TM 11-237

WAR DEPARTMENT

TECHNICAL MANUAL

on

RADIO SETS SCR-131 AND SCR-161

March 14, 1942

TECHNICAL MANUAL
No. 11-237

WAR DEPARTMENT,
WASHINGTON, March 14, 1942.

RADIO SETS SCR-131 AND SCR-161

1. **Use.**—*a.* Radio set SCR-131 is a portable, loop, continuous wave (cw) 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 SCR-161 is identical with radio set SCR-131 except for the capacitances 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 this manual all general statements apply to both the radio sets SCR-131 and SCR-161. Where settings, values, or type numbers for these sets differ, those shown in parentheses apply to the radio set SCR-161 only.

*This manual supersedes TR 1210-50, July 6, 1932.

2. Description.—*a. General.*—(1) When packed for transportation, the set consists of four parts: the radio receiver and transmitter BC-148 (BC-151), with a carrying strap ST-19, weighing when complete with batteries, headsets, and tubes 33.5 pounds and being $14\frac{5}{16}$ inches high, $14\frac{1}{2}$ inches wide, and $8\frac{1}{4}$ inches deep; the bag BG-49, containing the loop LP-7, the three legs and two cranks of the generator GN-35, and with its contents weighing 9 pounds; the case CS-41, containing the generator GN-35, and weighing with it 22 pounds; the bag BG-50, weighing when packed 12 pounds and

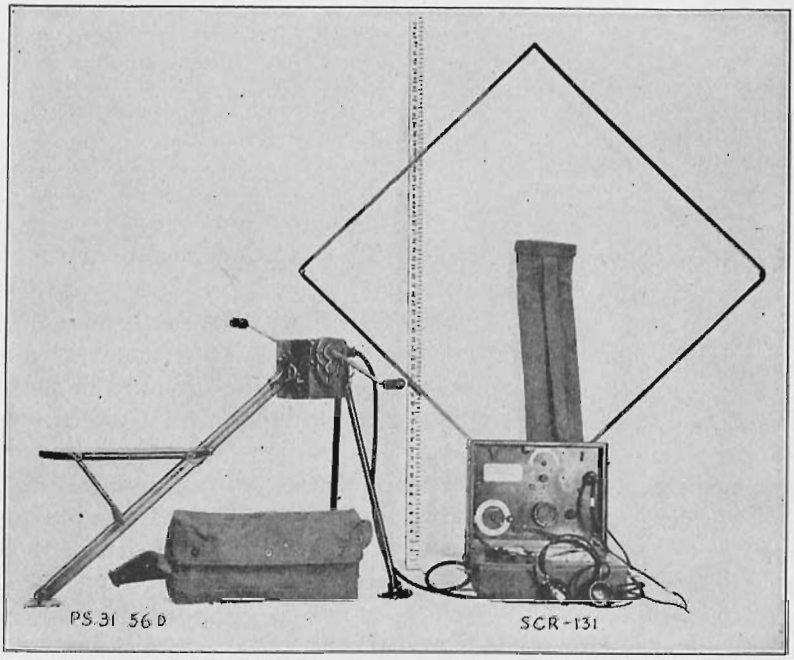

FIGURE 1.—Radio set SCR-131 (161), set up for operation.

containing three spare batteries BA-23, two spare batteries BA-2, two spare tubes VT-25, three spare tubes VT-24, one cord CD-103, message books, etc. The total weight of the set is 76.5 pounds.

(2) When set up for operation, the set consists of two essential parts: the radio receiver and transmitter BC-148 (BC-151), with loop LP-7, attached; and the generator GN-35. The cord 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.

