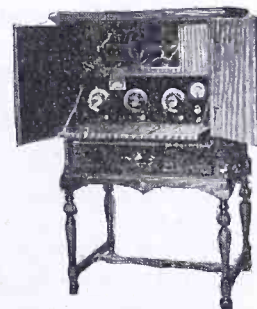
Type TU

Brown mahogany or walnut cabinet, housing Type T circuit. Panel exposed by raising lid. Loud speaker concealed behind grille. Dry cell "A" and "B" batteries enclosed in cabinet. Dimensions: 34 $\frac{1}{2}$ " high, 18 $\frac{1}{4}$ " wide, 18 $\frac{1}{4}$ " deep. \$150.00 without accessories



Type XU

(See WU for cabinet open)
Brown mahogany or walnut cabinet, with panels of contrasting shades. Embodies Type X Circuit. Loud Speaker concealed behind grille at top, below which a desk leaf turns down, exposing the panel. Dry cell "A" and "B" batteries enclosed in cabinet. Dimensions: 44" high, 27 $\frac{3}{4}$ " wide, 18 $\frac{3}{8}$ " deep. \$275.00 without accessories

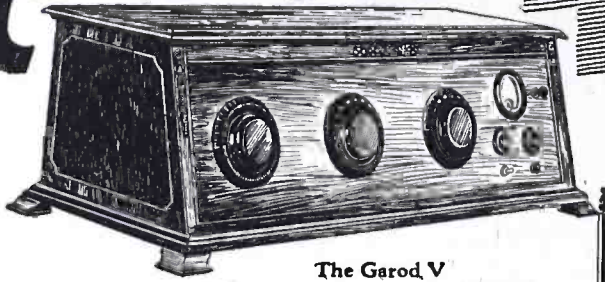


Type WU

(See XU for cabinet closed)
Brown mahogany or walnut cabinet, with panels of contrasting shades. Embodies Type W circuit. Loud speaker concealed behind grille at top, below which a desk leaf turns down, exposing the panel. Storage and dry cell batteries enclosed in cabinet. Dimensions: 44" high, 27 $\frac{3}{4}$ " wide, 18 $\frac{3}{8}$ " deep. \$300.00 without accessories

Licensed by the Independent Radio Manufacturers, Inc., under Hazeltine Patents Nos. 1,450,030 and 1,489,228 and patents pending, and the trademark "Neutrodyne," registered in the U. S. Patent Office, Certificate No. 172,137.

The Powerful **GAROD** Neutrodyne*
Power Plus



The Garod V
 Genuine mahogany highly finished cabinet—graceful 15° sloped genuine mahogany panel—carved feet, five-inch dials—double reading Weston volt-meter—5 tube model. Size 34 3/8" long—13 3/4" deep—11 1/8" high. **\$195.00**

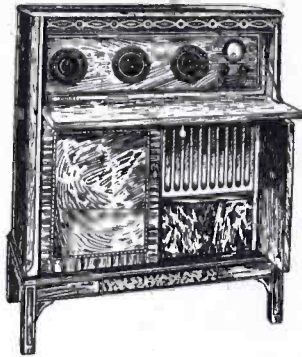
THERE'S far more than mere volume of tone in GAROD POWER.

For a more complete understanding of our meaning—we refer you to our old friend, Noah Webster—of dictionary fame. In his list of synonyms for POWER—you will find the following:—ability, energy, force, might, strength. Of these, we like "ability" best—but even Webster hasn't quite explained the meaning of POWER as applied to Garod.

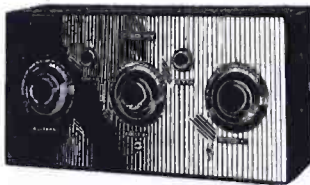
GAROD POWER lies in the ability of the Garod to receive radio broadcasts in such a manner as to overcome the annoyances, interruptions and extraneous sounds commonly encountered in the ordinary "set," and receive precisely as is ideally and theoretically intended. The matter of distance is a mere detail of Garod reception.



To Own One is to Know
 the Best in Radio Reception



The Garod Georgian
 Rich brown burled walnut, with door-panel borders of inlaid ebony and holly—5 tube model—built-in loud speaker—battery compartments and accessory drawer. Will grace the finest drawing room—provide the best in radio reception. Size 35 1/2" long—16 3/8" deep—42 1/2" high. **\$400.00**



The Garod RAF
 The receiver that made GAROD famous. Added mechanical improvements—4 tube model—with which you are familiar. Size 19 1/2" long—7 3/8" deep—10" high. **\$135.00**

THE GAROD CORP.
 120 Pacific Street
 Newark, N. J.

Continued from page 62

have been experimenting on paper—"the white-haired judge smiled—"with underground radio. I am getting too far along in years for active field work, so I am asking you to take the portable down into the mine and make some daylight and nighttime tests. The Bureau of Standards have given me a special call for the period of the experiments—KXX—and I'll see to it that your boss lets you off work for a week or so. I'll pay you twice the wages you get at the mine."

"Judge," said Kurt, proudly, "you know very well that I'm not worrying about the salary. As for my actually being able to help you, I am only too glad to be given the chance; I had been afraid that I was so deeply in your debt that I could never even begin to repay you. I think I really ought to thank you for the privilege instead of accepting pay from you, except that the family depend partly on me. Gosh—how can I ever show you."

"Tut-tut. Sh-h-h," chided the judge, coloring like a schoolgirl. "You make me feel foolish. Run along home now story; it's true."

* * * * *

"YOU haven't said anything about your old C. W. yet that a good spark can't duplicate," interjected the learned spark enthusiast who had been a ship operator.

"Shut up," returned the learned C. W. enthusiast. "Listen to the pretty story; it's true."

* * * * *

AGAIN it was 9:00 o'clock in the evening. For the third consecutive night Kurt stood with the members of the night shift on the floor of the cage elevator which rested at the top of the vertical main shaft, ready to plunge down to the depths below and carry the men to their work. As new arrivals came, they spoke to Kurt first, either in Czech or in English, then to others whom they numbered among their acquaintance. "Lo, Zemke." "Evening, Kurt." He smiled as he returned the greetings, shifting his grip upon the handle of the heavy suitcase which he held off the floor where vibrations might affect its sensitive interior. It was good to be known and liked by these men.

Somewhere above their heads in the shadows a shrill whistle sounded twice, and the cage dropped rapidly. Levels flew by, levels where men were working; brief flashes of yellow light followed instantly by long lengths of blackness. It was an odd thing that the quick splashes of yellow impinged themselves faintly upon Kurt's brain through his opaque lenses. Sometimes he wondered if he were really blind, after all, but he had never given the matter much thought, for as surely as he left the shaft and

Continued on page 66

RADIO long-distance COMPLETE sets

THESE are the finest long distance sets at the lowest prices in history. Wonderful new circuit that brings amazing results. SATISFACTION GUARANTEED. Everything furnished with complete sets. There's a set for every pocket-book.

- 4 tube set—with 3 dry cells, B Battery, 4 tubes. **\$57.95**
- 3 tube set—with 3 dry cells, B Battery, 3 tubes. **\$49.95**
- 2 tube set—with 3 dry cells, B Battery, 2 tubes. **\$32.95**

The above 3 sets can also be furnished for use with "A" storage battery instead of dry cells, \$12.00 extra.

- 1 tube set—with dry cells, B Battery, 1 tube. **\$19.95**

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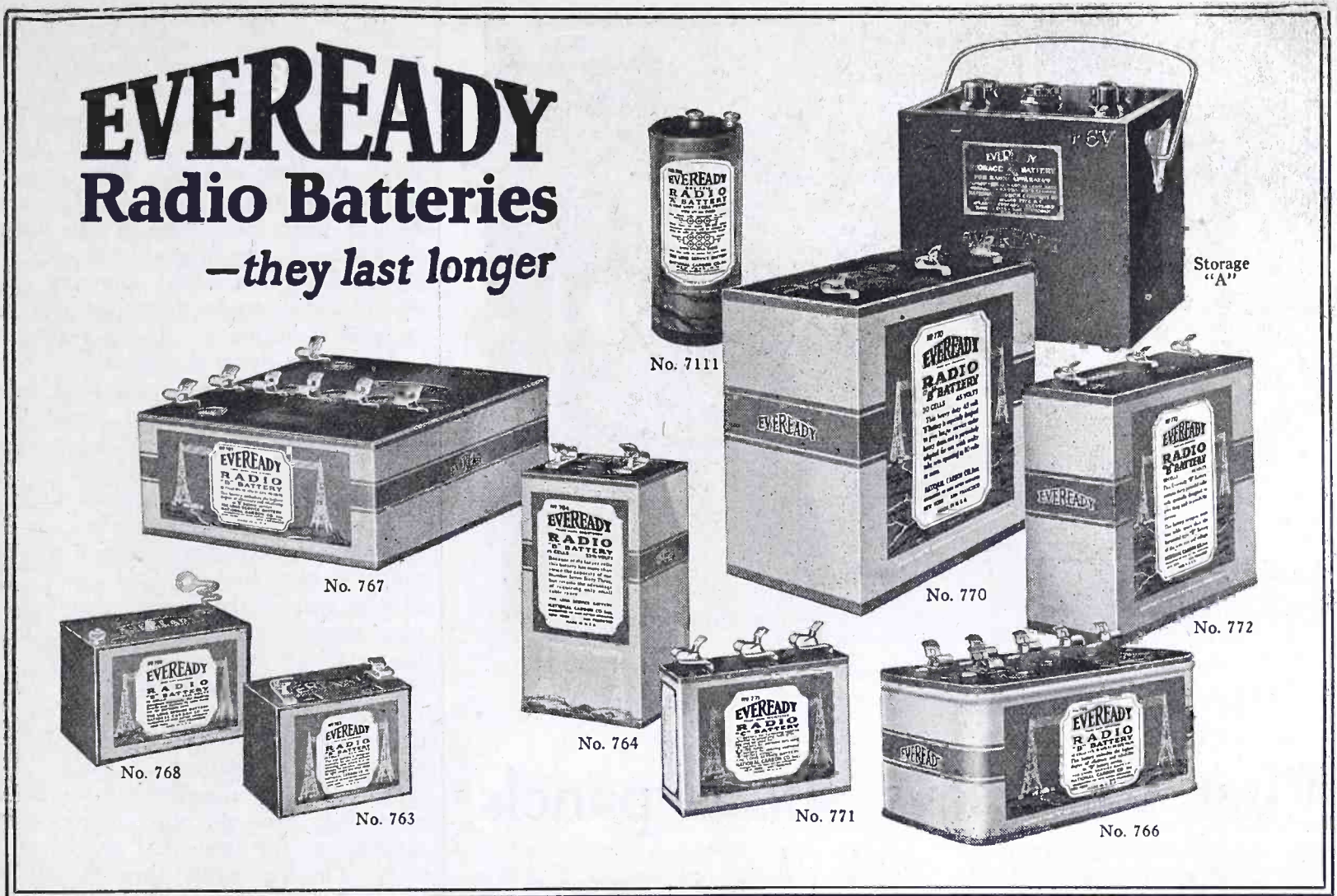


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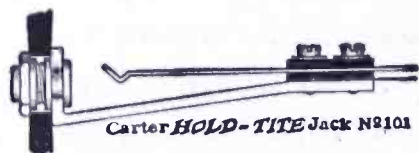
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70c

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walked in daylight, all became dark again—four, five, six, seven, jerk! The cage stopped and Kurt and the men who were to work in Seven, the lowest level in the mine, stepped out and started down the long passage. The cage shot up again to the surface. Used to it all as they were, each man felt an instant of despair as the lights in the cage disappeared from view, knowing that should it fail to be there later, he was as good as buried in a living grave.

It was hot down there in the Seventh. The men were already stripping themselves to the waist; Kurt heard their grunts as they pulled off heavy shirts and jerseys. For a distance of 300 yards or so from the main shaft the coal had been pretty well worked out, a space having been cleared which was not unlike a vast, low-ceilinged room. The illusion was spoiled by the massive propping timbers and the pair of narrow tracks which ran across the floor and into a black hole at the far side of the rectangular place, the entrance to the new workings which lay separated from the old by a partition of shale. The shale had been tunneled, and the tracks now led through this bottle-necked aperture to the fresh coal on the other side. The men passed through and fell to work with their picks and shovels. Kurt remained in the bottle-neck where the noise would not disturb him, though it would be necessary for him to occasionally make way for one of the bumping, squat, little coal cars as they were rolled along the tracks to the cage shaft.

Kurt lifted back the lid to the suitcase, carefully—almost tenderly. He was perplexed. For two nights, now, he had been unable to hear a sound. The set worked marvelously in his own home, but the moment it was taken underground its entire action seemed to undergo a change. A thousand volt direct current line ran on insulators along the black wall above his head, dangerous, but necessary to charge the screen wires of the air purification system by which all particles of coal dust were removed from the air circulating in the flues. He clipped on to this line with an insulated pair of clips and lit the filaments, supplied from step-down resistances, though there were transformers for A. C. Hiss-s-s! And that was all! Tears of vexation came to the boy's eyes as he realized that the third night was to be as unfruitful as the other two had been, and that he would have to report another failure to his benefactor. All he could pick up was the man-made static of the high tension discharges of the air cleansing machine.

He was calling KXX and alternating with CQ's when it happened. There was a slow, rumbling sound, as of a waterfall, which was followed instantly

by the machine gun reports of snapping timbers suddenly unable to bear the tremendous weight which rested upon them. Followed a chaotic roar, a sharp shock, and a nauseating sense of confinement as the draft of cool air was shut off. The ceiling of the old "room" which lay between the men and the shaft now rested upon the floor. Kurt, with the others, was cut off from the one exit by thousands of tons of caved-in coal, paying for the folly of a superintendent who did not believe in the frequent inspection of propping timbers.

Kurt heard the shrieks of men and the rushing tread of their heavy boots as they rushed past him through the shale tunnel and flung themselves upon what they found at its far end. It was useless, the bottle-neck was sealed with a seal solid enough to last until doomsday. He curved his body over the suitcase, determined to protect the radio set from destruction at the hands of any of the half-crazed Slovaks, and from their flying feet. Already his mind was working, trying to find some way out of the dilemma, though he was not greatly worried as to whether or not he should be successful. For himself Kurt felt no fear. One had to die some time; that was karma. And he had been cut off from the light of day all his life. Not so the others. The Slovaks were screaming.

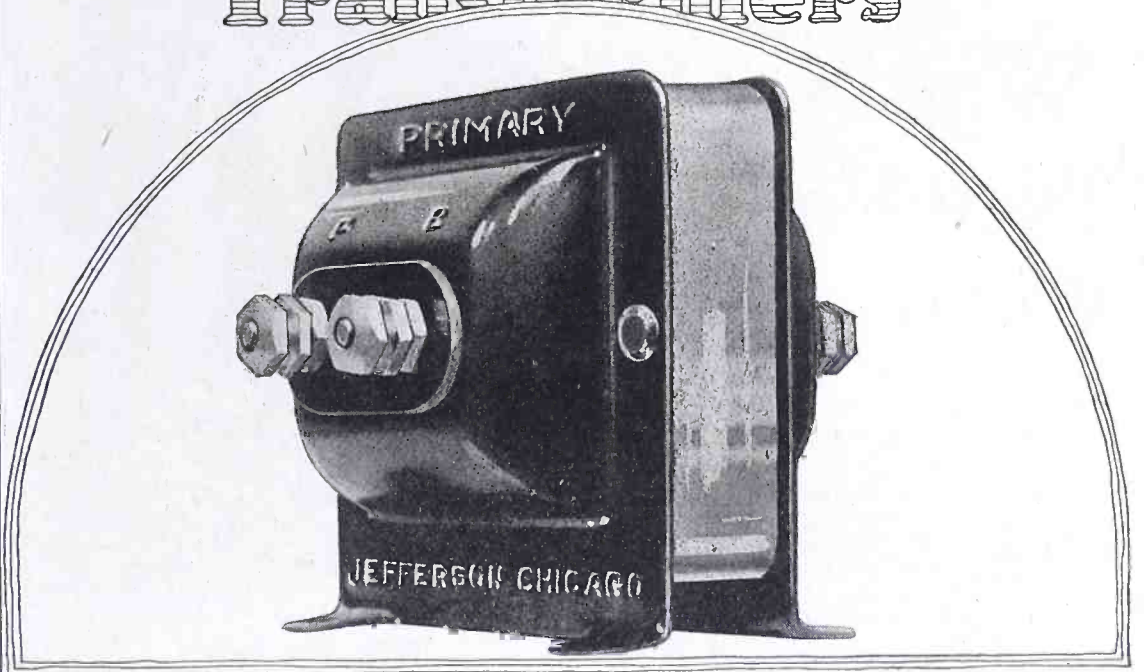
"Men," he called! "Come here. It is blind Kurt, who calls. Come, but come quietly." Silently they came, white lipped, fighting for control, emulating the example of one whom they shamefacedly realized to be the youngest amongst them. "Men," spoke Kurt, lapsing into the Czech tongue, "Go you into the new workings and lie down. Side by side, all in a row, like true brothers, and go to sleep. Thus you will use up but little air, and thus also will we be found, showing our manhood to those above who will find us, if we must die."

"There is but air enough to last until tomorrow morning," mumbled a miner.

"That is true," said Kurt. "Go you now and do as I say. If you can not sleep, then lie quiet and pray. Do not think that I am asking you to do this thing for no reason. I will try to save us all, but I can not promise. You can do nothing with your tools; perhaps I can do something with this black box. Let us hope."

The men filed away, shuffling their heavy shoes. One or two were weeping, silently. No man spoke though all were praying. Kurt busied himself with the set. The thousand volt line had gone dead a few seconds after the cave-in; the head electrician on the surface had no desire to electrocute any of the poor devils entrapped below. "Blow out your safety lamps," Kurt called in

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to the men. Kurt needed no light, and lights took oxygen. Swiftly he worked, detaching the loop and clipping and insulating the high tension line which was now dead, to form a makeshift antenna. Thank heaven they had not cut off the 110!

"Anton!" he called.

"Yes."

"Anton, how far above us is Number Six Level?"

"A hundred feet, I think. I do not know for sure, and I do not care. I am ready to die, and I know that you but talk to make it easier for us. The black box can not contain magic enough to save us."

"Close your mouth," said Kurt. "Hermann, is there not a bottle-neck through shale in Six as well as in Seven?"

"Yes, there is," growled the gorilla-like Hermann.

"Is it not true that the bottle-neck in Six inclines sharply downwards?"

"It drops all of thirty feet. It is so steep that one's feet slip when one walks through. They do not work in Six any more."

That was enough to know. Kurt had only wanted to refresh his memory. He adjusted the phones and re-lit the filaments. He pressed the key, and the snarling A. C. groan almost deafened him. "KXX, KXX, KXX—SOS, SOS, SOS—KXX, KXX, KXX—" Why had he not thought to use a real antenna on the other nights? A loop was no good compared to even the makeshift affair the set was hooked to now—"KXX, KXX, KXX—SOS, SOS—"

And so on through the night. For hours he called, changing hands when his wrists tired, and stopping at intervals to listen. No sound rewarded him. "KXX, KXX-1. SOS, SOS, de KXX-2." Kurt had come down the main shaft at 9:00 o'clock. It was now after 2:00. "KXX, KXX—SOS, SOS." The air was growing foul. "KXX—KXX."

He wept for joy, though he could hardly believe his tired ears, when he heard, so faintly as to make him doubt that he really heard.

"KXX-2 de KXX-1. Thank God. I get you, KZ ga."

Kurt replied slowly, his hand trembling like a leaf.

"Is Number Six clear, judge?"

In the great white house on the hill a pale man with tears streaming down his face ran to the telephone. The line had been closed to all other traffic than that which flowed from the house on the hill. At its far end a man sat in the office of the company, waiting. "Is Six clear? Tell me if Six is clear so I can tell my boy down there!" the judge gasped. Six was clear, the man at the other end said. The news went over the town like lightning that Judge Parker was in communication with the

entombed men. Hysterical women who had men below knelt in the mud of the streets and prayed to God and Judge Parker in the same breath.

Down in the blackness Kurt heard, "Supe says Six clear. ga." Kurt smiled. It would never do to let the judge hear a shaky "fist." He steadied his hand and sent, as precisely as if he had been in the comfortable Morris chair:

"Tnx. Tell Supe to dig on far side of shale bottle-neck 300 yards from main shaft in Six. We directly below it. Must reach us in five hours, or—" A sudden overload or kickback in the twisted electric wires blew out the lone fifty watter as Kurt quietly fainted.

At 6:00 o'clock in the morning dirt and coal fell into Anton's open mouth as he lay snoring, and the first of the rescuers fell through the ceiling and landed upon him. Fifty men, working in shifts, had dug seventy feet straight down from the floor of Six, in three and one-half hours.

Over a steaming breakfast Kurt explained how, being blind, he had had to learn the lowest and highest places in all the levels and so had been able to inform the superintendent the best place in which to dig. Anyone who could operate a radio set would have thought it all out as well as he had and would have acted just the same, he insisted.

"I knew," he said, "that you people on the surface would think we had had time to rush for the cage shaft. You would think that we had been caught and buried in the big room—the old workings in Seven, and you would dig there. Yes, you would have tried to dig out all of the old workings, while we were dying in the new room on the other side of the vein of shale. Three hundred yards deep, the old room is. That would have taken longer to dig than seventy feet. So I told you to go into Six and dig down to us. If the radio had not told you where we were—you would have found us all lined up and waiting for you, eh, Anton?"

* * * * *

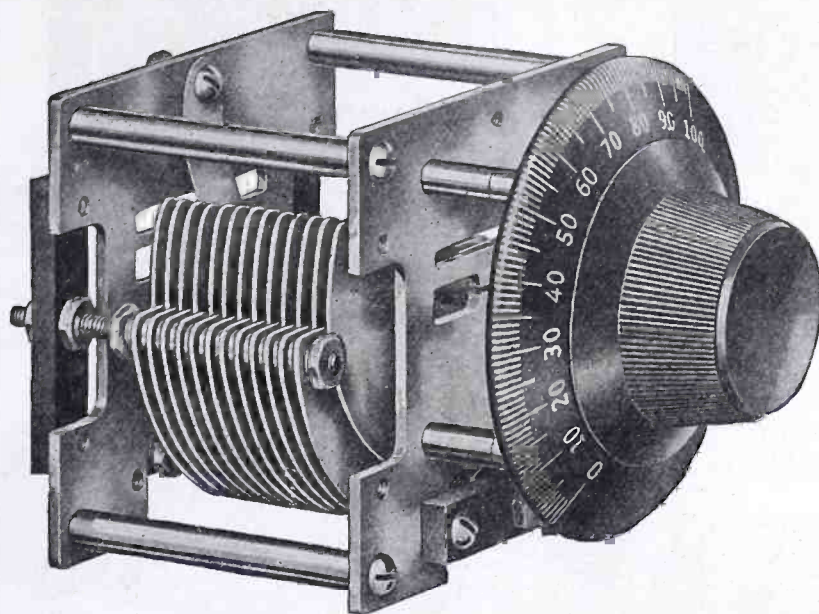
"AND as dead as door nails," said the learned spark enthusiast. "Young Zemke should have been a ship operator with that cool head of his. Ahem! But what the devil has it all to do with Spark vs. C. W.?"

