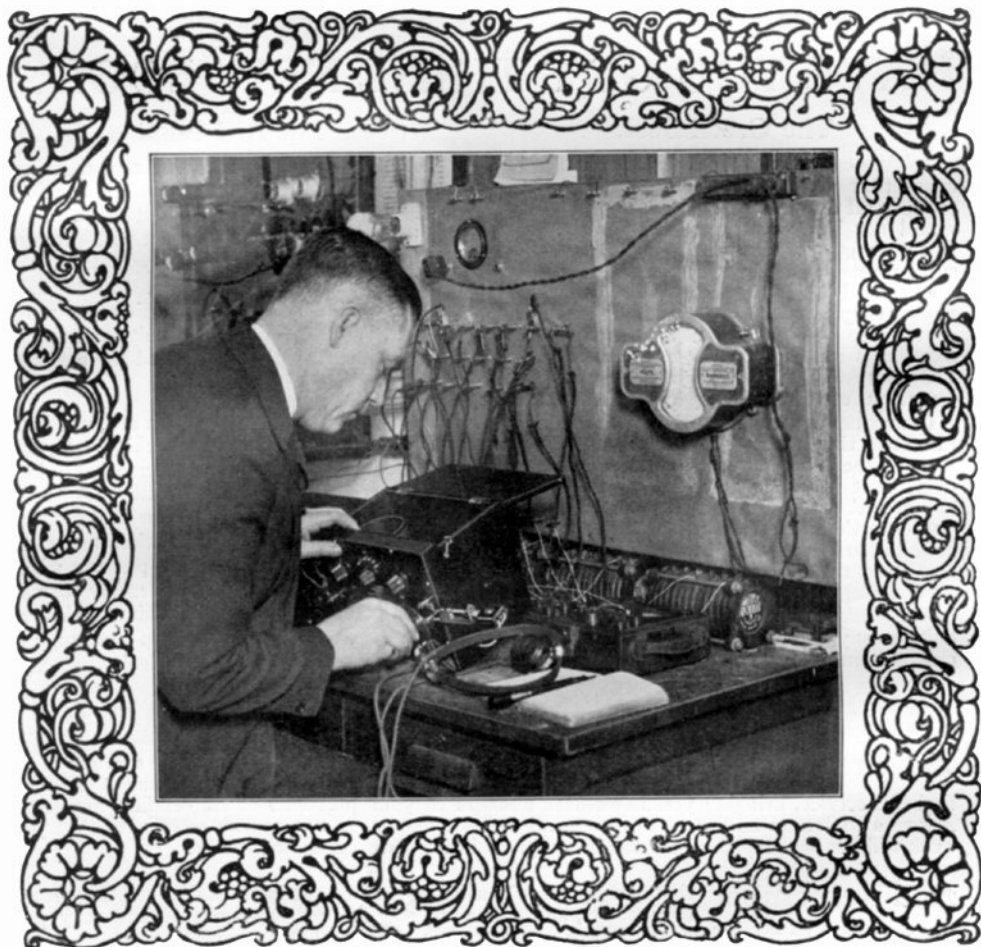


Vol. III

No. 2

RADIO & MODEL ENGINEERING

Edited by ~ M.B.Sleeper



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MARCH 1923

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A Magazine For The Experimenter Who Builds His Own Equipment



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Use of the Short Wave Variometer Tuning Unit

One of a number of sets which can be made up with a short wave tuning unit is shown, and details are given for building, testing, and operating.

The Tuning Unit

PARTICULARLY interesting is the combination variometer and adjustable inductance, generally referred to as a "tuning unit", because of the variety of circuits in which it can be used, and the long distance re-

far end, improves the sharpness of tuning, thus overcoming the greatest objection to single circuit outfits. Moreover, the best reproduction of speech is obtained when the set is not oscillating. If you bear that point in mind when you are tuning a set of this type you will



Fig. 1. Very clean-cut and attractive is the appearance of this 150 to 700-meter set.

ception that can be accomplished by it in conjunction with other simple instruments. Practically all the single circuit receiving sets about which such favorable comment is being made can be reduced to the simple elements of an antenna inductance and capacity, and plate coupling coil. The tuning unit supplies the first and last elements named.

Mr. Frank Conrad, of the Westinghouse Company, has shown the special advantages of single circuit regenerative sets, particularly when they are used with very short, or even in-door, antennas. Making the antennas from 25 to 75 feet in total length, from the set to the

help keep down the growing feeling against regenerative sets. Complaints are now being made with increasing frequency about heterodyne squeals between adjacent oscillating receivers, and, if Experimenters are not careful we may have regenerative sets outlawed here as they are in England already.

Beside the excellent results obtainable with a single circuit tuning unit set the element of cost is important. The saving over the price of a three-circuit set amounts to the cost of a variocoupler and variometer, as well as the lower expense due to the reduction of cabinet and panel sizes and the elimination of a number of small parts.

Type
4100
Receiver

In the particular outfit described here, the tuning unit is connected so that the adjustable inductance is in series with a 23-plate condenser in the antenna circuit, the grid and filament across that coil, while the variometer is in the plate circuit. Because of the extremely low distributed capacity of the variometer, a Split-a-Meter vernier condenser is shunted around it, to give the final close adjustment for tuning. These parts with the other auxiliaries, are so compactly arranged that they can be carried on a panel measuring $7\frac{1}{2}$ by 10 ins.

The panel has been laid out so that it conforms with the design of the type 3100 2-step amplifier, described separately. It can be used

the condenser in place. You must also be sure to mount the rheostat before the tuning unit.

The drill size required for the holes in the panel are confined to Nos. 9, 18, 31, and $9/32$ in. A countersink is also required for holes to take flat head screws, indicated in figure 6 with two concentric circles.

If you do not want to wind your own coil, the complete tuning unit can be purchased ready to mount. This also applies to the panels and cabinet.

L. P. F. panels are used for this set because, in addition to the exceptionally high insulating qualities, it can be obtained cut to size with smooth edges perfectly square. The front panel measures $7\frac{1}{2}$ by 10

Drilling
the
Panels

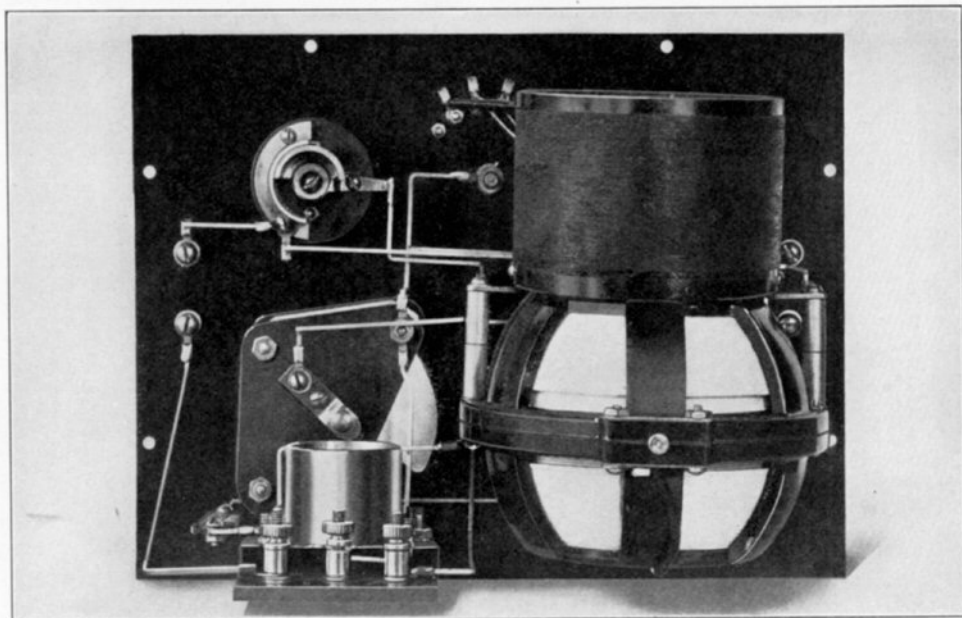


Fig. 2. The wiring of this set is simple, but there are one or two difficult kinks which must be handled carefully

also, with the 1-step radio frequency amplifier, type 4200.

An advantage in this outfit, in view of the proposed legislation to increase broadcast wave lengths, is that it can be loaded, by inserting an extra inductance in the ground, for long wave transmitters. Up to 2,000 meters no extra loading is necessary in the plate circuit.

Although the tool work for this set is confined to drilling the panels, the compactness of the arrangement calls for great care in assembly. If the picture wiring diagram in Fig. 5 and the step-by-step instructions are followed, however, no difficulties will develop. On the other hand, if you should, for example, mount the base panel and socket before the condenser, you will not be able to get

by 3-16 in., and the base panel $2\frac{1}{2}$ by 6 by 3-16 in. L. P. F. has a highly polished surface, and can be drilled readily without danger of checking or cracking.

Fig. 6 gives the layout of the panels at a one-half scale. Crossed lines indicate the centers of the holes. To determine the location of the holes on the panel, measure with your dividers the distance on the drawing from the top to the horizontal line passing thru the center. Double the distance measure down that amount on your panel, and scratch a horizontal line across the panel, using your combination square and scriber. Repeat this operation from the side. Where the lines cross make a mark with your center punch. A very handy and accurate tool is the Starrett automatic center punch, No. 18A. With this type

of punch it is only necessary to locate the point on the work and press down the handle. A spring is thus compressed and released, driving down the point. When the automatic is used there is no danger of driving the point off to the side.

Winding the Coils

A very simple matter is the inductance coil winding, as it calls for only one layer of wire, and the four taps. Details of this part are given in Fig. 6. An L. P. F. tube $3\frac{1}{2}$ ins. outside diameter and $2\frac{1}{2}$ ins. long, with a $\frac{1}{8}$ in. wall, is wound with 93 turns of No. 24 S. S. C. wire B. & S. gauge (22 S. W. G.) tapped at the 26th, 40th, and 63rd turns.

Note carefully the following directions for winding the coil. If they are not observed, the set may not oscillate properly. Start the winding on the left hand end of the tube, and turn the coil so that the top of the tube moves away from your body. In other words, as you look at the left hand end of the tube it will be turning anti-clockwise.

Two small angles cut from brass strip $\frac{3}{8}$ by 1-16 in. hold the coils to pillars fastened in place by the terminal screws. Because of the limited space on the outside of the tube the angle is put inside the tube.

Of great importance, too, is the direction of the variometer winding with respect to the coil winding. When the coil is mounted on the variometer the latter should be so placed that the right hand terminal, looking down on it as it appears in Fig. 4, takes the lead from the upper stator winding coming to it in an anti-clockwise direction.

There are four important elements in this set, namely, the tuning unit, socket, variable condenser, and vernier condenser.