(3) Figure 1 shows a normal installation of the radio set ready to operate; bags 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 inclusive, show various details of the circuits utilized in the set.

b. Detailed.—(1) *Radio receiver and transmitter BC-148 (BC-151).*—(*a*) 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

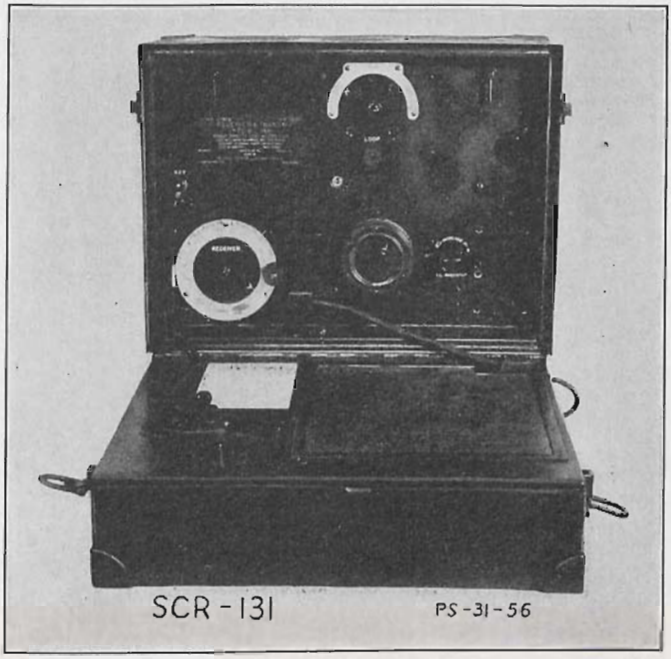

FIGURE 2.—Radio receiver and transmitter BC-148 (151), front view.

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 flashlight 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 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

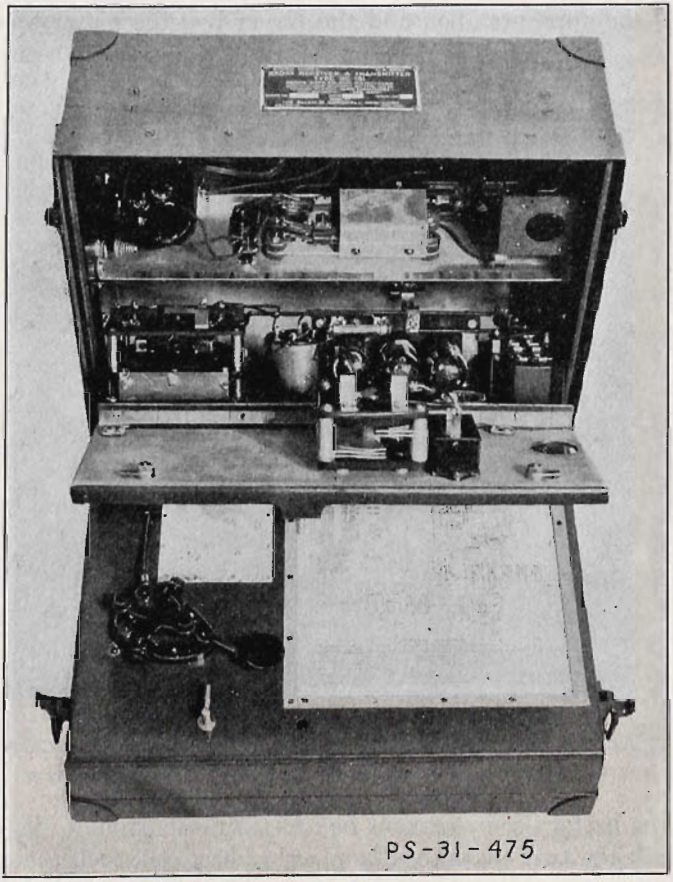

FIGURE 3.—Radio receiver and transmitter BC-148 (151), showing interior of apparatus box.

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, headsets, 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, headsets, and loops 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 CA–165 (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 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 CA–134; in the center is the transmitting relay; at the right is the socket for the plug of the cord CD–103. All tubes are on flexible mountings so as to reduce danger of accident and to minimize microphonic noise.

(*b*) 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 writing on 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 gives a view of the battery-compartment box.

The three receiver filament batteries 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 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 headsets 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 headsets to be passed to the outside with the shelf down. The headsets 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.

