

WAR DEPARTMENT

TECHNICAL MANUAL



TEST SETS EE-65 AND EE-65-A
THROUGH -E to F (344)

February 2, 1943

includes EE65F

SUPPLEMENT
to
TECHNICAL MANUAL
TEST SETS EE-65 AND EE-65-A
THROUGH -E
2 FEBRUARY 1943

The following information, published by the Connecticut Telephone and Electrical Division, Great American Industries, on Orders No. 5768-PHILA-44, 7621-PHILA-44 and 10062-PHILA-44, supplements that furnished in TM 11-361, 2 February 1943, for Test Sets EE-65 and EE-65-A through -E. Personnel using this equipment will attach this supplement securely in the front of the TM and will enter suitable notations beside each changed paragraph in the TM to indicate the presence of this supplementary information. The paragraph numbers conform with the sequence established in TM 11-361, 2 February 1943.

Page 2, par. 1. **Purpose.** Add the following: Test set EE-65-G in general is the same as test sets EE-65-C, -D, -E, and -F. There is no difference in the circuit used, general layout, and employment.

Page 3, par. 2. **Description.** Add the following at the end of subpar. b: The following differences are found in test set EE-65-G as compared to test sets EE-65-C, -D, -E, and -F:

(1) *Chassis.*—Material is steel instead of aluminum.

(2) *Generator.*—GN-38-B is used in place of GN-38. In an emergency GN-38 can be used for replacement.

(3) *Panel.*—Minor changes regarding layout of mounting holes and fastening to hinge.

(4) *Key mounting bars.*—Steel; change in method of fastening.

(5) *Hinge studs and supports.*—Steel; shortened support.

(6) *Screws.*—All screws are now finished steel.

(7) *Box.*—Minor changes regarding construction details, location of rivets, and hardware.

(8) *Circuit plate.*—Contains parts list with nomenclature; schematic wiring diagram is drawn in accordance with present standard practice.

Page 20, par. 26. **Functioning of parts.**—Delete heading of subpar.

a. *Generator GN-38* and substitute the following:

a. *Generator GN-38-B.*

Page 37. Insert new paragraph at the end of par. 31. **Removal and assembly of parts:**

31½. **Moistureproofing and fungiproofing.**—a. *General.*—Communication failures commonly occur when Signal Corps equipment is operated in tropical areas where temperature and relative humidity are extremely high. The following problems are typical:

(1) Resistors and capacitors fail.

(2) Electrolytic action takes place in coils, chokes, transformer windings, etc., causing eventual breakdown.

(3) Hook-up wire and cable insulation breakdown. Fungus growth accelerates deterioration.

(4) Moisture forms electrical leakage paths on terminal boards and insulating strips, causing flash-overs and crosstalk.

(5) Moisture provides leakage paths between battery terminals.

b. Treatment.—A moistureproofing and fungiproofing treatment has been devised which, if properly applied, will provide a reasonable degree of protection against fungus growth, insects, corrosion, salt spray, and moisture. The treatment involves the use of a moisture and fungi-resistant varnish applied by means of a spray gun. A brief description of the method of application follows:

(1) All repairs and adjustments necessary for the proper operation of the equipment are made.

(2) Equipment to be processed is thoroughly cleaned of all dirt, dust, rust, fungus, oil, grease, etc.

(3) Equipment is partially disassembled and certain points such as relay contacts, open switches, bearings, air capacitors, sockets, etc., are covered with masking tape.

(4) Equipment is thoroughly dried by heat to dispel moisture which the circuit elements have absorbed.

(5) All circuit elements and all parts of the equipment are sprayed or painted with three coats of moistureproofing and fungiproofing varnish.

(6) The equipment is given a final operational check.

c. Detailed Instructions.—For detailed instructions in the spray method of moistureproofing and fungiproofing, refer to maintenance manuals on Signal Corps equipment and instruction manuals covering moistureproofing kits. Following are step-by-step instructions for treatment of EE-65-G.

(1) Disassembly:

(a) Remove fiber clamp over three test leads.

(b) Remove leads.

