RADIO Engineering

A Magazine of Technical Accuracy for the Radio Set Builder, Engineer and Manufacturer

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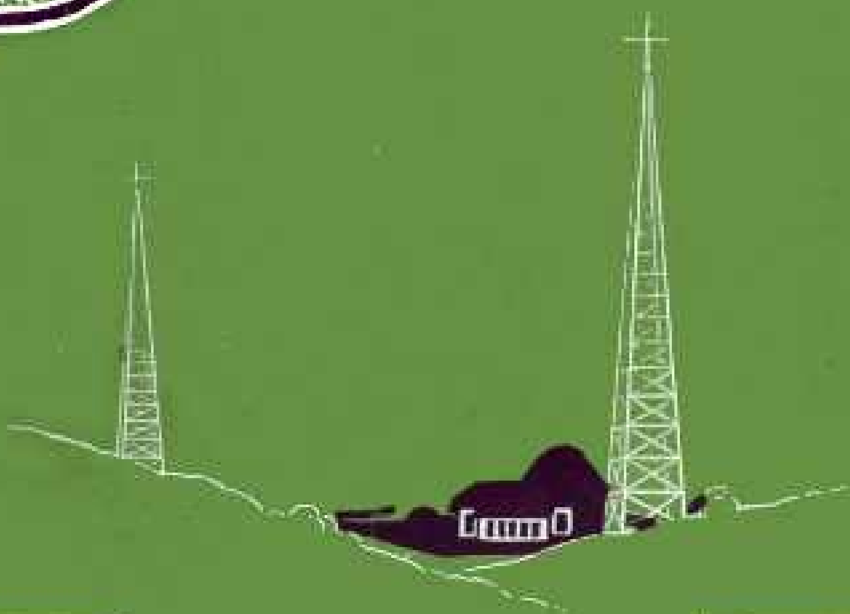
Edited by
M.B.SLEEPER



AUGUST 1925

VOL. V NO. 8


It isn't a genuine UV-199 unless it's a Radiotron
The familiar names WD-11, WD-12, UV-199, UV-200 and UV-201-A rightfully belong to Radiotrons only. To be sure of quality, it is important to look carefully at the base of every tube you buy to see that it carries the name Radiotron and the RCA mark as proof that it is a genuine Radiotron.
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RADIO ENGINEERING

Edited by M. B. SLEEPER

Associate Editor, Alfred A. Ghirardi

Fifth Year Vol. V, No. 8

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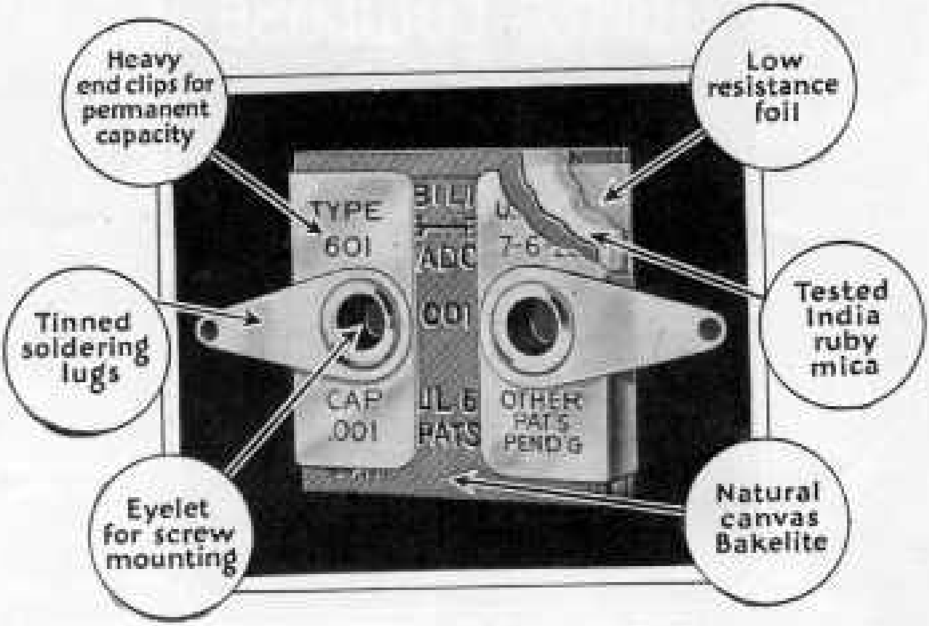

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This diagram indicates the efficient details of construction that have made Micadons the standard* fixed condensers of radio.

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**Standard—anything recognized as correct by common consent . . . . . . of a high degree of excellence.*
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CONDENSER AND RADIO CORPORATION

Fig. 1. The T. C. set at the Darien laboratory, operating from a Timmons B-Liminator. Note the double-range Jewell voltmeter, used to get the correct rheostat settings

Building and Operating the Samson T. C. Receiver

Presenting the complete construction data on the Samson outfit, the first new kit brought out this fall

Editor's Note: This article introduces an entirely new method of presenting assembly and wiring instructions. Altho Radio Engineering introduced the picture wiring diagram system in 1922, none of the other publications which have used it subsequently have been able to improve upon it.

We believe, however, that we ourselves have increased its usefulness greatly by the changes incorporated in this article. There have been two weaknesses in the past — the difficulty of locating numbers on the drawings, and the lack of adequate means for checking connections.

With the new system, any connection can be found in a second because each connection is identified with the instrument on which it is located. No wire can be omitted by mistake, because it will show up in the terminal checking list. Each instrument can be checked with the schematic, which also gives the constants and the manufacturer's name as well.

We shall be interested in having your comments on the new schematic and picture wiring diagrams.

MOST everyone has heard rumors and rumblings from Boston, portending interesting results of things which Prof. Bowles, in his quiet way, has been doing. "A construction kit," we heard. "New system of neutralizing," and a word or two about an R. F. choke which actually performed the service implied by the name.

And now that the set has made its initial appearance, if you know Prof. Bowles, you have an idea of the product so long anticipated — a finished job in every sense of the word, operating in a way to combine with full power and range.

The Samson T. C. Receiver The T. C. receiver, developed by Prof. Bowles, is being produced by the Samson Electric Company in the form of a construction kit, differing from the usual kits, however, in that it is assembled at the factory, but the wiring is left for the set builder. Thus the cost is greatly reduced over the expense of a finished outfit, yet most of the errors ordinarily made in putting together an unassembled kit are eliminated, since there is very little opportunity to go wrong on the wiring.

The various views of the T. C. set show the new features which have been incorporated. It is interesting to designers to note the increasing tendency to use one step of high efficiency R. F. amplification, capable of amplifying the higher wavelengths, instead of two stages which are very poor above 375 meters. The R. F. transformer is mounted at the center of the panel. The main tube carries the secondary winding, with the primary mounted at the bottom, and the plate coil, regulating the volume, at the top. Making the primary coupling adjustable is a new stunt, and a good one, because it allows a range of control from full power with slightly broad tuning to moderate power with extreme selectivity. The advantages of this design are obvious when the set is being adjusted, tho the two controls do not complicate the tuning since the primary coupling is left at maximum unless there is interference, while the volume control requires resetting only when the wavelength is changed considerably.

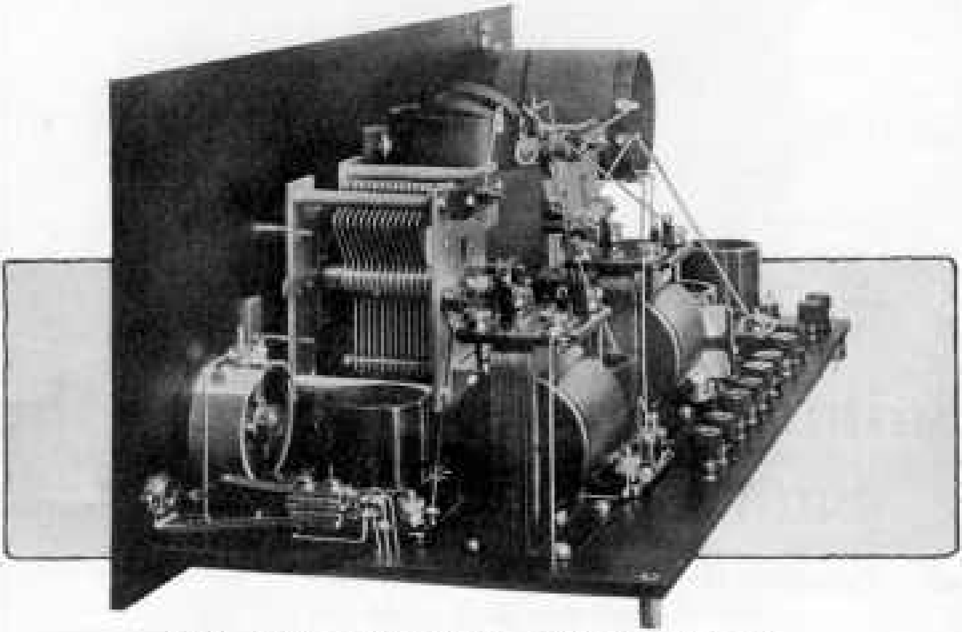

Fig. 2. The A. F. amplifying end of the T. C. receiving set

Fig. 6, the schematic diagram, shows the wiring of the neutralizing circuit. It includes the neutralizing condenser Q, R. F. choke R, and by-pass condenser S. The neutralizing condenser, Fig. 8, is mounted between the R. F. and detector sockets, while the choke and condenser can be seen in the end view, Fig. 3. It is an easy matter to neutralize the set, since the little knob on the condenser gives a wide range of control.

Contrary to general practice, both A.F. transformers are of the low ratio type, 1 to 3, for the amplification is so high that it was not considered necessary to take a chance of overloading the tubes on heavy, local reception.

Any tubes can be used on this set, tho it is built to operate UV201-A's or C301-A's from a 6-volt storage battery. Reducing the A battery to 4 volts, 199's can be substituted, with adapters to hold them, or the WD-12 tubes work without adapters from 1½ volts.

lighted unless the loud speaker is plugged in at the last jack. All the other instruments are mounted on the base panel.

Holes are already drilled in the base panel where leads from the binding posts are run along the under side. This leaves no drilling or assembly work to be done by the constructor.