(*c*) Figure 5 shows the back of the radio receiver and transmitter and the two sockets for the loop. The loop LP-7 is not a part of the radio receiver and transmitter. It consists of two parts; each part is a pair of lengths of square brass tubing permanently hinged

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

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.)

(2) *Generator GN-35.*—Current for the plate and filament circuits of the transmitting tube is furnished by the generator 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 CD-103.

(3) *Bag 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.

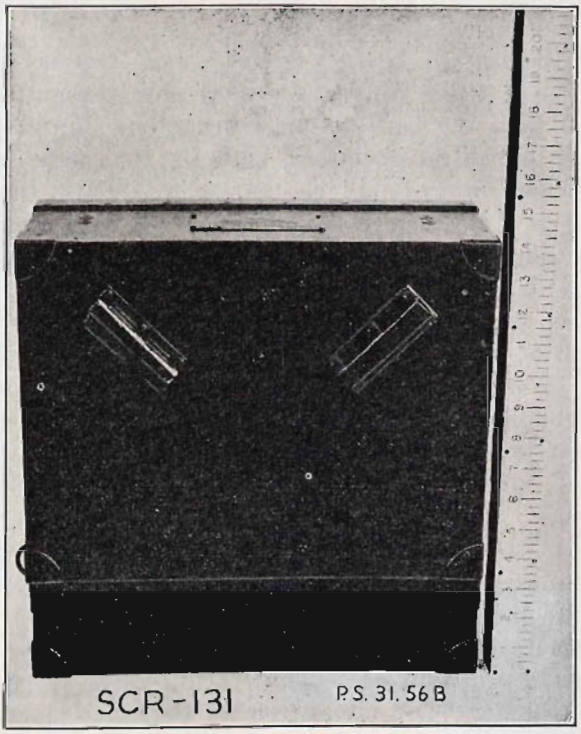

FIGURE 5.—Radio receiver and transmitter BC-148 (151), rear view.

(4) *Bag 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 under side 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 BA-23; to the left of these is a compartment designed to hold the two spare batteries BA-2; the front compartment on the left is for the message book, log sheets, etc. When the flap is closed enough space remains in the left-hand front compartment to pack the cord CD-103.

(5) *Case 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.

3. Installation.—*a. Radio receiver and transmitter 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 BA-23, fit them into the proper compartment, 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 BA-2; connect the red wire of the right-hand one to the +45 V binding post and the black wire of the left-hand one to the −45 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 headsets, plug them into the jacks beneath the binding-post panel, and bring the cords of the headsets 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 VT-25; insert in the receiver tube sockets three tubes 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 flashlight 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 CD-103; the arrow on the plug should be alined 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 alined with the arrow in the scale slot.

b. Generator GN-35.—Remove the generator and its legs from the carrying bags. Lay the generator on the ground with the name plate vertical 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 CD-103. Plug into the socket the free end of the cord CD-103. The plug will enter the socket only when the arrows on them are alined.

4. Operation.—*a. Net control station.*—(1) 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 headphones;

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.

(2) With the key held down move the receiver adjustment until the note in the headset 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.

(3) 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.

(4) 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.

b. Station other than net control station.—(1) 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 *a* above. 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; 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.

(2) 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.

5. Removal from service.—*a. Repacking.*—Pack the message books, log sheets, etc, into the compartment provided in the bag BG-50. Turn the filament rheostat to the OFF position. Remove the cord CD-103 and pack it between the flap and cover of the bag 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 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 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 headsets 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.

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

6. Function of parts.—*a. Radio receiver and transmitter BC-148 (BC-151).*—(1) *Transmitter.*—(*a*) 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_1, 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 of the receiver, and grounding the receiver. The transmitter circuit set up by the operation of the relay is shown schematically in figure 7.

