RADIO & MODEL ENGINEERING

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

Edited by M. B. SLEEPER

SPECIAL

SUPER-HETERODYNE

NUMBER

THE FIRST COMPLETE CONSTRUCTION DATA PUBLISHED ON THE SUPER-HETERODYNE. THIS SET IS EQUIPPED WITH THE NEW 30 K. C. TRANSFORMERS AND SEVEN UV-199 TUBES.

A COCKADAY RECEIVER OF NEW DESIGN, USING FULL CONTROLS IN THE LATEST CIRCUIT DEVELOPMENT.

BUILDING A MODEL 310-FOOT DESTROYER, THE START OF A SERIES WHICH WILL SHOW EVERY CONSTRUCTION DETAIL AND FEATURE.

20c a Copy—In England, 1/-

Vol. 4 No. 2

"THE AIR IS FULL OF THINGS YOU SHOULDN'T MISS"

EVEREADY "THREE," 4½ volts, three distinct uses. Length 4 in.; Width 1⅜ in.; Height 3 in.; Weight 14 oz. At all reliable radio dealers.

This "C" Battery is a Wonder Worker

YOU can make the loud speaker respond with a new fullness and naturalness of tone. You can save money by adding months to the life of your "B" Batteries. These things you can do by using the new Eveready 4½ volt "Three" as a "C" Battery.

You already have an "A" Battery for the filament and a "B" Battery for the plate. A "C" Battery is connected to the third element of your vacuum tube, the grid, affording a control that is marvelous in action on audio frequency amplifiers.

As a "C" Battery the Eveready "Three" prevents distortion and excessive flow of current from the "B" Battery, lengthening its life. It is a wonder worker that saves its small cost many times over. Connect it in your audio frequency amplifier and note the difference. Full directions on the label and in "How to Get the Most Out of Your 'B' Battery," a booklet on "B" and "C" Batteries, sent free on request.

This triple-use battery can also be used as an "A" Battery in portable sets. Light and full of pep. Its third use is as a "B" Battery booster.

Use the Eveready "Three"—a tested product of the world's leading electrochemical battery laboratory. It serves more radio uses and effects more economies than any radio battery heretofore developed.

If you have any battery problem, Radio Battery Information Headquarters will solve it for you. Write G. C. Furness, Manager, Radio Division, National Carbon Company, Inc., 130 Thompson Ave., Long Island City, New York.

NATIONAL CARBON COMPANY, Inc., New York and San Francisco

Headquarters for Radio Battery Information

CANADIAN NATIONAL CARBON CO., Limited. *Factory and Offices:* Toronto, Ontario

EVEREADY
Radio Batteries
—they last longer

7-TUBE SUPER-HETERODYNE

This set, incorporating several interesting features of mechanical and electrical design, is built to use UV199 tubes, operated from dry cells, altho, for greater volume, it can be changed to take UV201A tubes

Super-Heterodyne Set Design

The necessity for using a number of tubes to operate a super-heterodyne receiver brings in a very important problem of current supply. One extreme is a set using UV201-A tubes for amplifiers and UV200's for detectors. In that case a 7-tube set would require 3.25 amperes. With UV201-A's throughout, 1.75 amperes are drawn. Either combination requires a storage battery. The first will give the best results of all. The second calls for some sacrifice in volume. The third possibility is to equip the set with UV199's tubes, for then only 0.42 ampere is required. That can be taken care of by dry cells. At the same time, the volume is not nearly as great as when one of the other combinations is employed. In a super-heterodyne set, therefore, you must make up your mind to operate with small volume on dry cells or big volume with a storage battery. Designs for several super-heterodyne receivers will be published subsequently but, for a popular set to meet the requirements of the largest number of people, the outfit using UV199's seemed to be the first choice. Seven tubes were found to give a sufficient volume for ordinary requirements altho some Experimenters may feel that they must have another step of audio frequency amplification to bring the signal strength up sufficiently.

Standard Parts Required

The three panels are of Formica, one measuring 7 by 24 by 3/16 in. and two 3½ by 22½ ins. Clearance is left all around so that the set can be fitted into a cabinet made of ½-in. stock. A depth of 7 ins. is necessary to accommodate the rear panels. Three Malone-Lemmon condensers, of 0.0005 mfd. are needed. A less expensive condenser can be substituted for the filter but low-loss condensers of this type are advisable for the other two, particularly the one for tuning the loop. The filament control jack is a Carter No. 103. This disconnects the filament circuit when the telephone plug is removed. Three 30-ohm Raven rheostats control the filaments. A separate rheostat is required for each detector and one for the four amplifying tubes and the oscillator. It was originally planned to control everything from one rheostat but this did not seem to work out to the best advantage. The sockets are of General Radio manufacture, the binding posts from Eby Mfg. Co., and the knobs and dials from Kurz-Kasch. 2-in. Kurz-Kasch knobs were used on the Raven rheostats, in place of the knobs supplied, so as to give the front of the panel a symmetrical appearance. For transformers, there are three Acme 30 K. C.'s and one type AF6 Amertran. The 30 K. C. transformers are a new long wave design recently brought out by the Acme Apparatus Company, specially well adapted for super-heterodyne receiving sets. In fact, at the present time, they are the only satisfactory transformers available. Two Duo Lateral coils are used, one of 50 turns for the oscillator and one of 750 turns for the filter. In addition, two Dubilier condensers of 0.00025 mfd. are necessary for the grids of the detector tubes. In the construction of this set we simply put a little drafting ink across the terminals of the condensers to serve as leaks, but it is advisable to have regular 2-megohm gridleaks, such as those of the Daven type, for it is difficult to put on and take off the ink to give the correct resistance. This completes the list of standard parts employed. Other than these there are coil mounting pillars and terminal panel supports and Formica discs $2\frac{3}{8}$ ins. in diameter to clamp the Duo Lateral coils. This material can be purchased locally or by mail, so that there is no special work to do except with the screw driver, pliers, soldering iron, and drill.

Drilling the Panels

Because of the length of these panels it is necessary to make the drawings in two parts. Fig. 3 shows the left hand half of the front panel, Fig. 4 the right hand half, Fig. 7 the left hand halves of the tube and sub panels, and Fig. 8 the right hand halves. These drawings are all made exactly one-half size. To locate the correct position for the holes, measure on the drawing the distance from the bottom of the panel up to the horizontal center line, and from the end of the drawing to the vertical center line. Double these distances and lay them off in the same way on your panel. Where the lines cross make a mark with a center punch. Be sure that the panels that you get are absolutely square and true so that they will not throw you out in marking off your panels. Two sizes of holes are required, No. 18 for all the holes not marked and 15/32-in. for the shafts of the condensers and rheostats and the telephone jack. Some of the holes are marked with concentric circles. These must be countersunk to take flat head screws.

Winding the Coils

As you will see from the illustrations, two coil units are required, one for the oscillator and one for the filter. These are made up of Duo Lateral coils around which an additional winding is put on. They are mounted by Formica discs fastened to coil mounting pillars.

The oscillator unit consists of a 50-turn Duo Lateral coil. This is the inductance in the grid circuit of the oscillator. Around the coil a strip of gum paper is put on, over which 20 turns of No. 24 S. S. C. wire (22 SWG) are wound. The ends of the winding are held in place by strips of gum paper $\frac{1}{8}$-in. wide, put on right around the Duo Lateral coil and the extra winding. That coil is for the plate inductance.

Another strip of paper is put around the plate inductance on which the 4-turn coupling coil is wound. The terminals for this coil should be diametrically opposite the terminals for the plate coil. These leads, too, should be secured with narrow strips of gum paper.

Referring to Fig. 2, the ends of the Duo Lateral coil are run to terminals 26 and 27, the coupling coil to A and B, and the plate coil to C and D. It does not make any difference in which direction the coils are wound or the polarity of the windings except for the plate coil. These must be determined experimentally when the set is finished.

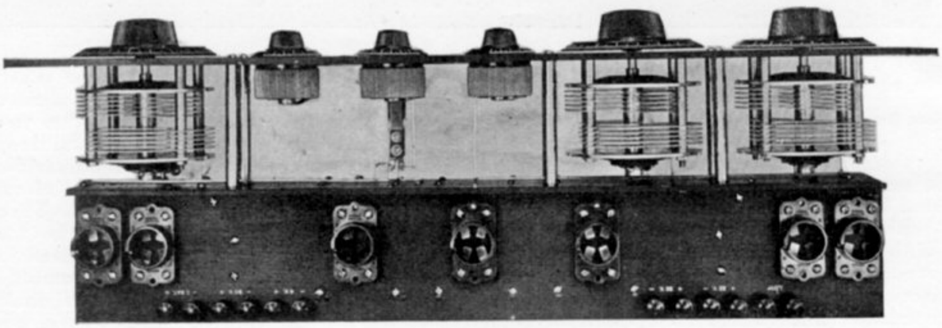


Fig. 5. Looking down upon the set you can see the new and very interesting arrangement for the instruments

The filter coil is a Duo Lateral of 750 turns, covered with a strip of paper on which 35 turns of No. 24 S. S. C. wire are wound. Narrow strips of paper are wound over the coils at four places to keep the turns from slipping off at the edge. Leads from the Duo Lateral are brought to the coil support pillars 43 and 45, while leads from the outside winding run to E and F which are fastened to the upper mounting disc.

