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RESTRICTED

TR 1230-2
1-5

TECHNICAL REGULATIONS }
No. 1230-2 }

WAR DEPARTMENT,
WASHINGTON, June 29, 1939.

SIGNAL CORPS
TELEGRAPH SET TG-5-A

TM 11-351

SUPERSEDED

By: TM 11-351

Date: 22 Sept. 41

Prepared under direction of the
Chief Signal Officer

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SECTION I

GENERAL USE AND DESCRIPTION

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1. **General use.**—The telegraph set TG-5-A (Stock No. 4A2805A) is a portable, open-circuit field set used for telegraph communication over short lines with few intermediate stations. Several sets may be operated in series but ordinarily not more than three or four should be required to work together on one circuit.

2. **Set TG-5 replaced.**—This set will replace the telegraph set TG-5 covered in TR 1230-1. (See par. 8.)

3. **Using units.**—The set is or will be authorized for and used by various units of the Infantry, Field Artillery, Coast Artillery Corps, and Signal Corps.

4. **Weight and size.**—The complete set in its case weighs 5½ pounds and measures 5½ inches in height, 10 inches in width, and 5½ inches in depth. With batteries installed, it weighs 7 pounds.

5. **Power.**—Two batteries BA-30 in series with a voltage of 1.5 volts per battery, or a total voltage of 3 volts, and one battery BA-2 with a voltage of 22.5 volts, when installed in the set, supply the power required to operate it. Hereafter the former will be called the "local battery," and the latter will be called the "line battery." Both are dry batteries. Any external batteries having equivalent voltages may be connected to and used with the set after the internal batteries are removed. (See par. 20e.)

6. Circuits on which installed.—Normally the set is used on a ground-return circuit obtained by simplexing a telephone circuit. It can be used on any other ground-return or metallic circuit, but cannot be used on a standard closed-circuit telegraph system. (See par. 23.)

7. Range.—The set should operate satisfactorily over field circuits of any length likely to be encountered within the infantry division. Where exceptionally long lines or high-resistance grounds are encountered, the range of the set may be increased by the addition of external line battery as indicated in paragraph 25.

8. Parts.—Figure 1 and the list below show the principal component parts of the set and the line battery. The batteries required are not parts of the set and must be requisitioned separately. The operating parts are described in section II; for complete information thereon, see the Signal Corps General Catalog. The batteries and parts of the set are listed below. Those preceded by an asterisk (*) may be used as replacements for similar parts used in the telegraph set TG-5 replaced by the set; the remaining parts may not be so used.

