



Five Tube Receiver

**Complete Building Instructions
For the SC-II**



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RADIO APPARATUS

How to Build the SC-II Receiver

Authoritative Data on the 5-Tube Shielded Receiver
Designed by McMurdo Silver and
Laurence M. Cockaday



Containing Full Description, List of Parts, Wiring Instructions, Photographs and Details of Assembly and Proper Operation of This Remarkable Radio Receiver

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THE S-C II receiver has been designed by Laurance M. Cockaday and McMurdo Silver with the idea of providing a radio receiver possessed of practically all the mechanical and electrical details of the finest factory-built receiver plus a quality of reproduction not obtainable in any except the most expensive of factory products.

The S-C II receiver will provide sufficient volume for home entertainment purposes, and even for a small auditorium upon local stations. If reception conditions are favorable, stations several hundred or more miles away may be received with ample loud speaker volume. The quality of reproduction obtainable is believed to be superior to that of practically all other receivers with the exception of a very few of the highest class receivers price at from \$250.00 up.

The sensitivity of the receiver is sufficient to allow the reception of out-of-town stations with pleasing regularity and its selectivity is sufficient to permit of separation between powerful local stations in such crowded areas as those encountered about New York or Chicago. At the same time, the operation of the receiver is simplicity itself, for only two tuning controls need be manipulated together with a single small knob used to turn the receiver on and off and adjust volume.

The receiver itself is easy to assemble since every detail of its construction has been planned with the utmost care, with the thought in mind that it would be assembled by an absolute novice, totally unfamiliar with radio. At the same time, investment value has been considered most carefully and it is believed that the S-C II receiver will not become antiquated for some years to come since its design is in accordance with best engineering practices and there seem to be few ways in which it could be practically improved upon. Nevertheless, should broadcasting conditions change, as in the matter of wavelengths employed, the S-C II receiver is so flexible that by a simple alteration of the coils used, or the substitution of a new set of coils, its wavelength range may be adapted to any particular class of broadcasting service that might be anticipated within the next few years.

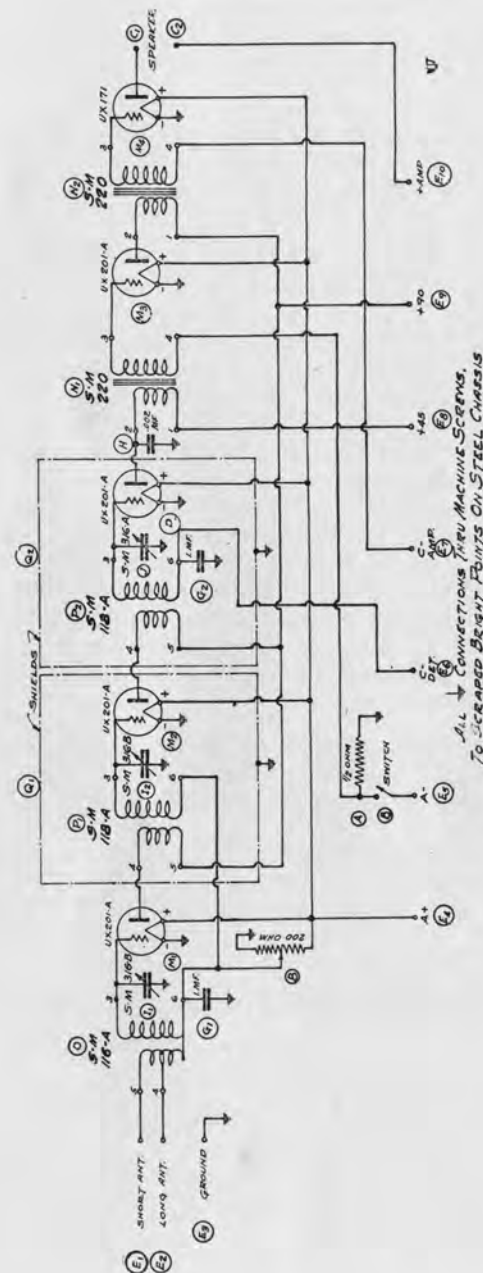
While it is very true that many five-tube factory-built receivers may be obtained upon the open market for figures as low as \$25.00, the purchaser should always remember that in radio, as in other fields, he only too frequently receives exactly what he pays for (often less), and it is hardly to be believed that a factory-built receiver, bearing as it must factory overhead and labor, can contain

the same value either in material or engineering design that is obtainable in a receiver constructed by the user and costing no more than many of the more reasonably priced commercial receivers. Thus, were the S-C II receiver to be supplied as a completely assembled outfit, and were it to be priced on a level with average factory-built sets, it would cost approximately \$120.00; whereas by virtue of a few hours of enjoyable work in building it himself, the purchaser is able to save approximately \$60.00. To state this in another way, he is able to obtain approximately double value for an expenditure of about \$60.00 for the S-C II receiver that he would receive in a factory-built set.

What the S-C II Receiver Is

THE S-C II receiver is a five tube set of standard design, incorporating two stages of tuned radio frequency amplification, a detector, and two stages of high quality audio amplification. The design of the radio frequency amplifier is such that it may be adjusted to peak efficiency for each wavelength received, no endeavor being made to provide semi-automatic means of holding it at a point just below peak efficiency for all wavelengths. (It is a well-known fact that this could not be accomplished practically due to variations in receivers, and to obtain stability it would be necessary in an automatically stabilized system to accept something less than peak sensitivity. In the S-C II receiver no compromise has been made, and by means of one small volume control knob, the set may be adjusted to the absolute limit of sensitivity and, literally, nothing in the way of performance be sacrificed as a result.)

The first radio frequency amplifier consists of an antenna coil, "O," tuned by a variable condenser "I-1," and so designed that it will cover the wavelength range of 200 to 550 meters, and allow for the use of either a long or short antenna. This first RF stage includes a UX201A tube, the plate circuit of which is connected to the second radio frequency transformer "P-1," the secondary of which (similar to that of the antenna coil "O"), is tuned by a second variable condenser "I-2." This second RF stage, consisting of transformer "P-1" with its socket "L-2," condenser "I-2" and tube "M-2" is housed in a complete aluminum box "Q-1" which effectually prevents the transfer of undesired energy between this stage and any other portion of the receiver and also eliminates the pick-up of extraneous interference upon the coils, condensers, and wiring of the stage itself. This second stage, incorporating also a UX201A tube, leads into the detector stage, similarly designed and constructed, and housed in the second aluminum shield "Q-2."



The sensitivity of the radio frequency amplifier as well as the volume, is controlled by means of a 200-ohm potentiometer "B," integral with which is an on-off switch which completely turns the receiver on and off.

The detector tube employs a negative grid bias to permit rectification, for it is well known that a grid bias will allow of the handling of stronger signals without distortion than will a grid condenser and leak.

The output of the detector tube is fed into an audio amplifier consisting of two audio transformers "N-1" and "N-2," a CX301A and a CX371 tube. The audio amplifier is extremely interesting and, in a sense, original, for its frequency range is from 30 to approximately 5,000 cycles, above which frequency it provides practically no amplification. This is desirable since the radio frequency portion of the receiver preceding the audio amplifier is designed to pass a 10 kilocycle band, which means that after rectification only frequencies up to 5,000 cycles (the range of frequencies employed in music and speech is from about 27 to 4,192 cycles), will be fed from the detector to the audio amplifier. However, the very sharp cut-off above 5,000 cycles of the audio amplifier results in the elimination of background hiss, and possibly more important, heterodyne squeals frequently heard in present-day broadcasting when some 600 stations are simultaneously operating in channels which will accommodate, at the most, only one-third this number of stations without pronounced interference.

The S-C II receiver is designed for operation with either batteries or battery eliminators and will be found quite satisfactory when so used. It may not satisfactorily be used with dry cell tubes, for the volume obtained, as well as the quality, will not be comparable with that obtained with standard CX301A and CX371 tubes. (It must be understood that the receiver will operate satisfactorily with CX299 and 220 tubes but that the volume and quality will suffer as a result of their use.)

Parts Specified for the S-C II Receiver

LIST

A	1 Carter H $\frac{1}{2}$ resistor.....	\$0.25
B	1 Carter M-200-S potentiometer.....	1.25
C-1—C-2	2 Carter tipjacks @ 10c.....	.20
D	1 Benjamin No. 9040 UX spring socket.....	.75
E-1—E-10	10 Eby binding posts (Ant., Ant., Gnd., A+,	

A—C—, C—, 45+, 90+, Amp.+)	@15c.	1.50
F-1—F-2	2 National B vernier dials, clockwise @	\$2.50. 5.00
G-1—G-2	2 Polymet 1 mf. condensers @	\$1.00..... 2.00
H	1 Polymet .002 condenser.....	.40
I-1—I-2	2 Silver-Marshall 316B condensers @	\$4.50.. 9.00
J	1 Silver-Marshall 316A condenser.....	4.50
K	1 Silver-Marshall 637 link motion.....	2.00
L-1—L-3	3 Silver-Marshall 515 coil sockets @	\$1.00... 3.00
M-1—M-4	4 Silver-Marshall 511 tube sockets @	50c 2.00
N-1—N-2	2 Silver-Marshall 220 transformers @	\$6.00..12.00
O	1 Silver-Marshall 116A coil.....	2.50
P-1—P-2	2 Silver-Marshall 118A coils @	\$2.50..... 5.00
Q-1—Q-2	2 Silver-Marshall 631 stage shields @	\$2.00.. 4.00
R-1—R-2	1 Van Doorn* S-C chassis unit (including pierced formed steel panel, chassis and nuts, screws and insulators).....	5.00

\$60.35

*With the panel and chassis will be found an envelope containing:

- 31 6/32 nuts
- 22 6/32 x $\frac{3}{4}$ " RHNP screws
- 9 6/32 x $1\frac{1}{2}$ " RHNP screws
- 9 collars $\frac{3}{4}$ x $\frac{1}{4}$ "
- 20 Belden soldering lugs
- 20 binding post insulating washers
- 4 tipjack insulating washers
- 3 potentiometer-switch insulating washers

Inspecting and Testing Individual Parts

FROM the foregoing general description of the parts used in the S-C II receiver, the builder should have become sufficiently familiar with them so that he may be able to intelligently inspect each part before attempting to assemble the receiver.

Resistor "A" is a small strip of fibre wound with a flat resistance wire, connections to which are made through two mounting lugs on either end. Unless it appears to be physically broken or damaged, no trouble may be anticipated.

Potentiometer-switch "B" should be examined very carefully. It will be seen to consist of a fibre strip wound with fine resistance wire held in a metal frame. As the knob is turned a contact arm moves over this wire-wound resistance strip and it is necessary that this contact be so bent that it presses firmly against the resistance sector at all points throughout its arc of rotation. The on-off switch

simply consists of two contacts carried on a metal frame attached to the potentiometer. The under or inside contact is actuated by a fibre cam attached to the potentiometer contact arm shaft. An angular bend in this inner arm will be seen to fall into the bakelite cam at one setting of the potentiometer adjustment. This is correct, and at this point the under switch spring should not press against the outside switch spring. As the shaft is rotated, the angular bend in the spring will be forced out of the slot in the bakelite cam and as this occurs it will be seen that the cam forces the inner contact of the switch against the outer contact blade and this condition of the two springs pressing against each other should persist throughout the balance of rotary movement of the potentiometer shaft. (When the angular bend of the under contact arm is allowed to fall into the slot in the bakelite cam, the on-off switch is open—at other positions it is closed.) Should the springs not make proper contact, they should be bent with the fingers so that they make firm solid contact, and care should be taken to see that the actual points of contact are clean, and free of dirt or dust.