- (c) Loosen knurled nut above meter to open case.
 - (d) Remove generator handle.
 - (e) Screw down knurled binding posts.
 - (f) Remove key handles.
 - (g) Remove keys.
 - (h) Remove generator.
 - (i) Remove spring pack from generator.
 - (j) Remove buzzer clapper.
 - (k) Cut cable lacing and spread wire.
 - (l) Meter (MAINTENANCE SECTION TM 11-472).
 - (m) Remove induction coil C-105 and holding coil C-158 from cabinet. Do not unsolder leads.
 - (n) Remove jack JK-37.
 - (o) Remove batteries. *DO NOT APPLY HEAT TO BATTERIES.*
- (2) Masking :
- (a) Mask two magnet cores on buzzer.
 - (b) Mask six battery contacts.
 - (c) Mask all key contacts.
- (3) Dry for two hours.
- (4) Spray with three coats of MFP VARNISH and reassemble.
- (5) Test operation.
- (6) Mark MFP and date of completion.

Page 37, par. 31. **Removal and assembly of parts.** Delete heading of subpar. d. To remove generator GN-38 and substitute the following :

d. To remove generator GN-38-B.

Page 38, par. 33. List of replaceable parts.—*a. Components.* Delete the following:

	<i>Weight</i>	
	<i>(lb.)</i>	<i>(oz.)</i>
1 generator GN-38 with crank GC-9	2	2

Substitute the following:

	<i>Weight</i>	
	<i>(lb.)</i>	<i>(oz.)</i>
1 generator GN-38-B with crank GC-9	1	14

Page 38, par. 33b. *Replaceable parts.*—Delete all of subpar. *b*, and substitute the following:

b. Replaceable parts.—Test set EE-65-G. -

Sig. C Stock No.	Name and Description	Function	Mfr's Part No.
3F4065D/R1	Resistor, 1000 ohms + 1%, 2½ watt, wire wound Stud, lock Washer Pin	Loop test resistance To lock panel To secure stud in panel	2454-X 954-X 2575-X 960-X
3F4065D/B2	CASE GROUP Draw bolt with rivets Footman loop; with rivets and burrs Dee ring Loop plate; with rivets and burrs Hinge, butt; with rivets Hinge, continuous with rivets Retainer, spring; phenolic block Spring, coil	Lock for case Attach strap to case Attach strap Attach dee ring Attach lid to case Attach panel to case Holds battery spring Contact and retains Battery BA-30 Carrying strap	943-X 947-X
4Z6951	Strap; harness snap and clip; belt rivets and burrs assembled	Carrying strap	9890-A
4Z6951/1	Strap; with bar buckle assembled to one end; other end punched for rivets and burrs (Item 46) in envelope stapled to strap	Carrying strap	
3F7193	Voltmeter IF-93 0-50 volts plus or minus 1%; 50000 ohms, plus or minus 1% LID SUPPORT GROUP Lid support, top link, bottom link and center pin assembled Collar, bottom Collar, top Insert; Stud, bottom Stud, top Washer, cup GENERATOR GROUP	To attach support to case	1016-X

4B838 or 4B838B 4B454 4B838/S2	Generator GN-38 or Generator GN-38B Crank, generator GC-9 Spring assembly, generator Screw, machine, binding head/ Washer, lock; for No. 10 screw Washer, fibre; Binding Post TM-149-A Bushing, steel; bonderized, black Buzzer, 80 ohms Spacer Capacitor CA355 Clip, battery, spring steel, bonderized, black Clip, battery, spring steel, bonderized, black, with wood screws 4 x 1/4" RH Clip, battery Fahnestock type single, wood screws 6 x 1/2" RH Clip, battery; Fahnestock type double; with wood screws 6 x 1/2" RH Clamp, cable Clamp, cord Cord CD-478	10225-A 1797 10 1/2 SCD-1791-8 2575-X 994-X 1003-X 2990-C 945-X 946-X 999-X 998-X 2364 959-X 1034-X-G 1034-X-1 1034-X-2
3D855 2Z2727-4 2Z2727-5 3Z1505 3Z1508 3E1478	Mounting generator Mounting generator Mounting generator and resistor Washer centers Buzzer mounting Retains battery BA2 Retains battery BA30 Battery connection Battery connection Secures wiring Secures test leads Test lead	