(*b*) The transmitter circuit is seen to be a modified Hartley type. The oscillatory circuit consists of capacitors C_1, C_2, C_8, and C_{10}, the

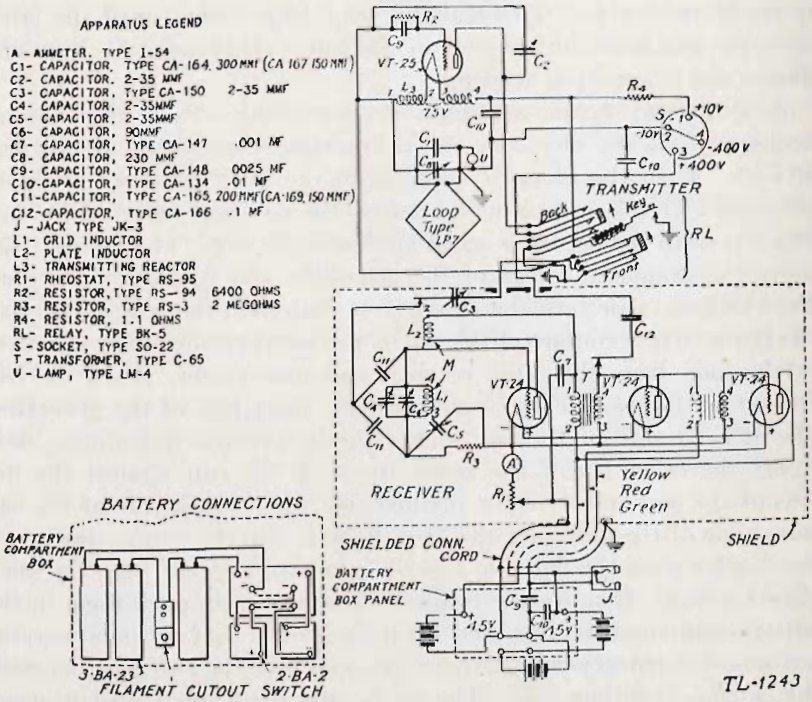

FIGURE 6.—Circuit diagram, SCR-131 (161).

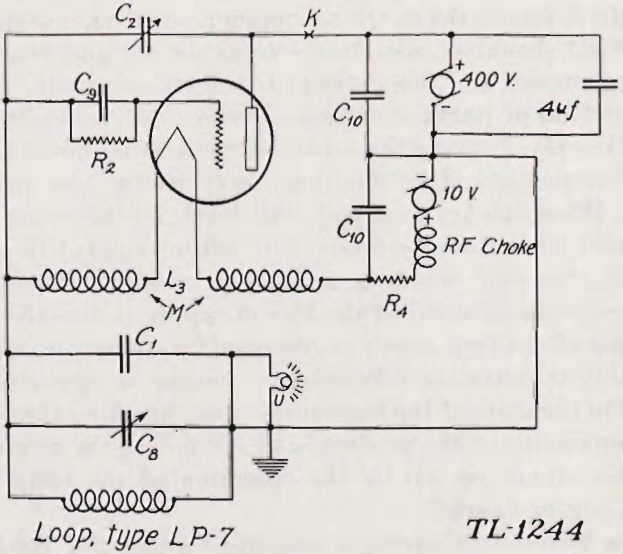

FIGURE 7.—Schematic transmitter circuit.

transmitting reactor L_3, and the loop LP-7. Since capacitors C_{10} are of 0.01 microfarad capacitance their impedance at the frequency of this set is negligible and they may be neglected in an effort to simplify the transmitter circuit. The capacitances of C_1, C_2, and C_8 may be lumped together as a single capacitance. The transmitter circuit may then be more simply represented as in figure 8. The transmitting reactor L_3 and the loop LP-7 are in parallel in an oscillatory circuit and since the loop has far less inductance, it, with the lumped capacitance C, determines the frequency of the oscillatory circuit. The purpose of L_3 is to provide grid excitation and plate load for the tube, it being impracticable to tap the loop inductance

