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WAR DEPARTMENT

U.S. Dept of Army

TECHNICAL MANUAL

SWITCHBOARD BD-14

June 30, 1941

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TECHNICAL MANUAL
No. 11–331

WAR DEPARTMENT,
WASHINGTON, June 30, 1941.

SWITCHBOARD BD–14

Prepared under direction of the
Chief Signal Officer

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* This manual supersedes TR 1225–5, February 12, 1930, including C 1, January 2, 1931.

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SECTION I

GENERAL USES AND DESCRIPTION

Paragraph
Where used 1
General description and capacity 2

1. Where used.—The switchboard BD–14 is designed to serve as a telephone switchboard in field operations where temporary or semi-

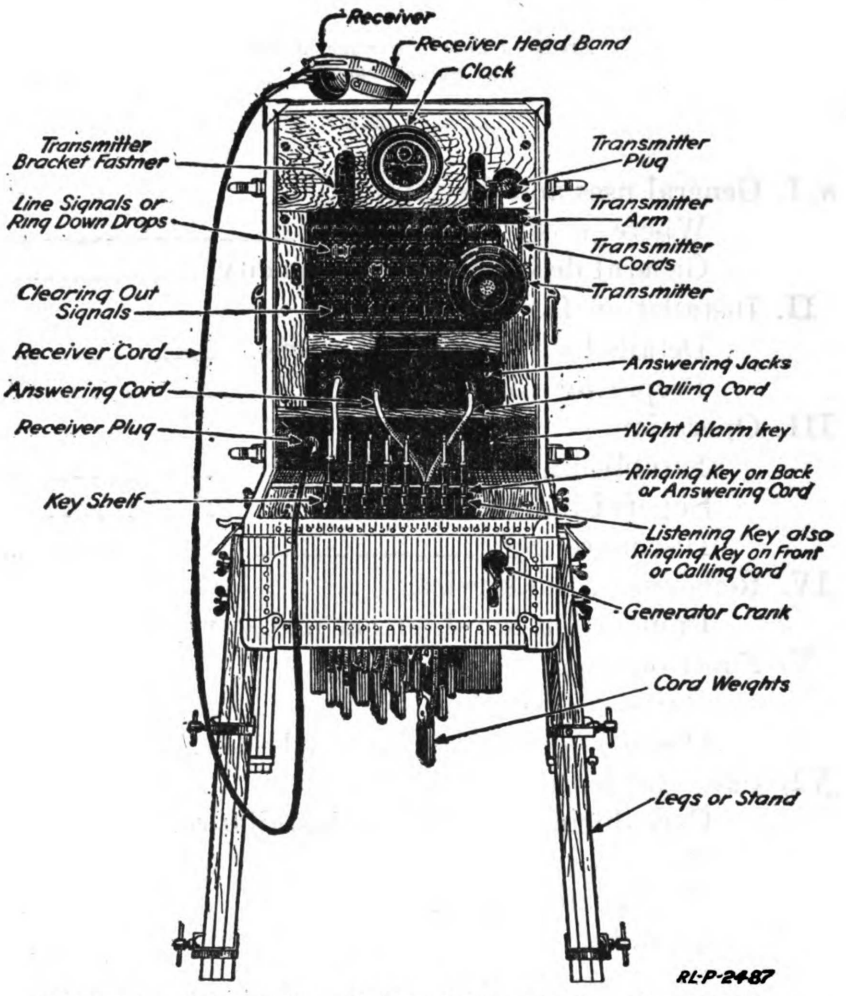


FIGURE 1.—A front view of the switchboard set up for operation.

permanent installations are necessary. It is used by units requiring more circuits than can conveniently be served by the monocord switchboards. It is also adaptable for use in small local battery telephone systems.

2. General description and capacity.—The switchboard BD–14 has a capacity of 40 line circuits and 8 cord circuits. The equipment

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is mounted on an angle iron framework, which may be withdrawn as a unit from the cabinet. The cabinet is made of wood, covered with fiber, and reinforced along the edges and at the corners. The main part of the cabinet viewed from the right side is shaped like the letter L. The top of the horizontal leg of the L is the key shelf, and on the vertical leg above the key shelf is the face equipment. On the back of the cabinet there is a door which gives access to the internal equipment. Within this door are racks which hold four