"Kurt is a ship operator now," answered the learned C. W. enthusiast. "When the doctor discovered that all that was wrong with his eyes was a bad pair of cataracts and fixed that part of him up, good old Judge Parker got him the job he knew would make him happiest."

"But still I don't see, dammit."

"Oh, yes! That was the funny part of it, you know. Remember how Kurt called and called, using that lousy antenna and low voltage alternating cur-

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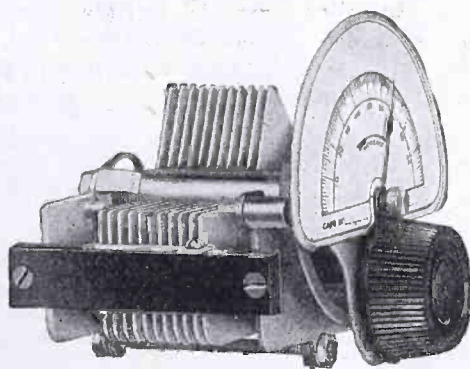
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rent on the plates? Well, a week later he had 'SOS RCD' acknowledgment cards from three districts and twenty-seven stations."

50-200-METER RECEIVER

Continued from page 34

denser the circuit will be found to oscillate as low as 50 meters. I am still experimenting with this circuit to get down lower than 50 meters, which I believe will be possible by trying different

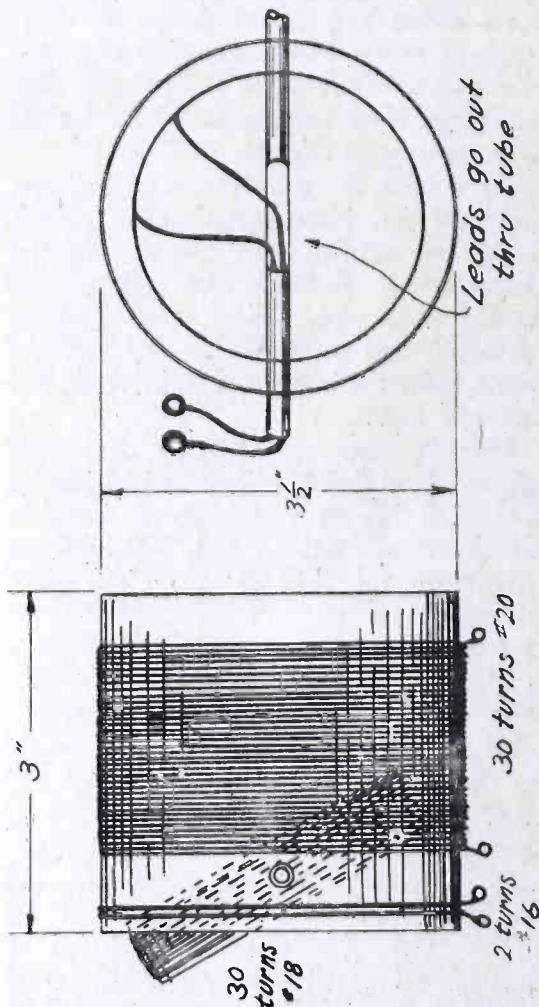


Fig. 2. Details of Tuning Coupler

tubes that might oscillate below that wave, also increase the number of turns on the tickler coil.

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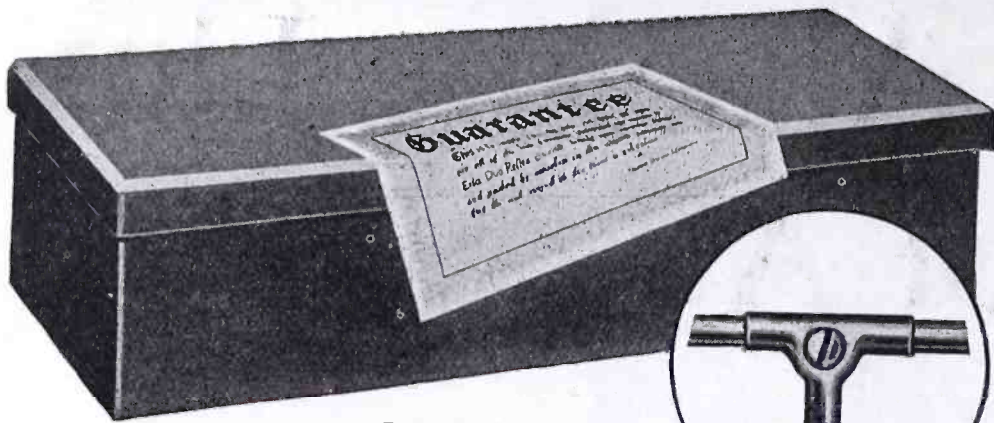
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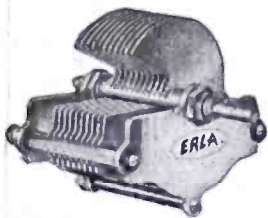


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ELECTRICAL RESEARCH LABORATORIES
Department H, 2500 Cottage Grove Avenue, CHICAGO

ERLA

SHORT WAVES

Continued from page 10

the use of the Army, limiting conditions are imposed that make the problem difficult. The amateur and the builder who provide apparatus for the public are not limited regarding weight, space and strength. Their radio apparatus can be spread out on a spacious table or built in a beautiful mahogany box. The Army must build its sets so as to be divided up in small units to be distributed to various corners in the fuselage of an airship, to be so light and portable that a soldier can carry the set, to withstand the rain and snow of a campaign or the jolting of an Army wagon. The limiting conditions regarding weight and size are especially important in Army sets.

It appears that the use of the short wave system will materially aid the Army in solving these radio problems, and the Signal Corps is studying these problems in its laboratories. Experiments are being conducted to obtain necessary data on which to base conclusions in regard to the merits of the system and the design of apparatus. An army operating in the field today requires a large number of channels of communication, some for telegraph purposes and some for the transmission of the voice. Long wave transmission limits the number of radio channels and requires that dependence be placed on wire lines for the remainder. Reliability, however, is the most important requirement for these channels of communication to be used in tactical operations. Ten reliable channels of communication within a field army will be of much greater value than fifty channels of doubtful reliability. The Signal Corps is therefore carefully studying the situation, not only with a view to increasing the number of channels by means of the short waves, but to determine the degree of reliability which can be placed on that means of transmission.

The new short wave problem presents an interesting field for investigation to the amateur, which he is already investigating and testing, and it will not be surprising if within the next few months interesting developments will come not only from the laboratories of scientists, but from the improvised apparatus of Young America.

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The Rectigon charges radio batteries over-night at less than one-tenth of the price paid for the same service at the battery station.

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Westinghouse

6-TUBE NEUTRALIZED RECEIVER

Continued from page 21

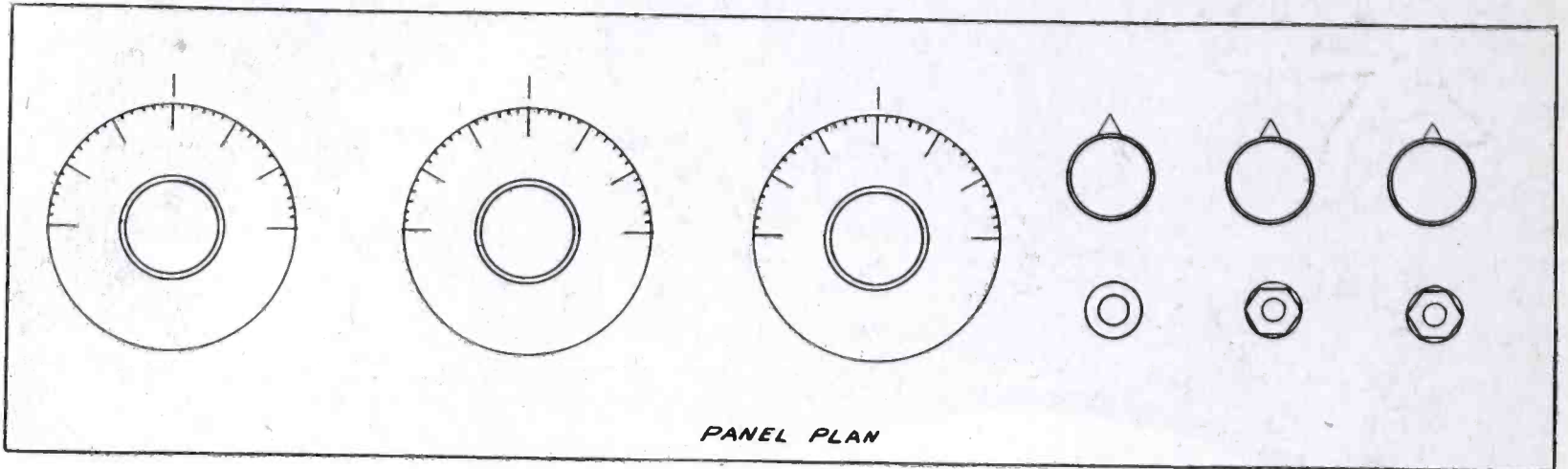
the negative end of the radio-frequency transformer.

The audio-frequency transformers should have a ratio of not more than three to one. While it is generally believed that three stages of audio-frequency will give howling and distortion, if good transformers of standard make are used, and the plate and grid of the last tube are shunted by a .001 fixed condenser, it will be found that they will

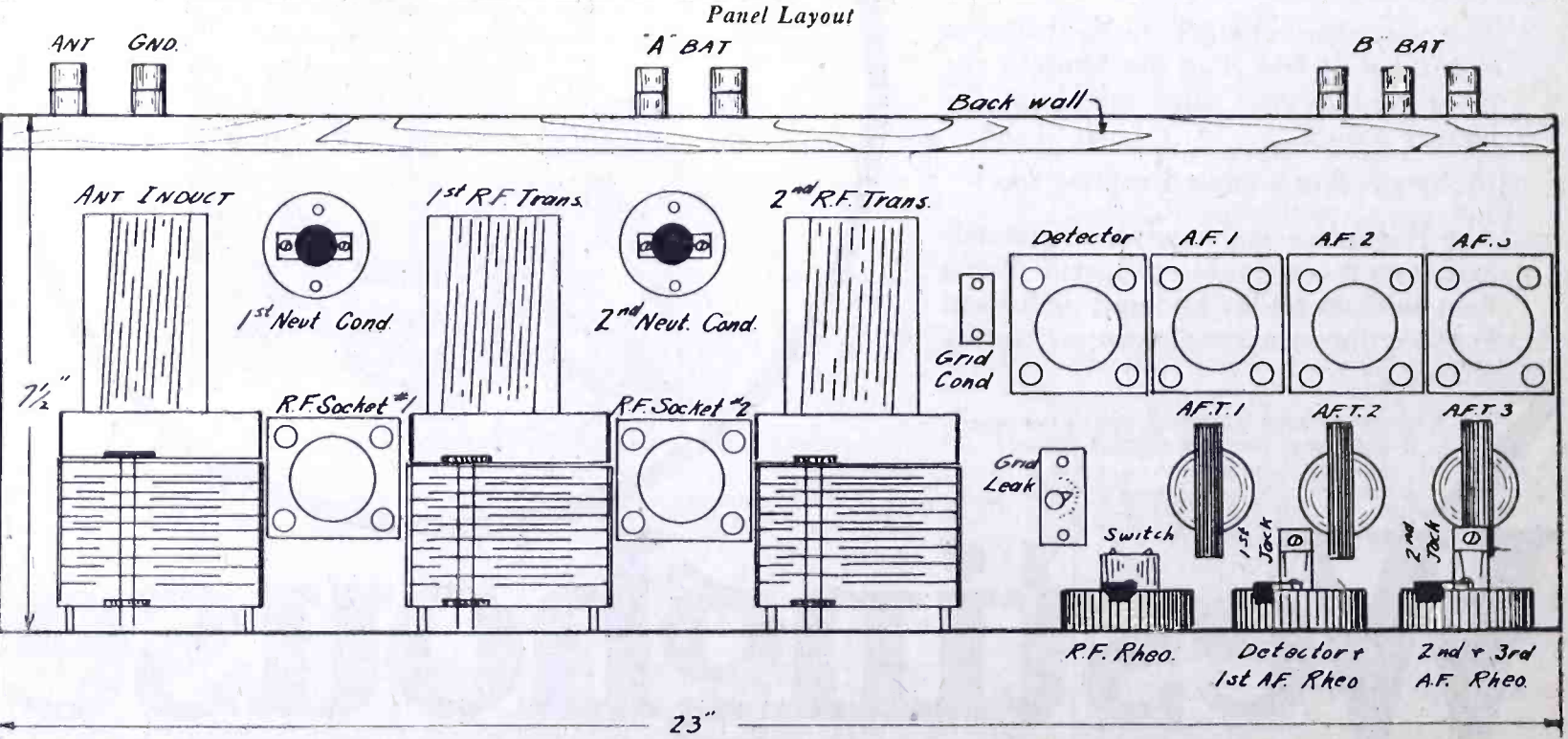
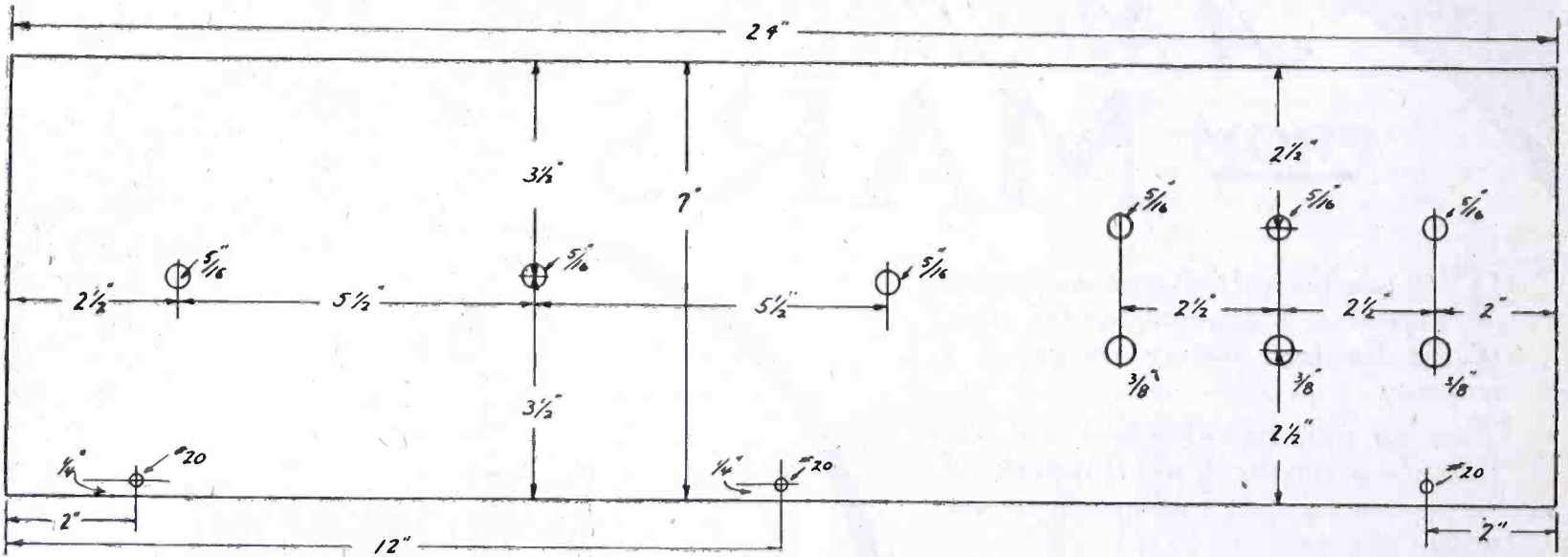
operate perfectly, as a general rule. In the event that there is still a tendency to distort or whistle on the last stage, this condenser should be shunted between grid and filament of the last tube, and in case this does not prevent the trouble, it should be shunted across grid and filament of the fifth tube. I have not yet known a three-stage audio-frequency amplifier that would fail to yield to one of these forms of treatment. With the condenser in one of these specified positions, it will be found that the tone of received speech and music will be

deeper than if the condenser were omitted, but the effect is not displeasing to the ear.

In most neutrodyne type circuits, it is customary to run the grid return lead to the positive side of the filament. In the circuit diagram shown herein, it is brought to the negative lead. Should it be run to the positive, and one of the neutralizing condensers be screwed down too far, a short of the *A* battery through the radio-frequency transformer will result. In the event that the connection should be made to the posi-



Panel Plan



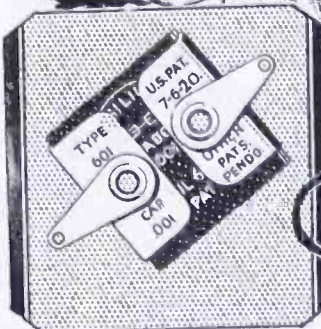
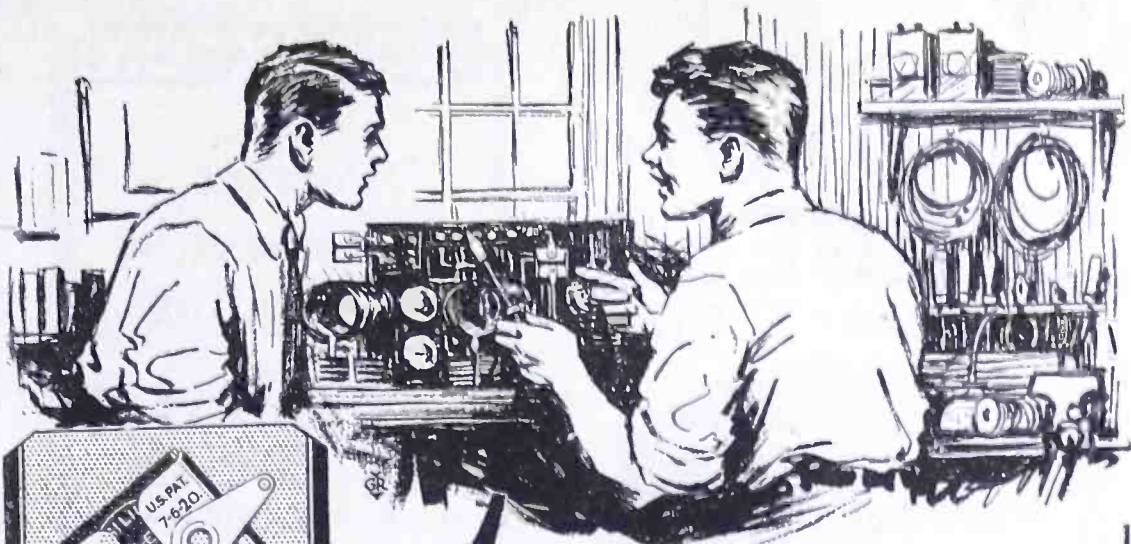
tive side, it would be well to place a small bit of empire cloth between the two plates of the neutralizing condenser, to prevent the possibility of this happening.

In wiring up the assembly, the main panel is detached from the baseboard, and as much wiring as possible on the units on the baseboard is done first. The panel is then replaced and connections made to the necessary points. The backboard is screwed to the baseboard last. The purpose of this backboard is two-fold—first, to provide a wall between the assembly and the *A* and *B* batteries where they are mounted inside of the cabinet (as they should be from the standpoint of convenience), and, second, to allow placing a wood cover from the backboard to the panel of the instrument, thereby providing effectual protection to tubes and interior mechanism from prying hands. If desired, however, the backboard and binding posts may be left off, and flexible leads brought out for the various connections.

After wiring, and checking up the circuit carefully, the instrument should be connected to an average outside antenna for test. The three dials should be set around, say, 40, with the rheostats at about half brilliancy on a new set of three dry cells. At first test it is advisable to plug in the head receivers on the last stage. Leaving the first dial set on 40, vary the other two dials at the same time, until a hissing, bubbling noise is heard in the receivers at a particular setting. This is the "background" and indicates that the three tuned radio-frequency transformers are now in resonance at a certain wavelength.

In hunting for stations, the whole trick of neutrodyne tuning is to set the three dials at the lowest point that it is possible to obtain the background note, and then to follow this background up the whole scale of the dial. On 23 plate condensers, the tuning will be quite a little bit sharper than on the 17-plate type, and it will be found in searching for distant stations that the dials should be advanced not more than two degrees at a time. The 17-plate condensers will admit of four degrees advance as a rule. It will be found that the full sharpness of this type of receiver is secured only when all three dials have been given a setting, the changing of position of one dial only not being so effective.

In the first test the two neutralizing condensers should be wide open. To prevent capacity effects from the hand while adjusting these condensers, it is well to cut a slot in the insulating knob of each condenser, and use a long, thin screwdriver, or better, a piece of wood suitably shaped to turn the condensers down for final adjustment. With the condensers open, the receiver will go into violent oscillation when a station is re-



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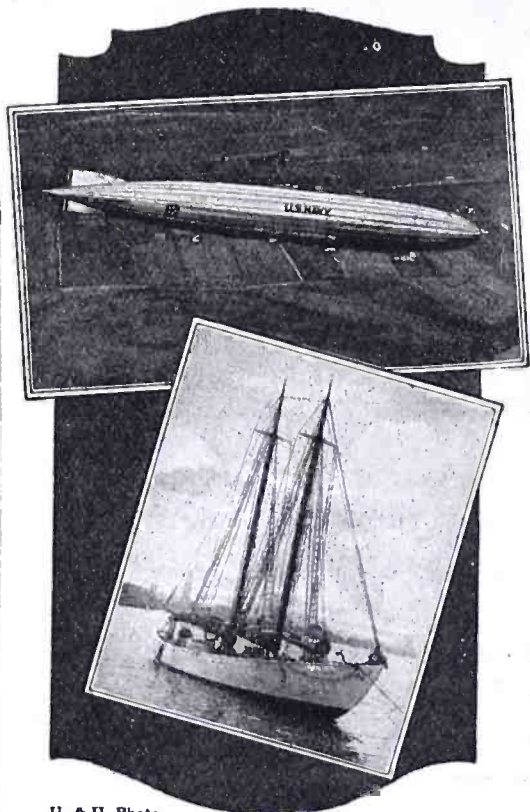
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A-C DAYTON XL-5

Perfect Clearness of Reception

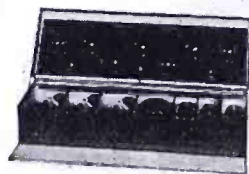
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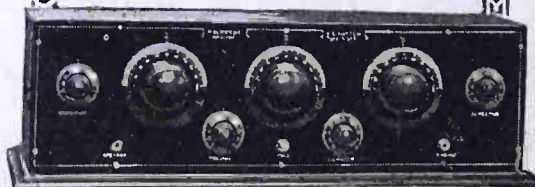
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ceived—they should be turned down until this oscillation stops and speech and music is clear. After tuning in several stations, a point will be found on the two neutralizing condensers where they may be left alone.