Standard Parts Required

The tuning unit variometer must have a distributed capacity so small as to be negligible. In the type shown the capacity is 0.000036 mfd. Moreover, the inductance range, in this case 0.08 to 1.20 millihenrys, must be high, for in these factors lie the secret of the circuit. The vernier has a maximum capacity of 0.000025 mfd., an amount so small as to seem ineffective, but in reality large enough to give just the correct vernier tuning adjustment. Losses in the variable condenser and socket must be guarded against by the use of the very highest grade of insulation. Otherwise signal strength will be lost and the tuning made too broad to give the sharpness required to select between stations operating on wave lengths only slightly different.

Assembly and Wiring

Fig. 5 gives both schematic and picture diagrams of this set. The latter illustrates the wiring as it was actually done on the original model. The numbers on the connections, referred to in the following instructions, are put on in the order of the successive steps planned so as to make the work as easy and simple as possible.

1. Mount the binding posts, marked 19, 31, 11, and 28, on the front panel, putting a

soldering lug between each screw head and washer. Have the lugs pointing in the direction indicated by the short, heavy lines.

2. Mount the four switch points and lugs, 7, 8, 9, and 10, and two stopping points, marked X. Fill each lug with solder. Tighten the nuts after soldering.

3. Mount the switch, making sure that the switch arm gives perfect contact with the points.

4. Mount the rheostat with the 6-32 F. H. screws and nuts provided, making sure that the terminals are to the left. Put on the knob so that the white lines on the knob and panel

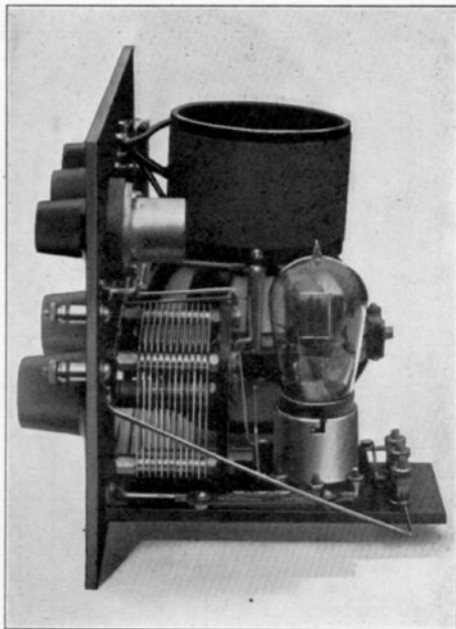


Fig. 3. This side view shows how compactly the various parts are arranged

coincide when the arm is in the position shown.

5. Mount the variable condenser with the 8-32 F. H. screws furnished. Put it on in the position shown, so that it will clear the variometer.

6. Mount the three binding posts with flat head screws on the base panel, placing a soldering lug between each base and washer. Put the socket in place with the screws provided, making sure that the slot is at the left, as shown.

7. Fasten the two angle brackets to the base panel, using $\frac{3}{8}$ in. 6-32 F. H. screws and nuts. Then, before those screws are finally tightened, fasten the brackets to the front panel with $\frac{3}{8}$ in. 6-32 R. H. screws and nuts. Tighten all screws. With the screws provided mount the tuning unit. Put two lugs under the head of the upper left hand mounting screw, to act as terminals 2 and 3.

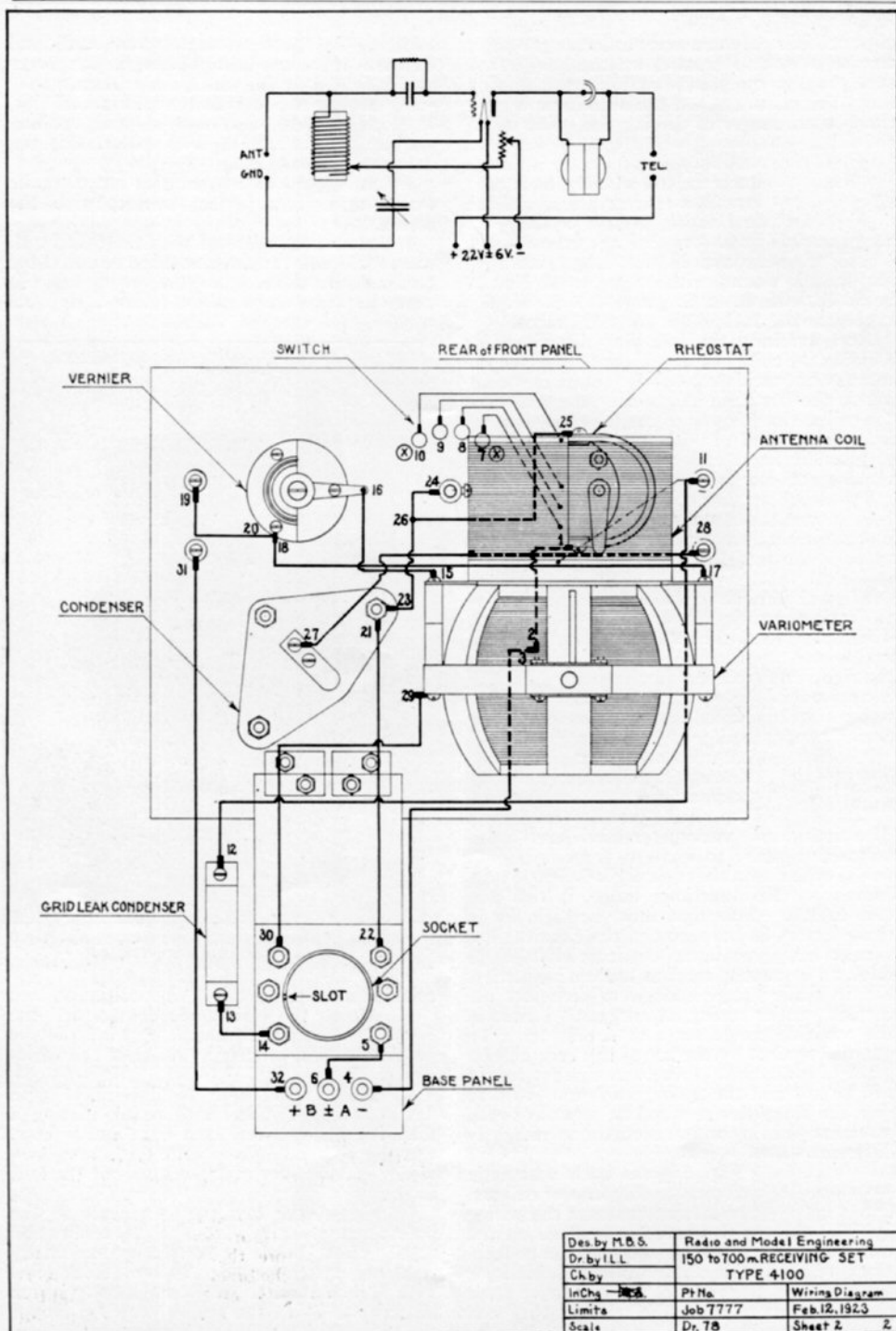


Fig. 5. Schematic and picture diagrams of the connections. The numbered terminals are referred to in the step-by-step assembly instructions

Des. by M.B.S.	Radio and Model Engineering	
Dr. by I.L.L.	150 to 700 m. RECEIVING SET	
Ch. by	TYPE 4100	
In Chg. M.B.S.	Pt. No.	Wiring Diagram
Limits	Job 7777	Feb. 12, 1923
Scale	Dr. TB	Sheet 2 2

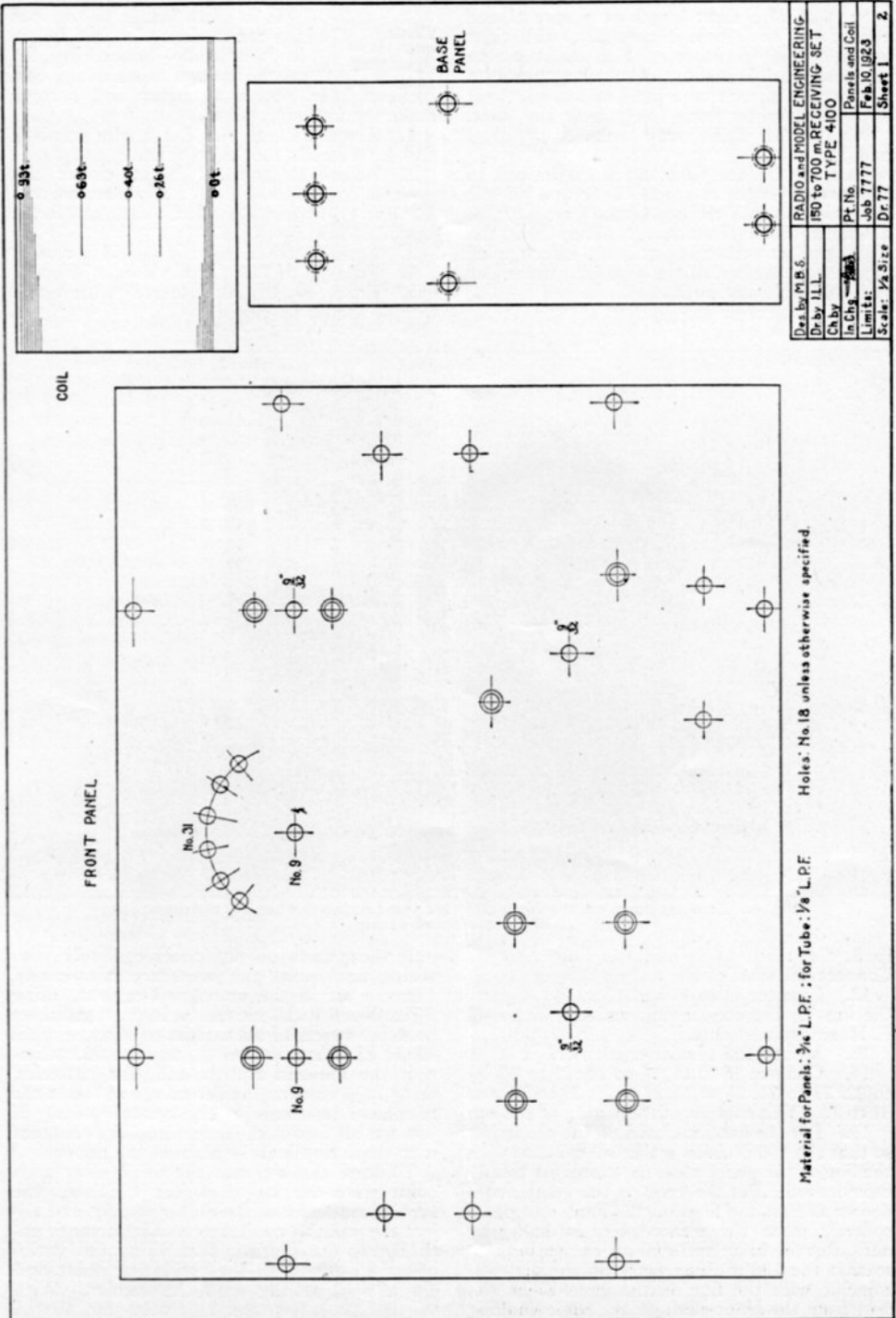


Fig. 6. Exactly one-half scale drawings of the panels and coil, the latter showing the tapping points

8. Cut off a short length of square tinned copper bus bar, form it carefully, with right angle bends, to fit from 1 to 2. Put the smallest possible amount of soldering paste on the terminals, melt on a little solder, and heat joint until solder flows freely over the joint.