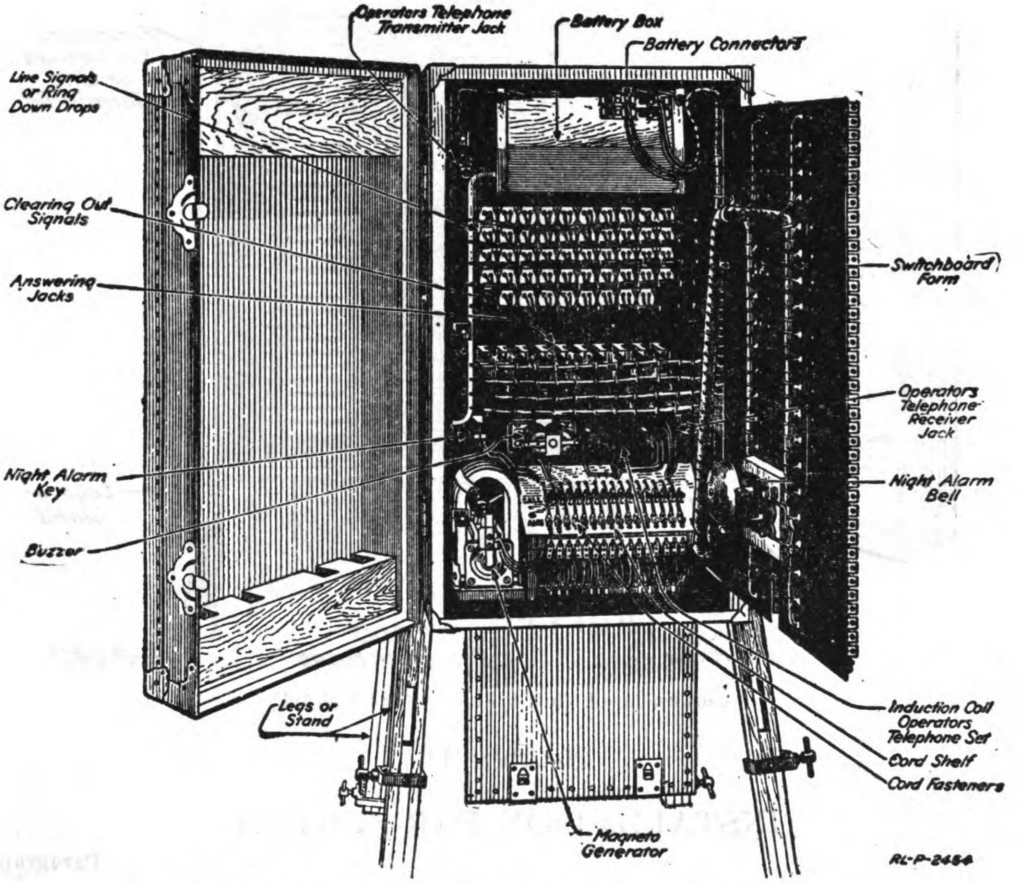


FIGURE 2.—A rear view of the interior of the switchboard.

telescopic legs. When installing the switchboard, these legs are attached to the corners of the cabinet. In the bottom of the cabinet there is a small trap door. When the door is opened, the cord weights drop and hang free below the cabinet. A box cover, open on one side and at one end, protects the face equipment from damage during transport. This cover also holds the tools and spare parts. It is fastened in place in front of the face equipment and above the key shelf. The approximate dimensions of the switchboard when

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packed for transport are 21 by 26 by 15 inches. Its weight is approximately 185 pounds. When set up for operation, the telescopic legs elevate the switchboard cabinet about 24 inches above the ground.

