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TELEGRAPH SET TG-5

SUPERSEDED

By: TM 11-351

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Prepared under direction of the
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SECTION I. General use and description.....	Paragraphs 1-2
II. Detailed description of parts.....	3-14
III. Installation and operation.....	15-20
IV. Maintenance.....	21-22

SECTION I

GENERAL USE AND DESCRIPTION

General use.....	Paragraph 1
General description.....	2

1. **General use.**—The telegraph set TG-5 is an open-circuit field telegraph set designed for use on field lines within the division, or in any situation requiring the use of portable telegraph equipment for short distances and with very few intermediate or way stations. It can be used on either complete metallic or on ground return circuits, but normally it will be used over simplex telephone circuits and will employ a ground return. It cannot be used in connection with a standard closed-circuit telegraph system. Using its self-contained batteries it ordinarily should operate over field circuits of any length likely to be encountered within the infantry division. The range may be still further increased by adding additional line battery in series externally where exceptionally long lines or high resistance grounds are encountered. (See par. 18 f.) Several sets may be operated in series if desired, although ordinarily not more than 3 or 4 should be required to work together on one circuit.

2. **General description.**—*a.* The set in its aluminum alloy case weighs 5 pounds including batteries, and is provided with a canvas and leather carrying case CS-49, weighing 1 pound. Figure 1 shows the telegraph set with its component parts including its carrying case. Figure 2 shows the set ready for connection to a line circuit. Figure 3 shows a rear view of the set and the manner in which the local circuit batteries are installed. Figure 4 shows schematically the working parts of the set, their terminals, the color scheme of the wires connecting them together, and the effect on the line relay of moving the external pointers when making relay adjustments.

b. The adjustable line relay in each set operates on a low direct current to control a local circuit in the set. If two sets are connected and the key of one is operated, it closes the line circuit, sending direct current over the line and through the line relays of both sets, operating them. (See fig. 5.) The battery which supplies this line current is furnished only by the set which is transmitting, no battery being supplied to the line by the receiving set. The line battery is normally a 22½-volt dry battery contained in the set.

TELEGRAPH SET TG-5

c. Each line relay when operated closes the local circuit in its set. If the headset set is *not* plugged in to the jack, this local circuit contains a 3-volt dry battery in series with a small bell. In this condition operating the key in either set causes



FIGURE 1.—Component parts of telegraph set TG-5.

the bell to ring. (See fig. 5.) However, if the headset is plugged in to the jack, the jack contacts cut the bell out of the circuit and place an interrupter of the "howler" type in series with the 3-volt battery. In this condition, operating the

key in either set causes the interrupter to send a 1,000-cycle tone into the receiver. (See fig. 6.)

d. Thus, by removing the plug of the headset from the jack, a set may be left in the stand-by position so that its call bell may be rung by operating the key at either station. Or, by inserting the plug in the jack, a set may be put in the operating position so that 1,000-cycle signals will be heard in the receiver when the key at either station is operated.

e. When more than two stations are connected in one circuit, the operation is similar. The transmitting station sends current from its line battery through the line relays of all stations in the circuit causing their local circuits to operate in the manner described above. (See fig. 8.)

f. Power for the line circuit is furnished by a 22½-volt battery BA-2 and for the local circuit by two 1½-volt batteries BA-30 in series. The batteries are contained within the set, but provision is made for attaching batteries externally, if required. (See figs. 1, 2, and 3.)



FIGURE 2.—Telegraph set TG-5 ready for use.

A station in a circuit uses no line battery except when the key of that set is operated, and no local battery except when its own plug is inserted in the jack or when the key of some set in the circuit is operated.