General Assembly Instructions

Remember that wherever a connection is made there is a number, and if there is no number no connection should be made. If you are not sure to which terminal a number belongs, refer to the assembly instructions and you will find that it is explained. If you have not had experience with bus bar wiring you will find it worth while to actually test each bend to make sure that it is absolutely at right angles for, otherwise, your wiring will not look attractive and you may get into trouble because wires will touch where they should not. If you use paste for soldering, do not put on

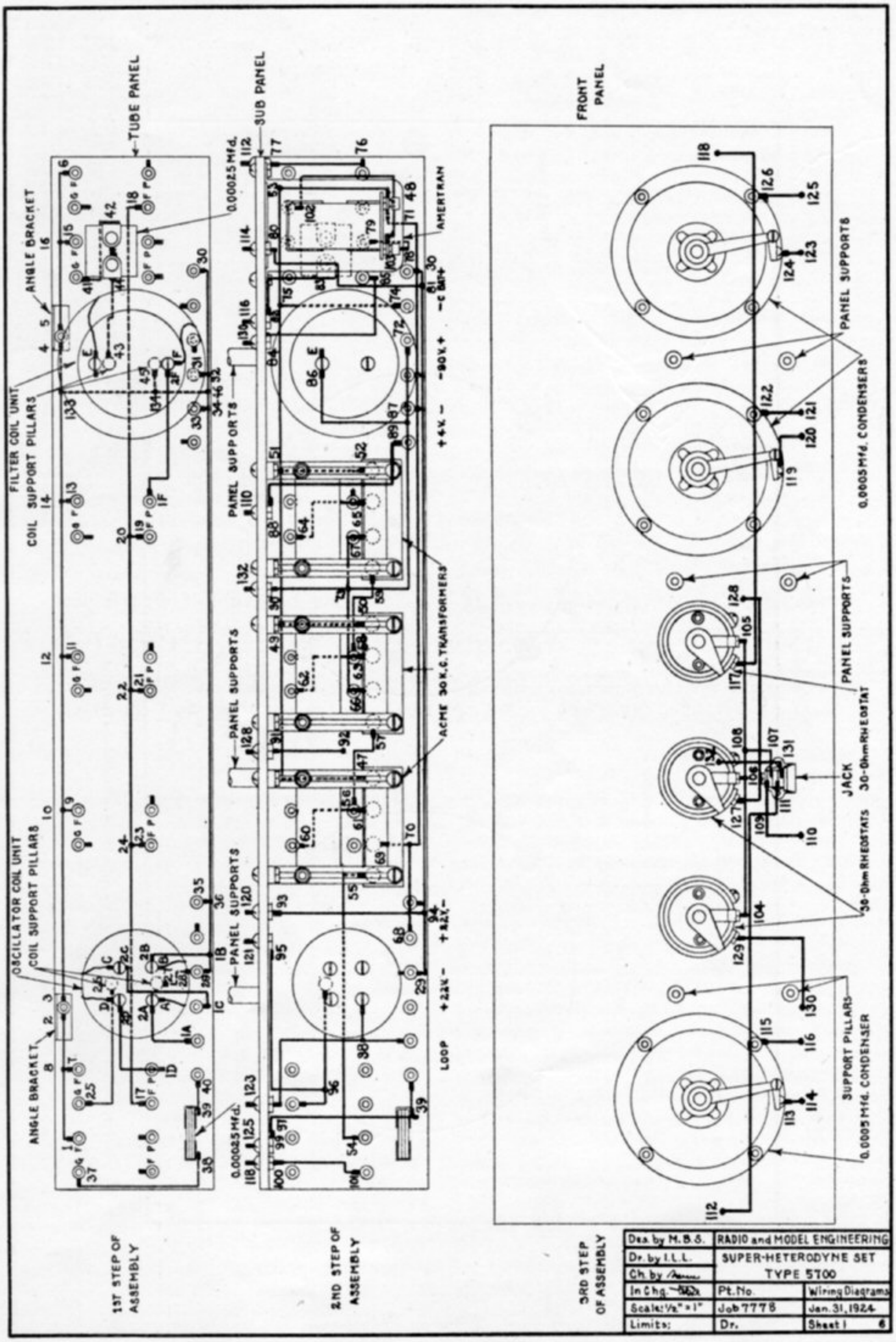


Fig. 2. Picture wiring diagram of the Super-heterodyne set, showing the connections as they are actually made on the set

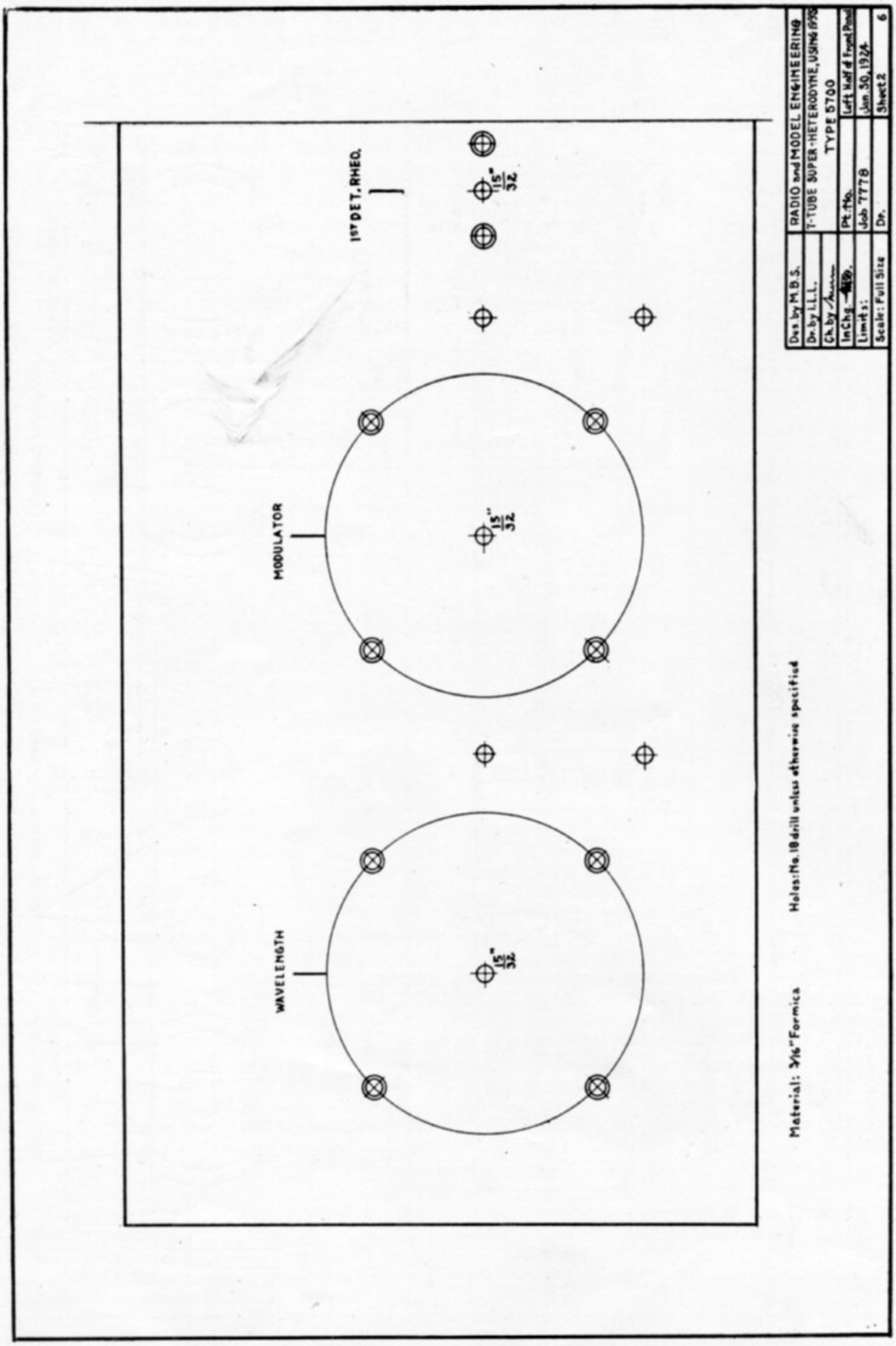


Fig. 3. Left hand half of the front panel, shown at one-half scale

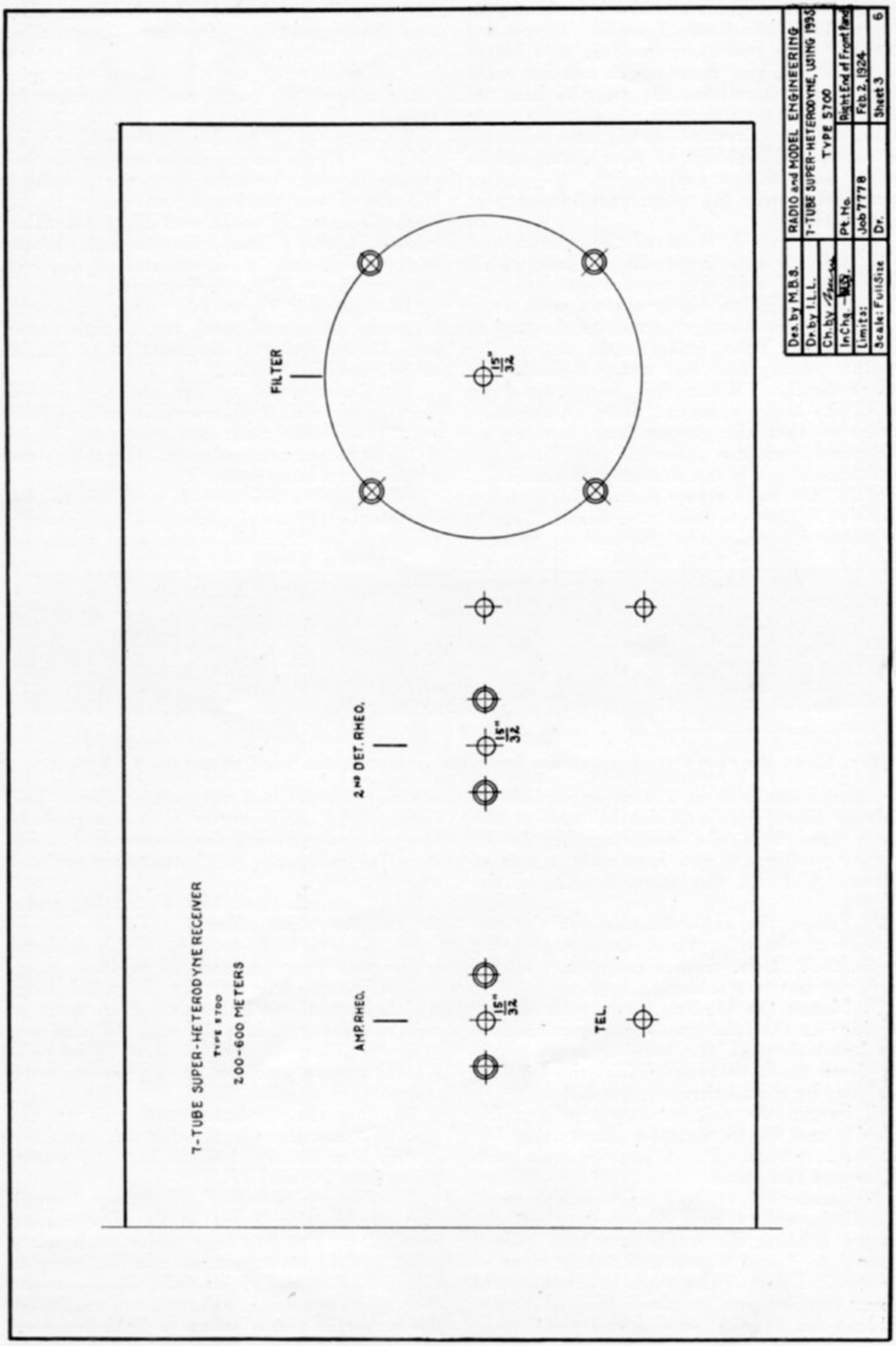


Fig. 4. One-half scale drawing of the right hand half of the front panel

any joint more than would be necessary to cover thinly the head of a pin. If you are familiar with rosin core solder, it is better to use it but you must watch out for rosin joints; that is, where the wire is held by the rosin but no connection is actually made with solder. Proceed slowly and with all the care and patience at your command so as to have this a perfect job. A poorly made set is only too often unsatisfactory in operation.