In cities, it will be found the background is considerably stronger than in rural localities, this form of radio-frequency receiver being sensitive to induction and man-made static in general. As a general rule, better results are secured by the use of a short antenna than a long one. An inside antenna is oftentimes very satisfactory. By arranging a jack on the baseboard or backwall of the four spring variety, so that a loop antenna may be connected directly to the first tube, considerable background may be eliminated, but this will be at a cost of volume.

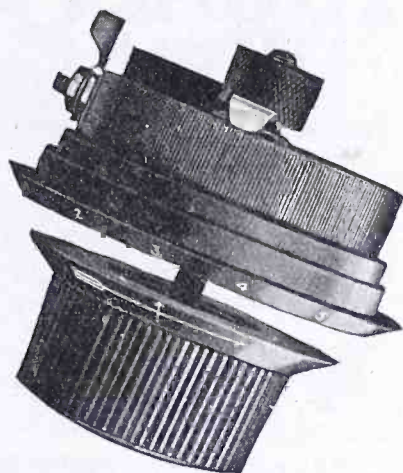
It will be found that complete neutralization of the receiver will be easier to obtain on some antennas than on others. One may completely neutralize the receiver for a given antenna, and then in connecting it up to another one, find that there is a tendency to oscillate on certain adjustments. In such a case, however, this oscillation will not be marked, and will be easily controlled by adjusting the first rheostat, which controls the radio-frequency tubes. Elimination of the .006 fixed condenser, which is shunted from plate to filament of the detector tube, also tends to make neutralization a simpler matter, but at a slight loss of signal strength. This condenser introduces a certain amount of regeneration into the detector tube, a study of that part of the circuit showing a modified form of ultraaudion effect.

In the event that short, sharp whistles are obtained during the process of tuning, over most of the scale, this is an indication that the receiver is setting up harmonics of its own, the fault lying in the improper arrangement of the radio-frequency transformer with respect toward each other, or improper adjustment of the neutralizing condensers.

When it comes to a consideration of the receiving range that may be expected on the neutralized receiver, the following should be borne in mind: Roughly speaking, one stage of radio-frequency before the detector tube is equal to a detector tube alone that is connected up so as to be regenerative. The addition of still another stage of radio-frequency does not double this sensitivity any more than does the placing of an extra tube in a transmitting circuit double the antenna radiation. Probably the sensitivity is increased about one-fourth. Therefore, as far as volume is concerned and distance, the results obtained from a six-tube neutralized receiver, allowing for possible loss from thorough neutralization, will be about equal to a good re-

Continued on page 78

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\$1.50

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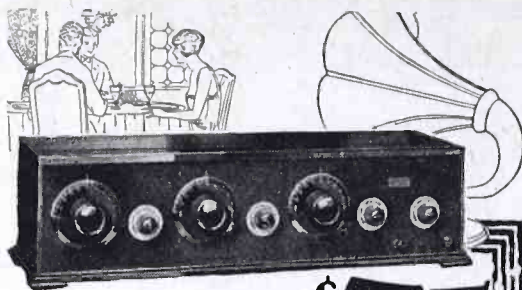
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Built for loud speaker reception from stations thousands of miles distant through local interference; composed of the finest parts; beautifully wired; encased in a beautiful hand rubbed solid mahogany cabinet; and fully guaranteed. At \$75 this fine, handsome, efficient Miraco "Ultra 5" five-tube outfit offers unquestionably the most astounding value the radio world has ever known.

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Non-rattling, non-howling, non-distorting. Equipped with filament switch, phone jack for tuning, bakelite panel, bakelite sub-base under which all wiring is concealed and other latest refinements. Two stages tuned radio frequency amplification, detector and two stages audio frequency amplification.

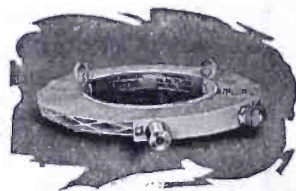
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Tuned Transformer Coil No. 14
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Sickles Tuned Transformer Coil No. 14 and the Knockout Reflex Coil No. 8 especially designed for popular circuits make a receiving set remarkably selective.

The No. 14 Tuned Transformer coil is absolutely self-neutralizing when placed at the proper angle in a set.

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Knockout Reflex Coil No. 8
Price \$4.00 a Pair

Continued from page 76

generative circuit employing detector and three stages of audio-frequency—four tubes in all. However, the increased satisfaction in absence of local oscillation together with the much sharper tuning, more than compensate for this.

As a suggestion, the panel in a finished cabinet, in which the loudspeaker has been incorporated, is shown. Many modifications are of course permissible, the taste of the builder, together with due consideration of financial status playing an important part.

By substituting a 400 ohm potentiometer for the first rheostat, and rewiring the filament circuit so that three tubes will be on each of the two rheostats, together with the plate circuit so wired that the jacks cut in at detector, and at three stage, the constructor may use the circuit either as potentiometer controlled, or neutralized, or with semi-neutralization and potentiometer together.

A fixed grid leak in place of the variable grid leak may be used. The value may be from 2 up to 10 ohms.

Some audio-frequency transformers will function much better if a standard grid condenser is shunted across the primary of the first audio-frequency transformer.

By using small-base standard sockets and adaptors, either the 199-299 or 201A-301A type tubes may be used. Remember that adaptors introduce 24 extra contacts into the circuit, any one of which, if not making good contact with the tube prongs, is a potential trouble maker.

If more than 45 volts on dry cell tubes is desired as a plate supply, a C battery must be used to bias the grids. Generally speaking, it isn't worth the increased cost.

Present day practice disproves the theory that it is necessary to mount audio-frequency transformers at right angles, to prevent distortion. However, connecting the three iron cores together and grounding them will help transformers that give trouble in this respect.

Noiseless
Grid
Leak



40c

each in any value
from 1/4 to 10

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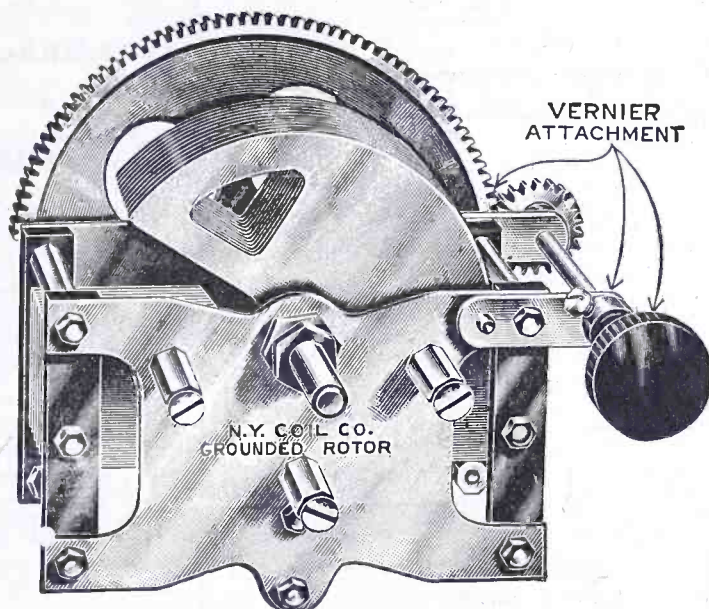
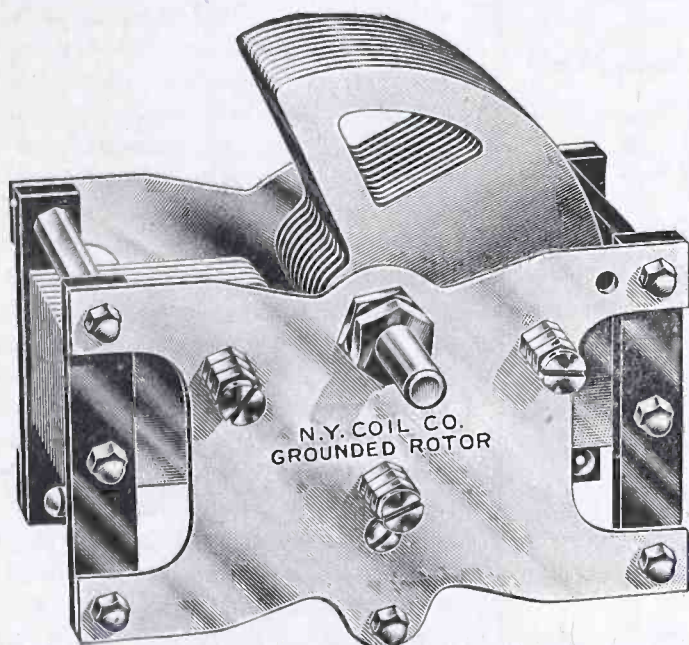
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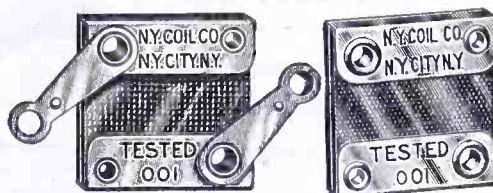
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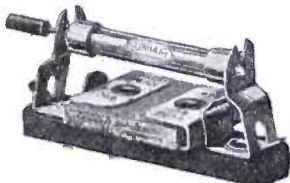
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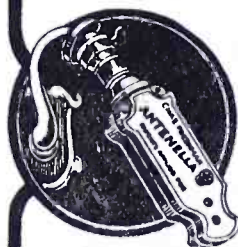
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No Aerial or Antenna Needed

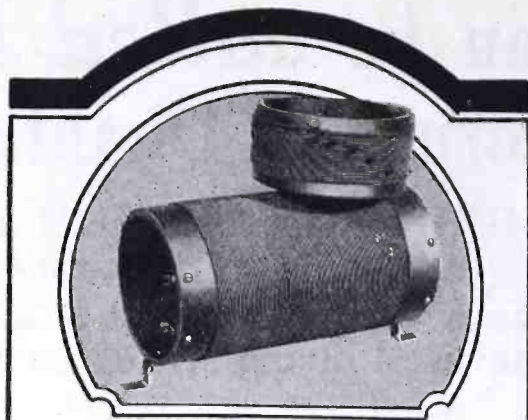


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Specified in Oct. Popular Radio as

Cockaday Precision Coil

The only coil specified by Mr. Cockaday in his New Four Circuit Tuner, with resistance coupled amplification because it meets all his specifications.

The only authorized Cockaday Coil, made in strict accordance with specifications of Laurence M. Cockaday, inventor of the famous Cockaday Four Circuit Tuner. Wound on hard rubber tubing, 1/8 inch wall, with No. 18 D. S. C. copper wire which insured selectivity, greater volume, sharp tuning and maximum sensitivity. Guaranteed.

Gets distant stations easily and clearly. Hundreds have substituted this quality coil for those of inferior make and are amazed at the improved reception, selectivity and general D-X results.

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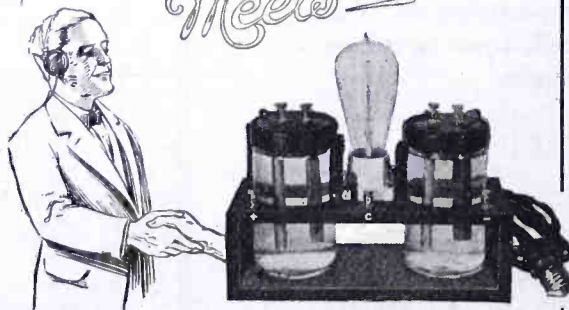
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**The Kic-O Double
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Meets—



**The need of every
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"Hook Up" our single or double Charger with a KIC-O "B" Storage Battery direct to any electric socket. Then you will have a permanent power plant. No need to worry about "juice" or buying new batteries. Write for literature and prices or ask your dealer.

KIMLEY ELECTRIC CO., Inc.
 2661 Main St., Buffalo, N. Y.

RADIO RECEPTION

Continued from page 24

which did not involve reduction of amplification. It is easy enough to stop an amplifier from howling by reducing its amplification. But then we would have an amplifier which did not amplify. If the causes for howling are understood, steps can be taken to prevent it without sacrificing amplification.

Any kind of oscillation in a tube circuit is due to some coupling or feedback between the grid and plate circuit of the tube. This holds true in audio-frequency amplifiers as well as in regenerative receivers. This feedback coupling may take place in a variety of ways. It may be inductive, as for example between the transformer of one stage and another, or it may be inductive between the plate and grid leads in the wiring of the set. It may be capacitive, as between grid and plate leads also, or it may be due to capacitive coupling within the tube itself, as between the plate and grid elements of the tube. Or it may be due to tuned plate and grid circuit, caused for example by the tuning of the distributed capacity of transformer windings and inductance. In short, coupling may be produced in the same variety of ways in an audio-frequency amplifier as in radio-frequency circuits. The result in oscillations are produced which are audible and give rise to squeals and howls.

To prevent howling, therefore, one must prevent these various feed-backs from plate to grid. In the first place wiring of the set should be simplified. All leads going to grid and plates should be of minimum length so that their inductance and capacity are a minimum. Secondly the grid and plate leads should not be run parallel to one another in this way reducing capacity and inductance between them. Thirdly, they should be run as far apart as possible so as to reduce coupling between them to a minimum. The only leads that may be run in parallel and together are the power supply leads, filament and plate.

Unless care is taken, coupling between audio-frequency transformers is very easily secured, for the flux from one transformer may extend into the magnetic field of the other transformer. To avoid this, shielded transformers should be used. They should be spaced as far apart as space in the set permits, and they should be mounted so that their cores and coils are at right angles, in this way reducing coupling to a minimum. It often helps to ground the case or shield of the transformer.

These precautions will usually suffice in the case of a two-stage audio-frequency transformer coupled amplifier. A three-stage amplifier is more difficult to handle since the amplification now becomes excessive. In such cases it is

Continued on page 82



For a Merry Christmas—for a merry time every day and for many years to come—give your loved ones a Thompson Radio Receiving Set, a Thompson Speaker, or both.

THOMPSON RADIO

Thompson Radio Receiving Sets and Thompson Radio Speakers deliver the highest quality of simplified and economical radio entertainment. Both nearby and distant radio programs cannot be more faithfully reproduced than with a Thompson Radio Receiving Set. One of the many reasons for the advanced development and perfection in Thompson Radio

products is an organization composed of radio engineers who have been making radio apparatus *exclusively* ever since "radio" was called "wireless."

The 5-tube GRANDETTE is \$125. The 5-tube PARLOR GRAND, (shown in large picture below) is \$145. The 6-tube CONCERT GRAND, is \$180. Prices are without tubes or batteries. The Thompson Speaker, with conical diaphragm and other special features, is now \$28.

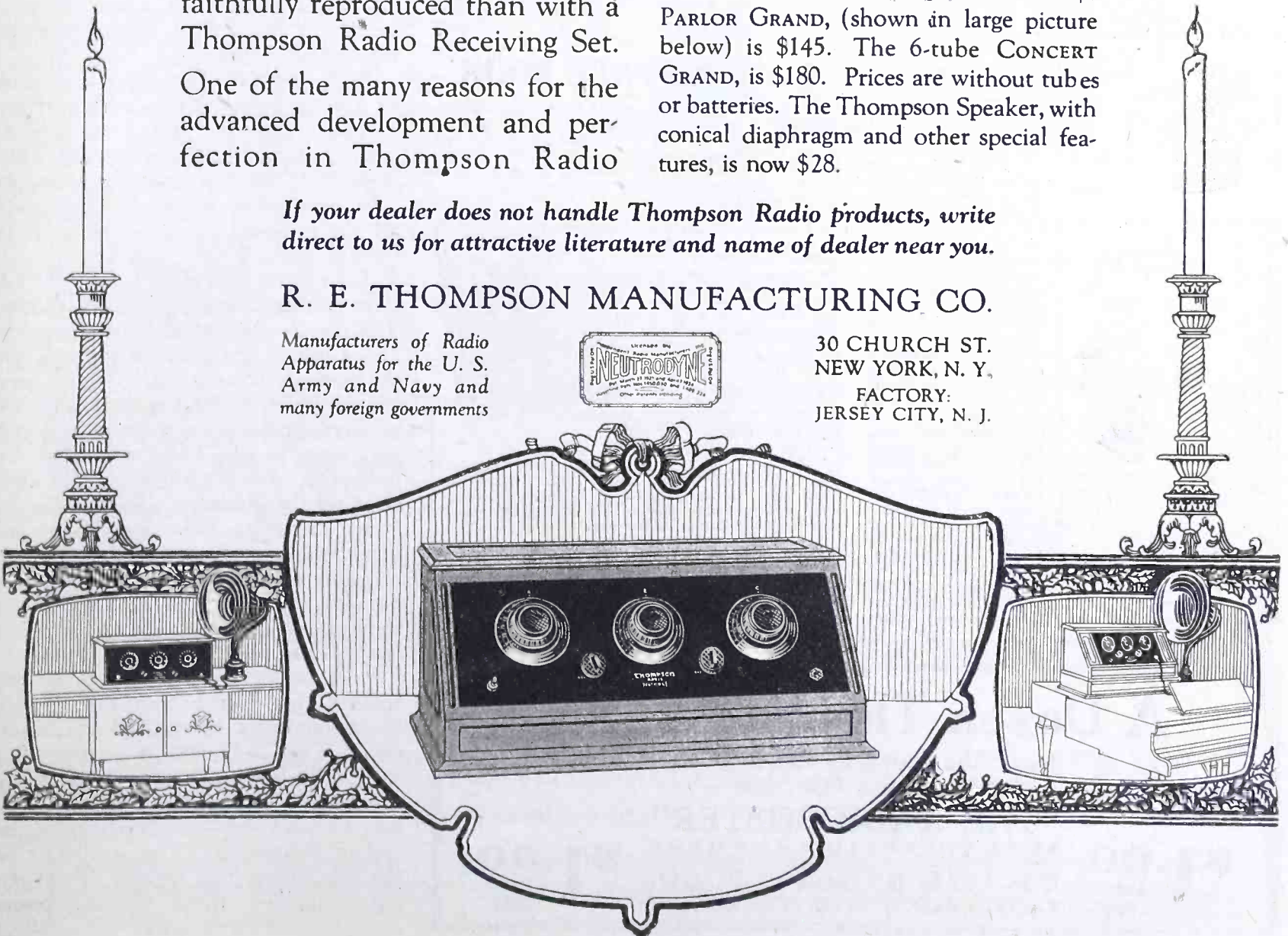
If your dealer does not handle Thompson Radio products, write direct to us for attractive literature and name of dealer near you.

R. E. THOMPSON MANUFACTURING CO.

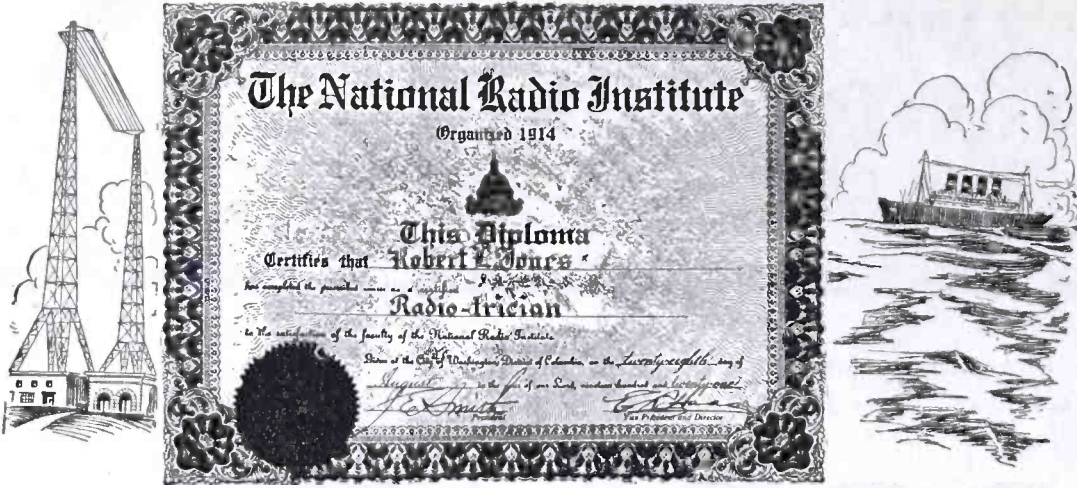
Manufacturers of Radio Apparatus for the U. S. Army and Navy and many foreign governments



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FACTORY:
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John P. Zinno, who was a buck private when he enrolled, now, with his certificate, is earning over \$3500 a year in his own Radio shop. L. A. Godby has increased his pay \$1800 a year since he received his certificate. L. G. Biles holds a splendid position as Asst. Radio Editor of the Philadelphia Public Ledger. Emmett Welch is making over \$400 a month as a Radio salesman. Hundreds of other men are occupying equally attractive positions after getting our Certified Radio-technician certificate.

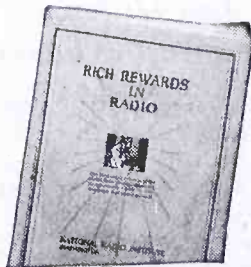
ment recognized, counting for 5 to 10 points on all government license examinations.

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Send me your book, "Rich Rewards in Radio," with full particulars about the opportunities in radio, and how you will quickly train me in my spare time at home to get a Certified Radio-technician Certificate. Also about your employment service and special tuition offer.

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necessary to place each tube and its associated apparatus in separate compartments which are surrounded by copper shielding which is grounded. Also it may be found necessary to supply the plates of the different tube from separate B battery supply, since the common B battery to all tubes gives sufficient coupling to cause audio-frequency howling. However in ordinary cases three stages of a. f. transformer coupled amplification are never needed.

The above noises are the most difficult to eliminate because the causes are not so evident. However there are other types of noises which are capable of elimination at once. There is first of all battery noise. When B battery runs down to 17 or 18 volts throw it out. In fact if a single cell of a B battery goes bad for one reason or another, the entire battery is useless, for it will give noise and reduce volume. The same holds true for the A battery, except that in the case of the storage battery all that is required is that it be recharged.


A ringing sound is often heard and this will be easily traced to jarring the tubes which causes the elements to vibrate, and hence changes in plate current are caused. A change in plate current means a sound in the phones. To avoid jarring or vibrating tubes, the best thing to do is to mount them on springs or soft rubber bases which will take up the vibration.

Poor contacts are often the cause of grating noises. A poor contact is a variable resistance, and a variable resistance causes changes in currents which manifest themselves as sounds in phones. The remedy is obvious. This covers all the principal causes of noise in receiving sets and their remedies.

A frequent complaint is that the last stage of amplification gives poor volume. The detector output and first stage amplifier output are both satisfactory, but the last stage is weak. If all other items are checked and found to be satisfactory, as for example, the transformer, it will very often be found that the simple expedient of interchanging tubes will often clear up the difficulty. Some tubes are better detectors than amplifiers, and some better amplifiers than detectors. By changing them around in the set, a combination can be found which will give the best results that can be secured from the tubes at hand.