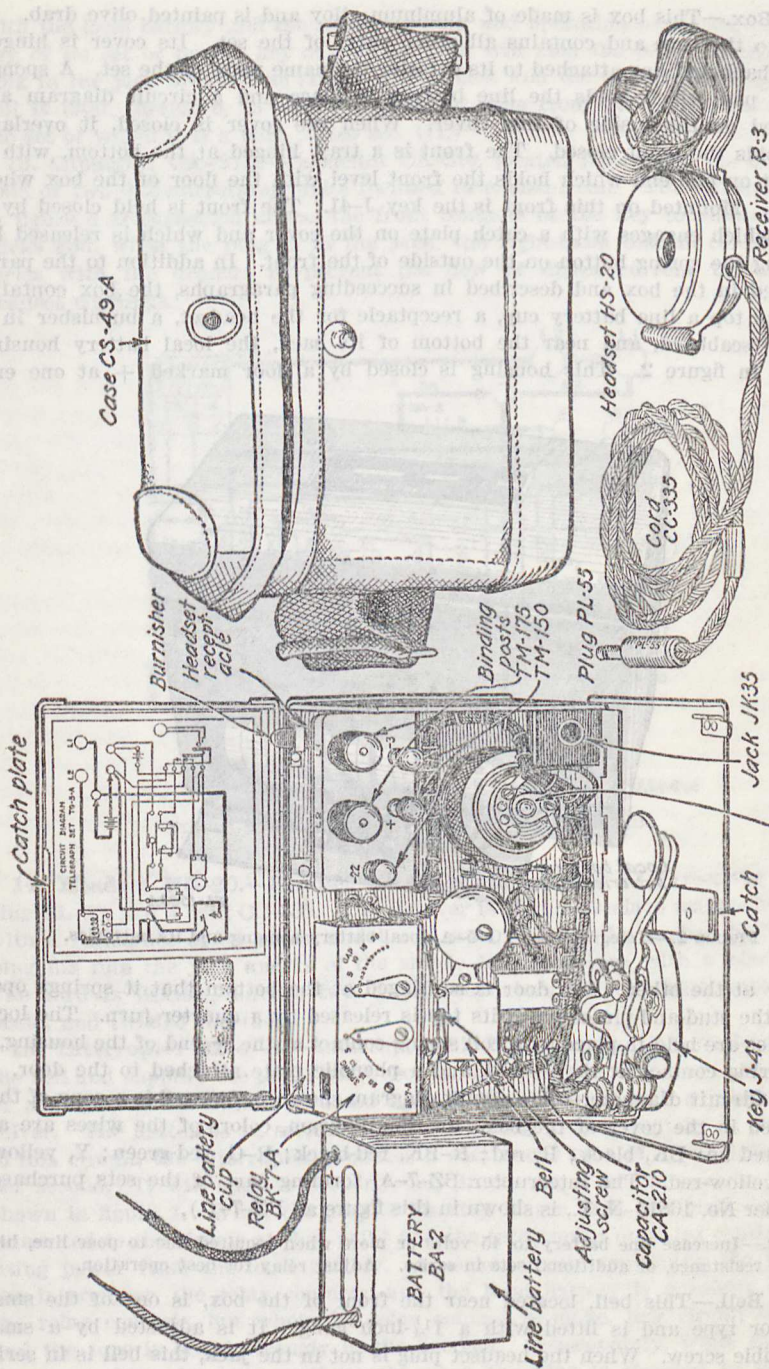
Quantity	Part	Stock No.
1	*Battery BA-2	3A2
2	*Batteries BA-30	3A30
1	Box (drawing SC-D-2881-C), containing—	
1	*Bell, Edwards Lungen 13	4Z416
3	*Binding posts TM-150	3Z250
2	Burnisher, Western Electric Co., No. 1A, or equal	3Z275
1	*Capacitor CA-210	3D210
1	Circuit diagram (drawing SC-D-2883-A)	
1	*Headset HS-20	4A920
1	Interrupter BZ-7-A	4Z5007A
1	*Jack JK-35	2Z5535
1	*Key J-41	3Z3441
1	*Relay BK-7-A	4A2007A
1	*Case CS-49-A	4A349A

SECTION II

DETAILED DESCRIPTION OF PARTS

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9. Case CS-49-A.—Case CS-49-A is used for holding and carrying the set when the latter is not in use. It is made of hard texture olive-drab duck with moulded leather corners and bottom. Its cover is hinged at the back, overlaps the back, front, and sides, and is fastened on the front with a snap fastener. Sewed to the sides of the case is an adjustable shoulder strap 2 inches wide and 85 inches long.



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FIGURE 1.—Telegraph set TG-5-A, component parts and the line battery.

10. **Box.**—This box is made of aluminum alloy and is painted olive drab. It fits into the case and contains all other parts of the set. Its cover is hinged at the back and has attached to its exterior the name plate of the set. A sponge rubber pad which holds the line battery in place and a circuit diagram are mounted on the inside of this cover. When the cover is closed, it overlaps and holds the front closed. The front is a tray, hinged at the bottom, with a support on one end which holds the front level with the floor of the box when opened. Mounted on this front is the key J-41. The front is held closed by a catch which engages with a catch plate on the cover and which is released by pressing the spring button on the outside of the front. In addition to the parts mounted in the box and described in succeeding paragraphs, the box contains near its top a line battery cup, a receptacle for the headset, a burnisher in a leather scabbard, and near the bottom of its back, the local battery housing shown in figure 2. This housing is closed by a door marked + at one end