First Step of Assembly

1. Remove the screws and nuts from the sockets which hold the contact springs. Replace those screws with 1-in. 6-32 R. H. screws, put in from the top of the socket. Then, underneath, put on the contact spring and one nut. Tighten this screw firmly. When this has been done to all the sockets, mount them on the tube panel so that the connections, looking at the panel from the underside, will be in the position shown in the first step of assembly, Fig. 2. On each screw put a soldering lug and nut. Tighten these nuts firmly using a Spintite wrench. The Spintite is recommended because it is almost impossible to tighten these nuts sufficiently, and at the same time hold the soldering lug in its proper position, if you have only a pair of pliers. Cut off the extra length of the screws.

2. Fasten the angle brackets to the underside of the tube panel as shown, using ½-in. 6-32 R. H. screws and nuts. Under each nut put two soldering lugs.

3. Mount the binding posts with soldering lugs on the tube panel. Be sure to have the holes through the binding posts pointing from front to rear. Hold the binding post top by a nail through the hole.

4. Fasten the coil mounting pillars, 26, 27, 43, and 45, to the tube panel using ½-in. 6-32 screws. Put a lug between each pillar and the panel.

5. Connect 1 to 2, 3 to 4, and 5 to 6. 2 and 3, and 4 and 5 are lugs on the screws holding the angle brackets. Keep wires 1 to 2 and 5 to 6 sufficiently clear of the vertical part of the angle bracket so that a nut can be put in place for the screw holding the bracket to the sub panel.

6. Connect 7 to 8, 9 to 10, 11 to 12, 13 to 14, and 15 to 16. These connections are actually made between the long wires and the lugs without the use of connecting wires.

7. Connect 17 to 18. Keep this wire close against the panel and run it right by lugs 19, 21 and 23.

8. Connect 19 to 20, 21 to 22, and 23 to 24. These connections are made between the lugs and the long wire, without the use of any connecting wires.

9. Connect 25 to 26 and 27 to 28. Terminals 26 and 27 are under the coil mounting pillars, and 28 is on one of the two lugs on the —22V. binding post.

10. Connect 29 to 30. Keep this wire close to the panel and run it right over lugs 32, 34 and 36. Connect 31 to 32, 33 to 34, and 35 to 36.

11. Connect 37 to 38, and 39 to 40. Terminals 38 and 39 are made to lugs held to the 0.00025 mfd. condenser by ½-in. 6-32 R. H. screws and nuts. Two lugs are required on connection 39.

12. Connect 41 to 42, and 43 to 44. Terminals 42 and 44 are soldered directly to the 0.00025 mfd. condensers, while 43 is a lug on the coil mounting pillar. This condenser must be mounted just as close to the panel as possible for, otherwise, it will interfere with the A. F. transformer later on.

13. Connect 45 to 46. 45 is a lug under the coil mounting pillar.

14. Connect 133 to 134. 134 is soldered to the wire running from 45 to 46.

15. Fasten one of the Formica discs which have three holes drilled in them to coil mounting pillars 26 and 27, and another to pillars 43 and 45. Use ½-in. 6-32 R. H. screws and put a lug under each screw.

16. Put the oscillator coil unit on the disc first mentioned. Solder the terminals of the Duo Lateral coil to lugs on screws going into 26 and 27.

17. Put ½-in. 6-32 R. H. screws through the four outside holes in the disc having five holes. Put two lugs under each screw head. This arrangement can be seen in Fig. 1. Put a 1½-in. 6-32 R. H. screw through the top and bottom discs and fasten the screw in place, so as to hold the discs and clamp the coil unit, with a 6-32 nut underneath. If you have trouble holding

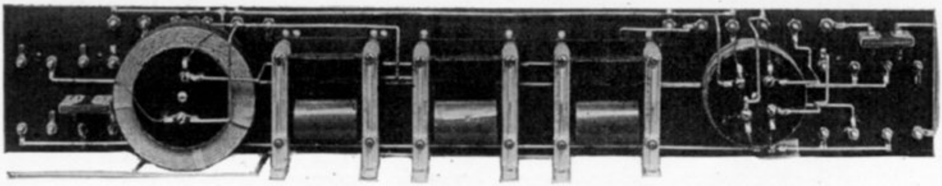


Fig. 1. In the rear view you can see the arrangement of the parts under the tube panels

this nut in place, wind the end of a short piece of wire around the nut and hold it with the wire until you get the screw started in it. Do not tighten this screw too much or it may cause short circuits in the Duo Lateral coil. Bear this in mind also when you mount the other coil unit.

18. Solder the leads from the inside winding to lugs C and D and from the coupling or outside winding to lugs A and B.

19. Connect 1A to 2A, 1B to 2B, 1C to 2C, and 1D to 2D. Terminals 2A, 2B, 2C, and 2D are the second lugs on the screws on the Formica disc.

20. Put the filter coil unit on the other disc and connect the ends of the Duo Lateral coil to lugs on the screws going into pillars 43 and 45.

21. Put ½-in. 6-32 R. H. screws in the two outside holes in the Formica disc, with two lugs under each screw head. Fasten the screws with 6-32 nuts on the under side. Put this disc on top of the coil unit and secure it with a 1½-in. 6-32 R. H. screw and nut passing through the center holes.

22. Connect the leads from the outside winding to lugs E and F and connect 1F to 2F.

This completes the first step of assembly.

Second Step of Assembly

1. Fasten the six panel support pillars to the sub panel with ½-in. 6-32 F. H. screws. These can be seen in Fig. 5.

2. Mount the three Acme transformers and the Amertran on the sub panel, using ½-in. 6-32 R. H. screws. The Acme transformers should be mounted so that the terminals are down when the panel is in the position shown in Fig. 2, and the Amertran so that the P and G binding posts are toward the Acme's. Put lugs on the terminals of the Amertran and on the Acme transformers with the exception of terminals 61, 63, and 65. On the three terminals mentioned the thumb nuts should simply be tightened firmly.

3. Put on the interpanel connection screws 118, 125, 123, 121, 120, 128, 132, 110, 130, 116, 114, and 112. These are ½-in. 6-32 R. H. screws with nuts. One lug is required under the screw head and under the nut of each one. All lugs on the front point up, while at the rear they point in the direction shown.

4. Connect 47 to 48, 49 to 50, 51 to 52, and 66 to 67. Terminals 47, 50, and 52 run to the A— post on the transformers and 48 is the F— post on the Amertran. Terminals 66 and 67 are the B+ terminals on the Acme's.

5. At point 53 cut the wire running from 47 to 48. This will be soldered together again later.

6. Remove the clamping screws at the tops of the Acme transformers and put them in the opposite way. Instead of using nuts to hold these screws put on coil mounting pillars. You can see this arrangement in Fig. 6. Do this carefully, one screw at a time, for the cores are made in two pieces separated by an air gap which must not be altered.

7. Put the sub panel on the tube panel, fastening them together with screws put in the other holes in the angle brackets. Use ½-in. 6-32 R. H. screws cut off enough so that they do not interfere with wires 1 to 2 and 5 to 6. Here, too, you may have to hold the nuts in place with a piece of wire.

8. Remove the sub panel from the Acme transformers, leaving the Amertran fastened to the sub panel and the Acme transformers fastened to the tube panel. That is the reason for cutting the wire from 47 to 48.

9. Connect 54 to 55, 56 to 57, and 58 to 59. Terminals 54, 56, and 58 are P terminals on the sockets and 55, 57, and 59 P posts on the transformers.

10. Connect 60 to 61, 62 to 63, and 64 to 65. Terminals 60, 62, and 64 are G posts on the sockets and 61, 63, and 65 G posts on the transformers. Connections on the transformers are not made to lugs but to the screw heads behind the terminal panels.

11. Connect 68 to 69, and 72 to 73.

12. Put the sub panel in place again, fastening it to the Acme transformers and angle brackets. Solder wire 47 to 48 together again where it was cut at point 53.

13. Connect 70 to 71. Terminal 71 is the B+ post on the Amertran.

14. Connect 74 to 75 and 102 to 103. 102 is the G post on the last socket and 103 the G post on the Amertran.

15. Connect 76 to 77, and 78 to 79. Terminal 77 is an interpanel connection, 78 is the P post on the Amertran and 79 the P post on the next to last socket.

16. Connect 80 to 81. Terminal 80 is an interpanel connection and 81 a connection to the wire from 29 to 30. Connect 82 to 83. Terminal 82 is an interpanel connection while 83 is on the grid condenser, soldered at the same point as 44. Connect 84 to 85. Terminal 84 is an interpanel connection and 85 the F post on the socket. Connect 86 to 87. 87 is soldered to the wire running from 72 to 73. Connect 88 to 89. Terminal 88 is an interpanel connection and 89 the +4V. binding post. Connect 90 to 73. Terminal 90 is an interpanel connection. Connect 91 to 92. Terminal 91 is an interpanel connection and 92 a connection made to a wire, not shown in the second step, running from 17 to 18.