Frequently attempts to secure extremely great volume from the last tube are accompanied by considerable distortion. This is especially true when using small dry battery tubes. This is unavoidable. The beginner should try to bear in mind that any vacuum tube has certain limitations. The smaller it is, the less power it is capable of delivering. Amplifier tubes are not power


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LOGGED ON DATE INDICATED FROM CHICAGO SUBURB

TODAY'S RADIO PROGRAMS

(Friday, May 2.)

(Daylight Saving Time Throughout)

CHICAGO PROGRAMS

- 6:30 and 7 a. m.—KYW [536]. Y. M. C. A. setting up exercises; swimming lessons.
- 11:35 a. m.—KYW [536]. Table talk, "Sunday's Dinner." Vivette Gorman.
- 1 to 2 p. m.—WLS [345]. Noonday farm program.
- 1:35—WDAP [360]. Midday concert.
- 2:35—WMAQ [448]. Lyon & Healy recital hall program.
- 3:15 to 4:45—WLS [345]. Home Makers hour.
- 4:20—WMAQ [448]. Items of interest to women.
- 4:30—WMAQ [448]. Pupils, Bush conservatory.
- 6 to 6:30—KYW [536]. Spanish lessons. Prof. A. A. Braschl.
- 6:15 to 8:15—WTAY [283]. Concert; Salvation Army Staff band.
- 6:40 to 7—WLS [345]. College Inn orchestra.
- 6:45—KYW [536]. Uncle Bob's bedtime story.
- 7 to 8—WLS [345]. American tunes, old and new.
- 7—WMAQ [448]. Weekly "Wide Awake club" program.
- 7 to 7:30—KYW [536]. Congress hotel orchestras.
- 7 to 8:30—WDAP [360]. Drake Concert ensemble; Blackstone String quintet.
- 7:30—WMAQ [448]. Music-memory program. Mrs. Marx E. Oberdorfer.
- 8 to 11—W-G-N [370]. Musical program.
- 8—WMAQ [448]. Americanization lessons.
- 8 to 9—WLS [345]. Radio cooperative marketing course.
- 8:20 to 8:45—KYW [536]. Farm bureau program.
- 8:40—WMAQ [448]. La Salle orchestra.
- 9—WMAQ [448]. "Modes of Travel in China and Tibet." Dr. Berthold Laufer.
- 9:15 to 10—WMAQ [448]. Cosmopolitan School of Music.
- 10—WDAP [360]. Cambridge Sisters trio: Mary McAuliffe, E. C. Mitchell, Barton organ played by Ralph Emerson, Jack Chapman's orchestra.
- 10 to 2 a. m.—KYW [536]. Midnight parade.

OUT OF CHICAGO

- 8 to 9, WHB [411], Kansas City. Various musical program; address.
- 8 to 10, WEAF [492], New York. Talks; recitals; orchestras.
- 8 to 10, WGAZ [360], South Bend, Ind. Orchestra; string trio.
- 8:10, WOO [509], Philadelphia. Temple Male quartet.
- 8:30, WOO [509], Philadelphia. Grand organ recital, Mary E. Vogt.
- 8:30, WCX [517], Detroit. Musical program, Caravan club.
- 8:30 to 1 a. m., WTAS [286], Elgin. Popular musical program.
- 8:30, WAAW [360], Omaha. Boys' day program.
- 8:30, WJY [405], New York. Blow by blow description, Zicenti-Moran bout, Madison Square Garden.
- 8:30 to 10, WHAS [400], Louisville. Concert program.
- 8:30, KFNF [266], Shenandoah, Ia. Legion Minstrels orchestra.
- 8:30 to 9:15, WLAG [417], Minneapolis. Farm lectures.
- 8:30 to 9:30, WBAP [476], Fort Worth. Concert, Texas Christian university.
- 8:30 to 10, WHO [526], Des Moines. Musical program.
- 9, WGI [360], Medford. Popular song hits.
- 9, WOO [509], Philadelphia.
- 9 to 10, KQV [280], Minneapolis. Popular song hits.
- 9:10, WDAR [395], New York.
- 9, WOS [441], Jefferson City. National Masonic Research.
- 9, WDAF [411], Kansas City.
- 9, KSD [526], St. Louis.
- 9:30, WMC [500], Memphis.
- 9:30, WJZ [455], New York.
- 9:30 to 10:30, WFAA [360], Dallas. Musical program.
- 10, WOAW [526], Omaha. Popular concert.
- 10 to 11, WHN [360], New York.
- 10:15, WGR [319], New York.
- 10:30 to 11:45, WLA [360], Minneapolis. Program by Mankato (Minn.) Chamber Commerce.
- 10:30 to 11:45, WBAP [476], Fort Worth. Hawaiian music.
- 11, KSD [526], St. Louis. Artists' recital.
- 11 to 1 a. m., KHJ [395], Los Angeles. Musical program.
- 1 to 3 a. m., KFI [409], Los Angeles. Concert. At 1 a. m., dance.
- 11:30, WGY [380], Schenectady. Musical program.
- 11:30, KFOA [457], Seattle. Classical concert.
- 11:45 to 1 a. m., WLAG [417], Minneapolis. St. Paul orchestra.
- 12 to 1 a. m., WAAW [360], Omaha. Musical entertainment.
- 12, WCK [360], Chicago. Popular song hits.
- 12, WMC [500], Memphis.
- 12:45, WDAP [360], Chicago. Popular song hits.
- 8, KDRA [326], Pittsburgh. Program to be announced.
- 8, WCK [360], St. Louis. Address; two act minstrel show.

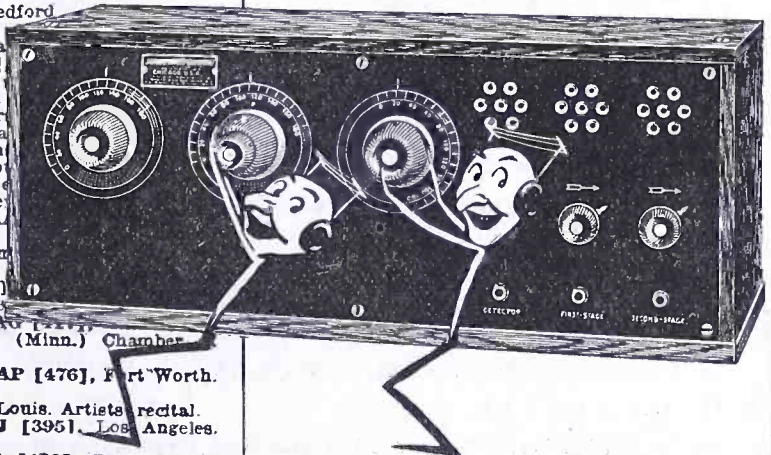
One evening's entertainment included the programs from the stations checked in the above list. These were all received on a loud speaker with ample volume to fill a room, and was practically a regular evening's occurrence up to the time indicated.

With Kellogg—USE is the Test

KELLOGG SWITCHBOARD & SUPPLY COMPANY

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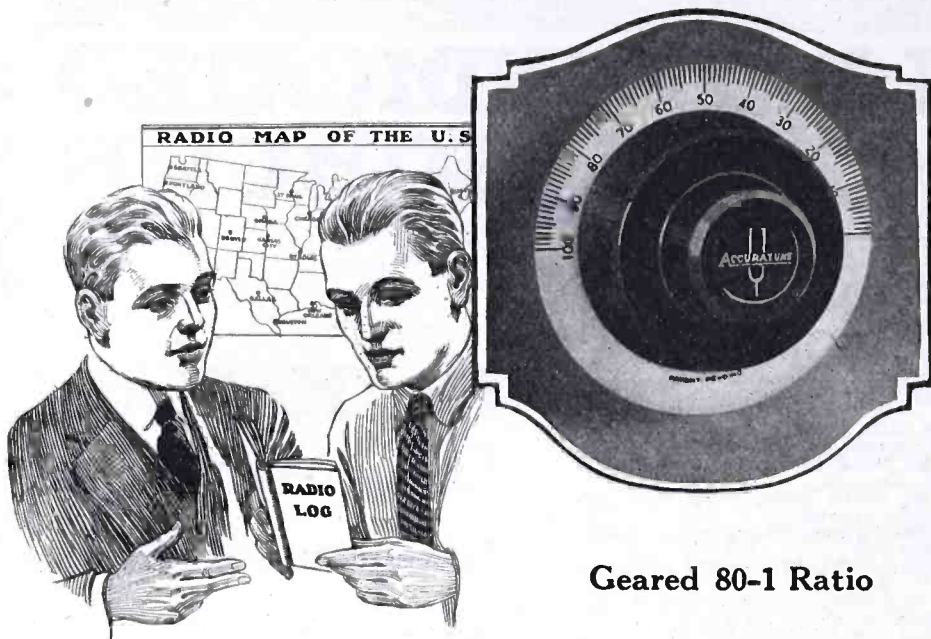
"My Kellogg Condensers bring in the Stations with Volume and Certainty" say the Radio Bugs



Kellogg radio equipment is built to produce definite results, and assures maximum distance, volume and clarity from your favorite circuit.

Every piece of Kellogg is guaranteed—you take no chance.

The set which received the stations shown used Kellogg condensers, rheostats, jacks, tube sockets, dials and audio transformers.



Geared 80-1 Ratio

Tune in "Hard-to-Get" Stations

"I LOGGED 48 stations in one evening with your Accuratune Dial. Twenty-nine of these I had never gotten before with ordinary dials on my set."

Accuratunes are actual micrometer tuning controls, geared 80-1 ratio for hair splitting adjustment. Those "hard-to-get" stations you ordinarily run past are brought in, clear and distinct, with perfect ease.

Accuratune Micrometer Controls give greater efficiency than any vernier condenser, vernier attachments or any other tuning device. Indispensable on all Super-Heterodynes. Fit all standard condenser shafts. Flush panel mounting.

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Pioneer Manufacturers of Quality Vernier Devices

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tubes. Hence if they are pushed too hard and are overloaded in the attempt to secure large signal volume, they will back down, and the way they back down is to distort the signal. When this is the case, the best thing is to adjust the set so that the signal is weaker and not so much input is fed into the last tube. A choice must here be made between lower signal strength and good quality, and greater signal strength and poor quality. The former is unquestionably preferable.

In the matter of distortion there are a great many causes. Thus a negative bias battery should be used on all a. f. amplifier tubes, good transformers and loud speakers should be used. Occasionally some distortions, such as ragged speech and music may often be cleared up by the use of a small condenser of about 0.002 microfarads. This condenser should be shunted around the loud speaker terminals and primary of the audio-frequency transformer for good results. Do not use much higher values or else the condenser will by-pass or shunt the audio-frequency currents.

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Here's what every radio fan has wanted—a convenient, permanent and authentic means of recording all stations heard over your set. The Ekko Album contains spaces for a stamp from each of more than 650 stations. These stamps are verified and prove your reception of the station.

Proof of Reception cards are furnished with the album. Send the card to the station, together with ten cents, to cover cost of verification, give facts which prove you have heard their broadcasting. In return they send you their verified stamp as evidence of actual reception. The stamps are beautifully engraved in different colors, an individual stamp for every station showing the call letters.

The album is 9 1/2 x 11 inches, handsomely bound in a two color cover. It contains 96 pages, with spaces for stamps of all recognized stations arranged alphabetically by states and call letters. Also an alphabetical list of the official names and other interesting features of stations, as well as a convenient log.

See your dealer today, get a copy of the Ekko Album and start a collection of these stamps. You will find this a new and fascinating method of verifying the stations you hear. If your dealer cannot supply you, send direct on receipt of price. Money back if not satisfied.

Price \$1.75

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TRADE MARK

The Aristocrat of Radio

Different From Any Set You've Ever Heard or Seen

Perfect tone, entirely free from distracting noises and distortion.

Its accomplishments have heretofore been thought impossible.

The BESTONE V-60 has been developed with one idea in mind—to furnish Radio entertainment without apologies or excuses for ordinary radio annoyances.

No other radio receiver incorporates such volume—distance—selectivity.

AND—simplicity itself. Nothing complicated in its makeup.

TRULY THE ARISTOCRAT OF RADIO

Sold only to the Musical Trade.

The Bestone V-60 five-tube receiver in beautiful, distinctive, antique polychrome cabinet, with built-in high-grade loud-speaker and battery compartment. List, \$165.00. West of the Rockies \$175.00.

Bestone V-60 five-tube receiver, Imperial Model, in beautiful polished mahogany cabinet. List, \$115.00. West of the Rockies \$125.00.

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Pennsylvania Head Sets and Loud Speakers

Pennsylvania Harmonized Head Sets are Perfect

Were **\$5.00** **NOW \$3.50 a Pair**

The endorsement of radio enthusiasts, demands tremendous production. To meet this demand, production has been planned on a gigantic scale. Manufacturing economies make possible the new low price. And above all, it's a wonderful headset—the world's standard of supreme quality. A one-year written guarantee with each pair. "Pennsylvania" for tone and distance—the choice of radio experts.



List \$3.50

PENNSYLVANIA LOUD SPEAKER \$10.00

WESTERN LIST, \$10.50

The Perfect Speaker for the Home!

A Speaker with tremendous volume and a clarity surpassed only by the human voice itself. The Pennsylvania reproducing unit in this speaker will take high voltage without blasting or distortion.

Unbreakable Textile fibre horn, 12-inch bell, stands 24 inches high—no batteries required. All "Pennilite" base. Unbreakable and highly polished in maroon finish.

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*It's a
Pennsylvania
Speaker*

RADEX TUBES

With Imported German Elements

Model 199 **\$3** Model 11
 Model 201-A Model 12
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Cash or C. O. D. Postpaid

"I can vouch for the quality of these Tubes and the policy of this company—both absolutely O. K."—Volney G. Mathison.

"Enclosed please find check for \$6.50 for which please forward to me two 199 or 299 radio tubes, as advertised in 'Radio.' I might say that you repaired two tubes for me some two months ago and out of 15 tubes they are the best for amplification. They are clearer and stronger than any new tubes I have had."

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Special quantity prices to Retail Buyers

In lots of 2.....\$2.85 ea.
 In lots of 4.....\$2.75 ea.
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Any tubes developing defects always cheerfully made good if filaments not blown out by mishandling. Why not try one or two today? Just mail a postal card and tell us what you need. Dealers' discounts. Immediate service.

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We repair all makes of burnt-out receiving tubes for \$2.45 each, C. O. D. Any defective work always made good. New bulb and base on every tube.

THE RADIO SPOOK

Continued from page 28

space within its range, we may not have mediate knowledge of its existence through the senses because there is absolutely no displacement of the air particles involved, which is the only means by which the auditory nerves of the ear could be affected.

"In the process of receiving radio speech or signals, a system of aerial wires, or loop antenna, is interposed in the path of the approaching waves. When the wave energy impinges on the antenna, a feeble electric current is created in the circuit of which it is a part. The next step is to rectify this feeble current, which is oscillatory in character. This is accomplished by means of a detector, usually a crystal or electronic tube. After leaving the detector the current, which is now pulsating in character, is passed through the windings of the electromagnets of the head telephones or loud speaker. The attraction and repulsion of the varying magnetic field caused a corresponding movement of the diaphragm, thus creating sound waves in the surrounding atmosphere which are conveyed to the auditory nerves through the diaphragm of the ear. From the foregoing you will appreciate the improbability of any person receiving radio signals or speech direct from the space by any known process."

Later in the day, when the incident of the spooky music had passed from my thoughts, I found myself in the midst of a group of radiophans who were discussing the relative performance of various types of loud speakers. One of the party stated that he had a set consisting of one radio-frequency amplifier, detector and two stages of audio with a current transformer and loud speaker, which could be heard clearly more than a mile from the set; that he was ready and willing to demonstrate it for the edification of the company, if they so desired. His statement was confirmed by another member of the group, who added that a most peculiar acoustic condition existed in the valley referred to. The ordinary voice waves were echoed and reverberated through the valley, so that one's voice carried unbelievable distances.

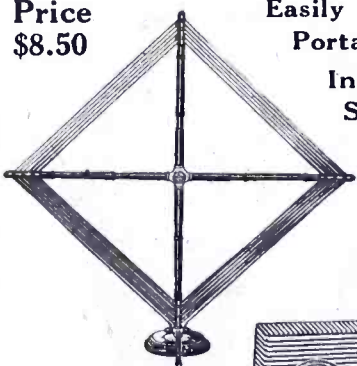
Readers may, perhaps, recall that at a certain spot in the rotunda under the dome of the capitol at Washington, the faintest whisper is re-echoed with increased amplitude, enabling the listener located in a remote part of the rotunda, to hear it distinctly, although the voice is inaudible to another listener only a few feet from the speaker. Ah! thought I, the mystery of the ghost music is solved at last, for it was probably in this valley, or in one similarly situated that the doctor's phantom set was discovered. However, much to my regret, I have never had the opportunity of conveying

Duo-Spiral Folding Loop

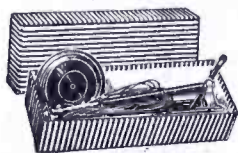
Price \$8.50

Easily Portable
 Increases Selectivity

Reduces Static



Patents pending



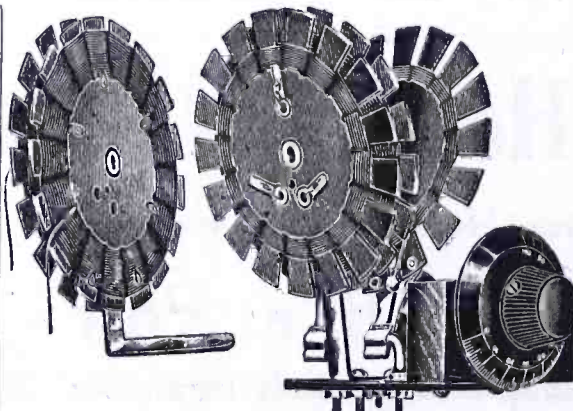
The favorite loop aerial because of its great convenience, handsome appearance and superior performance. Brings in the distant stations with remarkable volume. Fine for permanent installations or portable sets.

Rotates on base which has silvered dial graduated for calibration. Handle permits adjustment without body capacity effects. Standard loop for super-heterodyne. Adopted by leading manufacturers of complete sets. Handsomely finished in silver and mahogany.

Duo-Spiral is made by the manufacturers of Tiny-Turn, the superior vernier control which makes perfect tuning easy. If your dealer is unable to supply either of these standard products, write us direct.

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(Trade Mark)

THE WONDER CIRCUIT OF THE YEAR

Combining Neutrodyne—Regeneration—Reflex Developed by Walter Van B. Roberts, E.E., Ph. D. Editorially Endorsed by Radio Broadcast, as Without Doubt The Best We Have Ever Seen.

California Actually Heard at Princeton University On The Loud Speaker, WITH TWO TUBES.

ROBERTS UNITS consist of Five Coils in Two Mountings Ready for Installation. Packed complete with all instructions, Hook-up, Schematic Print, Cut of Complete Set, etc.

BUILD A ROBERTS AND REACH THE COAST
 Coils Mfg. under Zig-Zig
 Pat. Aug. 21, 1923.

\$8.00

ROBERTS KIT

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Complete Kit of High-Grade Parts for the ROBERTS TWO TUBE KNOCKOUT SET

Genuine Bakelite Panel, completely drilled. General Radio Condensers, F. M. C. Transformer, Sockets, Condensers, Genuine Roberts Units, Baseboard, Dials, Knobs, Busbar, Spaghetti—Everything, except Tubes, Batteries, Cabinet.

\$60 with Portena Folding (Loop for Local Use)

\$53 Without Loop

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Western Representatives
 BAKER SMITH CO.
 741 Call Building San Francisco

the information to my interviewer, having neglected to take his address and he has never communicated with me further regarding the matter. From the continued silence I deduce that the ghostly music has not been heard again.

THE radio bug is a term employed to designate certain degrees of enthusiasm in the amateur radio field, usually applied to those who are ultra active in experimentation, or in the operating phase of the art. There is, however, a mild form of insanity prevalent in the United States, which has affected a large number of persons in various sections of the country. I recall one case in which the afflicted one was said to be suffering from radio psychophobia, and lived in mortal fear of a group of anarchists who were supposed to have a radio projector focused upon him constantly. The effect was to keep his mind in a state of perturbation and imbue him with a deadly fear of some impending calamity. In all other respects the man appeared to be perfectly normal and highly intelligent. He became a regular correspondent of the radio office; punctual and persistent to a painful degree.

One morning this man called at the office just as I was reading a voluminous "essay" on the same subject from another man similarly afflicted. Being pretty well fed up on his particular line, I thought I saw an opportunity of diverting his attention from the office, at least temporarily. So I told him that the other man appeared to be a victim of the same gang of anarchists, and suggested that he communicate with him, and perhaps between them they might be able to locate the perpetrators and turn them over to the authorities. He acquiesced readily enough, and, after taking the address, departed from the office in a more cheerful frame of mind. Scarcely ten days had elapsed, however, when he returned. "Say!" he said, "do you remember that fellow out in X whose address you gave me?"

I told him that I recalled the person. "Well," said he, "that bird is bughouse, and no mistake; if I were you I wouldn't pay any attention to his correspondence in the future, it's simply a waste of time."

Several cases have developed locally within the last year which have taxed the ingenuity of our office diplomats to their utmost, but we have a bona fide sympathy for their misfortune and hence are ever patient and tolerant with them. Recently one of them, a woman, called several times at the office and insisted that she be furnished with free transportation to Washington, in order that she might apprise the Secretary of Commerce personally of secret machinations which were revealed to her through the ether.

Some years ago a similar case was en-

for scientific tube tuning

With the new and improved FIL-KO-STAT you get a battery switch that fits the FIL-KO-STAT mounting screws. This switch—"at your finger tips"—enables you to turn the current "on" or "off" without disturbing the FIL-KO-STAT'S adjustment and it distinctly signals "on" or "off". FIL-KO-STAT is the only radio rheostat enabling you to get maximum reception, bringing in stations you've never heard before and cutting out tube noises. It lengthens tube and battery life and permits infinite adjustment of any type tube in any hook-up. It's unconditionally guaranteed.

FIL-KO-STAT

SCIENTIFICALLY CORRECT RADIO RHEOSTAT
with Battery Switch

\$2

In Canada \$2.75

to eliminate leakage losses

You lose many DX stations through leakage in the antenna circuit. Make sure all radio impulses reaching the antenna reach your radio set. The FIL-KO Lightning Arrester will help you, because its "Umbrella" shield keeps dust, rain, etc., from the moisture-proof, hermetically sealed Bakelite insulation and prevents partial grounding of the antenna. And what's more the FIL-KO-ARRESTER carries a guarantee that's virtually an added insurance policy. You get positive protection for \$1.50

FIL-KO-LEAK

SCIENTIFICALLY CORRECT VARIABLE GRID LEAK
individually calibrated



\$2

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for correct grid bias

Unless the grid potential is precisely correct, incoming radio frequency impulses will be "blocked" FIL-KO-LEAK is the only variable grid leak that you can set for a specified resistance and adjust for best results. Each one is hand calibrated and doubly checked over the operating range for all tubes—1/2 to 5 megohms. FIL-KO-LEAK is not affected by atmospheric conditions or wear. Markings are read through panel peep-hole. Tablemounting bracket furnished. And it's unconditionally guaranteed for service and accuracy.