Wiring the T. C. Receiver In the preparation of the schematic and picture wiring diagrams, every precaution was taken to guard against mistakes, and at the same time they were arranged as simply as possible, so as not to be con-

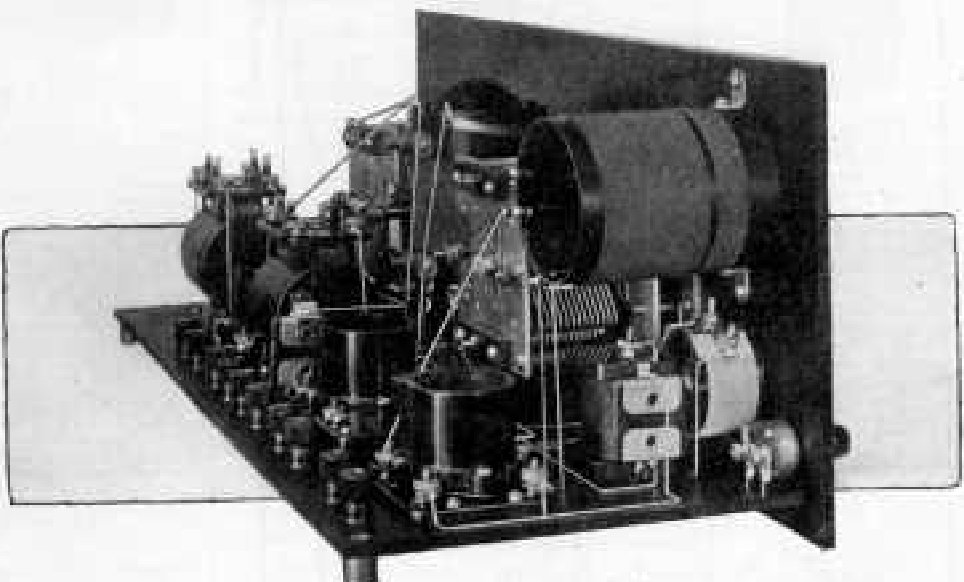

Fig. 3. R. F. amplifying end. Note the choke and fixed condenser

Description of the Design The front panel is of Formica, measuring 7 by 18 by 3/16-in., while the base panel, also of Formica, is 7 by 17 by 3/16-in. Lettering is engraved on the front panel to indicate the purpose of the various controls, while the Eby binding posts are identified by lettering also. A Carter Imp switch for filament control is mounted in the lower left hand corner, with a 30-ohm General Radio rheostat, for the detector tube, at the side, and the antenna coupling coil just above. Then come the R.F. tuning condenser, R.F. transformer, first stage jack, tuning condenser, 10-ohm amplifier rheostat, and second stage jack. The last tube is not

fusing to those who lack experience.

Fig. 4 shows the wiring between instruments on the front panel and the wires running from instruments on the front panel to those on the base panel. Fig. 5 illustrates the connections for parts on the base panel.

Each instrument is marked by a capital letter within a circle; each terminal is numbered, starting from 1. For example, the last stage jack is marked A, while the terminals are numbered 1, 2, 3, and 4. The combination A1, therefore, refers to the upper left hand lug of the jack.

If wires from the instruments in Fig. 4 end in small circles, they are run down into holes in the base panel. The wire

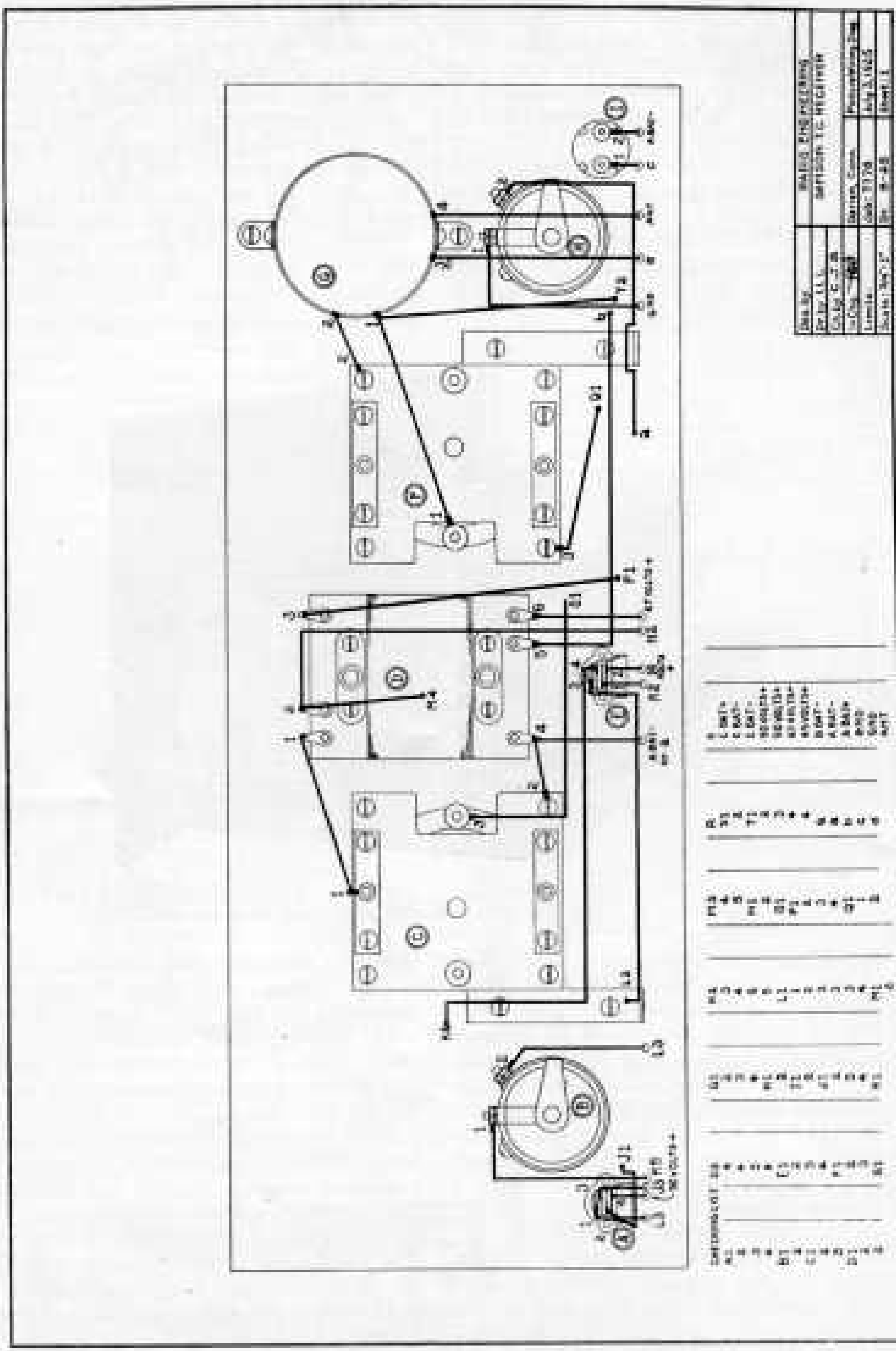

Fig. 4. Picture wiring diagram of the front panel, and the checking list of connections

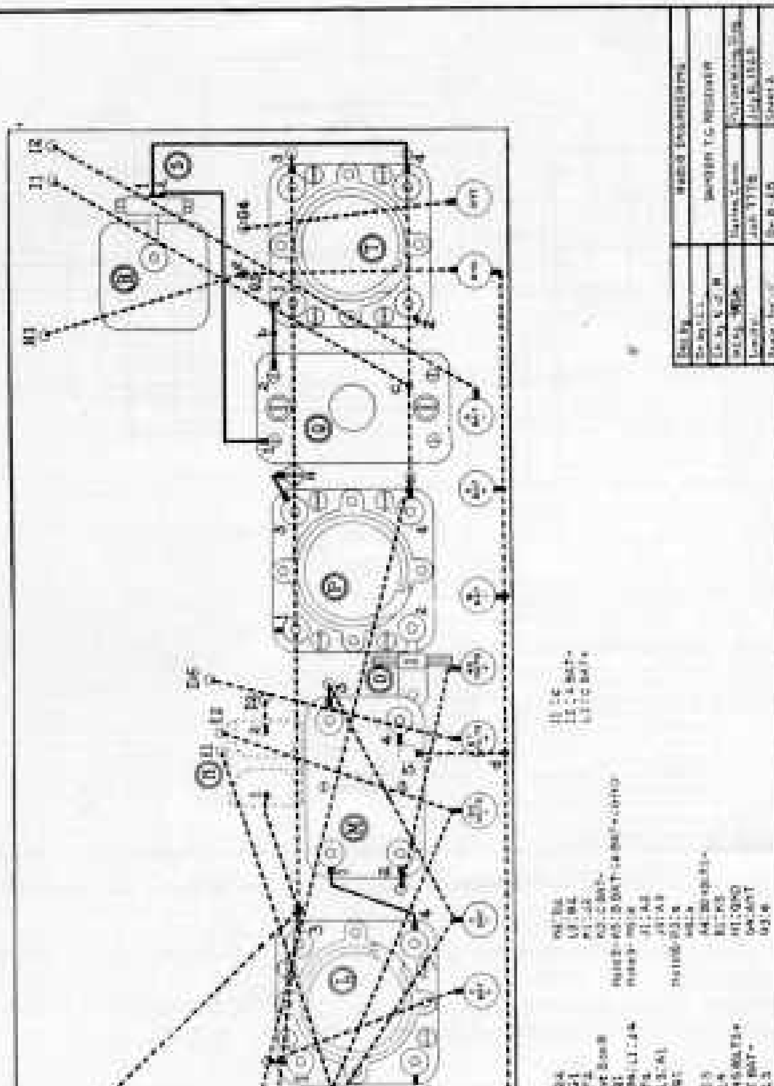

Fig. 5. The base panel. Dotted lines show wires beneath the panel. They must be covered with tubing

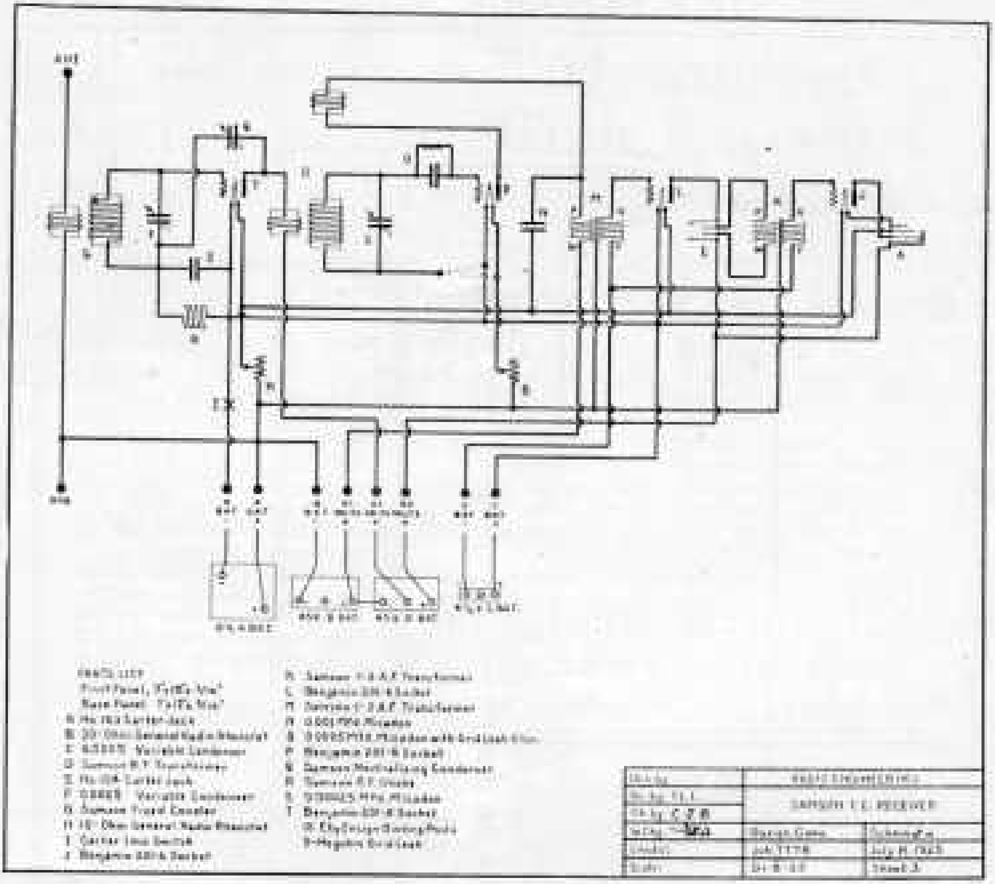

Fig. 6. Schematic diagram and list of parts and constants

from A1 ends in a hole marked L3. Instrument L is a socket, and 3 one of its binding posts, as shown in Fig. 5. A wire runs from terminal L3 down thru a hole and along the under side of the panel, as indicated by the dotted line, to a hole marked A1, thru which it goes up to jack A.