17. Connect 93 to 94. Terminal 93 is

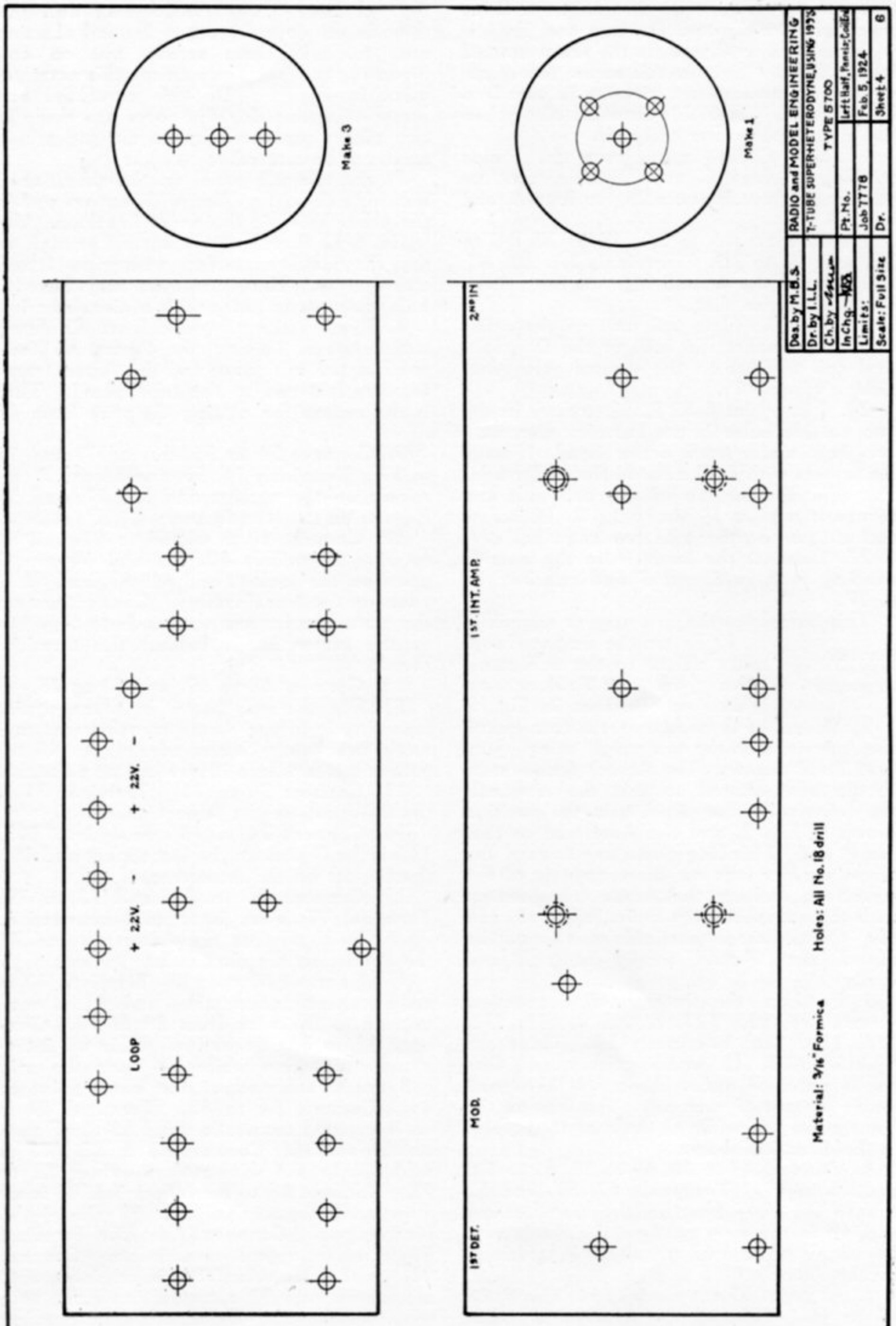


Fig. 7. Half-scale drawing of the left hand half of the tube panel and sub panel, as well as of the clamping discs

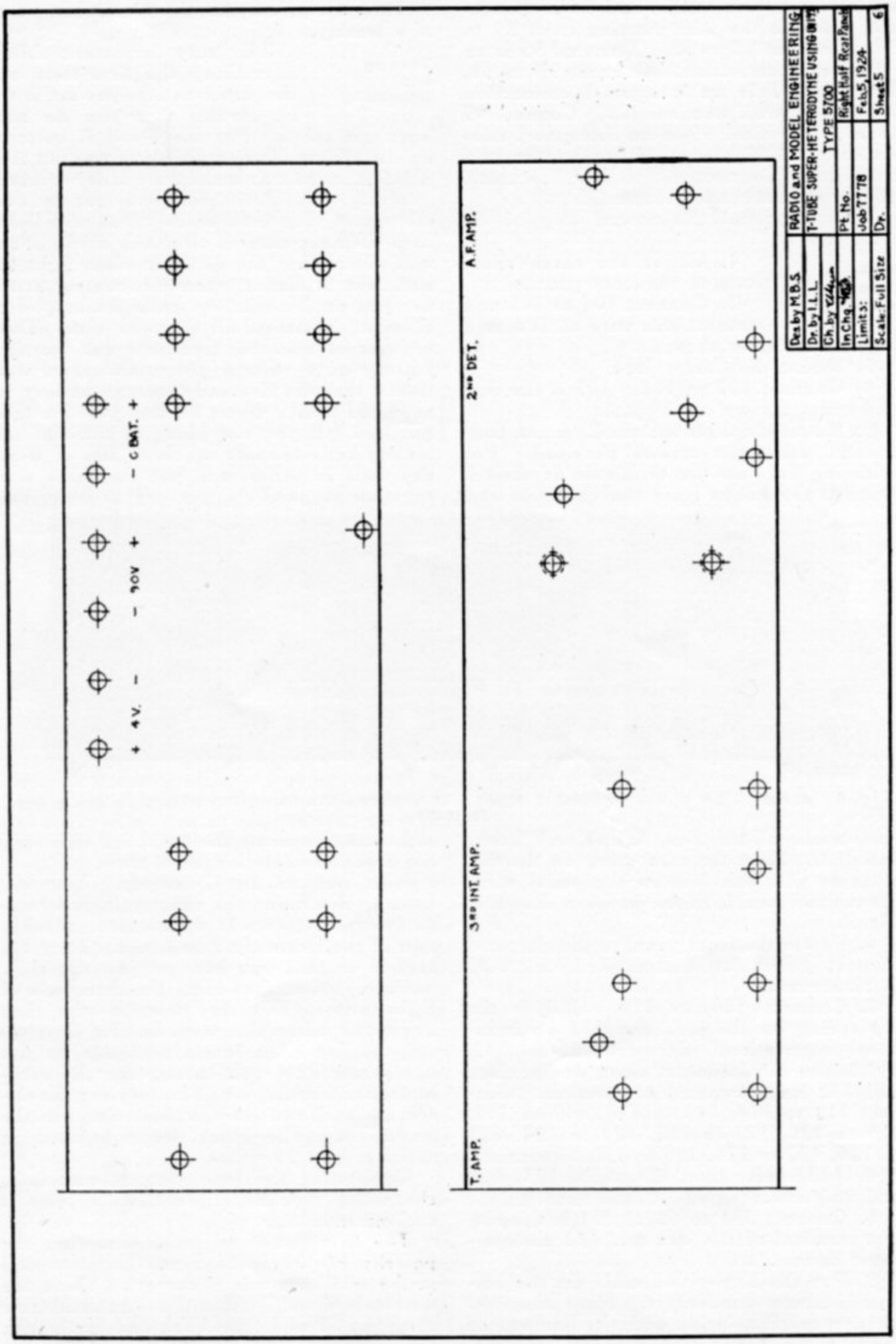


Fig. 8. Half-scale drawing of the right hand half of the tube panel and the sub panel. All dimensions should be doubled and transferred to the panel

an interpanel connection and 94 a connection made to the wire running from 29 to 30. Connect 95 to 96. Terminal 95 is an interpanel connection. Connect 97 to 98. Terminal 97 is an interpanel connection which goes with terminal 123. Connect 99 to 39. Terminal 99 is an interpanel connection and 39 the other lug on the grid condenser. Connect 100 to 101. Terminal 100 is an interpanel connection.

This completes the second step of assembly.

Third Step of Assembly

1. Mount the three rheostats on the front panel.

2. Connect 104 to 105 and connect this wire at 106 to a lug on the center rheostat.

3. Mount the Carter jack.

4. Connect 107 to 108. 107 is the second contact down on the jack.

5. Mount the three Malone-Lemmon condensers using the screws provided. Put soldering lugs on the terminals as shown. Remove the knobs from the rheostats and put on instead the 2-in. Kurz-Kasch knobs and dials. Have the zero mark on the dial coincide with the line on the panel when the contact arm is in the position shown in Fig. 2.

6. Fasten the front panel to the six panel support pillars by means of ½-in. 6-32 R. H. screws.

7. Connect 109 to 110. 109 is the top spring on the jack and 110 an interpanel connection. Connect 111 to 112. 111 is the third contact down on the jack and 112 an interpanel connection. Connect 113 to 114, 115 to 116, 117 to 118, 119 to 120, 121 to 122, 123 to 124, 125 to 126, 127 to 128, 129 to 130. Terminals 114, 116, 118, 120, 121, 123, 125, 128 and 130 are interpanel connections.

8. Connect 131 to 132. 131 is the bottom terminal of the jack and 132 an interpanel connection.

9. Put the knobs and dials on the Malone-Lemmon condensers. Have the 100 division mark coincide with the line on the panel when the plates are totally interleaved.

This completes the third and last step of assembly.

Testing and Operating

The very important thing in making the first tests on the super-heterodyne set is to be careful that you do not burn out tubes. Put the 4-volt A battery on the proper binding posts and test out the filament circuit to make sure it is working properly. It is necessary to put in the telephone plug before the tubes will light as a filament control circuit is used. You will notice that the detector tubes light to sufficient brilliancy when the contact arms are just on the winding while the amplifier rheostat is almost all the way out. This set can be operated from a 6-volt storage battery or 4 volts if you wish. You will notice that the Eveready storage battery is provided with a 4-volt binding post for this purpose. If you are going to run the set on dry cells connect up three sets of 6-in. dry cells in series, and put the three sets together in parallel. Six dry batteries are sufficient to operate the set at full efficiency for a considerable length of time.

Next put on the C battery. You will have to determine the exact voltage by experiment but you will want one or possibly two of the Eveready 3 batteries. They are tapped so that you can get just the right voltage. After that come the three sets of B batteries. You may wonder why they are arranged in this way, but for best results it has been found advisable to use a separate 22½-volt battery for the oscillator, another 22½-volt battery for the detectors and two 45-volt batteries for the amplifiers. The latter are connected in series to give 90 volts.

Connecting the loop antenna completes the set-up. A Ritter or Lincoln loop is recommended.