The Use of
FIL-KO-PARTS
for Radio
Guarantees
Satisfaction.
The Reputation
of the Makers
stands back
of the Guarantee!

FIL-KO-SWITCH

SCIENTIFICALLY CORRECT "A" BATTERY SWITCH

Simple
Sturdy
Sure



50¢

In Canada 70c

FIL-KO-ARRESTER

SCIENTIFICALLY CORRECT RADIO LIGHTNING ARRESTER

with the \$100 Guarantee



\$1.50

In Canada \$2.05

improved reception

Send 2c postage for our free booklet "Improved Radio Reception Through Scientific Tube Tuning." Tells about vacuum tubes, how to control them to get more DX, greater volume, etc. Write to Dept. RN 1124.

FIL-KO-SWITCH is made of non-magnetic metal. Wiping contacts, entirely insulated from the nicked brass housing and knob, assure sharp, clean "make and break." Scientifically correct to avoid current leakage and added capacity. And unconditionally guaranteed.

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SEATTLE - 101 SPOKANE ST.
Address All Mail to Dept. R - 1124, Harrisburg

MADE AND GUARANTEED BY
DX INSTRUMENT CO.
HARRISBURG - PENNSYLVANIA

DISTRICT SALES OFFICES
NEW YORK - 342 MADISON AVE.
CHICAGO - MANHATTAN BLDG.
ST. LOUIS - 915 OLIVE ST.



The PROUDFOOT

ONE-KNOB Vernier Condenser

13 plate (M. F. C. .00025)	25 plate (M. F. C. .0005)	43 plate (M. F. C. .001)
\$3.75	\$4.50	\$5.75

When you install this condenser on your panel, you are assured of results—regardless of the hook-up you use. Watch-like precision, plenty of strength with minimum bulk are all elements entering into its efficiency. It requires only small space in your cabinet—a mighty profitable quality in a radio unit today when everyone wants a set that "doesn't take up much room."

The Proudfoot has other important features—one-knob control of group plates and vernier, two-rod stator plate mounting, three wiping contacts instead of a pigtail. Get one today. Equip your set. If your dealer cannot supply you, write us sending us his name.

Jobbers and Dealers: We will be glad to give you detailed information about the Proudfoot if you will address us on your letterhead.

CRUVER MANUFACTURING CO.
2456 W. Jackson Blvd. Chicago, Ill.

RADIO **K. B.** PARTS



Formerly
"MASTER" Line

REDESIGNED AND IMPROVED

For ACCURACY, EFFICIENCY and APPEARANCE, insist on "K.B." products from your dealer. Ask to see our new type Variable Condensers with important Special New Features. Jobbers and Dealers write for attractive prices and discounts.

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Performance
Price and
Simplicity

of the SILVER SUPER-HETERODYNE

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"The Portable Super-Heterodyne"

It puts into your hands the results of Mr. Silver's experience with hundreds of Supers—dope never before available. Detail Drawings and Photographs show how all the "kinks and twists" have been eliminated, and make it easy for anyone to build the Silver Super. Price 50c

make a big hit with the fan, who wants to build his own Super-heterodyne at a low cost. The Silver Super surpasses 10-Tube sets for Clarity, Volume, Distance and Selectivity. Fans call it the "7-Tube Wonder," and Radio Authorities say it is an "ELECTRICAL MASTERPIECE."

PERFORMANCE

Sea to Sea with Loud Speaker Volume on an 18" Loop right thru the Locals—regular (not record) Performance.

SIMPLICITY

Designed by McMurdo Silver, Assoc. I. R. E. especially for the novice. You can build it on the kitchen table with a pair of Pliers, Screw Driver and a Soldering Iron.

Send For These Parts

	Price Each
2 Silver .0005 Low Loss Condensers No. 301	\$4.50
2 4" Moulded Dials—Tapered Knobs	1.00
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1 Silver R. F. Transformer Unit No. 401	14.00
1 Silver Oscillator Coupler No. 101	2.50
7 Benjamin Spring Sockets (199 or 201A?)	1.00
2 Jefferson Audio Transformers No. 41, 3-75-1	4.25
1 On-off Switch	.60
3 .5 MFD By-pass Condensers	.90
2 .00025 Mica Condensers with Leak Clips	.45
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1 .0075 Mica Condensers	.75
1 .000045 Balancing Condensers	1.50
1 5 Meg Ohm Grid Leak	.50
1 1 Meg Ohm Grid Leak	.50
1 7x24x3/16" Bakelite Panel, Drilled, Grained, Engraved	7.00
7x23x1/2" Oak Base Board, Bus-Bar, Spaghetti, Screws, Nuts, Solder, Lugs	1.50

All Parts for the SILVER SUPER, Postpaid, \$63.85
Mail Your Order Today

SIX SILVER SPECIALS

Bringing Your Old Super Up-to-date

Oscillator Coupler No. 101	\$2.50	50 KC RF Transformer Unit No. 401	\$14.00
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.0005 Low Loss Condenser No. 301	4.50	Collapsible Center-tapped Loop No. 601	6.50

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DEALERS—Write for our attractive Merchandising Plan.

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S-M Products are sold on the Satisfaction or Your Money back Guarantee.

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Am enclosing 50c. Please send me the book—The Portable Super-Heterodyne.

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Silver-Marshall, inc.

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CHICAGO

REMEMBER!: -- You can subscribe to "Radio" for Six Months at the special price of One Dollar. Do It Now!



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AN

I. X. L. KAT WHISKER

on your crystal set will bring in greater distance, clearer reception and louder signals. Solid gold, will not corrode or oxidize. Ideal for reflex.

PRICE 25 CENTS

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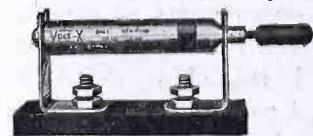
countered at Cleveland, Ohio. In discussing the case with a physician friend, it was agreed that the man should be sent to him when he came again. The arrangement was easily accomplished by informing him that the doctor was an expert on radio waves as well as in the dispensation of pills. After he had described his case to the medico, the latter informed him that he had arrived at a very opportune moment, as he just that day received a radio wave nullifier which was guaranteed to neutralize the effect of any wave. He then gave him a small spool magnet wire and told him to try it for ten days without expense, and to report back at the end of that period. The man departed very happy in the possession of the neutralizer, and as we never heard from him again, we both felt justified in the assumption that the cure was effective.

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Representatives, jobbers, dealers in every City, County, State and Country (correspondence confidential) to handle our new line of radio receiving sets—the Ultra Synchrony VII and The Staraco VIII. Something worth your while. Stanley's Perpetual Radio Bulb Fuse.
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RANGE—1/2 to 15 megohms.
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UNCLE SAM MASTER TUNING COIL

Mr. L. E. Browne, writing in the New York Sun Radio Section of August 30th, about the reception of Broadcasting from Lieut. Brandt's De Havilland plane speeding at 75 miles per hour, 3000 feet above New York, states:

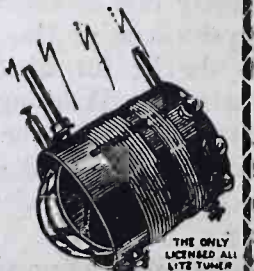
"and N. T. G., who was at Palisades Park trying to pick him up with an EIGHT TUBE SUPER-HETERODYNE seemed to be having trouble. Although we had only half of this—four tubes . . . hooked up with an Uncle Sam coil—we brought the whole thing in on the loud speaker as clear as a bell."

FREE

Ask your dealer or write direct for circuits in which this remarkable coil can be used.

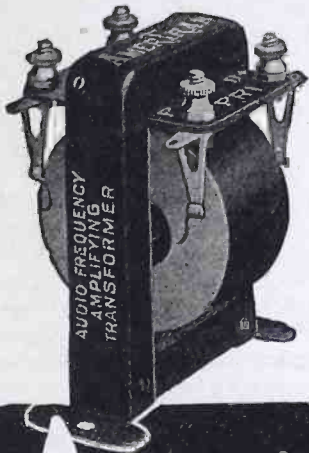
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Made in two types:
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Improve your set with an AmerTran Price, either type, \$7 at your dealer's

Send for booklet containing much helpful transformer information

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Designers and builders of radio transformers for over 23 years

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BUY TRIMM
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REPRODUCTION

Even though you pay more money for a loud speaker, you will not obtain a better value than the Home Speaker. Its size, appearance and efficiency ranks with that of speakers costing twice as much.

A wooden base enclosing the speaker unit eliminates "tinny" tones and guarantees mellow reproduction. Non-adjustable, factory-regulated diaphragm assures maximum satisfaction.

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All over the world, our graduates are traveling—with the rank of ship's officer—the title of "radio operator." The growth of radio opens up new opportunities, on shipboard and on shore. And the men at the top are our graduates—thoroughly trained—recognized as capable.

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You need know nothing of radio to start. The course begins with the beginnings of electricity, and includes code and modern commercial radio operation. A few months' study prepares you for a U. S. Government operator's license. And the license indicates your readiness for your first radio job, at a good beginning salary.

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\$6.00

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Manufactured by

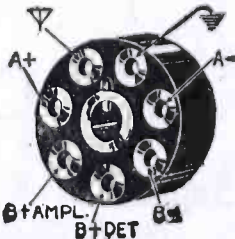
FORD MICA CO., INC.

33 E. 8th Street - - New York

Write for interesting literature.

Jones **MULTI-PLUGS** are supplied for panel mounting (see cut at right), for bracket mounting (see cut below) or for attaching to binding posts of any set (see cut at bottom of advertisement).

Panel mounting type, complete with 8 foot cable, \$4.



Bracket mounting type, complete \$4.50.

One Pull on the Jones MULTI-PLUG instantly disconnects antenna, ground, A and B batteries from your set. One push reconnects. And it can't be plugged in wrong! Eight foot cable permits placing batteries out of way—in basement, closet or elsewhere. Makes your set portable. All leads plainly coded.

Jones MULTI-PLUG

THE STANDARD SET CONNECTOR

Nothing else like it. Enables anyone to connect your set with safety. Prevents burning out tubes or shorting batteries. 100 per cent foolproof. Standard on Zenith, Workrite and many other leading sets. Ask your dealer to put one on the set you buy, if it isn't already equipped. Carried by all jobbers. Any dealer can supply you. May be ordered direct by stating dealer's name. Folder mailed free.



Binding Post Type complete with seven coded leads for attaching to binding posts of any set and 8 foot coded cable \$5.00

Patent Applied For
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Tell them that you saw it in RADIO

RADIO EDITORS NOT ONLY SUFFERERS

Government Gets Queer Queries

What's wrong in this hook-up? Perhaps you can aid the Philadelphian fan who sent this letter to the chief of a government radio office in Washington.

Philadelphia, Pa.,
September 25, 1924.

"Dear Sir:

I wish to describe my broadcast receiving set and ask your advice for getting better results.

I have a rubber aerial 674½ ft. long (not counting the insulators), but this stretches and touches the roof in the middle. I think this maybe grounds the signals. I am not using any lead-in because I bring my aerial to the edge of the roof and let the signals slide down the lightning rod to my window. A friend of mine loaned me a wavelength last week, as mine isn't working so good, and I wired it up in series with the grid of my tube, but even this doesn't work so well. I was advised to use a set of vernier binding posts and I went all over town trying to get them. In each store the salesman looked funny when I asked him. Do you think that maybe I was too technical? At last, after my fourth visit to a certain store, the clerk told me he had a pair. Probably he had to send to the factory for them. Well, I put them on my set, but they don't do any good at all.

I have tried so many things, and yet the set doesn't work, and I am really disgusted with radio. Even the fellows who don't know a thing about it seem to get better results than I do.

I even tried grounding my aerial, but that doesn't do any good at all. It even weakens what signals I get. For a time I thought I didn't get enough filament voltage, so I hooked up my B battery to the filament. The tubes lit up fine for a minute and then went down. Do you think the B battery is dead? It won't light them any more.

I have tried the tubes out with a magneto, and they spark fine.

I put a wire from the primary of megohm to the rotor of my microfarad and even punched the latter full of holes. Even this doesn't do any good.

Mr. Foster told me a negative bias on the grid would help the set. I could not locate any in the city, but the telegraph operator in New York sent three of them to the telegraph operator in Philadelphia who gave them to me. I connected the three in series and put them on the grid, but it produces an awful howling; is that what it is supposed to do?

For a time I thought the diaphragm on the phones kept the sound from coming out, so I took them out. This gave me no results either.

If you could only make my set work I would do you for almost anything. Waiting any early reply,

Yours truly,
W. C. G.

P.S.—Do you think a radio-frequency ammeter in the plate circuit, or some Pahnstock Clips in the ground circuit would improve the reception?—W.C.G."

Send 5c for a copy of

"RADIOCAST WEEKLY"
(For Pacific Coast)

You Will Enjoy It

433 Pacific Bldg., San Francisco

Ingenious

**The
"SELF ADJUSTING"
Rheostat**



\$1.10

Write for FREE Hook-ups

everywhere

AMPERITE controls perfectly and automatically the current flow from battery to tube. No Rheostat knobs on panel to turn. No ammeter needed. No worry. One AMPERITE for each tube inside the set regulates current on thermo-electric principle. Simplifies wiring and operation. Facilitates tuning. Proven in use. Adopted by 50 set manufacturers. Be sure your set is equipped with AMPERITE.

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The tension slot is the reason—a feature found only in Poly Plug. Permits the phone cords to be pulled and jarred without disturbing the contact a bit. The plug you have been waiting for.

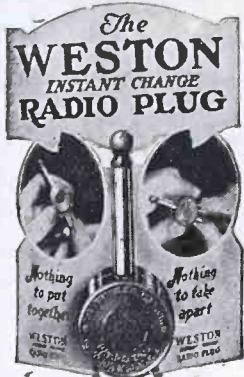
At your dealers or by mail on receipt of purchase price.

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Demand the Weston Instant Change Plug and insist on getting it. Then you are assured of the best results from your radio. Interchangeable in two seconds. Merely press triggers to pull

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Look for the name "Weston" on the plug. That's the surest way to be satisfied.

Weston Electrical Instrument Co., 156 Weston Ave., Newark, N. J.

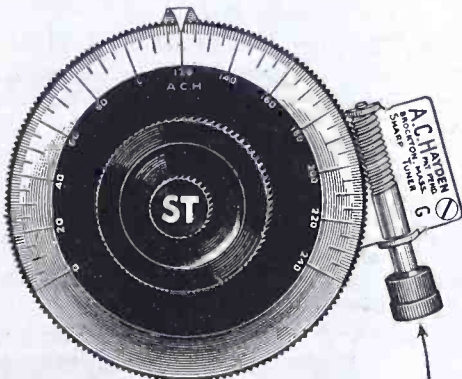
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Will improve any receiving set, making difficult tuning easy

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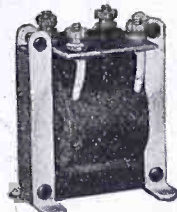
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It is the Dongan Type C which Set Builders are recommending to one another. Made right to give real performance with every type of hook-up. Will outlast the set.

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Voltmeter readings mean nothing if the instrument consumes a high amount of current. Really correct indications can be guaranteed by using such an accurate instrument as Dongan Double Duty High Resistance Voltmeter. Write for Radio Catalog.

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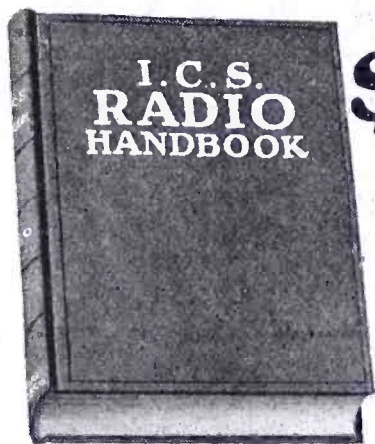
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Ohms



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Tune in tonight with the confidence that the air-world is yours. Your set, no matter how powerful, will be matched by Repeater Phones. No distance is too great to lose any single note or quality when received through Repeater Phones.

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Mellow,
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PACIFIC RADIO PUB. CO.

Pacific Building San Francisco

WAVEMETER & OSCILLATOR

Continued from page 29

midway between the two sets of notes, one decreasing in pitch, the other increasing. The process is repeated for each wavelength to which the set is to be calibrated.

Additional calibration settings can be found by tuning to the second and third harmonic of each given wavelength. For instance, KGO can be tuned in to its fundamental of 310 meters and then its first harmonic of 155 meters, or WSB to its fundamental at 700 kilocycles and its second harmonic at 1400 kilocycles.

To record the very short waves down to 22 meters, the author used a second oscillator with a .002 mfd. grid condenser, 5000-ohm grid leak, a .003 mfd. tuning condenser and an inductance coil made up of 17 turns of helically wound edgewise copper strip having a cross-section of 3-16 in. by No. 16 B. & S. The helix has an inside diameter of 4 in. and 5-16 in. separation between turns, the coil being supported by three thin slotted bakelite members outside of the coil. Great care was necessary in using this for the lower wavelengths, as slight changes introduce large errors.

The constants for the coils used in the regular wavemeter are as follows:

Coil No.	Number Turns	Size Wire	Diameter Tubing	W'length Range
One	1.75	18 DCC	1.625 in.	1.5 to 30
Two	3.0	18 DCC	2.875 in.	12 to 80
Three	7.0	16 DCC	3.625 in.	55 to 190
Four	60.0	24 SSC	3.125 in.	185 to 550

All coils were wound on bakelite tubing with 1-16 in. wall except coil 3, which was wound on 1/8 in. thick bakelite. No dope or filler of any kind was put on the coils, which were wound tightly and which held their shape well. Another coil of about 20 turns should have been made up to cover a wavelength band of from about 160 to 300 meters, which would have given a much better overlap than is the case at present.

The use of a sensitive thermo-galvanometer at least equal to the Weston 425 is by all means recommended unless the reader feels that he can afford an ultra-sensitive vacuum-type thermo-element and a high-grade D. C. instrument.

The oscillator need not be coupled closely to the receiving set when measuring the wavelength of the incoming wave. Usually it will be found that if the oscillator is within 10 or 15 ft. from the receiver sufficient energy will be picked up to give a strong beat signal. A loosely coupled oscillator is much more to be desired than one that is coupled too closely.

When working with any frequencies below 100 meters great care should be exercised to keep away from the oscillator—the farther away the better. Very serious errors are liable to be introduced if changes in frequency, due to the change in the field conditions, are per-

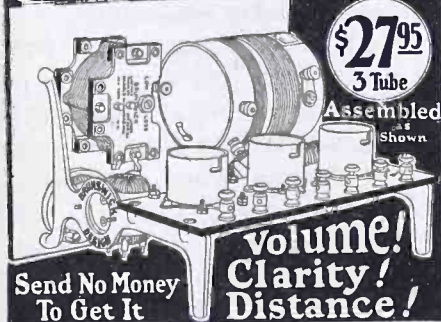
mitted, due to the operator's getting close to the apparatus.

In all cases it is very much more desirable to work the oscillator tube at as low a plate potential as possible. As the tube is oscillating simply into a dummy or closed circuit, practically all of the energy supplied to the tube must be dissipated in the form of heat, as there is no other place for it to go. A cool tube will last a lot longer, and work better when it is working, than one that is hot.

TABLE 1

Frequency in Kilocycles	Second Harmonic	Third Harmonic
580	1160	1740
590	1180	1770
610	1220	1830
640	1240	1880
700	1400	2100
710	1420	2130
760	1520	2280
790	1580	2370
920	1840	2760
960	1920	2880
1080	2160	3240

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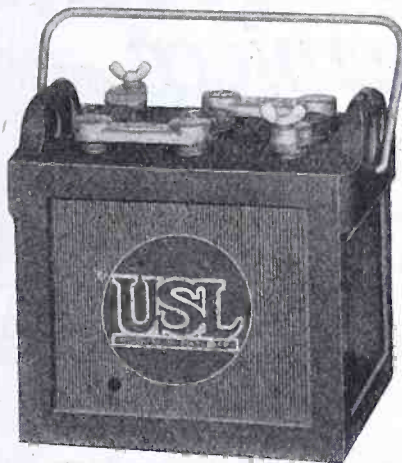
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 - 2 Brunswick Jacks with Gold-Plated Fronts; 1 for phones; 1 for loud speaker.
 - 1 Freshman Mica Grid Condenser.
 - 1 Standard Glass-Enclosed Grid Leak.
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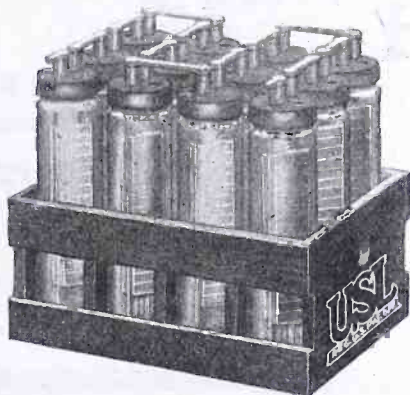
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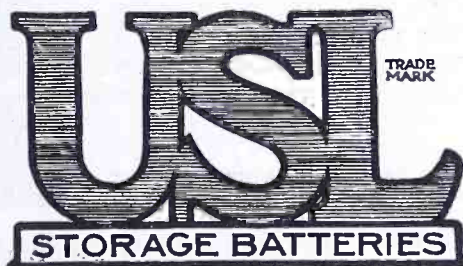
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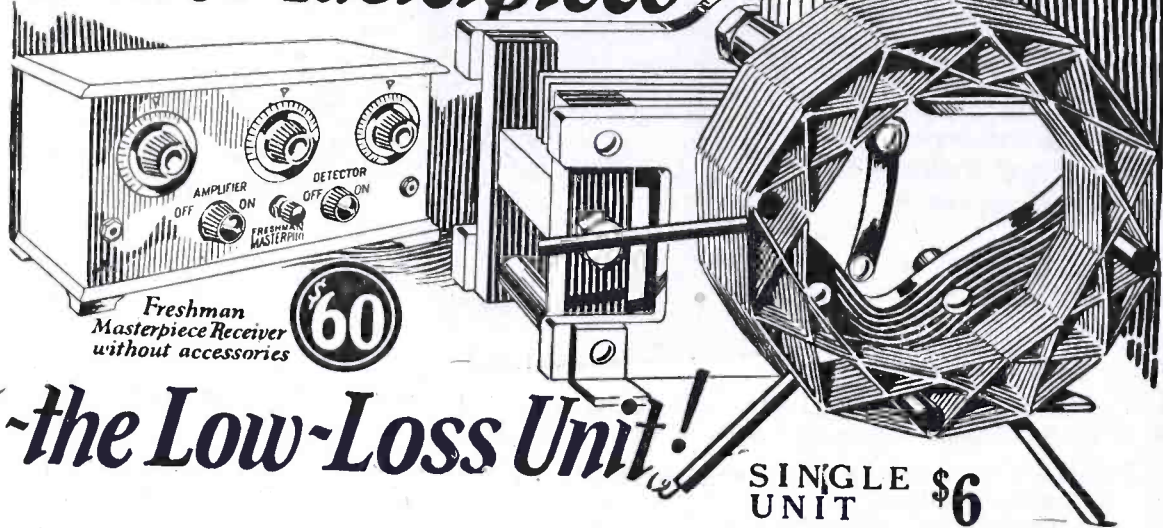
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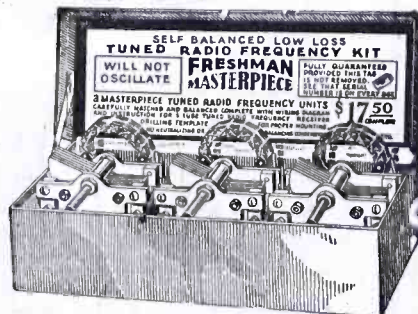
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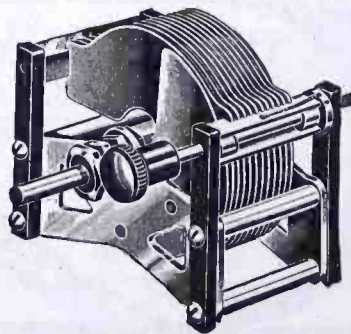
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THE RAZZBERRY CLUB DISCUSSES THINGS

By P. M. MORSE

THE other day I dropped in on a meeting of the Radio Razzberries Club, a disorganized organization, holding regular meetings at irregular intervals, usually at noon at some handy radio store, and having for its purpose a free-for-all discussion of anything pertaining to the radio game. From this very disorganization the club gets its charm. The members know their attendance is not required, and therefore they come regularly. They have no pre-arranged discussion, and so each member feels it incumbent on himself to bring some item of interest to talk about. Since there is no definite speaker, every one takes part as much as he pleases.