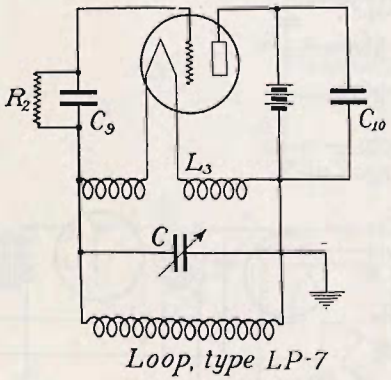

FIGURE 8.—Simplified transmitter circuit.

as would be done for the normal Hartley circuit. Alternating plate current flowing through L_3 gives the proper excitation to the tube; sufficient alternating plate current flows through the loop and capacitor C to maintain the oscillation of the loop circuit.

(*c*) 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 capacitance in the oscillatory circuit. C_8 is a variable capacitor by means of which the oscillatory circuit is tuned. C_2 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 capacitance 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_9 is a bypass for radio-frequency current around the resistor R_2. C_{10} is a bypass 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_3 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 flashlight lamp which is lighted by current in the oscillatory circuit and thus offers a check on the operation of the transmitter.

(*d*) 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

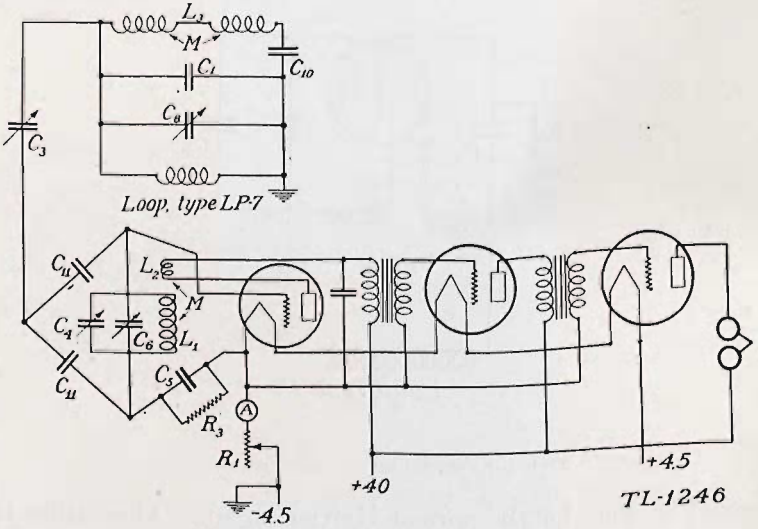

FIGURE 9.—Schematic receiver circuit.

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.

(2) *Receiver.*—(*a*) When the key is up, the relay is in the unactuated condition, connecting the loop, capacitors C_7 and C_8, and transmitting reactor L_3 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_7 and C_8, L replaces L_3 and the loop inductance, and C_0 replaces C_4 and C_6. From figure 10 it will be seen that the capacitors C_{11}, C_5, and the grid-filament capacitance of the first tube form the four arms of a bridge network. The bridge may be balanced by adjustment of C_5. The loop circuit

is coupled to the bridge through the capacitor C_8, 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_8 to the junction of the C_{11} capacitors, through the upper C_{11} 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_0. Thus the loop does not affect the frequency of the oscillatory circuit of the heterodyne tube.

(*b*) 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_4 and C_6. Since the grid-filament capaci-

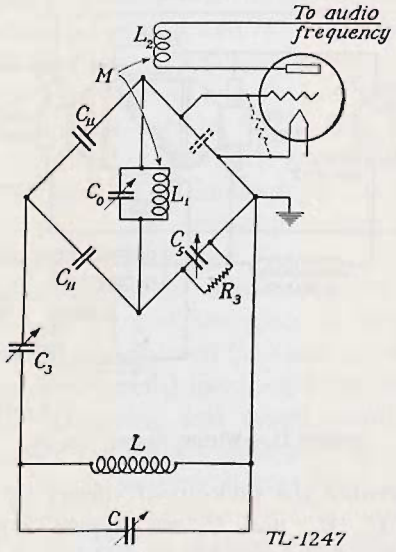

FIGURE 10.—Simplified receiver circuit.

tance of the tube is equal to that of C_5, 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 circuits 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_5 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.