Tip jacks "C-1" and "C-2" may be ignored until the receiver is completely assembled, at which time they should tightly hold the tips of loud speaker or phone cord inserted in them. If they do not, the springs may be bent so that they will do so.

Detector tube socket "D" should be examined to see that the four terminal screws and nuts are quite tight and a tube tried in it to make sure that proper contact is effected and that the socket springs hold the tube tightly in place.

Binding posts "E-1, E-2, E-3, E-4, E-5, E-6, E-7, E-8, E-9, E-10" should be examined to see that they have the proper markings, that they are equipped with fastening nuts, and that their tops unscrew and screw up properly so that a wire may be held between the top and base of each binding post.

Dials "F-1", and "F-2" should be examined to see that the indicator plates rotate as the control knobs are turned and that each one is accompanied by the three small studs and nuts necessary to fasten it to the panel.

Fixed condensers "G-1" and "G-2" should be examined for signs of physical damage and should preferably be tested with a B battery. If a B battery is available, and two wires from it are connected to the two terminals of the condenser, a spark should be noticed. With battery leads removed, the two contacts of the condenser should be short-circuited with another piece of wire, when it will be noticed that the charge given to the condenser by the battery will discharge with a slight spark.

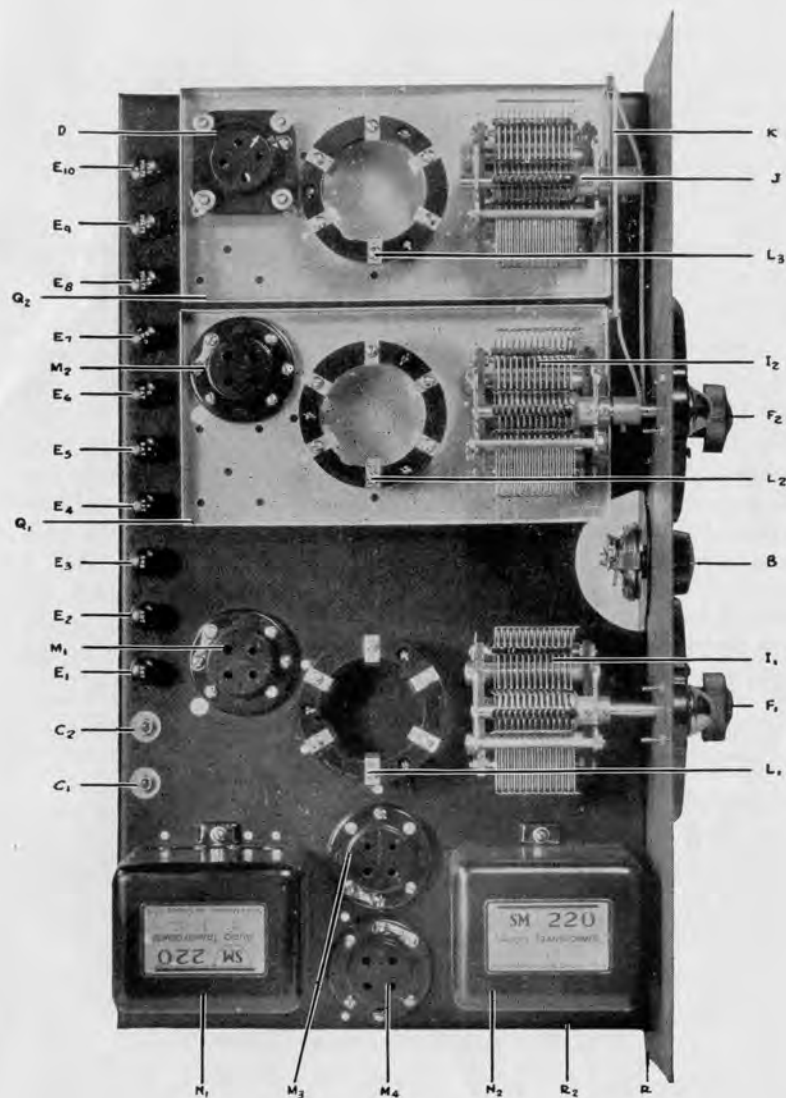


Fig 2.

Assembling the Receiver

Condenser "H" should be tested in the same fashion except that being very small it will not retain a charge and will simply show no spark as connections from the battery are made to it.

The variable condensers "I-1," "I-2" and "J" should be examined to see that they rotate properly and that the rotor plates do not touch the fixed or stator plates at any point thruout their arc. Should the condensers have been damaged in transit, they may be adjusted according to instructions appearing elsewhere in this booklet.

Mechanical link motion "K," unless it shows obvious signs of being bent, can be ignored until the time comes to assemble it on the condensers.

Coil sockets "L-1," "L-2" and "L-3" should be tested in connection with the RF transformers "O," "P-1" and "P-2." Each transformer should be inserted in a coil socket and the following test for continuity of winding made. Taking RF transformer "O" in its coil socket, one lead from the B battery should be touched to terminal No. 6 and held there. The other lead from the B battery should be touched successively to terminals Nos. 3, 4, and 5, from which a spark should be obtained. In the case of transformer "P-1" and "P-2" a spark should be obtained between contacts 3 and 6, and 4 and 5, but not between 3 and 4 or 5. If a spark is not perceived in this test, the coil sockets should be examined to make sure that the spring fingers touch the buttons on the coil forms.

Tube sockets "M-1, M-2, M-3, M-4" should be tested as was detector tube socket "D."

The two large transformers "N-1" and "N-2" should be tested with a B battery. A spark should be obtained between terminals 1 and 2, and 3 and 4, but not between terminals 1 and 3 or 4. No spark should be obtained between any terminals and the metal cases of the instruments.

Unless the shields "Q-1" and "Q-2" appear to be bent or crushed, they are OK; assuming the base pans to be pierced and the front ends of each shield to be slotted with a long U-shaped slot.

The steel panel and chassis "R-1" and "R-2" should be examined to see that they are not scratched and that they appear to be properly pierced and formed, but not bent thru damage in transit.

ALL parts for the receiver having been procured, and tested in accordance with the foregoing paragraphs, the assembly may be started by mounting all parts upon the steel chassis "R-2" in accordance with the photograph of Fig. 2. The first step is to put all binding posts and tipjacks in place. In the small package of assorted screws, washers, etc., accompanying the chassis, there will be found ten small flat insulating washers of fibre with holes in them just large enough to slip over the binding post screws. There will be found ten more similar washers with small projections on one side which are designed to be put into the over-size holes at the rear of the steel chassis for the binding posts. The nuts having been removed from the binding posts, they should be placed on the chassis in position shown with the extruded washers on top of the chassis and the flat washers beneath, with the extrusions of the upper washers falling inside the holes of the chassis. If this is done, it will be seen that when the nuts are screwed up upon the binding post shanks with a pair of pinchers, none of the metal of binding post shanks will come in contact with the chassis, but will be held away from it by the insulating washers. Under each binding post nut should be placed one of the small soldering lugs, exactly as seen in the photograph of Fig. 3.

The two tipjacks should be attached to the chassis in the same fashion as the binding posts, using the set of four (two plain and two extruded) insulating washers that appear to be slightly larger than those used for the binding posts. The details of attaching these tipjacks will be seen from the photograph. (Being of metal, they must not actually touch the metal chassis.)

The on-off switch and potentiometer, "B," should be fastened to the front of the chassis with its various contacts projecting upward, as seen in the different photographs. The knob having been removed from this instrument, the lock nut on the shaft bushing should also be unscrewed. Three large insulating washers will be found accompanying the chassis screw assortment. The two plain ones should be placed over the shaft bushing and pushed back. The shaft bushing should then be pushed thru the hole in the half-round projection at the front of the chassis, the extruded washer placed over the bushing so that the extrusion falls in the hole of the chassis, and the lock nut screwed up on the whole assembly. When this operation is performed properly a test should be made with a B battery. One wire from the B battery should be touched to the chassis and the other touched to all contacts of the switch and potentiometer. If the in-

ulating washers are properly arranged and there is no metallic contact between the chassis and unit "B," no spark will be observed, which is the correct condition. (The same test should be given the binding posts and tipjacks, for there must be no metallic contact between any of these instruments and the chassis at this stage of the assembly.)

The next step is to mount the two stage assemblies in shield pans at the right-hand end of the chassis. By placing the shield pans in the approximate positions shown in the photographs, it will be found that certain holes will coincide—notably, the large round lead hole to the rear of each shield pan, plainly visible in Fig. 2, as well as the two mounting holes for the tube socket, the three holes for the coil sockets, and those for the condensers "I-2" and "J." In the screw assortment will be found a total of nine hollow studs and nine long screws. Taking coil socket "L-3" three long screws should be pushed thru the mounting holes in it and over these screws on the under side of the coil sockets the three hollow studs for this socket should be slipped. The socket should then be placed in position in shield pan "Q-2" as seen in the various photographs. On the under side of the chassis, nuts should be tightened up on these mounting screws with a pair of pinchers. When the operation is completed, the coil socket will be held in place $\frac{3}{4}$ of an inch above the shield pan "Q-2" by means of the three mounting screws and the three hollow studs on the mounting screws. The actual arrangement of these studs may possibly be most clearly perceived from the photograph of Fig. 4. The same operation should be performed with coil socket "L-1" and "L-2" (the shield pan "O-1" being held to the chassis "R-2" under coil socket "L-2.") Caution should be observed in every case to make sure that the small indentation in the bakelite coil socket ring falls in the position visible in photograph of Fig. 2 and that terminal No. 3 of the coil socket is in every case the extreme right-hand terminal, viewing the chassis from the front.

The next step is to mount the detector socket "D." The details of this operation are evident in Fig. 2. A single screw is pushed thru the mounting hole located close to terminal "G" of this coil socket. Under the screw head is placed one of the small lugs and a nut is tightened up with a pair of pinchers on the end of the screw projecting thru the under side of the chassis. Socket "D" is held in place by this single screw and in order that contact be made by means of the wire shown connecting the minus terminal of this socket to

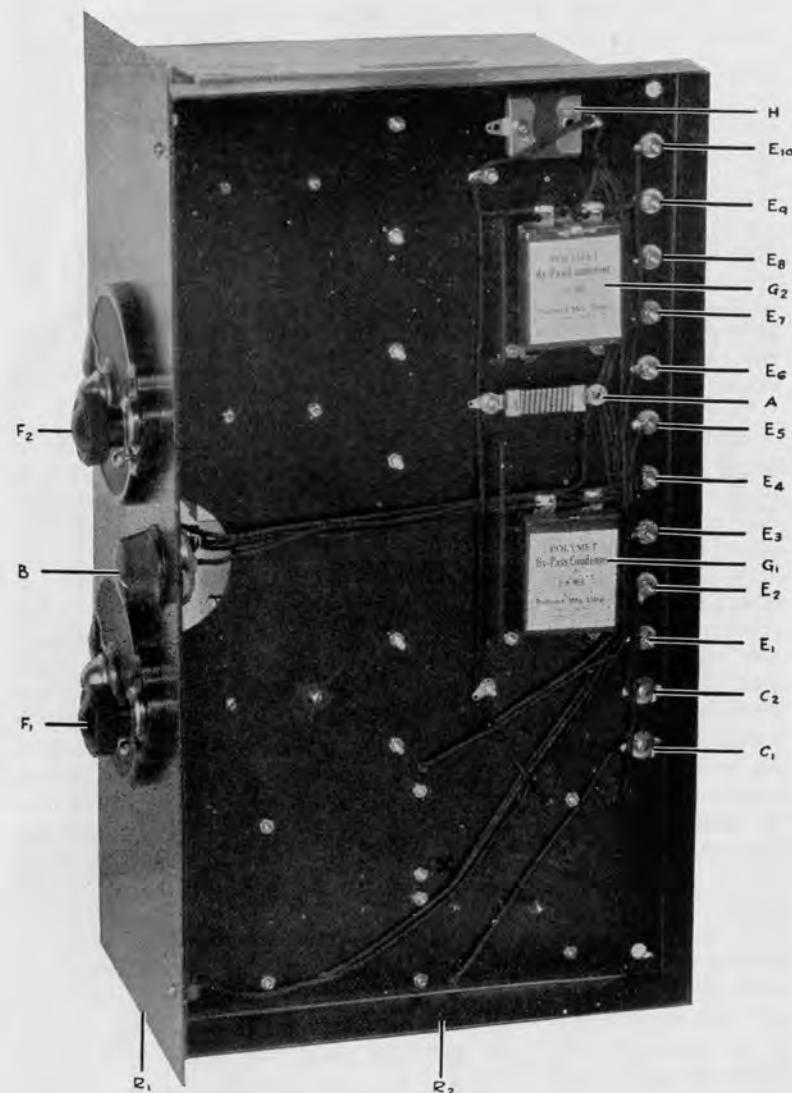


Fig. 3

the lug under the mounting screw head it is necessary that the bottom of the chassis be cleaned of enamel where the fastening nut makes contact with it.