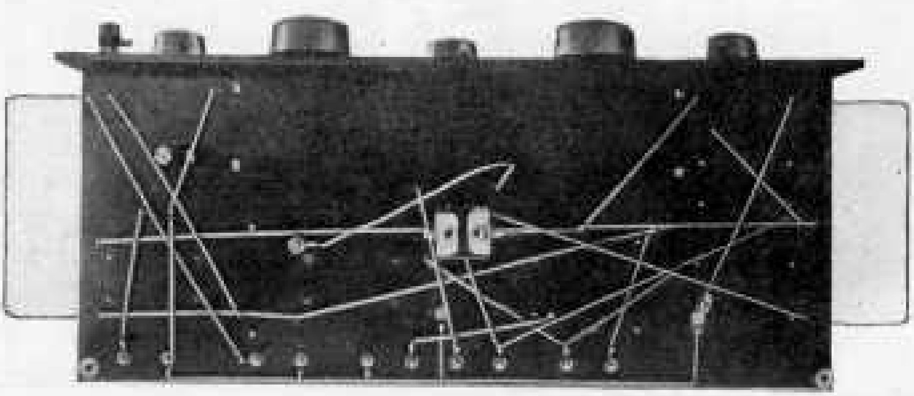

Fig. 7. A view of the base panel, showing the wiring and the by-pass condenser

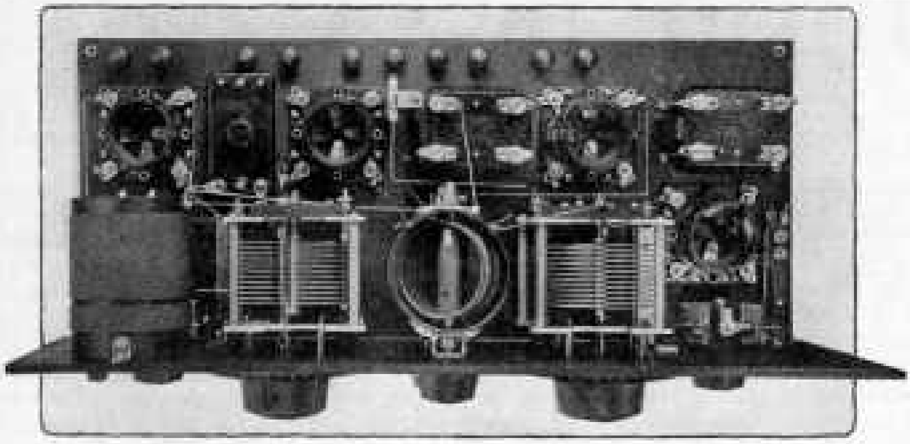

Fig. 8. Looking down on the set. The neutralizing condenser is at the left of the right hand socket

To trace the wire, therefore, start at A1, in Fig. 4, and locate the other end of the wire, L3, in Fig. 5. Then find out thru what hole on the base panel the wire goes up to A1. These drawings are exactly to scale, so that you can find the corresponding holes in the panel without any trouble.

Connection D5 to b presents a different story. Connections made to wires, not binding posts, are given small letters. Look straight down from point b, in Fig. 4, and you will find b in Fig. 5, marked on the wire running from Q2 to T1.

If there is any question about the meaning of the letters in Figs. 4 and 5, look them up on the schematic diagram and parts list in Fig. 6.

Now, for the wiring. The steps are given in Fig. 5, with the reference notes in the following paragraphs. After removing M, to permit access to the jack terminals, connect E2 to 90 VOLTS+. Terminal E2 is the right hand lower contact on the jack, Fig. 4. The wire runs down thru a hole in the tube panel, and along the under side to a lug on binding post 90 VOLTS+. All wiring under the panel must be covered with varnished tubing. As soon as you have completed this wire, put a mark beside E2 and 90 VOLTS+ in the checking list, Fig. 4. Do this with every wire: when you have finished, if any letters in the checking list are not marked, you have omitted a connection. If two wires go to the same terminal, it appears twice in the checking list.

Note 1: Remove transformer M from the tube panel, first noting the locations of the terminals.

Note 2: This lead from D4 must be long enough to reach either the screw on the A BAT — post or screw a. If a D-21 Sodion detector is to be used, the lead should be fastened to A BAT—, or to a, for a UV201-A detector.

Note 3: Be sure to put two lugs on K5, the rear right hand screw fastening the transformer to the panel.

Note 4: Solder the lugs on the R.F. choke, R, to the terminal of the 0.00025 mfd. Micadon.

Note 5: S2 is the lower lug on the Micadon.

Note 6: Solder a long wire to T4, run it under the hole next to P4, and solder a short wire from P4 to the long lead. Run the wire under L1, and make a similar connection to L1. Finally, run the wire up thru the tube panel to J4.

Note 7: S1 is the upper lug on the Micadon.

Note 8: Put a lug on P2 and solder it to the lower side of the grid leak condenser. Put a 5-megohm leak in the clips.

Note 9: K5 and M5 are screws holding the transformers to the tube panel.

Note 10: Terminal a is a ½-in. 6-32

(*Continued on page 398*)

Selenium and Photo Electric Cells

Chapter II. Essentials of Selenium cell construction and forms discussed—by Samuel Wein

The Selenium Cell Defined. The specific electrical resistance of selenium is said by Bidwell[13] to be in the neighborhood of 2,500 megohms per cubic centimeter. Therefore, in order to facilitate experimentation, it is necessary to apply the selenium in such a way that only a short path of a comparatively large cross section is traversed by the current. A further condition is that the selenium must be spread out in a thin layer, so that a comparatively large surface, with respect to its volume, will be affected by the light. This is necessary because the thinner the film of selenium, the less inertia the cell possesses, for the light appears to act only on the surface of the selenium. A device employing selenium so as to fulfill the foregoing conditions is called a selenium cell, bridge, unit, or element. Since the term "selenium cell" is used universally amongst those who have occasion to work with these devices, that term will be used hereafter.

A selenium cell consists of two electrically conducting substances, between which is deposited the selenium, and thereafter annealed, so that the selenium cell will exhibit the greatest light sensitive characteristics.

There are a number of various types of selenium cells in use. Of the various types, there are only three distinct forms in constructional details, viz: (1) in which the selenium is deposited between two electrically conducting mediums in the form of wires, tapes, or plates; (2) deposited on a metal plate on which is applied a transparent or translucent conductor, such as metallic foil; (3) a very fine cell construction consisting of a metal film divided into two parts between which the selenium is applied, filling the dividing lines.

The Conducting Materials. Use has been made of copper, iron, nickel, platinum, German silver, brass, various alloys, graphite, and carbon.

These various metals, excepting platinum and nickel, oxidize very freely, especially during the process of annealing the selenium cell. Metallic selenides—reaction product between the selenium and the metal plate used—are also formed during the annealing process. This oxidization and the formation of selenides produce poor grades of completed cells. For ideal purposes, although the cost is somewhat higher, the use of platinum is always advocated, or if this is prohibitive, nickel should be used. Any wire on which platinum has been electrolytically deposited can be used with ideal results.

The Non-Conducting Materials. Slate, free from metallic veins, mica, unglazed porcelain, roughened glass—sand blasted or etched with hydrofluoric acid—soap stone, and various compositions can be used as the non-conductor.

Applying The Selenium. The various forms or types of selenium cells have their advantages as well as disadvantages, depending greatly on the specific manner in which the cell has been made, as well as the layer or film of selenium itself. The temperature of annealing the cell has much to do with its characteristics. To show each phase of cell construction, we shall review the specific methods of applying the selenium to the embryo cell form.

Some investigators prefer to heat the cell and rub a rod of selenium over it, spreading the selenium evenly over the surface with a steel spatula. Others prefer to sprinkle a little of the powdered selenium over the hot cell form and after it has melted, spread it over the surface. A simple form is to melt a little of the selenium in a spoon and allow a few drops of it to fall on the embryo cell, spreading it over the surface afterwards. The former methods produce thick and uneven films of selenium. Keeping this fact in mind, several investigators produced thinner and more even films by means of cathode disentigration. This process necessitates considerable apparatus and time to produce such a film. The condensing of selenium vapors, made by boiling the element, has produced very fine cells.

It is well to mention the fact that the literature of the subject is very confusing with respect to credit for originality. Several experimenters have already

Fig. 1. Circular type of Siemens cell. The wires are covered with selenium

claimed priority on certain constructional forms. The author will not attempt to pass judgment on these claims, but will merely cite such cell forms as are identical to those described in earlier references in the technical literature and for those on which patents have been granted.

The details of the cell construction are those given by the original constructors, tho changes can be made to suit individual conveniences and requirements.

Group 1, Type A.

Siemens.[11] The first high efficiency selenium cells were made by Siemens. These he built by winding two separate lengths of No. 40 B. & S. gauge wire, side by side and equidistant throughout

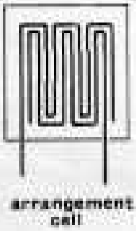

Fig. 2. Another arrangement of the Siemens cell

their entire length, on a non-conducting substance about 1/8 in. thick, and about 1 1/2 in. wide. Two typical cells are shown in the Figs. 1 and 2.

Bell and Tainter.[12] During their experiments, Bell and Tainter found that they required the use of cells which could be placed in the focal plane of a parabolic reflector. To this end they devised the cell shown in Figs. 3 and 4. Two No. 40 B. & S. guage wires 1/32 in. apart were wound throughout the entire length of a glass rod or tube about 2 1/2 ins. long and 3/4 in. in diameter. Fig. 3

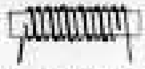

Fig. 3. A single cell made by winding two wires on a glass rod

shows the completed cell as used in their famous photophonic experiments, and Fig. 4, the cell fixed in the focal plane of a parabolic reflector.

Bidwell.[13] Simplified construction of the former types of cell construction developed by Bidwell, are used almost universally to-day.

This cell is made by winding on a piece of non-conducting material 2½ ins. long and ¾ in. wide, beginning at ¼ of an inch from one end, a flat spiral of No. 40 B. & S. guage wire. The pitch of each turn of the spiral is 1/16 in. The winding is brought to ¼ in. from the other end. The ends of the wire are fixed by passing them through holes drilled in the slab. Then a second wire is wound beside the other, forming a

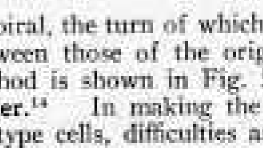

Fig. 4. The Bell-Tainter cell mounted in a parabolic reflector

second spiral, the turn of which are midway between those of the original one. The method is shown in Fig. 5.

