RADIO Engineering

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

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Edited by
M. B. SLEEPER

FEBRUARY, 1925

VOL. V NO. 2

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RADIO ENGINEERING

Edited by M. B. SLEEPER

Associate Editor, Alfred A. Ghirardi

Fifth Year Vol. V, No. 2

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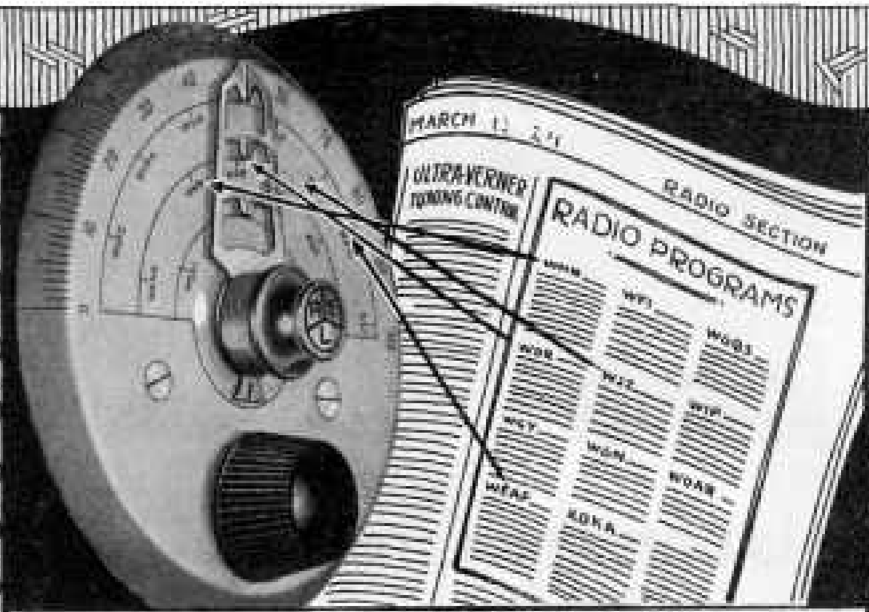

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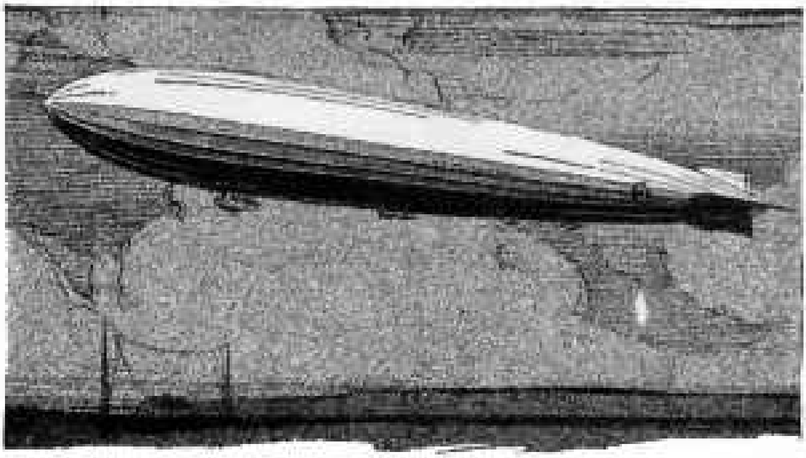

Dubilier Condensers

Important Links between the Shenandoah and Land!

Communication with land—under all conditions—at all times—this was the imperative need of the Shenandoah on its experimental flight across the continent. Impressed with this need, army and navy engineers equipped both transmitting and receiving sets with Dubilier mica condensers — not specially designed condensers but the regular standard product. Only complete confidence in the supreme reliability and efficiency of Dubilier condensers can explain their use in this important and daring adventure.

Dubilier

CONDENSER AND RADIO CORPORATION

Fig. 1. The chemical cells used in the Balkite unit.

The Chemist Contributes in the Radio Field

Unlike other storage battery chargers and B battery substitutes, the Balkite devices use chemical rectification instead of vacuum tubes. This makes the charger noiseless, gives the battery substitute better voltage regulation, and eliminates replacements

THE radio market has been literally swamped with battery chargers, and of late a number of B battery eliminators have made their appearance. Some are efficient, others are not; some are noisy in operation, others do their work in silence; some employ rectifying tubes others use mechanical vibrators and still others depend upon chemical reactions for their operation; some are handsome enough in external appearance to warrant their being placed right alongside of the radio set, others look so bad that they are put under tables, in cupboards, down in cellars, anywhere out of sight. We can truly say we have our full measure of the 57 varieties.

The tendency in the higher class of radio installations at the present time seems to be toward the use of the storage battery, in conjunction with a battery charger, for the filament current supply, and a plate voltage supply working directly from the 60 cycle lighting mains. The Balkite units shown in the accompanying photographs represent one of the highest developments in the solution of the problem. They are enclosed in handsome metal cases, the two units being nearly the same size and matching each other in appearance. The operation of the B battery substitute unit is absolutely noiseless. The storage battery negative side. A rubber covered duplex wire with a universal plug goes to the lighting socket. To stop the charging it is only necessary to turn the current off at the lamp socket. The clips can be left connected permanently to the battery if so desired without running it down or affecting the radio set. While in operation the charger consumes about 0.5 ampere or as much as an ordinary 60 watt lamp. A 4-ampere safety fuse is

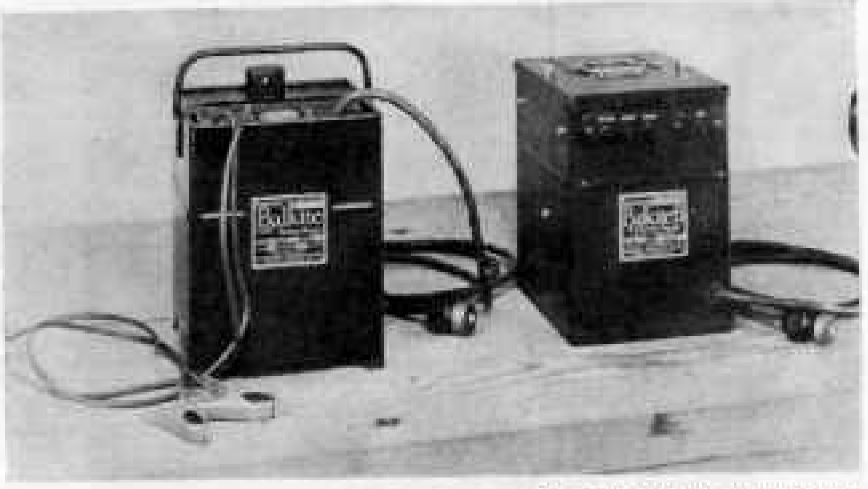

Fig. 2. At the left is the storage battery charger. The only attention it requires is the occasional addition of a little distilled water. This is also true of the B battery substitute shown at the right

charger makes a slight bubbling sound but it cannot be heard at a distance of over four or five feet. Both units employ electro-chemical reactions as a means of rectification.

The battery charger shown on the left in Fig. 2 is used for charging 6 volt storage batteries and can be used while the set is in operation. The standard type is designed to work from 110-120 A.C. 60 cycle current, a special type being made for 50 cycles. The outfit comes packed in a box with a bottle containing electrolyte. To put the device into operation it is only necessary to remove the rubber filler cap from the top of the cell and pour the entire contents of the bottle into the opening. The two rubber covered leads which connect to the battery are fitted with heavy clips. The red one goes to the plus terminal of the battery and the gray one goes to the provided on the lighting side to protect the charger from any overload currents. An extra fuse is also furnished. The only care necessary is the addition of a few drops of distilled water every once in a while to keep the plate in the cell covered, as is done with a storage battery.

The Balkite B unit shown on the right of Fig. 2, supplies the plate current directly. Five binding posts are arranged on the front connection board. There are three voltage taps, +100, +50, and +20 volts, the —B post, and the GR post which should be connected to ground. The +100 post is for the A. F. amplifier tubes and should be connected to the post marked +90V on most sets. The +50 post is for the A. F. amplifiers and also for the detector, when a hard tube is used. If soft tubes are employed, the +20 post is connected to the

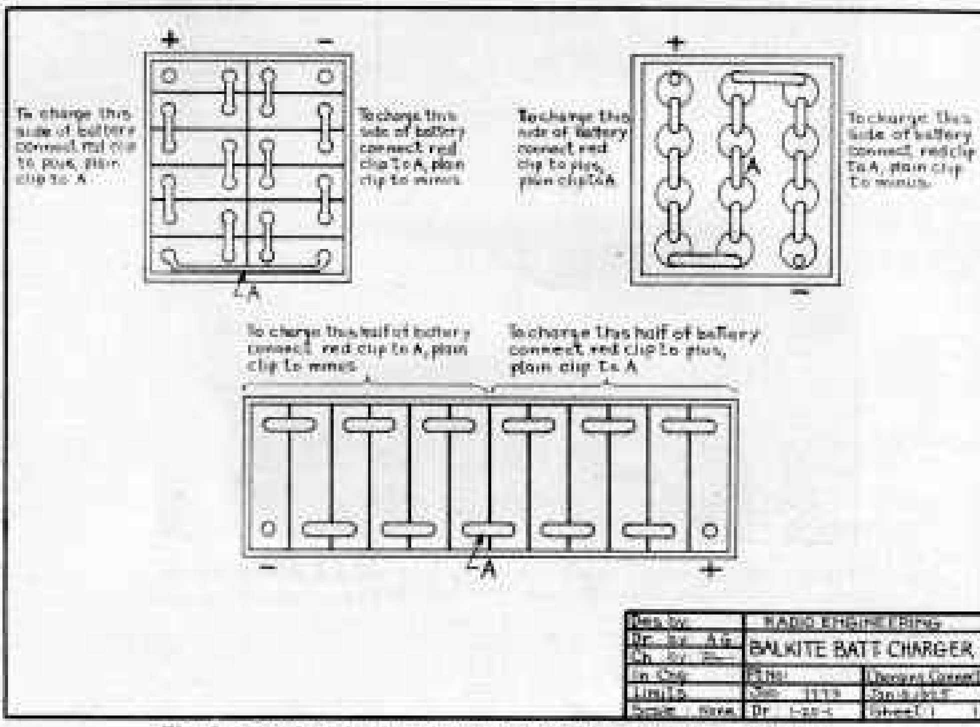

Fig. 3. Showing the connections for charging storage B batteries.

DET binding post of the set. The —B post goes to the B— post of the set.

This unit is packed in two compartments, one containing the electrical circuits and the other containing the glass cell assembly shown in Fig. 1. After unpacking the cell assembly, the six small rubber stoppers must be removed from the vent holes in the cell covers. These are put in to prevent leakage of the electrolyte during shipment. Then unscrew the two knurled nuts on top of the metal case and lift off the cover. Now unscrew the two composition binding posts A and B from the threaded studs, and place the cell assembly in the compartment case so that the two lead lugs extending beyond the cover of the cell assembly drop over the screws from which the binding posts have been removed. Replace the binding posts on the studs and secure them firmly so that good electrical connection is made between the cell assembly and the studs.

If it is desired to get higher voltage or more current for operation of sets with more than six tubes, remove the cover from the case and loosen the binding post to which the slotted switch arm is attached. Swing the arm over to the post marked H and fasten it in place by screwing down the fibre posts at each end. This is a very important feature as it permits an additional control of the voltage over the inherently good voltage regulation characteristics.

When the set is not in operation it is only necessary to disconnect the Balkite B at the lamp socket. A few drops of distilled water added to the cells once or twice a year is all the attention required. To do this the power should be turned off and the cell assembly removed from the case. The water in the glass jars should always be up to the level mark.

The storage battery charger can be used also to charge the 22½ volt rechargeable B batteries now on the market. This must be done by charging half the B battery at a time. The connections necessary for charging the various types of B batteries are shown in Fig. 3.

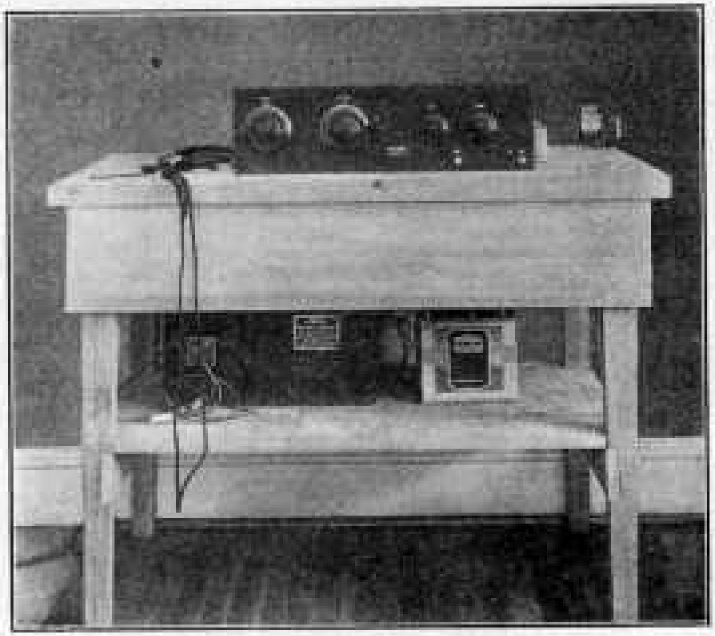

Fig. 1. The Browning-Drake 199 as it was set up at the Darien laboratory for the final tests.

The Browning-Drake 199

The data presented here is authorized by Mr. Browning, and the design has been personally approved by him. This set, using all UV-199 or C-299 tubes, can be operated from dry cells, and is practically equal to the type 6600 Browning-Drake receiver

WHEN the type 5300 DX receiver was described in the August 1923 issue of the magazine, the reports were so consistently enthusiastic that we thought it would be impossible to design a set which would be an improvement on it. The Browning-Drake, however, has left the type 5300 far behind for, altho it employs no more tubes, and is even simpler to build and operate, it is far superior to the other set in distance as well as volume.

Strangely enough, the original design for the DX receiver came from Boston, and again Boston scores as the home of the Browning-Drake, for both Mr. Browning and Mr. Drake are Boston men and graduates of Harvard University.

The Browning-Drake 199 Receiver Altho the type number of this set is 7000, we call it the "Browning - Drake 199" because it operates on UV-199 or C-299 tubes, while the original type 6600 uses a 199 for the R. F. tube and UV-201-A's or C-301-A's for the detector and audio amplifiers. In the matter of volume and distance, there is not as much difference between the 6600 and 7000 as might be expected, altho the quality with the type 6600 is slightly better. On the other hand, there is a tremendous advantage in being able to run a Browning-Drake receiver from dry cells. Moreover, the total B battery current consumption on the type 7000 set is only 5 miliamperes. Therefore, the No. 764 Eveready B batteries can be used. Four are required, as these batteries give 22½ volts each, or two No. 772 45-volt batteries. These units will last for several months. You will note that 4½ volts C battery, obtained from a No. 771 Eveready unit, is also needed. This is essential or the B battery current will be considerably increased.

For A batteries, the type 7111 is recommended. If eight of these are used, connected with two sets of four in parallel, they will have a life of approximately two months if the set is used on an average of four hours a day. The total filament current is 0.20 to 0.25 ampere.

This outfit is not only more economical to operate but it is less expensive to build because the design has been simplified in a number of ways. No set could be neater in appearance for, on this four-tube receiver, there are only eight or nine wires that can be seen when the cover of the cabinet is opened.

lengths, but with this set very nearly maximum results can be obtained over the entire wavelength range without adjusting the tickler at all. It is not necessary to neutralize this set.

The filament current of the R. F. amplifier tube is automatically adjusted by means of an Amperite. A 30-ohm General Instrument rheostat regulates the detector and another, of the same resistance, controls the two A. F. amplifier tubes. Right between the rheostat dials, and below them, is a Walbert filament lock switch by means of which the tubes can be turned on or off without changing the rheostats. A Carter jack in the lower right hand corner provides connections for the telephones.