9. In the same way connect 3 to 4 and 5 to 6.

10. Cut off the first tap from the coil to the correct length to reach 7. Scrape off the insulation and tin the end of the lead. Fit on a length of Empire tubing. Then heat the solder you have already put in the switch point lug. Press the end of the wire into the solder and hold it steady until cool.

11. In the same way connect the second tap

Testing and Operating

It is much better to test out the connections of a set before it is actually hooked up for receiving than to make any corrections later. With a buzzer and battery make the following tests:

1. Across 11 and 28. Put a wire across 6 and 4. Circuits should be open.

2. Across 11 and 28. Short circuit the variable condenser and put a wire across 6 and 4. Run the inductance switch back and forth. Circuit should be closed.

3. From 11 to 12. Circuit should be closed.

4. From 11 to 14. Circuit should be open.

5. From 19 to 30. Rotate variometer. Circuit should be closed.

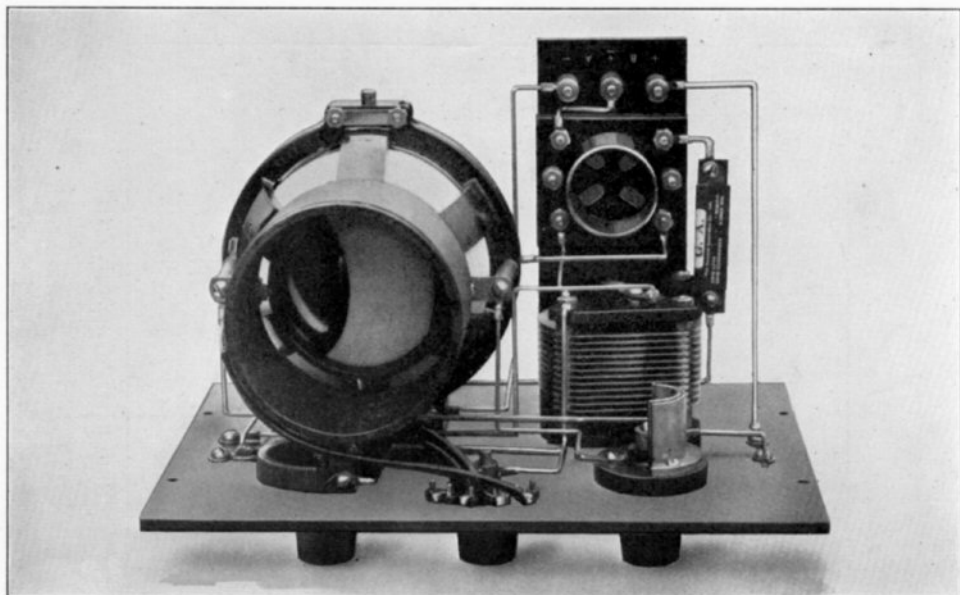


Fig. 4. Looking down on the completed set you can see the orderly arrangement of the parts and wiring

to 8, the third to 9, and the fourth to 10. Connect the start of the coil to 11.

12. Connect 11 to 12 and 13 to 14. Secure the lugs to the condenser terminals with 6-32 F. H. screws and nuts.

13. Mount the vernier condenser.

14. Connect 15 to 16, 17 to 18, 19 to 20, 21 to 22, 23 to 24, 25 to 26, 27 to 28, 29 to 30, and 31 to 32. This completes the wiring of the set.

15. Put the knob and dial on the condenser so that the 100 division mark will coincide with the line on the panel when the plates are totally inter-leaved. Put the knob on the vernier condenser so that the lines on the knob and panel coincide when the rotary plate is half way out. Put the knob and dial on the variometer so that the 100 division mark on the dial will coincide with the line on the panel when the lead from the front shaft to the rotor winding is upward.

If these tests do not check, go over your wiring and make the necessary corrections. Put the set in the mahogany cabinet, using $\frac{1}{2}$ in. No. 6 R. H. nickered screws. Drill three holes in the rear of the cabinet to take the wires to the binding posts on the base panel. Connect the antenna and ground, the batteries, using 22 $\frac{1}{2}$ volts on the detector, and fasten the telephone terminals to the output posts. If you use an audio frequency amplifier connect it to those terminals in place of the phones.

To tune the set, put the variometer at a point where the set does not oscillate, the vernier condenser at the center setting, and adjust the variable condenser and inductance until signals are heard. Then bring the variometer up almost to the oscillating point and get a final setting with the vernier. With W. D. 11 tubes use 1 $\frac{1}{2}$ volts for the A battery.

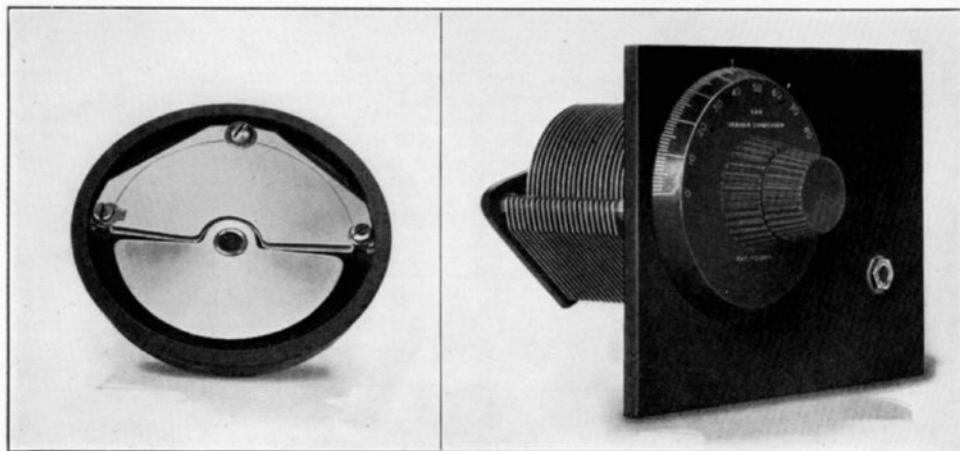
Knob and Dial Vernier Condenser

Here is a clever idea from the Kar Engineering Company—a vernier condenser contained in the dial and operated by a split knob.

OF THE various novelties in accessories about 95% can be passed by as being of no practical value or really not novel at all. There is in the vernier condenser illustrated here, however, something both useful and clever. The purpose of this vernier is to permit the use of a fine adjustment on any condenser of the rotary type by a mere change of knob and dial. As long as a shaft $\frac{1}{4}$ -in. in diameter is used, the ordinary variable can be fitted with the vernier with no other alteration

the under side of the dial gives you an idea of the construction. The lower half of the split knob is secured directly to the dial and, by a set screw, to the shaft of the condenser. When that part of the knob is turned, the dial and condenser plates rotate.

The top half of the knob is connected, thru a very clever arrangement, to a bushing which fits over the shaft and carries the rotating vernier plates which moves between two stationary plates secured under the dial. The



It is very convenient to be able to slip off the old dial and replace it with another which not only controls the condenser but gives a vernier adjustment as well

in its present form other than the drilling of one hole in the panel.

A word or two about verniers in general may not be amiss here. There are two types—one a separate condenser with plates of small area, the other a vernier rotating adjustment for the regular 23 or 43-plate types. In practical operation the latter type is practically worthless because a fine adjustment, to be of any real value in tuning, must be much finer than can be obtained with any lever or gear reduction. A little thought will show how true that is. A gear, to give a close control of a 43-plate condenser as a 3-plate vernier of the same size plates as used in a large condenser, must cause a reduction of 1 to 14. Most mechanical verniers cause a reduction of not more than 1 to 6.

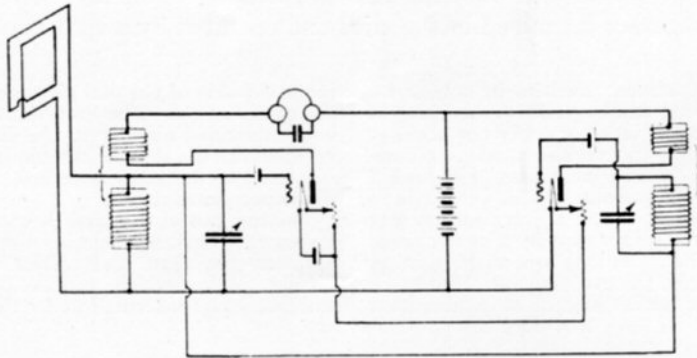
An examination of the illustration showing

bushing connects the movable plate to the shaft and the rotating condenser plates, while a flexible lead under the dial passes thru the panel to make connection with the fixed condenser plates. Thus the vernier is put in parallel with the main condenser. An additional advantage is the shielding effect accomplished thru the use of a stationary disc between the active plates and the dial.

You will agree, I am sure, when you see this vernier and its ready adaptation to any condenser, merely by substituting it for the plain knob and dial, that it is an accessory quite well worth using on your own equipment. And remember, when a dealer wants to sell you any type of vernier, to find out just how small a change of capacity, per degree of movement, it will give compared to the variation per degree of a 43-plate condenser.

101 Receiving Circuits

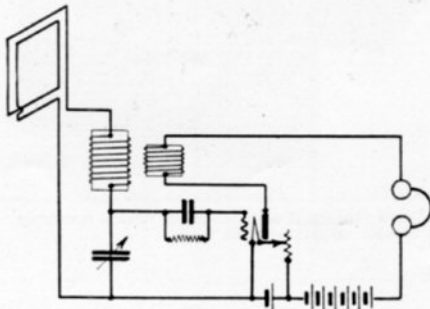
Eleventh Installment



81

81. In this outfit a loop antenna is connected to the double circuit which has been previously described. It must be remembered that the inductance of the loop antenna is generally high so that that value must be taken into consideration when designing the tuning

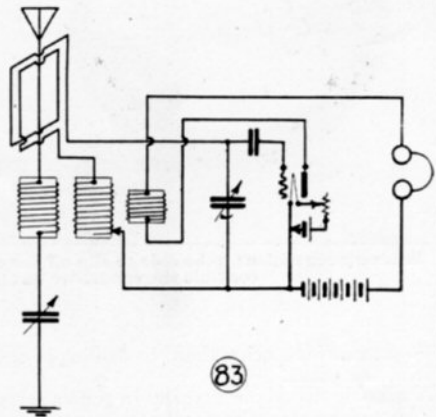
circuits. Sometimes taps are taken from a loop to vary the inductance over a wide wavelength range altho this is not generally satisfactory because of the tendency of the unused turns to absorb energy from the active turns. Loop receiving sets operate indoors as well as outdoors.