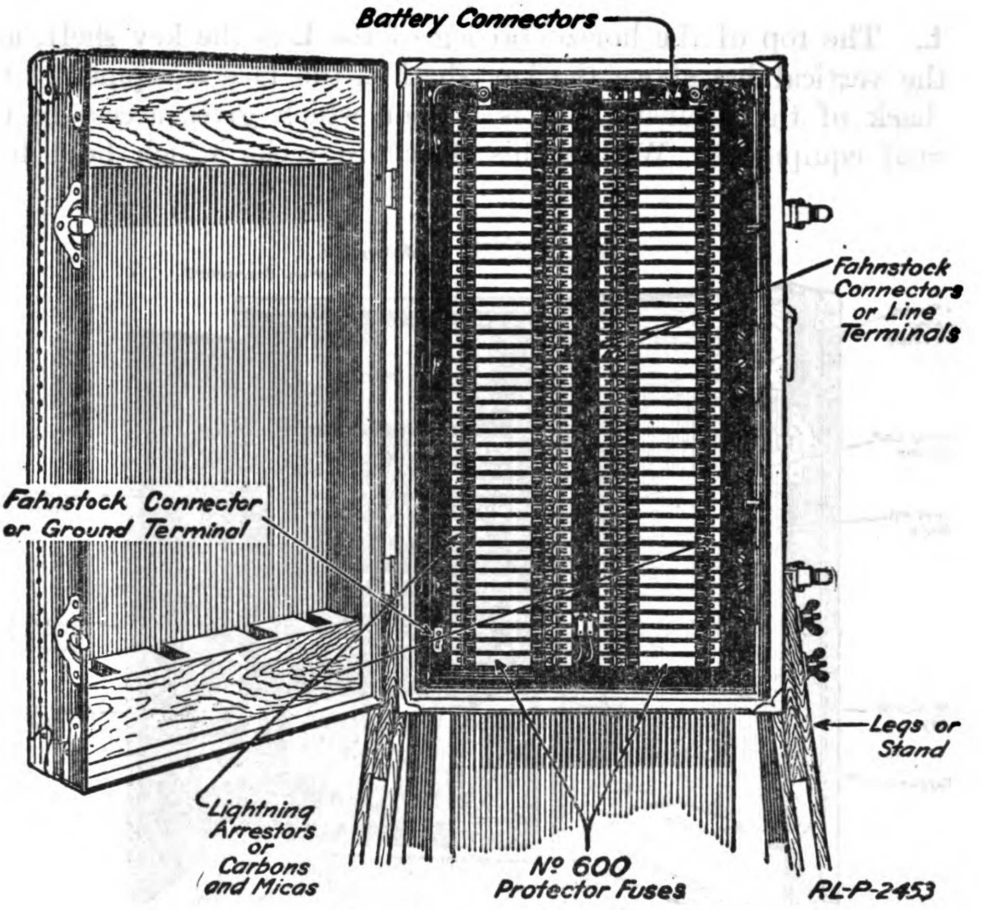


FIGURE 3.—A view of the protector panel.

SECTION II

INSTALLATION FOR SERVICE

	Paragraph
Detailed description of parts	3
Preparing for service	4

3. Detailed description of parts.—The switchboard as issued for service contains the following equipment permanently installed, together with all the necessary wiring and terminals:

40 line signals.
40 line jacks.
8 supervisory signals.
16 connecting cords, weights, and plugs.
1 hand generator.
1 night bell.

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1 night-bell switch.
1 transmitter and transmitter arm complete with cords and plugs.
1 transmitter jack.
1 single head receiver with cord and plug.
1 receiver jack.
40 pairs of protectors and line terminals.
1 clock.
8 double ringing and listening keys.
1 alternating-current buzzer.
1 fiber line-signal protecting plate shutter holder.

The following extra parts and tools are stored in the compartment built in the removable box cover of the case:

1 single head receiver with cord and plug.
8 connecting cords with plugs.
2 transmitter cords.
2 receiver cords.
3 line signals.
2 generator crank handles.
2 mouthpieces.
1 tool kit containing—
    1 monkey wrench, 6-inch.
    1 screw driver, 6-inch.
    1 screw driver, 3-inch.
    1 pair of pliers, diagonal cutting, 5½-inch.
    1 pair of pliers, longnose, 5½-inch.
    1 tool, WE 72.
    1 spring bender, WE 105.

4. Preparing for service.—*a.* To prepare the switchboard for service, open the rear door and remove the four telescopic legs from their racks. Attach the legs to the switchboard and adjust them to the desired height. Remove the front box cover of the case and the drop shutter holder. Open the trapdoor in the bottom of the switchboard and let the cord weights fall. Loosen the transmitter arm, suspend the transmitter therefrom, and insert the transmitter plug in the transmitter jack. Insert the receiver plug in the receiver jack. Attach the generator crank and throw the night-alarm key to the "ON" position. Connect the ground to the ground connection on the protector panel. (See fig. 3.)

b. Install two batteries BA-17 in the transmitter battery compartment, attaching the positive and negative poles to their respective terminals.

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c. Inspect the switchboard for damaged and missing parts, giving particular attention to cords, plugs, keys, drops, operator's telephone equipment, and hand generator. While inspecting the cords, make certain that they are of proper length.

d. Make a voltmeter test of the operator's transmitter battery. If the open-circuit voltage is less than 2.8 volts, install new cells. If a separate battery is provided for the night-alarm circuit, test it in the same manner as the operator's transmitter battery.

e. Test the operator's telephone circuit by putting on the operator's head receiver, opening No. 1 listening key, and placing a short on the plug of No. 1 calling cord. Blow lightly into the transmitter. A side tone should be heard faintly in the receiver if it is working satisfactorily.

f. Test the hand generator circuit by short circuiting the plug of No. 1 calling cord, operating the ringing key, and turning the hand generator crank. If serviceable, the generator crank should turn hard and the buzzer should operate.

g. To test the night-alarm circuit, lower a drop shutter to the operated position. The night-alarm bell should ring if this circuit is serviceable.