The four tube sockets "M-1, M-2, M-3, M-4," may be mounted using two screws and two nuts each. Under the mounting screw heads, falling between the minus and plus terminals of these sockets a soldering lug should be placed, turned toward the minus terminal. Another soldering lug fastened under the "minus" terminal screw of each socket is pointed toward the first lug, as can be seen from Fig. 2, so that both lugs touch. (They are later soldered together and make the minus connection between each tube filament and the chassis which actually forms the negative A and negative B battery wiring for the receiver.) It is needless to say that the under side of the chassis should be scraped where the nuts for these mounting screws come in contact with it.

Referring to Fig. 3, it will be seen that some of these mounting screws serve to hold the condensers and fixed resistances on the bottom of the chassis. Thus on the mounting screw holding tube socket "D" condenser "H" is fastened by means of another nut tightened up on this screw to hold the condenser firmly in position. It is very important that this procedure be followed out exactly—one nut must serve to hold the condenser away from the actual chassis while another holds it tightly to the screw. (To rephrase, it is necessary that the metal contact clamps of condenser "H" do not actually touch the chassis at any point but that thru the eyelet holding one of these clamps in place the mounting screw of coil socket "D" is passed with a nut on either side of the condenser.) Upon the mounting screws of sockets "M-1" and "M-2" are fastened to two bypass condensers "G-1" and "G-2." In this instance it is desirable that the metal cases of the condensers make contact with the chassis, and they are clamped directly to it by the fastening nuts on the tube socket mounting screws. Upon the rear mounting screw of coil socket "L-2" one end of the half ohm resistance "A" is held in the same fashion as was condenser "H": that is, as the screw comes thru the bottom of the chassis "R-2" one nut is placed over it and screwed up tightly; then one end of the resistance "A" is dropped over the screw and a second nut tightened up on top of this, so that at no point does any of the metal structure of resistance "A" come in contact with chassis "R-2."

The two audio transformers "N-1" and "N-2" should be fastened on the chassis at the left-hand end as shown in Fig. 2. The exact position of these transformers is evident from the photograph, and it

will be seen that the terminal strip of the rear transformer is toward the right while that of the front transformer is toward the left.

The three variable condensers "I-2," "I-1" and "J" should be fastened to the chassis. In the positions shown in Fig. 2 "I-1" (which is identical actually to "I-2") falls at the left of the chassis exactly in front of coil socket "L-1." Two mounting holes will be found in the chassis, the position of which coincides with the two threaded holes in the mounting feet of each condenser. Screws should be pushed up thru the chassis and screwed up tight into the mounting lugs of the condensers. (The screw-heads may be seen in Fig. 3) Condenser J, with the shortest shaft, mounts at the right end of the chassis, in shield pan "Q-2."

The assembly is now completed, and should be carefully examined and checked, making sure that all instruments are mounted exactly as seen in the photographs.

Wiring

THE wiring of the S-C II may be done entirely without soldering, if desired, although it is strongly recommended that certain connections be soldered. (No description of the wiring method where soldering is not employed will be given; for any prospective builder not familiar with the use of a soldering iron had best take his parts to a service station, where he may have his receiver assembled and tested at a very nominal cost.)

All wiring on top of the chassis should first be put in place starting as follows: One end of the fabric insulated Kellogg hook-up wire should be bared for about half an inch by pushing back the insulation and this end twisted around terminal "G" of the coil socket "D." The nut on this terminal is tightened up with a pair of pinchers, clamping the wire tightly to the terminal. The wire is then pulled straight forward on the chassis, scraped free of insulation so that it may be twisted around terminal screw No. 3 of coil socket "L-3." This screw, being tightened upon the wire, is continued directly forward to a soldering lug found under a nut on condenser "J." The end of the wire is pushed thru this lug, twisted around it, and soldered to the lug. This connection is plainly illustrated in Fig. 5, where the wire joining these three terminals can be seen.

A similar connection is made joining terminal "G" of tube socket "M-2," to terminal No. 3 of coil socket "L-2," to the soldering lug on condenser "I-2."

An exactly similar connection is made between terminal "G" of

tube socket "M-1," terminal No. 3 of coil socket "L-1," and the soldering lug on condenser "I-1."

These three exactly similar leads are plainly visible in Fig. 5 and should be as short and direct as possible.

A small wire should now be used to connect the minus terminal of coil socket "D" to the lug under the mounting screw head of this socket, exactly as seen in Figs. 2 and 5.

The two overlapping soldering lugs on the "minus" terminals and the mounting screws adjacent to these terminals in the case of tube sockets "M-1, M-2, M-3, M-4" should be soldered together exactly as illustrated in Fig. 2.

Starting now at the left end of the chassis, terminal "G" of tube socket "M-4" should be connected to terminal No. 3 of audio transformer "N-2." Terminal No. 2 of audio transformer "N-2" should be connected to terminal "P" of tube socket "M-3." Terminal "G" of tube socket "M-3" should be connected to terminal No. 3 of audio transformer "N-1."

One end of a long wire should be fastened under the plus terminal of tube socket "M-3," then carried over, kitty-cornered, scraped and fastened under terminal "plus" of tube socket "M-4." In the chassis adjacent to this terminal will be found a hole thru which the long end of this connecting wire should now be pulled. Turning to Fig. 3, it is practically impossible to see where this wire comes thru the chassis (the approximate point is marked at "X"), comes out underneath and follows the path of other connecting wires (which will later be put in place). This wire is pulled taut on the under side of the chassis and up thru the large hole adjacent to the "plus" terminal of socket "M-1" at which point the wire is scraped, wrapped around and fastened under terminal screw "plus" of the tube socket "M-1," and finally pulled back down under the chassis thru the same large hole thru which it came up. It is then drawn slightly to the rear of the chassis around the corner of condenser "G-2," scraped and soldered to the lug of binding post "E-4" and then carried straight along to a similar large hole in shield pan "Q-1" adjacent to terminal "plus" of tube socket "M-2." At this point it is scraped exactly as in the case of the previous tube socket, fastened under terminal "plus" of socket "M-2" and pulled back down thru the hole in the chassis thru which it came up. Again it is carried along the back of the chassis, this time behind condenser "G-2" and up thru the last of the large holes, this time found in shield pan "Q-2" just under the "plus" contacts of tube socket "D." The wire is here clipped, the

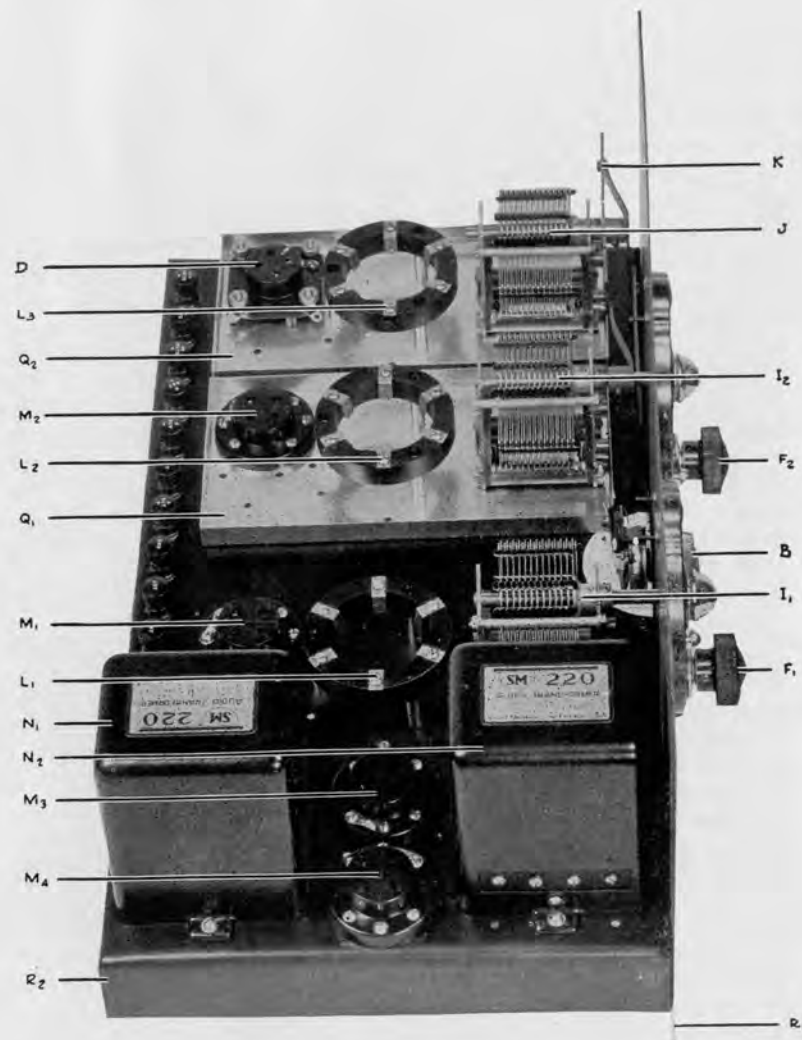


Fig. 4

end scraped, and fastened under the plus binding post nut of tube socket "D." This is the positive A battery lead.

A second wire is now soldered to the lug of binding post "E-4," pulled straight forward across the chassis to potentiometer switch "B," and soldered to the extreme right-hand lug of "B," viewed from the front. (This lug, like another opposite it, forms the connection to one end of the resistor segment of the potentiometer wound with fine wire.)

A wire is soldered to the left-hand lug of the potentiometer (directly opposite the one previously connected to), carried down beneath the sub-base along the path of its predecessor and is terminated by being soldered to the rear lug of condenser "G-1." A wire is now soldered to the lug of the potentiometer switch arm stamped "carter," pulled down and carried along the under side of the sub-base to the rear of condenser "G-1" and then pulled over and terminated by being soldered to the rear, free, end of resistance "A." Still another wire is soldered to the other contact of the switch. (The blade with the angular bend.) This wire is also carried down beneath the chassis and directly back to the lug of binding post "E-5" to which it is soldered.