82

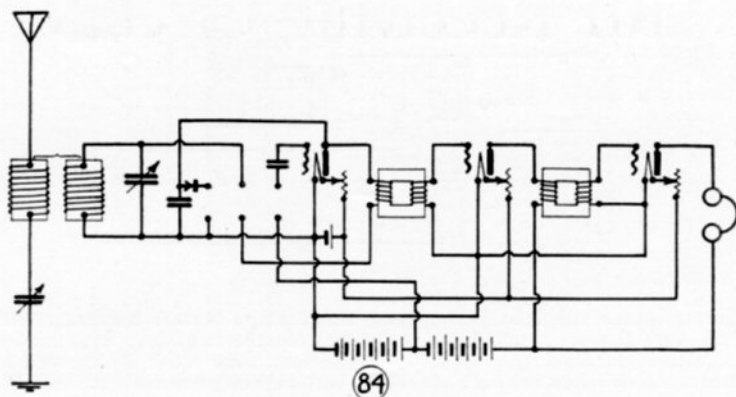
82. This is simply formed of regenerative loop receiver in which an inductance is connected in series with the loop and coupled to a coil in the plate circuit. A variable condenser across the grid and filament control the wavelength to which the set is tuned. Audio frequency amplification can be added by inserting the primary of the first amplifying transformer in place of the telephones.

83. An ordinary loop antenna receives with maximum intensity from stations 180 degrees apart. That is called a bilateral loop. The unilateral loop, however, receives in only one



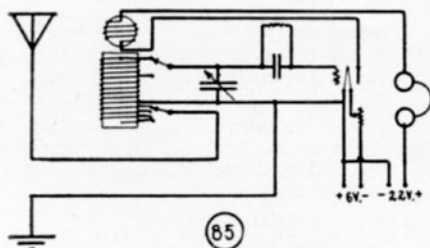
83

direction. This receiving set has a regenerative circuit composed of the plate inductance coupled to the grid coil in series with the loop and in addition a second coil is coupled to the grid inductance. It is in series with the antenna, a variable condenser, and the ground. When the antenna coil is rotated it increases the signals received on the loop, in one position or decreases them when turned 180 degrees. Having once determined the action of the antenna coil by receiving from a station in a known direction the side of the loop nearer the transmitter, when signals are received at maximum intensity, can be determined.

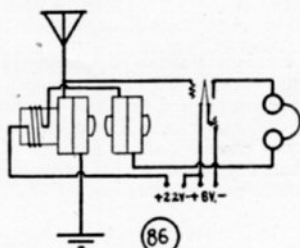


84. Some experimenters like to arrange their receiving sets so that they can either use an audion or crystal detector in connection with a 2-step audio frequency amplifier. In this circuit a double pole, double throw switch changes the amplifier from the crystal to the detector. Interesting comparisons can be made in this way between the sensitiveness of the two types of detectors. Moreover, it sometimes happens that the tube is not operative

and a crystal must be relied upon. When the audion is in use regeneration can be obtained by inserting a tickler coil in the detector plate circuit coupled back to the secondary inductance of the loose coupler. As in other cases inductances are shown as fixed when they might be variable if it is the desire of the experimenter to cover a wider range of wavelengths than is possible by means of the condenser alone.

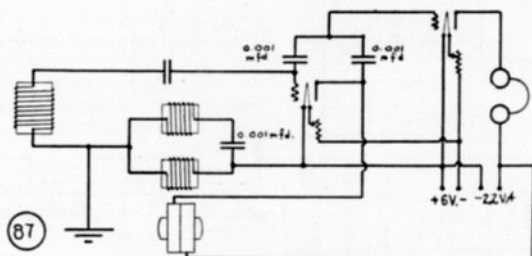


85. A very popular and dependable circuit is shown here, one with which splendid long-distance work has been done. The tuning inductance may be an ordinary variocoupler tapped for the antenna switch at the first 4 turns and for the grid stopper about 10 turns from the end and at the end. This is an adaptation of the Rheinartz Tuner, using the ball in place of the second condenser otherwise employed. Note that the antenna circuit is practically untuned, although the set itself is very



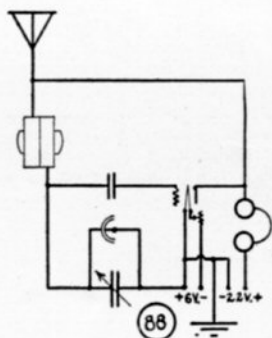
sharp, comparing favorably with a 3-circuit set.

86. In this two variometer circuit the tuning in the antenna is accomplished by one variometer and in the plate by a variometer and a fixed inductance, coupled closely to the antenna variometer. It is necessary to obtain the proper relation between the two variometers as to the direction of the turns, for the working of the set depends upon the coupling between the two variometers as well as upon their individual settings.

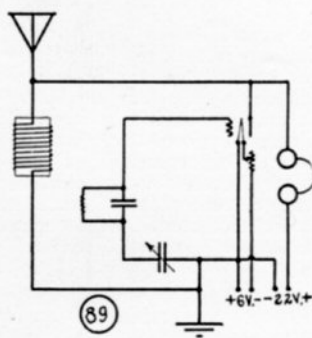


87. No ground is used with this receiving set although very long-distance work has been accomplished with it, particularly when a two-step audio frequency amplifier has been added. Tuning may be accomplished by means of a switch on the left hand inductance or it can be

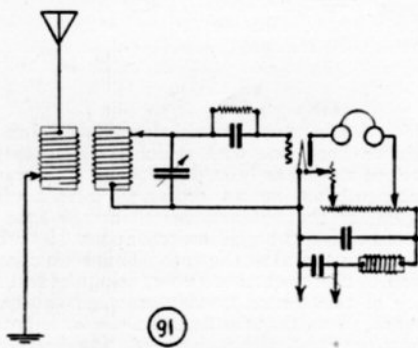
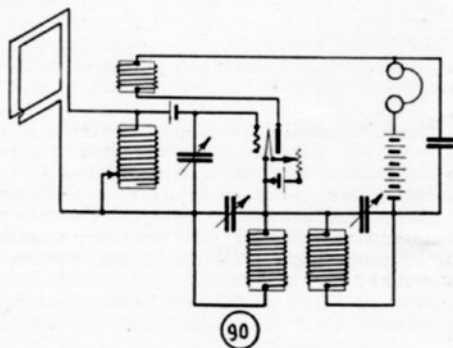
shunted by a variable condenser. The coupling between the two right hand inductances and the variometer must be adjusted for the best results. Regeneration is accomplished through the use of the two condensers across the grid and plate.



88. Here is one of the popular single circuit, single tube sets for broadcast reception. The tuning is accomplished with the variometer and variable condenser, the latter shunted by a vernier condenser for sharp tuning. It will be found that the rheostat adjustment exercises some control over the tuning.



89. This is an alteration of No. 88, using only a variable condenser for tuning. The inductance may be of the ordinary type or a honey-comb coil of about 70 turns. Coupling between the grid and plate circuits is accomplished by connecting the plate to the antenna side of the coil.



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EDITORIAL

A RADIO CRUISE! What thoughts do those words bring to your mind? Visions of an ocean voyage? Radio tests and experiments on board? Seeing radio apparatus as it is designed and built in foreign countries? And with it all a wonderfully interesting and exciting series of experiences?

That's just what I've had in mind ever since I got back from my second radio cruise last Christmas. I've been turning the idea over and over in my mind until I now have it ready to present to you.

Here it is—Let's get together a group of Experimenters and engineers from the larger radio companies for a real Radio Cruise. About the end of this September let's take one of those comfortable ships, such as the Celtic or the Baltic, 20,000 tons, and set sail for England. On the way, in addition to getting acquainted all around and going in for the various social events and the sports let's do a little experimenting in long distance reception. Arriving in Liverpool, let's visit a little as we swing round to London, where we can meet and exchange ideas with the English manufacturers and Experimenters, and spend some time in those fascinating scientific museums. If the Radio Show is held on the same date that it was last year, we shall be just in time for it. Next will come a hop by airplane over to Paris, an opportunity to visit other plants and the museums there, and finally take the boat home to New York.

What do you think of it? I can tell you from my own experience that there is so much to see and do that I could go twice a year every year and then not see and do as much as I would like to. Aside from the scientific interest there is a world of fun in making such a trip in company with the splendid lot of men we always find in a gathering of radio enthusiasts. This will not be, of course, a conventional "conducted tour", but just a trip planned so that each one can follow up the things, as we go along, which appeal most to him.

By grouping the expenses the individual expense can be greatly reduced, brought down, in fact, to a point where the cost will not be excessive. If you can make this trip next September, write in for the details. Information about the trip and expenses will be ready on March 15, and the full itinerary will be published next month in R and M. Are you going to be on board when the whistle blows?

The new question now-a-days is, "What's this wired wireless"? Part of the answer is easy— It's a system for rented receiving sets to pick up entertainment over the electric light or telephone wires. But how will it effect broadcasting? Interested officials don't answer that. It is plain, however, that if it could be put across on the general scale planned, broadcasting would be discouraged to the point that we would have only code to copy, as in the old days.

Fortunately the same Experimenters and Boiled Owls who are really responsible for the fact of broadcasting will prevent the use of wired wireless to the exclusion of radio broadcasting. Why? Just for the reason that it is as easy to connect a radio set to an electric light wire as to an antenna. Consequently, there will be little advantage in renting a wired wireless set when the present one will do. And if the electric light or telephone company wants people to use their own sets instead of renting others, they have only to announce a rule that no instruments are to be connected to the wiring!

While wired wireless has its uses, it is not practically suited to the use of the public, and it will be as difficult to protect against listening-in by people who do not pay the rental as it is to prevent the sale of rheostats because they are to be used with the patented vacuum tubes. It appears that the discussion of wired wireless is most likely a part of the radio control scheme, as is the suit recently started against Grebe and Bunnell to stop the manufacture and sale of radio apparatus employing vacuum tubes. Incidentally, if that suit should be successful, all Armstrong licenses would then become worthless.

M. B. SLEEPER,

Editor.

The Sleeper Circuit Set

A long receiving range is combined with sharpness of tuning and ease of construction in this short-wave outfit.

How the Set is Made up.

A COUNTLESS number of new circuits have been brought out in the last few months, usually recommended as being cheap and sensitive. Many of these sets are cheap but the results obtained with them are usually surprising only in so far as the builder's experience has taken him. In the outfit described here simplicity and satisfaction in operating have been achieved at a moderate price. Moreover, long distance reception has been accomplished which compares very favorably with much more elaborate outfits. There is nothing revolutionary about the circuit, how-

ever, variable condensers are employed. In fact, there are only 15 small holes to be drilled through the shield. This feature also makes the wiring and assembly very much neater and does away entirely with the sliding contacts.