Ruhmer.[14] In making the so-called Bidwell type cells, difficulties are always experienced in the short circuiting of the two wires, due to the expansion and contraction of the wires during the process of annealing and cooling the cell. To eliminate this difficulty, Ruhmer cuts the slab of non-conducting material in half, so that the wires will fit snugly in it. The expansion of the wires during the annealing process is taken up by separating the slabs a little.

Pfund.[15] Many experimenters find difficulty to wind the slab of non-conducting material with the two wires evenly spaced throughout its entire length. A convenient manner of accomplishing this is suggested by Pfund. He ground one side of a piece of glass plate 1 by 3 by 0.1 with emery, or etched the glass with hydrofluoric acid. Then he spread selen-

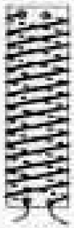

Fig. 5. A flat cell, with two spiral wires coated with a thin layer of selenium

ium over the ground glass surface by means of a hot glass rod. The thickness of the layer was such that in transmitted light the film of selenium, in its thinner portions, appeared deep ruby red. Next, he wound four strands of No. 30 B. & S.

Ruhmer mounted his cell in an evacuated tube to protect it against moisture and temperature changes

guage bare copper wires around the glass plate in such a manner that the entire selenium surface was covered. After binding the loose ends of the wires to the glass plate, he removed the second and fourth wires, leaving the first and third separated by a distance equal to the diameter of the wire.

Ruhmer.[14] The selenium cell used by Ruhmer was mounted in an evacuated glass bulb to eliminate the probabilities of errors in the change in ohmic value due to atmospheric pressure, humidity, and other physical conditions. Such a cell is more stable, and readily adapted into electrical circuits. Two forms are shown in Figs. 6 and 7.

These cells are made on a double thread cut into a soapstone or unglazed tubing. A convenient size for construction purposes is ½ in. in diameter and 2 ins. long. Into these grooves are wound, while hot, two No. 40 B. & S. guage wires. These are secured to the base of a standard Edison incandescent lamp. The selenium is applied over the surface of the wires and properly annealed, then enclosed in an evacuated glass bulb.

Fig. 7. This Ruhmer cell is mounted in an evacuated tube which is silvered on the sides to reflect light on the cell

The glass bulb of the cell shown in Fig 7 is silvered on the bottom, to reflect the light on the selenium around the entire surface.

These were first used in connection with the photophone.

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BAKELITE MOLDING

With the cooperation of the Hydraulic Press Manufacturing Company, we are preparing an article of special interest to radio manufacturers. It deals with the installations, operation, and maintenance of a typical moulding department, detailing the costs, space requirements, personnel, and other factors. This article will appear in the September or October issue.

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M. B. SLEEPER, Editor
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EDITORIAL

EVERY radio magazine naturally aspires to bring out a set which will be the big success among radio set builders and which, in turn, will be taken up by the manufacturers.

This summer we decided that Radio Engineering would introduce not only the outstanding set for this winter but a design which will set a precedent for future developments.

Because we always tackle our construction and design articles as laboratory problems, we had an advantage at the start. So it was as a laboratory problem that we set to work on this task. There are always plenty of set builders who make any new set, and of that number some are always conceited enough, or ignorant enough, to think the results are wonderful, no matter how they would show up against a good outfit.

Unfortunately radio sets won't give unusual results just to be obliging. They require reasons. So we knew we couldn't shake up a lot of parts and roll them out until they turned up in the right combination. Reviewing past experience, we remembered that the easiest set to operate, and the finest of all sets for quality, was the old crystal receiver. And we decided that if we could add sharpness of tuning and volume of tone to crystal set operation and quality, we would have the design which would dominate all others.

Three months ago we completed the RX-1 receiver at the Darien laboratory—produced the results we had sought—and did it with a non-regenerative circuit, a circuit so old that most of the men in the radio business to-day don't know there is such a thing as a set, unless there's something wrong with it, that isn't operated in a regenerating condition, just under the point of oscillation.

Put your finger on any part of the circuit, mention any feature of the operation and there's a reason for it or for what happens. Why is it non-regenerative, why is the tuning sharp, why the particular selection of tubes, the high R. F. amplification, the resistance coupled amplifier before the transformer stage, the almost uncanny quality of reproduction, the elimination of rheostat adjustments without which no tuned R. F. or neutrodyne set can be operated to full volume?

There is a plain answer to each of these questions, no camouflage or mystery, but ordinary facts which any novice can understand. That's why the RX-1 receiver, developed entirely in the Darien Laboratory, will be the most popular outfit among set builders this winter, and will set a new standard for radio manufacturers who now think a radio set that isn't tuned R. F. or straight regenerative must be a super-heterodyne.

You may wonder why, since the set was completed three months ago, we waited until now to talk about it. You'll understand if you have had experience in manufacturing radio equipment. To produce a laboratory model means nothing until the set has been in operation over a period of months, and has been tried out under all sorts of conditions, operated by all kinds of people. We have run the RX-1 for days at a time, exposed it to the weather, tried it on different antennas, worked with dozens of different tubes, operated it in the woods, and at the sea shore, working by the illumination from motor car head-lights.

We put it to every test we could devise, yet the greater the task, the more splendid the response until now, as we are preparing the complete construction article for the September issue, we are thoroughly confident that it will win your respect as it has won ours, that on a scale of points it will score above any other set as an example of radio engineering skill and judgment.

M. B. SLEEPER,
Editor.

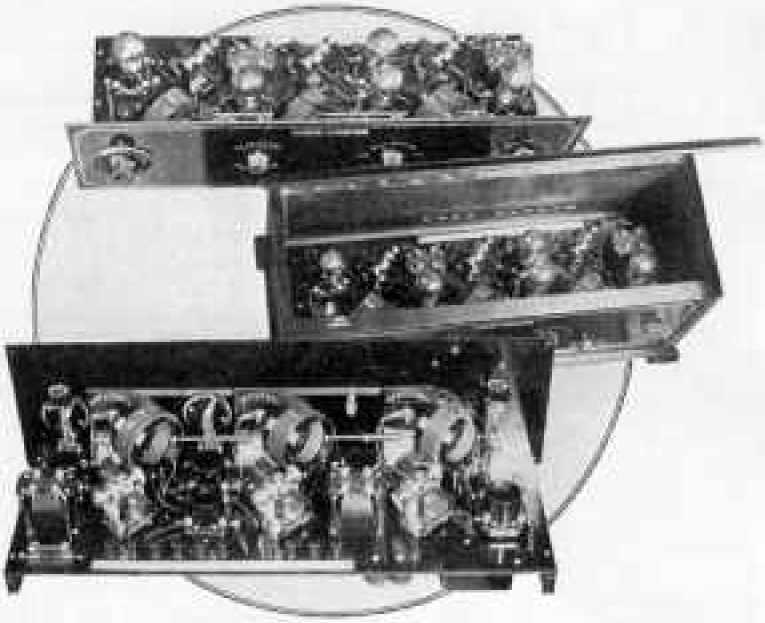


Fig. 1. Three views which show the mechanism of the Kellogg set

Tuning an R.F. Set by Inductance

Examine the design of the Kellogg Wave Master and you will discover a number of new ideas you have not seen before

THE first original development in single control receivers, so far this fall, is that of the Kellogg Wave Master. Detailed illustrations of the set are given in Figs. 1 and 2, with the complete wiring diagram in Fig. 3. Some of us will be rather surprised to see tapped coils on this set but, after all, when theory and practice disagree, we must be guided by practical results.

The new Kellogg set has two stages of tuned R.F., detector, and two stages of audio amplification. There are three tuned circuits, in this new type of receiver, but the control of the wavelength is obtained by a switch on each R.F. transformer secondary and a variometer control for fine tuning, with fixed air condensers to provide the capacity in each circuit.

In Fig. 1 you can see the three switches, controlled by a single knob at the front, and the common shafting for the variometer rotors, turned by a knob and dial connected through beveled gears.

Aside from the single control feature for tuning, this design was worked out to give extremely sharp tuning. In the ordinary Neutrodyne receiver, each circuit is adjusted over its full range by rotating a dial through 180 degrees. On the Kellogg set, there are nine wavelength ranges obtainable by a 9-point switch, each covering approximately 40 meters, with an overlap at the upper and lower ends of the scale. 60 degrees rotation are required for the 40-meter range which is equivalent to 540 degrees of rotation for the full range of the set. Therefore, the tuning is three times sharper than on the regular Neutrodyne receiver.

The primaries of the transformers are fixed, with the secondaries wound partly

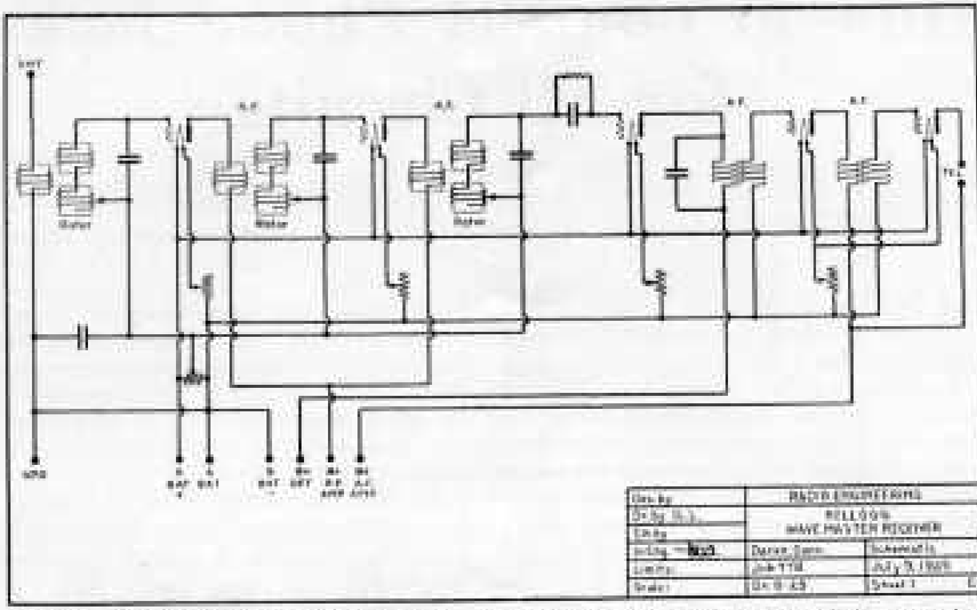


Fig. 3. Schematic circuit of the receiver. All three secondary inductance switches operate from one knob

on the stationary tube and partly on the rotating tube. This is somewhat on the order of the Danziger-Jones transformers, except that they cover the full range at one rotation of the movable coils.

The capacities of the variable condensers, mounted at the rear of the tube panel, are set at the factory when the outfit is given the final test. When the adjustments are being made, not only are the variable condensers regulated to their proper positions but the correct relation between the three rotors is also determined, in order that the circuit will be in tune at the longest wavelengths as well as the shortest.

By the use of variometers for tuning, as the design works out in practice, particularly close regulation can be obtained since the variation of inductance at the center of the scale is comparatively slow, increasing rapidly at the upper and lower ends. Since only 60 degrees are used at each setting of the inductance switches, those 60 degrees come at the center of the scale, right where the inductance is varied at the lowest rate.