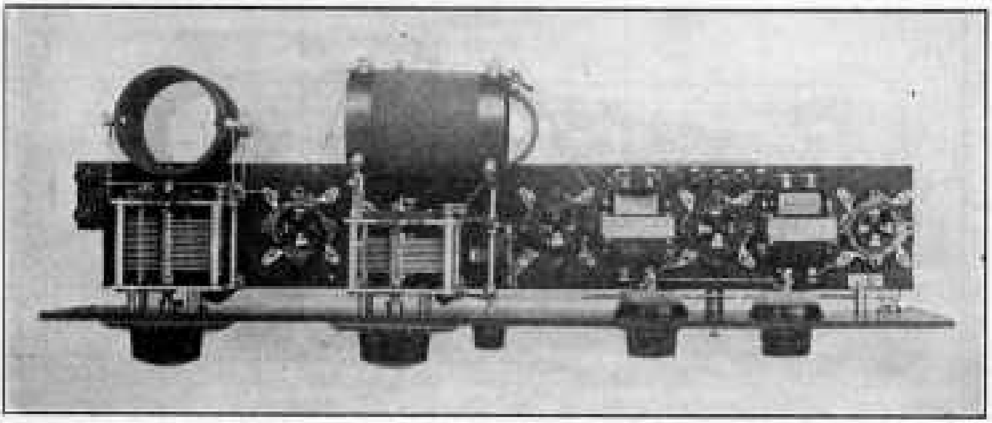

Fig. 2. You will see that few sets can match this outfit in appearance, nor can they surpass it in receiving range and volume.

Operating And Results Obtained Several views of the Browning-Drake 199 are given in the accompanying illustrations. You will see in Fig. 1 the outfit as it was installed for testing at the Darien laboratory. It is identical to the type 6600 from the front.

The Browning-Drake circuit is made up of one stage of tuned radio frequency amplification, a regenerative detector, and two stages of audio. The large dial on the left tunes the R. F. amplifier while the right hand dial tunes the detector circuit. There is a small knob just beside the latter dial which controls the regenerative effect. Unlike ordinary regenerative receivers, however, it is not critical, nor is it necessary to readjust it each time a station is turned in. Most regenerative circuits use much more feedback coupling at the longer wave

Antenna, ground, and battery posts are located at the rear of the set, as you will see in Fig. 2. For testing purposes, it is very convenient to use the Belden battery cord. This has five wires, each of a different color, formed into a cable. The insulation is very heavy, so there is no danger of short circuiting the batteries. The C battery is mounted right behind the set, as the leads should be kept as short as possible.

To tune the set, the large dials are rotated together. They run evenly at the center of the scale altho at the low and high waves the reading on the right hand dial is higher than on the left hand dial. The dials furnished with the National Regenaformer tuning units are of

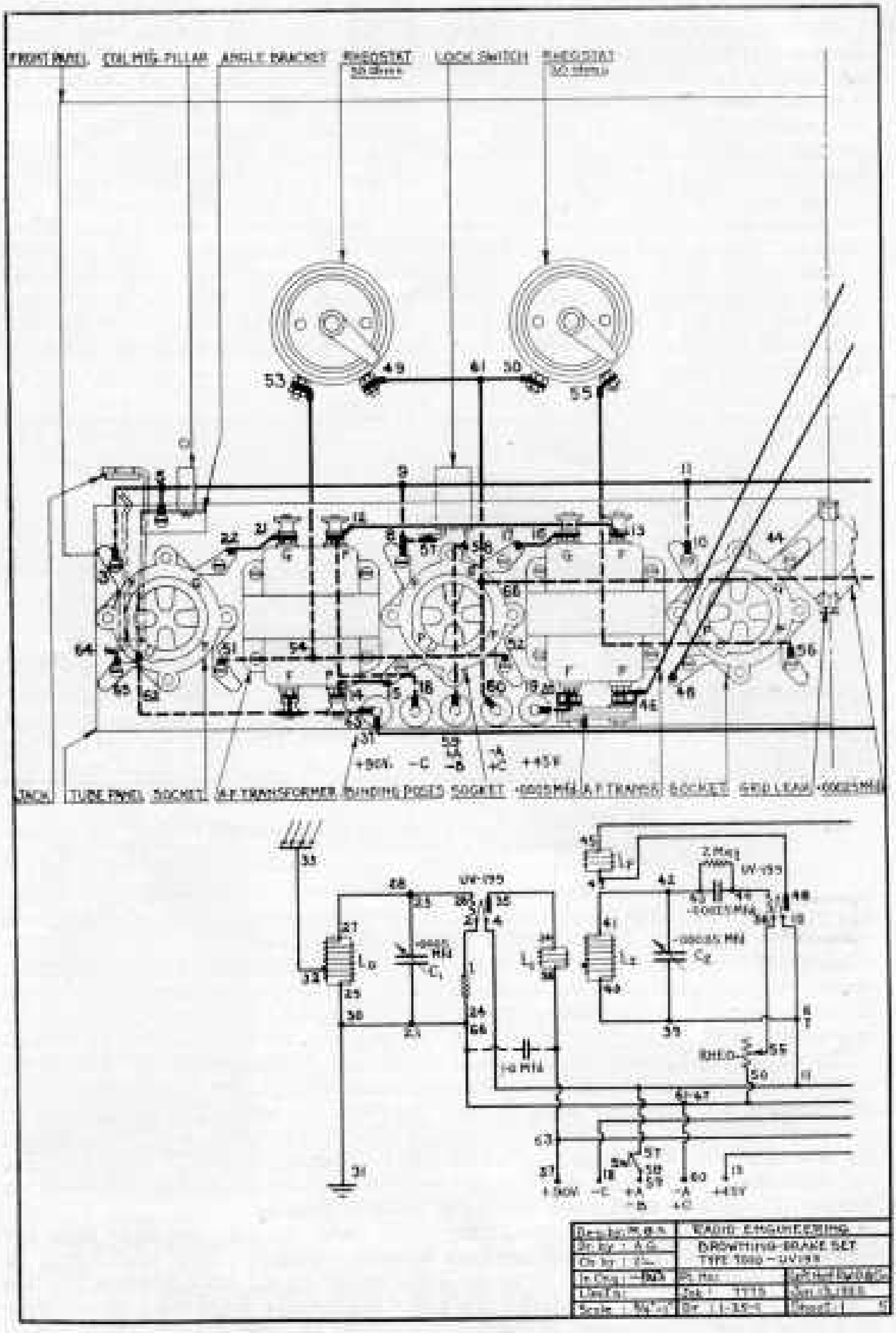

Fig. 5. Left hand half of the picture wiring diagram and schematic circuit

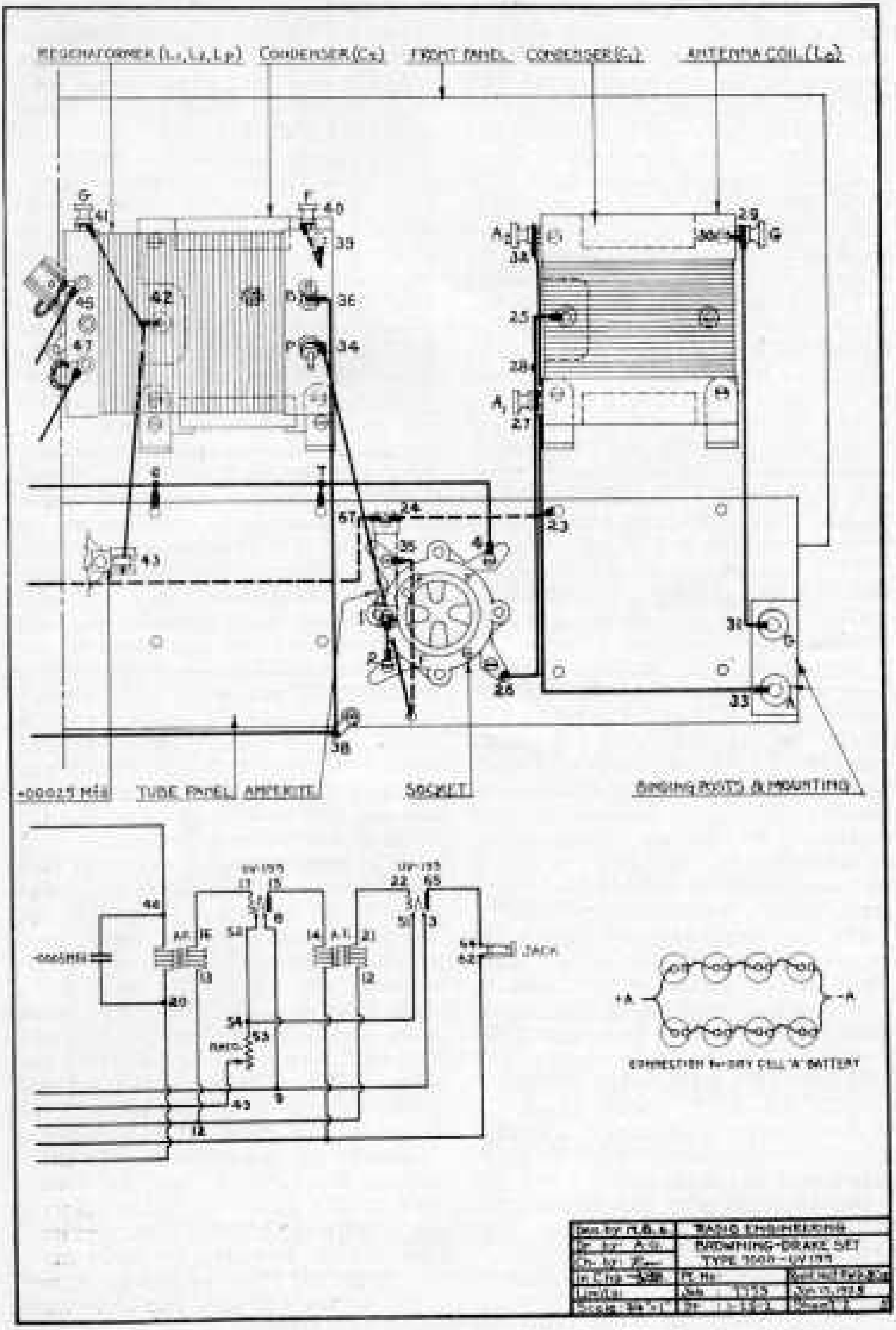

Fig. 6. Right hand half. Note that the tube panel is tipped down to show the parts

the vernier type. As the knob is rotated, the dial itself moves separately, approximately six revolutions of the knob being required for one revolution of the dial. This is about right for a vernier, and the adjustment is so smooth and positive that it is a pleasure to tune these dials. When a station is brought in, the small knob on the tickler is rotated in an anti-clockwise direction to bring up the signals to maximum. Then the condensers are re-adjusted for the exact settings.

There is no danger that this set will interfere with reception at other stations because the first tube does not oscillate at all and the detector tube cannot be used in an oscillating condition because the signals become distorted. This action serves as an automatic check against the operation of the set in a manner which would cause annoyance at other stations.

Standard Parts Required The front panel for this set is of polished black Formica, measuring 7 by 24 by 3/16., while the base panel is of the same material, 3½ by 23 by 3/16-in. The little terminal panel for the antenna and ground binding posts can be cut from a piece of scrap Formica. It measures 1¾ by ¾ by 3/16-in. Formica can be obtained with a mahogany or walnut finish if you want to make the panels match the woodwork on the cabinet. Celoron, Dilecto, or Duresto, are also satisfactory for this set. The mechanical strength is very important, as well as the electrical characteristics, for the panels must support considerable weight.

The key instruments for the set are the two National Regenaformer units. These are of the design developed by Browning and Drake and are licensed by them for use in the Browning-Drake Receiver. The first unit consists of a 0.0005 mfd. National condenser with the antenna and R. F. tuning inductance, while the second is made up of a 0.00035 mfd. National condenser with the R. F. transformer and tickler coil.

On the front panel are mounted the two 30-ohm General Instrument rheostats, Walbert lock switch, and open circuit Carter jack. The base panel carries four Benjamin 199 sockets, a 0.00025 mfd. New York Coil fixed condenser with mounting clips for a 2-megohm Daven gridleak two 1 to 4 Modern transformers, a 0.0005 mfd. Dubilier Micadon, and seven Eby or Marshall-Gerken binding posts, two of which are on the antenna and ground terminal strip. Beneath the tube panel there is the 6V-199 Amperite. This can be seen in Fig. 4.

For hardware, two terminal support pillars, 3⅛-ins. long by ⅛-in. in diameter, threaded at each end for 6-32 screws are required, as well as one angle bracket and three coil support pillars. One of the pillars holds the tube panel to the front panel at the right hand end, while the other two are fastened to the underside of the tube panel as supports, for they rest on the inside of the cabinet.

Suggestions For Wiring The best mechanical design is unavailing if the connections are not properly made. With the picture wiring diagram and the illustrations it is an easy matter to copy the original set. A little care in shaping the wire will not only prevent trouble when the set is in operation but will greatly improve the appearance of the outfit as well. There is a tendency to encourage set builders to make connections without soldering but this practice should be discouraged, for screws and thumb nuts have the most mysterious way of letting wires slip out from under them and they give no warning except that the set stops functioning as it should.

Altho many set builders feel that they must have an electric soldering iron, this is really not necessary. If you do not feel that you can get a good electric iron, such as the American Beauty, a Nokorode soldering kit, which costs only half a dollar, will do astonishingly good work when used in accordance with the very thorough instructions supplied with the soldering kit. The secret of successful joints does not lie in the design of the the iron but in its correct manipulation. Moreover, you must use non-acid paste, such as Nokorode, or rosin core solder, such as the Kester or Belden brands, which are made with the correct proportion of rosin necessary for radio work. If you use the paste, be sure to get soft solder or you will have trouble in making it melt properly.

Assembly And Wiring Figs. 5 and 6 show the picture wiring diagram for the set as well as the schematic circuit. The former illustrates connections as they were actually made. The base panel is dropped down in order that the parts can be seen more clearly. Wires shown in dotted lines are run beneath the tube panel. The terminals are numbered in both diagrams, but if the indications are not clear in the schematic, you can see just how they should be from the diagram. Otherwise you are liable to blow out a tube. When you fasten the third socket from the left, looking at the set from the rear, instead of putting a thumb nut between the spring and the upper side of the tube panel, put the screw through one of the corner holes of the New York Coil fixed condenser, first removing the Fahnestock clip. The arrangement is shown in the picture wiring diagram. This does away with any grid lead. Remove the mounting springs

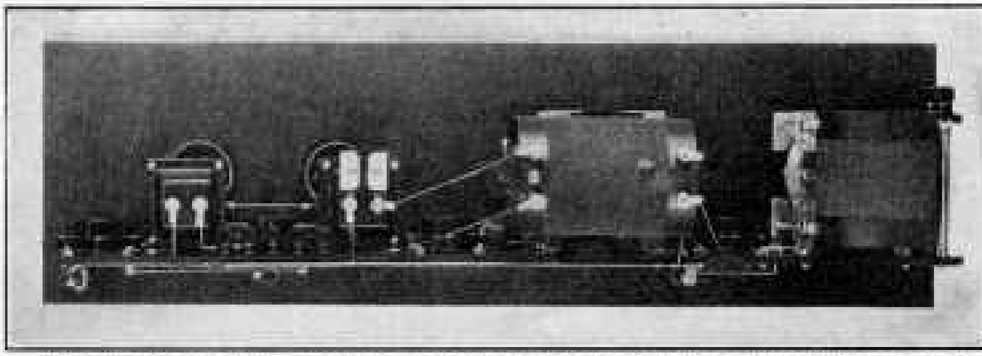

Fig. 3. The rear view. Note the arrangement of the transformers and the Micadon mounting.

picture wiring diagram. Wirit is recommended for the connections instead of the familiar, heavy buss bar.