The first test is to make sure that the polarity of the leads from the plate coil in the oscillator unit is correct. These are terminals C and D. Put the filter condenser at about 50 and tune back and forth with the wavelength and modulator condensers

(Concluded on page 46)

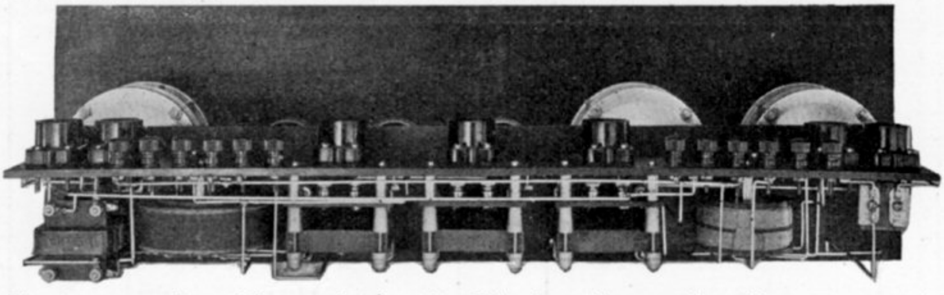


Fig. 6. A rear view of the completed outfit. This shows the mounting pillars on the transformers

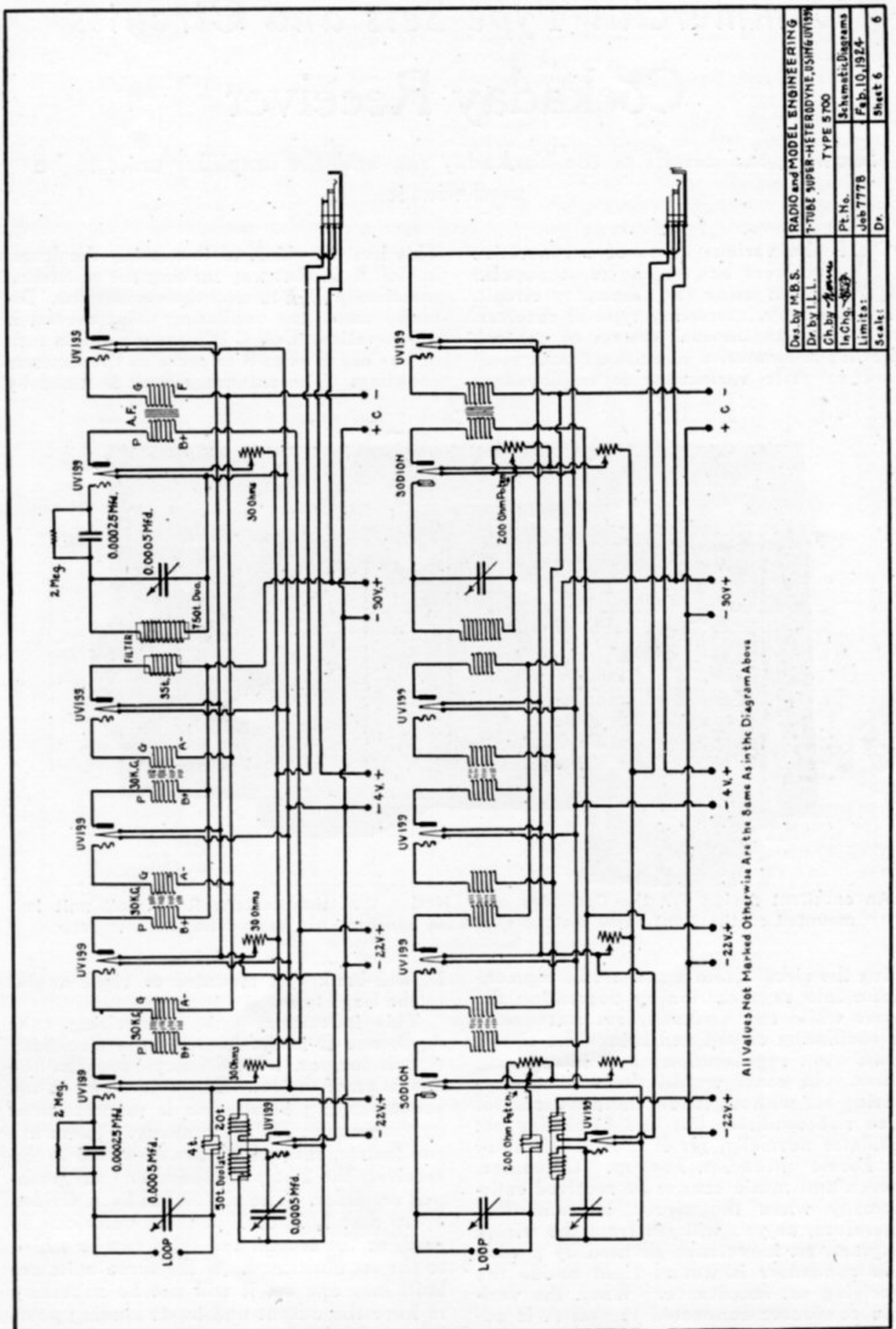


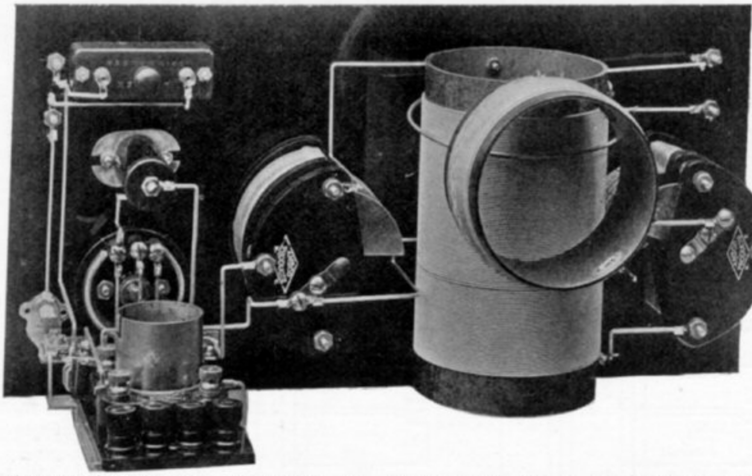
Fig. 9. Schematic wiring diagram of the set, above, as it is actually built, and below, as it should be wired for Sodion detector tubes

Commercial Type Sets and Circuits

Cockaday Receiver

Showing the details of the Cockaday set, and the amplifier units to be used with it

OF the various types of regenerative receivers one of the most popular is that using the Cockaday circuit. This is a very interesting type of receiver, for it uses an unusual system of control. In other regenerative circuits a tickler feed-back or plate variometer is employed to bring the circuit from a non-oscillating condition into regeneration by decreasing the losses while the Cockaday set starts with an oscillating circuit and brings the circuit down to regeneration by introducing losses. In other words, the ordinary receiving set without its regenerative control does not oscillate, but the Cockaday set oscillates normally, for it uses the familiar De Forest ultraudion hookup. Of course, speech and music cannot be received satisfactorily when the circuit is oscillating. Therefore, as you will see from the wiring diagram, an inductance shunted by a variable condenser is wound right beside the receiving set inductance. When the variable condenser connected to coil A is adjusted to the wavelength of the incoming signals energy is absorbed from Coil B. This has the effect of increasing the losses in Coil B, in that way making the resistance sufficiently high to stop the oscillations. Directly under the oscillating point the set is regenerative. Coil C is merely a single turn of bus bar around B to serve as the antenna coupling. The antenna circuit is tuned by D, a 2-bank coil mounted at right angles to the large tube.

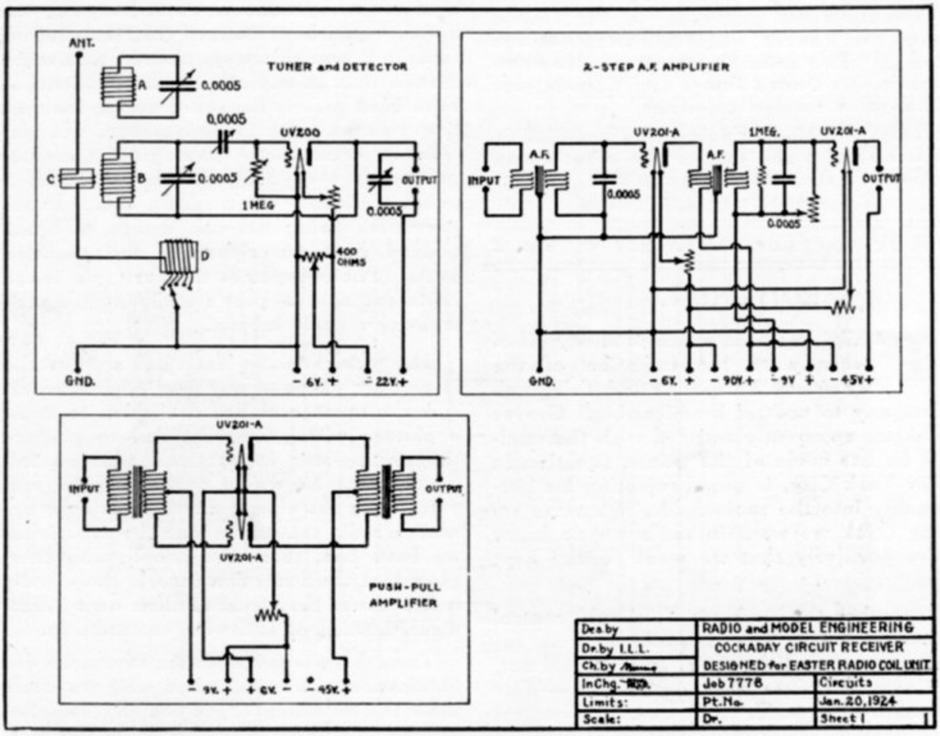


An excellent design for the Cockaday set. Notice that the Eastern Radio coil unit is mounted on the front panel instead of a base panel, as has been done on other sets

This inductance unit, comprising coils A, B, and D is the heart of the Cockaday circuit for, on its efficiency, depends the operation of the set. The unit shown in the accompanying illustration is manufactured by the Eastern Radio Company. There are two instruments, which can be added to the receiver, the 2-step amplifier and the push-pull amplifier. The circuit has been divided up so that 1, 2, or 3 of these units can be used, or the second and third can be added to the set illustrated. If the three units are built into one set it will not be necessary to have the output and input binding posts between them, for connections can be made directly across. Then terminals having the same marking can be put together. That is, the two binding posts marked GND go together, the three —6V. and +6V. binding posts, the — and +9V., and the — and +45V. The same thing is true if the units are made up separately and put together afterward.