Sig. C Stock No.	Name and Description	Function	Mfr's Part No.
3C158	Test clip TL-137 2 stamped G 2 stamped 1 2 stamped 2 Holding coil C-158		SCD2787-E
3C105	Induction coil C-105		SCD2877-G
2Z5537	Jack JK-37		961X
4C5039.97X	Key	Ringing and listening	997-X
4C5031.777A	Key	Reverse line LR1777A	LR1777A
4C5039.95X	Key	Reverse Voltmeter RMR Voltmeter return to line VMB or to ground VMG	995-X
4C5031.778A	Key	Connect voltmeter across line VM or substitute external battery EB	1778A
4C5032.214X	Key Handles, key	Loop resistance V/VX For CTE keys; 2 black, 1 red	2214-A
3F4065E/T1	Terminal lug	Connect voltmeter and test clips	2566-X
3Z10156	Terminal lug	Connect generator	1787-16
3Z11007	Terminal lug	Soldering connections	4007

RESTRICTED

TECHNICAL MANUAL }
 No. 11-361 }

WAR DEPARTMENT,
 WASHINGTON, February 2, 1943.

TEST SETS EE-65 AND EE-65-A THROUGH -E**DEMOLITION NOTICE****Destruction when capture is imminent**

In the event it should become necessary to prevent the capture of this equipment—

DESTROY IT SO THAT NO PART IS SALVAGEABLE OR USABLE BY THE ENEMY. BURN ALL DESCRIPTIVE PAPERS AND BOOKS.

In the destruction of equipment, all panels, switch and instrument boards, controls, relays, and meters should be demolished. All electrical wiring, where practicable, should be ripped out and all operating instruments such as microphones, keys, and phones should be broken.

Equipment can be destroyed by explosives, hammers, axes, burning, grenades, or by gunfire. When time permits, bury all debris or scatter into streams or other bodies of water.

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*This manual supersedes TM 11-361, August 25, 1941, and C 1, February 14, 1942.

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SECTION I

GENERAL

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1. Purpose.—Test sets EE-65 and EE-65-A, -B, -C, -D, and -E have been designed to provide a wire chief's testing equipment in a compact portable form for use both in the field and in permanent central office installations.

2. Description.—*a.* Each of these test sets contains equipment for talking, signaling, and testing wire line installations. The circuits used in the test set for talking and signaling are similar to those used in the telephone EE-8-A, except that the test set EE-65 does not employ an antisidetone circuit for its talking circuit. The testing circuit contained in the test set permits measurement of d-c voltages up

to 50 volts, and of resistances from 22 ohms to 2 megohms. The test circuits of each of these test sets are fundamentally the same electrically although later models incorporate minor improvements in mechanical arrangement and the addition of a sixth key to increase the range and versatility of the test set. The weight of the test set complete without batteries is approximately 16 pounds, 13 ounces.

b. There are minor differences in the several models of this set. All voltmeters are of 50,000 ohms resistance except on the test set EE-65, the voltmeter of which has a resistance of 3,000 ohms. The test set EE-65-B has a larger voltmeter and correspondingly deeper case cover. The test set EE-65 is equipped with a separate transmitter, a separate receiver, and a separate ground rod which are carried in the case; none of these items is a part of the other test sets. The key arrangement on test sets EE-65 and EE-65-A and -B is identical. The test sets EE-65-C, -D, and -E are identical; they differ from the test set EE-65-A principally in having a sixth key and some differences in their key connections.

c. The handset and plug (for all models except test set EE-65), the two telephone batteries BA-30 (or one battery BA-1 for test set EE-65), and the two test batteries BA-2 are not component parts of the test set. They must be supplied separately.

d. Hereafter when the information contained herein applies to all models of this test set, they will be referred to collectively as test set EE-65-(*).

3. Set box.—*a. Test set EE-65.*—The set box consists of a wooden case, metal bound, with hinged cover. It is provided with a quick-acting latch lock and has two supports for attaching the carrying strap. The case acts as a support for the testing equipment, the entire set of keys, voltmeter, generator, buzzer, induction coil and holding coil, together with the necessary wiring, all mounted on a hinged bakelite panel. Within the case a battery compartment is provided for the talking and testing batteries, whereas a compartment on the left side of the test panel provides space for carrying the transmitter, receiver, test cords, and clips. Inside the cover is a clip for holding the ground rod. The test set EE-65 is equipped with a 3,000-ohm voltmeter.

b. Test set EE-65-A.—The set box consists of a wooden or fiber box similar to that of the test set EE-65, except that instead of a compartment for listening equipment, a small receptacle is installed in the cover for storage of the three test leads. A wiring diagram of the test set is also placed inside the cover. No ground rod, transmitter, or receiver is furnished.

c. Test sets EE-65-B, -C, -D, and -E.—The set box is similar to that of test sets EE-65 and EE-65-A, except that a deeper voltmeter is

used, making it necessary to provide a deeper cover. Charts for the evaluation of measurements are also included in the cover.