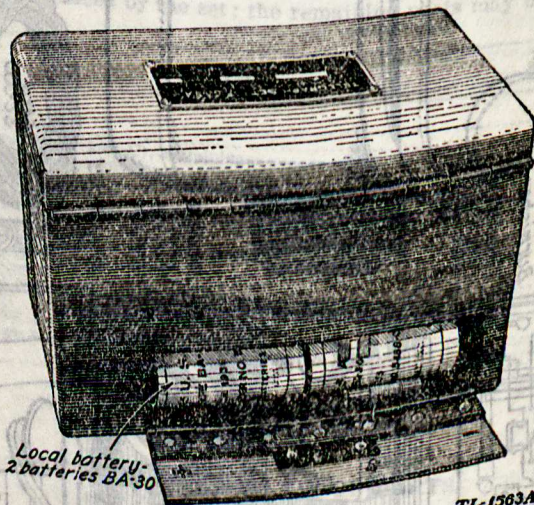


FIGURE 2.—Telegraph set TG-5-A, local battery housing and its batteries.

and — at the other. The door is so hinged at the bottom that it springs open when the stud-and-pin catch at its top is released by a quarter turn. The local batteries are held in place by a coil spring contact at the — end of the housing, a flat spring contact at the + end, and a phenolic plate attached to the door.

11. **Circuit diagram.**—The circuit diagram shown in figure 3 is a copy of that mounted in the cover of the box. In this diagram, colors of the wires are abbreviated as: BK, black; R, red; R-BK, red-black; R-G, red-green; Y, yellow; Y-R, yellow-red. The interrupter BZ-7-A, forming part of the sets purchased on Order No. 16815-N. Y., is shown in this figure as BZ-7-().

NOTE.—Increase line battery to 45 volts or more when required due to poor line, high ground resistance, or additional sets in series. Adjust relay for best operation.

12. **Bell.**—This bell, located near the front of the box, is one of the small vibrator type and is fitted with a 1¼-inch gong. It is adjusted by a small accessible screw. When the headset plug is not in the jack, this bell is in series

with the local battery and the relay contacts, and operation of the relay by the key of its set or by the key of a distant set will ring the bell. Inserting the plug in the jack breaks this circuit at the jack and the bell cannot ring. The bell is used, therefore, to receive and sound calls from other sets and to test the set of which it is a part. (See sec. III.)

13. Capacitor CA-210.—Capacitor CA-210, located just under the bell, consists of two 0.25-microfarad units inclosed in a metal can. The left-hand unit in figure 3 is connected across the front contacts of the key to eliminate key clicks and, when the plug is in the jack, the right-hand unit is connected in series with the headset to prevent the flow of direct current through the headset windings.

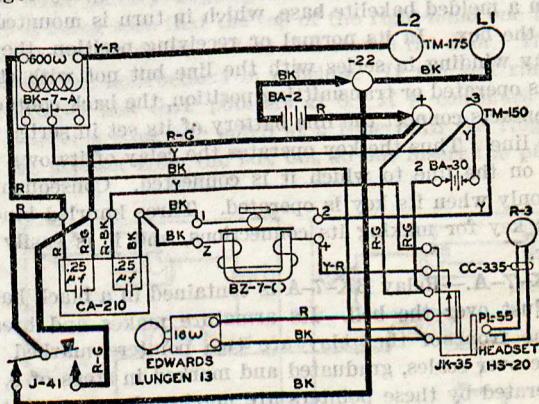


FIGURE 3.—Telegraph set TG-5-A, circuit diagram.

14. Headset HS-20.—Headset HS-20 is an assembly of a receiver R-3, a plug PL-55, and a cord CC-335. The receiver is of the standard watch-case type, with a resistance of 80 ohms, and has a web head band attached to it. The plug fits into the jack and is of the simple tip-sleeve type with a black shell. The cord is flexible, having two tinsel conductors covered with rubber and braid, and twisted together.

