

TECHNICAL REGULATIONS }
No. 1210-50 }

WAR DEPARTMENT,
WASHINGTON, July 6, 1932.

RADIO SETS, TYPES SCR-131 AND SCR-161

Prepared under direction of the
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SECTION I

GENERAL USE AND DESCRIPTION

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1. **Uses.**—*a.* Radio set, type SCR-131, is a portable, loop, continuous wave (C. W.) telegraph transmitting and receiving set operating within a frequency band of 3,960 to 4,360 kilocycles. The set is designed to give reliable communication between headquarters which are separated by a distance of 5 miles or less. It is also designed to furnish 40 operating channels spaced 10 kilocycles apart; however, in order to avoid possible interference between nets it is desirable so to assign frequencies as to have nets which operate within 5 miles of one another spaced at least 20 kilocycles apart. The set requires only two men to carry it. When set up, it occupies little space and can be used in any location from which satisfactory radiation may be expected.

b. Radio set, type SCR-161, is identical with radio set, type SCR-131, except for the capacities of three capacitors, which difference causes the former to operate within a frequency band of 4,370 to 5,100 kilocycles. It is designed to furnish 74 operating channels spaced 10 kilocycles apart; however, in order to avoid possible interference between nets it is desirable so to assign frequencies as to have nets which operate within 5 miles of one another spaced at least 20 kilocycles apart. In these regulations all general statements apply to both the radio sets, types SCR-131 and SCR-161. Where settings, values, or type numbers for these sets differ, those shown in parentheses apply to the radio set, type SCR-161, only.

2. **General description.**—*a.* When packed for transportation, the set consists of four parts: The radio receiver and transmitter, type BC-148 (BC-151), with a carrying strap, type ST-19, weighing when complete with batteries, head sets, and tubes, 33.5 pounds and being 14 $\frac{5}{8}$ inches high, 14 $\frac{1}{2}$ inches wide, and 8 $\frac{1}{4}$ inches deep; the bag, type BG-49, containing the loop, type LP-7, the

three legs and two cranks of the generator, type GN-35, and with its contents weighing 9 pounds; the case, type CS-41, containing the generator, type GN-35, and weighing with it, 22 pounds; the bag, type BG-50, weighing when packed 12 pounds and containing three spare batteries, type BA-23, two spare batteries, type BA-2, two spare tubes, type VT-25, three spare tubes, type VT-24, one cord, type CD-103, message books, etc. The total weight of the set is 76.5 pounds.

b. When set up for operation, the set consists of two essential parts: The radio receiver and transmitter, type BC-14S (BC-151), with loop, type LP-7, attached, and the generator, type GN-35. The cord, type CD-103, connects the generator to the set box. The top of the loop is 57 $\frac{3}{4}$ inches above the level of the ground upon which the set rests.

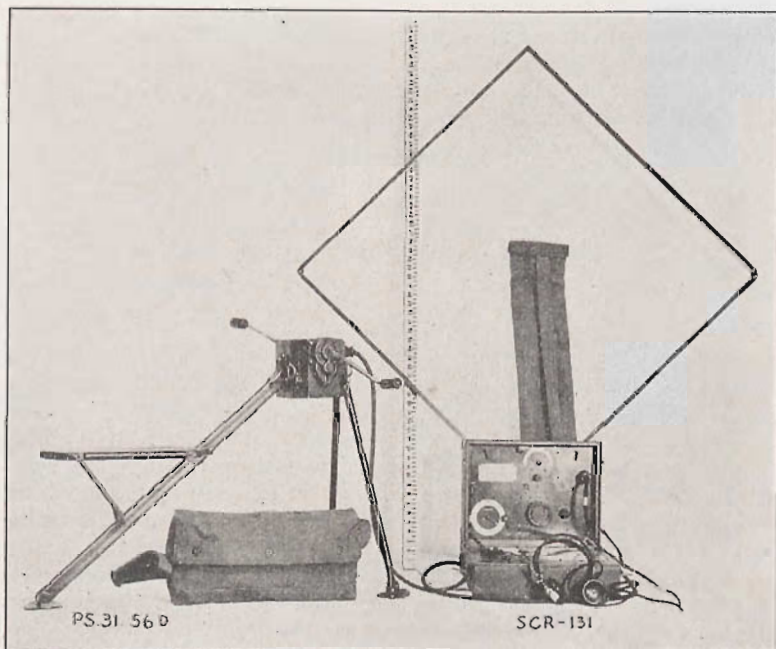


FIGURE 1.—Radio set, type SCR-131 (161), set up for operation

3. Illustrations.—Figure 1 shows a normal installation of the radio set ready to operate; bags, types BG-50 and BG-49, are shown under the generator and behind the loop, respectively. Other views of the radio receiver and transmitter appear in Figures 2, 3, 4, and 5. Figures 6 to 11 show various details of the circuits utilized in the set.

SECTION II

INSTALLATION FOR SERVICE

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4. Detailed description of the set as issued.—*a. Radio receiver and transmitter, type BC-14S (BC-151).*—(1) The radio receiver and transmitter consist

of two wooden boxes permanently hinged together and held closed for transportation by two catches, one at each side. The smaller box will hereafter be called the apparatus box and the larger box the battery compartment box. The radio receiver and transmitter having been placed so that the battery compartment box rests on the ground, the catches which lock the two boxes together having been released, the apparatus box may be swung up and back on the hinges so that it rests upon the projecting portion of the battery-compartment box. Figure 2 shows the radio receiver and transmitter in this opened position. On the panel of the apparatus box can be seen the receiver tuning control RECEIVER, the loop tuning control LOOP, and the filament rheostat FIL. RHEOSTAT, all clearly marked. In the upper center of the panel is a