In addition to the Eastern Radio inductance unit, there are in the receiver itself, two variable condensers of 0.0005, such as in this set, however, because of the potentiometer regulation on the B battery. A variable gridleak is indicated on the wiring diagram altho a fixed 1-megohm Daven leak is satisfactory.

In the 2-step amplifier there are two transformers. These may be Amertrans or Ark transformers. These are recommended not only because of their efficiency but because it is convenient to make connection



Above, at the left, the circuit for the tuner and detector; on the right, the two-step amplifier; below, the push-pull amplifier

the Comsco or Amsco types are required, two adjustable condensers of 0.0005, one for the grid and one around the telephones or primary of the first transformer. These may be of Freshman or Amplex design. A Filkostat gives very fine adjustment on the detector filament. For the potentiometer an Amsco of 400 ohms was used. This is not to regulate the voltage on the grid but to adjust accurately the detector plate voltage. The socket is of the Bestone manufacture, a particularly good type because of the two-point contact on the springs. The jack is a Carter type 101. These details can be seen from the illustration. You will note that there are four Eby binding posts for connecting to the A and B batteries where, ordinarily, three are sufficient. It is necessary to use two for each battery to the transformer core. Two Micadons of 0.0005 are used across the secondaries of the transformers. A 1-megohm gridleak is put across the secondary of the last A. F. transformer and in addition a variable resistance to regulate the volume in the form of three or four 12,000-ohm Lavite resistances in series. This can be cut in by means of a switch, the first contact of which should leave this circuit open so that the full volume can be obtained when required.

The push-pull amplifier unit is made up of Como input and output transformers with the tube sockets and rheostat.

Reports on this receiver show that it is not only exceedingly good for long distance reception but very sharp in tuning.

RADIO & MODEL ENGINEERING

Published monthly by
M. B. SLEEPER, Inc.
A-52 Vanderbilt Ave., New York City

Twenty cents per copy in the United States and Canada; in foreign countries one shilling. Two dollars per year, twelve numbers in the United States and Canada; ten shillings in foreign countries.

Radio and Model Engineering is mailed to subscribers at the end of the month, and appears in the radio stores on that date.

Vol. IV FEBRUARY, 1924 No. 2

EDITORIAL

THERE has been much publicity given recently to the intention of the American Telephone and Telegraph Company to control broadcasting. Grover Whalen, apparently satisfied with the muddle he has made of the transit situation in New York City, is now projecting his personality into the radio field. Whatever we may think we want in radio we do know very positively that we want politics kept out.

Whether the A. T. & T. should control broadcasting or not, it would be well, before we say that the A. T. & T. should not, to ask ourselves these questions:—Why shouldn't the A. T. & T. Company control broadcastings? Is there any other concern or system that would assure the public as satisfactory broadcasting?

The mere fact that the A. T. & T. might make money from broadcasting should not influence us to answer in the negative. On the contrary, broadcasting on a permanent basis must be done profitably, for there is no indication that a satisfactory way can be worked out to make the public pay for it directly.

With this issue, the price of R and M is increased to twenty cents a copy. If you will compare the Magazine today with copies of a year or two ago, you will see that this increase is justified by the increased value of the contents. During the three years that R and M has been published and sold at ten cent a copy, it has been developed steadily in usefulness and size, and this will continue.

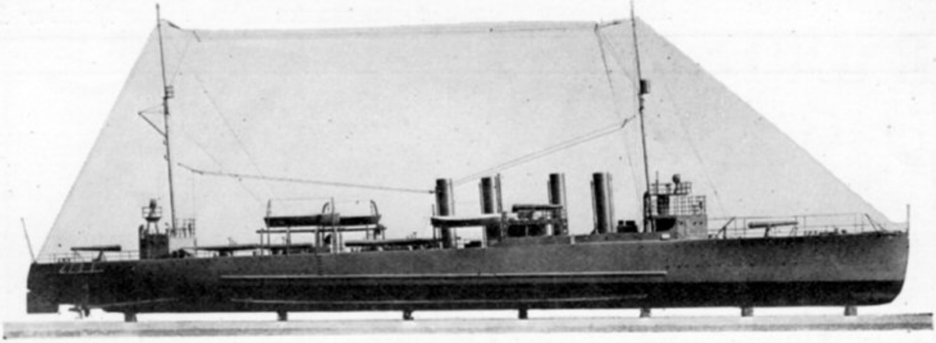
While a trade magazine covering established industries need not change from year to year, a radio magazine should grow and change, and improve just as much as the apparatus it describes. There are things to be "discovered" by radio magazines just as much as by radio laboratories. For example,—you have noticed that the illustrations in R and M, always clearer, with more details, than in any other radio publication, have been greatly improved during the past few months. Radio instruments are extremely difficult to photograph because practically everything that is not black is polished nickel. As a result, sufficient exposure to bring out the details of black molded parts over-exposes the nickeled parts. Photographs as they are now taken represent over a year's study and experimenting on this subject.

The picture wiring diagrams are covered in another phase of our development work. Ask the average skilled draftsman to make a picture wiring diagram and to prepare the step-by-step instructions. If you followed what he would probably give you, you might get almost anything but an operative radio set. Even with the experience we have had, there are people who complain that their sets don't work, tho usually it is because they trust to their own judgement, instead of following instructions.

Then there is the selection of articles for publication. We are asked why we don't show the Suternuperdyne set, the Trioplioflex or something like that. Usually it is because the circuit is not practical to build, not efficient in operation, or just an old set under a fancy name. In the R and M laboratory are relics of dozens of circuits, built, tested, and found lacking. And it costs just as much to build sets which are later rejected as those which are accepted.

After all, if you should get just one design from R and M it would be worth the cost of the twelve numbers. But you have my promise that R and M in the coming year will be improved and expanded even more than in the year passed. We shall see to it that the price is justified.

M. B. SLEEPER,
Editor.



Construction of a One-Eighth-Inch Scale Model 310-Foot U. S. Destroyer

Part 1. The general problems involved in the building of this exhibition model, the handsomest type in the U. S. Navy, and preliminary plans for the shaping of the hull, in subsequent parts, photographs and drawings will be given for every detail

OF all the different things of which models can be made, the handsomest, in which the most interesting details can be shown without going to extremes of elaborateness, is the U. S. Navy destroyer. Its long, rakish lines, the slight flare at the bow, its appearance of speed and trimness give it a decided air of its own. In a scale model of which ⅛-in. is equal to a foot, it is not practical to instal a power plant, tho that can be done if the boat is made to a larger scale. The real beauty of the destroyer, however, is as an exhibition model.

That this may be fully realized, the details must be carried out fully, and to scale. For that reason, thru the courtesy of H. E. Boucher, Inc. we have obtained one of their scale models, of which complete photographs and drawings are being made, so as to provide all the necessary construction details. In this first part, three general views are given, together with the lines and deck plan. Subsequently, the individual parts, such as the arrangement of the bridge, the guns, anchors, life boats, rigging, and torpedo tubes will be taken up.

It may appear that it is very difficult and delicate work to carry out all the details, but when they are explained you will see how simple they are, and when you are actually doing the work you will be surprised at the effect of little pieces of cardboard, blocks of wood, nails, and pieces of dowels, when they are glued in place and painted. Some of the more difficult fittings, such as anchors, blocks, ventilators, propellers, and bits can be bought at small expense. But most of the things, under the magic touch of the paint brush, can be transformed into realism. A dowel, shaved off underneath, becomes a torpedo tube, another dowel is a depth bomb on a water tank, a piece of wire, a flag staff.

Laying out the Hull

The first step in building the model 310-ft. destroyer is to lay out the hull. The actual over-all length of the hull is 314 ft., which, for a ⅛-in. scale model calls for a block 39¼ ins. long. In width, the block must be 3⅞ ins. thick by 4⅛ ins. wide. This must be of the best grade white pine, such as is used by pattern makers. Both deck and keel are perfectly straight. Consequently, the block must be cut down until it is 3 5/16 ins. thick at the bow end and 2 3/16 ins. at the stern. All dimensions can be scaled off from Fig. 4, as it is ¼-size, altho full-size photostat copies of the lines can be obtained if you prefer to have them to lay out directly on your wooden block. Moreover, templates showing the contour of the hull, can be cut out from the full-size drawings, to use in testing the block as you shape it.

It is necessary to cut the drawing in half to get it on one sheet. To obtain the full lines, simply cut it down the center and paste the two parts together, end to end. The sections show that the deck is not