h. To test the line circuits, test both sides of each circuit at the switchboard side of the fuse clip for ground. To make this test, connect one terminal of the testing equipment used to the ground terminal of the protector panel and touch the other terminal to the switchboard end of the fuse clip. The test should show an open circuit between each side of the circuit and ground, if in working order.

i. Take position as an operator in front of the switchboard. Station a man at the rear of the switchboard with a servicable magneto telephone, preferably one equipped with test clips to facilitate making connections. Direct the man at the rear of the switchboard to connect his telephone to circuit No. 0, on the line side of the fuse, and then to turn his hand generator crank. The corresponding drop shutter should fall and the night-alarm bell ring. Test all other line circuits in a similar manner.

j. To test the cord circuits, direct the man at the rear of the switchboard to connect his telephone to circuit No. 0. Insert No. 1 answering plug into the jack of the line circuit No. 0. Open the listening key and blow softly into the transmitter. A side tone should be heard in the receiver. Next direct the man at the rear of the switchboard to hang up his hand set (or to release the push button). Then operate the ringing key associated with the cord being tested and

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at the same time turn the crank of the hand generator. The generator buzzer and telephone ringer should both operate.

k. Without removing No. 1 answering plug, direct the man at the rear of the switchboard to turn his hand generator crank. No. 1 clearing out drop should fall and the night-alarm bell should ring. Remove the answering plug and insert the calling plug of the same pair of cords and repeat the tests as outlined for No. 1 answering cord. The remainder of the cord circuits should then be tested in the same manner.

SECTION III

OPERATION

	Paragraph
Establishing a connection	5
Supervising a connection	6
Disconnecting	7

5. Establishing a connection.—When a line drop shutter falls, indicating that a party is calling, the operator should insert the plug of the most convenient answering cord into the jack associated with the fallen drop and operate the listening key. After ascertaining the number desired by the calling party, he inserts the plug of the calling cord, corresponding to the answering cord used, into the jack of the number called. He then operates the ringing key associated with the calling cord and at the same time turns the hand generator crank several times. The operator then releases the ringing key, supervises the connection, and restores the drop shutter.

6. Supervising a connection.—Supervision is maintained by the operator to insure that conversation is established and that connections are promptly removed when conversation is discontinued. Supervision is accomplished by periodic listening in on the connection.

After establishing a connection, the operator should supervise the call until the called party answers, unless it is necessary to supervise other connections or answer other calls. In case it is necessary to leave a connection before conversation is established, the operator should return and supervise it as soon as practicable. As soon as conversation is established, the operator should restore the listening key to normal and restore the drop shutter. Connections existing for more than the reasonabl length of time should be carefully supervised. Before breaking a connection, an operator should carefully supervise it and ascertain that conversation is finished.

7. Disconnecting.—When a clearing-out signal falls, indicating that a conversation has been completed, or that one of the parties desires to attract the operator's attention. the operator should operate the

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listening key and determine whether or not the connection is in use. If not in use, he should restore the listening key and disconnect both cords. If on the other hand, one of the parties asks for another number, the operator should ascertain which number is calling, and if it is the number to which the answering cord is connected, he should complete the call in the usual manner. If the number calling is the one which is connected to the calling cord, he should complete the connection by inserting the plug of the answering cord in the jack of the number desired and operate the ringing key associated with the answering cord. When conversation is established, he should restore the listening key and the clearing-out drop shutter.

SECTION IV

REMOVING FROM SERVICE

Paragraph
Preparation for shipment and storage 8

8. Preparation for shipment and storage.—To remove the switchboard from service and prepare it for shipment or storage, the operator should proceed as follows:

Disconnect the line circuits from the line terminals at the protector panel. Raise the cords and close the trap door. Disconnect the receiver, transmitter, and generator crank, and store them in the proper compartment. Secure the transmitter arm with the transmitter bracket fastener. Fasten the drop shutter holder in place. Remove the telescopic legs and place them in their racks. Close the rear door and secure it. Replace the box cover of the case and secure it by means of the fasteners. If the switchboard is to be stored or is to remain out of service for more than 24 hours, remove the batteries BA–17. If the switchboard is to be kept out of service less than 24 hours, it is not necessary to remove the batteries.

SECTION V

FUNCTION OF PARTS

Paragraph
Purpose of certain circuits 9
Operation of switchboard BD–14 10

9. Purpose of certain circuits.—See figures 4 and 5.

a. The line circuit enables the user to signal the operator. It affords a means whereby the operator can signal and converse with the user and connect two parties together by the use of the cord circuit.