SECTION II

DETAILED DESCRIPTION OF PARTS

Case	Paragraph
Relay BK-7	3
Interrupter BZ-5	4
Key J-41	5
Capacitor CA-210	6
Headset HS-20	7
Bell, Edwards no. 13	8
Jack, Western Electric no. 226-A	9
Binding posts TM-150	10
Battery BA-2	11
Batteries BA-30	12
Circuits	13
	14

3. **Case.**—*a.* The aluminum alloy case is hinged in such a manner that the top, front, and a part of the back may be opened. The top is hinged along the back edge so it may be raised, after pressing the latch button on the front, to expose the compartments for the headset HS-20 and battery BA-2. The front is hinged along the base and lowers to a horizontal plane with the key J-41 mounted in the proper position for sending. After the front is lowered, the binding posts TM-150, relay BK-7, interrupter BZ-5, Edwards no. 13 bell, and Western Electric no. 226-A jack are exposed. The small door in the back may be opened by turning the catch one quarter turn with a screw driver, exposing a compartment for two batteries BA-30. The case is painted olive drab. A name plate is fitted on the top. The circuit diagram is cemented inside the top.

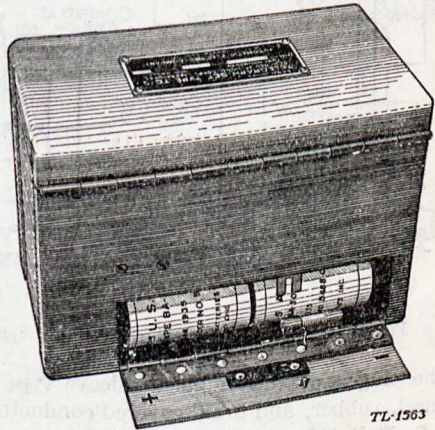


FIGURE 3.—Rear view of telegraph set TG-5 showing local circuit batteries.

b. The carrying case CS-49 is of heavy canvas with its bottom reinforced by leather. Its top is sewed to the case at one side to form a hinge, and fastens with a snap when closed. An adjustable web-carrying strap is attached to the case.

4. **Relay BK-7.**—The relay is contained in a black bakelite housing with two pointers mounted on the front side for adjusting the spring tension on the armature and the air gap between the armature and core ends. The pointers are designated SPRING and GAP, respectively, and move over graduated scales from 0 to 30. (See fig. 1.) The relay has a winding resistance of 150 ohms and may be adjusted to operate on as low a current as 1.5 milliamperes. Five terminals at one end provide connection to the winding and the break-make contacts. The contact adjusting screws are properly set and sealed at the factory and should not require adjustment. An opening in the top of the relay housing permits cleaning of the relay contacts by the operating personnel. Another opening in the bottom of the housing exposes the armature tension spring and thread.

5. **Interrupter BZ-5.**—The interrupter, sometimes known as the howler, serves as a local tone source for the operator and consists of a double carbon

TELEGRAPH SET TG-5

13. Batteries BA-30.—These batteries are of the same size as standard commercial flashlight batteries. Two are used in series for the 3-volt bell and interrupter circuits. The lid of the rear compartment is properly marked for polarity of the batteries. A spiral spring in the $-$ end of the compartment connects to the base of one battery and a flat spring contact in the $+$ end connects to the top of the other battery. It is important that the two batteries BA-30 be properly connected in series; that is, the top of one battery making contact with the base of the other. If one of the batteries should be reversed the local circuit will not operate.

14. Circuits.—Figure 4 shows the circuit diagram and wiring of the set. Figure 5 is a schematic diagram of only the calling circuit when one station is calling another. Figure 6 illustrates the sending and receiving circuits of two stations installed with a telegraph line wire and ground return when one station is transmitting to another. Figures 7 and 8 illustrate the same for a 2- and a 3-station circuit respectively but over simplex telephone circuits with ground return.

SECTION III

INSTALLATION AND OPERATION

	Paragraph
Preparing the set for installation.....	15
Testing the calling circuit.....	16
Testing the sending and receiving circuit.....	17
Methods of connecting into a telegraph line circuit.....	18
Ground connections.....	19
Adjustment of the line relay.....	20

15. Preparing the set for installation.—Open the telegraph set and see that the line battery and local circuit batteries are properly installed. (See

figs. 2 and 3.) In case batteries BA-2 and BA-30 are not available, any batteries of the proper voltage may be connected externally, care being exercised to connect them with polarities as indicated in figures 2 and 4. Remove the headset from its compartment but do not insert the plug in the jack. Adjust the key as desired, being careful not to screw the back contact down so far that both front and back contacts "make" at the same time, since this will short-circuit the line battery.