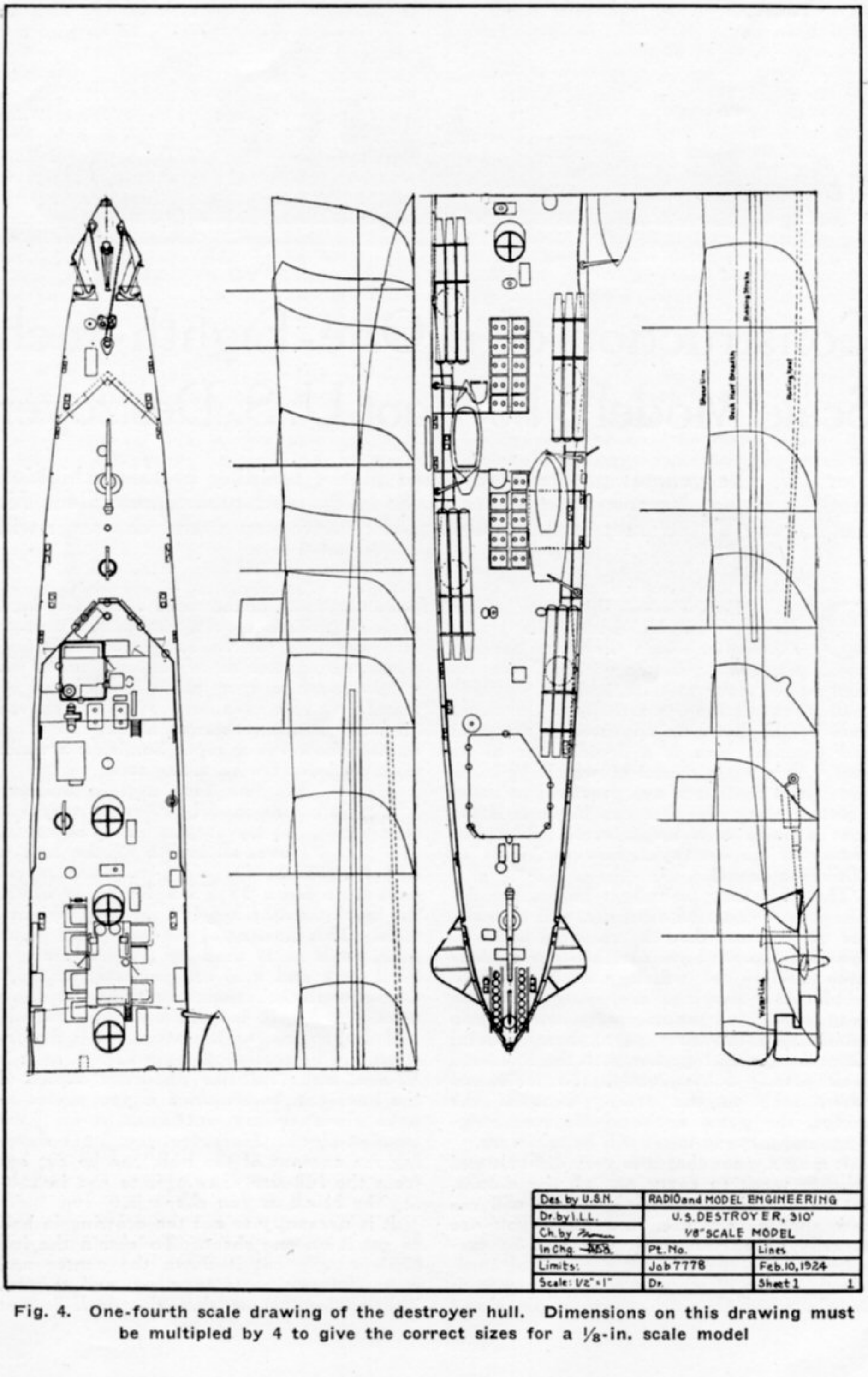


Fig. 4. One-fourth scale drawing of the destroyer hull. Dimensions on this drawing must be multipled by 4 to give the correct sizes for a 1/8-in. scale model

flat. However, it will not affect the appearance, and will make the work much easier to make it flat.

The drawing of the lines shows the rolling keel, the water line, rubbing strake, and sheer line. One-half of the deck is indicated by the deck half breadth. Do not pay any attention, for the present, to the water line, rolling keel, or rubbing strip. The first only affects the painting, the two latter are strips to be secured to the finished hull. There is no bottom keel protruding, for, in the real destroyers, the keel is merely an extra heavy plate that does not extend down more than ½-in.

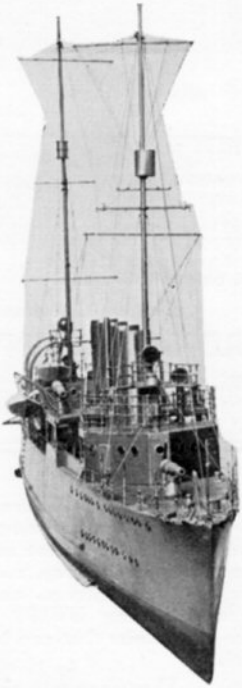


Fig. 2. You would hardly think that this is a picture of a model, so perfect is the reproduction of the details of the real destroyer

When you have cut out your block to the proper length and width, and have tapered it correctly from bow to stern, the next job is to draw a center line down the top, bottom and ends. Then, both on the bottom and top, mark out the greatest width as shown by the cross-sections. If you are working directly from Fig. 4 measure the distance from the bow to the first vertical line, multiply it by 4, and lay out that distance on the center line of your block, both top and bottom. Again, measure the distance from the center line to the greatest width of that cross-section, multiply it by 4, and lay off that distance each side of the block center line. Continue this process, always measuring from the bow. When you finish, you will have a series of lines which, when connected will give you the full size contour of the hull. If you get the full-size photostats, you can get the lines by putting the drawing directly on the block and pricking thru with a scriber.

As soon as you have made the lines on the top and bottom of the block, cut it down to that shape. Do not round the block above or below. Now make another series of measurements on the drawing to determine at what distance down from the deck the hull is of the greatest width. This can be determined from the cross-sections. Note that, at the bow, the deck is widest. Having laid off these distances down from the deck on both sides of the block, join the points by a line.

Do not cut into the block until you have marked out on the top of the block the contour of the deck. Then, with a draw-knife, round the sides of the blocks from the line showing the greatest width of the hull up the deck line. Just shape it roughly, but do not cut in too far. Then round off the underside a little. As soon as the block takes on the approximate shape, cut out a set of templates using Fig. 4 or the full-size photostat as a pattern. Make a template for each cross-section shown, and make each one double, so as to show the shape of the hull on both sdies, not on one, as it appears in the cross-sections. You can tell where to fit these templates on the hull from the marks previously made on the deck center line. Gradually work the block down until each template fits accurately. Then take out the knife marks with No. 1 sandpaper and finish with No. 00.

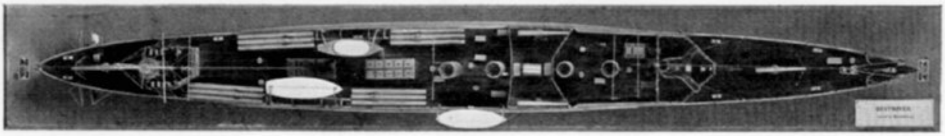


Fig. 3. This odd-looking picture was taken with the camera pointed straight down on the deck of the destroyer

(Continued from page 38)

until signals come in. You will pick up a slight whistle. If the set does not seem to be operating properly reverse the leads to terminals C and D. Then the polarity will be correct and the oscillator will function properly.

If the set does not operate correctly check over the circuit against the schematic as well as the picture wiring diagram. Start off with the loop terminals and go right through to the last tube. For example, the first wire runs from the loop to one side of the grid condenser. Checking on the diagram you find that this is the wire 39 to 40. From that side of the grid condenser a wire also goes to one side of the variable condenser. That is wire 39 to 97, and 125 to 126. The other side of the grid condenser goes to the grid post of the first socket. That is connected from 37 to 38. On the other side of the loop a wire runs to the coupling coil of the oscillator unit, wire 1A to 2A and also to the other side of the variable condenser, 98 to 123, and 123 to 124. Continue this process until you have gone over all the wires.

Do not listen in on your super-heterodyne and then, after hearing a single circuit regenerative receiver with two steps of A. F. amplification with UV201-A tubes, operating on antenna and ground, feel that your set, with seven tubes, is down in efficiency. Bear in mind that different radio sets are built to meet different requirements. You do not look for a furnace in a summer cottage. You cannot make direct comparisons between a loop receiver and one working on an antenna and ground. Moreover, a set using UV199 tubes will not produce the results that can be obtained with UV201A's.

Changes and Alterations

There are two changes that can be made in this receiving set for those who want to take this design as basis and work out their own details. If you want UV201A tubes throughout you can use exactly the same circuit and the same parts, changing the design so as to provide room and height for the larger tubes. The volume will be greatly increased if that is done. A still further improvement can be effected by substituting Sodion tubes for the two detectors. A wiring diagram is given in Fig. 9, showing the connections. All the constants not marked are the same as in the upper diagrams. The only alteration necessary concerns the 200-ohm potentiometers which are required for proper biasing of the Sodion tubes.

To operate the set on an antenna and ground connect a coil of 40 turns of No. 24 S. S. C. wire, 3½ ins. in diameter in place of the loop, and run the antenna and ground to 6 turns of the same wire wound over that coil.

Standardized Parts List

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 R & M when you write them.

PARTS FOR THE 5700—SUPER-HETERODYNE RECEIVER

Type	Name	Price
	Acme Apparatus Company, Cambridge, Mass.	
30 K. C.	3—Long-wave transformers	$15.00
	American Transformer Co., 178-L Emmet St., Newark, N. J.	
AF-6	1—1-5 A. F. transformer.......	7.00
	Carter Radio Company, G-209 So. State St., Chicago, Ill.	
103	1—3 spring jack	.90
	Cornish Wire Company, R-30 Church St., New York City	
	1—¼-lb. spool No. 24 S. S. C. wire	.50
	Dubilier Condenser & Radio Corp., A-48 West 4th St., New York City	
601	2—.00025 mfd. Micadons	.70
	H. H. Eby Mfg. Co., 40 So. 7th St., Philadelphia, Pa.	
Ensign	12—Ensign binding posts........	2.40
	General Radio Company, 11 Windsor Street, Cambridge, Mass.	
299	7—UV199 sockets	5.25
	Kurz-Kasch Company, South B'way, Dayton, Ohio	
A-218	3—3¾-in. tapered knobs and dials	3.60
A-212	3—2-in. tapered knobs and dials	1.80
	Pacent Electric Co., A-22 Park Place, New York City	
US50	1—50-turn Duo Lateral coil....	.60
US750	1—750-turn Duo Lateral coil....	1.80
	Poster & Company, 26-R Barclay Street, New York City	
156	1—7x24x3/16-in. Formica panel	4.18
98	2—3½x22½x3/16-in. Formica panel	5.52
152	4—2⅜-in. Formica discs, ⅛-in. thick	.80
	Raven Radio, Inc., 8-R Learned St., Albany, N. Y.	
	3—30-ohm rheostats	2.55
	Ritter Radio Corp., 232-R Canal St., New York City	
	1—Ritter Portable Loop	6.50
	Stephenson Laboratories, 342-R Madison Ave., New York City	
A-44	3—.0005 mfd. Malone-Lemmon balanced condensers	15.00
	MISCELLANEOUS PARTS	
47	24—Lengths sq. tinned copper bus bar	1.20
58	6—Pkgs. 25 tinned soldering lugs	1.20
22	1—Right hand nickeled angle bracket	.10
185	1—Left hand nickeled angle bracket	.10
14	10—Coil supports pillar..........	.80
151	6—Terminal panel supports....	1.80
62	1—Pkg. 10 ½-in. 6-32 F. H. screws	.12
63	6—Pkg. 10 ½-in. 6-32 R. H. screws	.72
143	3—Pkg. 10 1-in. 6-32 R. H. screws	.42
178	1—Pkg. 10 1½-in. 6-32 R. H. screws	.18
49	4—Pkgs. 10 6-32 nickeled nuts	.32
	COMPLETE SET OF PARTS..........	**$81.06**

AUXILIARY EQUIPMENT

Type	Name	Price
	National Carbon Company, Long Island City, N. Y.	
763	Small 22½-volt B battery......	$1.75
766	Large 22½-volt B battery.....	3.00
767	Large 45-volt B battery........	5.50
771	4½-volt variable battery	.70
6810	50-amp. storage battery 6-volts	15.00
	Stanley & Patterson, West & Hubert Sts., New York City	
843	Deveau Gold Seal Phones, 2200 ohms	6.00
844	Deveau Gold Seal Phones, 3200 ohms	8.00
	Music Master Corp., A-Cherry St., Philadelphia, Pa.	
14	Music Master Loud Speaker, 14-in. horn	30.00
21	Music Master Loud Speaker, 21-in. horn	35.00
	Clark and Tilson, Inc., 1-A East 42nd St., New York City	
W	Automatic drilling template...	1.00
	C. Brandes, Inc., 237-M Lafayette St., New York City	
	Brandes Table Talker	10.00
	Pacent Electric Co., A-22 Park Pl., New York City	
40	Universal phone plug	.50
51	Twinadapter for two plugs....	1.00
	Stevens & Company, 395 Broadway, New York City	
	Set of 3 Spintite wrenches for nuts	1.00

IMPORTANT ANNOUNCEMENT

As announced on the editorial page, the price per copy of Radio and Model Engineering is now twenty cents. Renewals, extensions, or new subscriptions received before the end of April, 1924, will be accepted at the old rate of one dollar per year.