There is now only one connection on potentiometer-switch "B" which has not been used. This is the small soldering lug fastened under the screw head holding the assembly of the two switch springs and their bakelite insulators to the frame of the instrument. To this lug a long wire is soldered, which is carried along the path of predecessors to the nearest terminal of condenser "G-1" to which it is soldered. It is then carried back and around the case of condenser "G-1" and finally up thru the large hole in the chassis adjacent to the "plus" terminal of tube socket "M-1." It is now pulled directly forward on the chassis under coil socket "L-1" and finally terminates by having its scraped end fastened under terminal screw No. 6 of coil socket "L-1."

A new length of wire is also soldered to the same contact of condenser "G-1" and carried along the chassis and up thru the large hole adjacent to the plus terminal of tube socket "M-2" after which it is pulled straight forward along the chassis under coil socket "L-2" and terminates with its scraped end being fastened under terminal No. 6 of coil socket "L-2." The remaining or rear contact of condenser "G-1" has a short length of wire soldered to it which is carried back around the condenser case and terminates by being soldered to a lug under the rear mounting screw of tube socket "M-1," which serves to connect one side of condenser "G-1" directly to the metal chassis of the receiver.

A wire soldered to the lug of binding post "E-1" is carried along the chassis and up thru the hole adjacent to terminal No. 5 of coil socket "L-1" under which terminal screw the bared end of this wire is terminated. A second wire similarly joins binding post "E-2" to terminal No. 4 of coil socket "L-1," coming up thru the hole in the chassis adjacent to this terminal, visible in photograph "X."

A wire is connected to terminal "P" of tube socket "L-1," carried down thru the adjacent hole in the chassis, along the under side of the chassis, and up thru the hole in shield pan "Q-1" adjacent to terminal No. 4 of coil socket "L-2" under which terminal the scraped end of this wire terminates. Care should be taken to see that where this wire runs under the chassis it is at least $\frac{1}{2}$ inch away from the chassis. A second wire, similarly held away from the chassis, is used to connect terminal "P" of tube socket "M-2" to terminal No. 4 of coil socket "L-3." Both of the above wires can be seen in photograph "3" coming down thru the chassis and running parallel to it and $\frac{1}{2}$ inch below it.

A wire is connected to terminal "P" of tube socket "D," carried back and down under the chassis thru the large hole found under the "plus" terminal of this tube socket and then over to the free lug of condenser "H" (see Fig. 3). It is soldered to this lug and then carried back and under a lug fastened to the rear mounting screw of coil socket "L-3" straight along the chassis, and under another lug, fastened to the rear mounting screw of coil socket "L-2," then up thru under a similar fastening lug on the rear mounting screw of said socket "L-1," the hole adjacent to terminal No. 2 of audio transformer "N-1," under which terminal the bared end of the wire is terminated. The three lugs on the mounting screws of coil sockets "L-1," "L-2" and "L-3" serve simply to hold this long wire definitely in position close to the chassis, but they at no point make metallic contact with this wire itself.

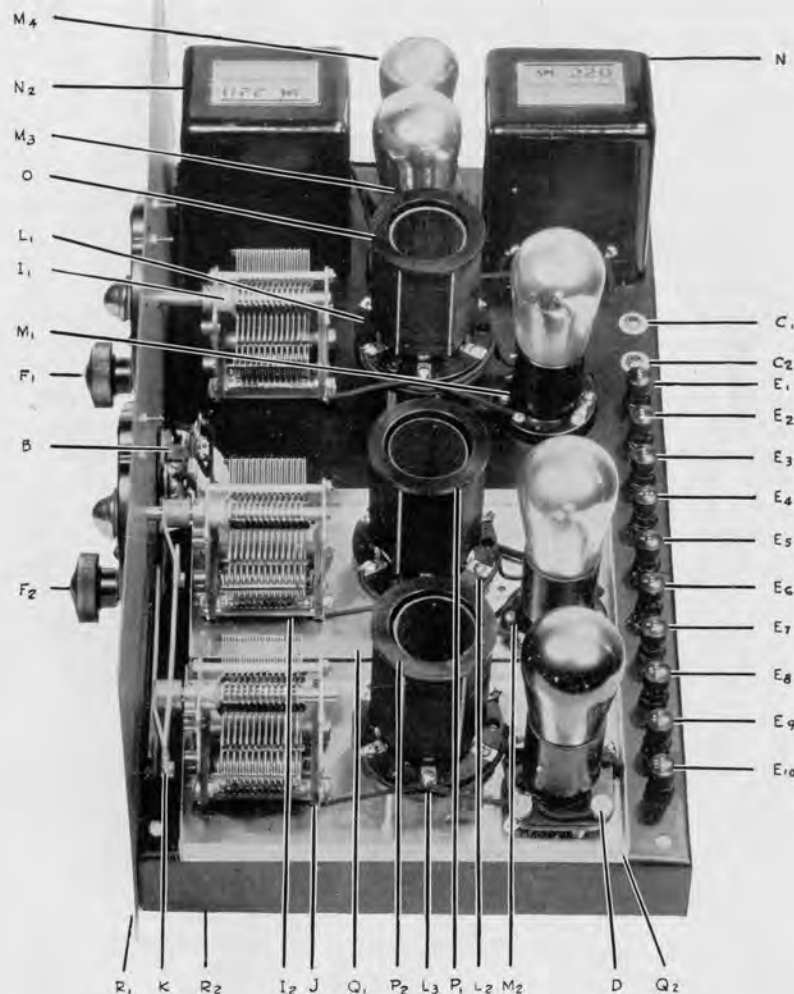
A wire is attached to terminal No. 1 of audio transformer "N-1" pulled down thru the hole in the chassis back around the rear side of condenser "G-1" and is terminated by being soldered to the lug of binding post "E-8." A wire soldered to the lug of binding post "E-10" is carried back along the rear of the chassis, around condenser "G-1" and over to the left front corner of the chassis, along the back of the chassis by condenser "G-1" and terminates in tipjack "C-2." A wire soldered to tipjack "C-1" is carried diagonally across the chassis and comes up thru the hole adjacent to terminal "P" of tube socket "M-4" under which terminal screw its bared end terminates.

A second wire is soldered to the free end of resistance A, carried along the rear of the chassis, around corner of condenser "G-1" and diagonally across the chassis up to the hole adjacent to terminal No. 4 of audio transformer "N-1" under which terminal screw its bared end is terminated. A wire is soldered to the lug of binding post "E-7" carried back along the chassis around the corner of condenser "G-1" and up thru the hole adjacent to terminal No. 4 of audio transformer "N-2" under which terminal screw its bared end is terminated. One end of a wire, pulled up thru the hole in the chassis is now fastened under terminal No. 1 of audio transformer "N-2." It is then pulled back diagonally along the chassis around the corner of condenser "G-1" and up thru the large hole in shield pan "Q-1" adjacent to the plus terminal of tube socket "M-2." It is then carried forward to terminal No. 5 of coil socket "L-2," scraped, wrapped around this terminal which is tightened upon it, and carried back and down thru the same hole in the chassis. It then continues under the chassis, comes up thru the similar large hole in shield pan "Q-2," is pulled forward and is scraped and fastened under terminal No. 5 of coil socket "L-3." It now turns back on itself, goes back down thru the large hole in the rear of the shield pan, and terminates in the soldering lug of binding post "E-9."

A wire is fastened to terminal No. 6 of coil socket "L-3," carried back and down thru the same large lead hole in the rear of the shield pan "Q-2," scraped, and soldered to the rear contact of condenser "G-2." From here it is then pulled back along the rear of the chassis, around the corner of condenser "G-2," and terminates by being soldered to the lug of binding post "E-6." The final connection is put in by soldering one end of a length of wire to the lug of binding post "E-3," then continuing it to the front contact of condenser "G-2," and to which it is soldered, and the end terminates in lug on the rear mounting screw of coil socket "L-3" which also serves to hold the long detector plate lead in position on the under side of the chassis.

Checking Connections

The wiring, now completed should be examined with the utmost care. Every connection should be traced back in accordance with the above instructions and, if possible, compared with the diagrams in the booklet, and with all photographs for the actual positions of wires. While the builder may not be able to interpret the symbols of the diagrams at first sight he should be able to do so upon a careful examination, since every instrument in them which is represented by symbols also bears the designating letters used in the



F g. 5

photographs and parts list, and, in addition, has every terminal numbered exactly as on the instrument itself. These terminal numbers have also been used thruout the foregoing wiring instructions. (It is much simpler in case any error has been made to find it and correct it by an immediate check than to do so later possibly as the result of blowing out one or more tubes or damaging batteries, for such damage could very easily result if a mistake were made in wiring the receiver.)

Attaching Link Motion

THE receiver having been completely wired but without the front panel mounted, the next step is to attach the link motion. With the front edge of the chassis toward the builder, the two right hand variable condensers "I-2" and "J" should be turned to the right so that their plates entirely interleave (and are stopped from turning farther only by contact with the round tie bar connecting the condenser end plates). The link motion should then be taken in the fingers in such a position that the two parallel bars are above the lock collars and that these collars, with their set screws, project to the rear. The two lock collars should then be slipped gradually over the shafts of condensers "I-2" and "J" back to a point where there is a space of only about $\frac{1}{8}$ of an inch between the link motion lock collars and the lock collars on the condenser shafts. In this space of $\frac{1}{8}$ of an inch between the link and condenser lock collars the front edges of the shields "Q-1" and "Q-2" fit.

The two variable condensers "I-2" and "J" should now have their rotor plate sections entirely disengaged from the stator plates by turning the shafts in a counter-clockwise direction. The link "K" should also be turned as far to the left as it will go so that on each condenser shaft one arm of the link points straight to the left and one arm straight upward. In this position the set screws in the link motion lock collars will be visible when looking straight down upon the chassis and they should be tightened up upon the condenser shafts with a screw driver. If this is done, it will be found that if one condenser is now rotated, the other condenser will rotate with it due to the mechanical linkage provided thru the link "K."

It is very important that the linking of the two condensers be done with the condensers adjusted to exactly the right positions. This may be determined either in actual operating tests of the receiver, or before it is ever tested. (The proper position mechanically is with the two condensers so adjusted that as the rotor plates of one just start to interleave with the stator plates, the rotor plates of the other condenser will be in exactly the same position.)

Mounting Front Panel

THE receiver, now completely wired and with the link motion attached, is ready to receive the front panel. The knob, front lock nut, and the insulating bushing on the shaft of the potentiometer switch "B," should be removed so that the unit hangs loosely in its hole in the chassis. With the entire chassis assembly in such a position that the condenser shafts point directly forward, the builder may simply slip the panel in place against the chassis in such a fashion that the shafts of condensers "I-1" and "I-2" project thru the two large centrally located holes in the panel and the bushing of the potentiometer switch "B" projects thru the hole falling within the circular arrow marked "VOLUME" at the center bottom edge of the panel. The panel should be fastened to the chassis by means of two machine screws and nuts, one of which goes thru the panel and front edge of the chassis at each end of the assembly. These screws should be tightened up, with the nuts on the under side of the chassis, the screw heads being upon the front panel.

With the fingers of the left hand, the potentiometer switch should have its shaft bushing lined up centrally in the holes in the chassis and panel. The remaining extruded insulating washer should be pushed over the bushing of unit "B" in such a fashion that it serves to hold the potentiometer switch shaft away from the panel and chassis. The lock nuts should be tightened down upon the threaded shaft bushing using a pair of pinchers so that the potentiometer switch is firmly held in place and yet so that at no point does any of its metal assembly touch the panel or chassis (the extruded washer serves to insulate unit "B" from the panel and chassis at all points). The shaft of the potentiometer switch should be turned entirely to the left as far as it will go and the control knob pushed over this shaft with the arrow-head pointing to the word "OFF" upon the front panel. The set screw in this knob should then be tightened up using a small screw driver, which completes this operation.