16. Testing the calling circuit.—Test the calling circuit by temporarily short-circuiting the line binding-posts L_1 and L_2 , and at the same time pressing the key. The bell should ring. If it does not, adjust the relay as in paragraph 20 b and c.

17. Testing the sending and receiving circuit.—Test the sending and receiving circuit by inserting the plug of the headset in the jack. The interrupter (howler) should operate continuously and its 1,000-cycle tone should be faintly

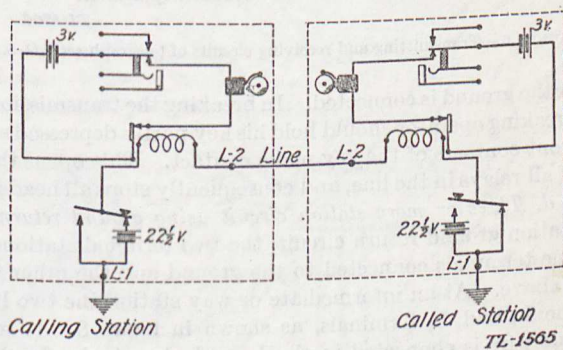


FIGURE 5.—Calling circuit of a telegraph line circuit using telegraph set TG-5.

audible, but not in the receiver. Adjust the receiver to the ear, again temporarily short-circuit the line binding posts L_1 and L_2 , and at the same time press the key. A strong signal should be heard in the receiver when the key is depressed. If a constant signal is heard in the receiver when the key is not depressed, or if no signal is heard when the key is depressed, adjust the relay as in paragraph 20 b and c.

18. **Methods of connecting into a telegraph line circuit.**—*a. Two-station circuit using telegraph line wire and ground return.*—Two stations connected together in a ground return circuit, the single line wire of which is used exclusively for telegraph, are shown in figure 6. This method is used when there is a separate line wire available exclusively for telegraph use.

b. Two-station circuit using simplex telephone circuit and ground return.—When there is no separate line wire available exclusively for telegraph communication, the usual case in a military wire system, a simplex telephone circuit serves as the line wire as shown in figure 7. In this case both telephone wires together make up the telegraph line wire, and the single wire from the mid-point of the

line side of the repeating coil provides the line connection to the telegraph instrument.

c. Line and ground connections, two-station circuit.—In both cases a good ground connection should be made to one of the line terminals of the set and the line should be connected to the other. It makes no difference to which of the two line terminals L_1 and L_2 the line

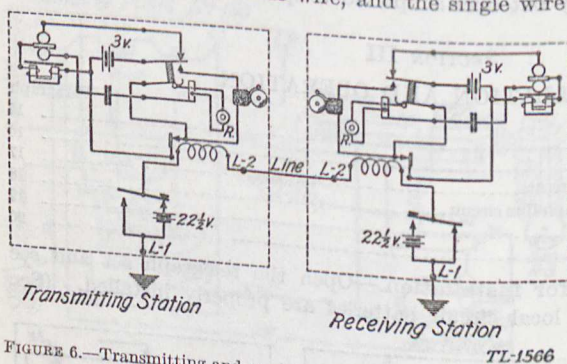


FIGURE 6.—Transmitting and receiving circuits of telegraph set TG-5.

or the ground is connected. In breaking the transmission from another station, the breaking operator should hold his key partly depressed so that neither the back nor front contacts of the key make contact. This opens the line, stops the operation of all relays in the line, and consequently stops all headset or bell signals of all sets.

d. Three or more station circuit using ground return.—With a three or more station ground return circuit, the two terminal stations should have one of their line terminals connected to the ground and the other to the line as described in *c* above. At an intermediate or way station the two line wires are connected to the L_1 and L_2 terminals, as shown in figure 8. It makes no difference which line wire is connected to the L_1 or L_2 terminal. In this particular example the telegraph line circuit is simplex around an intermediate telephone switchboard.