4. Test unit.—*a. Test set EE-65.*—The test unit set up in position for service is shown in figure 1. The voltmeter at full scale reads 50 volts. Each space on the scale has a value of 1 volt, every fifth and tenth unit being shown by a longer line on the scale. The upper left-hand binding post is for the ground connection and is designated GND. The next two posts are the line terminals and are designated L-1 and L-2, respectively. The thumbscrew directly over the voltmeter

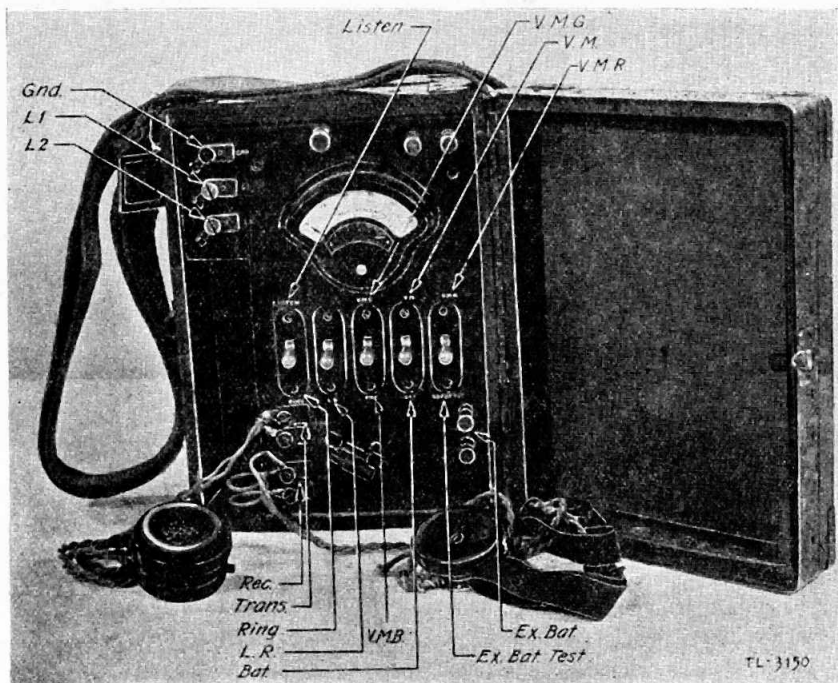


FIGURE 1.—Test set EE-65 ready for operation—front view.

locks the front panel in position. At the lower right-hand side are two binding posts for connecting an external battery when batteries BA-2 are not available. These posts are designated EX. BAT., the left terminal being the positive terminal. When an external battery is used, the internal battery must be disconnected. The transmitter is connected to the two upper binding posts located at the lower left-hand side of the testing panel and are designated TRANS. The testing receiver is connected to the next two binding posts which are designated REC. Two-way flexible cords are used for these connections. The generator handle is located in the lower center of the panel.

The binding posts marked BAT. TEST are no longer used under the new test procedure described herein.

b. Test sets EE-65-A and -B.—The test unit set up in position for service is shown in figure 2.