Attaching Dials

IT NOW remains only necessary to attach the two National dials, "F-1" and "F-2" to the receiver to complete it. The small nickel center caps, serving to conceal the central bushings of the dials, should be pulled off with the fingers, the set screws in the bushings found underneath these caps loosened, and the dials pressed down over the shafts of condensers "I-1" and "I-2" so that they come up flush against the panels. Before actually putting the dials in place,

however, the three small threaded studs found accompanying each dial should be screwed into the holes in the dial intended to receive them. Thus as the dials are pressed over the shafts of condensers "I-1" and "I-2" the three studs on each dial will go thru holes in the panel intended to receive them. The three small nuts accompanying each dial are then screwed up on these threaded fastening studs on the rear of the panel. Two of them can be seen in the photographs toward the top of each dial, while one projects thru panel and chassis and will be found on the under side of the front edge of the chassis.

It will be noticed that as condensers "I-2" and "J" are rotated, the link motion will strike the upper right threaded mounting stud of dial "F-2" and this one should be twisted off just behind its nut with the pliers. (This may be accomplished by simply twisting the stud back and forth, when it will snap off almost flush with the rear side of the fastening nut.)

Both dials "F-1" and "F-2" should be adjusted to read zero against their indicating marks and all variable condensers "I-1," "I-2" and "J" turned in so that their rotor and stator plates are entirely interleaved. The dial bushings should then be fastened tightly to the condenser shafts by tightening up the set screws previously loosened to allow these bushings to slip over the condenser shafts. This being done, the small nickel mounting caps, removed with the fingers, may be replaced on the center of each dial to conceal the bushings and set screws.

Care should be exercised in operating the receiver never to strain the dials and condensers by turning the dials too far to the left or right. If this is done, the points of the dial-bushing set screws will score grooves in the condenser shafts, possibly at an angle, with resultant strain and possible damage to the condensers I-1 and I-2. (If this occurs, the trouble may be remedied by realigning the dials as suggested above, and tightening up the dial-bushing set-screws very tightly.)

Coil Placement

THE actual placement of the three coils "O," "P-1" and "P-2" in the receiver is very important, for, if "O" is misplaced, a short circuit will result which may burn out all tubes and will certainly result in damage to the coil and to the batteries if allowed to continue. Coil "O" may be told from coils "P-1" and "P-2," which are alike, by the fact that in a slot at its base are contained a few turns of green silk covered wire, while in coils "P-1" and "P-2" this same winding consists of white silk covered wire.

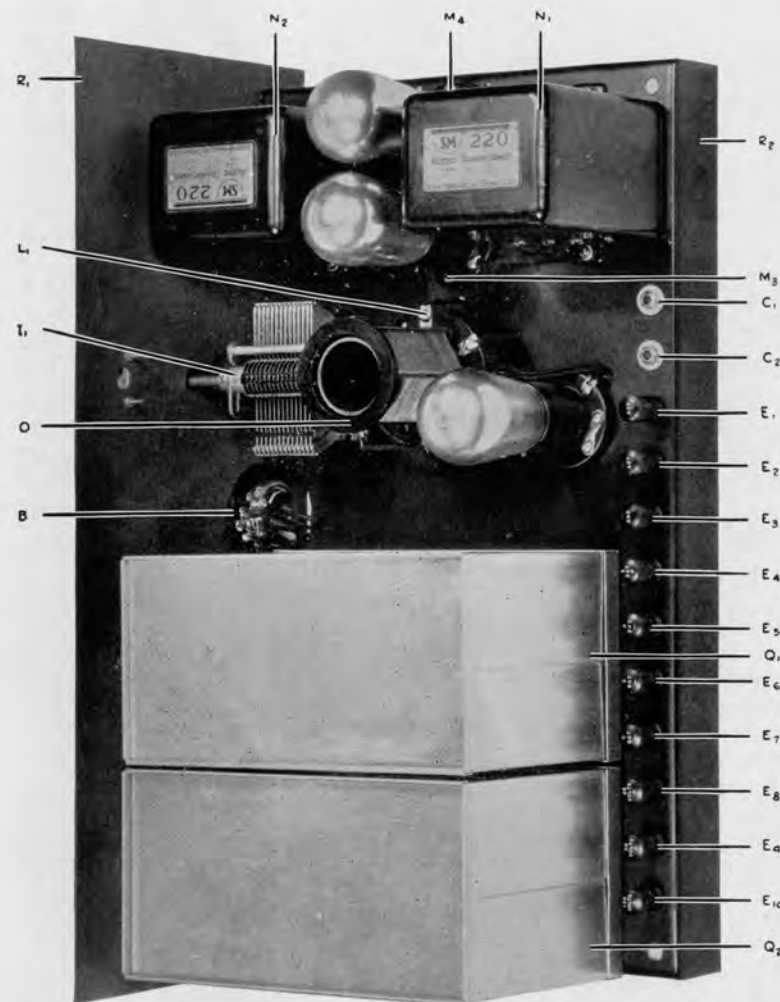


Fig. 7

Coil "O" should be inserted in coil socket "L-1" while coils "P-1" and "P-2" should be inserted in coil sockets "L-2" and "L-3." It will be found that the coils can be inserted only one way due to a small round guiding key of bakelite on the bottom of each coil from which fits in a similar recess on the coil socket rings. When the coils are first inserted it will be found that the coil socket springs are very stiff, which is correct, and the coils will go in very hard; and, in fact, may have to be worked in gradually by twisting them from side to side, at the same time exerting a downward pressure.

Preliminary Testing

ELSEWHERE in this booklet (see index) will be found a list of the accessories required to operate the S-C II receiver and it is therefore assumed that the builder has all of these accessories available.

The first step is by means of two wires which may be either bell wire, flexible hook-up wire (or two wires of a standard Belden 7-lead battery cable), to connect the A battery to binding posts "E-4" and "E-5." The plus or red terminal of the six volt storage battery should be connected to the binding post "E-4," marked "A BAT. +"; while the black, or negative terminal, of the storage battery should be connected to the binding post "E-5," marked "A BAT. —." A single tube should then be inserted in tube socket "M-4" and the volume control knob turned from the "OFF" position all the way to the right. Just as it leaves the "OFF" position, the tube in socket "M-4" should light and should remain at exactly the same brilliancy thruout the entire arc of movement of the volume control knob (if the brilliancy of tube "M-4" varies, the volume control is adjusted, it indicates that the switch on unit "B" is not functioning satisfactorily and it should be inspected in accordance with paragraphs devoted to inspection of this switch).

The tube should then be moved successively to all sockets, starting with "M-3" and progressing thru "M-1," "M-2," and "D." In each socket it should light and it should be extinguished when the volume control knob is turned to the "OFF" position.

This test made, the remaining four tubes may be inserted in the sockets in the receiver, making sure to place the CX371 power tube in socket "M-4" while UX201A tubes should go in all other sockets. The same condition should now exist in that if the volume control knob "B" is turned up from the "OFF" position, all tubes should light and their brilliancy should remain constant at all adjustments of the volume control knob other than the "OFF" position.

It is very important that the wire from the storage battery connected to binding post "E-4," marked "A BAT. +," should now be removed and connected successively to binding post "E-8," "E-9," and "E-10," marked respectively "45+," "90+," and "AMP+." **THE TUBES ABSOLUTELY SHOULD NOT LIGHT WITH ANY OF THESE CONNECTIONS.** If they do, it indicates that the receiver has either been incorrectly wired or a temporary, short-circuit has developed which must be located in accordance with the trouble-shooting data. If they do not light, the lead from the positive post of the storage battery may be re-connected to its proper binding post, "E-4."

Connecting Batteries

THE above tests having been very carefully gone thru, the balance of batteries may be connected to the receiver. One 45 volt B battery should have its minus terminal connected directly to the minus, or black, terminal of the 6 volt storage battery. A wire from binding post "E-8," marked "45+," should be connected to the positive terminal of this first B battery and also to the negative terminal of a second 45 volt B battery. A wire from binding post "E-9," marked "90+," should be connected to the positive terminal of this second B battery and also to the negative terminal of the third B battery. A wire from binding post "E-10," marked "AMP+," should be connected to the positive terminal of the third and last B battery. (If four B batteries, giving a total of 180 volts, are used, the wire from binding post "E-10" should connect to the positive terminal of the last or fourth B battery while the negative terminal of this B battery should connect to the positive post of the third B battery, and to nothing else.)

Assuming a 171 tube to be used with 135 volts maximum B voltage, the positive side of a 22½ volt C battery should be connected to the black, or minus, terminal of the storage battery. A binding post upon this battery marked "—4½" should be connected to binding post "E-6" marked "C —." The binding post marked "— 22½" upon this same B battery should be connected to post "E-7," marked "C —," of the receiver.

Antenna and Ground System

THE builder of the S-C II receiver had best consult with his local dealer or service man in order to find out the most suitable type of antenna for use in his particular location, since in many locations close to large powerful broadcasting stations, it is necessary

What They Say of the SC-II

Arthur H. Lynch, former editor of "RADIO BROADCAST," wires:

S-C second receiver sent me for test is proving more than satisfactory. Mechanically and electrically it is a perfectly fine job. I congratulate you.

Volney D. Hurd, radio editor of the CHRISTIAN SCIENCE MONITOR writes of the remarkably sensitivity of the S-C II. Here's what he says:

The ability to obtain maximum sensitivity with simplicity of operation is a fundamental need of present day radio receivers and our test with the new Silver-Cockaday II gives just these results. One of the interesting points is the uniform degree of sensitivity at all wavelengths. Stations from 200 up to 545 meters are brought in with equal volume and clarity.

A word from an internationally famous acoustical engineer on the S-C II means a lot, for such a man knows tone quality. Here's what **Francis H. Early**, who designed the K Y W (Westinghouse, Chicago) studios and the practise hall of the Chicago Philharmonic orchestra to mention but two of his accomplishments, says of the S-C II:

...the S-C II Receiver that I am now using in my acoustical work, far surpasses the claims that you make for it.

In checking up on the acoustical properties of distant radio stations, I find that this receiver gives results that I have heretofore been unable to obtain from several high-priced instruments. This is particularly true over the shorter wave-lengths and you will probably be glad to know that I have found absolutely no distortion over the entire range.

It cuts through the maze of local stations very nicely and has such tremendous natural volume that it will operate my loud speaker on coast stations.

Kenneth A. Hathaway of the technical staff of the CHICAGO DAILY NEWS, acutely aware of broadcast congestion in the middle west, comments as follows:

I wish to say that I have personally tried out the S-C II receiver and have found it highly satisfactory for the Chicago territory where conditions are worse than at any other point in the county. The reproduction keeps pace with the best and the clarity is remarkable, under conditions naturally favorable to radio reception.

A radio writer and authority known to almost every newspaper reader is **Carlton E. Butler**, radio editor of the CHICAGO EVENING AMERICAN. He finds the performance of the S-C II quite satisfying:

The S-C II is what I would call an ideal home receiver. It has beautiful tone quality, volume sufficient for any needs, and selectivity to cope with present broadcasting congestion.