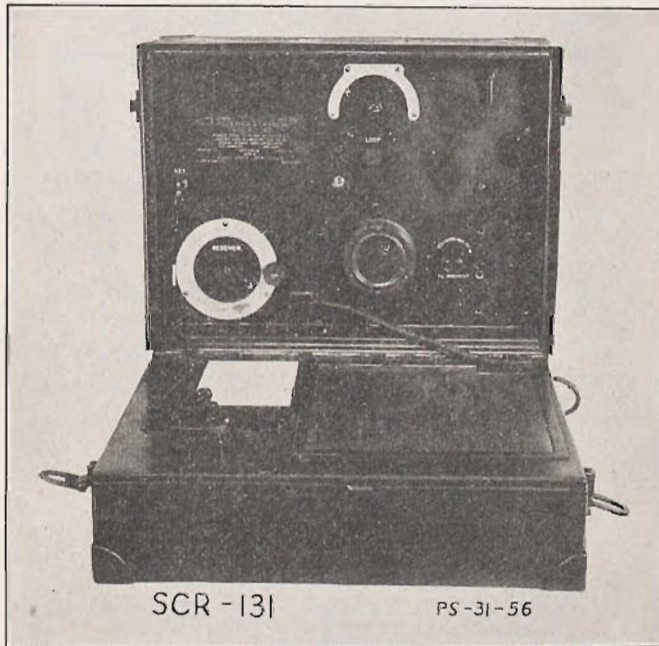


FIGURE 2.—Radio receiver and transmitter, type BC-148(151), front view

flash-light bulb which lights when the set is transmitting. Just above the center at the right is seen a socket for the 4-prong plug of the cord, type CD-103, which is used to connect the generator to the radio receiver and transmitter. At the bottom of the panel and nearly in the center is the filament current ammeter for the receiver; of the scale of this meter there is visible only a small sector about the mark which shows the correct position of the pointer for proper receiver filament current. The cord connecting the key to the panel need never be disconnected except for purposes of replacement. At the upper right and left of the panel are seen the catches which lock the panel to the apparatus box. Releasing these catches by turning them so that the handles are toward one another, the panel which is hinged at the bottom may be pulled forward. The inside of the apparatus box is then visible as in

Figure 3. On the bottom of the panel is mounted the receiving apparatus except batteries, head sets, and loop. The panel is of metal and when closed makes a spring contact with the sides of a metal box which fills the lower part of the apparatus box; the receiving apparatus except the batteries, head sets, and loop is thus contained within a metal shield. From left to right across the bottom of the panel, the major items of equipment visible are the receiver tuning capacitor, behind which are mounted two capacitors, type CA-165

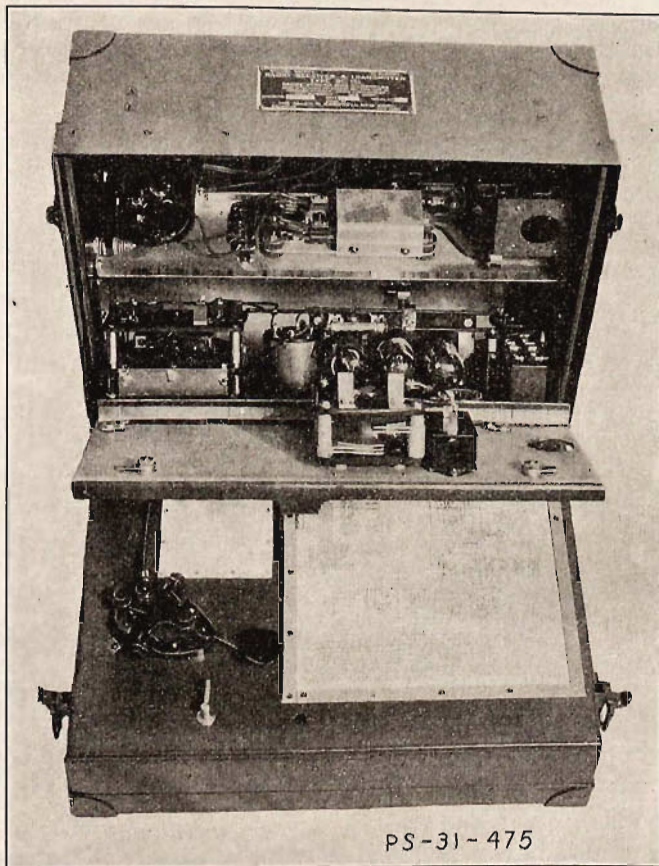


FIGURE 3.—Radio receiver and transmitter, type BC148(151), showing interior of apparatus box

(CA-169), and two capacitors labeled C_4 and C_5 in Figure 6; a cylindrical metal case which contains the grid and plate inductors of the receiver heterodyne tube, the receiver heterodyne tube, in rear of which is the grid leak; two audio-frequency amplifier tubes and on the extreme right, two audio-frequency transformers, type C-65. On and above the shelf which divides the apparatus box in two are the transmitting tube, relay, and all transmitting equipment except the key, generator, loop, and loop-tuning capacitor. The transmitting tube is seen in the upper left; beneath it are the transmitting reactor and a

capacitor, type CA-134; in the center is the transmitting relay; at the right is the socket for the plug of the cord, type CD-103. All tubes are on flexible mountings so as to reduce danger of accident and to minimize microphonic noise.