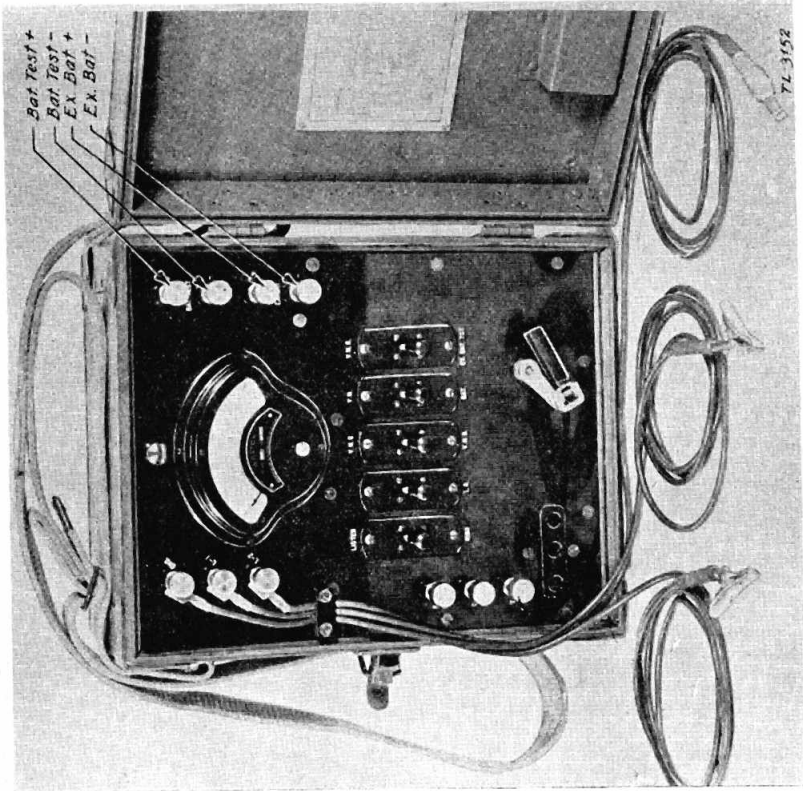


FIGURE 2.—Test set EE-65-A ready for operation—front view.

(1) The voltmeter at full scale reads 50 volts. Each space on the scale has the value of 1 volt, every fifth and tenth unit being marked by a longer line on the dial.

(2) The upper left-hand binding post is for the ground connection and is marked GND. The next two posts are the line terminals and

are designated L-1 and L-2, respectively. The thumbscrew directly over the voltmeter locks the front panel in position. At the upper right-hand side are two pairs of binding posts. The upper pair is for connecting any external battery source whose value is to be measured, and is marked BAT. TEST; these binding posts are no longer used, as a new procedure for testing an external battery has been developed. The lower pair is for connecting an external test battery when batteries BA-2 are not available.

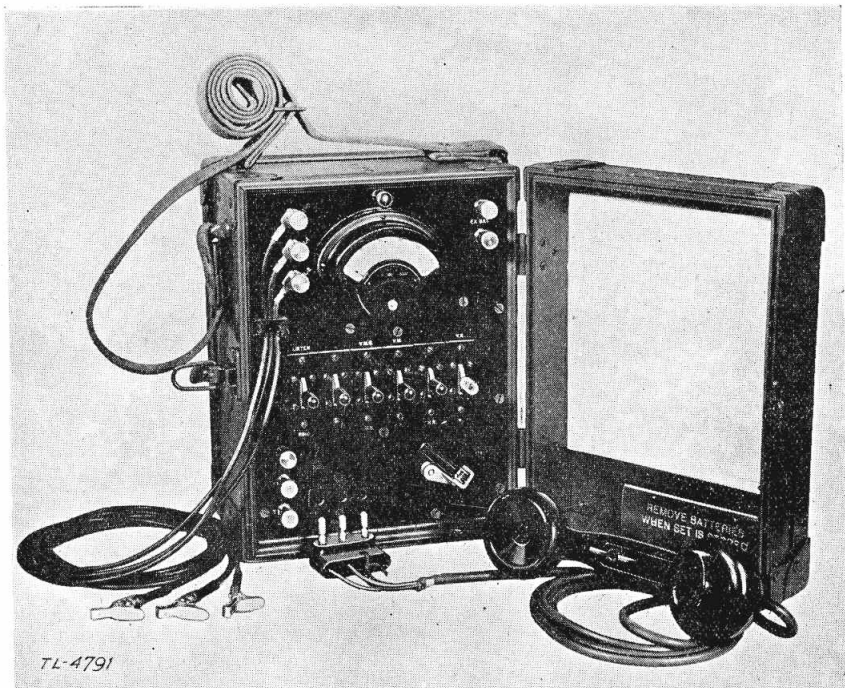


FIGURE 3.—Test sets EE-65-C, -D, and -E ready for operation—front view.

(3) The hand set, if similar to hand set TS-9, is connected to the jack JK-37 at the lower left-hand side; otherwise the handset is connected to the binding posts T, C, and R.