After the S-C II had been perfected to its final form, the comments of many prominent authorities were solicited. Each was asked to try the set under any conditions he cared to choose, and then, after his test, to express his full and unbiased opinion. Read what these authorities have to say:

Frank L. Brittin, radio editor of POPULAR MECHANICS, and designer of the famous POPULAR MECHANICS super-heterodyne comments:

The S-C II looks good, sounds good, and tunes sharp.

Ernest R. Pfaff, radio designer and authority, chief engineer for a large manufacturer, says:

I wish to compliment you on the design of the S-C II Receiver.

I have found it to possess all of the desirable characteristics that make up a good receiver; namely simplicity, efficiency and excellent tone quality.

In addition to being an excellent receiver from a "radio" standpoint, the set is very easy to construct.

Wendell Buck, a writer and authority well known as a contributor to the NEW YORK SUN, and designer of the Varion receiver, writes:

Allow me to congratulate you upon the neat and compact design of the S-C II receiver which I consider to be one of the best receiver values for the money in the home constructor field.

To be able to provide a shielded five-tube receiver with metal panel and chassis at so low a price as \$60.35, for the component parts, and yet to have included such high quality products throughout is a most noteworthy accomplishment.

John F. Rider, contributor to many technical magazines, possessor of an enviable engineering reputation, writes:

Whenever the names of two known writers and radio engineers are combined, as in the case of **McMurdo Silver** and **Lawrence M. Cockaday**, it is only natural that the results of their efforts would be closely scanned and widely commented upon.

When I heard that the new S-C II receiver was to make its appearance I was more than interested to learn the details, both electrically and mechanically, of the new receiver and I can say very frankly that the design appeals to me very favorably.

You have a circuit here that is quite sufficiently selective for the most congested areas, a simple method of tuning control, and a very attractive ensemble. The new S-C II appears to have had very careful engineering thought and consideration and should be a great success.

It is particularly fortunate you have been able to bring the price of the parts for such a receiver down to as low a figure as approximately \$60.00 and the receiver should fill a long felt demand.

Charles H. Callies, designer of the Callies Super, and many popular pieces of apparatus, writer of national reputation, expresses his opinion:

It has been tried and proven—every statement that you have made about the new Silver-Cockaday II receiver is substantiated in detail.

I have tried out the set the last few evenings. It is beautiful in tone, the volume is adequate and it tunes sharply. I think it fills the long felt want for a reliable five-tube receiver.

Needless for me to say the S-C II was tried out in about as poor a location for broadcast reception as is to be found anywhere in this city of cluttered up air lanes (Chicago). In my estimation it is delivering about 100%.

The opinion of a careful and deliberate engineer, famous for the design of fine audio amplifying equipment and such popular receivers as the Radio Broadcast Super-heterodyne, is worth much. **Kendall Clough**, after carefully operating the S-C II receiver in the Testing Department of the Research Laboratories of Chicago, reports as follows:

We have carefully tested the S-C II receiver and found it to be an extremely satisfactory receiver. Electrically, the design is excellent, for the receiver possesses sufficient sensitivity for present-day requirements. The degree of selectivity appears to be ample for present congested broadcasting conditions. We can offer no suggestions for materially improving the quality of reproduction of the receiver. Its mechanical design is most pleasing, particularly when its durability and structural excellence are compared to that of many receivers submitted to this laboratory for test.

to use comparatively short antennas while other locations will frequently allow different types of antennas more suited to particular conditions.

For general purposes an extremely satisfactory antenna would consist of a single wire approximately 60 to 75 feet long, terminating in an insulator fastened either to a tree, barn, garage, or other support approximately 60 to 75 feet away from the house in which the receiver is located. The other end of this wire should be fastened to another insulator, in turn fastened to the building housing the receiver. This same wire which most simply would merely be pulled thru the eyelet of an insulator and wrapped back around itself for several turns, would then be carried down and into the house to the receiver, either thru a standard lead-in strip, or porcelain tube or possibly even just held down by a window frame. This lead-in then continue thru the house to either binding post "E-1" or "E-2" of the receiver.

If it is impossible to erect an outdoor antenna, a single wire, 50 to 60 feet long, strung along a picture moulding or placed in an attic will be entirely satisfactory for local and medium distance reception. This wire should have an insulated covering, but need have no other insulation.

The ground connection is made by means of a wire connected to binding post "E-3" of the receiver which terminates in a standard ground clamp fastened to a scraped and bright portion of a water, steam, or gas pipe near the receiver.

Loud Speaker

THE loud speaker, a Western Electric cone type, should have the tips on the end of its cord inserted in two tipjacks "C-1" and "C-2" on the receiver chassis. The loud speaker should *not* be placed directly upon the cabinet containing the receiver as mechanical hum may develop if this is done. It should preferably be located several feet from the receiver itself.

Operation

THE above connections having been made as outlined, the receiver is ready to be operated. With all tubes in place, the two shield tops "Q-1" and "Q-2" should be dropped down over the parts contained in the shield pans and their edges allowed to fall inside the turned up edges of the shield pans so that each shield with its pan will form a tightly closed aluminum box housing a coil, coil socket, variable condenser, tube, and tube socket.

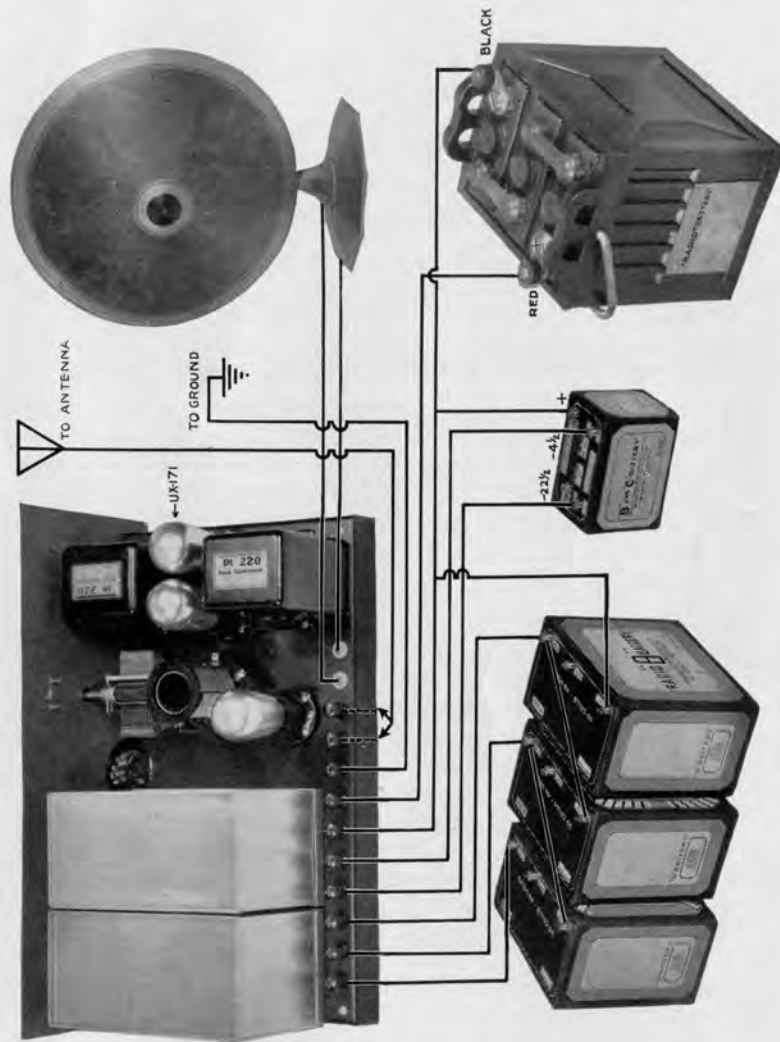


Fig. 8

To operate the receiver the volume control should now be turned just up from the "OFF" position so that all five tubes light. As this is done, a slight plunk will be heard in the loud speaker indicating that the set has been turned on and current is flowing through it. If the two dials "F-1" and "F-2" are now adjusted thruout their scales in such a fashion that they always both read approximately alike, a local station is sure to be heard if operating. To properly tune any station in, the two dials "F-1" and "F-2" should be adjusted for maximum volume, after which the volume knob should be turned slowly to the right. As this is done, the volume of the received signal will increase up to a point where as the volume knob is turned further to the right, the signal suddenly becomes distorted, and if weak to begin with, will turn into a squeal.

Most Sensitive Operating Condition

THE most sensitive operating condition of the receiver is with the volume knob turned just as far to the right as it will go without causing the station received to be heard as a squeal. This volume adjustment is not critical except on very weak distant stations, and besides serving as a sensitivity control for the receiver it also serves the main purpose of reducing volume on powerful stations.

It will be noticed that if the volume control is turned too far to the right, that as dials "F-1" and "F-2" are rotated, a plunk will be heard when they arrive at a position relative to each other at which a signal can be heard if one were broadcasting within range at the wavelength to which the two dials "F-1" and "F-2" are at that moment set. With the volume knob just to the left of this position, the receiver is most sensitive.

Tuning for Distant Stations

IN TUNING for extremely distant weak stations, it is well to set the dial "F-2" at any setting at which a local station cannot be heard. Then if the volume knob is turned practically all the way to the right beyond the point at which the local stations will be heard as a squeal, and dial "F-1" rotated approximately thruout the range of settings of the dial "F-2," a plunk will be heard. If dial "F-1" is moved slowly back and forth so that this plunk disappears and re-appears with each movement and the volume knob is at the same time slowly turned to the left, the most sensitive condition for out-of-town stations will be reached just as the volume knob is turned so far to the left that as dial "F-1" is rotated about the set-

ting at which the plunk was heard, it will no longer be heard and instead a slight hissing, due to static or atmospheric noise, will be evident in its place. If, however no distant station is heard, dial "F-2" should be re-set about one degree either way, followed by a resetting of dial "F-1" and the volume knob, and this method of tuning pursued over the entire range of dial "F-2," thruout which operation some stations are certain to be heard.

Logging

ONCE a station has been heard, if the dial settings of "F-1" and "F-2" are written down, the station may be tuned in again by simply resetting the two dials to the same figures again, and adjusting the volume control as far to the right as possible in order to obtain the most sensitive condition (just before the "plunk" is heard). If, however, the antenna should have been moved from binding post "E-1" to binding post "E-2" the setting of dial "F-1" will be altered by several degrees and so a record should also be kept in the log of which binding post the antenna was connected to—either "E-1" or "E-2."

Preliminary Selectivity Adjustment

WHEN the receiver is hooked up, the antenna should be tried first upon binding post "E-1" and then upon binding post "E-2." In the case of a weak station it will come in much louder with the antenna connected to one post than when it is connected to the other end and at the same time the tuning of dial "F-1" will be broader and less critical. This post should be used for the reception of out-of-town stations with greatest volume if local interference is not very great. If local interference is great, however, the antenna must be connected to the binding post which gives the sharpest tuning of dial "F-1" (with slightly less volume than on the other connection).

If sufficient selectivity to get thru the local stations is not obtained by this simple change, then the antenna length must be cut down. As an example of a satisfactory arrangement, many users in Chicago and New York have two antennas—one about 20 feet long and the other about 50 to 60 feet long. On silent night (on Monday in Chicago) the long antenna is used connected to the binding post giving the greatest signal strength on out-of-town stations while on week-day nights a small antenna is generally used, connected to the binding post giving most satisfactory selectivity.