1. On the original set the bases of the Benjamin sockets were removed from the upper parts and the upper part mounted directly on the tube panel. It may be more satisfactory, however, to leave them on. If you want to leave the bases on the sockets, remove the screws which serve as terminals, then throw away the thumb nuts. Put the machine screws in the opposite direction with the round head resting directly on top of the contact spring. Put the screws right through the tube panel and fasten them with nuts on the under side. Do not forget the soldering lugs. The arrangement can be seen in Fig. 2. If, however, you do not use the bases, put the machine screws in with the heads on the contact springs but put the thumb nuts between the springs and the upper surface of the tube panel. Then put on the nuts and lugs underneath as before. Make sure that the markings on the sockets come in the exact positions shown in the picture wiring from the Amperite base strip, and fasten the springs to the under side of the base panel. The holes for the mounting screws are in line with the plate and filament terminal holes for the right hand socket. Use a flat head screw for holding the rear mounting spring so that it will not come in contact with the plate contact spring on the socket.

2. Solder lug 1 directly to lug 2. They are so close together that no connecting wire is necessary. Terminal 1 is the rear lug on the Amperite mounting spring and 2 is the lug on the socket filament terminal.

3. Fasten an angle bracket to the left end of the tube panel, using a ½-in. 6-32 R. H. screw and nut. Put a lug on the screw under the panel. Fasten lugs to the under side of the tube panel, using ½-in. 6-32 R. H. screws and nuts, at points 6 and 7.

4. Connect 3 to 4, and solder this wire to lugs 5, 6, and 7, past which the wire should run. Put No. 7 M-R varnished tubing over the wire between points 3, and 5, 5 and 9, and 9 and 11. Leave

spaces for connections 9 and 11 as they are to be made afterward. Connect 8 to 9, and 10 to 11.

5. Mount the two audio frequency transformers on the tube panel, using ½-in. 6-32 R. H. screws and nuts. Make sure that the primary terminals are at the rear. Connect 12 to 13. These are the F posts on the transformers. Connect 14 to 15. 14 is the P terminal on the transformer and 15 the P terminal on the socket. Connect 16 to 17. 16 is the G terminal on the transformer and 17 the G terminal on the socket.

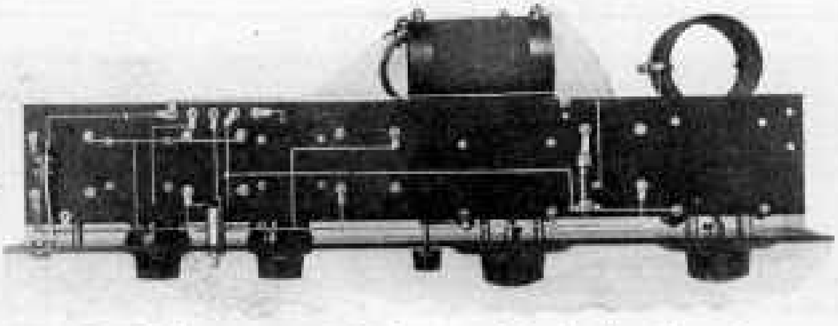

Fig. 4. Here you can see the wires concealed under the tube panel.

6. Mount the five binding posts on the tube panel, making sure that the connection holes run from front to rear. Connect 18 to 12. 18 is the —C binding post and 12 the F post on the transformer. This wire runs from the transformer straight down through a hole in the tube panel and around to a lug on the binding post screw beneath the panel. Connect 19 to 20. 19 is the +45V binding post and 20 the F post on the transformer. This wire runs up through a hole in the tube panel. Connect 21 to 22. 21 is the G post on the transformer, and 22 the G post on the socket.

7. Solder soldering lugs to the lugs furnished on the Dubilier condenser and have them pointing down so as to slip over the primary terminals on the right hand audio transformer. The arrangement can be seen in Fig. 3. This condenser is of 0.0005 mfd. Eight mounting legs are supplied with the Browning-Drake kit. The vertical part of each leg has two holes. Fasten the long parts of the mounting legs to the four screws which hold the front and rear end plates to the lower spacing pillars. Remove the screws passing through the end plates into the spacing pillars one at a time. Put the screw through the lower hole in the mounting leg and then turn the screw back into the pillar again. Have the short ends of the legs pointing toward the rear of the set. Fasten the right hand unit to the tube panel, putting ½-in. 6-32 R. H. screws through the mounting legs and the tube panel and holding them in place with nuts on the under side. Put a lug under the front left hand nut on the under side of the panel to provide connection 23.

8. Connect 23 to 24. 23 is a lug under the nut of the screw holding the condenser mounting leg to the tube panel and 24 the front contact spring screw on the Amperite. Connect 25 to 26. 25 is a lug under the binding post nut which serves as a terminal for the fixed plates and 26 the grid contact on the socket. Connect 27 to 28. 27 is the A1 terminal on the coil and 28 a connection made to the wire running from 25 to 26. Connect 29 to 30. 29 is the G terminal on the coil and 30 a lug put on the screw which holds the rear end plate to the spacing pillar of the condenser in the upper right hand corner.

9. Fasten the two long panel support pillars to the tube panel with ½-in. 6-32 R. H. screws and, after removing the nuts from two Eby binding posts, put the binding posts screws through the short terminal panel and thread them into

the upper ends of the terminal panel supports. A lug must be put between each pillar and the terminal panel.

10. Connect 30 to 31 and 32 to 33. 32 is the A2 terminal on the coil and 33 the rear binding post.

11. Remove the two screws holding lugs 6 and 7 and mount the second unit on the tube panel with the mounting feet as previously explained. Put a ½-in. 6-32 R. H. screw through the tube panel at terminal 38, with soldering lugs above and below the panel. Fasten this screw with a nut and then put a coil mounting pillar on the screw.

12. Connect 34 to 35. 34 is the P terminal on the Regenaformer and 35 the P terminal of the socket. This wire runs through a hole in the panel and forward to the socket terminal. Connect 36 to 37, fastening the wire at 38. 36 is the B+ terminal on the Regenaformer and 37 a lug on the +90V binding post. Put a 3-in. length of M-R varnished tubing on this wire at the binding post end to prevent possible short circuits, and hold the tube in place by a drop of solder on the wire at the right hand end. Connect 39 to 40. 40 is the F terminal on the Regenaformer and 39 a lug put under the screw which holds the rear condenser end plate to the spacing pillar at the upper right hand corner. Connect 41 to 42. 41 is the G terminal on the Regenaformer and 42 a lug under the thumb screw which provides connections to the fixed plates. Connect 42 to 43. 43 is a connection made to the Fahnestock clip on the grid condenser. 44 indicates the connection between the other side of the grid condenser and the grid contact on the socket, altho no wire is employed. Connect 45 to 46. 45 is the upper terminal of the tickler coil and 46 the P terminal on the transformer. Connect 47 to 48. 47 is the lower terminal of the tickler coil and 48 the P contact on the socket.

13. Mount the two rheostats on the front panel using the screws provided. Adjust the thumb nuts at the rear so that the knobs turn smoothly. Mount the telephone jack with the frame up and down, as shown in Fig. 4, put the lock switch in place, and fasten a coil mounting pillar to the front panel with a ½ in. 6-32 R. H. screw put through the panel in the hole just above and to the right of the jack.

14. Connect 49 to 50. These are the adjacent terminals on the rheostats.

15. Fasten the front panel to the two variable condensers. It is necessary to remove the dials from the condensers. First loosen the set screw which holds the knob to the shaft. Then take out the three R. H. screws which fasten the dial to the gear box, remove the four screws which hold the gear box to the condenser mounting posts, and undo the set screw on the collar which fits over the condenser shaft. You will find three washers on each condenser mounting post. Take off all but one from each post. Put the condenser behind the panel and put in the screws which go through the gear box and thread into the mounting pillars, put back the three screws holding the dial to the gear box, and finally, fasten the knob in place by tightening the set screw in it. Turn the condenser plates so that they are totally interleaved, loosen the set screw on the collar over the condenser shaft, set the dial so that the 100 division line coincides with the line on the panel and tighten the set screw again. Fasten the angle bracket at the left hand end of the tube panel to the coil mounting pillar on the front panel by means of a ½-in. 6-32 R. H. screw.

16. Connect 51 to 52. These are the F terminals on the two left hand sockets. This wire must be covered with M-R tubing, leaving a space for connection 54. Connect 53 to 54. 53 is the left hand rheostat terminal and 54 a connection made to the wire running from 51 to 52. This wire drops down and then runs back under the tube panel. Connect 55 to 56. Connect 57 to 8. 57 is the left hand contact on the lock switch. Connect 58 to 59. 58 is the right hand terminal of the lock switch and 59 the +A −B binding post. Connect 60 to 61. 60 is the—A+C binding post and 61 a connection made to the wire running from 49 to 50. Connect 62 to 63. 62 is the frame contact

(Concluded on page 116)

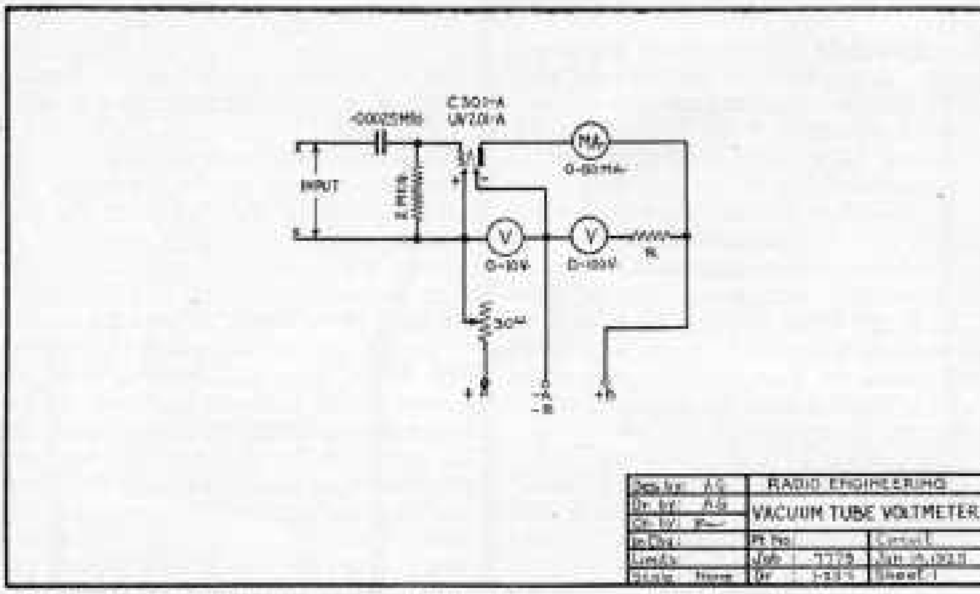

Fig. 1. The input leads are connected to the device across which the voltage is to be measured, and voltage determined by the calibration of the plate milliameter.

Our Laboratory Type Vacuum Tube Voltmeter

Complete description of an extremely accurate 201-A type voltmeter for measuring small voltages

THE vacuum tube voltmeter shown in the accompanying illustrations is one of the most useful measuring instruments we have in our laboratory at Darien. It provides a quick, accurate means of measuring potentials up to 2 to 5 volts, and possesses a feature which is invaluable in radio work, it does not draw any current from the circuit whose voltage is being measured.

The circuit is shown in the diagram, Fig. 1. The data on it was furnished to us by Mr. Samuel Cohen, Chief Engineer of the General Instrument Company. You will see that it is simply a UV 201 - A or C 301 - A tube connected up as a detector with measuring instruments in the various circuits. It operates on the principle of rectification and slight amplification produced by a vacuum tube when used as a detector. The voltage to be measured is applied at XX, across the grid and plus filament side of the tube. The filament return lead goes directly to the plus side of the filament so that the grid is not biased. When a difference of potential exists between the grid and filament of the tube, the current flowing in the plate circuit is a function of this difference of potential. If, then, we apply various known voltages to XX and measure the corresponding plate currents we can plot a calibration curve with voltages as ordinates and plate currents as abscissae. After this has been done, any unknown voltage to be measured can be applied and corresponding plate current observed, and by referring back to the calibration curve the value of the unknown voltage found. Some may find it preferable to make up a scale for the plate milliammeter so that the voltage may be read directly.

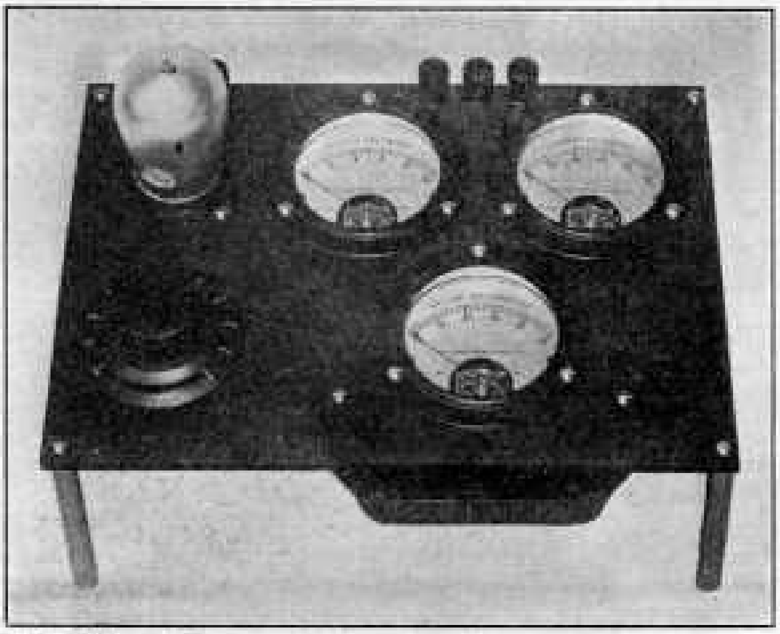

Fig. 2. When the filament and plate voltages have been adjusted, the voltage to be determined is read from the milliameter.

The photographs of the top and bottom views together with the wiring diagram should give ample information for construction of one of these instruments. You will see that the parts are all fastened to a horizontal Formica panel measuring 7 by 10 in. 3/16 ins. thick, supported on four panel support pillars.

The arrangement of the instruments has been worked out very carefully. Notice that the rheostat is in front of the tube and in line with it. This puts the tube back out of the way so that it does not cause any interference when adjusting the rheostat or reading the instrument. The two voltmeters have been placed side by side in the rear as it is not necessary to refer to them after the filament and plate voltages have been checked up at the beginning of the test. This leaves the milliammeter in front by itself so that it is read instinctively without any mental interference caused by the presence of the two voltmeters. In addition this layout balances very well and makes the instrument attractive. The horizontal panel construction matches up with the receiver unit previously described, and with other instruments which will be taken up later.

The two Eby binding posts at the left are the XX posts. In the group of three, the left one is —A—B, the middle one is +A and the one on the right is +B. Since it is important that both the voltage applied to the filament and the B battery voltage be always of the same value as when the instrument was calibrated, two voltmeters have been included in the instrument. The filament voltmeter is a Weston model 301, 0 to 10 volts D. C. The plate voltmeter is a model 301, 0 to 100 volts D. C. with multiplier R. The plate current meter is a model 301, 0 to 50 milliamperes, D. C. An advantage of these instruments is that they can be placed either horizontally or vertically without affecting the calibration. The Kellogg No. 2 socket is supported to the panel by screws and two coil mounting pillars. The clips from a Daven grid leak mounting were removed from the base and fastened directly to the F and G terminals of the socket. A 2-megohm Daven grid leak, and .00025 mfd. and .005 mfd. Micadon were used. The 30-ohm General instrument rheostat is for fine filament control. The multiplier for the 0 to 100V. voltometer is fastened to the panel with four coil mounting pillars.