With a circuit of three or more stations, each of the idle stations will hear all transmissions between any other stations working together in the circuit. These signals will be heard as bell signals unless the headset is plugged in, in which case the idle operator must remain close enough to his set to hear in the receiver any call for his station. Breaking transmission is accomplished in the same manner as in *c* above.

e. All metallic telegraph circuits.—When any consideration makes a ground return circuit impracticable, a metallic return may be used instead. In this case both line terminals may be connected to line wires reserved for telegraph use only, both may be connected to the telegraph legs from the line sides of the repeating coils in simplex telephone circuits (the more usual case), or one may

TELEGRAPH SET TG-5

be connected to a wire reserved for the telegraph and the other to a simplex telephone circuit. Intermediate stations must make certain that their sets are connected in series with the line circuit and not across it.

f. *Additional line battery.*—When long lines, high resistance grounds, or leaky lines in wet weather reduce the current through the relay at the receiving station so that it fails to operate, additional battery may be connected in series with the battery BA-2 in each set in the line circuit. In any case it is advisable to employ at each set a line battery with approximately the same voltage. Although the relay winding will stand a constant current of approximately 300 milliamperes without injury, nevertheless the line current should be kept below 30 milliamperes, if possible, since the relay works much better at the lower current value, interference troubles are less, and interception is more difficult. However, before adding external battery, care should be taken each time to adjust the relay for minimum current operation (see par. 20 b and c), and additional battery should be added only if the relay still fails to function.

19. **Ground connections.**—When ground return circuits are used, which will usually be the case, a good ground connection (i. e., one of low resistance)

is necessary not only to insure sufficient operating current, but also to prevent interference with neighboring telegraph circuits. A metal ground rod about 2 feet in length driven well into the ground where it is moist, or where a good contact is made with the ground by wetting it, should provide a satisfactory ground. Where difficulty is experienced in obtaining a satisfactory ground connection, and when interference with other telegraph circuits is noted, the difficulty may be reduced by using separate grounds placed at some distance from each other for each instrument, and with the ground moistened and packed around each ground

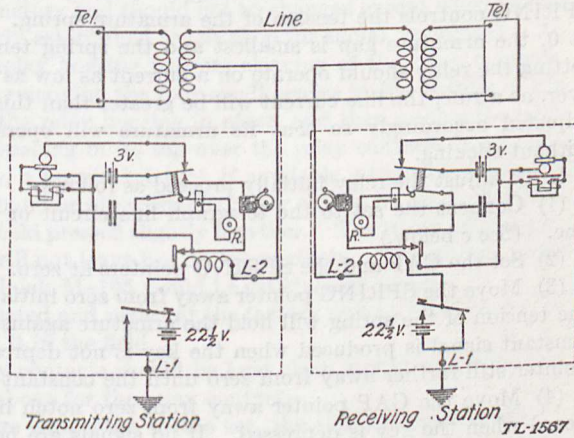


FIGURE 7.—Two-station circuit of telegraph set TG-5 operating over a simplex telephone circuit.

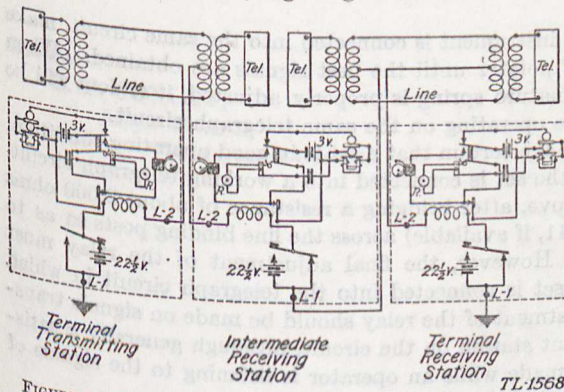


FIGURE 8.—Three-station circuit of telegraph set TG-5 operating over simplex telephone circuits.

and when interference with other telegraph circuits is noted, the difficulty may be reduced by using separate grounds placed at some distance from each other for each instrument, and with the ground moistened and packed around each ground

rod. If it is found impossible to obtain a satisfactory ground, it will be advisable to eliminate the necessity for a ground by using a metallic return. (See par. 18 *e*.)