15. Interrupter BZ-7-A.—Interrupter BZ-7-A is located just to the right of the bell and supplies the tone signal used in the operation of the set. It consists of a single carbon button mounted against the diaphragm of a telephone receiver. The button is in series with the winding and, if battery is connected to this circuit, the interrupter produces a continuous tone of about 1,000 cycles per second. It will operate properly only if the set is in the upright position shown in figure 1. When the plug is inserted in the jack, the local battery is connected to the circuit at that point and the interrupter operates continuously, using power from the local battery. A series circuit containing the headset, the interrupter, the relay contacts, and the local battery is normally open at the interrupter, but when the relay contact is made, this circuit is closed and the tone is heard strongly in the headset. Consequently, while the interrupter produces its tone continuously when the plug is inserted in the jack,

the tone is heard strongly in the headset only when the relay is operated by its own key or by that of another set.

16. Jack JK-35.—Jack JK-35 is a two-conductor, tip-and-sleeve jack with spring contacts which give the equipment of a single-pole, double-throw switch. It is located at the lower right-hand corner of the box. The bell is normally in series with the local battery and the relay contacts before the plug is inserted. Figure 3 shows the spring contacts in their normal position; that is, with the plug *not* inserted in the jack. After the plug is inserted, the local battery is switched to the interrupter and the headset is connected in series with the relay contacts and the right-hand unit of the capacitor.

17. Key J-41.—Key J-41 is an open-circuit operating key of the usual lever type mounted on a molded bakelite base, which in turn is mounted on the inside of the front of the box. In its normal or receiving position, the back contacts connect the relay winding in series with the line but not with the line battery of its set. In its operated or transmitting position, the back contacts are opened, and the front contacts connect the line battery of its set in series with the relay winding and the line. Thus the key operates the relay of its own set and places its line battery on the line to which it is connected. Consequently a set uses its line battery only when its key is operated. Three knurled binding posts are available on the key for making its connections, and it is easily adjustable to suit the operator.

18. Relay BK-7-A.—Relay BK-7-A is contained in a black bakelite housing and is located just over the bell. Its armature makes and breaks the relay contacts. On the front of the relay are two pointers marked SPRING and GAP which move over scales, graduated and marked in steps of 5, from 0 to 20. The controls operated by these pointers are notched for each unit setting, however, and may be set at any unit at or between the scale markings. The SPRING pointer controls the amount of tension on the spring of the armature and the GAP pointer controls the air gap between the armature and the magnet core ends. The relay winding has a resistance of 600 ohms, and the relay may be adjusted to operate on a current as low as 1.0 milliamperes. (See par. 24.) Terminals at one end provide connections to the winding and the contacts. An opening in the top of the housing permits cleaning the relay contacts with the burnisher supplied with the set. Another opening in the bottom of this housing permits access to the tension spring and thread. If the plug is in the jack, the relay contacts connect the local battery in series with the interrupter and the headset; if the plug is not in the jack, the relay contacts connect the local battery in series with the bell. Breaking the relay contacts opens those circuits. In figure 3, the relay contacts are broken.

19. Terminal block.—The terminal block is a bakelite block located just to the right of the relay. On it are mounted—

- a. Two binding posts TM-175 at the top marked L1 and L2, to which the line must be connected.
- b. One binding post TM-150 on the left edge marked -22 to which the negative (black) lead of the line battery must be connected.
- c. Two binding posts TM-150 at the bottom marked + and -3, which are wired within the set to the terminals of the local battery, and to which an external battery may be connected. The positive (red) lead of the line battery must be connected also to the + binding post.