Binding posts on the front of the panel, at the left, provide connection to the antenna and ground, at the right, to the telephones or amplifier, while the battery posts are carried at the rear of the base panel, inside the cabinet. These are reached through three small holes drilled in the cabinet.

Like other sets which have been described previously, this outfit is arranged to be used

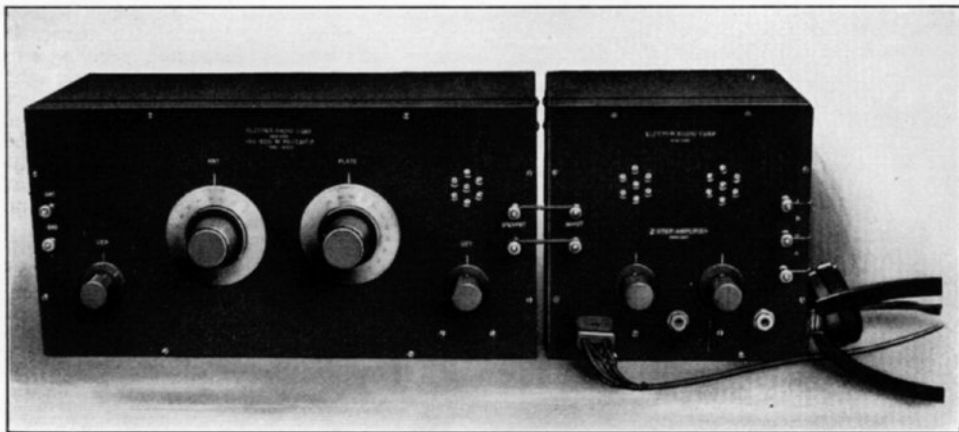


Fig. 1. The two controls are worked simultaneously until the signals are brought up to maximum strength

ever. On the other hand an excellent combination has been achieved and efficiency brought to the highest point by the proper selection of constants.

The completed set is shown in Fig. 1 and the interior layout in the subsequent illustrations. A variometer is connected in the antenna circuit with the detector across it. There is also a vernier condenser around the variometer, and another variometer, as closely coupled as possible to the first, is inserted in the detector plate. The panel is shielded with a thin aluminum sheet to prevent capacity effects. In view of the present agitation against regenerative receivers it is interesting to note that this set operates best when it is not oscillating.

Unlike other types of shielded receivers there is no cut-out work to do because no switches or

with the type 3100 2-step amplifier, already shown. With this addition the set can be operated with a loud speaker on signals up to a very considerable distance.

Construction Work Required.

This set, indicated for reference purposes type 4000, calls for no construction work other than drilling, since the vernier condenser, variometers, rheostat, and socket are mounted just as they are furnished. The front panel, of L. P. F., measures $7\frac{1}{2}$ by 15 ins., 3-16 in. thick. A thinner panel can be used but this is not advised because the weight of the variometers is liable to make the panel sag. The cabinet shown in Fig. 1 is made with a strip across the front so that it is possible to fasten the panel on all four sides. This prevents any tendency to warp and gives additional strength to the panel. You can pur-

chase a cabinet such as the one shown here already made up, well finished, of polished mahogany, or, if you prefer, you will not find it very difficult to make up your own providing you have the simple wood-working tools necessary.

If you do not want to take care of the drilling and engraving of the panels yourself you can buy them with this work already done.

Standardized Parts Necessary. The variometers shown were chosen because of the high inductance ratio which gives a longer wavelength range than with other types. On an antenna of 0.0001 mfd. the wavelength range is 169 to 653 meters. A

Laying Out the Panels.

Fig. 5 gives a one-half size drawing of the front panel, with one-half scale drawings of the shield and base panel in Fig. 6. To get the location of the holes on your panel, measure the distance, on the drawing, from the top of the panel to the center of the hole and double it. Then scratch a line, with your combination square and scribe, parallel to the top of the panel, that distance down. Repeat the operation from the side. Where the two lines intersect make a mark with a center punch for drilling. Drill sizes are given by number or fraction of an inch. Two concentric circles indicate that countersinking is required for flat head screws.

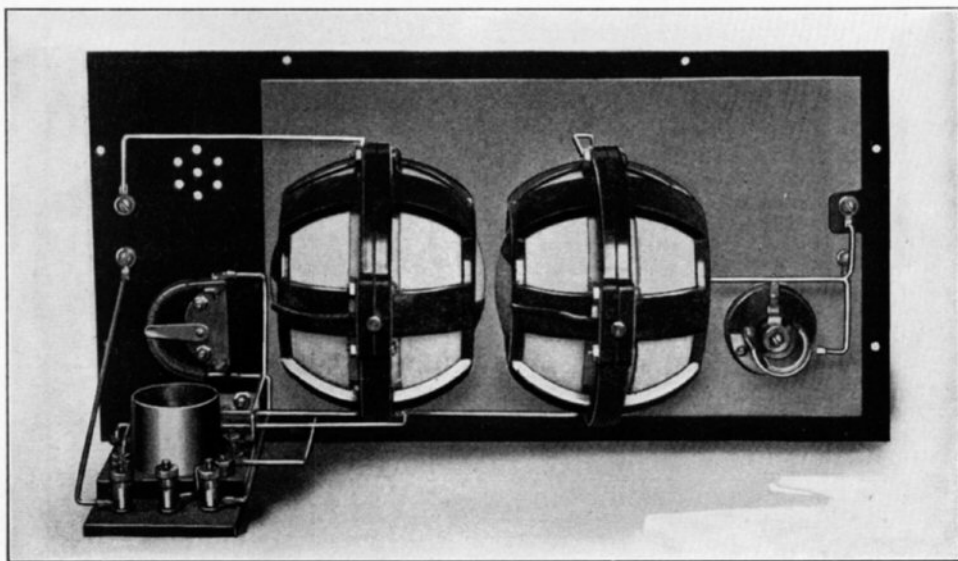


Fig. 2. Only twenty-three soldered connections are required for this set, indicating the simplicity of the wiring

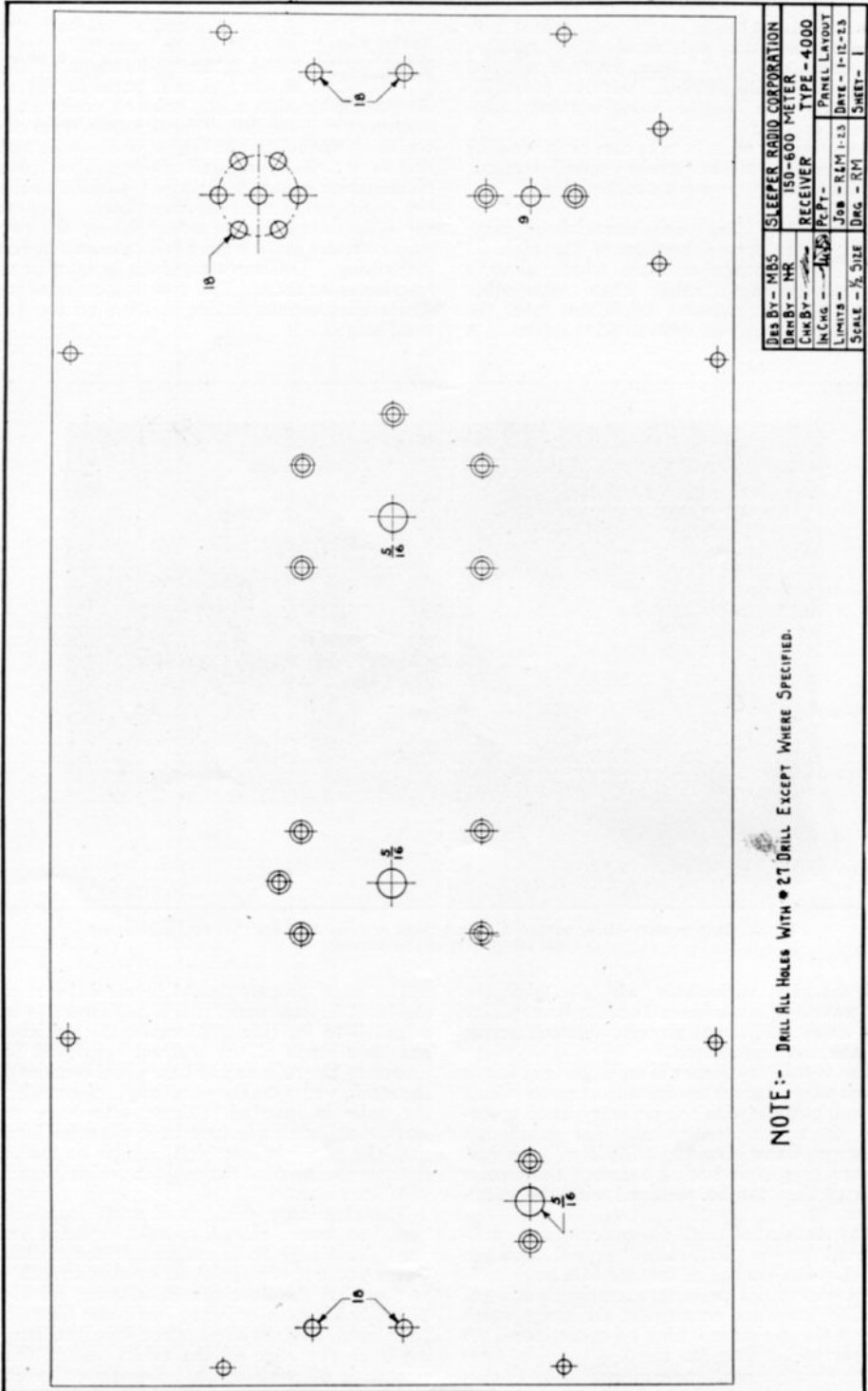
high-capacity variometer will not give the low wavelength minimum because its capacity acts as an additional amount shunted across the antenna and ground.

The vernier condenser is an important factor in this set as it gives the fine adjustments which are not possible with the ordinary hand operation or a gear reduction. The maximum capacity of the vernier, 0.000025 mfd., is just enough to permit tuning between the closest settings that can be obtained with the variometer.

Any rheostat of small dimensions can be substituted for the "half-moon" type illustrated, but this one has the advantage of a large cooling surface which prevents excessive heating of the fibre strip and consequent shrinkage which allows the resistance wire to come loose. A Sleeper socket just fits the 2½ by 6 in. base panel, giving a neat appearance.