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b. The purpose of the night alarm circuit is to give an audible signal to the operator when either a line drop or a clearing-out drop falls.

c. The cord circuit furnishes a means for the operator to signal and converse with a user and for connecting the telephones of any two users together. It also enables a user, when conversation is completed, to attract the attention of the operator by ringing off.

d. The purpose of the operator's telephone circuit is to enable the operator to converse with the user.

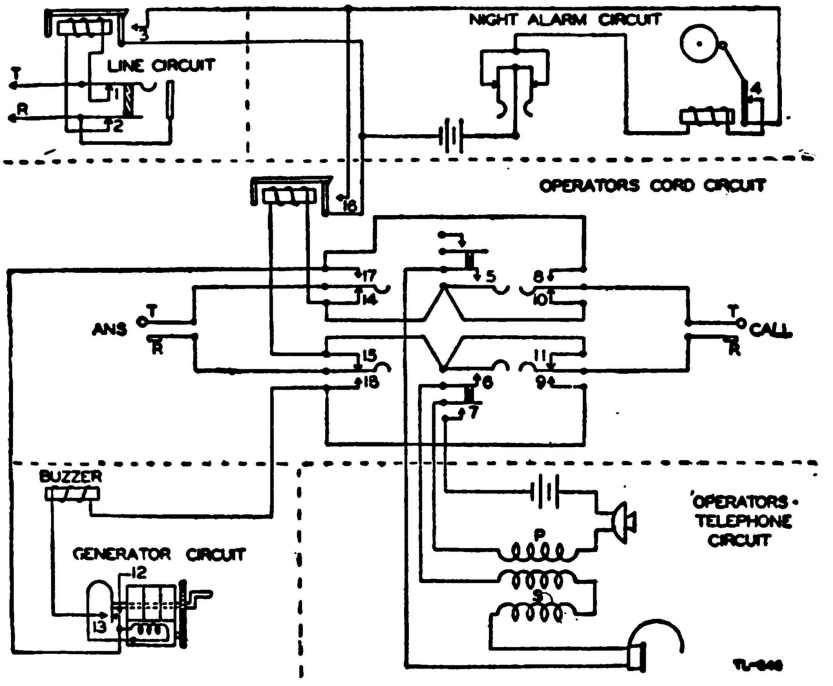


FIGURE 4.—A complete schematic diagram of all the circuits in the switchboard BD-14.

e. The generator circuit is used for the purpose of signaling the user.

10. Operation of switchboard BD-14.—*a.* When a user desires to place a call, he turns the hand generator crank of his telephone several times. This produces an alternating current which flows over the line circuit, through T and R, contact springs No. 1 and No. 2, and the winding of the line drop. The line drop is energized and the drop shutter falls. (See fig. 4.) The drop shutter in falling closes the night-alarm circuit at contact 3, causing current to flow through the night-alarm battery, contacts 3 and 4, the winding of the night-alarm bell and the night-alarm key. This magnetizes the core of the night-alarm bell winding, attracting the armature and breaking contact 4. As soon as contact 4 opens and breaks the cir-

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cuit, the magnetic field collapses allowing the armature to fall back, closing contact 4. This action continues and causes the night-alarm bell to ring until the line drop shutter is restored by the operator.