TELEGRAPH SET TG-5-A

SECTION III

EMPLOYMENT

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Testing the transmitting and receiving circuit-----	22
Installing the set-----	23
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20. Preparing the set for installation.—*a.* Remove the box from the case.
- b.* Open the local battery housing and install two batteries BA-30 as indicated in figure 2, being sure that the top of the right-hand one is in contact with the bottom of the left-hand one. Close and secure the door. If batteries BA-30 are not available, see instructions in *e* below. If the bell rings, open the box and set the SPRING and GAP pointers at 0. If it continues to ring, increase the SPRING pointer setting one notch at a time until the ringing stops.
- c.* Remove the headset from the box but do *not* insert the plug in the jack at this time.

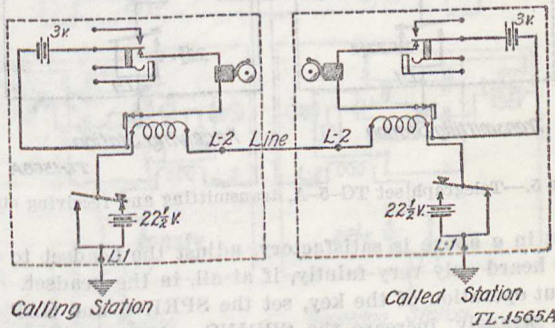


FIGURE 4.—Telegraph set TG-5-A, calling circuit with plugs *not* in jacks.

- d.* Adjust the key but do not screw the back contact down so far that both it and the front contact are closed at the same time because, if that is done, the line battery will be short-circuited and probably ruined and the key contacts may be damaged by a heavy arc across them. After the line battery is installed, always disconnect one of its terminals from the set before adjusting the key.
- e.* Place a battery BA-2 in its cup on the left and connect its positive (red) lead to the + binding post and its negative (black) lead to the -22 binding post. If a battery BA-2 is not available, similarly connect any other battery of 22.5 volts. If batteries BA-30 are not available for installation as in *b* above, connect the positive and negative terminals of any other battery of three volts to the + and -3 binding posts respectively, being sure that the polarities are correct and that the local battery housing is empty.
21. Testing the calling circuit (fig. 4).—If the set has been prepared as directed in paragraph 20, test the calling circuit by short circuiting the L1 and L2 binding posts and pressing the key. The bell should ring; if it does not, it

is probable that the local battery is not properly connected, its voltage is too low, or the relay is not adjusted. If it is known that the fault is not in the battery, increase the GAP pointer setting one notch at a time beginning with 0 until the bell rings when the key is depressed. Release the key. If the bell continues to ring, increase the SPRING pointer setting one notch at a time until the ringing stops. Remove the short circuit from L1 and L2.

22. Testing the transmitting and receiving circuit (fig. 5).—Having completed the actions directed in paragraphs 20 and 21, test the transmitting and receiving circuit as follows:

a. Insert the plug in the jack. The interrupter should produce a tone which may be heard faintly. If the box is in an upright position, and if the tone is not heard at all, it is probable that the local battery is not connected properly or its voltage is too low.

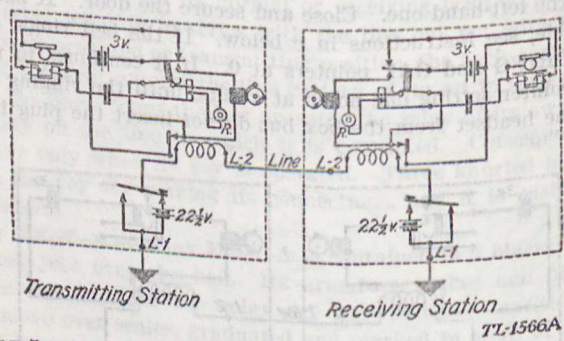


FIGURE 5.—Telegraph set TG-5-A, transmitting and receiving circuit.

b. If the test in a above is satisfactory, adjust the headset to the ear. The tone should be heard only very faintly, if at all, in the headset. If it is heard strongly without operation of the key, set the SPRING and GAP pointers at 0. If it continues strongly, increase the SPRING pointer setting one notch at a time until the strong tone stops.

c. Short circuit L1 and L2 and press the key. The tone should be heard strongly in the headset. If the tone is not heard when the key is depressed, increase the GAP pointer setting one notch at a time beginning with 0 until the tone is heard strongly when the key is depressed. Release the key. If the strong tone continues, increase the SPRING pointer setting one notch at a time until it stops. If this test is satisfactory, remove the short circuit from L1 and L2.