(2) The shelf carrying the key, shown in Figure 2, has also upon it a wiring diagram of the set and a sheet of white celluloid beside the key for operator's pencil memoranda; the celluloid can be erased with a damp cloth. The shelf is hinged at the back and is held in place by a catch at the front; it affords access to the battery compartment box. Figure 4 shows the shelf raised and

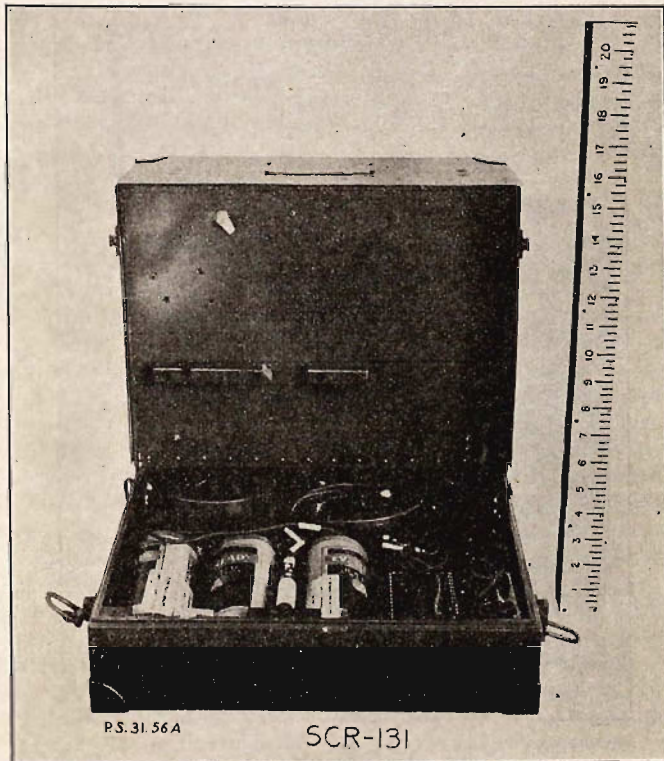


FIGURE 4.—Radio receiver and transmitter, type BC-148(151), showing interior of battery compartment box

gives a view of the battery compartment box. The three receiver filament batteries, type BA-23, are connected in series by means of the flexible cords provided and the resulting battery is connected to the 4.5 V binding posts at the right center of the compartment. To the right of the filament battery are two batteries, type BA-2, which form the plate battery for the receiver; these batteries are connected in series by means of the binding posts directly in rear of them. Just beneath the rectangle of bakelite on which are mounted the binding posts is a double jack for the head sets, type P-11. The jack is open to the rear; an opening at the upper right rear of the battery compartment box allows the cords of the head sets to be passed to the outside with the shelf down. The

head sets are carried in the rear of the battery compartment box as shown in Figure 4. To the right of the catch in Figures 2 and 4 is seen a hole in the shelf; when the set is closed for transportation, a projection at the top of the panel in Figures 2 and 3 passes through this hole and strikes the spring switch in the battery compartment box, thus opening the receiver filament circuit when the set is packed for transportation.

(3) Figure 5 shows the back of the radio receiver and transmitter and the two sockets for the loop. The loop, type LP-7, is not a part of the radio receiver and transmitter. It consists of two parts; each part is a pair of lengths

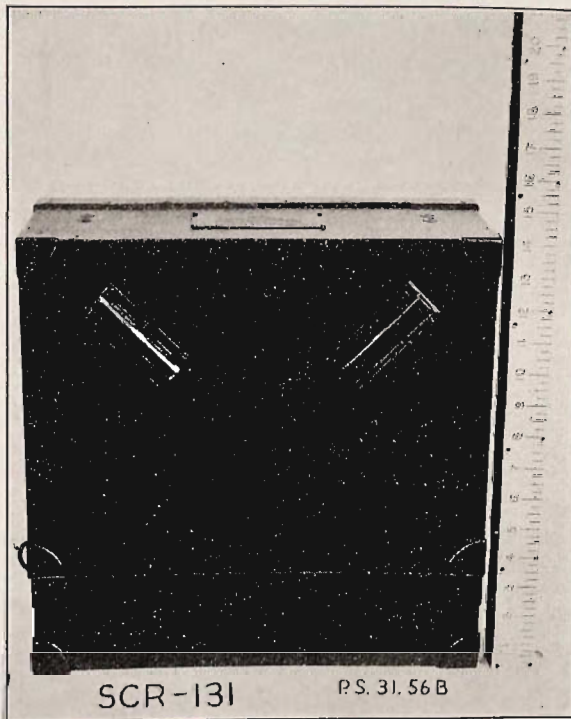


FIGURE 5.—Radio receiver and transmitter, type BC-148 (151), rear view

of square brass tubing permanently hinged together. The free end of one tube of each pair plugs into one of the sockets on the radio receiver and transmitter; the free ends of the other tubes of each pair snap together in a knife switch contact at the top of the loop. (See fig. 1.)

b. Generator, type GN-35.—Current for the plate and filament circuits of the transmitting tube is furnished by the generator, type GN-35. The latter is a self-excited generator having a double-wound armature and is equipped with a voltage regulator. For use, the generator is mounted on three removable legs, one of which carries a seat for the man who turns the generator. The cranks by which the generator is turned are also removable. No connections to the generator are required to be made other than plugging into it the plug of the cord, type CD-103.

c. Bag, type BG-49.—This bag resembles a golf bag cut in half along its longer dimension and fitted with a hinged cover at the top. The bag is of canvas with web top and metal bottom; the top fastens with an automobile curtain fastener.

d. Bag, type BG-50.—This bag is of webbing with a hinged cover which is held closed by automobile curtain fasteners. Under the cover is a flap on the underside of which are marked the items to be carried in the various compartments into which the bag is divided. At the right of the bag as it is opened is a rectangular fiber container for the spare vacuum tubes of the set; the tubes will not fit into this container in their original pasteboard cartons but should be wrapped with the protective tissue within the paper carton when being packed into the container. To the left of the container and at the rear of the bag are three compartments each designed to hold one of the three spare batteries, type BA-23; to the left of these is a compartment designed to hold the two spare batteries, type BA-2; the front compartment on the left is for the message book, log sheets, etc. When the flap is closed down there is left enough space on the top of it to pack the cord, type CD-103.

e. Case, type CS-41.—This is a rectangular webbing case with a leather reinforced bottom and hinged cover held closed with two automobile curtain fasteners. It serves to protect the generator during transportation and has no other purpose.