Two pillars at each side are held together by a screw. Either a Pawood or Stevens adjustable circle cutter can be used to cut the holes in the panel for the various instruments.

Possibly the simplest way to calibrate the instrument is to pass an alternating current through a potentiometer arranged for obtaining a variable voltage. The voltage for each setting of the slide arm can be read with an AC voltmeter. The source of alternating current can be an ordinary 60-cycle lighting supply. There is no need to doubt a calibration at low frequency, for with the .005 mfd. condenser connected as shown, the calibration will hold good for all frequencies as long as the same tube is used.

The calibration is made by observing and plotting the various readings of the milliammeter as the applied emf. is varied and measured. If the voltage to be measured does not exceed 2.5, the calibration curve is a straight line which cuts one of the axes.

Small changes in plate voltage affect the calibration less and less as it is increased, in fact if it is about 80 volts, a change of 4% in its value has no effect whatsoever. This is fortunate since, by using say 80 volts on the plate, the plate voltage can vary by two or three volts from this value, and the ordinary Eveready B battery can be employed. Moreover, with 80 volts on the plate, the filament voltage can be varied between about 3.6 volts and 4.2 volts with a change in calibration of only about 2%. So the ordinary storage battery is all right for a filament current supply for, by means of the rheostat, the filament voltage can be held at about 3.7 volts, making the life of the tube almost indefinite. Changing the grid leak from 2 to 4 megohms changes the calibration about 4% so that any slight changes in its resistance caused by atmosphere conditions will have no detrimental effect on the instrument.

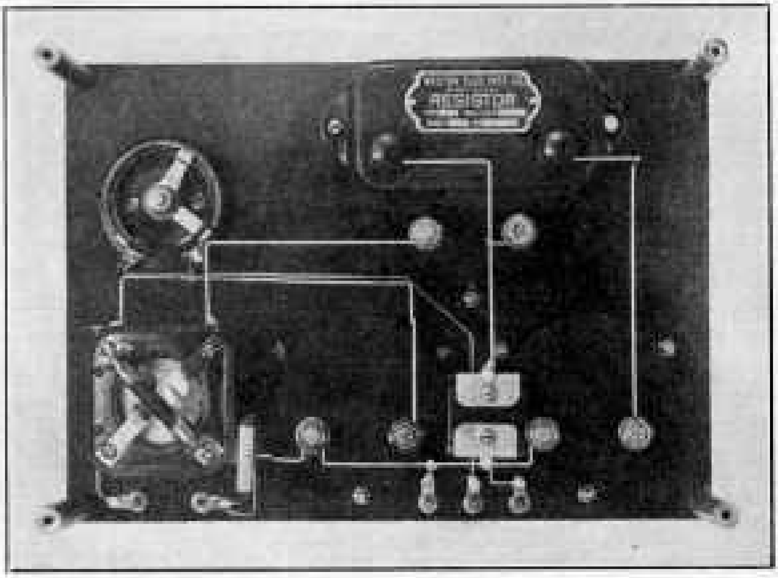

Fig. 3. Here is a view of the underside of the vacuum tube voltmeter

It is almost impossible to sit down and think of all the uses to which the voltometer can be put. A few of its uses in radio work, as applied to everyday laboratory testing will be mentioned. It may be used to measure the amplification produced by either audio or radio frequency amplification at any frequency by measuring the potential difference between the grid and filament of each tube. This makes it possible to ascertain the performance of an amplifier exactly since no load is put on the coil.

RADIO ENGINEERING

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Vol. V FEBRUARY, 1925 No. 2

EDITORIAL

JUDGING from the way rumors spread throughout the radio industry, from dealer to jobber to manufacturer and publishing house, with a speed that suggests simultaneous broadcasting, a lot of us must think we're back in the Army. The only difference is that rumors didn't really amount to much then, but now they make the difference between dollars and sense.

Right now we are being told that radio parts are not selling. Dealers, all of a sudden, have assumed the elbow-on-the-counter pose, and are sighing over the recent and very serious falling-off in parts sales. As usual, the dealer asks plaintively, "Why don't they buy?" instead of taking stock of himself by asking, "Why don't I sell?"

If parts manufacturers find their sales falling off, and their dealers complaining that parts won't move, it may be that sales have dropped, or that they are moving in disguise.

To expand — Parts must be sold. It isn't enough to put them out on the shelves, just as the manufacturer who simply offers a high quality instrument does only half the work that must be done to start repeat orders on their way. Nor is the manufacturer doing his part by displaying his wares in the advertising sections of newspapers and magazines.

In 1920, approximately one million dollars' worth of radio equipment was sold, bought by real experimenters who were doing more or less original and independent work. But the people who bought two hundred million dollars' worth of parts in 1924 are of a different class. They are novices, men and boys who, in most cases, made their initial attempt to assemble the wonderful this-circuit or that-circuit they read about. And, sad to relate, a very high percentage of the home-built sets, assembled from assorted parts, didn't work, nor did the dealer who sold the parts help much to straighten out the troubles. With certain exceptions, parts sales have dropped off, and for the very good reason that the sets built from them haven't been satisfactory. Why? Because the manufacturers haven't shown the set builders how to use the parts, because most magazine and newspaper articles don't give sufficient instructions, or purposely omit the names of the particular instruments which should be used, and because the dealer can't do the work that the manufacturers, the magazines, and the newspapers should do for him.

On the other hand, some parts are selling very well indeed because, through carefully planned advertising, publicity, and instruction booklets, set-builders have been shown how to use them successfully. An excellent example of this is the campaign of the Rauland Manufacturing Company.

Then there are the parts "moving in disguise." Dealers don't think of construction kits when they say "Parts are dead." If you think that radio sales are all on complete outfits, ask Acme Apparatus, Erla, Phenix, Freshman, and the other kit manufacturers, or try to get deliveries on the National units.

Companies making parts and materials must get them out in the form of kits, or sell the parts to other companies that do put out kits. Parts will be sold in greater quantities in 1925 than in 1924, parts will always be sold and in huge quantities, but an increasing proportion of them will be disguised as construction kits.

M. B. SLEEPER,
Editor.

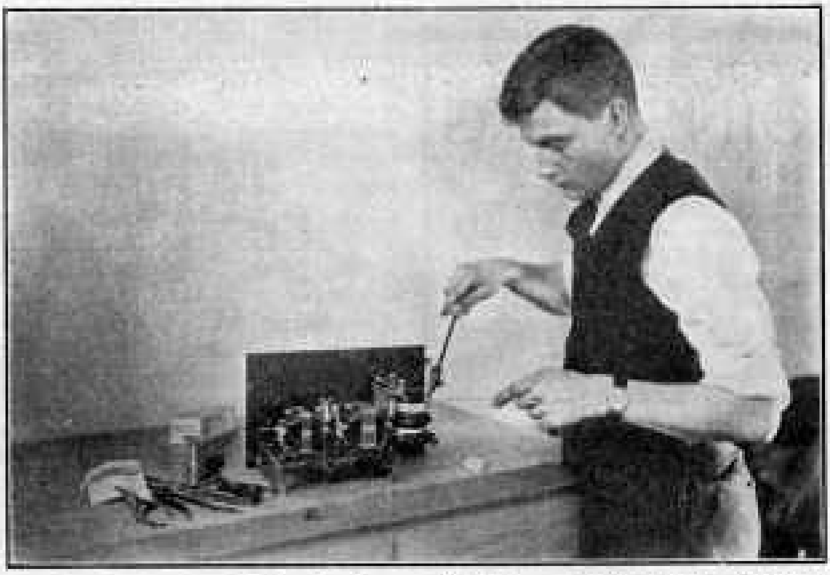


Fig. 1. Putting the finishing touches on the Rasla set at the Darien laboratory

Rasla Reflex-2

The popular two-tube Rasla Reflex makes a powerful, compact, and attractive set capable of operating a loud speaker

WE HAD read and heard so much about the new Rasla type two-tube receiver that we had to make up one for ourselves. After testing out the circuit thoroughly and making little changes here and there the problem resolved itself into the construction of a compact unit which could be easily built and used as a portable set if desired. The hardest job was to arrange the parts so that the wiring would be short and simple and yet preserve the high efficiency of the receiver. In presenting the type 7100 receiver we feel that all of the obstacles have been surmounted. The set is small, measuring 7 by 12 ins., by 7 ins. deep. At the Darien laboratory we brought in all of the broadcasting stations around New York City as well as many DX stations on the loud speaker. The set is extremely selective when used with an aerial about 60 feet long.

The Rasla Reflex Circuit The circuit employed in this set is not of the trick variety, but rather depends for its high efficiency on the correct design of the various parts. Referring to the schematic wiring diagram you will notice that the Rasla tuning unit consists of an untuned primary with a tap for use with long aerials, and a secondary coil tuned by a 0.0003 mfd. Cardwell variable condenser. The condenser tunes the entire secondary winding, but only part of the coil is included in the grid circuit. This increases the selectivity. Oscillations are controlled by a small two plate Rasla balancing condenser used in conjunction with the remainder of the secondary winding. This condenser also serves as a volume control. The first tube is reflexed to provide both radio and audio frequency amplification. The interstage Rasla radio frequency transformer is designed so that its impedance matches that of the fixed Rasla crystal detector, giving efficient coupling. The high ratio Modern A. F. transformer used in the first stage has a low primary impedance to match that of the crystal detector and provides the unusual kick peculiar to this circuit. A .00025 mfd. Micadon by-passes the radio frequency current around the secondary. The second stage of straight A. F. amplification uses a low ratio Modern transformer to prevent dis-

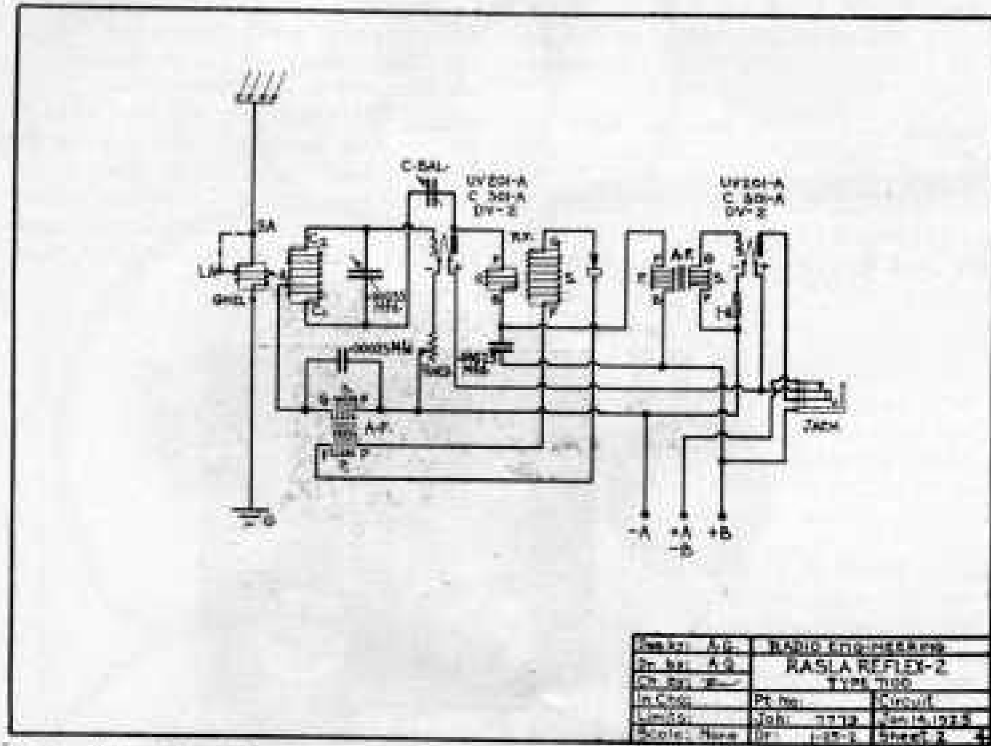


Fig. 2. Schematic wiring diagram of the circuit developed in the Davidson laboratory, called the Rasla-2

tortion. After very careful experimenting it was found that a 0.00025 mfd. Micadon connected across the primary of this transformer not only cleared up the reception greatly but also increased the volume. The filament current of the first tube is controlled by a 30-ohm Cico rheostat. An Amperite is used on the second tube. A filament control jack is employed as it does not complicate the wiring.

Design of the Receiver Much thought was given to the design of the set in an effort to make it compact and easy to construct without decreasing its efficiency. The front panel layout balances very well and is hard to improve upon. The tube panel is supported by two Benjamin panel support brackets. These brackets are essential in this set as the weight of the two A. F. transformers concentrated at the back of the panel is too great to permit of the use of the conventional angle brackets. The tube sockets are hung under the panel with coil mounting pillars and screws so that most of the wiring is below. These sockets are of white Isolantite and have sterling silver contacts. Aside from their high electrical efficiency, they present a very pleasing appearance when contrasted against the black panel material. The base of the R. F. transformer is also fastened under the tube panel. The mounting of the Amperite has been worked out so that it is fastened directly to the panel, and the terminal which goes to the socket is under the coil mounting pillar which supports the socket, thus utilizing it to convey the filament current to the contact spring. The right hand panel support bracket, looking at the set from the front, is used as part of the filament lead from the —A binding post to the rheostat. The antenna coupling coil has a separate binding post strip for the antenna and ground connections. This is supported on a coil mounting pillar. This scheme eliminates the long parallel leads which would be required if the binding posts were located on the tube panel. The variable condenser is fastened in the position shown so as to make the connections as simple as possible.

Standard Parts Required The panels may be either of Formica or Celoron. The front panel measures 7 by 12 ins., 3-16 ins. thick, the tube panel is 7 by 6⅜ ins., 3-16 ins. thick, and the binding post strip is 2 by ⅝ ins., 3-16 ins. thick. The instruments required are a Rasla tuner, fixed crystal detector, compensating condenser and knob, and type CR radio frequency transformer, a Modern 1 to 10 and 1 to 4 ratio A. F. transformer, two General Instrument Isolantite sockets, one Cico 30-ohm rheostat and knob, a pair of Benjamin panel support brackets, 1-A Amperite, Carter 3-spring filament control jack, six Eby or Marshall-Gerken binding posts, Cardwell 0.0003 mfd. variable condenser, two 0.00025 mfd. type 601G Micadons with grid leak clips, and one 4-in. Accuratune vernier dial. In addition there are the following standard small fittings: Five coil mounting pillars, thirty-five soldering lugs, twentytwo ½ in. 6-32 R. H. machine screws, and twenty nuts.

Drilling the Panels If you desire, you can scale off the location of the holes in the tube panel from the picture wiring diagram, as it is shown at exactly one-half size here. However it is easier to work from the full size blueprints. All of the screw holes in the tube panel are made with a No. 18 drill, and the holes through which the wires pass are made with a No. 27 drill. The holes for the sockets are 1¾ ins. diameter and the hole for the R. F. transformer 1⅝ ins. diameter. These can be easily cut with a Pawood adjustable circle cutter. This tool is inexpensive and is very useful around the laboratory.