(4) The generator handle is located in the lower center portion of the panel.

c. Test sets EE-65-C, -D, and -E.—(1) The test set in position for service is shown in figure 3.

(2) The voltmeter at full scale reads 50 volts. Each space on the dial has a value of 1 volt, every fifth and tenth unit being marked by a longer line on the dial.

(3) The upper left-hand binding post is for the ground connection and is marked GND. The next two posts are the line terminals and are designated L-1 and L-2, respectively. The thumbscrew directly over the voltmeter locks the front panel in position. At the upper right-hand side are two binding posts for connecting an external battery when batteries BA-2 are not available. These posts are designated EX. BAT., the upper terminal being the positive terminal. When an external battery is used, the battery within the case must be disconnected.

(4) The hand set, if similar to the hand set TS-9, is connected to the jack JK-37 at the lower left-hand side; otherwise the hand set is connected to the binding posts T, C, and R.

(5) The generator handle is located in the lower center of the panel.

5. Test keys and their uses.—*a. Test sets EE-65 and EE-65-A and -B.*—The various talking and testing circuits of these sets are controlled by five keys mounted in a row in the center of the testing panel. For purposes of identification, these keys are considered as numbered from left to right.

(1) Key No. 1 when thrown to LISTEN position is used for listening or talking. When thrown to RING position, it is used for ringing out on the test leads, the generator crank being turned at the same time. The buzzer provides a signal to show whether or not the line is closed. Key No. 1 on test sets EE-65-A and -B locks in both up and down positions. Key No. 1 on test set EE-65 is nonlocking in RING position.

(2) Key No. 2 can be moved only to position L. R. It is used for reversing the test leads.

(3) Key No. 3, when in the V. M. G. position, connects the positive side of the test battery to GND and connects the negative side of the battery through the voltmeter to L-1, or to L-2 if switch No. 2 is also operated. Key No. 3 is used when testing for grounds. When thrown to V. M. B. position, the voltmeter, in series with the testing battery, is connected directly across L-1 and L-2 for locating short circuits or for making other resistance tests.

(4) Key No. 4 in the V. M. position disconnects the testing battery and is always used in conjunction with key No. 3. If used with key No. 3 in the V. M. B. position, it connects the voltmeter directly across L-1 and L-2. Thus, by placing any external battery source on binding posts L-1 and L-2, its potential may be measured. This procedure eliminates the necessity for using the binding posts marked BAT. TEST. With key No. 3 in the V. M. G. position, it connects the voltmeter directly across L-1 and GND.

(5) Key No. 5 in the V. M. R. position is used to reverse the terminals of the voltmeter. This relieves the tester from having to change the test leads when measuring an external battery. In the EX. BAT. TEST position, the voltmeter is connected directly across the BAT. TEST binding posts for measuring any outside potential within the range of the voltmeter.

(6) Various combinations of the keys provide the necessary testing circuits for the usual magneto and common battery system tests.

b. Test sets EE-65-C, -D, and -E.—The various talking and testing circuits of these sets are controlled by six keys mounted in a row in the center of the testing panel. For purposes of identification, keys are considered as numbered from left to right. The operating positions of each are designated by letter combinations.

(1) Key No. 1, when thrown to LISTEN, is used for listening or talking. When operated to RING, it is used for ringing out on the test leads, the generator crank being turned at the same time. The 80-ohm buzzer provides a signal to show whether or not the line is closed.

(2) Key No. 2 can be moved in one direction only, to position L. R., and is used for reversing the test leads.

(3) Key No. 3, when in the V. M. G. position, grounds the positive side of the test battery and connects the negative side of the battery through the voltmeter to binding post L-1. This key is used when testing for grounds. When key No. 3 is thrown to the V. M. B. position, the voltmeter, in series with the testing battery, is connected directly across the test leads for locating shorts or making other resistance tests.

(4) Key No. 4, when in the V. M. position, disconnects the testing battery and connects the voltmeter directly across L-1 and ground (with key No. 3 thrown to V. M. G.). With the key in the E. B. position, the self-contained testing battery is disconnected and the external battery is inserted into the circuit instead.

(5) Key No. 5 can be moved to the V. M. R. position only. It is used to reverse the terminals of the voltmeter. This relieves the tester from having to change his test leads when measuring voltage from an external source between L-1 and L-2, or between L-1 or L-2 and ground.