5. Installing the set.—*a. Radio receiver and transmitter, type BC-148 (BC-151).*—(1) Place the radio receiver and transmitter firmly on the ground with the battery compartment box down and the apparatus box toward the operator. Unfasten the catches at the right and left by an upward pull on the latches. Raise the apparatus box to a vertical position so that it rests upon the projection of the battery compartment box. Assemble the loop on the radio receiver and transmitter. The plane of the loop should point toward the most distant station of the net or toward that station with which communication is expected to be most difficult. Unlatch and raise the shelf of the battery compartment box. Connect in series, by means of the flexible cords, three batteries, type BA-23, fit them into the compartment made for them and see that the positive and negative terminals of the 3-cell battery are now connected to the proper binding posts, +4.5 V and -4.5 V, respectively. Put into the right-hand front compartment two batteries, type BA-2; connect the red wire of the right-hand one to the +4.5 V binding post and the black wire of the left-hand one to the -4.5 V binding post; connect the remaining wire of each battery to either of the binding posts marked COMMON B. The foregoing procedure of connecting the batteries will be followed only when putting the set into service for the first time, or for battery replacement or when the set has been withdrawn from storage. Remove the head sets, plug them into the jacks beneath the binding post panel and bring the cords of the head sets out through the slot at the right of the battery compartment box. Lower the shelf and lock it with the catch.

(2) See that the filament rheostat is in the OFF position. Turn the catches at the top of the panel of the apparatus box until the handles point toward one another and pull the panel forward. The panel will not pull forward easily; this is normal and results from the strong contact which the panel makes with the box shielding the receiver circuits. Insert in the transmitter tube socket a tube, type VT-25; insert in the receiver tube sockets three tubes, type VT-24. If certain tubes have been selected for the heterodyne tube, care

should be exercised that one of these is placed in the first receiving tube socket at the left. Push the panel back and lock it into place with the catches. The foregoing procedure of inserting tubes will not be followed except when the set is used for the first time, for tube replacement, or after the set has been stored; at other times the tubes are left in the sockets.

(3) Screw the flash-light bulb into its socket in the center of the panel; this also may be left in place except when the set is to be stored. Plug into the socket at the upper right of the panel one end of the cord, type CD-103; the arrow on the plug should be aligned with the arrow on the socket, otherwise the plug will not enter the socket. The ends of the cord are interchangeable.

(4) Turn the receiver filament rheostat slowly until the ammeter pointer is aligned with the arrow in the scale slot.

b. Generator, type GN-35.—Remove the generator and its legs from the carrying bags. Lay the generator on the ground with the name plate vertical and so that it can be read. Slip the legs which do not have the seat attached through the rings on the top of the generator and engage them firmly with the spring beyond the rings. Raise the generator upon the legs so that the name plate is up. On the vertical face of the generator opposite the two attached legs is a D ring and beneath the D ring a slot. Holding the D ring up, engage the projection at the bottom of the upper end of the third leg in the slot; then push the D ring down over the top of the leg. Raise the seat, raise the seat holder and insert the free end of the seat holder into the slot in the bottom of the seat. Insert the cranks in the holes at the right and left of the generator. Just above the top of the two legs of the generator is the socket for the cord, type CD-103. Plug into the socket the free end of the cord, type CD-103. The plug will enter the socket only when the arrows on them are aligned.

SECTION III

OPERATION

	Paragraph
Operating procedure for the net control station.....	6
Operating procedure for stations other than the net control station.....	7

6. Operating procedure for the net control station.—*a.* Turn the receiver adjustment to the frequency assigned the net in which the set is to work. Direct the assistant to turn the generator at approximately 50 to 60 revolutions per minute; minimum proper speed will be indicated to him by the seemingly easier turning of the generator when it reaches the speed at which the voltage regulator starts to function. Hold down the sending key and turn the loop adjustment until zero beat is reached. As the adjustment approaches zero beat, a note of decreasing frequency will be heard in the head phones; if the adjustment passes zero beat on the other side, the note will again be heard but with increasing pitch. When zero beat has been reached, turning the loop adjustment in either direction will produce a note of increasing pitch. The transmitter has now been set at the assigned frequency and the loop adjustment should not be touched until another set-up is made or the net frequency is changed.

b. With the key held down move the receiver adjustment until the note in the head set is satisfactory to the ear. The key is then released. The receiver is now adjusted. Henceforth adjust the receiver slightly as required to secure a pleasing note during operation with the other stations of the net, but do not touch the loop adjustment.

c. The set is now ready to send to other stations in the net for their adjustment. When establishing the net or when one or more stations temporarily out of the net may be expected to return to the net, the net control station transmits at sufficiently frequent intervals to facilitate the entry of the other stations into the net.

d. To transmit, direct the assistant to turn the generator at the proper speed. When this speed is attained, transmit by use of the key; no other operations are required. When the key is up the set is ready to receive. To break in, send long dashes until the other operator has heard this signal in the intervals between his dots and dashes, and has stopped sending.

7. Operating procedure for stations other than the net control station.—
a. Tune both loop and receiver to the frequency assigned the net by setting the pointers. At the time of the prearranged schedule, turn the receiver adjustment knob slowly back and forth until the signal transmitted by the net control station is heard. Then tune the receiver to zero beat with the signal from the net control station. For description of zero beat, see paragraph 6. Signal the assistant to turn the generator and when the generator is turning at proper speed, hold down the key. Adjust the transmitter by varying the loop adjustment until zero beat is secured; the transmitter is now set at the same frequency as that of the net control station. With the key held down, move the receiver adjustment until a pleasing note is heard in the head phones; release the key. The receiver is now adjusted. The loop adjustment should not be changed until another set-up is made or the net changes to another frequency. The receiver may be adjusted during reception when it is desired to change the pitch of the note heard.

b. To transmit, signal the assistant to turn the generator at the proper speed. When that speed is attained transmit by use of the key; no other operations are required. When the key is up the set is ready to receive. To break in, send long dashes until the other operator has heard this signal in the intervals between his dots and dashes and has stopped sending.