Tests indicate that it is practical to use a fairly long antenna with this outfit, and still maintain the extreme selectivity. It will operate on a short single wire but for best results one wire about 80 ft. long is recommended.

Fig. 2. The outward appearance is simple and attractive enough for anyone

How to Connect Phone Jacks for All Circuits

By reducing telephone and filament control jack circuits to their elements, they can be applied easily to any type of hook-up

WHEN Mr. Engelson, of the Brooklyn Metal Stamping Company, suggested that a set of diagrams showing various ways to connect jacks in different kinds of circuits would help to clear up the confusion and misunderstanding about their use, we agreed with him, and started forthwith to determine what hook-ups would present the most information. But we discovered a few diagrams would not show enough, and even a great many would not cover all circuits.

Which accounts for the peculiar set of sketches opposite. Since we couldn't possibly show all the receiving set circuits using jacks, we decided to show all the jack circuits used in receiving sets.

Just because these diagrams look different, don't assume that they are complicated, for if you think about them enough to get the idea, you'll be able to use them as simply as a footrule.

Examine a filament control jack and you will see that it has two sections—on top, the two or three springs for the filament circuit, and one, two, or four springs below for the plate circuit. Accordingly, we divided the diagrams into those which concern the filament, and those connected to the plate. If you don't want filament control, pay no attention to sketches E to J. Simply pick what you want from A to D. Or, in case you want filament control, get the combination from E to J and add it to the suitable diagrams from A to D.

A: Ordinary method for an A.F. amplifier except the last stage. This is often used, but is not recommended because it does not cut out the transformer when the phones are plugged in.

B: Most common arrangement for all stages except the last. A simple way to disconnect one side of the transformer when the plug is inserted.

C: Here the transformer is disconnected entirely when the phones are plugged in. Many designers prefer this method altho, so far as the operation of the set is concerned, it is no better than B. This is for all except the last A.F. stage.

D: The last stage of an A.F. amplifier, or the detector, if no A.F. amplification is employed, is always connected this way.

Notes: Only the transformer primary is shown, as the wiring of the secondary is not affected by the use of jacks. The +B lead goes to +22V. if the jack is in the detector or, in an amplifier circuit to +45V. or whatever is used for the amplifier voltage.

A set without an A.F. amplifier should use D in the detector plate. With a detector and one stage of A.F. use B in the detector plate, and D in the amplifier plate circuit. When there are two stages of A.F., use B in the detector and first stage, and D in the second.

E: When you have a detector and two stages of A.F., if you want to plug in at each tube, you must use this circuit, with three rheostats, for filament control.

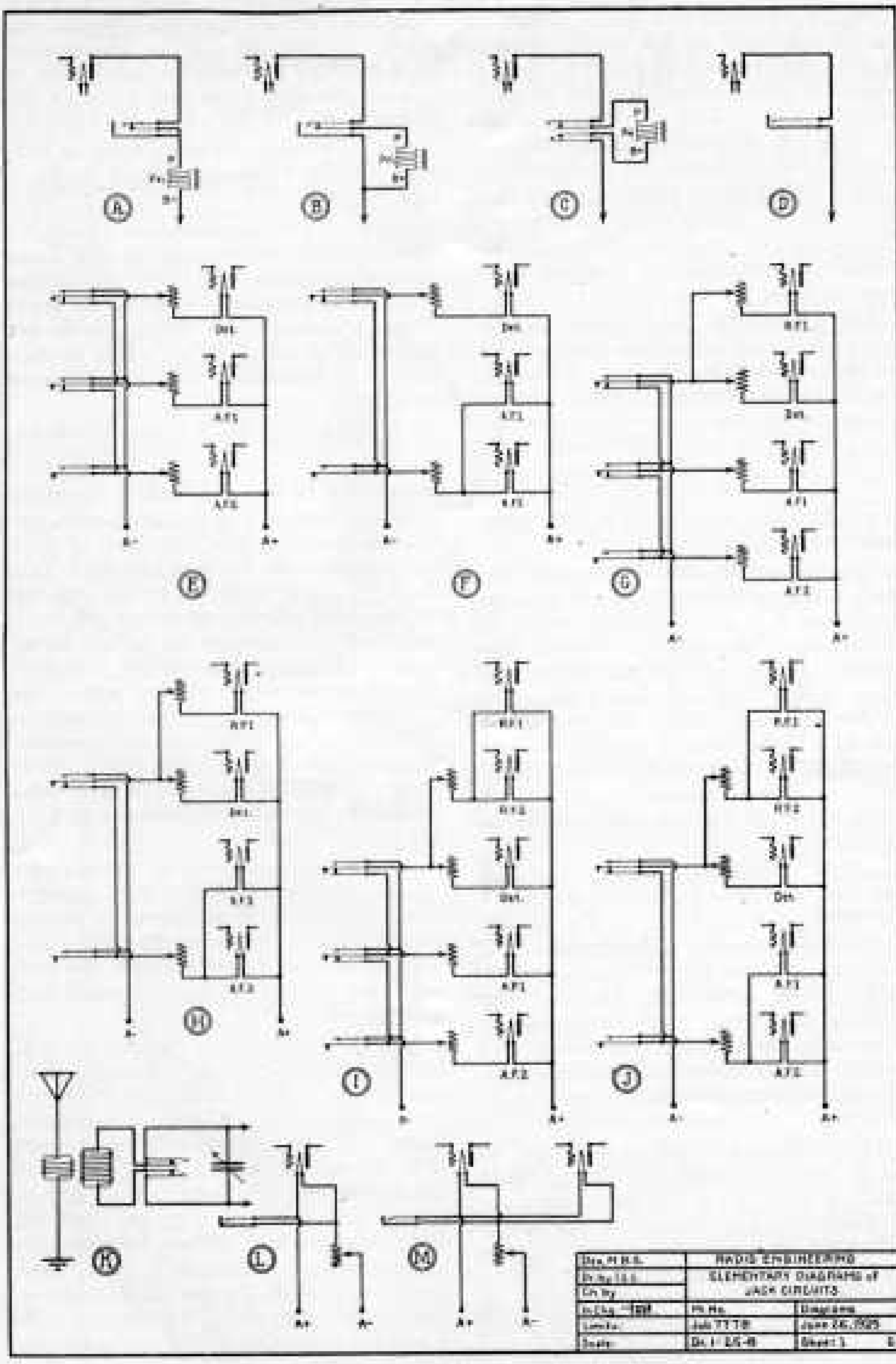
F: Both A.F. tubes can be controlled by one rheostat if you do not want to plug in at the first A.F. stage.

G: Four-tube set with three jacks, using a separate rheostat for each tube.

H: Four-tube set with two jacks, one rheostat controlling both A.F. tubes.

I: This is for a five-tube set, arranged with filament control jacks at the detector, first stage, and second stage. Both R.F. tubes are on one rheostat, but separate rheostats are required for the A.F. tubes.

J: The same sort of set as at G, except that both A.F. tubes work on one rheostat. No jack is used at the first stage.



Thirteen different elements of circuits using telephone jacks

Notes: To obtain a positive bias on the grid of any tube, connect the filament side of the transformer to the + lead, as shown in the sketches, or for a negative bias, to the — lead. Where rheostats are shown, Amperites, Brachstats, or Daven balast resistors can be substituted.

K: This diagram gives the connections for a set to operate on an antenna and ground or on a loop. Normally the coupler is connected, but plugging in the loop cuts out the coupler.

L: If you want to measure the voltage across your tubes, and don't want to mount a meter on the panel, you can use jacks for plugging in the voltmeter. You must use an open circuit jack, and connect it on one side to the common filament lead and on the other side to a wire running from the tubes to the rheostat.

M: Two or more tubes must be connected to the voltmeter jack as shown in this diagram.

Note: It is important to remember that soldering paste must be kept away from the insulation. This is particularly true on the amplifier jacks, for the paste forms a leakage path which causes the insulation to break down. For safety's sake it is advisable to use rosin core solder.

(*Continued from page* 389)

machine screw put thru the tube panel, and held by a nut.

While you are wiring the set, bear these points in mind: Have the soldering iron clean and hot enough to make the solder run smoothly—use rosin core solder—if the lugs are not bright and clean, scrape them off with a file or the solder will not stick — for the wiring use Wirit, the No. 18 special-tempered tinned copper wire which you can stretch and straighten yourself—use Spintite wrenches to get the nuts and thumbscrews tight.

Testing and Operating

When the wiring has been completed, connect the A battery as shown in Fig. 6. Put in the tubes, turn the rheostats about half way on, and put the filament switch at ON. If the tubes light, disconnect the positive lead from the storage battery and connect it to each of the +B binding posts. The tubes should not light then. If they do, there is a short circuit in the wiring.

If the filament circuit is O.K., put on the B and C batteries, Fig. 6. The only exact way to tell about the correct adjustments of the rheostats is to have a voltmeter by which the voltage can be measured across each tube. In Fig. 1, showing the outfit set up for test at the Darien laboratory you will see a Jewell double-range voltmeter mounted above the bench. Leads are provided so that the voltage can be measured across the tubes. It is also used to test B battery voltages, since it has one scale for 0 to 12 volts and another scale for 0 to 120 volts. This takes the guess work out of the rheostat settings and assures maximum life from the tubes. To measure the voltage across a tube, connect a low-reading voltmeter directly to the socket binding posts. Do not measure the voltage of the A battery, since that does not show the potential actually applied to the tubes. With 201-A tubes the voltage measured at the socket should not be over 5, or 3 volts with UV-199 tubes.

As for the C battery, on the Crosley Musicone we had only 1½ volts negative C taken from a small Eveready biasing battery, for a Western Electric Cone speaker we used 4½ volts, while the Kellogg and N & K speakers worked best with 3 volts.

It took a little study to find out just how to get the best results from the T.C. set. Accordingly, a few suggestions are given below. The T.C. set is extremely sharp, much more so than the usual tuned R.F. set, so that the dials must be turned slowly and carefully or a station may be passed over. In our tests we used the D-21 standard base Sodion detector with a negative grid return, as it gave louder signals and made the set much easier to handle than with the 201-A detector with a positive bias. On all dial settings above

(*Continued on page* 413)

Fig. 1. We didn't count stations, in the RX-1 tests, unless the Musicone would bring them in clearly. This photograph was taken at 2.00 A. M. on the shore at Southport, Conn.

Some Angles On A. F. Circuits

Explaining the line of reasoning followed in planning the audio frequency amplifying end of the RX-1 non-regenerative receiver.

FIGS. 2 and 3 show the detector and audio frequency amplifier of the RX-1 receiver. The first striking thing about these illustrations is the extreme simplicity of the arrangement, the short leads, and the small number of wires required.

But simplicity is only useful when it serves a practical end. It is largely a matter of good fortune that the RX-1 amplifying system is so simple.

The reason that the RX-1 gives the impression of having big reserve power lies in the D21 Sodion. This tube also supplies the answer to the question that has already been raised, "Why doesn't the detector circuit oscillate?" There are other questions which will be answered but let us take them up, with their answers, in the sequence in which they appear in the circuit.