(6) Key No. 6 has two nonlocking positions and is used for making loop resistance measurements. In the V. X. position the voltmeter, with key No. 3 in the V. M. B. position, is connected across the test leads. In the V. position, it is connected across a built-in resistor. Since in either operated position the current drain from the testing battery is very great, this key should be operated only as short a time

as possible. In order to indicate this, the key has been provided with a red handle.

(7) Various combinations of the keys provide the necessary testing circuits for the usual magneto or common battery tests.

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6. Initial procedure.—After test set EE-65-(*) is taken from its cardboard container it is ready for installation.

7. Installation.—*a. Batteries.*—Open set box, loosen the knurled screw at top center of panel, and swing hinged test panel out. This exposes space for batteries. Put two batteries BA-2 in place, connecting the minus lead of one battery to the Fahnestock clip marked minus (-), and the plus lead of the same battery to the double Fahnestock clip in the center. Connect the minus lead of the second battery BA-2 to the same double clip, and the plus lead to the Fahnestock clip marked plus (+). If no batteries BA-2 are available, connect any available battery between 38 and 48 volts, located outside the test set, to the terminals on the panel marked EX. BAT., observing correct polarity. Also insert two batteries BA-30 (flashlight cells) with the center terminals facing toward the right (generator side). The test set EE-65 is designed to use one battery BA-1 in place of two batteries BA-30. However, when battery BA-1 is not available, two batteries BA-30, with a metallic spacer to make them

equal the length of a battery BA-1, may be substituted and used on the talking battery holder of test set EE-65.

b. Hand set.—(1) Hand set TS-9-(), used with test sets EE-65-A through -E, is connected to the three binding posts located at the lower left-hand side of the testing panel. The upper of these terminals marked R is to be connected to the white wire of the hand set, the center terminal marked C to the red wire, and the lower terminal marked T to the black wire. If a hand set or a head and chest set with a plug PL-58 is used, the connection should be made by inserting the plug into jack JK-37 which is located next to the hand set terminals.

(2) The test set EE-65 has a separate transmitter and receiver furnished as component parts of the set. (See par. 4*a*.)

8. Preparation for use.—Test set EE-65-(*) can be used in either a vertical or a horizontal position.

a. Before using, remove the test lead clips from the fiber pocket in the cover and connect the clip marked G to a ground connection (water pipe, ground spike, etc.). The test and ground leads of test set EE-65 remain attached to binding posts L-1, L-2, and GND.

b. If the voltmeter fails to read "zero" with all keys normal, adjust the screw on the face of the voltmeter.

c. Inspection of the set, to determine that it is in operating condition, should be made as follows:

(1) Inspect all cords and terminals and see that the cords are securely held by their respective binding posts.

(2) Operate key No. 3 to V. M. B., short-circuit test leads from posts L-1 and L-2, and read the battery voltage. The voltage should be approximately 45 volts when the battery is new.

(3) Operate key No. 1 to LISTEN and short-circuit the test leads from posts L-1 and L-2. Place the receiver to the ear, press the thumb switch in the hand set (or separate transmitter of test set EE-65), and blow lightly into the transmitter. If sound is clearly reproduced, the transmitter batteries are in satisfactory condition.

9. To ring a local battery substation or exchange.—Connect line wires to cords CD-478 from posts L-1 and L-2. Hold key number 1 at RING and at the same time turn the generator crank. Party line ringing signals can be made by moving the key from normal to RING the required number of times. To signal or ring on a ground return circuit, L-1 clip should be clipped to the desired line wire and the cord CD-478 from post L-2 clipped to ground. Conditions will then be similar to ringing on a metallic circuit.

10. To signal a common battery exchange.—*a. Test set EE-65.*—Move key No. 1 to LISTEN position. This places the re-

ceiver and induction coil in series across the line and provides the necessary shunt to operate the central office subset.

b. Test sets EE-65-A and -B.—The 0.5 μ f capacitor in series with the telephone circuit of this test set prevents its use with a common battery switchboard without the use of auxiliary equipment. To signal and talk to a common battery exchange, a coil 12-A or 12-S or suitable substitute is needed. To signal the exchange, connect the coil across the terminals L-1 and L-2. This will provide the necessary shunt to operate the central office signal and present a high impedance to the voice currents. The coil must be disconnected when it is desired to release the line.

c. Test sets EE-65-C, -D, and -E.—Operate key No. 1 to LISTEN. This places the holding coil across the line and provides the necessary shunt to operate the central office signal.