SECTION IV

REMOVAL FROM SERVICE

	Paragraph
Repacking the set.....	8
Preparation for storage.....	9

8. Repacking the set.—Pack the message books, log sheets, etc., into the compartment provided in the bag, type BG-50. Turn the filament rheostat to the OFF position. Remove the cord, type CD-103, and pack it between the flap and cover of the bag, type BG-50; snap the securing strap and then the cover of the bag. Remove the cranks and legs of the generator and fold down the seat. Put the generator into the case, type CS-41, and close the cover. Unsnap the knife switch contact at the top of the loop; remove the two halves of the loop from the radio receiver and transmitter. Pack the bag, type BG-49, as follows: First insert the two short legs of the generator, one at each side of the bag and with the pivoted foot down; next insert the other leg of the generator with the seat against the flat side of the bag and with the pivoted foot up; at each side of the bag insert one of the halves of the loop, folded; slip the cranks down into the bag between the flat side and the generator leg carrying the seat; close the bag. Remove the head sets from the jack, pack

them in the battery compartment box, and latch the shelf. Lower the apparatus box onto the battery compartment box and lock the two together with the catches at either side. The set is now ready for transportation.

9. Preparation for storage.—The set as packed for transportation is ready for storage except that the flash-light bulb, the batteries, type BA-23, the batteries, type BA-2, the vacuum tubes, type VT-24, and the vacuum tubes, type VT-25, should be withdrawn from the set and from the bag, type BG-50. Batteries and tubes should be stored separately.

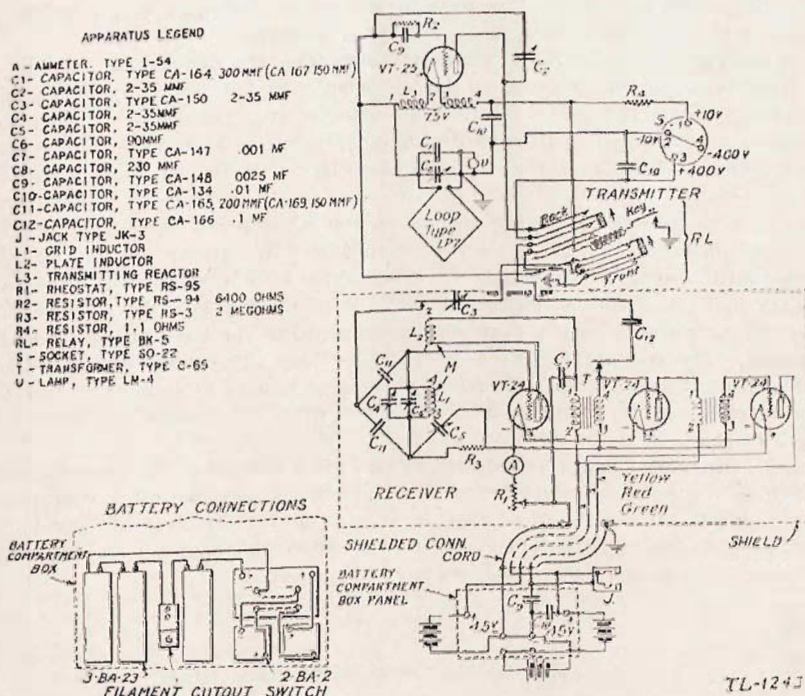


FIGURE 6.—Circuit diagram, type SCR-131 (161)

SECTION V

FUNCTION OF PARTS

	Paragraph
Radio receiver and transmitter, type BC-148 (BC-151)	10
Generator, type GN-35	11

10. Radio receiver and transmitter, type BC-148 (BC-151).—*a. Transmitter.*—(1) In Figure 6 is shown the wiring diagram of the set. This diagram shows transmitter and receiver circuits. When the key is closed with the hand generator in operation, current flows from the positive 10-volt terminal of the generator through R_2 , the relay winding and key to ground. It will be noted that the negative terminal of the 10-volt supply is directly connected to that side of the loop which is grounded. Current through the relay winding operates the relay thereby closing the positive 400-volt supply onto the plate

of the transmitter tube, breaking the connection of the loop circuit to the receiver, and grounding the receiver. The transmitter circuit set up by the operation of the relay is shown schematically in Figure 7.

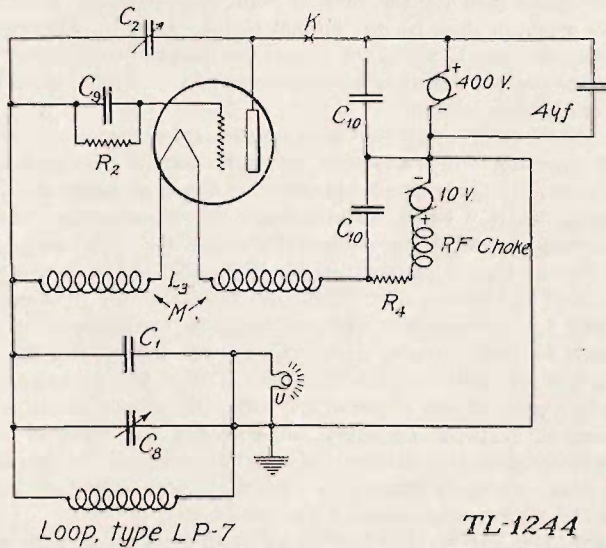


FIGURE 7.—Schematic transmitter circuit

(2) The transmitter circuit is seen to be a modified Hartley type. The oscillatory circuit consists of capacitors C_1 , C_2 , C_3 , and C_{10} , the transmitting reactor L_3 and the loop, type LP-7. Since capacitors C_{10} are of 0.01 microfarad