23. Installing the set.—The instructions which follow are based on the assumption that the actions directed in paragraphs 20, 21, and 22 have been satisfactorily completed. Each of the binding posts L1 and L2 must be connected to a wire which forms part of the circuit on which the set is to be installed. Both of these wires may be part of a line but usually one is part of a line and the other leads to a ground near the set. In all terminal stations shown in figures 4 to 7, inclusive, L1 is connected to the ground and L2 to the line. If those connections are reversed, however, the operation of the sets will not be affected.

TELEGRAPH SET TG-5-A

a. As a terminal station on a ground-return circuit.—(1) *Ground connection.*—In the usual case in which a ground-return circuit is used, a good, low-resistance ground connection is necessary for each terminal station not only to insure sufficient operating current, but also to prevent interference with neighboring telegraph circuits. It is almost always possible to obtain a good ground, but if not, it may become necessary to use a metallic circuit. (See c below.) Having prepared a good ground, connect it to either L1 or L2. To obtain a good ground connection—

(a) Drive a metal ground rod about 2 feet in length well into the ground where it is moist. Use a longer rod if one is necessary and available. Usually the ground near the roots of a shrub, cactus, or other vegetation is moist. If only dry ground is available, wet it thoroughly and pack it down around the rod.

(b) Use a separate ground for each telegraph set or other equipment and keep separate grounds at least 15 feet apart.

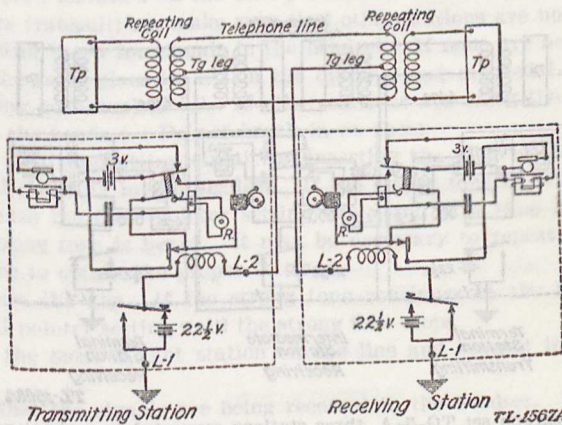


FIGURE 6.—Telegraph set TG-5-A, two terminal stations connected to a simplex telephone circuit.

(c) Use two or more ground rods at least 15 feet apart connected together as a ground for a single set if one ground rod will not suffice.

(d) Keep the wire leading from the ground rod to the set as short as possible but do not hesitate to use a wire several hundred yards long if necessary to reach moist ground, such as a stream bed.

(2) *Line connection.*—If the ground has been connected to L1, connect the line to L2. This line may be a wire which is to be used exclusively for telegraph, in which case the two terminal stations are connected as shown in figure 5. Usually, however, this line will be the telegraph leg of a simplex telephone circuit, in which case the two terminal stations are connected as shown in figure 6.

b. As an intermediate station on a ground-return circuit.—No ground connection is necessary at an intermediate station. Connect the line leading to one terminal station to L1 and the line leading to the other terminal station to L2. As in a (2) above, these lines may be either lines which are to be used

exclusively for telegraph or they may be telegraph legs of simplex telephone circuits. Figure 7 shows two terminal stations and one intermediate station connected to a telephone circuit which is simplex around an intermediate telephone station.

c. *As a terminal station on a metallic circuit.*—When a ground-return circuit is impracticable, a metallic return may be used instead. In this case, either or both of the lines in the metallic circuit may be lines used exclusively for telegraph or they may be telegraph legs of simplex telephone circuits. Connect one of the lines to L1 and the other to L2.

d. *As an intermediate station on a metallic circuit.*—At an intermediate station, cross-connect one of the wires leading to one terminal station to one of the wires leading to the other terminal station. Connect the other two wires to L1 and L2 as in b above. This places the intermediate set in series with the circuit, and not across it. If the set is connected improperly, or across the circuit, the sets on the circuit will not operate satisfactorily.