The membership is many and varied, from doctors and building contractors to typesetters and lawyers, the only entrance requirement being that the applicant be a radio bug of the nth degree. And so, as you can see, some very interesting and heated discussions take place at these noonday gatherings.

Well, as I was saying, I dropped in on one of these meetings not so long ago. Some of the members had already arrived, and the discussion—if you can call it a discussion when everyone talks at once—was in full blast. A continuous buzzing noise could be heard for nearly a block, and a crowd of idly curious was gathered at the doorway, watching the members' extravagant gestures, listening to their pungent comments and wondering how this peculiar gathering of benevolent madmen could so disturb the peace with their mixture of meaningless phrases and good American language and get away with it.

I pushed my way through these on-lookers and entered the meeting during a spell of comparative quiet. One of the old-timers was sedately telling of his incredible adventures with his latest superhet. He had put an extra step of r.f. ahead of his first detector, and, according to him, the results were stupendous. But every member of this organization is a native son of Missouri, and so his wonderful tale was constantly punctuated by the caustic comments for which the club is so famous. This form of baiting was, of course, old stuff for the veteran members, who grinned as they made remarks which would have been the cause of a blood feud anywhere else. But the newer members looked on fascinated, wondering why the talker didn't at least get peeved at some of the slurs on his truth-telling ability. One old gent, whom I had never seen before, seemed particularly interested and appeared to be taking notes.

But through all this cacaphony the old-timer went placidly on, telling what new and distant stations he had heard and how close he could split a meter in

tuning. The story began to get entirely too incredible, and everyone welcomed the interruption offered by the entrance of two other members.

They were the society's Inventor and the Theorist. Since someone had beat the Inventor to it on his variable grid leak, and he had seen his D coils come into recognition, he had turned to other fields of endeavor. He was trying to explain how he was going to make a vest-pocket variable condenser out of a spark plug, a washing machine part and a piece of rubber hose, but he was constantly interrupted by the Theorist with, "But, you know, theoretically that isn't right."

Next in came one of the younger set, who had a circuit for which he claimed wonders. It tuned, he stated, as sharp as a razor—he had to rig up long levers for his dials—and distance came in with terrific volume. One of the old-timers examined the circuit and looked up with a grin. "I tried that circuit out a year ago. It's hard to get working right—you were lucky—and it's liable to go on the blink any time. As a receiving set it's a doggone good transmitter."

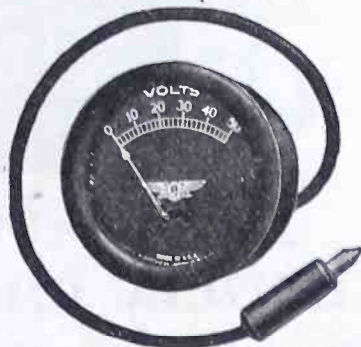
"You're all wrong there," interrupted another, and soon the novice was the unwilling center of an excited group, who gabbled incomprehensible arguments at him, couched in highly technical terms. The poor fellow probably spent the rest of the week trying to figure out whether any of their statements meant anything.

Four more members came in just then. One of them was holding forth on resistance coupling. "The best thing to use is a variable resistance so you can adjust them to your tubes. A resistance varying from 10 to 100,000 ohms is alright. You need four steps to get real volume. Three steps won't quite do; you can only hear it a block away. Even then you must use a 150-volt B battery. But the quality music that you get is better than anything I've ever heard."

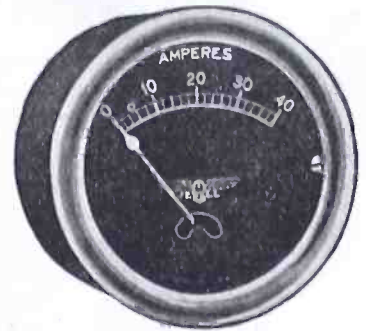
"With an eight-foot loud speaker horn it would probably give nearly true reproductions," spoke up another. He was a bug on loud speakers, and at that time was using a huge bass horn, which a musician friend had lent him, with a special reproducer unit. He claimed that the band concerts he heard were better than the bands that make the music.

The Authority on Impedance Coupling disagreed with the resistance coupling enthusiast. "Why don't you use impedance coupling?" he said. "You'll get as good quality, and you'll only have to use 90 volts on the plate. As for volume, when I turn my impedance amplifier on full blast, people ten blocks away run out of their houses wondering why Sousa has chosen to give their street a special concert."

At this statement Gargantuan shouts of laughter drowned out further com-



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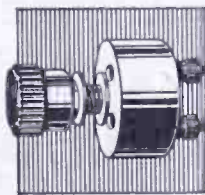
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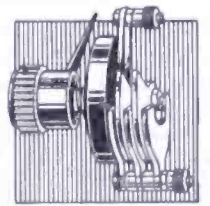
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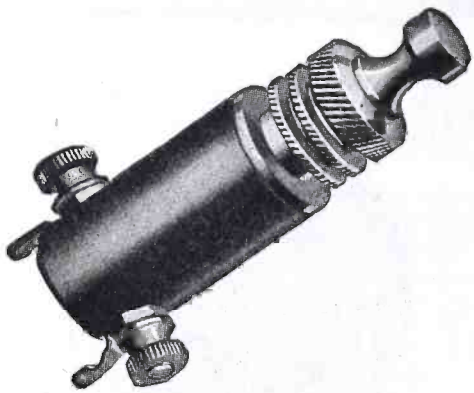
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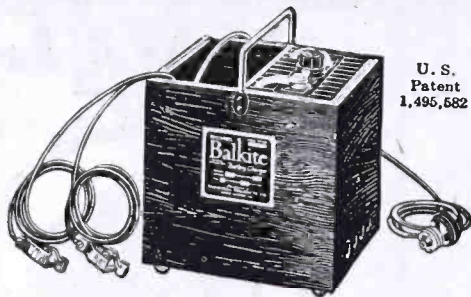
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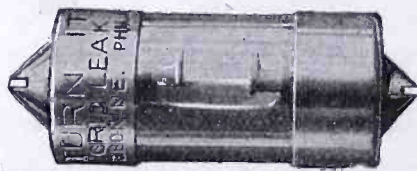
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ment for a while. But suddenly one of the newcomers, a young man, who had listened disgustedly for a while, blew up. He snorted. "You fellows make me sick. Nearly all of you have sets with eight or ten tubes and think you're getting wonderful results. I'm not ashamed to say that I've still got a three-tube single circuit, and I'm willing to bet that I'm getting every bit as good results as any of you, though I'm not so good at embellishing my tales. My three tubes get as good results as your ten, and they cost less and are easier to operate and build. I don't have to charge my battery every day, because I don't use much juice. When I foolishly stick a screwdriver into my set I only burn out three tubes, and so I don't quite go bankrupt. When I want a station I twist two dials and get it in; I don't have to adjust this and that for five minutes. I've been listening to your dope for quite a while, and I think you and your 10-tube sets are all the apple sauce."

This, of course, was rank treason to most of the members, and although some insurgents raised a cheer, it was lost in the riot of vigorous argument that followed. Some, red-faced, yelled, "Traitor!" "You aren't a radio bug!" "Out with him!"

Finally one iron-lunged veteran was heard above the tumult. "Have you ever heard a superhet?" he asked. Well, no, the rebel hadn't. The members subsided then, with victorious smiles on their faces, and listened to their champion.

"You bring your set up to my house," he said, "and I'll show you an eight-tube set that will walk circles around yours in distance, volume and clarity."

"Yes, and if he don't, I will," was the interrupting chorus.

"You'll have to work on an outside aerial, and I'll have the advantage of a loop; my set is thus portable. You bother all your neighbors with your eerie whistles, while I can work any number of sets like mine in the same room without interference. Finally, a superhet, or other six or eight tube sets, can be built so they are far easier to tune than any single-circuit set. The reason we have so many adjustments on our sets is that we like to have them; we'd rather adjust the adjustments than listen to most concerts. If—God forbid—any of us should ever build a single circuit again he would have seventeen controls and three meters on it. But we have tried both the single circuit and the superhet, and we think the large sets are better, on the whole."

And he went out, taking with him the still unconvinced but considerably mollified young man, and the rest of the gang rushed out to lunch. The last to leave was that strange old man I had noticed before. He went out with a rather perplexed look on his face.

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RADIO PARLEY ENDS; HOOVER TO RULE ON PROPOSALS

WASHINGTON, Oct. 11.—The third national radio conference called by Secretary of Commerce Hoover last Monday, has adjourned after a series of sessions in which leading members of the radio crafts of America participated, filing with the department a set of recommendations which they passed unanimously.

In accepting the recommendations, Hoover said that the government would be guided to a great extent by the findings of this conference. The report outlined "interference" as the major problem of broadcasting, and called for a stricter allocation of wave lengths, the use of higher power on limited license, and a revision of amateur wave bands.

Recommendations

The detailed recommendations of the committee were:

(a) The reservation of an exclusive wave band of 200 to 545 meters for the following three classes of broadcasters: Class 1 (formerly Class B), 545 to 285 meters; Class 2 (formerly Classes A and C), 275 to 214 meters; Class 3 (under 100 watts), 211 to 205 meters.

(b) The much-discussed increase of power to five kilowatts for transcontinental work was recommended, under a new revocable experimental license, with very limited experiments permitted on the high power ratings.

Zoning Plan

(c) Establishment of a new zoning plan whereby Class 1 stations will operate on the same wave lengths on both Atlantic and Pacific Coasts, which allows a maximum of 126 Class 1 stations only.

(d) Slight adjustments in the wave length allocations of existing stations to conform to conference discussions.

(e) Seven bands of waves reserved for amateur use for continuous wave transmission with loosely coupled circuits, as follows: 150 to 200 meters, 75 to 85.6 meters, 37.5 to 42.8 meters, 18.7 to 21.2 meters, 4.7 to 5.3 meters. No provision was made for spark transmission.

Amateur Work

(f) Interrupted continuous wave and wireless telephone work of amateurs is to be confined to 170 to 180 meters.

(g) Retention of marine calling and distress signals on 600 meters.

(h) Marine communication is restricted to 660 meters, 730 meters, 875 and 706 meters.

(i) Gradual lessening of spark decre-

A Frank Statement and Explanation to the Radio Public

From C. H. Thordarson, President
Thordarson Electric Manufacturing Co.

HERETOFORE, Thordarson Super Transformers have been mainly obtainable only by the manufacturers of quality radio sets. Fans, the world over, have of course noted the use of our transformers in a preponderance of leading makes of receivers.

Quite rightly they concluded that Thordarson transformers must be decidedly superior. And so they sought to buy the same transformers for replacing unsatisfactory types and for use in home-built sets.

Despite the fact that we lead the field in number of transformers produced, dealers were unable many times to supply Thordarsons to these customers. This led to some feeling that we might be purposely restraining the general sale of our product.

The truth is that the tremendous gains in sales enjoyed by the makers who standardize on Thordarsons, took nearly all we could turn out even though our production was continually multiplied.

Not until last summer were we able finally to increase the capacity of our immense six-story factory sufficiently to provide for supplying the needs of the general public in addition to the larger wants of more and more set builders.

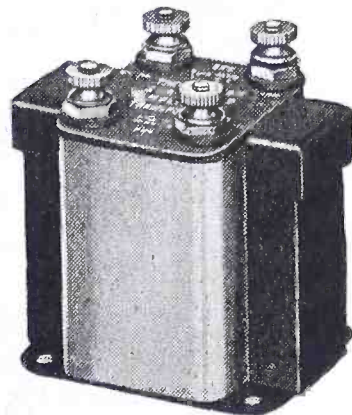
From now on, however, you should experience little if any difficulty in being able to buy Thordarson transformers. My aim is to build enough Thordarsons this season to permit every store to handle them.

*Six floors, 100,000 square feet
devoted to transformers*

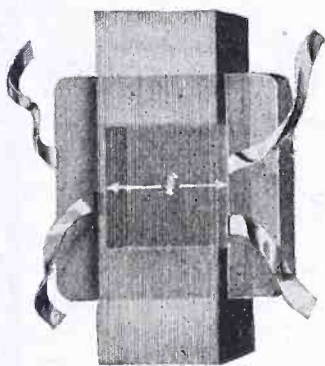
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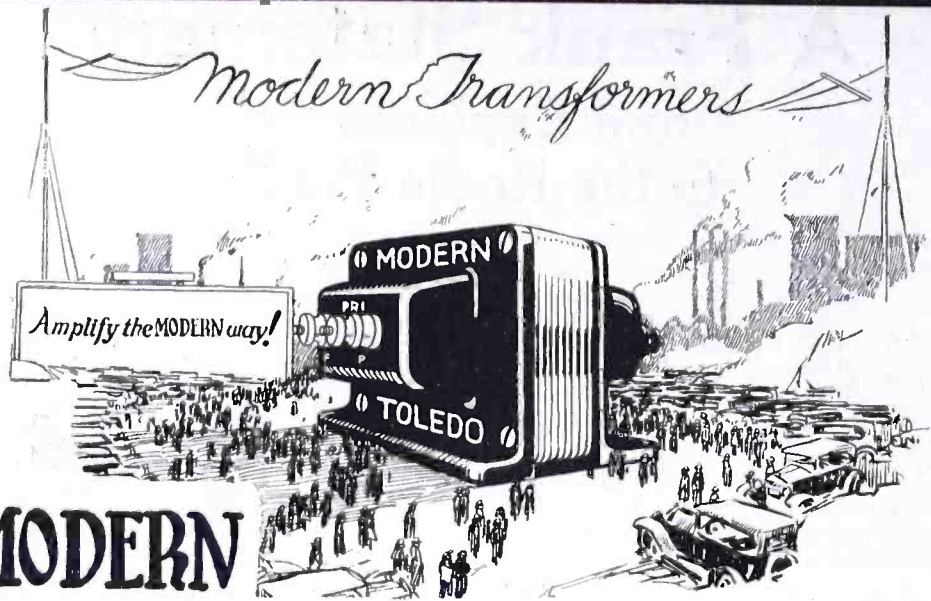
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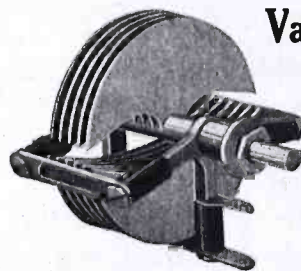
ment with a voluntary reduction of ship position reports.

Await Approval

All recommendations, together with suggested allocations, are tentative until approved by the Department of Commerce. The conference set itself squarely against government censorship of broadcast programs, but favored the inter-connection of broadcast stations throughout the United States. It urged co-operation by non-radio agencies in the problem of decreasing interference.

It is felt here that Secretary Hoover will approve most if not all of the conference recommendations, as all were submitted after deliberation by the leading representatives of all of the radio crafts in the country.

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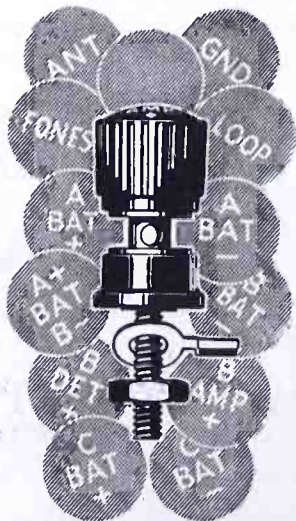
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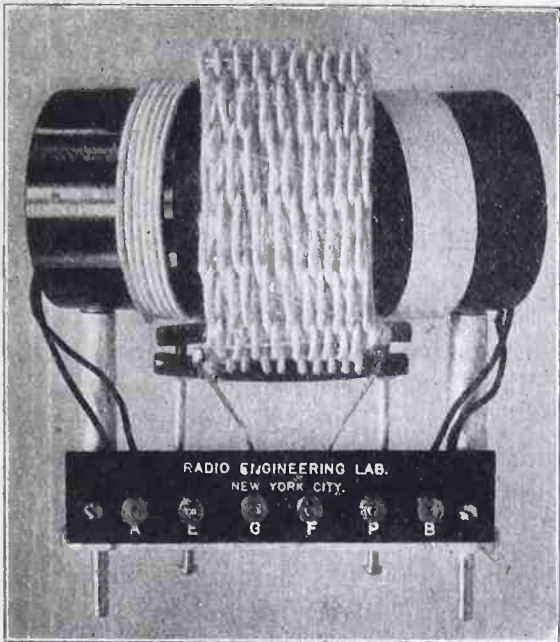
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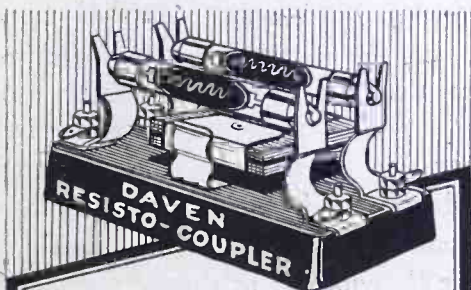
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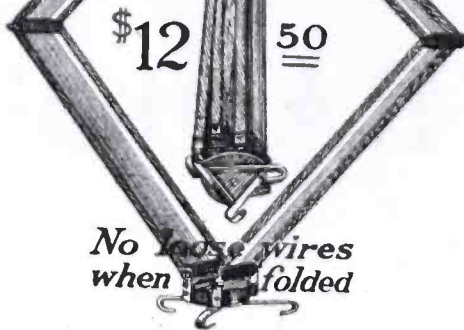
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VAGARIES OF THE ETHER

By WALLACE KELK

THE Canadian Government Direction Finding Station at Pachena Point, on the west coast of Vancouver Island, recently made a series of observations on an 800-meter wavelength which reveal amazing differences in the stability of signals traveling over water as compared with those over land during the night. These tests were made at the instigation of Commander C. P. Edwards, director of the Canadian Radiotelegraph Service, through whose courtesy this publication is possible.

The observations were taken on Gonzales Hill, Vancouver, B. C., and on Bull Harbour, the former being 75 miles southeast of Pachena Point and the latter 150 miles northwest, both being over land. The tests consisted of radio compass readings on two-minute signals transmitted from each station at hourly intervals, commencing at 12:30 a. m. and continuing for 24 hours.

From the time of the first test until 5:30 a. m. (sunrise) great variations were observed on both transmissions. The lowest variation checked on Gonzales Hill from its true bearing (111 degrees) was a minus of 5 degrees and the highest a minus variation of 45 degrees. It was noticeable also during this particular period that minus variations showed a preponderance over plus. On Bull Harbour (true bearing 312 degrees) the lowest variation was 2 degrees and the highest 87 degrees, minus in each case, while here again minus variations slightly preponderated.

Despite the comparative short duration of the testing signals, variations were detected while the observations were actually in progress, which means to say that the shifting minimum could be distinctly followed on the radio-goniometer. It was also possible to gauge the violence of the fluctuations by noting the Bull Harbor observation at 1:30 a. m., which first showed a plus variation from true of 20 degrees and subsequently veered round to a minus of 70 degrees, a total swing of 90 degrees in the two minutes.

Between 5:30 a. m. (sunrise) and 7:30 p. m. (sunset) the bearings remained constant and true with the exception that at 6:30 p. m., when the power of the sun was beginning to wane, slight variation commenced, which, however, did not exceed three degrees from either station.

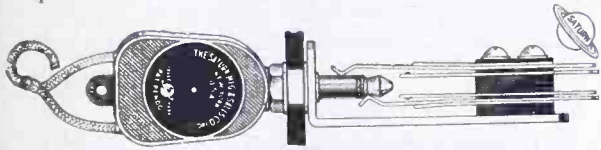
The 7:30 to 11:30 p. m. period gave practically the same results as the early

morning period except that positive variations predominated from Gonzales Hill and negative from Bull Harbor.

While these overland transmissions were showing such fluctuations, check observations over water on the Canadian station at Estavan Point and on the United States naval station at Tatoosh Island, off Cape Flattery, were normal and steady throughout the night and showed no tendency to deviate.

The existence of this marked night effect over land may be explained as due to less rapid de-ionization over water than over land and its influence on the reflecting surface of the Heaviside layer.

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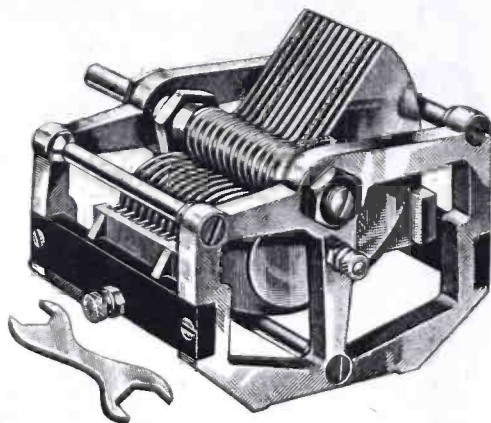
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SOMETHING ABOUT TESTING TUBES

By RALPH W. WIGHT

The usual test for defective tubes gives only an indication as to whether it will oscillate. This comparison of good and bad tubes does not show how good they may be. It is still a matter of luck if the customer gets a really good tube.