The same process should be carried out on the L. P. F. base panel which measures 2½ by 6 ins., 3-16 in. thick. Occasionally criticism has been made of the method employed for mounting the tube socket base panel because of the strain put upon the small angle pieces when the tube is inserted. Those who have remarked about this feature have not considered that the panel is just high enough so that it rests on the inside of the cabinet, which is made of ¾ in. wood.

The aluminum shield is of 0.020 in. thickness, just heavy enough to hold its shape and yet light enough to be cut and drilled readily. When you cut out the sheet to size scratch it first so that the lines can be followed readily. Then, holding an ordinary hack-saw blade in your hand, saw the sheet when it is just hanging over the edge of the table. After that smooth it off with a file. Remember to cut



NOTE:- DRILL ALL HOLES WITH #21 DRILL EXCEPT WHERE SPECIFIED.

Fig. 5. Exactly one-half size drawing of the front panel, from which the location of the holes can be scaled off. Remember the extra holes near the variometer, used for connections to the shield

out a generous amount to clear the antenna binding post. In drilling, put the panel on a block of wood, run the drill at high speed, and use the least possible pressure. A good finish can be put on the shield by rubbing it down with No. 0 sandpaper and oil.

Instructions for Assembly. 1. Fasten the metal shield onto the back of the front panel, holding it in place with the two $\frac{3}{8}$ inch 6-32 F.H. machine screws and nuts placing a soldering lug between the plate and each nut for connections indicated as 23 and 10 in Fig. 7.

2. Of the seven binding posts furnished, take the four with the round head machine screws apart, slip a soldering lug between each washer and screw head, and fasten them so as to have the posts on the engraved or front side of the panel, numbers 6, 7, 11 and 13.

These are the antenna, ground, and output terminals.

All lugs are indicated by short heavy lines, and should point in the directions shown.

3. Mount the vernier condenser with the screws furnished. Set the revolving section in mid-position as depicted. Slip the knob on the shaft so as to have the line on the knob coincide with the line on the panel. Tighten set screw in the knob.

4. Place the rheostat in position. Shift the rheostat contact arm to the bare portion of the resistance elements as shown. Slip the knob on the shaft, and tighten set screw in the knob, when the engraved markings on the knob and panel are in line. Make sure a firm contact exists between the switch arm and the rheostat winding.

5. Next, assemble the two variometers, using the machine screws and nuts supplied. Be sure that the terminals are arranged so that the turns on the stators are in the same direction and also on the rotors when they are set at maximum. This is very important.

6. Now take the base panel and fasten to it the two 1 in. angle brackets with two $\frac{3}{8}$ in. 6-32 F. H. machine screws.

7. Fasten the remaining three binding posts with the flat head machine screws to the base panel with a soldering lug between each post and washer.

8. Mount the socket in place. See that the slot is in the relative position depicted. Failure to observe this precaution may mean the burning out of the vacuum tube.

9. Screw the base panel to the front panel with two $\frac{3}{8}$ in. 6-32 R. H. machine screws and nuts. You are now ready to wire the set.

10. Connect 1 to 2. To do that, first fit a piece of square tinned wire from 1 to 2, running it as directly as possible, with right angle bends, but avoid contact with any intermediate metal or wire. Then solder the terminals neatly. For all other connections use this fitting and soldering process. Use the least possible amount of soldering paste, and keep the iron hot enough to make the solder run freely.

11. In the following order mentioned, con-

nect 3 to 4, 5 to 6, 7 to 8, 9 to 10, 11 to 12, 13 to 14. Run another wire from 12 to 15, 15 to 16, the latter being a lug attached to a small grid condenser. 17 to 18, 19 to 20, 21 to 22. Also run a wire from 4 to 23.

This completes the wiring, and the set is ready to be tested.

Testing and Operation.

Do not put the set into the cabinet until you have tested it and found it O. K. Connect the antenna and ground to the left hand posts, the phones at the right and the batteries according to the markings in Fig. 7. Do not put on the plate battery until you have

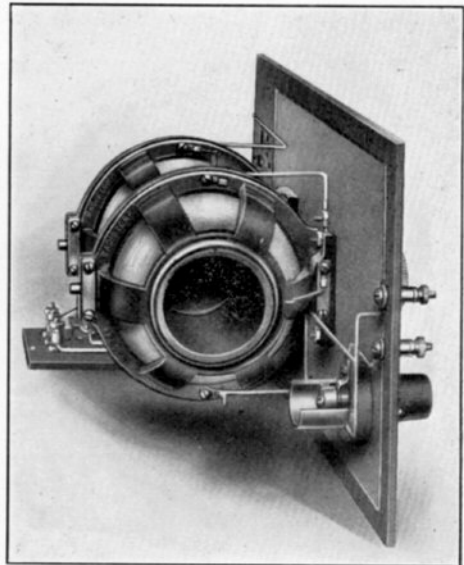


Fig. 3. The side view shows details of the variometer mounting and the vernier condenser

tried the filament circuit of the tube, so as to prevent any possibility of burning out the tube from an error in wiring.

The antenna should be quite short, perhaps not more than 50 feet in total length. In testing out this set we have used simply a 30 foot length of No. 24 B. & S. gauge bare copper wire (No. 22 S. W. G.) run along the floor. If an antenna of much more than 50 feet in length is employed it will probably be necessary to connect a fixed condenser of 0.0005 mfd. or a variable condenser having a maximum capacity of 0.001 mfd. in the antenna lead.

To operate the set put the vernier condenser half way out, the antenna variometer at minimum and the plate variometer at almost maximum. Light the tube to normal brilliancy. As soon as a station is heard, vary the antenna variometer for maximum signal strength, then the plate variometer and finally the rheostat. Then adjust both variometers

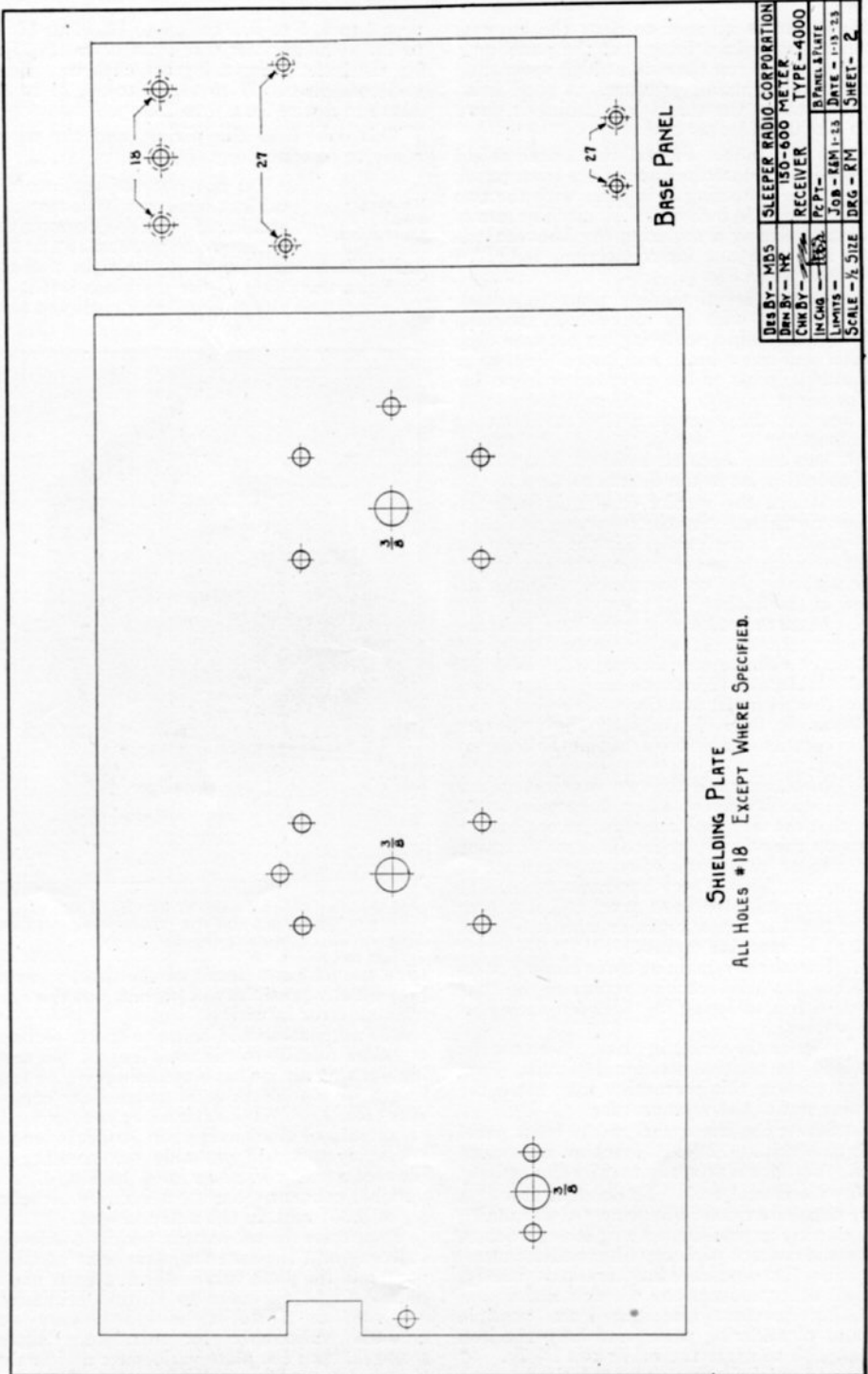


Fig. 6. Exactly one-half size drawings of the aluminum shield and base panel. A notch is cut in the shield to clear the antenna binding post