Balancing

IN PURCHASING condensers "I-2" and "J" the dealer should be asked for Silver-Marshall condensers, the boxes of which are marked with crayon figures of either plus or minus 1, 2, or 3. These figures represent the percentage deviation from a standard condenser. For example, if one plus 3 and one minus 3 condenser were procured as condensers "I-2" and "J" it is doubtful if maximum satisfaction would be obtained from the S-C II receiver. The builder should therefore always be sure to get two condensers the boxes of which are marked within one number of each other; that is, a plus 1 and a plus 2 or a minus 1 and a zero condenser would be entirely satisfactory together.

Despite this precaution of matching taken at the factory it frequently happens that condensers will be slightly damaged in transit or strained by the builder in the mechanical assembly of the receiver. Therefore after the receiver has been completely assembled and is in operation, it may be well to check the ganging of the condensers "I-2" and "J" by loosening the set screw in the lock collar of link motion "K" upon the shaft of condenser "I-2." Thus with a station tuned in, it is possible by means of the dial "F-2" to rotate condenser "I-2" independently of "J" and by grasping the link motion "K" with the fingers, condenser "J" may also be moved independently of condenser "I-2." This test should be made upon a fairly weak station on a wavelength somewhere between 300 and 400 meters and the two condensers set for best signal strength independently of each other. The set screw locking the link "K" to the shaft of "I-2" should then be tightened and the receiver tuned in to other wavelengths. If this ganging is correct, each station will be tuned in comparatively sharply on dial "F-2" (if a short antenna of 10 to 20 feet is used for this test it may be made on local stations). With the condenser so locked, the shield tops "Q-1" and "Q-2" should be removed and the condensers carefully examined to see that they start to interleave at exactly the same point. If, however, they do not interleave at some points and one leads in ahead of the other, by more than $\frac{3}{16}$ ", it may be assumed that they have been slightly strained at some time and they must be adjusted to compensate for this strain.

This adjustment is made in accordance with the drawing appearing in this booklet, by means of a wrench accompanying either condenser "I-1" or "I-2." The adjustment actually consists of loosening the lock nuts upon the stator plate support bar at the right-hand side of either condenser "I-2" or "J" and re-adjusting the position of this



Fig. 9

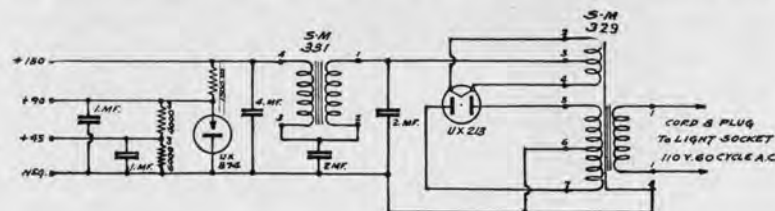
side of the stator so that as the rotor plates start to interleave they will interleave absolutely centrally between the stator plates. The condenser upon which this adjustment should be made (if it is necessary) will be the one in which the rotor plates do not appear to start to interleave centrally between the stator plates. When the rotor plates of both condensers interleave centrally between the stators, the two condensers will gang properly and the tuning on dial "F-2" will be quite sharp except on the most powerful local stations.

Battery Eliminators

THE S-C II receiver may be employed with standard A battery eliminators, if desired, although it will probably be found most economical to operate it in conjunction with a trickle charger and storage battery together with a standard relay switch connected in one of the filament battery leads, which will automatically throw the battery on charge when the receiver is turned off, and vice versa.

If a B eliminator is to be used, it should be selected most carefully, for practically all standard B eliminators are provided with adjustable voltage controls with obviously no means of allowing the builder to determine definitely the voltages he is applying to his receiver. In itself, this may not seem advantageous until it is realized that a UX201A detector tube will give the same apparent results as a detector on voltages between 20 and 200 in the hands of an inexperienced operator, and it is almost certain that the use of B eliminators of unknown voltage output will result in short tube life.

Aside from this fact, the average B eliminator, due to very poor output voltage regulation, will cause motor-boating when it is used with receivers employing high quality audio amplifiers. A circuit is therefore presented herewith, in accordance with which a very satisfactory B eliminator may be constructed with constant output voltages (suited to the S-C II receiver), and free from troubles such as motor-boating, humming, or condenser break-down. (This eliminator may be used with any standard receiver and, in fact, will be found superior to practically all factory-built B eliminators available at this writing—February, 1927.) Due to the fact that its output volt-



ages are substantially constant and are those required for proper operation of the S-C II receiver, normal tube life may be anticipated since it is impossible to misadjust the eliminator with resultant high output voltages which would damage tubes and result in poor quality of reception, due to inability to properly adjust the C biases required. It is not suggested that any endeavor be made to obtain C potential from this eliminator since the cost of a C battery is nominal, its life practically indefinite and such an effort would unduly complicate the situation.

TROUBLE-SHOOTING

Failure to Receive Signals

WITH the receiver connected for operation, should no signals be received, the trouble may be traced to an improper antenna and ground system, improper or defective batteries, improper or defective tubes, defective speaker, or poor or incorrect connections.

Lack of Volume

Should, in the opinion of the builder, insufficient volume be obtained from the receiver, a direct comparison should be made between the S-C II and any standard five or six tube tuned RF receiver. The S-C II should give volume equal to or greater than that obtainable with standard five tube receivers when properly tuned to local or out of town stations. Should it fail to do so, trouble may be traced to improper antenna and ground system, improper or defective batteries, improper or defective tubes, defective speaker or poor or incorrect connections. A possible cause of weak signals would be improper operation (see operating instructions).

Lack of Sensitivity

Should the S-C II fail to give satisfactory reception of out-of-town or weak stations, it should first be compared against a standard five tube receiver. In practically all cases the S-C II should give stronger signals on weak stations than other average types of standard five and six tube receivers. Should it fail to do so, the trouble may be attributed to any one of the causes outlined under "Lack of Volume."

Poor Tone Quality

The tone quality of the S-C II should be equal to or superior to that obtainable from any standard receiver. Should this not be the

case, the trouble may be traced to improper or defective batteries, improper or defective tubes, unsuitable or defective loud speaker, or improper operation.

Noisy Reception

The S-C II should be practically silent with the antenna disconnected from the receiver. If no disturbing noises are heard with the antenna disconnected, the receiver itself may be considered to be free of noise, and the trouble is due to the particular location in which the receiver is used and may not be remedied. It will be found that the ratio of atmospheric noise (static to signal strength will be more favorable with the S-C II than with other standard types of five tube receivers. Should noise be heard with the antenna disconnected, the trouble may be attributed to improper or defective batteries, improper or defective tubes, or poor or incorrect connections.

Blocking or Motor-Boating

Should the reception of signals be interfered with by a "put-put-put" noise or a periodic blocking of reception, the trouble may be traced to defective or improper batteries, particularly C batteries, defective or improper tubes; or more probably to poor connections, probably in the grid circuits of the detector or audio amplifier portions of the receiver.

(The use of a "B" eliminator with poor voltage regulation would also cause this trouble, to be encountered with any good receiver operated in conjunction with average adjustable voltage "B" eliminators.)

Humming

With the S-C II in operation a steady low-pitch howl or squeal may be noticed which will build up gradually from inaudibility to quite high intensity and which will continue irrespective of the control adjustments on the receiver. This condition may be remedied by inclosing the receiver in a cabinet and removing the loud speaker from close proximity to the receiver. The loud speaker should always be kept at least three to four feet from the receiver, and in such a position that the mechanical vibration given off by it will not be transmitted to the receiver cabinet. It is also helpful to wrap the detector tube in a thick old handkerchief, which, touching the sides of the detector stage can "Q-2," will tend to dampen the vibrations of this can. Any standard anti-microphonic tube cap will also stop humming. It is recommended that the S-C II be used in a cabinet

with a built-in loud speaker since howling, or, in any event, distortion, is almost certain due to the vibrations of the loud speaker being communicated to the detector tube through the cabinet.

Batteries

Suitable batteries, together with proper methods of connection, are described under "Preliminary Testing." Only good, well known standard makes should be employed, and in the case of B batteries, the "Heavy-Duty" types preferably.

Current Consumption

The A battery current drain with the tubes recommended is $1\frac{1}{2}$ amperes, the C battery drain negligible, and the B current about 30 miliamperes using 135 volts of B battery.

Loud Speaker

A Western Electric cone speaker is recommended. Other types of loud speakers will perform satisfactorily but the Western Electric cone has been found to perform extremely satisfactorily in conjunction with the S-C II receiver. The tips of the loud speaker cords should be inserted into the two tip jacks marked "C-1, C-2."

Fitting Shields in Place

To put the shield tops in place after insertion of tubes and coils in their proper sockets, a shield top should be taken in the right hand with the "U" shaped slit in one end slipped down over a condenser shaft. The front end of the shield should be allowed to nest inside the front edge of the pan. It will then be found that if the rear end of the shield is pressed forward slightly with the right hand, it may be fitted down inside the rear edge of the bottom pan very simply.

Coil Placement

It is imperative that the 116A antenna coil be inserted only in the left-hand or "L-1" socket. If inserted in the right-hand sockets, the tubes may be turned out and the coil damaged. The 116A coil is the one of the three which has a small winding of green silk covered wire in the slot at the bottom of the coil form.

Tubes

THE use of one UX371 tube in socket "M-4" together with four UX201A tubes, is recommended. If the 171 tube is operated with 135 volts B battery, the C bias should be 22½, while if it is operated with 180 volts of B battery the C bias should be increased to approximately 35 to 40 volts. If a 112 tube is used in the output stage, the quality will not be as satisfactory as with a 371. With 135 volts B battery the C battery should be 9 to 12 volts.

Use of UX200A Detector Tube

A UX200A detector tube may be used, if condenser "G-2" and binding post "E-6" are omitted from the receiver, and contact No. 6 of coil socket "L-3" connected directly to the shield. It will also be necessary to insert a .00025 grid condenser (with 2 to 5 megohm grid leak in its clips) between terminal "G" of tube socket "D" and terminal No. 3 of coil socket "L-3," as the UX200A does not appear to function as well with a C battery as with grid-condenser and leak.

Potentiometer Switch

Suggestions have already been offered under "Inspecting and Testing" in connection with the Carter potentiometer switch. If this instrument is suspected of being defective, that is, if in operation the tube filaments vary in brilliancy as it is rotated or if the volume of the received signal is not controlled by the potentiometer, it should be removed and taken to a service station for examination. It may be tested by making sure that the contact arm makes contact with the resistance sector at all points thruout its arc and that the resistance sector is not broken at any point nor short-circuited to the frame of except thru the contact arm (which is grounded to the frame). The two switch springs should not be grounded to the frame, and except when the instrument is in the "OFF" position they should make firm positive contact with each other. This contact may have to be cleaned from time to time with a nail file inserted between the two contacts of the switch, particularly if any form of A battery eliminator is used.

Coil Socket Contact

Should any trouble develop in operation, the contacts of the coils "O," "P-1" and "P-2" should be carefully examined to see that they are clean and bright and that when the coils are inserted in their sockets the contact springs and buttons, numbered 3, 4, 5 and 6, make good, firm contact with each other. It may be necessary to bend the springs outward slightly to insure good contact and, if necessary, this should be done.

Selectivity Adjustment

The selectivity of the S-C II is such that it will allow of satisfactory separation of the large number of powerful local stations found in the territories surrounding New York and Chicago. It will also allow the reception of out-of-town stations thru the locals if favorably located and carefully operated. Should the selectivity be found insufficient, the antenna should be moved from binding post "E-1" to "E-2" as suggested previously, and antennas of different lengths, say between 10 and 100 feet, tried. It might also be well, if extreme selectivity is required of a receiver in close proximity to a powerful broadcaster, to purchase an S-M 340 midget condenser which may be connected in the antenna lead-in and allowed to fall in the back of the cabinet behind the receiver (not in contact with the metal chassis, however). Varying this condenser will allow extreme selectivity to be obtained, with, of course, a slight loss of volume.