The detector circuit doesn't oscillate because of the extremely high impedance in the plate circuit of the Sodion detector. It is several times higher than the impedance of the 201-A tube. Some experimenters use a high variable resistance in the detector plate of a 201-A to stop oscillations. That is not an efficient method, although it is effective in stopping oscillations. The same result is obtained efficiently in the Sodion, for the construction which is employed to make the tube extremely sensitive turns out, happily, to produce a high impedance in the plate.

If the Sodion is followed by a transformer coupled amplifier, and a tickler coil is provided, the detector can be made to oscillate at short wavelengths. However, in the RX-1 no tickler was used, nor it is necessary to produce maximum efficiency either at the high or low wavelengths.

Because of the high impedance of the Sodion, there is no need to use a transformer. In fact, the Acme Apparatus Company, in their Cabot Circuit Receiver, use only the secondary of an A. F. transformer, connecting it as an impedance coupled amplifier. Our tests show that as great or greater amplification can be obtained with resistance coupling. This effects a saving in expense, assures distortionless amplification, and, without sacrificing efficiency, allows the addition of 100,000-ohms in the plate circuit of the Sodion as a further prevention of regeneration or oscillation. Resistances up to 1.0 megohm have been used in the resistance coupled amplifier without cutting down the signal strength. A very definite saving in B battery consumption is effected since the detector plate current is only 0.25 milliampere, against 3 to 5 milliamperes with a UV201-A detector.

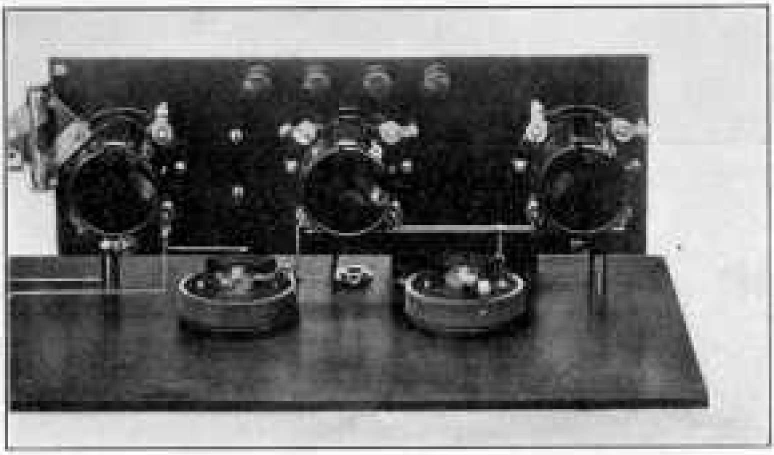


Fig. 2. Efficiency usually means simplicity. That is the case with the RX-1 receiver

The first impression of the circuit arrangement, using resistance coupling first and then transformer coupling, is that it is exactly opposite to the customary method in amplifiers which have both resistance and transformer coupling. In the ordinary amplifier the transformer coupling is used first to get extra amplification at the start for the resistance stages to work on. In the RX-1 circuit, on the other hand, no useful purpose would be served by having a transformer stage following the detector since the amplification would not be increased at all.

In the second A. F. stage we used a 1 to 3 Samson transformer. A little greater amplification can be obtained with the 1 to 6 type, but the 1 to 3 transformer has a slightly better amplification curve, and sufficient kick is delivered to the primary of the transformer so that there is no necessity for forcing the last tube.

Several people who have seen the original model of the RX-1 have remarked on the fact that four-tube sets do not give quite enough pep, and that one stage of radio frequency amplification is not enough to bring in distance.

The obvious answer to arguments of that sort is given by the results produced. If you think that a five tube tuned R. F. receiver requires two stages of R. F. for its range, try putting the antenna and ground on to the primary of the first R. F. transformer, eliminating the first R. F. tube altogether. You will probably find that the range will not be affected appreciably. Most five-tube sets have two stages of R. F. for reasons of convention only.

If you think that a set must be operated just under oscillation to have real kick in the loudspeaker, try the RX-1 and you will get the answer from the set itself. Over a period of ten days in a series of final tests, the RX-1, set up at the Darien laboratory using a single wire antenna sixty feet long and eighteen feet high at each end, has brought in sixty-seven stations, ranging from New Orleans to Montreal, Miami, Fla. comes in as loud as many of the New York stations. After midnight, WSB, WTAM, WJJD, WREO, operate a Crosley Musicone with sufficient volume to dance by. These tests were made from July 3rd to July 12th, a time at which in New England, the worst static of the year is experienced.

During the last four months, we have tried the RX-1 set under all kinds of circumstances, using it right in New York City, to test the selectivity, operating it in the woods and at points on Long Island Sound to see how it would respond away from the more or less ideal conditions at the laboratory. Fig. 1 is reproduced from a photograph taken at night by the illumination from the motor car headlights. The set was put up on the shore at Southport, Conn. The ground connection was a sparkplug wrench, fastened to the ground lead and dropped into the water. The antenna was a thirty-foot length of wire two feet high at one end and seven feet high at the other end. On this occasion we heard WREO, WJJD, WMBF, WBZ, WPG, WGN, KDKA and a number of other stations less distant, in addition to those in New York City.

However, these results are not given to indicate that the RX-1 receiver is primarily a long distance outfit. As a rule, the DX hound is the sort of man who wants a lot of knobs on his set, so that the RX-1 would not appeal to him for that reason alone. The outstanding features of this set are the simplicity of tuning, lack of hairsplitting adjustments, freedom from howling, and the quality of reproduction of which only a non-regenerative receiver is capable, together with volume equal to that obtained from circuits which depend for signal strength upon operation just below the oscillating point.

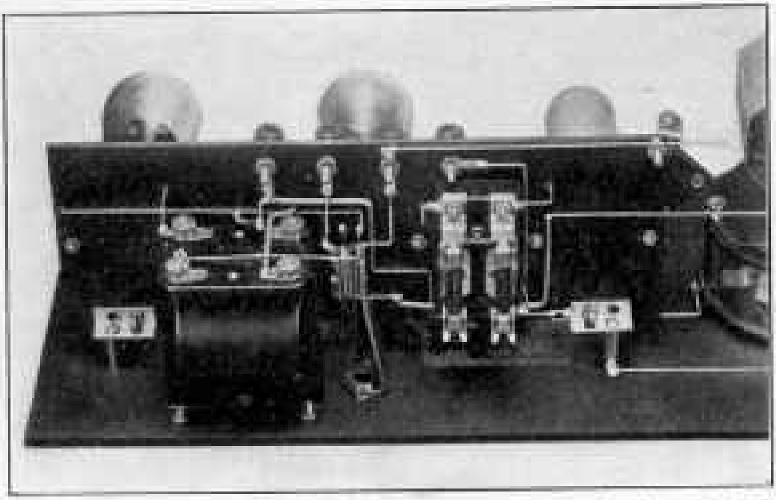


Fig. 3. The same general design was followed in the final model, but improvements were incorporated here and there

The set shown in the accompanying illustrations, and in the illustrations in the previous article on the RX-1 tuning circuit, is the original experimental model. This has been changed considerably in working out the mechanical design for the final set. The electrical constants and characteristics have not been altered but the appearance is quite different. Complete photographs with picture wiring diagrams and step-by-step instructions for the final RX-1 design will be given in the September issue of RADIO ENGINEERING.

Dataprints are already available, giving full-size panel patterns, picture wiring diagrams, parts list, and all other details necessary, including the winding data for the pickle bottle coils. The construction of the set is extremely simple, no kinks or tricks, and the parts required are all of standard makes which you can obtain easily.

Silver-Marshall SLW variable condenser

A SPECIAL exhibition of German precision instruments and radio equipment is a feature of the Leipzig Technical Fair which will be held from August 30th to September 9th, 1925 and from February 28th to March 10th, 1926.

The Alden Manufacturing Company has announced a new series of sockets and adapters to take the new R. C. A. tubes, UX199, UX11, UX12, and UX201-A. The Na-Ald socket for these tubes bears the type number 481X, while the adapter is designated as type 419X. These new R. C. A. tubes have contacts similar to those on the WD-11, but of different dimensions.

Glass panels and cabinets are being featured by the A. W. Hornig Company of Chicago. They are designed for home use or for special display purposes in dealers' stores. Each hole in the glass is protected by a safety bushing, so that screws can be tightened without fear of breaking the glass. This is an important point, making the use of glass panels and cabinets thoroughly practical.

No tube is too critical in the adjustment of the filament for the "Three E" rheostats, a new development recently introduced by the Electrical Engineers Equipment Company of Chicago. These rheostats accomplish in a very simple way what a number of designers have tried to do unsuccessfully. The resistance wire unwinds from a threaded spool of insulating material on to a threaded metal spool, as the controlling knob is rotated. In this way the contact is made with every fraction of an inch of the resistance wire, giving the finest variation that can be obtained. A clever arrangement of the mechanism prevents the spools from being turned so far that the wire would be broken off at the minimum and maximum settings. The rheostat has been worked out mechanically in a very attractive way.

The Heliotron power tube, manufactured at a price of $5.00 by the Helios Electric Company at West New York, New Jersey, operates at 5 volts with a filament current of 0.5 ampere. The plate voltage can be varied from 45 to 135. The voltage amplification is 7.5 to 8.5, plate impedance 4000 to 5000 ohms, and mutual inductance but 500 to 1,700 Micromhos.

Silver-Marshall is now making deliveries on their new S. L. W. condenser, a very small and neat single bearing type with an unusually clever tension adjustment which holds the plates securely. Only one strip of insulating material is used on this condenser. The plates are silver plated.

Philco is announcing A and B battery supply devices, operating from 110 volts A. C. It was recently demonstrated at Philadelphia for the first time.

The Samson Electric Company will feature an S. L. F. condenser which is very different from any of the other designs. Recognizing the importance of keeping dust from the insulation, they will enclose it in an attractive metal case.