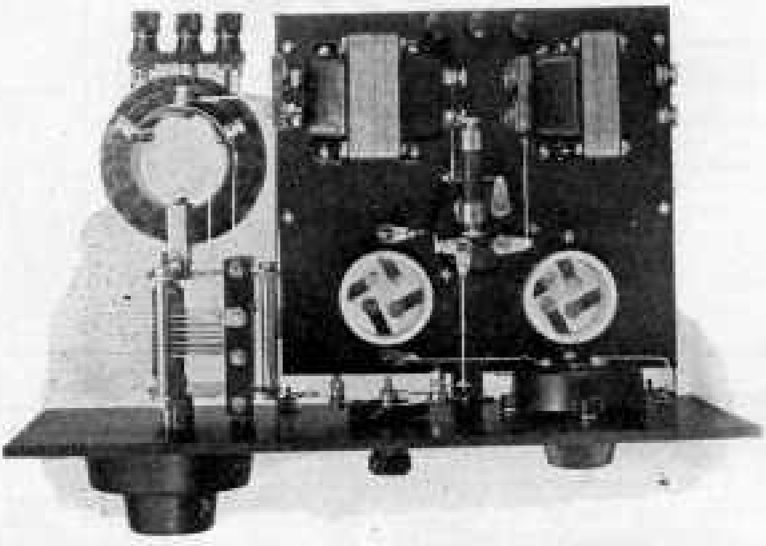


Fig. 3. The Benjamin mounting brackets helped us in working out an attractive mechanical design

Assembly and Wiring Fig 5 shows a picture wiring diagram of the set, in which the connections have been drawn exactly as they were arranged in the original receiver. The diagram is drawn looking up at the bottom of the set.

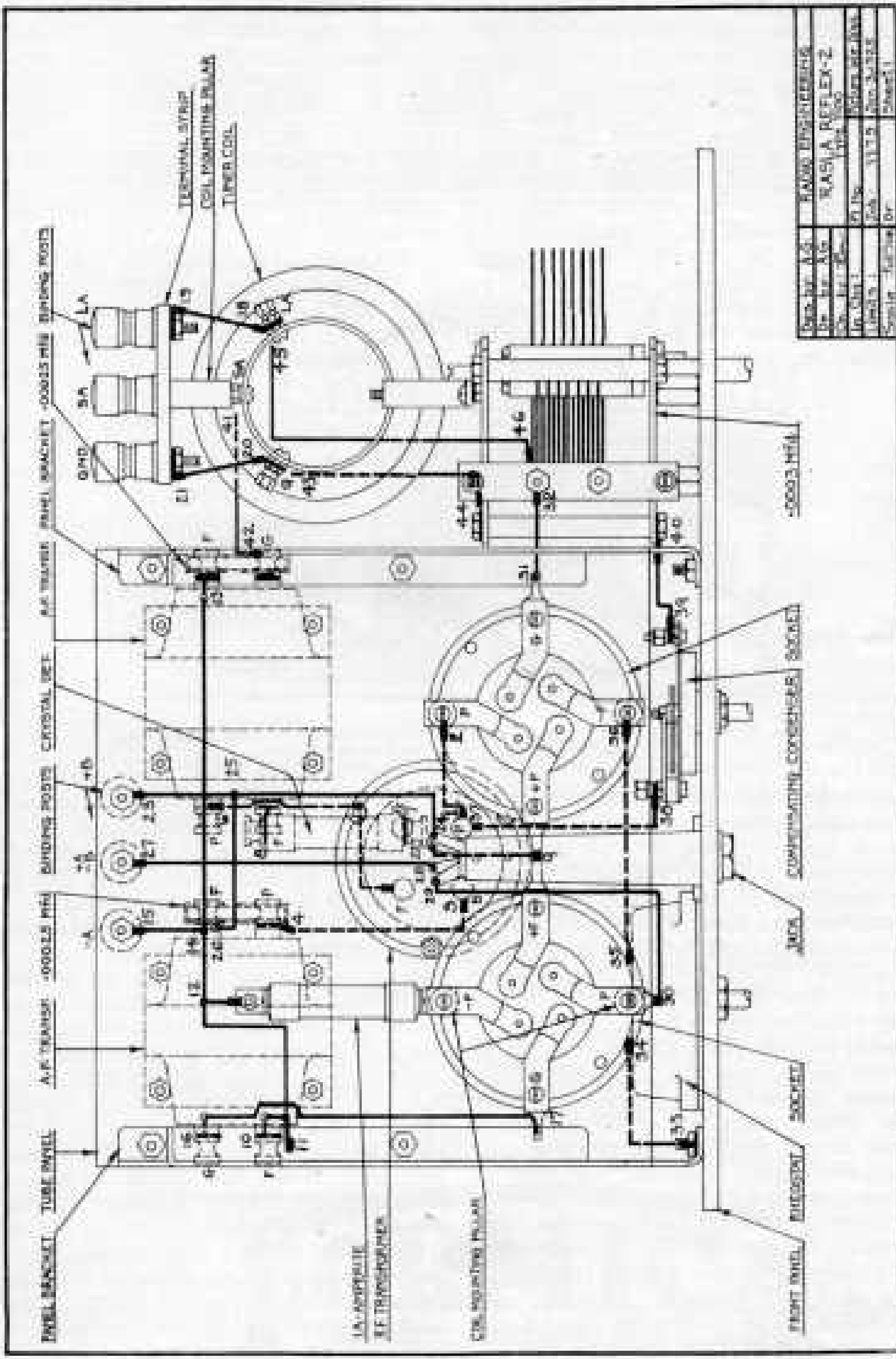


Fig. 3. This picture wiring diagram shows the set from the under side.

Place the lugs on the instruments as they are mounted, having them pointing in the directions shown by the short heavy lines in the picture wiring diagram and have nuts tightened securely. Spintite wrenches are very good for this work.

1. Put the R. F. transformer through the middle large hole in the tube panel and fasten its base to the panel with three ½-in. 6-32 R. H. machine screws and nuts. Be sure that the terminals are located correctly. Remove the two nuts from the P and —F terminals of each socket and put a coil mounting pillar on each screw instead. Now fasten the sockets to the underside of the tube panel by means of a ½-in. 6-32 R.H. screw threading into the coil mounting pillars from the top of the panel. Before fastening the left hand socket, remove the mounting clips from the base of the Amperite, and cut off the clips where they bend over the ends of the base. Mount one of these clips under the coil mounting pillar on the —F terminal of this socket so that when the screw is put in from the top of the panel the whole unit is clamped tightly together. Mount the other Amperite clip on the panel with one of the F. H. screws from the Amperite base. Snap the Amperite in place between the clips. Mount the three binding posts on the panel with the holes pointing to the back edge. Fasten the two Benjamin panel support brackets to the panel with the R. H. screws and nuts provided. Now mount the two A. F. transformers on top of the panel with ½-in. 6-32 R. H. machine screws and nuts. The 1 to 10 transformer, the one with the thick core, goes on the left, looking at the panel from the top-front. Flatten out the grid-leak clips on the two Micadons and mount one on the secondary of the 1 to 10 transformer and one on the primary of the 1 to 4 A. F. transformer. Fasten a soldering lug to the Micadon on the 1 to 10 transformer with a ½-in. 6-32 R. H. screw put through the front eyelet hole.

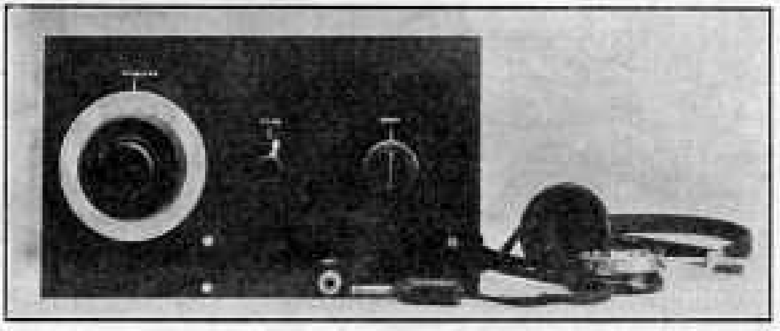


Fig. 4. All the tuning is done with the Accuratune dial, the center knob being for the control of regeneration only

2. On top of the panel, connect 1, the P. terminal of the R. F. transformer, to 2, the lug which is fastened to the P. terminal of the left hand socket, looking at the panel from the front. Connect 3, the B terminal of this transformer to 4, the P terminal of the 1 to 4 A. F. transformer. Connect 5, the F. terminal of the R. F. transformer to 6, the P terminal of the 1 to 10 transformer.

3. Put a lug on each terminal of the Rasla crystal detector.

4. Solder one lug 7, to the lug on the G terminal of the R. F. transformer. Solder the other lug 8, to that on the primary F terminal of the 1 to 10 transformer. These lugs may have to be twisted slightly in order to get the crystal detector straight. Now turn the tube panel upside down and connect the two +F lugs on the tube sockets together. This is connection 9. Connect 10, the secondary F terminal of the 1 to 4 transformer, to 11, a point on the panel support bracket. This wire runs through the small hole in the panel. Connect this same point, 11, to 12 and through the small hole in the panel to 13. Connection 12 is made to the lug on the Amperite terminal and 13 is the secondary

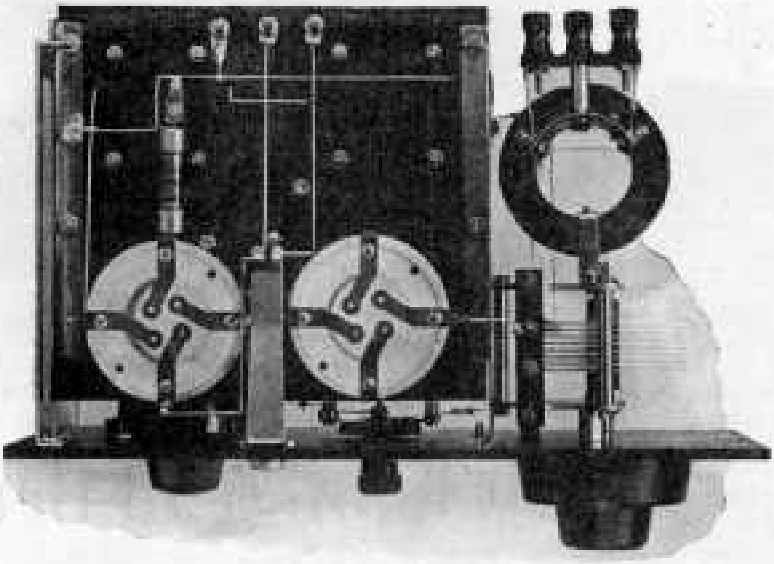


Fig. 6. The under side of the Rasla-2 is quite as neat as the top

F terminal of the 1 to 10 transformer. Connect 14 a point on this wire to 15, the —A binding post. Connect 16, the G terminal of the 1 to 4 transformer, to 17. Keep this wire clear of connection 11.

5. Mount the jack on the front panel, keeping the frame toward the bottom. Loosen the set screw in the knob of the compensating condenser, and take off the knob, pointer, lock nut, and washer. Fasten the condenser to the panel with the lock nut and washer, keeping the rotor plate terminal facing the side of the panel where the Cardwell condenser is to be mounted. Put on the knob and dial so that the dial is vertical when the rotor plates are halfway interleaved with the stator. Mount the rheostat on the panel, and fasten the knob so that the arrow points to the line on the panel when it is turned all the way to the left. Mount the two outside binding posts on the small terminal strip, putting a lug under each nut. Remove the outer nut from the SA terminal of the Rasla tuner and screw a coil mounting pillar on it. Now put the middle binding post through the terminal strip and screw this into the free end of the coil mounting pillar, keeping the strip parallel to the tuner coils. Mount the two legs of the tuner unit to the end plate of the Cardwell condenser, fastening them with ½-in. 6-32 R. H. machine screws threaded into the two holes which you will find in the end plate. It so happens that these holes in the end plate are spaced correctly for the mounting.

6. Connect the LA terminal, 18, of the tuner to the LA binding post, 19. Connect the GND terminal, 20, to the GND binding post, 21.

7. Mount the condenser and tuner unit on the front panel with the three flat head screws. Put the Accuratune dial on the shaft so that the 100 division line coincides with the line engraved on the panel when the condenser plates are totally interleaved. If you use the old style Accuratune you will find it necessary to cut off the shaft of the condenser just a little bit, so that the dial will fit flush up against the panel. Make sure that you press the dial on firmly before tightening the set screw for, otherwise, the cork friction disc will not hold. Remove the two binding posts from the rheostat and put on lugs and ordinary nuts instead. Fasten the front panel to the brackets on the tube panel with the four flat head machine screws provided. Make sure that the nut on the top screw

(Concluded on page 91)

Spark-Coil Windings for Better Radio Transformers

The helical windings used for Samson transformers were developed for spark coil, but this method has special advantage for radio use not found in the layer-wound coils

SEVERAL years ago the Samson Electric Company undertook the development of a combination ignition coil and spark plug for use on motor boats. The purpose of the devices was to eliminate high tension wiring which would break down when, in heavy weather, the engine and ignition system got wet. The necessity for making the ignition unit very small complicated the problem of winding coils which would stand up under the high voltage. Layer wound coils were unsatisfactory because of the high potential difference between the layers and the paper between layers increased the mechanical dimensions considerably.

To overcome these two difficulties, experiments were carried out on winding coils in vertical pies, one turn thick, instead of making them in horizontal layers. This work extended over a period of several years and, by the time the winding machine was perfected, there was no demand for the ignition units because motor boat engines had begun to use regular automobile ignition systems.

Then the Samson Company discovered that, in working on spark coil design they had produced an ideal type of radio transformer winding.

The helical winding machine is an exceedingly clever mechanism for it does a most unusual job in a very simple way. However, the action of it cannot be described intelligently without photographs and the details of the machine are not yet available. The effect of the winding method, however, is to produce a coil in the form of a continuous winding in which the turns form flat spirals, alternately wound from the inside out and the outside in. Some people have been under the impression that the coils were wound in the form of separate pies subsequently joined together. Actually, the winding is continuous, the spindles revolving at the same speed throughout the entire winding process.

As to the advantages of the system:

The difference in potential between pies is much lower than between layers in a layer-wound coil. Consequently, no paper insulation is required. In the Samson transformers, the coils are of average size but larger wire is employed than would be possible with paper insulation. Reducing the potential difference also decreases the capacity effect in the coils. A perfect transformer would have no capacity effect for, then, there would be no tendency to by-pass the audio frequency currents through the transformer instead of doing their work by following through one turn after another in the coil. This effect becomes very marked as the frequency increases. In reflex sets radio and audio frequency transformers are put in series and the radio frequency currents by-pass around the transformer without going through the windings at all.

The accompanying illustrations shows the Samson audio and long wave transformer, in which the helical windings are employed. The audio frequency transformers are at the right and the long wave and filter transformers at the left and center. The audio transformers, however, are not furnished with the super kit.

Altho these transformers go through a number of very elaborate tests as a part of the inspection and the maintenance of electrical and mechanical standards, the final tests are particularly interesting.

Samson audio transformers are not tested for short circuits, open circuits, or short circuited turns. Instead, each transformer is measured for the actual amplification it produces at audio frequencies. In this way an additional check is obtained upon the quality of the core iron, the insulation, and the winding of the coils. As a matter of fact, this is the only way to get a final and complete check upon an audio transformer.

The long wave and filter transformers are similarly tested. At the same time, while the amplification is being measured, an adjustable oscillator is employed by means of which the transformers are matched. On the bottom of each long wave transformer you will find a number written in pencil. This number indicates the setting of the oscillator condenser at which maximum amplification was obtained. On the condenser scale, 12 divisions represent a change of one kilo-cycle. Each transformer is marked with the condenser scale reading and, in this way, the transformers are matched and put into kits. Therefore, the matching is accurate to one-twelfth kilocycle.

Rasla Reflex-2

(continued from page 89)

on the right hand bracket has a tinned lug under it.