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

(*d*) 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_3, C_8, C_{10}, C_{11}, C_5, L_1, L_3, 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

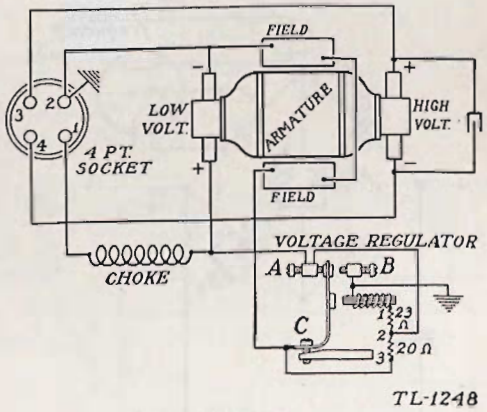

FIGURE 11.—Wiring diagram GN-35.

sending so as to reduce the pick-up of energy by the receiver from the transmitter. C_7, C_8, and C_9 are bypass capacitors. T is an audio-frequency transformer C-65.

(*e*) An incoming signal beats with the signal of the heterodyne 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 heterodyne oscillator. The resultant audio-frequency signal is amplified by two stages of transformer-coupled audio-frequency amplification, using tubes VT-24, before being applied to the headsets.

b. Generator 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-voltage and low-voltage windings. A radio-frequency air-core

choke coil is connected in the positive lead of the low-voltage winding and the high-voltage winding 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 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 short-circuited 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-circuit across the 20-ohm resistor has been removed and the 20 ohms are 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 short-circuited 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.

7. Care and adjustment.—*a. Radio receiver and transmitter 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_4, 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 capacitance 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 capacitance bridge is made by adjusting the capacity of capacitor C_5, figure 6. When the bridge is properly balanced the signal heard at a nearby 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 headphones as it comes into resonance with the local heterodyne oscillator and absorbs power from it. Balancing cannot be performed in the field and should be attempted only by competent personnel having the requisite equipment. The sets wil be balanced during production and should require little balancing thereafter. In the field, however, it is highly desirable to try out all available tubes 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_5 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 heterodyne 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_2, figure 6, the capacitance 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 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 6 months the bearings should be greased with petrolatum 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 SCR-131, SCR-161, SCR-171, and SCR-163. For the radio set SCR-163, the generator will provide 8 volts and 350 volts; as received from the manufacturer 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 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.

8. Maintenance and repair.—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 7 and 9, respectively.

9. 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 headsets should not be left plugged into the jacks during transportation because some headsets 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.

10. List of parts.—The following are the component parts of the radio set SCR-131 (SCR-161):

1 bag BG-49, for loop, generator legs, and cranks.
1 bag BG-50, for spare batteries and tubes, cord CD-103, and message books, log sheets, etc.
1 case CS-41, for generator GN-35.
4 batteries BA-2, 2 in use, 2 spare.
6 batteries BA-23, 3 in use, 3 spare.
1 cord CD-103.
2 cranks GC-2, for generator GN-35.
1 gage TL-127.
1 generator GN-35.
2 headsets P-11 or P-12.
2 lamps LM-4, 1 in use, 1 spare.
1 leg LG-2, with seat.
2 legs LG-3, without seat.

1 loop LP-7, consisting of 2 similar halves.
1 radio receiver and transmitter BC-148 (BC-151).
1 strap ST-19, for radio receiver and transmitter BC-148 (BC-151).
6 tubes VT-24, 3 in use, 3 spare.
3 tubes VT-25, 1 in use, 2 spare.

[A. G. 062.11 (12-30-41).]

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:

J. A. ULIO,
Major General,
The Adjutant General.

DISTRIBUTION:

D 2, 17 (2); R and H 6, 7 (3); IBn 6 (5); IC 7 (6), 11 (10).
(For explanation of symbols see FM 21-6.)

U. S. GOVERNMENT PRINTING OFFICE: 1942