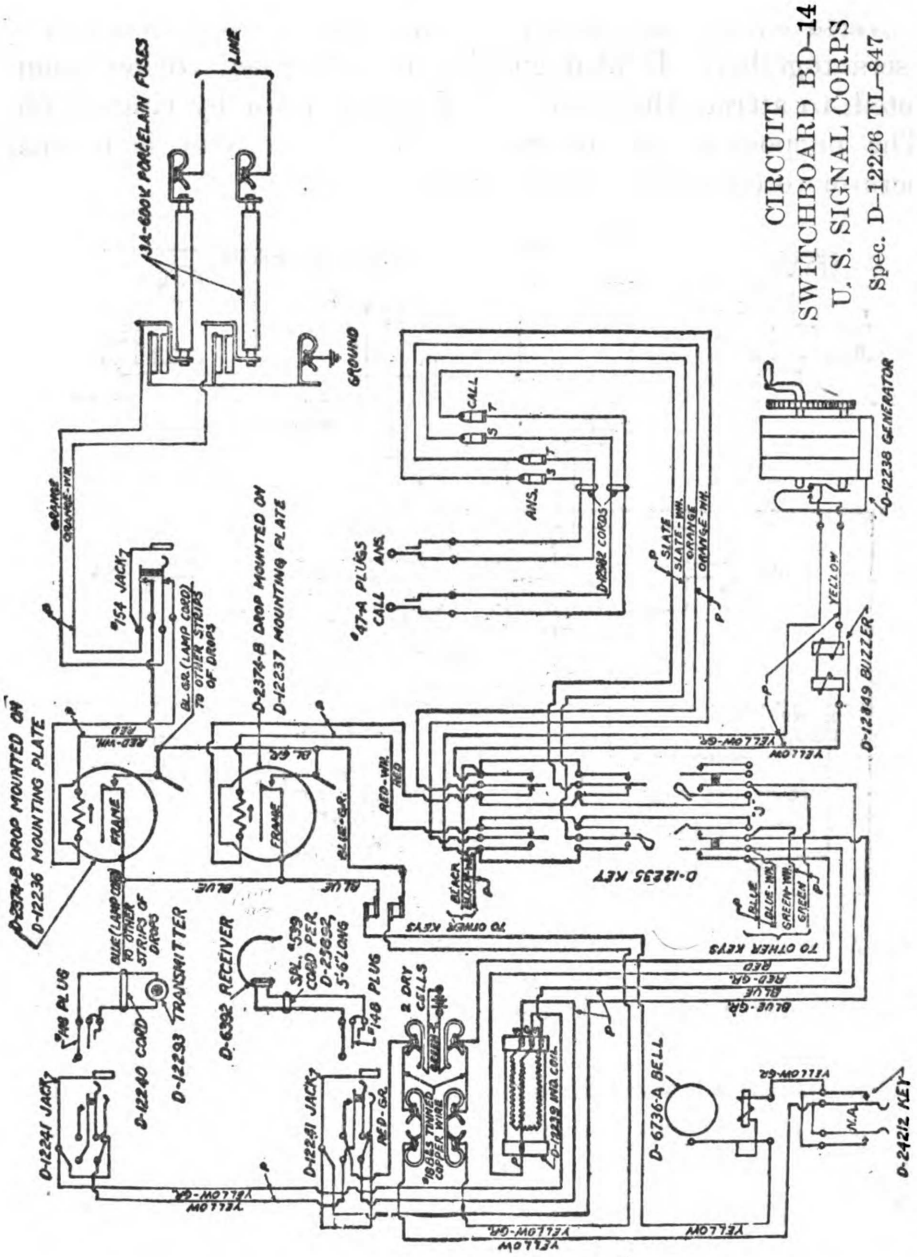


FIGURE 5.—A complete wiring diagram of switchboard BD-14, together with the code numbers of the principal parts of apparatus used.

b. The operator should take the plug of the most convenient answering cord and insert it in the line jack associated with the line drop. This operation establishes metallic connections from T and R of the answering cord to T and R of the line circuit. The operator should then operate the listening key which closes the contacts

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5, 6, and 7. The closing of contacts 5 and 6 places the secondary of the operator's circuit across T and R of the cord circuit, thus enabling voice currents from the calling party's telephone to flow through the operator's receiver. The closing of contact 7 closes the primary of the operator's circuit, thus enabling direct current to flow from the operator's battery through the primary circuit and energize the operator's transmitter. As the operator speaks into his transmitter to ascertain the number desired, the sound waves produced by his voice strike the diaphragm of the transmitter and cause it to vibrate. The vibration of the transmitter diaphragm varies the resistance of the transmitter, thus causing a variation in the strength of the current flowing in the primary circuit. Due to the action of the induction coil, the voice currents set up in the primary circuit are induced into the secondary circuit and sent out over the cord circuit and line circuit through the calling party's receiver. This causes the calling party's receiver diaphragm to vibrate at the same frequency as the operator's voice and reproduces the sounds made by the operator's voice. Having ascertained the number desired by the calling party, the operator should then insert the plug of the calling cord into the line jack of the number called. This operation completes the connection through the cord circuit between the calling party and the called party. To signal the called party, the operator should operate the ringing key associated with the calling cord. The ringing key closes contacts 8 and 9 and breaks contacts 10 and 11. At the same time the operator should turn the crank of his hand generator. The closing of contacts 8 and 9 connects the generator circuit to T and R of the calling cord. The opening of contacts 10 and 11 disconnects the answering cord so as to avoid ringing back in the calling party's receiver. The turning of the hand generator crank breaks contact 12 and closes contact 13, producing an alternating current which flows from the generator circuit out over T and R of the line circuit and operates the called party's ringer and the series buzzer in the ringing circuit. The operator should then release the ringing key which breaks contacts 8 and 9 and makes contacts 10 and 11. This operation reestablishes the circuit between the telephones of the calling and called parties. When the hand generator crank is released, contact 13 automatically opens and contact 12 automatically closes. As soon as conversation is completed, one of the parties should operate the hand generator of his telephone which causes alternating current to flow over the line and the cord circuits, through contacts 14 and 15, and through the winding of the clearing out drop, thus causing the shutter to fall and close contact 16. The closing of this contact

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completes the night-alarm circuit and causes its bell to ring, thus indicating to the operator that conversation is completed or that one of the connected parties desires to make another call.

c. The cord circuit is also equipped with a ring-back key which is used when it is necessary to ring with the answering cord. In using the ring-back key, the operation is the same as when using the ringing key, except that contacts 14 and 15 break and contacts 17 and 18 make, thus causing the ringing current to flow over the answering cord instead of over the calling cord.