The manufacturers' data give the average electrical characteristics for all classes of tubes. If we are to test tubes at all, let's test them against these standards. We can then refuse tubes which do not meet these requirements regardless of whether they oscillate or not.

Assume that an "A" tube at 45 volts plate potential has an amplification constant of about 6, a plate impedance of about 19,000 ohms and a mutual conductance of 345 micromhos. To simplify matters, think of amplification constant as voltage amplification, plate impedance as simple resistance, and mutual conductance as power amplification. These measurements can be made in the following manner.

Amplification constant is expressed

$$\mu = \frac{V_{p1} - V_{p2}}{V_g}$$

Where V_p is plate voltage and V_g grid voltage.

Hook up a circuit in accordance with Fig. 1.

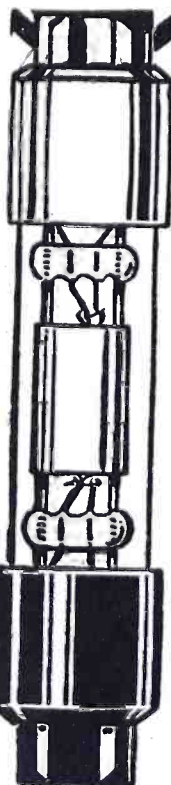
With V_g at zero and V_{p1} at 45 volts, read the plate current. Next make V_g 5 volts negative or any convenient voltage. Now increase plate voltage until the plate current reads the same as the first reading. This we will call V_{p2} . Then, dividing the difference in plate voltage by the grid voltage causing this difference, we have the amplification constant. For example, our V_{p1} was 45 and our V_{p2} was 77. The difference being 32 volts, we divide by our V_g of 5 and get 6.4.

With the same circuit we may also measure the mutual conductance of the tube. To find mutual conductance (G_m)—

$$G_m = \frac{I_{p1} - I_{p2}}{V_g}$$

I_p being plate current and V_g grid voltage. Two readings are taken of plate current. The first at zero grid potential and the second at a few volts negative grid. The difference in these readings divided by the grid voltage causing it, gives us the mutual conductance. Plate reading is in microamperes. So if at zero grid voltage, our tube draws 1970 microamperes and at negative 5 volts on the grid the plate current is 420 microamperes, we find by dividing by our grid voltage we get 310 micromhos, micromhos being the expression of conductance, the reciprocal of resistance.

Keeping in mind that amplification constant is voltage amplification and mu-



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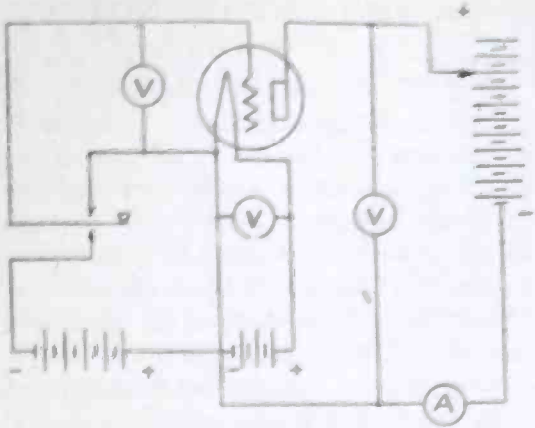
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tual conductance is power amplification we may arrive at the plate resistance as in ohms' law.

$$R_p = \frac{\mu}{G_m}$$

You may say, "Yes, but we can not all make these measurements." That is admitted, but retailers can be so situated as to protect you as well as themselves by building up a small test set and making these tests for you. Readings of this nature should be taken with good instruments. One or two good voltmeters and a good 0 to 6000 microammeter will fill the bill. Remembering that the grid of our tube controls the plate, we readily see just how important the data secured in the above manner really are. It tells us exactly what control our tube has. If the grid regulation is poor, it naturally follows that we have a poor tube. Also from the above we see that not all tubes are satisfactory for the same kind of service. For example, power tubes would have much higher conductance than others. It should also be noted that all three of these measurements are directly dependent upon the other two. From any two we may find the third.

$$R_p = \frac{\mu}{G_m} \quad G_m = \frac{\mu}{R_p}$$

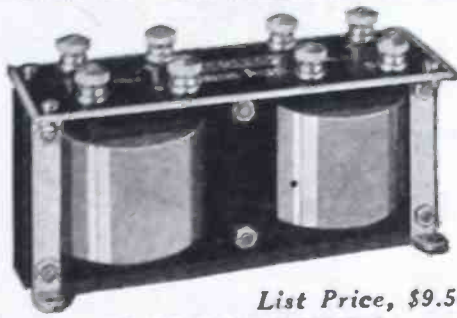
$$\mu = R_p \times G_m$$

Some tube data as supplied by the manufacturers follow. This information is published in pamphlet form for distribution by retail dealers.

Tube	Plate voltage	Mutual cond.	Amp. constant
UV199 or C299...	40	315	6.20
	60	350	6.20
	80	400	6.25
UV201A-C301A ..	40	345	6.50
	60	425	6.55
	80	535	6.60
WD11 or WD12..	100	630	6.60
	20	190	5.70
	40	290	5.20
	60	420	5.80
	80	470	6.10

TURN TO PAGE 111
— for —
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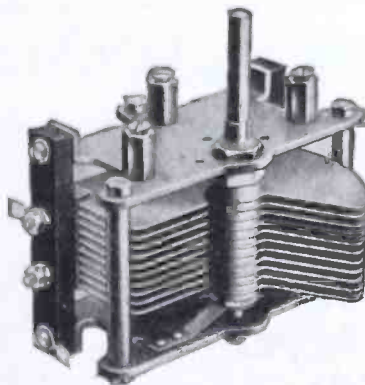
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as his exclusive choice of a low loss, grounded rotor condenser for use in his new improved Four Circuit Tuner as described in the October issue of Popular Radio.

This again emphasizes the fact, that of all the various kinds of radio apparatus on the market today, the Cardwell Condenser is the only unit which is recognized by the leading Radio Engineers as the ONE best. It is the original rotor grounded, low loss condenser.

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Points of Construction

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Super-Heterodyne. A binding post is furnished on each shield for connection to Neg. A. Battery.

2. Accurately matched in sets of four.

3. Moulded of genuine Bakelite.

4. Kit includes 3 matched Intermediate transformers, 1 matched input transformer. Complete Blue Prints giving every detail for the making of an eight tube set.

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RADIO COMPASS NOTES

By F. L. ULRICH

Due to the difficulty frequently experienced in getting radio bearings on ships using C. W., it is suggested that a buzzer or other means be employed to break up the carrier wave, as it is much easier to get good bearings from I. C. W. Ship operators should also adjust their transmitters as closely as possible to 800 meters, as that is the wavelength on which the compass stations stand continuous watch.

In most commercial installations of a radio compass on shipboard the loop is exposed to the weather and its characteristics are liable to vary with moisture conditions. The Navy loops are covered with a weatherproof housing that not only prevents these changes, but also protects the loop from swinging booms, etc.

RADIO SUPERVISORS WILL MEET HOOVER

One phase of the national radio conference for better volunteer regulation, which opens in Washington on October 6, will be the assembly for the first time of all the Department of Commerce district radio supervisors. Secretary Hoover has authorized the radio supervisors to report at headquarters in order that he may have first-hand reports as to radio activities in the nine national divisions of the country, and get suggestions from his technical field force. The district supervisors include the following men listed with their headquarters: First District, Boston, C. C. Kelster; Second, New York, Arthur Batchelder; Third, Baltimore, R. Y. Cadmus; Fourth, Atlanta, W. Van Nestrand, Jr.; Fifth, New Orleans, Theodore G. Deiler; Sixth, San Francisco, J. F. Dillon; Seventh, Seattle, O. R. Redfern; Eighth, Detroit, S. W. Edwards; and Ninth, Chicago, E. A. Beane.

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Stands 22" high.

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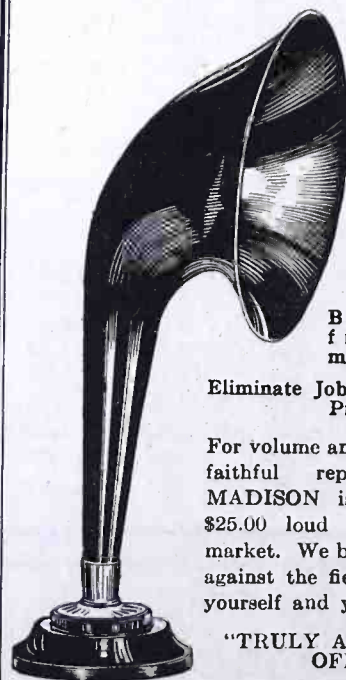
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Why it is Better

LOOK at this illustration—see for yourself the eleven distinctive features in the construction of the Federal Condenser. Every feature is a distinct point of superiority—essential to clear, sharp tuning and clear reception.

You can get the outstanding advantages of Federal Tone and Federal Selectivity in your pet hook-up *only* by insisting on Federal Parts.

There are over 130 Federal Standard Radio Parts bearing the Federal iron-clad performance guarantee. Use them—for your own protection and enjoyment.

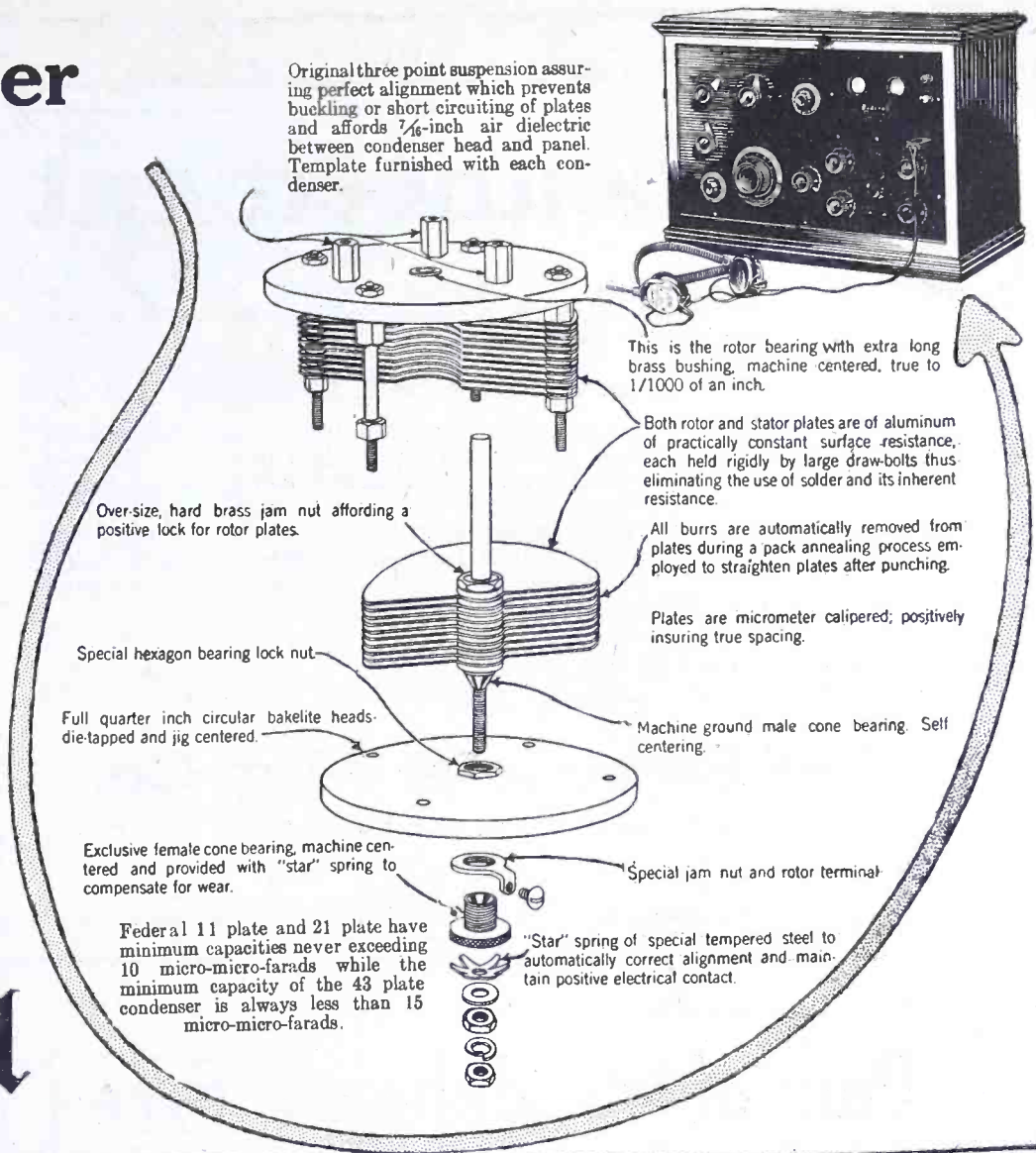
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Buffalo, N. Y.

Boston New York Philadelphia Pittsburgh Chicago
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Original three point suspension assuring perfect alignment which prevents buckling or short circuiting of plates and affords 7/16-inch air dielectric between condenser head and panel. Template furnished with each condenser.

This is the rotor bearing with extra long brass bushing, machine centered, true to 1/1000 of an inch.

Both rotor and stator plates are of aluminum of practically constant surface resistance, each held rigidly by large draw-bolts thus eliminating the use of solder and its inherent resistance.

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Plates are micrometer calipered; positively insuring true spacing.

Over-size, hard brass jam nut affording a positive lock for rotor plates.

Special hexagon bearing lock nut.

Full quarter inch circular bakelite heads—die-tapped and jig centered.

Machine ground male cone bearing. Self centering.

Exclusive female cone bearing, machine centered and provided with "star" spring to compensate for wear.

Special jam nut and rotor terminal.

Federal 11 plate and 21 plate have minimum capacities never exceeding 10 micro-micro-farads while the minimum capacity of the 43 plate condenser is always less than 15 micro-micro-farads.

"Star" spring of special tempered steel to automatically correct alignment and maintain positive electrical contact.

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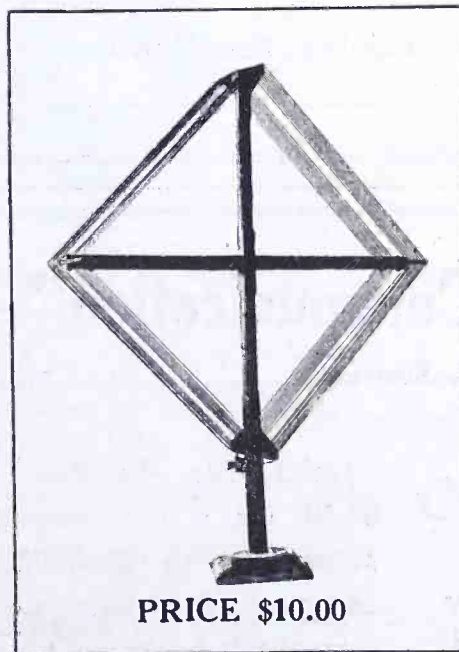
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Announcement

By arrangement recently completed with the Acme Apparatus Company of Cambridge, Massachusetts, we will now manufacture the

Terlee-Acme Reflex Receiving Set

—a five tube set embodying the world-famous Acme Circuit with selectivity and distance of an eight tube set. This new set will be representative of unexcelled quality and workmanship. Highest grade Acme parts will be used assembled with the customary Terlee engineering precision. Recognized jobbers are invited to write us for detailed information and prices. We suggest that radio enthusiasts get acquainted with this set through their local dealer.

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WIRING THE RADIO RECEIVER

By H. BUNCH

The wiring of a receiving set is one of the most important factors in making for its efficiency. The best method, after the parts have been mounted on the panel, is to draw a rough diagram of the wiring, particular care being taken to observe where wires cross and to see how these crossings can be avoided. Care should also be taken to avoid parallel wires for any considerable distance, and as great a space as possible should be allowed between wires so that interaction between the different circuits is kept at a minimum.

A well-planned receiver, in which the wires have all been bent to shape and kept in either horizontal or vertical planes, looks much better and generally gives much better results than a receiver in which the wiring has been done in great haste without any regard to order or appearance.

For internal wiring it is better to use thick tinned copper wire of approximately 16 to 18 gauge. Great care should be taken to make sure that the high-tension leads cannot come in contact with other leads, and it would perhaps be safest to cover these wires with insulative sleeving (spaghetti), but the remainder of the wiring should be done with uncovered wire.

The first rule in soldering is absolute cleanliness, because solder will not adhere to any metal that is dirty or oily. A good soldering flux is necessary. Probably one of the best and easiest to use is "killed acid," a solution of zinc chloride, formed by placing two or three pieces of ordinary commercial zinc into a dilute solution of muriatic acid. Acid fluxes should never be used. If the builder decides to use soldering paste, care must be taken not to use too much. The flux will run when heated, and should it happen to run onto another connection, a high resistance leak will be shunted across the two wires.

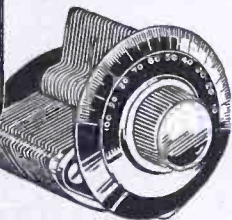
The soldering iron or "bolt" is made of copper. It should be "tinned" before using. To tin the bolt, the tip should first be filed so that the copper shows up brightly. Then heat the iron, apply a small quantity of flux to the part that has to be tinned, and melt a little solder onto it. While soldering, the bolt should be hot enough to make the solder flow freely, but it must not be overheated. In soldering two parts together the solder must run freely between them, and parts should be kept pressed together until the solder has set. If this pressure is not maintained the wires will often spring apart.

It should be remembered that a large lump of solder on two wires does not

look neat, nor does it necessarily make a good electrical connection. Unless the solder has run freely, it is quite possible that it will make a connection of high resistance and will result in either a total absence of signals, or at best very faint reception. This point cannot be too strongly emphasized. Many an otherwise perfect set has been discarded because it contained a high resistance joint that was not observed at the time of building, the poor results being attributed to a poor ground, Major Armstrong or Dr. De Forest.

Two other important points to be remembered in wiring are that the grid circuit wires should be made as short as possible, and the leads of the primary and secondary of the transformers should be kept apart and, if possible, at right angles to each other.

U.S. TOOL CONDENSERS
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Point Number Two

NEW HEXAGON SHAFT

THE SECOND OF FIVE UNIQUE FEATURES

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For 2-volt peanut tube cells, for 6-volt A batteries and for 24-volt B batteries in from one to four units, the Valley Battery Charger is the one charger and the only charger which you need.

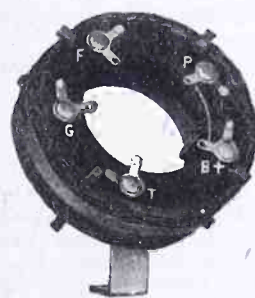
It plugs into the ordinary light socket like a fan or other household necessity, and is just as easy to operate. Takes about a dime's worth of current to bring your battery up to full charge.

It has a grained and engraved Bakelite panel which harmonizes with any radio set. Clear glass top shows the simple, patented working parts at all times. Scientifically planned and substantially made by experienced manufacturers of storage battery charging equipment.

At radio dealers everywhere. Further information furnished on request.

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No. 602

The Kellogg radio frequency transformer is of the aperiodic type suitable for all sets with which tuned radio frequency is desired, and also suitable for one stage of radio frequency amplification ahead of regenerative sets to prevent re-radiation. The primary of this aperiodic transformer is arranged with two taps—one for all wavelengths with a short antenna, and the other for all wavelengths with a long antenna. The secondary is arranged with suitable taps for biasing features. Manner of construction reduces losses to a minimum.

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Use—Is The Test

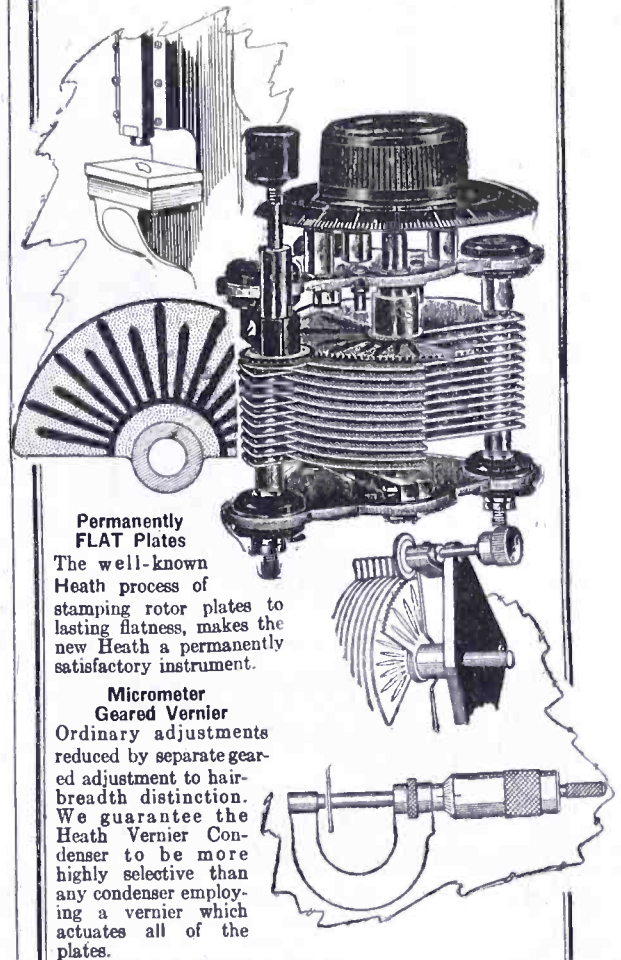
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Insure Full Life of Tubes

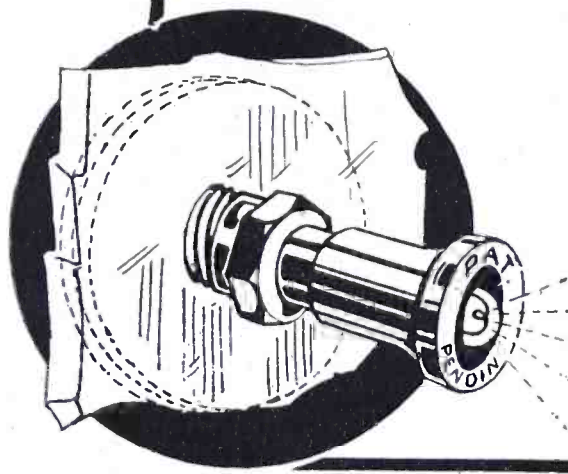
KANT-BLOS are the apex of Radio tube insurance without interfering in any way with the reception of your set.

KANT-BLOS are not fuses or plain high resistances.

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SWITCH SIGNAL BINDING POST

"Lights on any Short Circuit"

ACROSS THE PACIFIC BY RADIO COMPASS

By CARL E. SODERSTROM,
M/S. H. T. Harper

Ever since the first radio signal was sent out in space radio has been first of all an aid to navigation. And so important and valuable an aid has it proven that millions of dollars of property and thousands of lives have been saved through radio.