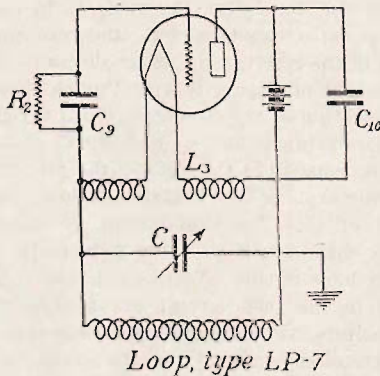


FIGURE 8.—Simplified transmitter circuit

capacity their impedance at the frequency of this set is negligible and they may be neglected in an effort to simplify the transmitter circuit. The capacities of C_1 , C_2 , and C_3 may be lumped together as a single capacity. The transmitter circuit may then be more simply represented as in Figure 8. The transmitting

reactor L_a , and the loop, type LP-7, are in parallel in the oscillatory circuit and since the loop has far less inductance, it, with the lumped capacity C , determines the frequency of the oscillatory circuit. The purpose of L_a is to provide grid excitation and plate load for the tube, it being impracticable to tap the loop inductance as would be done for the normal Hartley circuit. Alternating plate current flowing through L_a gives the proper excitation to the tube; sufficient alternating plate current flows through the loop and capacitor C to maintain the oscillations of the loop circuit.

(3) Refer to Figure 7. The functions of the various parts are as follows: C_1 is a fixed capacitor which provides the major part of the capacity in the oscillatory circuit. C_2 is a variable capacitor by means of which the oscillatory circuit is tuned. C_3 is a small variable screw driver capacitor which is connected to the loop circuit by the action of the key relay; it compensates the loop circuit for the loss of capacity which is occasioned by disconnecting the receiver circuit from the loop circuit and thus maintains the frequency calibration of the loop tuning capacitor whether the set is transmitting or receiving. C_4 is a by-pass for radio-frequency current around the resistor R_2 . C_5 is a by-pass capacitor for radio-frequency current. R_2 is a grid leak the use of which gives the grid of the transmitting tube the proper negative bias for efficient operation. L_a is a 4-terminal, air-core coil the turns of which are properly proportioned to give grid excitation and plate load for the tube. U is a flash-light lamp which is lighted by current in the oscillatory circuit and thus offers a check on the operation of the transmitter.

(4) The left-hand side of the loop is at ground potential with respect to radio frequency; this acts to give it a transmitting and receiving characteristic which is a combination of the nondirectional characteristic of a vertical antenna and the directional pattern of a loop antenna. Thus the set transmits and receives well in all directions, but for extreme distance ranges the plane of the loop should point in the direction of the distant station.

b. Receiver.—(1) When the key is up, the relay is in the unactuated condition, connecting the loop, capacitors C_1 and C_2 , and transmitting reactor L_a to the receiver. The circuit of the receiver is then as shown in the simplified drawing in Figure 9. Comparison of Figure 9 with Figure 10 will show that the latter is a further simplification of the circuit in which C replaces C_1 and C_2 , L replaces L_a and the loop inductance, and C_3 replaces C_4 and C_5 . From Figure 10 it will be seen that the capacitors C_1 , C_2 and the grid-filament capacity of the first tube form the four arms of a Wheatstone bridge. The bridge may be balanced by adjustment of C_2 . The loop circuit is coupled to the bridge through the capacitor C_3 , made small so as to reduce the interaction of the heterodyne tube and the loop circuit. Voltages across C and L because of incoming signal current in the loop circuit are applied through C_3 to the junction of the C_1 capacitors, through the upper C_1 capacitor to the grid-filament circuit of the heterodyne tube. Since the bridge is balanced, there is no voltage due to the incoming signal across L_1 and C_3 . Thus the loop does not affect the frequency of the oscillatory circuit of the heterodyne tube.

(2) The heterodyne tube is a simple regenerative tuned grid oscillator, energy being fed from the plate circuit in L_2 to the oscillatory circuit consisting of L_1 , C_1 , and C_2 . Since the grid-filament capacity of the tube is equal to that of C_2 , half of the voltage across the oscillatory circuit is applied to the grid-filament circuit of the tube. Further, since the bridge is balanced, there is no voltage

because of the oscillatory circuit current between the junction of the C_{11} capacitors and ground; hence the loop circuit is unaffected by the heterodyne oscillatory circuit. The bridge arrangement by which loop and heterodyne cir-