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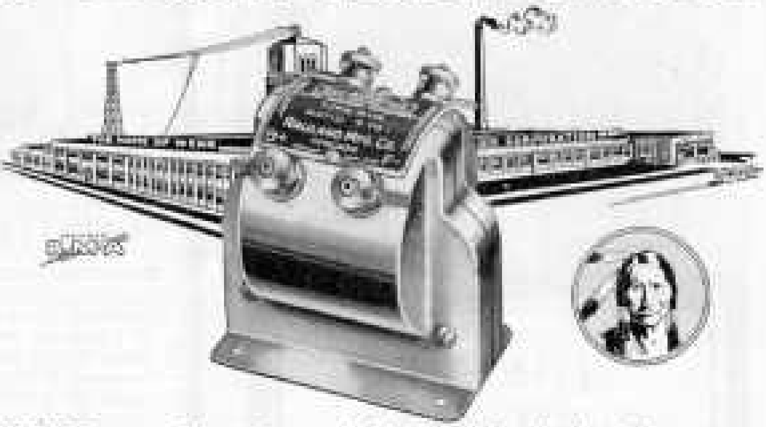

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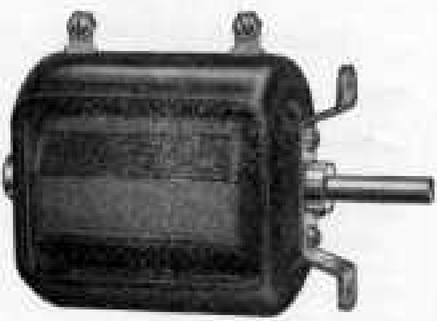

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National Vulcanized Fibre Co., Wilmington, Del.
Spaulding Fibre Co., North Tonawanda, N. Y.
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Chicago Screw Co., Chicago, Ill.
Cincinnati Automatic Mach. Co., Cincinnati, O.
Columbia Metal Prod. Co., 361 E. Ohio St., Chicago, Ill.
Dayton Auto Specialty Co., Dayton, O.
Eby Mfg. Co., H. H., Philadelphia, Pa.
Economy Screw Corp., 5215 Ravenswood Ave., Chicago, Ill.
Golde Mfg. Co., Inc., 100 S. Third St., Brooklyn, N. Y.
Hubbell, Inc., Harvey, Bridgeport, Conn.
New England Screw Co., 44 Farnsworth St., Boston, Mass.
Olsen Mfg. Co., 56 Commercial St., Worcester, Mass.
Pawtucket Screw Co., Pawtucket, R. I.
Perry-Fay Co., Elyria, O.
Phell Mfg. Co., 5700 Roosevelt Rd., Chicago, Ill.
Progressive Mfg. Co., Torrington, Conn.
Screw Machine Products Corp., 1011 Eddy St., Providence, R. I.
Scovill Mfg. Co., Waterbury, Conn.
Steinen & Co., 297 Washington St., Newark, N. J.
Thomaston Mfg. Co., Thomaston, Conn.
Trumbull Elec. Mfg. Co., Plainville, Conn.
Waterbury Mfg. Co., Waterbury, Conn.

SOLDER

American Solder & Flux Co., Philadelphia, Pa.
Belden Mfg. Co., 2300B S. Western Ave., Chicago, Ill.
Chicago Solder Co., 4212 Wrightwood Ave., Chicago, Ill.
Dielectric Mfg. Co., Vandeventer & Duncan Aves., St. Louis, Mo.
National Lead Co., 111 Broadway, New York, N. Y.
Solderall Co., 129 Sussex Ave., Newark, N. J.

WIRE, MAGNET

Acme Wire Co., New Haven, Conn.
Allied Magnet Wire Corp., Indianapolis, Ind.
American Brass Co., 25 Broadway, New York, N. Y.
American Electrical Works, Phillipsdale, R. I.
American Enameled Magnet Wire Co., Muskegon, Mich.
American Insulated Wire & Cable Co., Chicago, Ill.
American Steel & Wire Co., Chicago, Ill.
Ansonia Electrical Co., Ansonia, Conn.
Atlantic Insulated Wire & Cable Co., Rome, N. Y.
Belden Mfg. Co., 4685 W. Van Buren St., Chicago, Ill.
Bradford Kyle & Co., Plymouth, Mass.
Chicago Insulated Wire & Mfg. Co., Chicago, Ill.
Crescent Ins. Wire & Cable Co., Trenton, N. J.
Dudlo Mfg. Co., Fort Wayne, Ind.
General Elec. Co., Schenectady, N. Y.
Goldmark Co., James, 83 Warren St., New York, N. Y.
Harvey Wire Co., 277 Sherman Ave., Newark, N. J.
Kellogg Switchboard & Supply Co., Chicago, Ill.
Waring Wire Co., Muskegon, Mich.
Marion Insulated Wire & Rubber Co., Marion, Ind.
Massachusetts Elec. Mfg. Co., West Lynn, Mass.
Philmore Mfg. Co., 105 Chambers St., New York, N. Y.
Providence Insulated Wire Co., Providence, R. I.
Rockbestos Products Co., New Haven, Conn.
Roebling's Sons, Co., John A., Trenton, N. J.
Rome Electrical Co., Rome, N. Y.
Rome Wire Co., Rome, N. Y.
Standard Alloy Wire Co., Elizabeth, N. J.
Strand & Sweet Mfg. Co., Winsted, Conn.
Super-Insulated Wire Co., Plymouth, Mass.
Wheeler Insulated Wire Co., Bridgeport, Conn.
York Insulated Wire Works, 1737 Broadway, New York, N. Y.

(Continued from page 398)

50 we put the upper coil of the R.F. transformer at maximum coupling and adjusted the lower coil to stop oscillations. The lower coil, when turned to increase the coupling, stops oscillating. Below 50 degrees on the dials we reduced the coupling at the upper coil, and set the lower one at an angle of 45 degrees.

The volume from the set is tremendous. Altho the set has only four tubes, there is no reason for adding another tube since, even on stations several hundred miles away, the Musicone is given as great a load as it can handle.

This set, while simple enough to be operated by the ordinary B.C.L., will appeal strongly to the more experienced set builders as a splendid outfit for long distance reception. While the set was under test, we tried the experiment of receiving as many stations as possible out of those listed in the New York Sun's daily radio program. In 45 minutes we heard and verified by the station call twenty-four of the broadcasters listed in the program, ranging from New York to Chicago on wavelengths from 276 to 526 meters.

Do S. L. F. Condensers Eliminate Squeals?

FROM some source or other many radio men seem to have the idea that the use of S. L. F. condensers will eliminate heterodyne squeals. The S. L. F. condenser serves several important and useful purposes but it cannot affect squeals caused by regenerative receivers, either to make the effect less pronounced or more so.

Heterodyne squeals come from three sources, beat notes set up between your station and the broadcast transmitter, when your own set is adjusted to an oscillating condition, beat notes set up between an outside receiver in an oscillating condition, and your own when it is also oscillating, and between an outside receiver and the broadcasting station, even tho your own set is not oscillating. The last is the most common cause of whistling or heterodyning interference and has nothing to do with your own set.

SUPER **SM** PARTS

Entirely silver-plated! And a new standard has been set for low-loss condensers! It is only logical that the new Silver-Marshall S-L-W Condensers should be the first to be so built. Their losses are lower than many laboratory standards—their mechanical design unique and original. The S-L-W plates mean *real* selectivity and station separation.

No. 305 .0005 ....$6.00
No. 306 .00035 ....5.75
No. 307 .00025 ....5.50

S-M Type 210 and 211 Transformers

S-M 210 and 211 transformers are known as the finest intermediate transformers ever made. They were an important feature of the receiver built entirely of S-M parts, that took the grand sweepstake prize at the recent Los Angeles Radio Show.

Price, each $8.00

Send 4c in stamps for Free Circulars of S-M Products, and reprints of article from Radio Engineering, describing the remarkable new Super-Autodyne Receiver.

Silver-Marshall, Inc.

108 S. Wabash Avenue
CHICAGO, ILL.

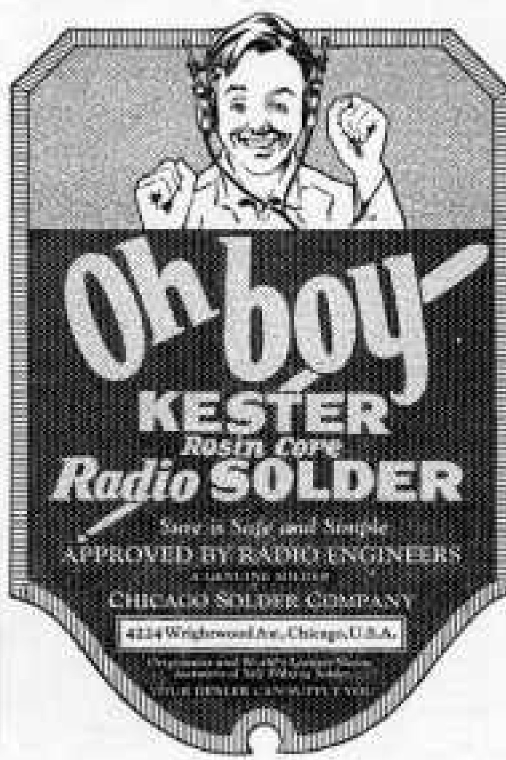
DURHAM
Metallized
High Resistors

for special Work

Leaping into popularity on account of its accuracy and permanence, the DURHAM *Metallized* filament has been in great demand for all high resistance purposes—couplers, bypasses, and B power units. Special designs have been worked out to meet special conditions. Above is shown a pig tailed unit. No doubt our engineers can help you, too—if you'll just write!

INTERNATIONAL RESISTANCE CO.

728 Sansom St., Philadelphia



Announcing *the* Balkite Trickle Charger *at* $10 *and the new* Balkite "B" *at* $35

A

Balkite
Trickle Charger

Charges both 4 and 6 volt radio "A" batteries at about .5 amperes. Usable in 3 ways: (1) As a regular charger with a low capacity storage battery for sets now using dry cells. (2) With storage battery sets of few tubes. (3) As a "trickle" or continuous charger for storage battery sets of as many as 8 tubes. Size 5½ in. long, 2¾ in. wide, 5 in. high. Operates from 110-120 AC 60 cycle current.

Manufacturers are offering switches which turn on Balkite "B" and turn off the charger when you turn on your set. This makes the current supply for both circuits automatic.

Price $10
West of Rockies, $10.50
Slightly higher in Canada

Balkite
Battery Charger

The most popular battery charger on the market. It can be used while the radio set is in operation. Charging rate 2.5 amperes. Operates from 110-120 AC 60 cycle current. Special model for 50 cycles.

Price $19.50
West of Rockies, $20
Slightly higher in Canada

The Balkite Battery Charger is today the most popular charger on the market. It is the only charger commonly used while the set is in operation. Balkite "B" II is also well known. It replaces "B" batteries entirely and supplies plate current from the light socket.

We now announce the Balkite Trickle Charger at $10. This low-rate charger is especially adapted to use with sets of relatively low "A" current requirements—any dry cell set and storage battery sets with few tubes. Owners of dry cell sets can now make a very compact and economical installation with a Balkite Trickle Charger and a low capacity storage battery of the type offered by battery manufacturers this fall.

We also announce the new Balkite "B" at $35. This new model will serve sets of five tubes and less. It fits in your present "B" battery compartment.

Noiseless—No bulbs—Permanent

All Balkite Radio Power Units are entirely noiseless in operation. They have no moving parts, no bulbs, and nothing to adjust, break or get out of order. Each is a permanent piece of equipment with nothing to replace. They require no other attention than the infrequent addition of water. They require no changes or additions to your set. They are guaranteed to give satisfaction.

Manufactured by
FANSTEEL PRODUCTS COMPANY, Inc.
North Chicago, Illinois

FANSTEEL
Balkite
Radio Power Units

B

Balkite "*B*"

Eliminates "B" batteries. Supplies plate current from the light socket. Operates with either storage battery or dry cell tubes. Keeps "B" circuit always operating at maximum efficiency. Requires no attention other than adding water about once a year.

Will serve any set of 5 tubes or less. Occupies about same space as 45 volt dry "B" battery. Operates from 110-120 AC 60 cycle current.

Price $35
Slightly higher in Canada

Balkite "*B*" *II*

Same as the new Balkite "B" but will fit any set including those of 10 tubes or more. Operates from 110-120 AC 60 cycle current. Special model for 50 cycles.