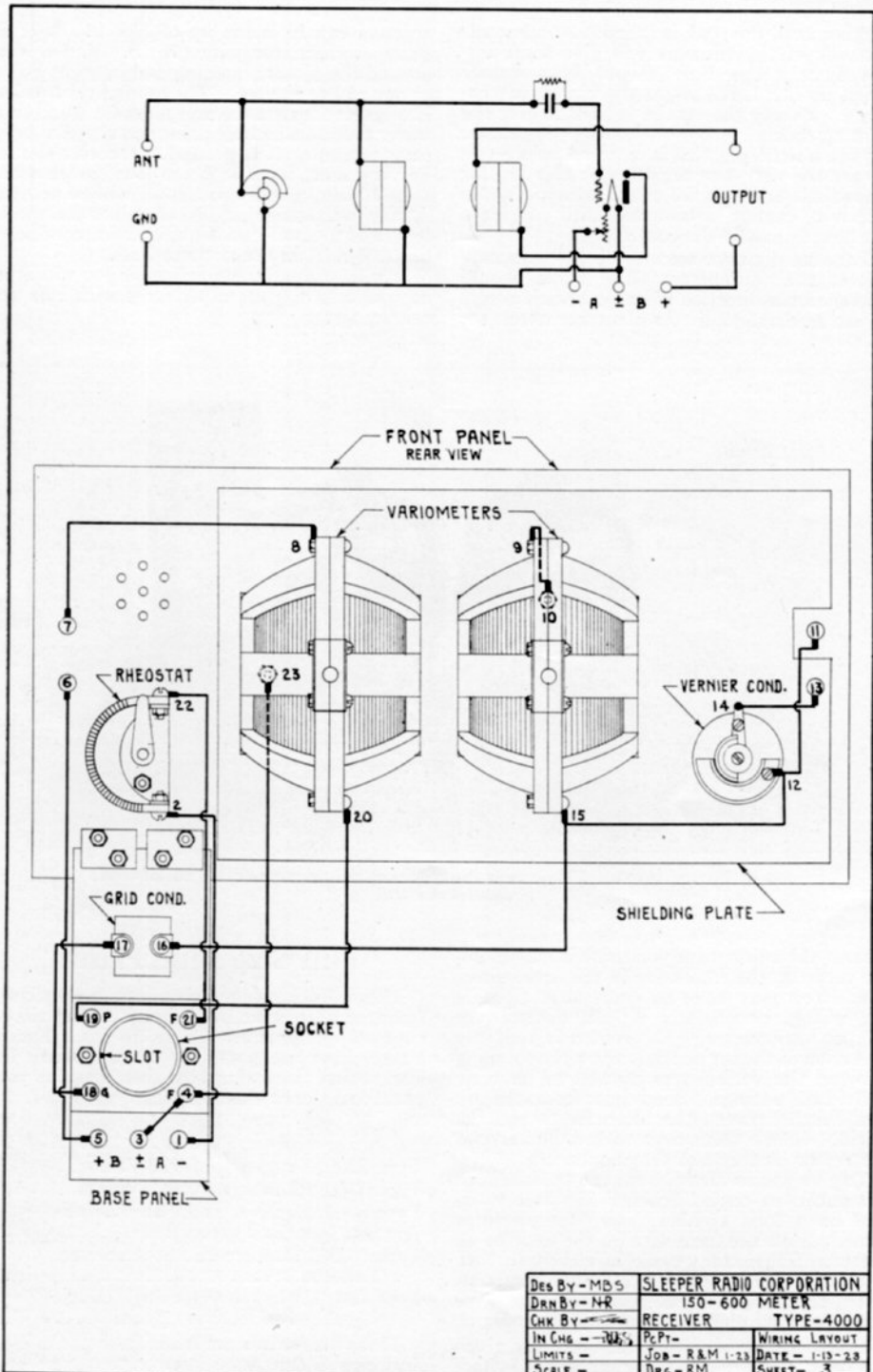


Fig. 7. Schematic and picture diagrams of the connections

together until the peak is found. Another adjustment of the rheostat will give some improvement. The tube should burn rather dimly, for if it is too bright the circuit will oscillate. Finally the vernier is used to give the finishing touch.

Quite a little practice is required before you can get the very best results with this set, for it has little tricks of its own. Moreover, the selectivity cannot be obtained until you learn just how to handle the controls.

If the set does not seem to operate properly look at the variometers. The turns should be in the same direction when both variometers are set at maximum. As a further check see

antenna can be made up of No. 18 B. & S. gauge annunciator wire (16 S. W. G.) run around the picture molding and brought down at one end to the set. The ground connection is of great importance and must be made to a water pipe on which all paint and rust has been scraped away. The ground connection should be very short for if it is too long, much more than 10 feet, a series condenser will be needed. A very inexpensive method to reduce the wavelength is to connect a Dubilier mica condenser of .0005 mfd. in the antenna lead.

It will be greatly appreciated if you will send any reports of your experiences with this receiving set.

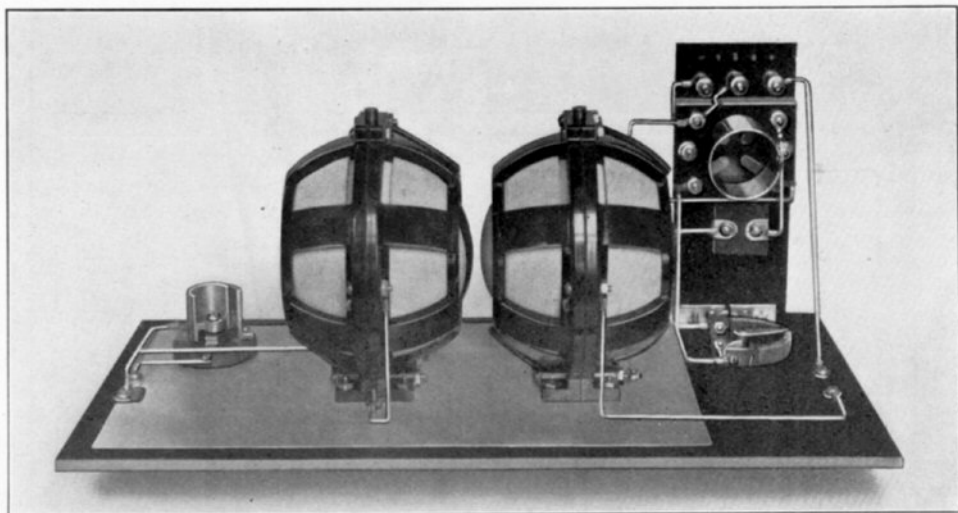


Fig. 4. Having the shield cover only the space behind the vernier and variometers simplifies the drilling

that, at the adjustment you think is maximum, the turns on the rotors are in the same direction. You may have to make alterations in the wiring, particularly if you do not use Sleeper variometers. The reason is that the operation of the set depends upon the coupling between the variometers as well as on their individual settings. Sometimes contacts are established between the instruments and the shield. Check them over with a buzzer and battery or battery and telephones.

To give you an idea of what can be done with this outfit, we copied Schenectady from Hartford on a loud speaker, using the detector alone. With the bare wire on the floor as an antenna, Schenectady came in clearly in New York when we were using telephone receivers. With the amplifier western stations were copied without difficulty on an indoor antenna.

Unlike other sets this receiver has given excellent results on indoor antennas. Bare wire is not, of course, recommended. A better

Full Size Blue Prints

The following blue prints can be obtained from the Blue Print Department. They are on sheets approximately 11 by 16 ins. Except where otherwise noted the drawings are full size, so that you can put the sheet right on your panel and punch them to locate the holes.

Type X-1900, 150 to 600 meter regenerative receiver, 3 sheets	\$.75
Type 3100, 2-step amplifier, 3 sheets75
Type 3300, Rheinartz tuner, 4 sheets	1.00
Type 3900, Receiver and 2-step amplifier, $\frac{1}{2}$ scale, 2 sheets50
Type 4000, Sleeper Circuit Receiver, 3 sheets75
Type 4100, 150 to 700 meter single circuit regenerative receiver, 2 sheets50

These blue prints are made from the original drawings which have been reproduced in R and M.

Back Numbers Still Available

The following numbers of R and M are available to those who want to complete their files. Of some issues only a few remain, so that orders will be filled in rotation, and money refunded if copies cannot be sent. Copies listed last month but which do not appear here cannot be supplied, nor can we furnish any issue, at any price, which is not shown.

The months and feature articles are listed below:

June 1921	Design of loose couplers.
Oct. 1921	Radio frequency amplifier and tuner.
Dec. 1921	Transmitting rectifier, short wave set.

Standardized Parts for the Type 4000 Receiving Set

These parts can be obtained from the Sleeper Radio Corporation, 88-F Park Place, New York City, or from your local dealer. In ordering by mail be sure to give the part numbers and the type number of the set for which the parts are intended. Remember the postage.

A-5-D	1—Polished mahogany cabinet 7½ x 15 x 6½ in.	\$ 5.50
33	1—L. P. F. panel 7½ x 15 x 3-16 in.	2.97
30	1—L. P. F. panel 2½ x 6 x 3-16 in.	.39
A-101	2—Moulded variometers	15.00
A-95	1—Vernier condenser	1.75
A-20	2—100° knobs and dials, ¼ in. hole	2.00
A-1-X	1—Audion socket	.80
A-22-X	1—Rheostat	1.00
A-4	1—Gridleak condenser	.50
A-10	4—Polished nickel binding posts, R. H. screws	.40
A-85	3—Polished nickel binding posts, F. H. screws	.30
22	1—1 in. nickeled angle bracket, right hand	.10
185	1—1 in. nickeled angle bracket, left hand	.10
58	1—Pkg. 25 tinned lugs	.20
71	1—Pkg. 10 6-32 ¾ in. F. H. nickeled screws	.12
141	1—Pkg. 10 6-32 ¾ in. R. H. nickeled screws	.12
49	1—Pkg. 10 6-32 nickeled nuts	.08
47	3—2 ft. lengths square tinned cop- per bus bar	.15
140	1—Pkg. 10 No. 6 ½ in. nickeled wood screws R. H.	.14
210	1—Sheet aluminum, 0.020 in. thick	.50

SPECIAL ITEMS

Drilling front panel, extra	\$ 1.25
Drilling base panel, extra	.35
Engraving front panel, extra	3.85
Engraving base panel, extra	.30
Type 3100 two-step amplifier in 7½ x 7½ in. mahogany cabinet, complete	35.00
Set of parts, panels drilled and engraved, for amplifier ready for assembly	28.00

Apr. 1922	3-step radio frequency amplifier.
Aug. 1922	2-step audio frequency amplifier for X-1900, Rheinartz, long wave, short wave, and Sleeper circuit re- ceivers.
Oct. 1922	Loop receiver, wavelength, induc- tance, capacity tables.
Nov. 1922	2-tube transmitter, Inductance tables for receiving set coils.
Jan. 1923	Non-regenerative set with detector and 2-step amplifier, X-1900 super range receiver.

The price of these copies is 10c., with 1c. postage on each magazine. Don't delay about ordering your copies, the supply of Sept. 1921, July 1922, and December 1922 has been exhausted already during the past month.