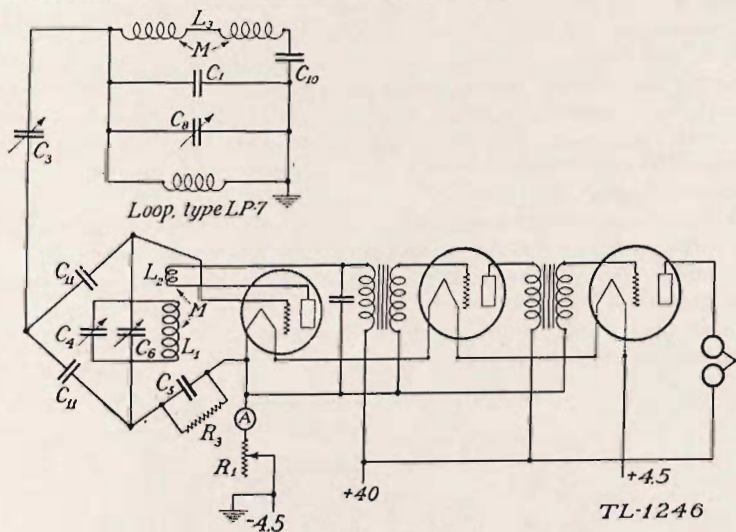


FIGURE 9.—Schematic receiver circuit

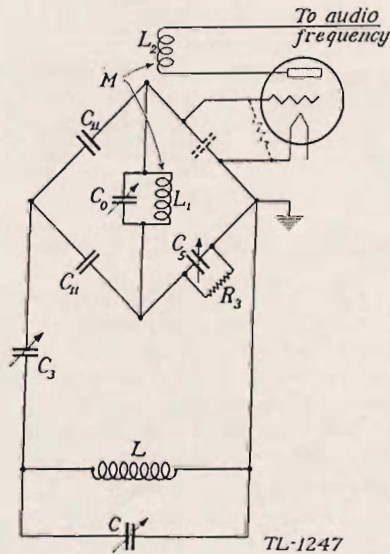


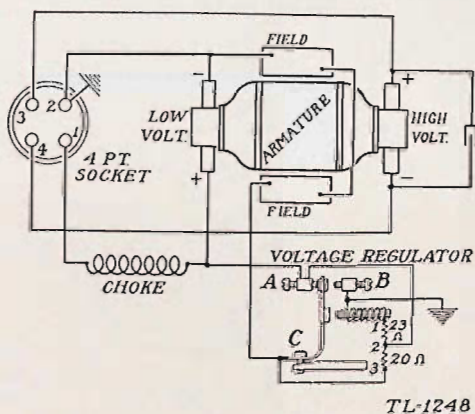
FIGURE 10.—Simplified receiver circuit

cuits are coupled together prevents radiation from the local oscillatory circuit and also prevents the loop circuit from affecting the tuning of the local oscillator. The local oscillator tube acts also as a regenerative detector because of the capacitor and grid leak C_2 and R_3 in the grid-filament circuit. The path for direct current in the grid circuit is from filament through R_3 and L_1 to grid.

(3) If the receiver were not carefully shielded, the operation of the transmitter would paralyze the local oscillator detector and prevent the method of tuning transmitter and receiver which is used with this set.

(4) Refer to Figure 6. The functions of the various parts are as follows: The operation of the following has been described above: C_1 , C_2 , C_3 , C_{10} , C_{11} , C_5 , L_1 , L_2 , and the loop. C_4 is an adjustable capacitor; C_6 which is in parallel with it is a variable capacitor for tuning the oscillatory circuit of the heterodyne tube. C_{12} is a capacitor through which ground is placed upon the receiver while sending so as to reduce the pick-up of energy by the receiver from the transmitter. C_7 , C_8 , and C_9 are by-pass capacitors. T is an audio-frequency transformer, type C-65.

(5) An incoming signal beats with the signal of the local oscillator and the tube, acting also as a detector, amplifies current of an audio frequency which is the difference between the frequencies of the incoming signal and of the local oscillator. The resultant audio-frequency signal is amplified by two stages of transformer coupled audio-frequency amplification using tubes, type VT-24, before being applied to the head sets.



TL-1248

FIGURE 11.—Wiring diagram, type GN-35

11. Generator, type GN-35.—The wiring diagram of the generator is shown in Figure 11. The field winding connects across the low-voltage winding of the armature and provides excitation for both high and low voltage windings. A radio-frequency, air-core choke coil is connected in the positive lead of the low voltage and the high voltage is shunted by a capacitor C_{10} , Figure 6; these function together to reduce the noise interference in the receiving resulting from commutator action. The cord, type CD-103, plugs into the 4-point socket; the cord is shielded and the shield is grounded at each end. The voltage coil of the regulator is connected in series with the 23-ohm resistor directly across the low-voltage winding of the generator. The contactor operated by the voltage coil may be in one of three positions, against A, between A and B, or against B. When the contactor is against A, the 20-ohm resistor is shorted and the field winding is connected directly to the low voltage of the generator. Increase of current through the regulator coil due to a rising low voltage pulls the contactor into a position intermediate between A and B; in this position the short

across the 20-ohm resistor has been removed and the 20 ohms is in series with the field winding and the low voltage. If the contactor is drawn all the way over to B, the field winding is shorted by being grounded at both ends and the 20-ohm resistor is left across the low voltage. The change from one to another of the three possible positions of the contactor occurs rapidly and the regulating action is exceptionally good.

SECTION VI

CARE, ADJUSTMENT, MAINTENANCE, AND REPAIR

	Paragraph
Care and adjustment of the set.....	12
Maintenance and repair of the set.....	13
Troubles and their remedies.....	14

12. Care and adjustment of the set.—*a. Radio receiver and transmitter, type BC-148 (BC-151).*—(1) *Care.*—This piece of equipment has been constructed to require a minimum of care and attention. It should, however, receive the same careful handling accorded to any piece of precision apparatus. Dropping and rough handling of the radio receiver and transmitter are not a proper part of service conditions. Routine care will consist in keeping it free from dust inside and in inspecting the spring contacts between panel-mounted apparatus and apparatus mounted in the box to see that the contacts make positive connections.

(2) *Adjustment of frequency in the field.*—It is desirable that all sets operating within a unit be calibrated for frequency. This is done by adjustment of the pointer on the receiver tuning dial. One set should be selected as the standard and the frequency of its receiver adjusted to 4,360 (5,100) kilocycles by a wavemeter; with the receiver tuning knob held firmly, the pointer of the receiver dial should be moved to the 4,360 (5,100) kilocycle mark. This set is then used to calibrate the other sets by having the standard use the procedure prescribed for a net control station. The other sets tune their receivers to zero beat with the transmitter of the standard, the latter being set at 4,360 (5,100) kilocycles. Each set when tuned to zero beat is calibrated by holding the receiver tuning knob firmly while the pointer of the receiver is slid around to the 4,360 (5,100) kilocycle mark. The sets are then adjusted for field use.

(3) *Receiver balancing adjustment.*—The capacitor C_1 , Figure 6, is a small screw driver capacitor access to which for adjustment is obtained through the screw plug at the back of the apparatus box marked RECEIVER COMPENSATING. To make this adjustment, the screw plug is removed and the capacitor capacity varied by using a screw driver made by forming a tip on a bakelite rod. The capacitor should be adjusted until the receiver tunes at both 3,960 (4,370) and 4,360 (5,100) kilocycles against a precision wavemeter. This adjustment is made in production and should not be necessary in the field.