8. Turn the set so you are facing the bottom of the tube panel and connect 9, the junction of the F+ terminals of the sockets, to 22, the lower right hand tab of the jack. Connect 23, the +B binding post, to 24, the right hand tab next to the frame. Connect 25, a point on this wire, to 26, the primary F terminal of the 1 to 4 transformer. Connect 27, the +A — B binding post, to 28, the lower left hand tab of the jack. Connect 29, the remaining tab on the jack, to 30, the P terminal of the left hand socket. Connect 31, the G terminal of the right hand socket, to 32, the stator terminal of the Cardwell condenser. Keep this lead clear of the bracket. Turn the set right side up again and connect 33, the lug under the nut on the bracket, to 34, the outer terminal of the rheostat. Connect 35, the other rheostat terminal, to 36. Connect 37, the P terminal of the R. F. transformer, to 38 on the compensating condenser. Connect 39 to 40. 40 is a lug under the spacer rod of the Cardwell condenser. Connect 41, the —A terminal of the tuner, to 42 on the .00025 Micadon. 41 is shown as a free dotted line in the picture wiring diagram. Connect 43, the C1 terminal of the tuner, to 44 on the rear end plate of the condenser. Connect 45, the C2 terminal, to 46 the top stator terminal of the condenser.

This completes the assembly and wiring of the set. It will be well to check over every connection against the picture wiring and schematic diagrams as well as the illustrations.

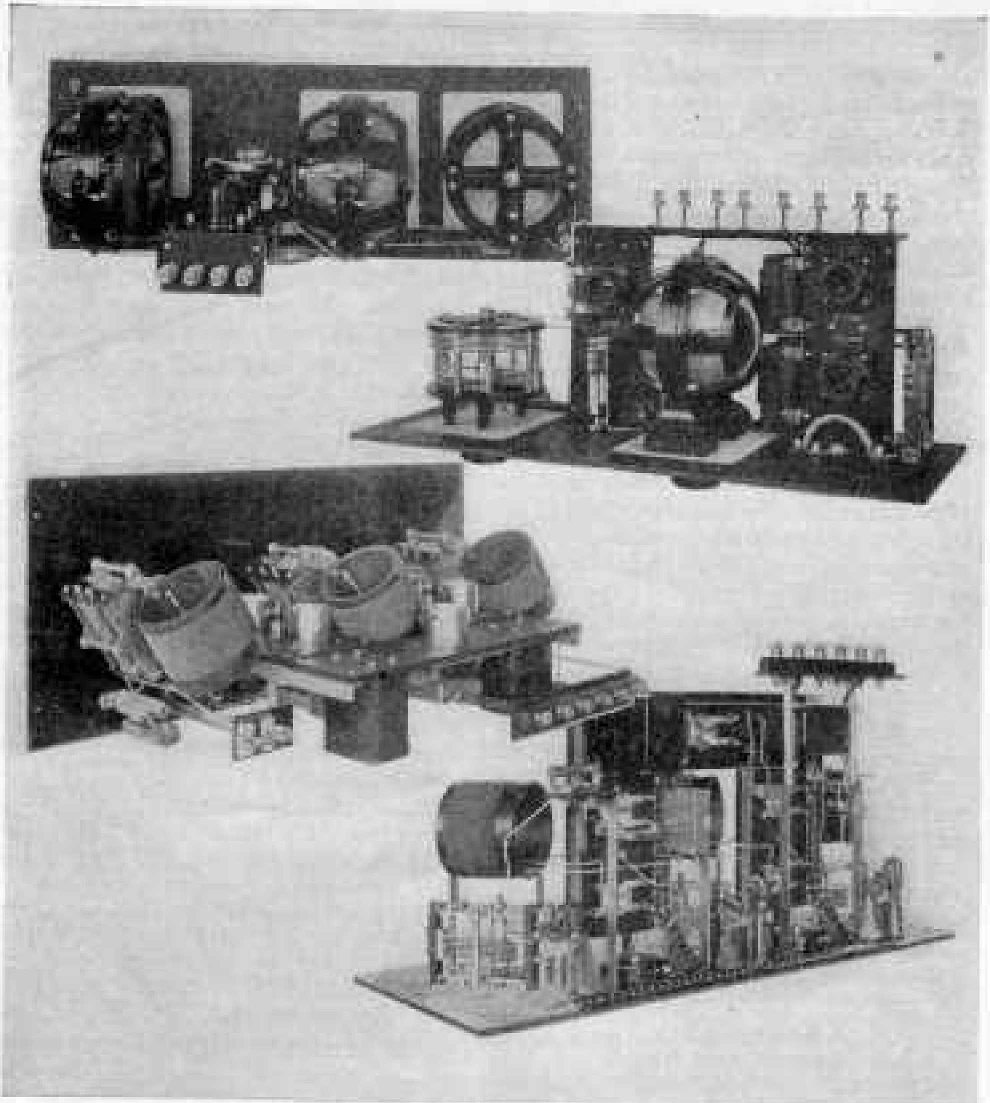


Fig. 1. Examples of sturdy designs as developed by Cardwell and Grebe

Are Standards Changing?

There seems to be a tendency toward flimsy, awkward designs, indicating a lowering of the standards set during the 1923 season

RADIO instruments are, by their nature, really precision devices. That is, they should be substantially designed so as to maintain themselves against long and hard use. It is necessary for them to be substantial mechanically, the insulation must be strong and permanent, they must not develop faults, the coils must be carefully wound, and the condensers must maintain their alignment. It is upon these factors that continued satisfactory operation depends.

Experienced designers of radio apparatus realize the importance of these points and, unless they are prevented from doing so by the policy of the companies employing them, make a conscientious effort to work out the details as well as the assembly in a creditable manner. Unfortunately, however, they are sometimes prevented from doing their best because of the unwillingness of the concern to make the necessary investments to produce good equipment on an economical basis. Moreover, there are many men designing radio equipment who are not familiar with the fundamentals of correct design.

Judging from the apparatus produced in 1924 and some of the 1925 models, the standards of design are being lowered or else there is an increasing amount of apparatus developed by inexperienced men.

Price competition may be responsible for this change. With the greater production and the increased resources of radio concerns it is hard to understand why they are not making better equipment today. Instead, so many of our receiving sets are flimsy mechanically, provisions for insulating are unsatisfactory, and a general impression of cheapness is most apparent. There are concerns, of course, who are simply capitalizing their present opportunities with the idea of getting out large stock issues, after which the present management will step out of the business but, fortunately, this is true only in specific instances.

It is rather alarming, for example, to see wooden panels and parts employed in radio sets. Wood is not satisfactory because it lacks permanence and the necessary insulating qualities, and is liable to cause trouble from splitting in transit or warping in use.

The accompanying illustrations show a few examples of really good design. In Fig. 1, at the top, are two Grebe sets. Comparing these with almost any of the outfits now found in radio stores the reasons for the foregoing remarks are quite obvious. The lower illustrations show some of the first Adler neutrodyne outfits built for that concern by Allan Cardwell. Of course, a great deal is to be expected from the Cardwell Company because one of their specialties is the manufacture of the Kolster decremeter and the Bureau of Standard's wavemeters, as well as precision instruments for the Western Electric Company. In Fig. 2 a special receiver, also from the Cardwell Company, is illustrated.

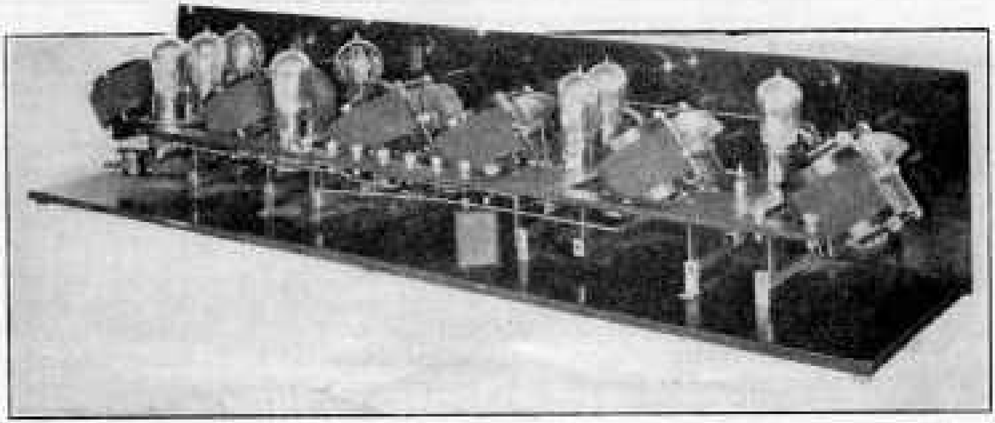


Fig. 2. This tuned intermediate frequency super-heterodyne from Cardwell's gives the impression of construction made to last

There is no reason why the standards of design should not be raised from year to year. In fact, manufacturers are bound to come to the realization that a great part of their service expense is a result of their failure or unwillingness to build quality and substance into their receiving sets.

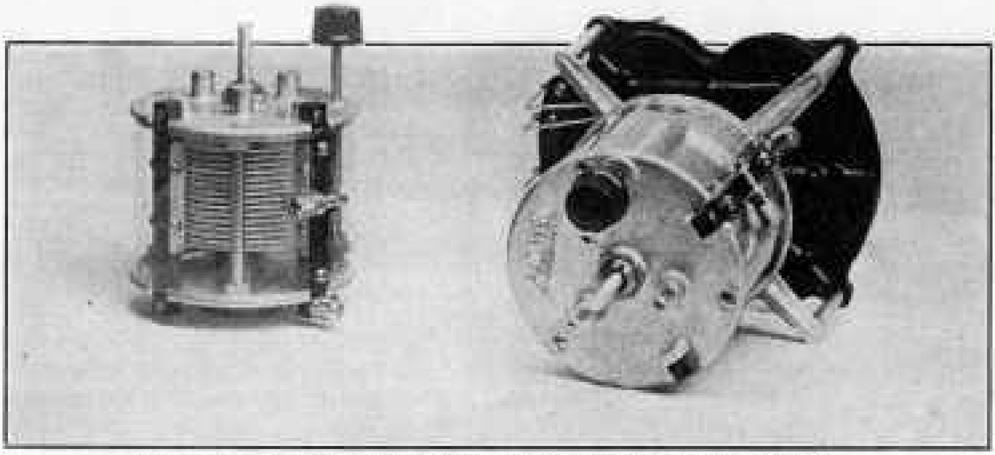


Fig. 1 The key instruments in the tuning circuits of the Cabot set

Cabot Circuit Receiver

While New York may be the radio center, Boston is producing a large share of the new things. Sewell Cabot, of the Acme Apparatus Company, is responsible for this remarkable inductance-tuned reflex receiver

Have you a long distance receiver? Easy, now before you answer, for you may have to alter your reply. Mr. Zwicker, of the Acme Apparatus Company makes a standing offer that he will pay ten dollars each night he does not hear the Pacific coast from Boston, receiving on a small loop, to anyone who will pay him ten dollars every night he gets across. Is your set that kind of a long range outfit?

The set Mr. Zwicker uses is the new Cabot reflex, developed by Sewell Cabot for the Acme Company. Mr. Cabot, by the way, is one of those rare engineers who can conceive that a certain thing is possible, and can then make the possibility an actuality. And, while he is very much of a theorist, he has surprised many of us who were inclined to criticize the design of the instrument upon which the success of the circuit is most dependent.

In Figs. 1 and 2 you will see the D-coil unit, a tuned R. F. transformer, mounted on the shaft of the variable condenser which tunes the loop. The unit comprises a rotor and stator, each carrying two D coils. One rotor and one stator coil are in series, serving as the primary, and the other rotor and stator coils form the secondary of the R. F. transformer. In Fig. 3 you will see that a fixed condenser of 0.0004 mfd., a special type of Dubilier Micadon, is connected across the R. F. transformer secondary.

Thus there is, in the tuning unit, a variable condenser working with the fixed inductance of the loop and a variable inductance working with the fixed capacity of the Micadon. A second variable condenser is put across the Micadon, but it is only for close tuning, to compensate for any inaccuracy in the tuning from the R. F. transformer secondary. The condenser is varied only a few degrees over the entire wavelength range. Therefore, this set is practically a mono-control outfit, since the second condenser is only used to bring the signals to the peak of intensity.

While the tuning unit is sold separately, for those who want to experiment with it, the complete construction kit is more interesting and much safer to use since the design for the set has been worked out with such great care. Every item necessary is included in the kit—front panel, base-board, tools, and all the other parts and devices. With no other kit are such full instructions given. There is a drawing which shows the exact dimensions and shape of each wire, so that the connections can be formed first and fitted to the terminals afterward. By careful planning, all butt joints have been eliminated. Consequently no soldering is required, although lugs are furnished for those who prefer soldered connections. The assembly instructions are arranged in steps following each other in similar to the familiar four-tube Acme reflex, except that only one tube is reflexed. You will note that one side of the reflex A. F. transformer is not connected. This is done purposely, because of the characteristics of the Sodion. The complete circuit provides one stage of tuned R. F., two stages of transformer

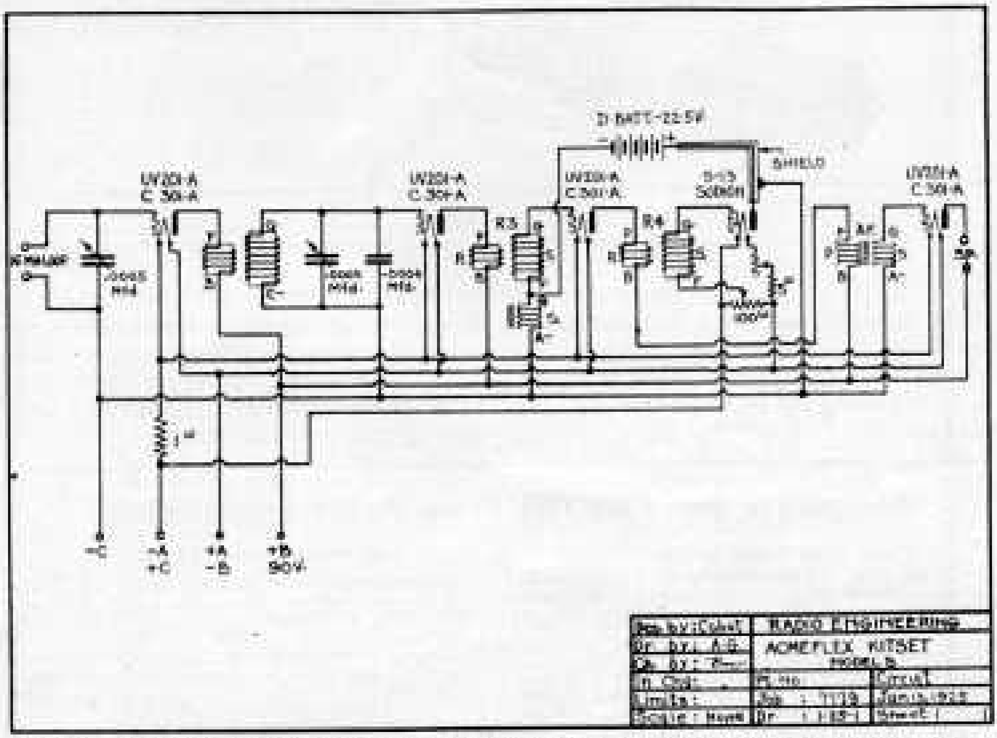


Fig. 3. Another innovation in this set is the use of an S-13 Sodion for the detector. This accounts in part for the sensitiveness of the set and the quality of reception

the proper sequence to make the work as easy as possible.

Another unique feature of this set is the use of an S-13 Sodion tube for the detector. In fact, the extreme sensitiveness of this set, as well as the excellent tone quality, is due to the Sodion. A standard socket with an adapter are provided in order that a UV201-A or DV-3 tube can be used as a detector. This is the first multi-tube set designed for an S-13 detector, although other concerns will probably arrange for its use as soon as the manufacturers can make further increases in their production schedule.

The amplifying part of the circuit is coupled R. F. detector, a stage of reflexed A. F., and a stage of straight A. F. amplification. UV201-A or DV-2 tubes can be used for the amplifiers.