SECTION VI

CARE AND MAINTENANCE

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Routine tests	13
Troubles	14
Night-alarm circuit	15
Operator's circuit	16
Cord circuits	17
Hand generator circuit	18
Adjustments	19
Cleaning	20

11. Care during storage and installation.—*a.* The quality of service rendered by a telephone system depends largely upon the care and maintenance of the telephone switchboard. Care in handling the switchboard and proper measures taken in its maintenance will insure a maximum of service.

b. Before storing a switchboard, it should be placed in first class operating condition. It should then be stored in a dry place which is free from dust. When the switchboard is removed from storage and is to be placed in service, a thorough inspection should be made of all apparatus and circuits as prescribed in section II. In transport, the switchboard should be handled with care, always being kept in an upright position and protected from the elements.

c. When installing the switchboard for service, it should be placed in a location where it will be reasonably protected from inclement weather and carefully leveled. All connections should be made firm and the loose ends of wires trimmed so as to eliminate the possibility of short circuits. In operating the switchboard, care should be exercised in the handling of the plugs, cords, and drop shutters. In establishing and taking down connections, the operator should take hold of the plug shells instead of the cords. This prevents pulling

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the cord connections loose from the plug. Defacing the switchboard or spilling liquids on it should be avoided. The key pan should not be used as a storage place.

12. Routine inspections.—The proper maintenance of a telephone switchboard consists of keeping it in the best possible operative condition. To do this it is not only necessary to be proficient in locating and clearing troubles which may occur, but to follow a system of routine tests and inspections. This routine testing allows corrective action before interruptions to service occur. Routine inspections and tests should be made as follows:

A daily inspection should be made of the switchboard for damaged or missing parts. In making this inspection, the operator should carefully examine the plugs to find any that may be worn or bent. He should examine the cords for wear and loose connections in the plug and at the key shelf. The ringing and listening keys should work freely and the drop shutters should not stick. An inspection of the protector panel for loose fuses, loose connections, and misplaced carbons should then follow, and any deficiencies noted should be immediately corrected.

13. Routine tests.—Daily tests of the operator's telephone circuit, night-alarm circuit, and operator's generator circuit, as prescribed in section II, should be made. Line circuits and cord circuits should be tested at least weekly and oftener when maintenance conditions require. These tests should be made as prescribed in section II, or if more convenient, line circuits may be tested from a user's telephone.

14. Troubles.—*a. Line circuits.*—The failure of a line circuit to operate properly may be due to an open, a short, a ground, a cross, or to the drop being out of adjustment. Grounds or crosses will not be apparent from talking or ringing tests unless both sides of the circuit are grounded or are crossed with other circuits.

b. Grounds.—When both sides of a circuit are grounded, the effect is the same as when shorted. If both sides are crossed with other circuits, the drop shutter of all line circuits affected will fall. Grounds of this nature are found usually at the protector panel and are caused by dirty or burnt carbons. Crosses are often caused by the touching of adjacent protector blocks or by the wires of two line circuits making contact with each other at the line terminals.

c. Opens.—If open, the trouble is probably caused by an open fuse, by cut-off springs of the jack being out of adjustment, or by an open connection at the jack or protector.

d. Shorts.—If the trouble is caused by a short circuit, it probably will be found at the protector or at the contacts of the jack. If

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both sides are grounded, the trouble should be treated in the same manner as for a short.

e. Noisy circuits.—Poor connections will cause noise on circuits although the circuit may test satisfactorily or may indicate intermittent opens, shorts, or grounds. All connections should be carefully checked to see that they are tight. (See also par. 17.)

15. Night-alarm circuit.—*a.* If the night-alarm circuit fails to function on all drops, the trouble is probably due to one of the following causes:

The bell being out of adjustment.
The contacts at the night-alarm key being out of adjustment.
An open at the night-alarm key.
An open at the bell.
An open at the battery.
An open in the night-alarm lead at the drops.

b. If the night-alarm circuit functions on some circuits and not on others, the trouble is probably caused by the failure of the drop shutter to make contact when it falls, or to an open strap between the drop strips.