Standardized Parts for the Type 4100 Receiver

A-6	1—Mahogany Cabinet 7½ x 10 x 6½ ins.	\$5.00
38	1—L. P. F. Panel 7½ x 10 x 3-16 ins.	1.97
30	1—L. P. F. Panel 7½ x 6 x 3-16 ins.	.39
A-204	1—Short Wave Tune-a-Meter	10.50
A-16	1—23-Plate Variable Condenser	3.50
A-20	2—100 Division Knobs and Dials	2.00
A-1-X	1—Audion Socket	.80
A-9	1—Locked Lever Switch	.60
A-22-X	1—Rheostat	1.00
	1—Split-a-Meter Vernier Condenser	1.75
A-13	4—Switch Points with Nuts	.16
A-28	4—Stopping Points with Nuts	.29
A-4	1—Gridleak Condenser	.50
A-10	4—Polished Nickeled Binding Posts, R. H. Screws	.40
A-85	3—Polished Nickeled Binding Posts, F. H. Screws	.30
22	1—1-in. nickeled angle bracket, right	.10
185	1—1-in. nickeled angle bracket, left	.10
58	2—Pkgs. of 25 tinned lugs	.40
71	1—Pkg. 10 6-32 ¾-in. F. H. screws, nickeled	.12
141	1—Pkg. 10 6-32 ¾-in. R. H. screws, nickeled	.12
140	1—Pkg. 10 No. 6 ½-in. R. H. wood screws, nickeled	.13
49	1—Pkg. 10 6-32 nuts, nickeled	.08
91	1—2 ft. length Empire tubing	.25
47	4—2 ft. lengths square tinned cop- per bus bar	.20

SPECIAL ITEMS

Drilling front panel for type 4100 set, extra	\$1.40
Drilling base panel, extra	.28
Engraving front panel, extra	3.95
Engraving base panel, extra	.30

AUXILIARY PARTS

Deveau Gold Seal phones, 2,200 ohms	\$8.00
Radiotron detector U. V. 200 tube	5.00
Radiotron amplifier U. V. 2 O 1-A	6.50
Eveready B battery, 22½ volts, weight 3 lbs.	2.50
Eveready B battery, 45 volts, weight 5 lbs.	5.00
T-1 12-in. Starrett combination square	3.60
T-6 Vulcan electric soldering iron	7.50
T-8 Automatic center punch	2.40
T-12 Starrett scriber	.35
T-13 Starrett 6-in. dividers	2.10

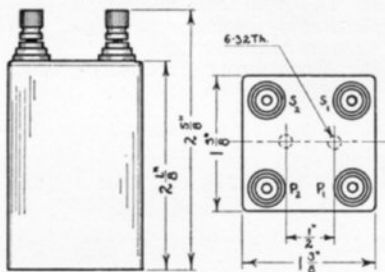
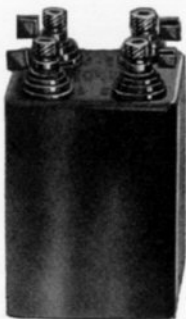
SPECIAL! A set of 2 blue prints has just been prepared giving preliminary data on the construction and use of the new Hazeltine Neutrodyne Circuit, the most remarkable development since regeneration.
PRICE, \$1.00. These drawings will not be published in R. and M.

SLEEPER

Radio

CONSTRUCTION SETS

A complete series of standardized parts designed to work together, both electrically and mechanically. This equipment is planned particularly to meet the requirements of the Experimenter who builds his own apparatus



Sleeper Radio and Audio Frequency Transformer

Description: The A-14 or A-25 transformer is a compact, capable looking instrument, in appearance quite in keeping with the splendid workmanship inside and its high-test electrical characteristics. Designed for use by Experimenters or novices who want to minimize the possibility of transformer trouble, SLEEPER audio and radio transformers meet that requirement fully. One manufacturer who equips his sets with A-14 and A-25 transformers, says, "Our factory inspectors have never rejected a set, during the final tests, because of defects in your transformers." As a distinction between the radio and audio types, the former is supplied in a red bakelite case and the latter in a black case.

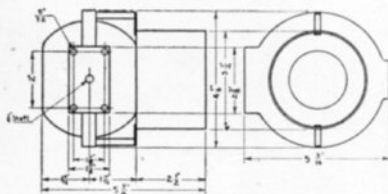
Application: Except for the special tuned radio frequency amplifier (described in Radio and Model Engineering, April 1923) radio frequency amplification is not applicable to regenerative circuits. Moreover, there is not enough gain in the second step of radio frequency to justify its use. Therefore, radio frequency transformers should be used only in non-regenerative circuits. (See diagrams in 101 Receiving Circuits). Experimenters are sometimes disappointed in the results obtained with radio frequency amplification because they expect as much signal increase from a radio as from an audio transformer. Actually radio amplification gives only a small increase on local signals, but a larger increase on distant stations. It also reduces interference and outside noises such as static and induction humming. These transformers are for reception on 200 to 500 meters.

Audio frequency amplifiers give a moderate amplification at the first step and a very large increase at the second. SLEEPER audio transformers, because the ratio, 1 to 4, is small, produce a high and constant amplification over the entire range of audio frequencies. High ratios cause distortion because they give greater amplification at some tones and less on others. It is important, therefore, to choose a transformer having a constant amplifying factor, or you will be disappointed in the quality of speech and music.

A very important point about SLEEPER transformers is that the windings are designed to operate with W. D. 11 and 201-A tubes. This special feature is not found in other transformers.

Specifications: Mechanical dimensions are shown above. Case is of polished bakelite, with nicked fittings. Audio Frequency type: Core is of the closed magnetic circuit type, preventing interaction between transformers even when they are placed side by side. Special high permeability iron is used. Winding is of No. 44 enamelled wire, insulated in the waxed paper between each layer. Ratio 1 to 4. Insulation is designed to withstand 150 volts, though higher voltages are frequently used. Impedance of primary 20,000 ohms. Radio Frequency type: Mechanical dimensions and finish the same. Air core, anti-resonance type, winding No. 40 enamelled wire, insulated for 120 volts. Ratio is 1 to 1.7. Wave length range 200 to 500 meters, with a peak at 380 meters.

Price: Type A-25 Sleeper radio frequency transformer, mailing 10c..... \$4.00
 Type A-14 Sleeper audio frequency transformer, mailing 10c..... 5.00



Sleeper Tune-a-Meter

Description: Combination of variometer and adjustable inductance has been worked out for the Tune-a-Meter so that it can be connected in a single circuit receiving set of the type so popular for long distance reception with a single tube. For a single circuit regenerative set the inductance is connected in the antenna circuit and the variometer in the plate circuit of the tube. Two types are furnished, one for reception on wave lengths of 150-700 meters and the other for 150-2600 meters. The regular SLEEPER moulded variometer is employed with coil wound with No. 24 wire on a Bakelite tube. The coil for the short wave coil is of one layer and coil for the long wave coil is wound in four banks. Full length taps are brought off so that they can be connected directly to the switch points without any extra soldering. The unit is furnished ready to mount on the panel by means of four machine screws and nuts.

Application: In the "Red Book" designs are given for complete sets employing the short wave and long wave Tune-a-Meter. The short wave Tune-a-Meter is connected specifically for broadcast reception. Although the long wave Tune-a-Meter gives excellent results on 360 to 400 meters, some slight efficiency is sacrificed in order to reach the long waves on which time signals and other interesting transmitting is done. A short antenna is recommended for use with Tune-a-Meter sets as that tends to sharpen the tuning and overcome the only objection that has been raised against single circuit sets. An advantage in the use of the Tune-a-Meter is that as auxiliary equipment only a 23-plate variable condenser is required in addition to the usual audion detector, socket and rheostat, so that a splendid set for long distance receiving can be made up at a very small price.

Specifications: Mechanical dimensions are given in the sketch above. The variometer is of moulded Bakelite. Shaft $\frac{1}{4}$ in. diameter. Inductance range 0.08 to 1.20 millihenrys. Maximum inductance of short wave Tune-a-Meter 0.07 millihenrys; long wave Tune-a-Meter 10.0 millihenrys. Nickel plated metal parts and very best finish employed throughout.

Price: Type A-204 Sleeper Tune-a-Meter, 150 to 700 meters, mailing 15c. \$10.50
Type A-205 Sleeper Tune-a-Meter, 150 to 2600 meters, mailing 15c. 12.00

SLEEPER RADIO CORPORATION

88 Park Place, New York City

English Agents: Melchoir, Armstrong & Dessau, 111 Gt. Portland St., London

WELSH

PEANUT

TUBE

W.T. 501

"The Tube That Cannot Squeal"

Sold for experimental use as a detector only

\$2.00

Actual size $2\frac{1}{4}$ inch. without socket.

Long Life. Uses only $\frac{1}{2}$ amp. on three dry cells or regular six volt "A" battery. Plate voltage 16-22 $\frac{1}{2}$ v.

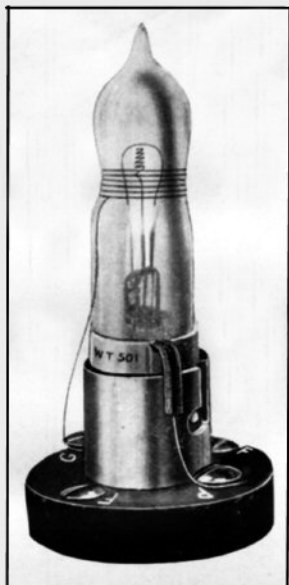
Special Nickel plated socket, moulded base, double spring contacts, 40c. extra.

Adapters to fit Standard V.T. Sockets, 75c. extra.

Wiring diagram packed with each tube showing how to use the W.T. 501 with any crystal set.

Show this ad to your dealer. If he hasn't got his stock yet, send us his name and a money order covering the price of the tube and socket and we will send direct by insured parcel post.

We cannot fill orders which do not give your dealer's name.



RADIO TECHNICAL LABORATORIES
MANUFACTURERS



Dec. 2, 1922

Radio Research Guild. re TEST 112922
Newark, New Jersey.

Gentlemen:

The W.T. 501 detector tubes submitted to us for test are being returned to you today with test records.

These records we consider speak favorably of the high quality of your tubes particularly in view of the low current consumption.

The detectors function clearly, with good volume and a minimum of distortion. We have carefully tested each tube individually and over a wide range of conditions. We also note a complete absence of any tendency to howl. Answering your other question specifically: We believe your method of construction renders it practically impossible for it to howl. We believe you are quite justified in advertising your W.T. 501 detector tubes as "The Tubes Which Cannot Squeal".

Respectfully yours

Radio Technical Laboratories.

[Signature]
K. per Chief testing dept.

RADIO EXPERIMENTERS' LEAGUE
"RUN BY AMATEURS FOR AMATEURS"

NEWARK, N. J.

Dec. 9, 1922

Radio Research Guild
9-15 Clinton Street,
Newark, N.J.

Gentlemen:

Thank you for your promptness in shipping us the 100 W.T. 501 detector tubes.

We have tried them out on all sorts of hook-ups and the members are enthusiastic about them.

From now on no one needs to bother with a crystal set as you have placed the price of a tube within the reach of everyone. We are glad to place the W.T. 501 PEANUT tube on our list of approved apparatus and are so notifying our members.

The enclosed order for 300 more tubes is for use here locally and we certainly hope you will rush them to us---our members are clamoring for them.

You are to be congratulated on what you have accomplished. The W.T. 501 surely is "The tube without the squeal!"

Sincerely yours

Radio Experimenters' League.

[Signature]
per Secretary

WG/ee.

Hook the W.T. 501 right up with your crystal set. No need to discard any apparatus. (Full directions packed with each tube.) If you own a tube set use the W.T. 501 and the special adaptor to fit V.T. socket.

RADIO RESEARCH GUILD

9-15 Clinton Street

Newark, N. J.