No rheostats are provided for the amplifiers, the 1-ohm resistance in the -A lead being relied upon to regulate the current. While this is contrary to customary practice, it seems to work out in a satisfactory manner, although a rheostat would give a better control. Both a rheostat and potentiometer are used with the Sodion, because it is more critical than the amplifiers. The pot-rheo, or combination rheostat and potentiometer, is shown between the A. F. transformers

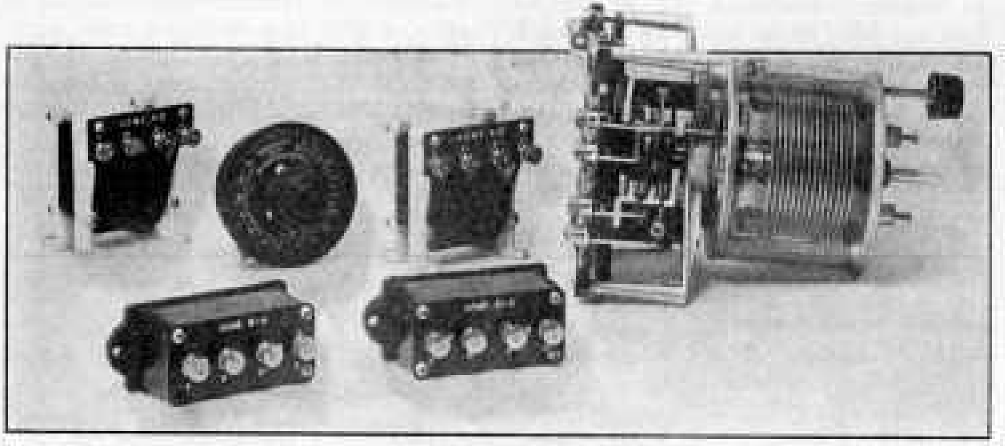


Fig. 2. The complete construction kit includes the A. F. and R. F. transformers, pot-rheo, tuning instruments, and every single item that is needed to complete the set

in Fig. 2. It is fitted with two concentric resistance elements and concentric shafts which move the two contact arms. By turning the smaller knob at the front the potentiometer can be regulated, or the rheostat adjusted with the larger one.

A construction article describing the assembly and operation of this set is now in process at the Darien laboratory. You will find it in the March or April issue of RADIO ENGINEERING, illustrated with photographs and diagrams.

Blueprints You Can Get From Radio Engineering

ONE-TUBE SETS

3 CIRCUIT REGENERATIVE RECEIVER, the famous X-1900 type, sharply tuned and very sensitive. 150 to 600 meters. Type X-1900, 3 sheets .... 75c.

REINARTZ RECEIVER, one of the most popular models ever described in Radio Engineering. A splendid set for all around broadcast work. Type 3300, 4 sheets.......... $1.00

ONE-TUBE REFLEX RECEIVER, using an Acme R-2 transformer and a crystal detector. Type 4200, 3 sheets.......... 75c.

TC CIRCUIT SET, a 2-control regenerative receiver exceptionally sharp and sensitive. Particularly adapted for indoor antennas. Type X-4000, 3 sheets.......... 75c.

IMPROVED RASLA REFLEX, unusually attractive in design as well as in the results produced. This set is also intended for a small antenna. Type 3900, 3 sheets.......... 75c.

HAYNES TUNER, known as the "One Thousand Miles for Fifteen Dollars" set. 2 sheets. .... 50c.

R-D-X REFLEX, brings in local stations on a loud speaker and distant stations with surprising volume. Type 6400, 3 sheets. 75c.

TWO-TUBE SETS

TUNED RADIO REFLEX, using fixed couplers tuned by variable condensers for maximum amplification. Type 5100, 3 sheets.......... 75c.

NO-LOSS REGENERATIVE RECEIVER, with condenser control for feed back. Equipped with 1-step AF amplifier. Type 6300, 3 sheets. .... 75c.

FOUR-TUBE SETS

BROWNING-DRAKE 201-A, using one UV199 and three UV201-A tubes, the 100% receiver, Type 6600, 6 sheets.......... $1.50

BROWING-DRAKE 199, using UV199 tubes thruout, designed for dry cell operation, Type 7000, 5 sheets.......... $1.25

DX RECEIVER, because of its high efficiency, owing to the use of tuned RF, this is one of the most popular sets ever described in Radio Engineering. Type 5300, 6 sheets.... $1.50

PORTABLE TUNED RF RECEIVER, similar in design to the Type 5300 set, but very compact and built for UV-199 tubes. Type 5800, 3 sheets.......... 75c.

4-TUBE REFLEX, with the standard Acme circuit in an improved design. Can be used with the Run-A-Radio battery substitute. Type 6500, 5 sheets.......... $1.25

AMPLIFIERS

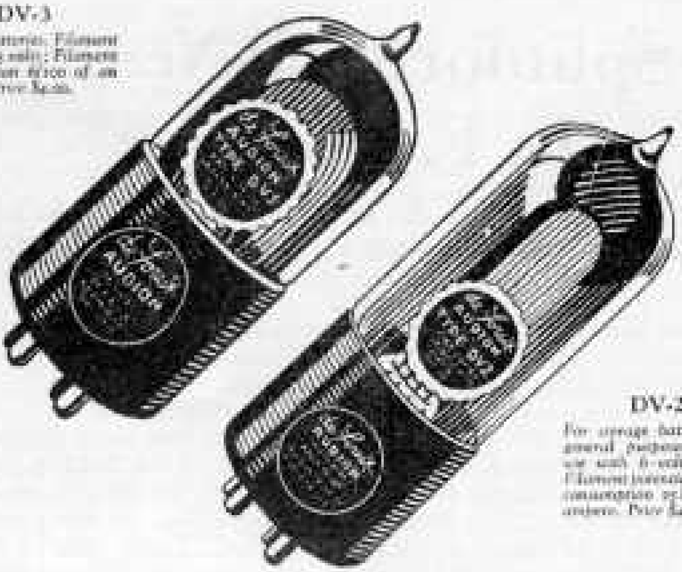
2-STEP AF AMPLIFIER, designed for use with any type of receiving set where additional amplification is required. Type 3100, 3 sheets. 75c.

4-TUBE AMPLIFIER, with one stage of transformer coupling and three stages of resistance coupling. Gives tremendous undistorted amplification. Type 6200, 3 sheets.......... 75c.

HAYNES AMPLIFIER, two stages AF. Can be used with any set, although it is designed particularly for the Haynes tuner, 2 sheets. .... 50c.

DV-3

For dry batteries. Filament potential 3 volts; Filament consumption 6/100 of an ampere. Price $4.00.



DV-2

For storage batteries. A general purpose tube for use with 6-volt battery. Filament potential 4½ volts; consumption 25/100 of an ampere. Price $4.00.

One radio trouble you can stop

YOU can't prevent static. You can't hold up your hand and stop interference from surrounding sets. These things affect the reproduction of the finest set made.

But you can see to it that your reception is not handicapped by imperfect tubes. You can make sure your tubes detect and amplify without distorting the sound that comes to them or adding to that sound the common tube noises.

De Forest Audion Tubes are the remedy for such radio and tube trouble. They transmit incoming sound waves clearly, accurately, with freedom from microphonic noises—rings, sings, and howls. De Forest Tubes reproduce exactly the richly soft beauty of the most delicate tones as well as the full volume of the strongest.

You have a right to expect De Forest Tubes to be all that good tubes should be. Lee De Forest, one of radio's greatest geniuses, invented and perfected them. His first three-electrode vacuum tube was the forerunner of all present-day tubes. With his tube he made modern broadcasting possible.

De Forest Tubes are economical of battery current, are constructed to withstand sudden current overloads, have standard bases, and can be used on all standard circuits. Try De Forest Tubes in your set and use them for experimental purposes.

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Jersey City, N. J.

DE FOREST TUBES

Reg. U. S. Pat. Off.

The "Magic Lamp" of Radio

The Splitdorf Self-Neutralized R. F. Receiver

In this five-tube set, the problem of neutralization has been attached in a unique manner incorporating many interesting mechanical features. Part 2

7. Fasten the binding post panel to the baseboard with the three 1-in. F. H. wood screws provided. Bend the soldering tabs on the jack so that they fan out giving room for a connection.

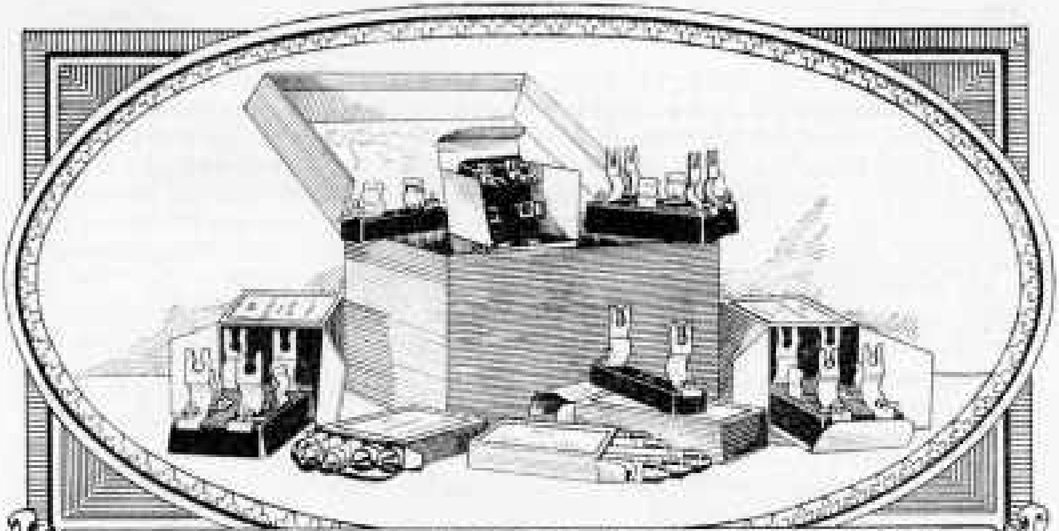
8. Bend a piece of bus wire in the form of a U and connect 13 and 14, the two outside springs of the jack together. The horizontal part of this wire should just clear the baseboard. Connect 15, the B Amp + binding post, to the middle point of this wire. Run the wire close to the baseboard and 1-in. from the edge. Connect 16, the Speaker + binding post to the second jack spring from the left, running this wire ¼-in. from the top of the baseboard and ¾-in. from the edge.

9. Mount the 1 mfd. by-pass condenser at the back edge of the baseboard flush against the binding post panel, using the two short R. H. wood screws provided. Mount the deck assembly in place using the four long wood screws, and brass spacers. The three tube sockets face toward the front panel.

10. Turn the set on end so you are looking at its left hand side. Connect 17, the front terminal of the A. F. transformer under the deck, to the fourth spring of the jack from the left. Connect 18, the other terminal of the transformer, to the second jack spring from the right. Connect 19, the lug on the end socket under the deck, to the third jack spring from the left. This completes the jack wiring. Connect the free end of the copper braided wire from 2, the left hand terminal of rheostat No. 2, to 20, a lug under the deck. Connect 1, the right hand terminal of rheostat No. 1, to 21 in the same manner. Connect 22, the left hand stator terminal of condenser No. 2, to 23, a lug under the deck. Use a piece of the flexible braided copper wire for this connection. Solder the 2-in. piece of bus wire sticking up from the Speaker—binding post to terminal 24, directly over it, under the deck. Do the same with the wire from the C Bat — post to 25, and from B Det + to 26. Connect the 4-in. wire from the B Bat — post to 27 on the deck, and 28, the left hand terminal of the 1 mfd. condenser. Make sure that this wire clears connection 26. Connect 29, the right hand terminal of this condenser, to the B Bat + binding post.

11. Mount the two radio frequency transformers, the shorter tubes, behind the 1 plate condensers, making sure that the two heavy-wire primary terminals face the binding post panel. Use the short R. H. wood screws put into the holes drilled in the baseboard.

12. Connect 30, the rotor terminal of 17 plate condenser No. 2, to 31 on R. F. transformer No. 2. Connect 32 on this same terminal to 33, a lug on the A. F. amplifier units. Use a piece of the copper braided wire for this connection. Connect 34, the right hand stator terminal of the same condenser, to 35, the front right hand terminal of R. F. transformer No. 2. Connect 36, the P terminal of the left hand socket, to 37, the rear right hand terminal of the R. F. transformer. Connect 38, a point on the wire connecting 29 and the B Bat + binding post, to 39 and 40. 40 is the rear left hand terminal of R. F. transformer No. 1. Connect 41, the G terminal of the left hand socket, to 42, the adjacent stator terminal of 17 plate condenser No. 1. Connect 43,



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For those who prefer to buy a complete Resistance Coupled Amplifier Unit rather than build. This unit comes ready to install—it is the neatest and most compact amplifier now offered to the public.

It is laboratory tested and represents the ultimate in amplifier design. The base is of molded Bakelite and is small enough to fit within any cabinet. All connections are hidden beneath the base.

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The assembly is very simple, while the satisfaction of having built such a perfect device yourself is beyond mere words to describe. Its volume is adequate for all purposes—its perfect tone quality and absolute lack of distortion place it beyond comparison.

These Kits can be purchased at all good Radio Stores—they come with complete instructions for assembly so that the novice will have the same success as would be expected of Radio Engineers. Sockets and mica fixed condensers are not included, but instructions are furnished giving complete information and diagrams. Supplied for either three or four stages.

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"The Aristocrat of Amplifiers"

a point on wire 10 to 12, to 44 and 45. 44 is the rotor terminal of the condenser and 45 is the front left hand terminal of R. F. transformer No. 1. Connect 46, the other stator terminal of the condenser, to 47. Connect 48, the P terminal of the right hand socket, to 49.

13. Fasten one terminal of the .00025 mfd. fixed condenser directly to the G terminal of this socket, placing a soldering lug under the same nut for a latter connection.

14. Connect 50, the other terminal of the fixed condenser, to 51, the Ant binding post. Connect 52, the A Bat + binding post, to 53, the right hand terminal of the filament switch. Keep this wire at the edge of the baseboard. Connect a piece of wire 5 ins. long at 54, the gird binding post, letting it stick up vertically.

15. Now mount the antenna coupling coil in the position shown.

16. Connect the other end of the wire from 54 to 55, the rear terminal of this coil. Connect the wire sticking up from connection 4, the rotor terminal of the 43-plate condenser, to 56, the right hand terminal at the front of the coil. Finally connect 57, the lug on the G terminal of the right hand socket, to 58, the stator terminal of the 43 plate condenser, to 59, the remaining terminal of the antenna coupling coil. Now put the three large dials on the condenser shafts making sure that the 100 mark coincides with the vertical line engraved on the panel, when the condenser plates are totally interleased. Put the two rheostat dials on so that the zero mark coincides with the line engraved on the panel when the shaft is turned all the way to the left. This completes the assembly and wiring of the set.

Testing and Operating. After the set has been wired, go over each connection, checking it against the picture wiring diagram. See that the filament switch knob is pushed in. Connect a 6-Volt A battery across the A Bat + and A Bat — binding posts. The A+ terminal on a storage battery is usually painted red. Insert the five tubes in the sockets, pull out the knob of the filament switch, and turn the left hand rheostat dial, looking at the set from the front, up to about 8. This should light the first and second tubes. Turn up the other rheostat knob. This should light the remaining three tubes. Leaving everything else in the same position, disconnect the A Bat + lead and connect it successively to the B Amp +, B Det +, and Bat + binding posts. The tubes should not light up for either of these connections if the set is wired correctly.

To put the set into operation, connect the + terminal of the battery to the A Bat + binding post. Connect the aerial and ground to their respective binding posts. Connect five 22½-volt, or two 45-volt and one 22½-volt Eveready B batteries in series. Connect the — terminal of the first B Bat — binding post. Connect the 22½-volt tap of the same battery from which the B— lead was taken off, to the B Det + binding post. Connect the + 67½-volt tap to the B Bat + binding post. Connect the + terminal of the last battery in the series, 112½-volt tap, to the B Amp + binding post. Connect the C Bat + and C Bat — binding posts together with a short piece of wire. Now connect the two cord tips from the loud speaker to the two speaker binding posts, the cord with the colored thread woven in it going to the Speaker + post.