Loop Operation

The S-C II is designed for operation with an antenna but it may be operated with a standard loop designed for a .00035 mfd. condenser if the loop is connected to terminals No. 3 and 6 of coil socket "L-1." The range of the receiver will be reduced and the selectivity probably increased. The receiver will be quite satisfactory for local operation but volume on distant stations will probably be insufficient for adequate loud speaker operation.

Short and Long Wave Reception

The S-C II is not suited to operation below 200 meters with any standard coils, although by the use of S-M type 115D and E coils and type 116D and E coils it will cover the range of 550 to 3000 meters (range with one 116D and two 115D coils 550 to 1500 meters; range with one 116E and two 115E coils 1400 to 3000 meters).

Condenser Adjustment

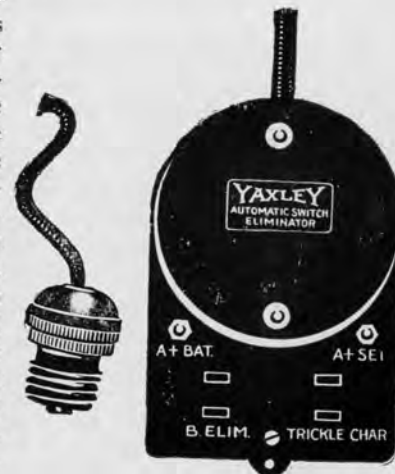
The variable condensers used in the "SC-II" are provided with a number of features which will permit of special adjustment to take care of wear, damage in transit, or special operating conditions. Unless the condensers are very carefully ganged, the receiver will give poor volume on distant stations, and insufficient selectivity. The drawing herewith indicates the means of adjustment which may be employed to adapt the condensers to suit individual conditions and how

the plate sections may be lined up should they be dis-aligned in handling. Normally, these instructions would not be necessary since all condensers are very carefully tested and inspected before leaving the factory, but in the interests of absolute safety, the data are presented.

From the drawing it will be evident that the alignment of the stator and rotor plates may be changed by simply shifting the position of the entire stator plate assembly, which is held to the condenser frame by means of two rods to which all stator plates are soldered, each rod carrying two nuts on either end which lock against opposite sides of the two bakelite insulator strips. If the builder cares to assure himself that his receiver is working absolutely 100 per cent, he may, after assembling the condensers upon the chassis, and the link motion to the shafts, adjust the condensers by means of the wrench supplied with the 316B types. This adjustment of a condenser would consist of shifting the position of the stator plate section so that the rotor plates interleave absolutely centrally between the stators, particularly on the right-hand side (over the first half of the rotary movement). Such an adjustment would not be necessary unless unmatched condensers had been procured, as it was found in actual test that condensers "I-2" and "J" did not hold the same relative adjustments for maximum signal strength at all wavelengths.

Automatic Control of Power Equipment

If a standard storage A battery with trickle charger is used, it is a very simple matter to obviate all switching or turning on and off of the trickle charger or battery thru the use of an automatic relay. The Yaxley automatic relay pictured herewith will allow a receiver, used in conjunction with a B battery eliminator, an A battery, and a trickle charger, to be turned on and off at will with no other control than the "Volume" knob on the front panel. At the same time when the receiver is turned off, the A battery is automatically connected to the trickle charger.



If the Yaxley relay is to be used, the wire from binding post "E-4" to the storage battery should be broken at a point near the A battery and the ends connected to binding posts No. 1 and 2 of the Yaxley automatic relay. The attachment plug from the B eliminator should be inserted in the relay socket at the point marked for it; while the attachment plug from the trickle charger should be inserted in the other socket of the relay marked "TRICKLE CHARGER." The clip leads of the charger should be connected to the storage battery. The cord and plug of the relay may then be connected to the nearest home lighting socket or wall receptacle.

In operation, it is merely necessary to manipulate the "Volume" knob of the receiver to turn the set on and off. When the "Volume" knob is in the "OFF" position, the A battery is automatically disconnected from the receiver and connected to the trickle charger, and the B eliminator is disconnected. With the "Volume" knob turned to the "ON" position, the trickle charger is automatically disconnected, the A battery is connected to the receiver, and the B eliminator is turned on for operation, all by means of a single control knob on the receiver front panel.

Mail Order Houses

FOR readers of this booklet who may find difficulty in procuring, locally, the parts or accessories required for building their own radio receiver, the following convenient list of mail order houses specializing in radio is submitted:

Albin Radio Corporation 350 W. 34th St. New York, N. Y.	Graymore Radio Corp. 142 Liberty St. New York, N. Y.	Montgomery Ward & Co. Chicago Ave. & Larabee St. Chicago, Ill.
American Radio Mfg. Co. 1416 McGee St. Kansas City, Mo.	The Harco Company 1255 So Wabash Ave. Chicago, Ill.	Randolph Radio Corp. 711 W. Lake St. Chicago, Ill.
B.C.L. Radio Service 221 Fulton St. New York, N. Y.	Heins & Bolet 44 Park Place New York, N. Y.	Security Radio Co., Inc. 1506 Pine St. St. Louis, Mo.
The Barawik Company 32 So. Clinton St. Chicago, Ill.	Madison Radio Corp. 35 W. 31st St. New York, N. Y.	Shure Radio Co. 19 So. Wells St. Chicago, Ill.
Western Radio Mfg. Co. 134 W. Lake St. Chicago, Ill.	Wholesale Radio Service 6 Church St. New York, N. Y.	

Service Stations

THE following Radio Service Stations may be recommended as experienced and reliable laboratories where home-built receivers may be checked, rewired or rebuilt at reasonable cost:

Albert's Radio Co. 30 Brattle St. Boston, Mass.	Radio Const. Laboratories 156 Chambers St. New York, N. Y.	Rossiter, Tyler & McDonell 136 Liberty St. Chicago, Ill.
Knight Radio Laboratories 1171 So. Elmwood Ave. Oak Park, Ill.	Radio Doctors, Inc. 504 So. State St. Chicago, Ill.	St. Joseph Sporting Goods Co. 420 Felix St. St. Joseph, Mo.
Moskowitz & Herbach 512 Market St. Philadelphia, Pa.	Radio Inspection Co. 193 Trumbull St. Hartford, Conn.	John Spang 125 Massachusetts Ave. Boston, Mass.
Public Radio Service 66 E. South Water St. Chicago, Ill.	Radio Serv. Laboratories 508 So. Dearborn St. Chicago, Ill.	
Tremont Elec. Supply Co., 70 Stuart St. Boston, Mass.	Wagner Radio Co. 643 W. Washington Blvd. Chicago, Ill.	

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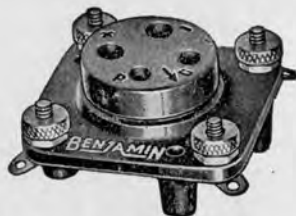
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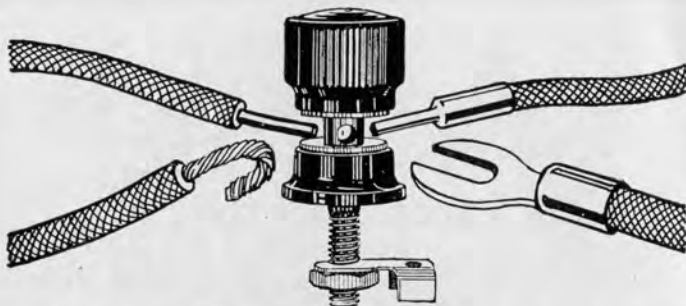
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EBY Binding Posts were used in building and are specified exclusively for the S-C II Receiver. The markings illustrated here are for the binding posts you will need to build this receiver. Your dealer has them already packed in a separate carton. Insist on and get genuine EBY Binding Posts to build this receiver. Carton of 10, \$1.50.

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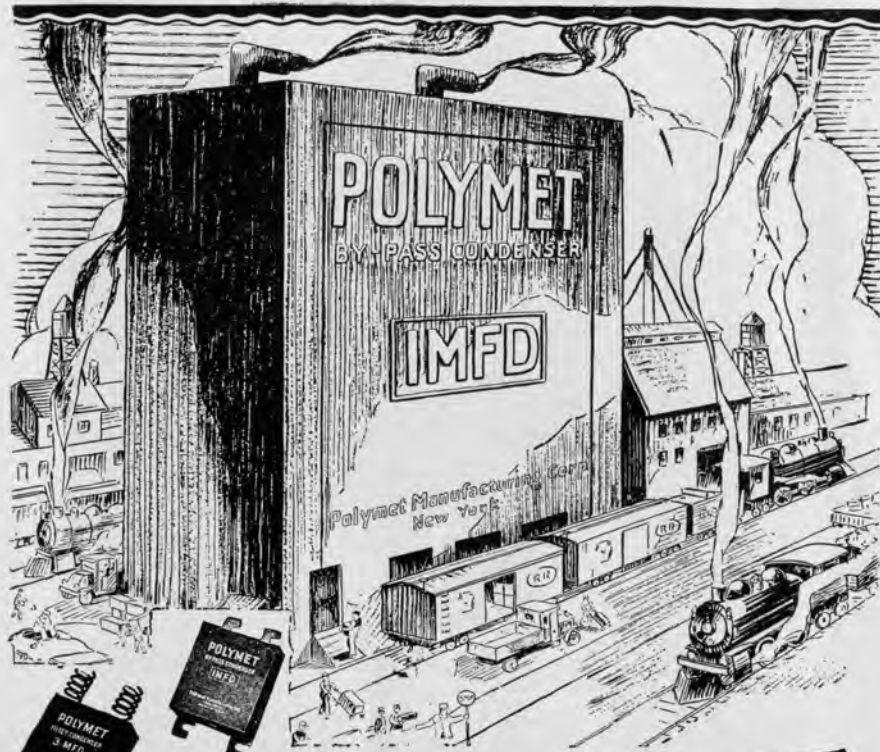
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for the range of zero to 45 milliamperes, as compared to a 25% or greater change for ordinary eliminators!

This constancy of output voltage means absolute absence of "motorboating," "putting," and "humming," irrespective of the number of receiver tubes operated from the 652. It also means that quality of reproduction with the 652 is as good as with new fresh batteries, and it doesn't change with use!

These and other facts demonstrating the remarkable superiority of the 652 B supply kit account for its selection for use with the S-C II receiver, its enthusiastic approval by Radio Broadcast, its principle and many of its parts forming the basis of the Citizens' Call Book eliminator, and of many others as well.

The kit contains all necessary parts except one CX131 and one CX374 tube, and may be procured from any good dealer. It can be assembled in two hours using but three tools, and it is guaranteed to give greater satisfaction with any receiver than any other B eliminator.

Silver-Marshall, Inc.

846 West Jackson Boulevard • • • Chicago

SM

The Proof of Merit

The selection of S-M parts for the new S-C II receiver is not surprising when their unquestioned reputation, based upon sheer merit, is considered.

Take 220 audio transformers, for instance. While all other transformers are backed only by claims, S-M audios are guaranteed to be more satisfactory than all other methods of audio amplification and Silver-Marshall backs the guarantee of perfect satisfaction by a money-back guarantee.

Then consider S-M variable condensers. They may be procured from any dealer in any quantity matched to plus or minus 1% accuracy at all dial settings. They have removable shafts, may be operated from front or rear, or in gangs of two or three at will.

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