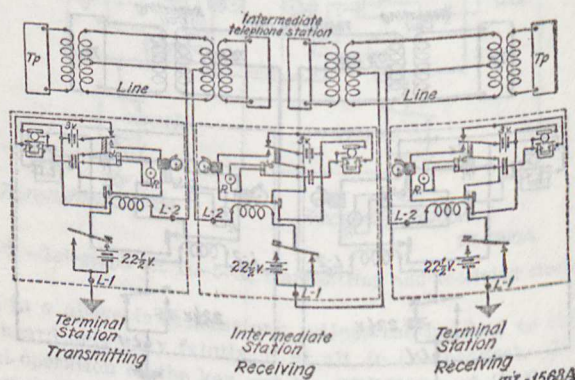


FIGURE 7.—Telegraph set TG-5-A, three stations connected to a simplex telephone circuit.

24. *Adjusting the relay.*—a. *General.*—(1) Since the resistance of the relay is fixed, it is necessary to adjust the armature so that it will make and break its contacts properly with various values of current flowing through the relay winding. The resistance of the external circuit connected to L1 and L2 largely determines the value of this current, and this resistance varies widely. Consequently the relay must always be adjusted for the circuit over which the set is to operate, and may need to be adjusted frequently as the resistance of that circuit changes or as stations are added to or removed from that circuit. The adjustments prescribed in c below will always be made when a set has been removed from a line and installed at a different location on that line.

(2) When the pointers described in paragraph 18 are set at 0, the armature spring tension is least and the air gap is smallest. In this condition, a current of approximately 1.0 milliamperes is required to operate the relay, but if a strong current flows through the relay winding, the spring will not be strong enough to break the contact quickly after the current ceases to flow. The adjustment consists of properly balancing the pull of the spring on the arma-

ture against the pull of the magnetizing current in the relay. The best adjustment for any conditions is that which gives satisfactory operation with the smallest values of GAP and SPRING pointer settings. For all adjustments, therefore, obtain the lowest setting of the GAP pointer which will permit the relay to operate with the current from the most distant set, then obtain the lowest setting of the SPRING pointer which will open the relay contacts sharply. With the normal line battery installed in the set, there is a limit to the possible adjustment, and if that limit is reached without obtaining satisfactory operation, it may be necessary to increase the voltage of the line battery as indicated in paragraph 25.

b. Before installation.—As a final check of the operation of the set before it is installed, connect a resistance of about 2,000 ohms, such as a headset P-11, to L1 and L2. With the set connected to this artificial line, make the tests and adjustments indicated in paragraphs 21 and 22.

c. During installation.—When the relay has been adjusted as in *b* above and the set has been installed on the line, proceed as follows:

(1) Before transmitting, make sure that other stations are not using the line. To do this, first listen for signals in the headset. If none are heard, remove the plug from the jack, place its tip on the binding post marked L1 and its sleeve on the binding post marked L2. If other stations are using the line, clicks will be heard in the headset. Do not break in on them.

(2) Test the transmitting circuit by inserting the plug in the jack, pressing the key, and listening in the headset. If the strong tone is not heard—

(a) Increase the GAP pointer setting one notch at a time beginning with 0 until the strong tone is heard. It may be necessary to repeat this adjustment several times to obtain the proper setting.

(b) Release the key. If the strong tone continues in the headset, increase the SPRING pointer setting until the strong tone stops.

(3) Call the most distant station on the line and request it to transmit for a test.