Pull out the knob of the filament switch to turn on the tubes. Turn up the rheostat dials to about 8 and insert the phone plug in the jack. This should give a loud click in the phones. Set the three large dials at zero. Move the second and third dials in step one degree at a time, and for each of these settings rotate the first dial back and forth very slowly. Continue this process until a station is heard. Now readjust all three dials to get the best possible reception. Write down the name of the station and the dial settings. This station will always come in on the same setting provided the aerial and ground are not changed. By

Now try varying the B battery voltage on the detector, A. F. and R. F. amplifier tubes by using different voltage taps on the B battery. In each case use the lowest voltage consistent with good reception, as this increases the life of the B battery.


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The materials used to make up the set described in this issue were supplied by the following companies. The manufacturers whose names appear below will be glad to send you bulletins describing other products which they make. Please mention RADIO ENGINEERING when you write them.

COMPLETE PARTS FOR THE TYPE 7,000 BROWNING-DRAKE 199

Type No.	Name	Price
	Benjamin Elec. Co., Chicago, Ill.	
199	4-UV-199 Sockets	$4.00
	B. L. Sales Co., A-218 Fulton St., New York, N. Y.	
1-4	2-Modern transformers 1-4 ratio	10.00
	Carter Radio Co., G-209 So. State St., Chicago, Ill.	
101	1-Open circuit jack	.70
	Daven Radio Corp., 9-15 Campbell St., Newark, N. J.	
D	1-2-megohm gridleak	.50
	Diamond State Fibre Co., A-423 Broome St., New York, N. Y.	
	1-Mahogany Celoron panel 7 by 24 by 3/16 in.	3.94
	1-Mahogany Celoron panel 3½ by 23 by 3/16 in.	1.90
	Dubilier Condenser & Radio Corp., A-48 W. 4th St., New York, N. Y.	
601	1-0.0005 mfd. Micadon	.35
	H. H. Eby Mfg. Co., X-40 S 7th St., Philadelphia, Pa.	
Ensign	7-Ensign binding posts	1.40
	General Instrument Co., 423-G Broome St., New York, N. Y.	
40	2-30-ohm rheostats with dials	3.00
	James Goldmark Co., E-83 Warren St., New York, N. Y.	
W	1-100-ft. spool of Wirit	.90
	Mitchell-Rand Mfg. Co., 18-F Vesey St., New York, N. Y.	
7	1-Length special No. 7 varnished tubing	.15
	National Co. Inc., Brookline St., Cambridge, Mass.	
B-D	1-Complete Regenaformer kit, including two condensers, 2 coil units, hardware, and Velvet vernier dials	22.00
	New York Coil Co., 338 Pearl St., New York, N. Y.	
	1-0.00025 mfd. mica condenser with gridleak clips	.45
	Radiall Company, RE-320 W. 42nd St., New York, N. Y.	
UV199	1-Amperite and mounting for UV199	1.10
	Walbert Mfg. Co., A-931 Wrightwood Ave., Chicago, Ill.	
F	1-Filament lock switch	.50
	MISCELLANEOUS PARTS	
58	3-Pkgs. of 25 soldering lugs	.60
185	1-Left hand nickeled angle bracket	.10
14	3-Nickeled coil mounting pillars	.24
151	2-Terminal panel supports	.60
62	1-Pkgs. of 10 ½-in. 6-32 F. H. nickeled screws	.12
63	3-Pkgs. of 10 ½-in. 6-32 R. H. nickeled screws	.36
49	3-Pkgs. of 10 6-32 nickeled nuts	.24
	Complete set of parts	$53.15
	BROWNING-DRAKE 199 BLUE PRINTS	
7000	Set of full-size panel patterns and diagrams, 5 sheets	$1.25

Back Issues of Radio Engineering

If you have missed any issues of RADIO and MODEL ENGINEERING for this year, check over the following list and order those that you did not get so as to make your file complete.

January—Tuska Superdyne, 4-tube Monotrol, oscillating wavemeter......10c.

February—7-tube super-heterodyne set, Cockaday Receiver.

March-April—Portable tuned R. F. set using UV-199 tubes, Harkness circuit for Diode or crystal detector.

May—Improved Rasla reflex, the most successful 1-tube receiver ever built, 100-meter Sodion receiver.

June—Sodion reflex set using UV-201—A amplifier, the Bestone V-60, tuning filter for cutting out interference.

July—Resistance coupled amplifier, Tools for the radio model shop, Crystals that oscillate.

August—Construction of 4-tube No-Loss regenerative receiver, Description of the Boonton light four receiver, The R-A-R receiving circuit.

September—Out of print.

October—Improved design for Acme 4-tube reflex, Effective losses in inductances, Construction of Haynes audio amplifier, B. M. S. type super-heterodyne, Use of crystallizing lacquer.

November—Browning-Drake set for 201-A tubes, Die-castings in radio manufacturing, Assembly of the Melco R. F. receiver, Tools for the radio shop, Crosley Trirdyn 3R3, Inspecting telephone jacks.

December—Construction of the Ballantine receiver, Capacity measurements, Laying out instrument panels, Assembling the Silver-Marshall super-heterodyne, Standard receiver for testing, Super-heterodyne with Acme units.

January, 1925—Manufacture of variable condensers, Haynes transformer resistance amplifier unit, Condensers for laboratory tests, Coto symphonic receiver, Assembling the Splitdorf R. F. receiver, Part I, Making A. F. transformer amplification curves, Assembly of the Receptrad multiflex.

The price of these issues is 20 cents each. They will be sent promptly upon receipt of a check, money order, or stamps to cover the cost. Postage is prepaid.

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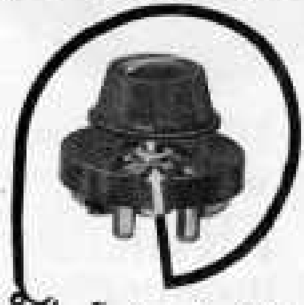

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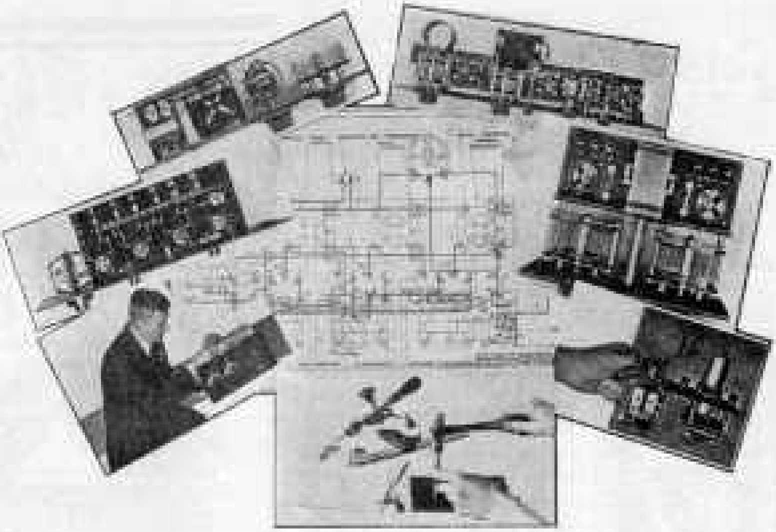
You know how the B. C. L.'s love to show off their factory-made sets, and the perfect line of excuses they've developed to explain their failures on the special nights when they promised to get everything. They think it's wonderful the way they can tune their sets.

But anyone can tune a set. It's nothing to be so proud about. The only man who has a right to swell out his chest is the one who built his outfit himself. That's something to talk about, and there is the real fun of radio. If you like to operate a set, you might as well have all the enjoyment there is in radio—build a set yourself. You will find that you can handle a receiver far more skillfully if you know about it from the inside out—and when the B. C. L.'s start gossiping about their store-sets you'll have something real to tell them about the outfit you made yourself.

As for your ability to make your own outfit, don't worry about that. The M. B. Sleeper books are your success insurance, for they take you thru each individual step of assembly with picture wiring diagrams, drawings, photographs, and detailed instructions.



Some Illustrations from the

RADIO SET-BUILDERS' BOOK

By M. B. SLEEPER

What to Build The sets described in this book were chosen from the various types which have been shown in Radio Engineering Magazine, and are the ones on which we have had the most favorable comments. They are the R-D-X, a one-tube reflex, the NoLoss two-tube regenerative, the new design Acme Reflex with four tubes, and the super-sensitive Browning-Drake four-tube set.

How to Build It: Each set is described in detail, with clear photographs, picture wiring diagrams, scale drawings, and step-by-step assembly instructions. It is also possible to get full-size panel patterns for these outfits if you want them. A special chapter gives in pictures all information about the panels and their preparation.

Parts Required: All the sets described are made of standard parts which you can obtain from your local radio store. You don't need special apparatus to make up the sets, or a machine shop to assemble them—just the simple tools which you probably have in your home right now.—Certainly, you can build your own set.

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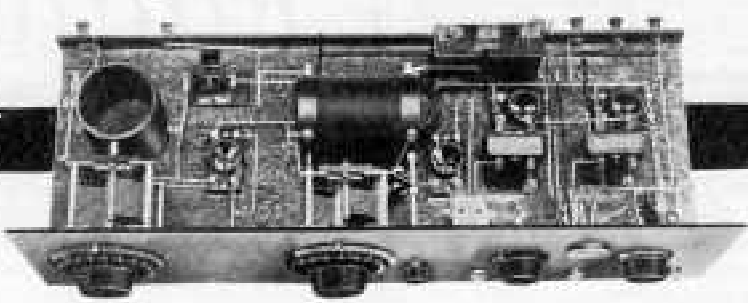

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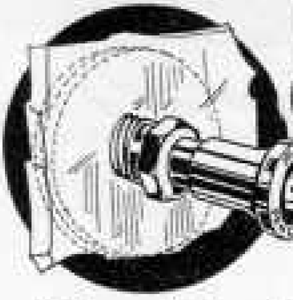

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Browning-Drake 199

(continued from page 79)

on the jack and 63 the second lug on the +90V binding post. Connect 64 to 65. 64 is the spring contact on the jack and 65 the P contact on the socket. Connect 66 to 67. 66 is a connection on wire 60 to 61, and 67 the second lug on the forward Amperite spring. Connect F post of the left hand transformer to the wire from 62 to 63 by a short lead put thru a hole in the tube panel.

This completes the wiring of the Browning-Drake 199 receiver.

Testing and Installation When the set is ready to install, put on the A battery first. The picture wiring diagram shows how the connections should be made. Either 4 volts or 6 volts can be used for the A battery, as the rheostats are of sufficiently high resistance to take care of it and the Amperite controls the R. F. amplifier current automatically. Insert the tubes and see that they light properly. Then put on the 4½ volt C battery. If everything seems to be O. K., put 90 volts of B battery across the —B and + 90V binding posts and bring off a tap at 45 volts to the +45 V binding post. Light the filaments and plug in the telephones or loud speaker. This should give a strong click. If the click is not clear, the plate circuit is open. You may find that the brilliancy of the filaments will change slightly when the B battery is connected but this does not affect the operation of the set.

At the Darien laboratory we find it very convenient to use the new Belden battery cable for the A and B batteries with the C battery mounted in the cabinet.

The antenna should be a single wire 50 to 100 ft. long from the set to the far end. An indoor antenna is quite satisfactory, made with annunciator wire or Talking Tape run around the wall. The ground connection must be made to a water pipe which has water in it at all times.

Set the tickler coil at right angles to the main winding and revolve the left hand condenser slowly while the other is turned back and forth. As soon as a station comes in, get accurate settings with the dials and increase the volume by turning the tickler coil.

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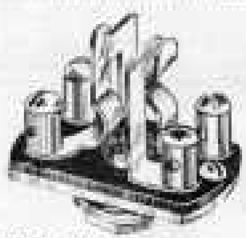

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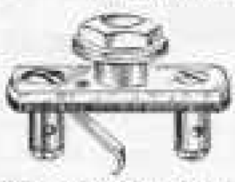

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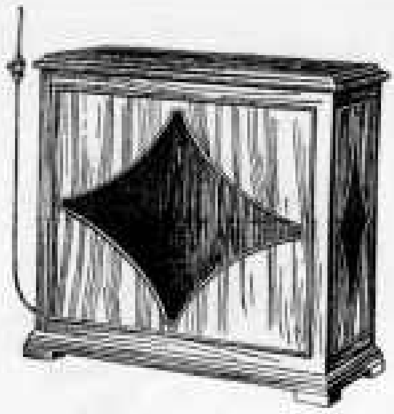

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Apply some NOKORODE and sal ammoniac.

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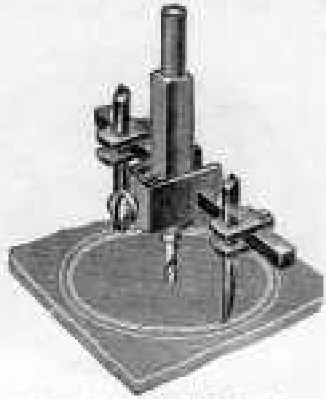

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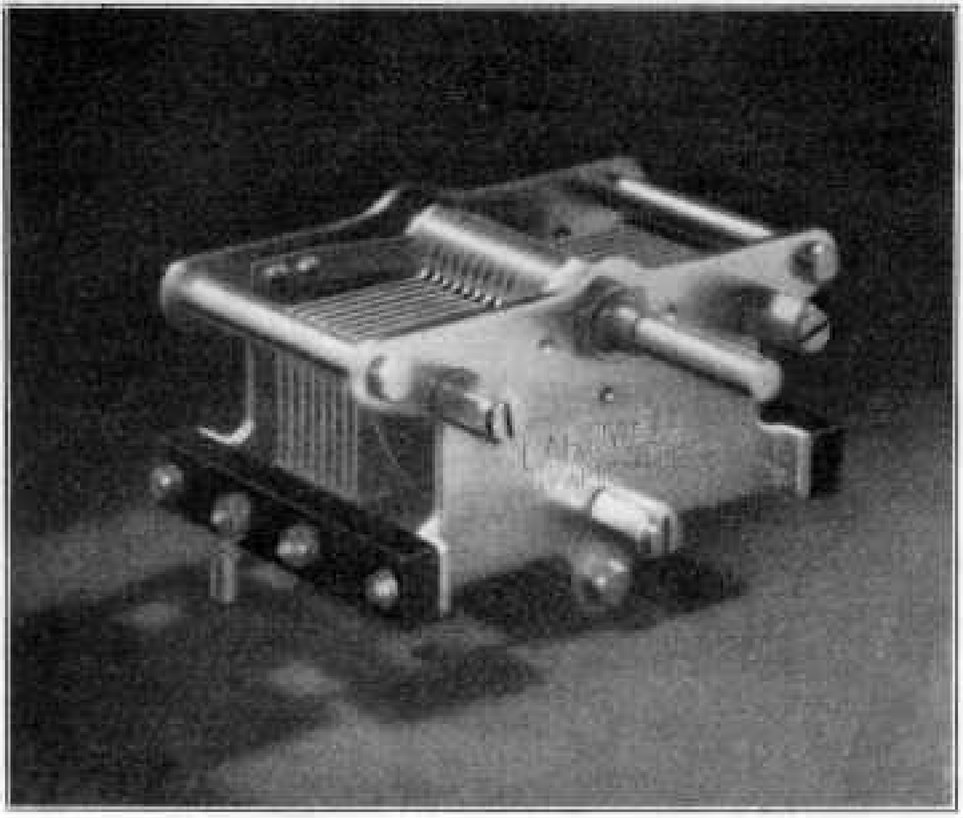

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