Take advantage of this offer at once—here is your chance to make sure of getting the bigger and better R and M regularly each month, and at the same time save half the cost.

SPECIAL COMBINATION OFFER

You can save two dollars by sending for this Special Combination. Send in two dollars, check, money order, or stamps, and you will receive the following:

One year's subscription (or extension) to R and M..........................	$2.00
Copy of Super-Heterodyne Book	.50
Full size blue prints, 6 sheets, Super-Heterodyne Receiver...................	1.50
Total	$4.00

PATENTED
June 1, 1920
April 3, 1923

GENUINE PACENT
DUO LATERAL COILS
And Mounting Equipment

Duo Lateral Coils, unmounted. Sizes US 25 to US 1500. Prices, 50c to $3.20

Duo Lateral Coils, mounted. Sizes MS 25 to MS 1500. Prices, $1.40 to $3.85

Pacent Coil Plug No. 110. Price, $1.00

Pacent Coil Plug Receptacle No. 111. Price, $1.00

Pacent Microcouple Receptacle No. 118. Price, $2.00

Pacent Panel Receptacle No. 119. Price, $1.50

Send for Bulletin K-2

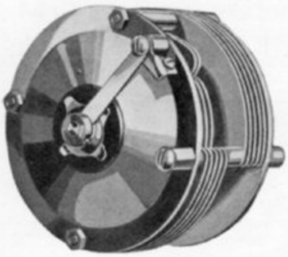
The Genuine Duo Lateral Coil, PACENT, has been recognized by authorities as the most efficient inductance.

Auxiliary coil equipment products mentioned herewith are built for maximum operating efficiency and are endorsed as particularly suited for Super Heterodyne sets.

PACENT ELECTRIC CO., Inc.
22 Park Place New York, N. Y.

Pacent
RADIO ESSENTIALS

for the
Super-Heterodyne



where just ordinary condensers *won't do,* the Malone-Lemmon condenser is ideal because—

It has negligible losses

The super heterodyne is tuned entirely by condensers and these units *must* be highly efficient.

It is velvety smooth in action

The super heterodyne tunes exceptionally sharp—tuning control *must* be smooth and even.

It is permanently balanced

Any tendency to "slip" after an adjustment has been made, will make the super very disagreeable to tune—Malone-Lemmon condensers *can't* slip.

Send for literature describing Malone-Lemmon Condensers and other Malone-Lemmon products

MALONE-LEMMON PRODUCTS
Made by STEPHENSON LABORATORIES
342 MADISON AVENUE
NEW YORK CITY

ABSOLUTE ACCURACY in Resistance Units

Means Better Results in Reception

A good resistance unit must be correct and constant in value, and therefore silent in operation. PRECISION RESISTANCE UNITS meet these demands of the exacting radio man who knows that the use of a calibrated FIXED resistance of proper value eliminates one unnecessary control and produces pure tone reception.

PRECISION UNITS, which are strictly hand made and individually calibrated are constructed with elements of fixed resistance.

After the moisture is removed they are mounted and hermetically sealed in a glass tube. Final inspection is then made and each unit tested.

PRECISION RESISTANCE UNITS are made in a wide assortment of values.

See them at your dealer's or write for descriptive folder and price list

DAVEN RADIO CO.

Radio Resistor Specialists

9 Campbell St. Newark, N. J.

Everybody Likes

EBY

Quality Binding Posts

The Tops Don't Come Off!

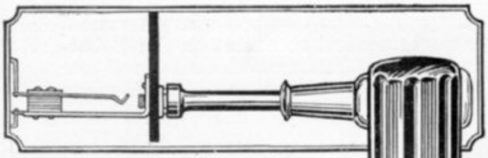
They excel all others in quality.

They're easily mounted on your set.

They are built for service and give it.

They are surprisingly low in price.

THE H. H. EBY MFG. CO.
Philadelphia, Pa.

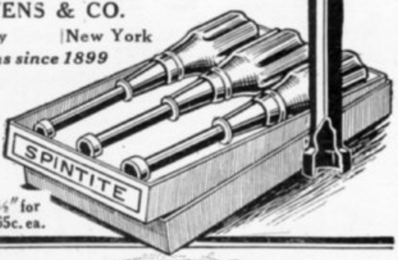


Spin *All* Nuts On—

IT'S so easy now—assemble any radio hook-up in half the time—make connections leak-proof as soldering with **Stevens SPINTITE Wrenches.** **Fit all radio nuts.** Hollow stem goes over projecting screws—hex socket gets full grip and protects nuts—ebonized handle for comfortable leverage—cinch to reach difficult places. All sizes from 3/16 to ½ inch.

STEVENS & CO.
375 B'way | New York
Toolsmiths since 1899

Send $1 for Set No. 71 Illustrated



Sizes 3/16 and 1/4" for phone jacks 65c. ea.

Stevens SPEED UP *Tools*
TRADE MARK

RADIO HANDBOOK

Only $1

514 PAGES

Just off the press! The greatest book on Radio ever written. Price only $1. Filled with sound, practical, tested information for every radio fan, from beginner to hard-boiled owl. Written, compiled, and edited by men of national reputation. Every page tells you something useful—and there are 514 pages. Mail $1 to-day and get this I. C. S. Radio Handbook before you spend another cent on parts.

Money back if not satisfied

— — — TEAR OUT HERE — — —

INTERNATIONAL CORRESPONDENCE SCHOOLS
Box 8776, Scranton, Penna.

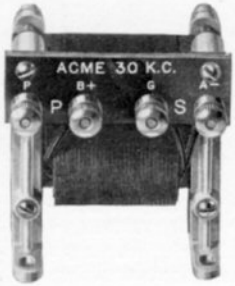
I enclose One Dollar. Please send me—postpaid—the 514-page I. C. S. Radio Handbook. It is understood that if I am not entirely satisfied I may return this book within five days and you will refund my money.

Name..

Address..

Another Acme Radio Frequency Transformer—The Acme 30 K. C.

For Long Wave R. F. Circuits



WE have found in our laboratory that we can run these transformers with the grid return to the negative side of the filament; in fact, can run them as high as six volts negative. We have also found that it is not necessary to shield the transformers, and that they operate satisfactorily in cascade as high as four stages without interstage oscillation.

This new Acme 30 K. C. Transformer is a worthy member of the Acme Transformer family. The Acme A-2 Audio Amplifying Transformer and the Acme R-2 Radio Frequency Transformer have made the name Acme synonymous with "the best transformers" in the mind of radio amateurs. We brought out the Acme 30 K. C. Transformer because we found that a real need existed for a transformer of this kind for long wave and R. F. circuits. Send 10 cents for our booklet "Amplification without Distortion."

ACME APPARATUS COMPANY
Dept. R. M. 2, Cambridge, Mass.

ACME
~ for amplification

ACME APPARATUS COMPANY
Dept. R.M. 2, Cambridge, Mass.

Gentlemen: I enclose 10 cents (in U. S. Stamps or Coin) for "Amplification without Distortion."

Name ....

Address ....

City ....*State* ....

"The Best That Money Can Buy"

"DEVEAU GOLD SEAL" HEAD SETS are electrically and mechanically,—as well as from a radio standpoint,— as perfect as the highest-priced Head Set on the market,—yet, with all their perfection, they retail at only $8.00 for 2200 Ohm and $10.50 for 3200 Ohm.

The trade mark "DEVEAU" has stood for the highest quality in telephone apparatus for thirty years,—a guarantee that every known advantage in design and manufacturing has been taken into careful consideration.

Magnets are extra-heavy one-piece units; cups are of aluminum to keep down the weight but unlike other Head Sets, every exposed metal part of the set is finished in genuine 24-karat gold,—under a protective lacquer so that the finish will last for years; the terminals of each unit are concealed,—no contact possible with users' hands.

"DEVEAU GOLD SEAL" HEAD SETS are like a piece of fine jewelry in appearance, but with all the radio niceties that the most advanced radio enthusiast can desire. DEVEAU Units exactly match each other in tone,—each has maximum sensitivity and perfection of tone quality.

The patented design of headgear is far ahead of any Head Set on the market,—affording as it does, instant fitting to ears and head without "re-harnessing" and without binding or pressure,—the latter an admitted nuisance with all other makes of Head Sets.

Caps are of genuine Bakelite,—of scientific design, and comfortable to the ear; the bakelite never loses its jet-black lustre or highly polished surface

"DEVEAU GOLD SEAL" HEAD SETS are never found in the cut-rate market,—they are only sold to Jobbers who appreciate their value.

"DEVEAU GOLD SEAL" HEAD SETS are guaranteed to be electrically and mechanically perfect,—our Guarantee protects every purchaser.

Order through your regular Jobber or write direct for the names of authorized Distributors throughout the country

Send for descriptive Bulletin of Deveau Radio Apparatus and Micrometer Adjustable Air-Gap Radio Loud-Speakers.

STANLEY & PATTERSON

250 WEST STREET

Downtown Stores { 27 WARREN ST. / 23 MURRAY ST.

NEW YORK, U. S. A.