16. Operator's circuit.—*a.* If the operator's circuit fails to function on all keys, and if the operator's telephone equipment is known to be serviceable, the trouble may be caused by either an open circuit or a short. If due to an open circuit, it will likely be found at one of the following points:

At listening key No. 1.
At the transmitter jack.
At the receiver jack.
At the battery.
At the induction coil.

b. If caused by a short circuit, shorted contacts at one of the listening keys or at either the transmitter jack or the receiver jack may be the reason for failure.

c. If the operator's circuit functions on one or only a few keys and not on all the others, the trouble may be due to an open strap between the listening keys or the failure of the key to make contact.

17. Cord circuits.—The failure of a cord circuit to operate properly may be caused either by an open, a short, a cross, a partial open, or a partial short. If an open or a short is discovered, the trouble may be found in the plug, in the cord, at the cord shelf, or at the key. If a cross is found, the trouble will usually be located at the cord shelf. If a partial or intermittent short or open is disclosed when the cord is handled (evidenced by noise), the cord should be repaired or replaced.

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18. Hand generator circuit.—*a.* If the hand generator fails to function on all keys, the cause may lie in the contact springs of the hand generator being out of adjustment, the generator lead at No. 8 ringing key may be open, or the circuit may be open at the generator buzzer.

b. If the hand generator functions on one or more keys and not on the others, the trouble may be caused by the key contacts being out of adjustment or by an open generator strap between keys.

19. Adjustments.—*a.* The apparatus of the camp switchboard is of fairly rugged construction and will maintain its adjustment for a long period of time if proper care is exercised in handling it. However, under service conditions, it is sometimes necessary to make adjustments. In making these adjustments, care should be taken not to bend or kink the springs. They should be tensioned by applying the adjusting tool at the base. The parts requiring adjustment are the—

Line and supervisory drops.
Ringing and listening keys.
Line jacks.
Night-alarm key.
Night-alarm bell.
Hand generator contacts.
Generator buzzer.

b. The parts of the drop which may require adjustment are the armature, the trip rod, the inner face, and the shutter. The armature may become out of adjustment due either to the air space between the armature and the core of the drop winding being too small or too great, or to the two small screws on which the armature is pivoted being too tight or too loose. The air space should be such as to allow the armature to operate freely on current from a hand generator through about 1,500 ohms resistance and to release promptly after being rung on with a hand generator through zero resistance. The trip rod may be placed out of adjustment by being bent or sprung. When the drop is nonoperated, the trip rod should extend along the center of the groove in the shell and through the center of the notch in the face of the drop. The catch on the end should hold the drop shutter in the "UP" position. When ringing current is passed through the drop winding, the operation of the armature should raise the trip rod sufficiently to allow the shutter to fall. The inner face of the drop and the shutter should be adjusted so as not to bind the trip rod. The pin by which the shutter is pivoted should allow the shutter to work freely.

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c. The springs of the ringing and ring-back keys should be adjusted so that when the ringing key is operated, contacts 10 and 11 will break before contacts 8 and 9 make. On the ring-back key, contacts 14 and 15 should break before contacts 17 and 18 make. All contacts should be properly tensioned to insure positive connections. When the listening key is operated, contacts 5, 6, and 7 should be made. They should be broken when the listening key is in the normal position.

d. The adjustment of the line jack should be such that when the jack is in the normal position, contacts 1 and 2 will be made, and when the plug is in, contacts 1 and 2 should be broken.

e. When the night-alarm key is in the "OFF" position, both contacts should be broken. If the key is in the "ON" position, both contacts should be made.

f. When the night-alarm circuit is normal, contact 4 should be firmly made. If current is flowing in the circuit, contact 4 should break and make alternately, giving the effect of a buzzer.

g. When the hand generator is in the normal position, contact 12 is closed and 13 is open. If it is operated, contact 12 should open and 13 should close.

h. The series buzzer in the hand generator circuit resembles closely the ordinary polarized ringer, except that it has no gongs or clapper. The armature should be adjusted so that it has free play to operate, and that when it is moved with the fingers against either pole, it will hold of its own accord.

20. Cleaning.—The outer surface of the switchboard should be cleaned daily with a soft, dry cloth. The plugs should be kept free from tarnish by cleaning and polishing with an approved plug polish. All contacts should be cleaned as often as required with carbon tetrachloride, applied with a clean cloth or a small brush. The protector panel, key pan, jacks, and wiring should be cleaned as often as required with a hand bellows or vacuum cleaner.

[A. G. 062.11 (5-1-41).]

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G. C. MARSHALL,
Chief of Staff.

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Major General,
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