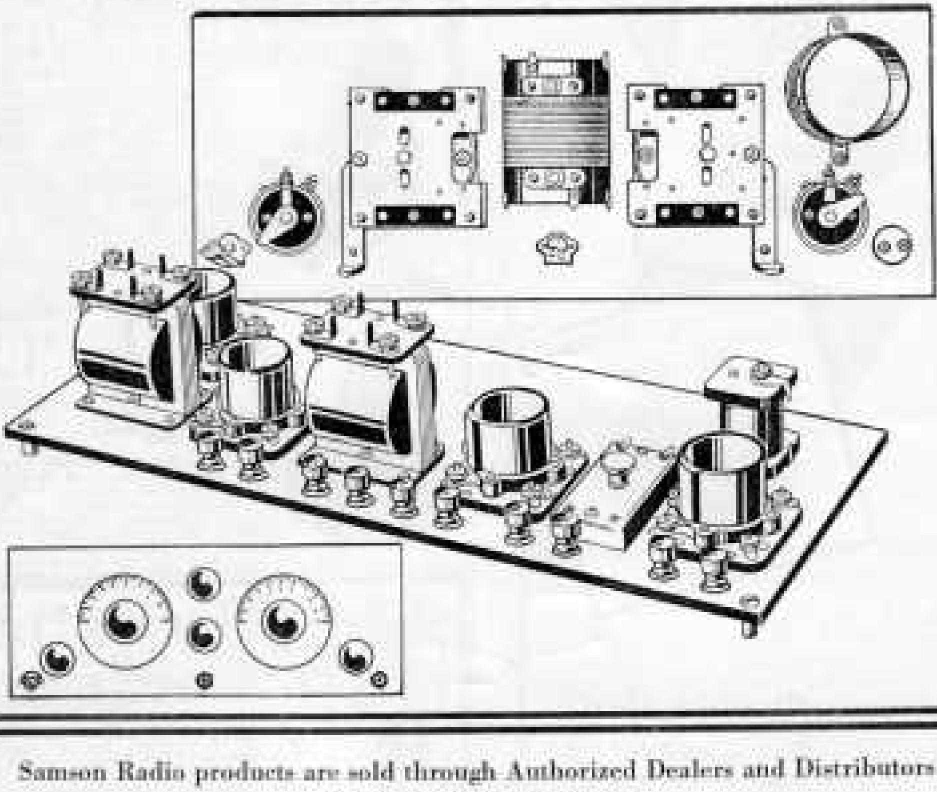
Price $55
Slightly higher in Canada

The Gould Unipower is equipped with a special Balkite Radio Power Unit

BALKITE BATTERY CHARGER · BALKITE TRICKLE CHARGER · BALKITE "B" · BALKITE "B" II

Samson T Assembly

AN engineered assembly of quality parts designed for fidelity of reproduction, utmost selectivity, simplicity of operation and nerve like sensitivity, offering to the dealer and constructor a custom made set which will meet the most exacting requirements.



Samson Radio products are sold through Authorized Dealers and Distributors

Write for information to

SAMSON ELECTRIC COMPANY

CANTON, MASS.

Manufacturers since 1882

Why

Set Manufacturers are Standardizing on DXL Condensers---the New Single End Plate Model C

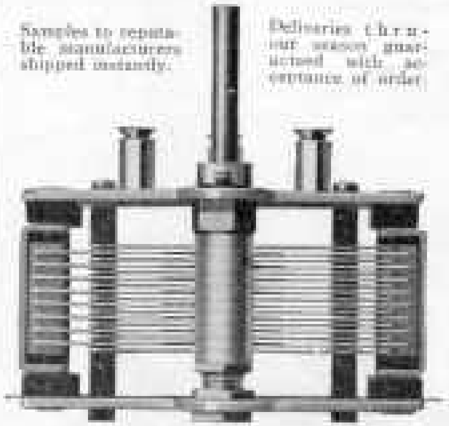
When the engineers of many set manufacturers from all parts of the country specify D X L Condensers for the new Sets — when they select D X L from the hundreds offered them — it means they are satisfied with the sound, sensible principles of design upon which D X L Condensers are built.

Light, yet sturdy and rigid — Simple, yet a marvel of precise workmanship — Instant admiration is won for Model C — just one end plate, yet any engineer will vouch for its absolute rigidity.

Like all D X L Straight Line Condensers Model C is guaranteed to run true to specifications and careful workmanship in every single shipment. Buy D X L with perfect confidence.

Samples to reputable manufacturers shipped instantly.

Deliveries thru-out season guaranteed with acceptance of order.



Individual Set Builders

D X L Condensers will make your set perform at maximum. Ideal for low wave lengths. Details and prices on request.

TRADE **DXL** MARK

RADIO CORPORATION
5777 Stanton Ave., Detroit, Mich.

Take the "GUESS" Out of Tube Control with

$1.10
Everywhere

Amperite automatically controls tube current, eliminates hand rheostats, filament meters, guessing and all tube worry.

Simplifies wiring, tuning and operation.

Permits the use of any type of tube or any combination of tubes.

Tested and used by more than 50 set manufacturers and in every popular construction set.

RADIALL COMPANY
Dept. S.L.-2, 50 Franklin St., New York City

Write for FREE *Hook-ups*

AMPERITE

The "SELF-ADJUSTING" *Rheostat*

I and M REGISTRY

The men whose names are listed below are prepared to handle all emergency work, take care of batteries, and replace tubes. Their charge is $1.50 per hour, not including travelling time except to unusual distances.

The charge for listing in this section is 50c. for one month, $2.00 for six months, $3.00 for twelve months, payable in advance. The * indicates that we have received letters from six set owners stating that the men after whose name the * appears has handled their I and M work satisfactorily.

A REGISTRY OF RADIO INSTALLATION and MAINTENANCE SERVICE MEN WHO INSTALL, MAINTAIN, and REPAIR RADIO EQUIPMENT

Conn., South Norwalk—A. GHIRARDI*
Rowayton. Tel. Nor. 2724

D. C., Washington—A. C. BURG
U. S. Soldiers' Home. Tel. Col. 750 Br. 41

Ill., Chicago—WEILAND & CO.
6711 Stewart Ave. Tel. 1124 Normal

Mass., Boston—H. A. NICKERSON
201 Devonshire St. Tel. Cong. 5156

Mich., Detroit—J. E. JOHNSON
91 Gladstone Ave., Tel. Empire 8581J

Minn., Minneapolis—GEO. A. BECKER
4709 Wentworth Ave. Tel. Locust 6291

N. Y., New York—APEX RADIO CO.
123 Liberty St. Tel. Rector 3176

N. Y., New York—HERBERT MULLER
954 Lexington Ave. Tel. Rhldr. 3905
154 Nassau St. Beek. 8040

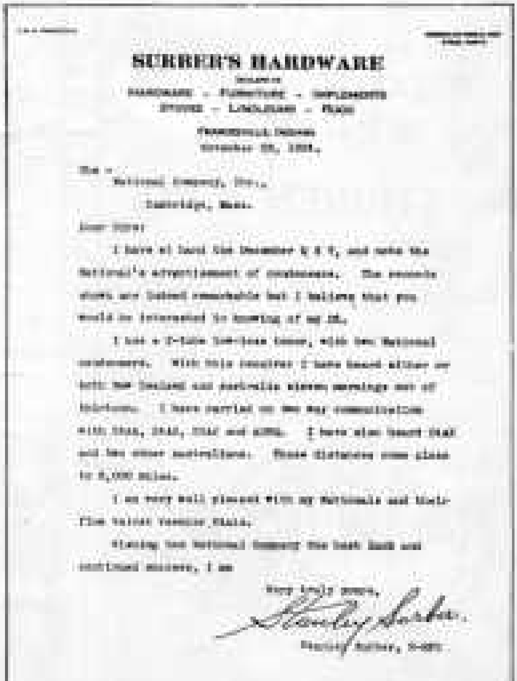
N. Y., New York—RADIO CONST. LABS.*
71 W. B'way. Tel. Walker 2143

O., Kent—KLADAG RADIO LABS.*
Kline Bldg. Tel. 127

We have five 1924 Bound Volumes of RADIO ENGINEERING in stock available for those who are interested in keeping a complete file of our publication. The price for two weeks only is $2.00 each.

M. B. SLEEPER, INC.,
52 Vanderbilt Ave.,
New York, N. Y.

Another tribute to
New England's Radio Craftsmen


SURBER'S HARDWARE

"I am very well pleased with my *NATIONALS* and their fine Velvet Vernier Dials," writes Mr. Surber.

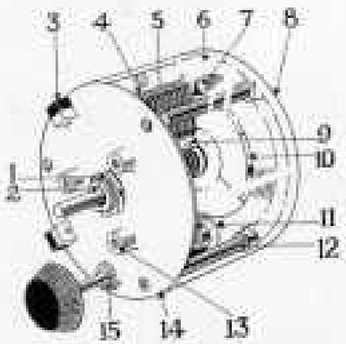
★ **Write for Bulletin 106 R.E.**

National Company
Engineers and Manufacturers
110 Brookline Street
Cambridge - - Mass.

Sole manufacturers of the genuine and justly famous Browning-Drake Transformers. Patents pending.

WILLIAMS PRESS INC.
ALBANY — NEW YORK

The ACME condenser has these advantages



All parts are of non-rusting metal, except steel bearing, which is covered with nickel-plated protective surface. End plate capacity is .000010 m.f., full capacity is .0005 m.f.

Price $6.50

Distinctive Points

1. Steel to brass cone bearings adjustable.
2. Lock nut for bearing.
3. Highest grade hard rubber Dielectric in that part of the field to prevent losses.
4. Brass separator to which both rotary and stationary plates are soldered, making continuous circuit for each.
5. Brass silver-plated plates; rotary plates logarithmic.
6. Dust-proof covering.
7. Stops at extreme end of movements.
8. Coiled connections between shaft and heads allowing lubrication of bearings.
9. Brass separator to which both rotary and stationary plates are soldered, making continuous circuit for each.
10. Counterweight which balances rotary plates.
11. Noiseless friction Vernier control seven to one ratio.
12. Brass separators, to prevent twisting and to take strain off Dielectric.
13. Panel mounting holds for 120 degrees spacing.
14. Metal heads.
15. Steel bushing to prevent wear on Vernier shaft.

Low loss, sharp tuning --- practically all currents on antenna can now be used

IT remained for Acme—manufacturers of the famous Acme transformers — to perfect the "lowest loss" Condenser. The Acme Engineers have been working for two years to bring out a condenser which would give to Radio Experimenters sharp tuning and minimum losses.

The new Acme Condenser has these fundamental advantages and also has many new improvements in structure and equipment. See the illustration with explanation, and, for more information, write to us for booklet—"Amplification without Distortion," which contains many diagrams and helpful hints on how to build and get the most out of a set. Enclose 10 cents in stamps.

ACME APPARATUS COMPANY
Dept. H-7 Cambridge, Mass.

ACME ~*for amplification*

SCREW MACHINE PRODUCTS
WITH
UNIFORM PRECISION

Fifty years of experience plus the latest obtainable equipment together with an efficient organization and a sincere desire to give our customers quality and service we feel places us in a position to offer you a satisfactory source of supply on screw machine products.

Steadfast standards maintained by rigid inspection assures you a clean cut product that you can have complete confidence in for quick and accurate assembly.

Brass parts acid dipped clean and bright.

Send us samples or blue prints for quotation.

CHICAGO SCREW COMPANY

1026 So. Homan Avenue — Chicago, Ill.