(4) *Balancing adjustment.*

(a) This adjustment to the capacity Wheatstone bridge is made by adjusting the capacity of capacitor C_2 , Figure 6. When the bridge is properly balanced the signal heard at a near-by set caused by the local heterodyne oscillator is reduced to a minimum. When the set is considerably out of balance, tuning the loop circuit will cause a click to be heard in the head phones as it comes into resonance

with the local oscillator and absorbs power from it. Balancing can not be performed in the field and should be attempted only by competent personnel having the requisite equipment. The sets will be balanced during production and should require little balancing thereafter. In the field, however, it is highly desirable to try out all available tubes, type VT-24, in the left-hand socket of the receiver and use there that tube which gives the best signal strength when receiving a weak signal and at the same time causes no frequency change when the loop is brought into tune. The tube, if so selected, gives a satisfactory balance for operation.

- (b) The balancing adjustment, when necessary and when competent personnel with proper equipment is available, is performed as follows: Remove the metal screw plug at the back of the set box, marked BALANCING. Then use a screw driver made from a bakelite rod by forming a tip on it to turn the capacitor adjusting screw. The panel must be firmly closed, all tubes in their sockets and the set in a receiving condition. Set the receiver tuning at 4,360 (5,100) kilocycles. Connect a vacuum tube voltmeter capable of reading 0.05 volt alternating current effective across the loop terminals. Then adjust the loop tuning capacitor for maximum reading of the voltmeter. Now adjust C_s with the bakelite screw driver until minimum reading of the voltmeter is obtained, indicating the best possible balance. Tune the loop tuning capacitor again to resonance with the local oscillator tube as indicated by the maximum reading of the voltmeter and adjust further the balancing capacitor.

(5) *Transmitter compensating adjustment.*—This is the adjustment of the capacitor C_s , Figure 6, the capacity of which replaces that of the receiver when the set is transmitting. The adjustment is made by removing the screw plug marked TRANSMITTER COMPENSATING near the top at the right-hand side of the apparatus box. A screw driver made by forming a tip on a bakelite rod is inserted into the hole and used to turn the capacitor adjusting screw. The receiver is carefully tuned to 4,360 (5,100) kilocycles and the key is held down; the adjusting screw is then turned until zero beat between transmitter and receiver is reached. The sets will have this adjustment made during production and the necessity for further adjustment will be exceptional.

b. *Generator, type GN-35.*—(1) *Care.*—The generator is built to require a minimum of care. It is rugged but should not on that account be subjected to hard usage. The shafts run in ball bearings; these last do not require lubrication but the balls and race must be kept greased to prevent rusting. Every six months the bearings should be greased with vaseline or light motor grease; excessive greasing will result in generator trouble as surely as failure to grease the bearings. To grease the bearings, remove the five screws holding the projection on the right of the generator housing; the projection may then be removed and three ball bearings will be found. On the left-hand side of the generator are two diamond-shaped plates, each held to the housing by two screws; removing these plates gives access to the other bearings of the generator, one beneath each plate.

(2) *Adjustment.*—This generator is used with radio sets, types SCR-131, SCR-161, SCR-171, and SCR-163. For the radio set, type SCR-163, the generator will provide 8 volts and 350 volts; as received from the manufac-

turer it will be adjusted to give these voltages. For the remaining sets it is readjusted to 10 volts and 400 volts; this readjustment is made before issuing the generator with the set. The name plate used with the generator has two stamped sides and that side should be uppermost which bears the voltage rating for the set with which the generator is issued. The rating on the name plate should be checked to see that it agrees with the set requirements. If found to be wrong, the voltages may be adjusted to the proper values as follows: The generator is connected to the set which is in a transmitting condition and the generator is turned at normal speed. A voltmeter, or series of voltmeters of the same type, is connected to prongs 3 and 4 of the cord, type CD-103, at the generator end. The tension on the armature screw, marked C in Figure 11, is then adjusted until the voltage read is 400 volts with the transmitting key depressed. Turning the armature screw in a clockwise direction increases the voltage; turning it counterclockwise decreases the voltage. Access to the armature screw for this adjustment is obtained by removing the four screws on the top of the generator housing and lifting off the top.

13. Maintenance and repair of the set.—The field maintenance of this set will consist in general of routine care given the set and of such minor repairs as are practical in the field. The adjustments necessary and the troubles which may be expected are covered in paragraphs 12 and 14, respectively.

14. Troubles and their remedies.—Practically all of the troubles experienced with this set will be due to mechanical causes. If the panel is not completely closed, the spring contacts in the apparatus box will not make good contact and the set may fail to function. In case of receiver failure, the contacts at the battery binding posts should be checked, then the condition of the batteries themselves. Occasional faulty contact may be had in the tube sockets because of dirty prongs on the tubes or because the set has not been kept free from dust and grit. The head phones should not be left plugged into the jacks during transportation because some head sets have a ground from their windings to the receiver case; this case may come into contact with the frame of the set and provide a circuit for the B batteries, gradually running them down.

SECTION VII

LIST OF PARTS

List of parts.....	Paragraph 15
15. List of parts.—The following are the component parts of the radio set, type SCR-131 (SCR-161):	
1 bag, type BG-49, for loop, generator legs and cranks.	
1 bag, type BG-50, for spare batteries and tubes, cord, type CD-103, and message books, log sheets, etc.	
1 case, type CS-41, for generator, type GN-35.	
4 batteries, type BA-2, 2 in use, 2 spare.	
6 batteries, type BA-23, 3 in use, 3 spare.	
1 cord, type CD-103.	
2 cranks, type GC-2, for generator, type GN-35.	
1 Gauge, type TL-127.	
1 generator, type GN-35.	
2 head sets, type P-11 or P-12.	
2 lamps, type LM-4, 1 in use, 1 spare.	