The navigator's greatest enemy has always been fog. When the sun shines, when the stars twinkle, when landmarks are visible, navigation is easy. But, when the fog sets in, the lead and look-out, until recently, was the navigator's only aid. And this aid has never been very satisfactory at its best. But, even this is changing, thanks to radio. For many years experiments were conducted to obtain bearings from a radio transmitting station, with more or less satisfactory results. The most successful result obtained up to present time has found its perfection in the Kolster radio compass.

The question of the limit as to distance possible to obtain accurate bearings on this radio compass came to the mind of the writer, and for this reason a number of bearings were taken from the *M/S. H. T. Harper*, during a voyage to the Hawaiian Islands and return to San Francisco. Some of the diagrams of these bearings, copied from the chart on which they were plotted, are herewith shown. The bearings from Estevan, B. C. (VAE) have been singled out, as they are truly remarkable.

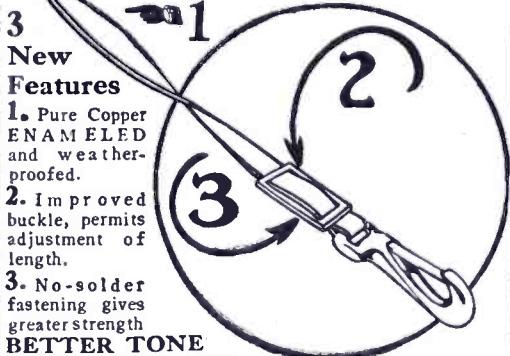
The bearings were taken at night and given to the captain, who plotted them on the chart. He had previously plotted the ship's latitude and longitude position on the chart. This method was used so as to eliminate any possibility of guesswork from either side. The bearings were taken at times when the respective stations were transmitting regular commercial work, and unknown to them. They did not know that they were making radio history.

Some interesting phenomena were observed in obtaining these bearings. In certain locations, as for instance three to four hundred miles east of the Hawaiian Islands, the incoming signals were so erratic as to place the coast stations up to 100 miles to northward. A perfect minimum was obtained at such readings. Again, about 100 miles from the Islands, the bearings were perfect, the signals coming in steady and with correct minimum. Some nights, for instance, it was found that Bolinas (KPH), gave a minimum reading with an error ten to fifteen degrees to the northward, while at the same time the Federal Telegraph Company station at the Beach, San Francisco (KFS), only a few miles to the southward of Bolinas,

Continued on page 110

The New ACORN Enameled RIBBON AERIAL

Now enameled and weather proofed—will give unlimited service, regardless of time or weather. Not a strip of flat copper, but a Laboratory product in which resistance, capacity and strength have been calculated for best results.



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50ft. \$1.75

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New Window Lead-In



No. 1—Triple Insulated 35c
No. 2—Window Lead-In 25c

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Continued from page 50

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Can.—3bg, 3bp, 3bq, 3co, 3oh, 3wv.

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Tell them that you saw it in RADIO

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fresh lists of all telephone broadcasting stations in the world, all standard hookups with a complete description of each, how to build thirty and fifty kilocycle Super-Heterodyne, Greene Concert Selector and Low Loss Tuner, complete article on receiver troubles and how to remedy them, maps, log sheets, distance chart and a world of information well worth \$5.00 of any radio fan's money.

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Fourth Annual

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Only a Few On Hand

"RADIO"—Pacific Building, San Francisco

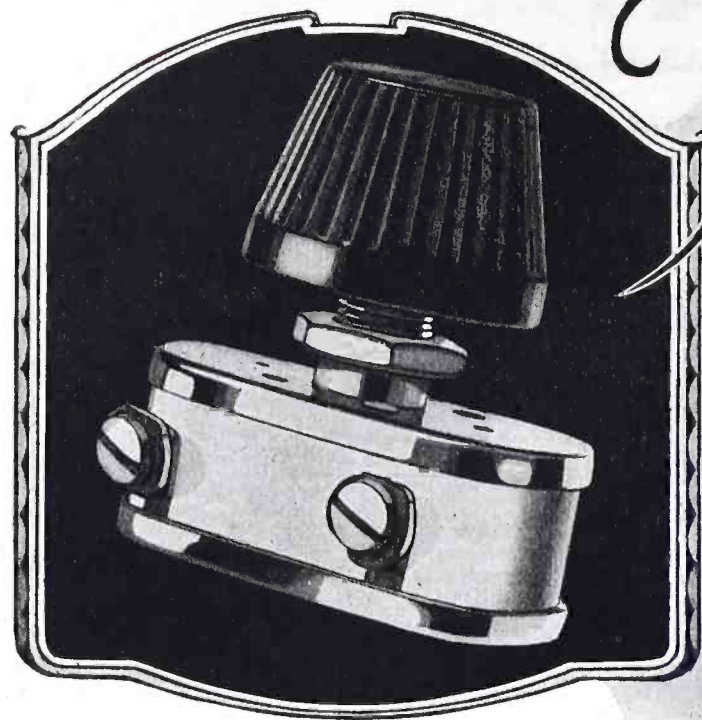
Continued from page 108

proved correct. At no time did an error show to the *southward* of the transmitting station. In the location three to four hundred miles east of the Hawaiian Islands all stations showed an error to *northward*, while closer to the Islands they all came in correct.

The station to give the most correct signals at all nights, with the exception of three to four hundred miles east of Hawaii, is Estevan, B. C. Every bearing taken on this station, with the above exception, proved to be correct. In general, it seems that there is a *northerly* error from all stations bearing to the *east* of the vessel, and that this error is variable. Future experiments should be of value and interest to confirm this observation.

As an example of this error we take March 9th. Estevan proved accurate, but every other coast station was way out to the *north*. On the 10th, Estevan was correct, but all other coast stations except Wilmington (KSE) was way out to the *north*. On the 11th, Estevan was again right and checked up with the previous 48 hours' run so perfect that it is remarkable. This seems to indicate that the only station found constant is Estevan. It was also noticed that the signals from coast stations in general proved more constant and accurate when the vessel was heading in a westerly direction than when heading in an easterly direction.

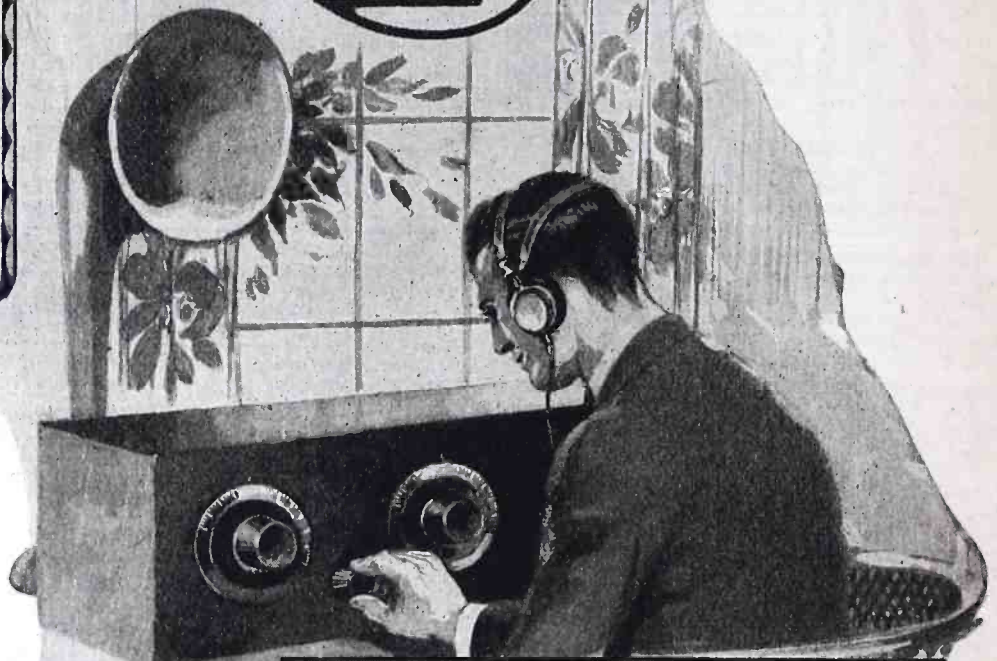
Now comes the shock. All these bearings were plotted on the Mercator Chart, that is to say, a chart whose projection is as if the earth was flat. Now, at this day and time, it is, with the exception of prophet Viola of Zion City, generally agreed that the earth is not flat. So, for this reason, several experts have declared that the bearings could not be right if plotted on the Mercator Chart without the necessary corrections. The lighthouse service, in their instructions regarding taking bearings from radio beacons, caution the observer that, when such bearings are taken at a long distance and plotted on Mercator Chart, the proper corrections should be made, or the bearings would not be right. In this case no corrections have been made, but nevertheless the bearings are correct. This fact has caused considerable controversy among navigation and radio experts. Of course, such controversy can be nothing but speculative. No one really knows how radio signals travel. In this particular case it seems that the signals did not travel at a certain angle to the surface of the earth, or with the earth's circle, as we have been told that they do. It actually seems that they accommodated us in our experiment, by traveling *straight* and *true*. And, consequently, there should be no correction to apply.



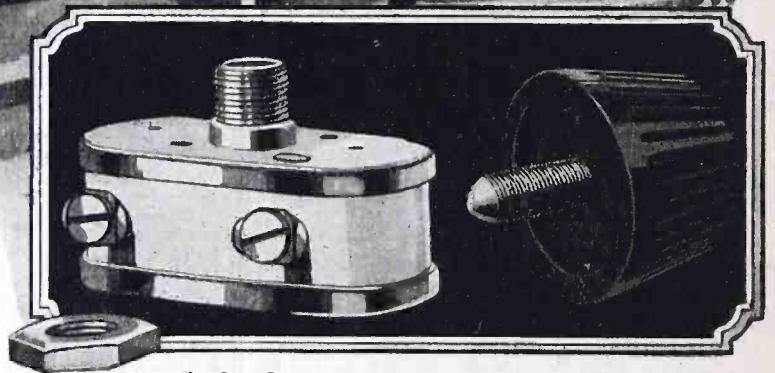
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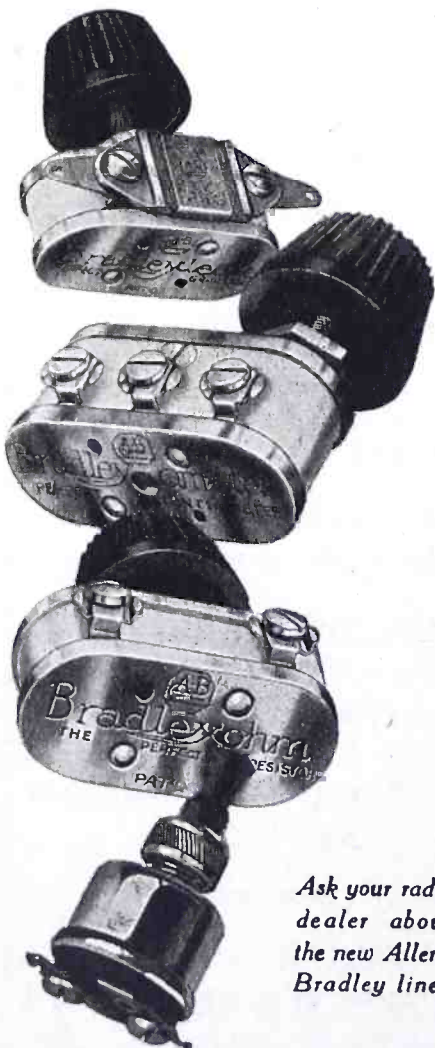


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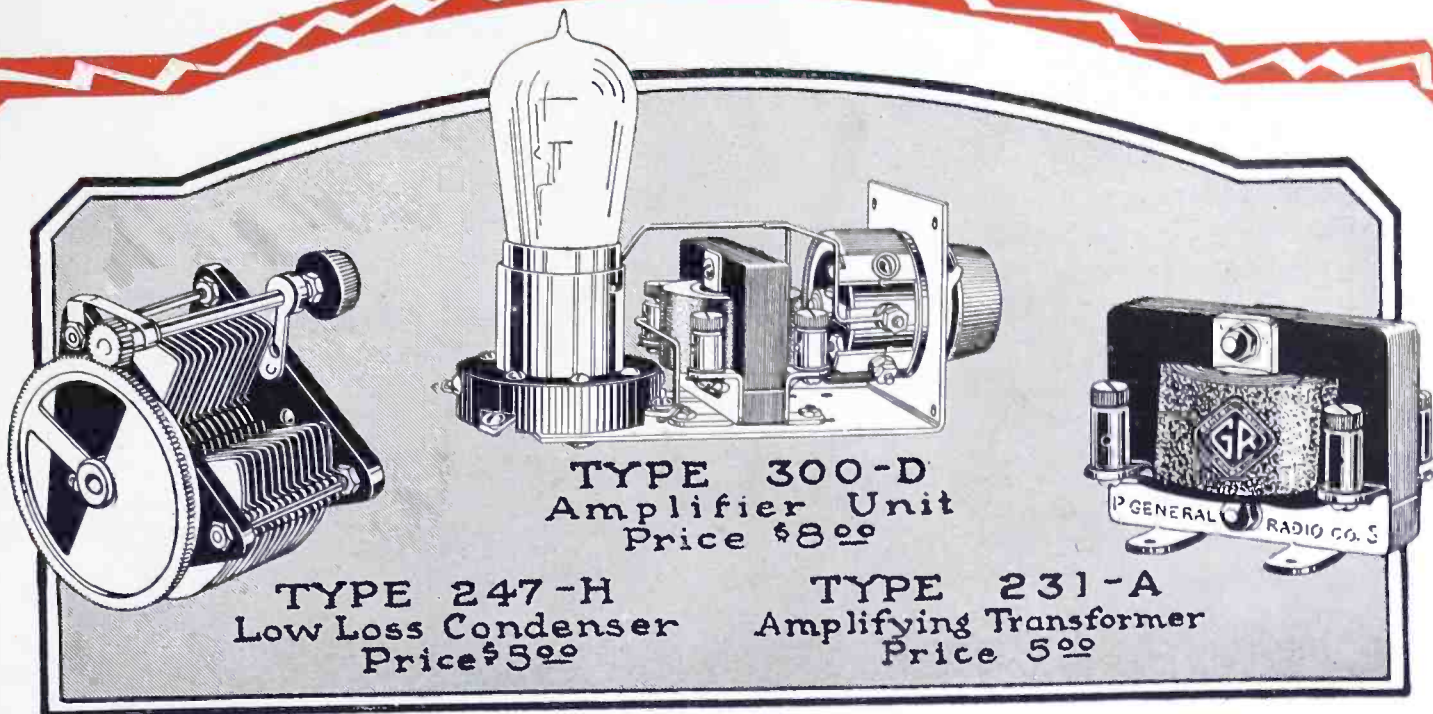
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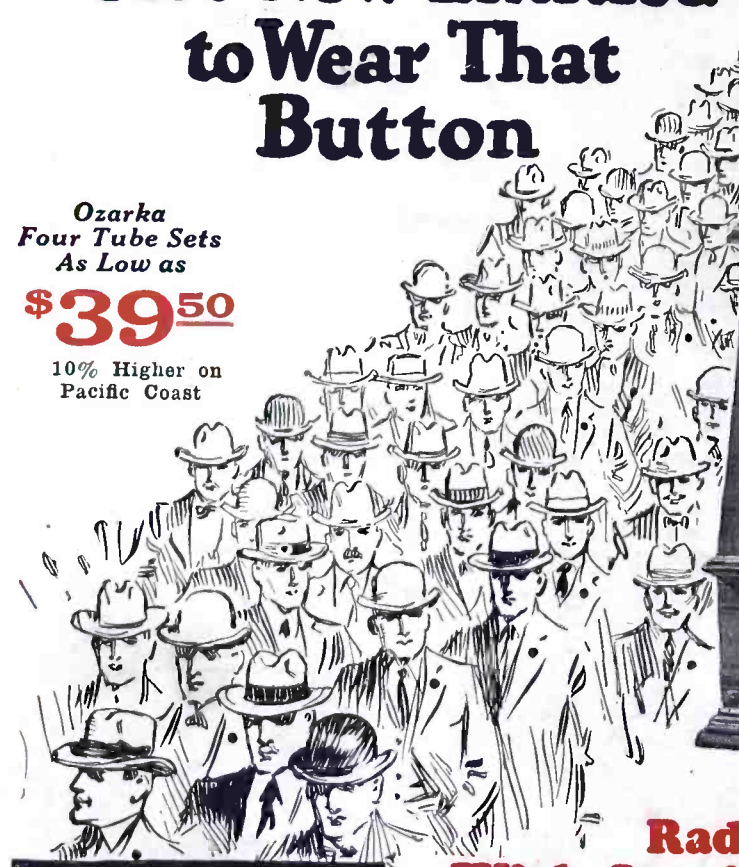
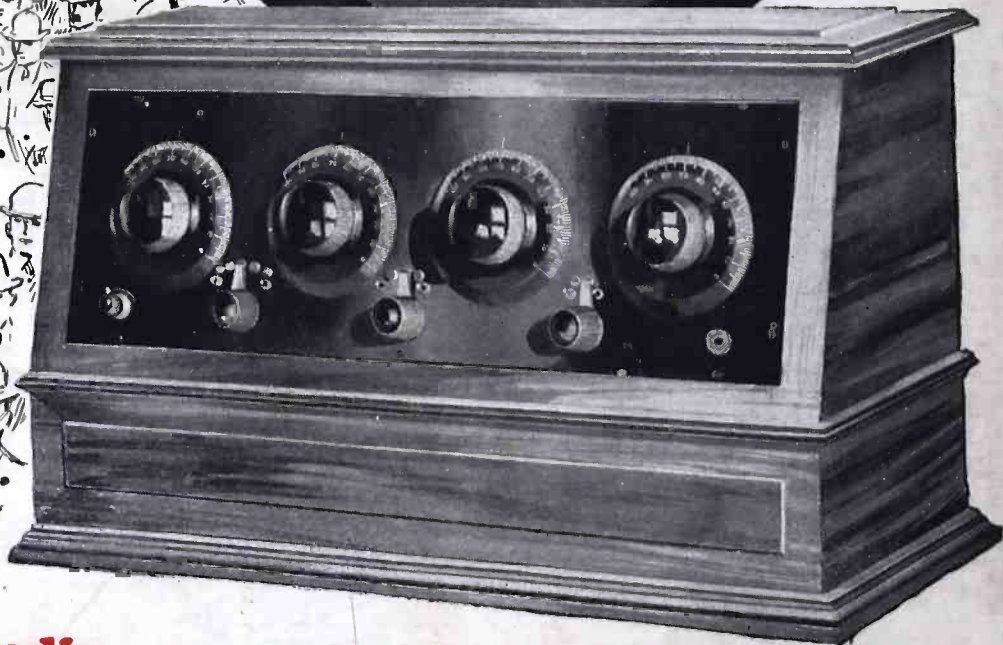
1934 Trained Factory Representatives

Are Now Entitled to Wear That Button

Ozarka
Four Tube Sets
As Low as

\$39⁵⁰

10% Higher on
Pacific Coast



Radio With Service

OZARKA radio instruments are demonstrated, sold, installed and serviced by direct factory representatives only. These men have been thoroughly trained by our own engineers who designed and perfected Ozarka.

The success of any radio instrument, like the automobile, depends on the quality of service rendered.

No matter how perfect any radio instrument leaves the factory, little things may sometimes go wrong. You've no doubt learned, by costly experience, that the ordinary handy man cannot properly service your automobile. The same is true of Radio. Troubles are generally caused by very little things which are exasperating to the owner, but are quickly corrected by the man who is trained on that instrument.



Today 1934 factory trained representatives are authorized to wear the Ozarka button. These men know Ozarka perfectly; more are now being trained; soon there'll be one in every town.

Without obligation to you, the Ozarka representative will set up an Ozarka in your home on trial. He won't claim that it is better than others. All he asks is the opportunity of letting the Ozarka do its own selling. With *your own operating* you must satisfy *yourself* that it has no equal for volume, tone, distance and ease of operation.

The Ozarka Representative will erect the most effective aerial possible. He will teach every member of your family how to receive results from your Ozarka which will make you the envy of your radio friends. More than this, he *can* and *will* keep your instrument working perfectly at all times. Ozarka quality speaks for itself. Ozarka prices, quality considered, are low. \$39.50 and up.

Let us send you the stories of Ozarka long distance reception—from many people who have heard London and Manchester, England; Cardiff, Wales; Glasgow, Scotland; Buenos Aires, South America; and even Honolulu, H. I. Write for *free* illustrated book No. 200. Please give name of your county.

Ozarka Offers Real Opportunities

It is not exaggerating to state that hundreds of thousands of homes are waiting for "Radio with Service."

In other words they are waiting for the Ozarka trained man. Already we have 1934 such representatives, and the field is barely scratched. Ozarka training is very thorough, intensely interesting, and quickly absorbed through study in spare time, by any man who is mechanically inclined.

Three other qualifications are necessary: the desire to better your condition, willingness to work, and at least a little capital.

You may not think that you possess the necessary selling ability. But with the qualifications just mentioned, plus Ozarka training, you can and will talk convincingly of what Ozarka will do—and you can set up the Ozarka instrument in the approved manner that insures satisfaction.

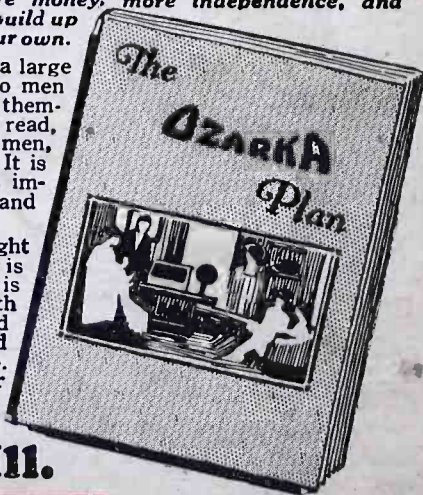
Lack of information is keeping thousands and thousands of prospective purchasers from enjoying radio. They think that operating a radio is the job of an expert. They fear that their investment in a radio instrument will not bring the results they want.

This situation is "made to order" for the Ozarka man. He has only to let the Ozarka Receiving set do its own talking—its results will sell itself—and thus convince folks that is the set they want. He sells it on the basis of satisfaction guaranteed—sets it up all in first class working order—and keeps a supervising eye on the installation until familiarity has resulted in confidence.

The Ozarka Plan offers you more money, more independence, and possibly your first real opportunity to build up a permanent, profitable business of your own.

The Ozarka plan is fully described in a large illustrated book. A copy will be sent to men who are willing to tell us fully about themselves. Unlike any book you have ever read, the Ozarka book is a true story of life, of men, of why they fail, and how they succeed. It is founded on the principle that nothing is impossible to the man who is determined and willing to try.

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