(4) See that the signals are being received in the headset. If not, see paragraph 25.

(5) Remove the plug from the jack and see that the bell is receiving the signals from the distant station. If not, adjust the bell by varying its adjusting screw.

(6) Usually a set which has been adjusted properly for the most distant station will operate satisfactorily with all other stations. Nevertheless, repeat the above procedure with other stations.

(7) Once the SPRING pointer setting has been properly made, subsequent adjustments can usually be made by varying the GAP pointer setting only.

25. Additional line battery.—*a. When needed.*—If, by placing the tip and sleeve of the plug on L1 and L2, it is determined that a distant station is transmitting and the relay cannot be adjusted as directed in paragraph 24 to give satisfactory reception, proceed as follows:

(1) Add another battery BA-2 in series with the line battery.

(2) Call the other station, inform it that the line battery has been increased to 45 volts, request it to increase its line battery to the same value, and to transmit for a further test.

(3) Adjust the relay as directed in paragraph 24 *c*.

(4) Add more line battery if necessary, but see *b* below.

b. Amount.—It is possible to cause serious damage to the set by adding an excessive amount of line battery. (See fig. 7.) If the keys of two or more sets are depressed simultaneously, the combined voltage of the line batteries of all these sets is impressed upon the series circuit containing all of the relays. Although the relay winding will withstand relatively high voltages without injury, keep the line current as low as practicable because the relay works much better at lower current values, interference troubles are less, and interception is more difficult. Add only enough voltage to assure satisfactory operation, and no more.

26. Operating the set.—*a. Transmitting.*—Use the key as in any other telegraph instrument. If minor adjustments of the relay become necessary, make them before the transmission of messages.

b. Receiving.—The connection made by the back contacts of the key is an essential part of the receiving circuit. Do not operate the key while receiving except as indicated in *c* below.

c. Breaking in.—If during reception it is desired to break in on the transmitting operator, attract his attention by operating the key slowly. The faulty operation of the transmitting set relay caused by this action is immediately detected in the transmitting operator's headset and is recognized by him as a break-in signal.

d. Continuous operation.—If the set is to be operated continuously, keep the plug in the jack. Call signals are then received only in the headset which must be worn in order not to miss a call.

e. Stand-by operation.—Since the set continuously uses power from the local battery while the plug is in the jack, keep the plug habitually out of the jack when the set is not in use. Call signals are then sounded by the bell.

SECTION IV

MAINTENANCE

	Paragraph
Care and repair-----	27
Removal from service-----	28

27. Care and repair.—*a.* Keep the set in the case when it is not in use, and keep the cover and the local battery housing door of the box closed to protect the set when it is in use.

b. Test the headset occasionally and replace the receiver, head band, cord, or plug when necessary, but do not disassemble the receiver to any greater extent than is necessary to replace the cord.

c. When unserviceable, replace the batteries, bell, capacitor, interrupter, jack, key, relay, or the case. The contact adjusting screws of the relay are set properly at the factory. Repairs to the interrupter and the relay and changes in the contact adjusting screws of the relay will be made only at regularly established Signal Corps repair shops and not elsewhere.

d. Inspect and keep the contacts of the bell, jack, key, and relay clean. The relay contacts are accessible through the opening in the top of the relay housing. To clean these contacts, insert the burnisher between them, press them together slightly, and draw the burnisher across them. If the burnisher supplied with the set is not available, use in its stead a piece of smooth steel or a piece of unglazed bond or other paper which will not leave lint on the con-

tacts. One of the sheets of vellum in the back of the message book M-105 is suitable for this purpose. Similarly clean other contacts.

28. Removal from service.—When removing the set from service for a period exceeding two days, remove all batteries from the set.

[A. G. 062.12 (4-18-39).]

BY ORDER OF THE SECRETARY OF WAR:

MALIN CRAIG,
Chief of Staff.

OFFICIAL:

E. S. ADAMS,
Major General,
The Adjutant General.