20. **Adjustment of the line relay.**—*a*. The two pointers on the front of the set marked GAP and SPRING are for adjusting the line relay to obtain good signals. (See fig. 4.) The one marked GAP controls the length of the air gap between the armature and the magnet core of the relay. The one marked SPRING controls the tension of the armature spring. When both pointers are at 0, the armature gap is smallest and the spring tension is least. With this setting the relay should operate on a current as low as 1.5 milliamperes. However, as a rule, the line current will be greater than this and the relay should be adjusted accordingly so that its armature will operate and release properly without sticking.

b. To adjust the relay initially proceed as follows:

(1) Connect the set to the telegraph line circuit or to an artificial telegraph line. (See *c* below.)

(2) Set the GAP and the SPRING pointers at zero.

(3) Move the SPRING pointer away from zero initially about 5 points so that the tension of the spring will hold the armature against the back contact. If a constant signal is produced when the key is not depressed, move the SPRING pointer still farther away from zero until the constant signal ceases.

(4) Move the GAP pointer away from zero notch by notch until signals are heard when the key is depressed. If no signals are heard upon depressing the key after the pointer has been moved to the other end of the scale, the spring tension is probably too great; the SPRING pointer must be moved back toward zero and the GAP pointer again moved away from zero until signals are heard when the key is depressed.

(5) Move the GAP pointer still farther away from zero until the signals disappear.

(6) Now move the GAP pointer back toward zero until the signals are heard again.

(7) Make minor adjustments with the SPRING pointer until the best signals are heard.

(8) Thereafter, while the instrument is connected into the same circuit, make adjustments with the GAP pointer until the best signals are obtained. When once the tension of the armature spring is properly adjusted, it seldom will be necessary to change it while operating on the same telegraph circuit.

c. When it is desired to make certain that a set is in good operating condition, in a repair shop, or before the set is connected into a working telegraph circuit, it may be tested as in *b* above, after bridging a resistance of about 2,000 ohms (such as a radio headset P-11, if available) across the line binding posts so as to produce an artificial line. However, the final adjustment of the relay must always be made while the set is connected into the telegraph circuit in which it is to operate. This adjustment of the relay should be made on signals transmitted from the most distant station on the circuit, although generally a satisfactory adjustment can be made while an operator is listening to the signals of his own set while it is connected into the line circuit.

d. Often it will be found necessary to have different relay adjustments when working with different stations on the circuit. These minor adjustments are made at the time an operator is ready to work with a particular station in the circuit. They generally will consist only in making minor changes in the setting of the GAP pointer.

TELEGRAPH SET TG-5

SECTION IV

MAINTENANCE

Paragraph

Care and repair.....	21
Removal from service.....	22

21. Care and repair.—*a.* The contact adjusting screws of the relay are adjusted and sealed at the factory and should not be changed except when repairs are being made at a regularly established repair shop for signal equipment. An opening in the top of the relay housing permits cleaning of the relay contacts. This opening is reached by removing the four small screws in the bottom of the case of the set which hold the relay housing in place, and then pulling the relay housing forward until the opening in its top over the relay contacts is exposed. To clean the relay contacts, a burnishing tool, if available, otherwise a piece of smooth steel, or a piece of bond or other similar paper should be drawn between the contacts while they are held pressed slightly together. The paper used should be unglazed, and one that will not leave lint on the contacts. The tracing paper in the back of the message book M-105 would be satisfactory to use.

b. The interrupter is adjusted and sealed at the factory and no attempt should be made to adjust or repair it in the field.

c. The bell, jack, and key contacts should be kept clean and in adjustment in the manner described in *a* above for the relay contacts.

d. After the line wires are connected to the set, the top and back compartments should be closed to protect the instrument.

e. When no traffic is being handled *remove the plug from the jack* to conserve the local 3-volt battery. The bell then serves as a calling signal for the operator. With the plug in the jack the bell will not ring, but the battery will be used up by the continuous operation of the howler.

22. Removal from service.—When removing the set from service, *all batteries should be disconnected and removed from their compartments.*

[A. G. 062.12 (11-4-35).]

BY ORDER OF THE SECRETARY OF WAR:

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