11. To talk to a local battery substation or exchange or to a common battery exchange.—Operate key No. 1 to LISTEN and operate the thumb switch in the hand set TS-9-(), chest set TD-1, or in the separate transmitter of test set EE-65. This supplies the 3-volt battery to the transmitter. In order to conserve the battery, press the switch only while actually talking.

12. To talk to a common battery substation.—Although test set EE-65-(*) is not wired to supply talking battery to a common battery substation, it is possible to do so by making the following connections: with key No. 1 at LISTEN, connect an external battery to L-1 and L-2 terminals in series with a retardation coil (165 ohms). Also connect L-1 and L-2 to the desired line by means of the test clip. This method should be used only in an emergency and only for the length of time necessary as the drain on the external battery is excessive.

13. Test for continuity of a metallic circuit.—Operate key No. 3 to V. M. B. The voltmeter is then connected in series with the testing battery, the combination being connected directly across the test leads from posts L-1 and L-2. The voltmeter reading, as compared with the reading on short circuit, will be a measure of the resistance of the external circuit. The greater the reading of the voltmeter when connected to the external circuit, the smaller will be the value of the resistance being measured. To determine the exact value of the resistance of the line circuit see paragraph 22. For test sets EE-65 and EE-65-A and -B, see the chart in paragraph 35. For test sets EE-65-C, -D, and -E, see the charts in figure 23 which appear also in the covers of these test sets. There will be no permanent deflection of the voltmeter needle if the line circuit is open or if the nature of the distant terminal equipment does not provide a

metallic connection across the circuit. See paragraph 16 for the effect of a capacitor across the circuit; and paragraph 17 for determining, by means of tests for capacity, how to locate a break in a line circuit.

14. Test for continuity of a ground return circuit.—Operate key No. 3 to V. M. G. Connect terminal marked GND to a water pipe, or, if using the set in the field, drive the ground rod into moist earth. Connect the line to the L-1 binding post. If the line is closed, the voltmeter will give a reading as explained in paragraphs 13 and 22.

15. Test for a ground on a metallic circuit.—Operate key No. 3 to V. M. G. Connect L-1 and L-2 to the desired circuit. Connect the GND post to ground. If the voltmeter shows a reading the wire connected to L-1 is grounded. Next operate key No. 2 to L. R. If the voltmeter shows a reading, the L-2 wire, which has been substituted for the L-1 wire by the operation of key No. 2, is grounded. A case may develop where both sides of the line are grounded, or where the line is short-circuited and one side grounded. In this case the voltmeter will show a reading when key No. 3 is thrown to V. M. B. It will also show a reading when key No. 3 is thrown to V. M. G. whether or not key No. 2 is operated to L. R. A partial check on the trouble may be had by carefully observing the difference, if any, between the voltmeter readings with key No. 3 at V. M. G., before or after key No. 2 has been moved to L. R. The wire giving the greater reading, in most cases, will be the grounded wire.

16. Test for capacity.—Operate key No. 3 to V. M. B. Throw key No. 2 to L. R. and back to normal, observing the momentary deflection of the voltmeter needle. This test is applicable to a line circuit connected to a substation telephone, such as the telephone EE-8-A adjusted for common battery, with a capacitor in its bell circuit. The test set can be calibrated to indicate roughly the number of such telephones on a line circuit by reading the deflection on line circuits having one bell and one capacitor, two bells and two capacitors, etc. The capacitor at the substation is first charged and then discharged by the opening and closing of the circuit under control of key No. 2. For further details see paragraph 23.

17. Test for distance to an open.—*a.* In case of a break in one wire of a circuit, connect one line wire to post L-1 and connect GND to ground. Operate key No. 3 to V. M. G. Operate key No. 4 several times between V. M. and normal. The reading measures the effect of capacity between that wire and the earth. (See also par. 27.) Connect the other line wire to post L-1, if a metallic line, and measure in the same manner, the effect of capacity in that line wire. The distance from the testing point to the open in the circuit can be found approximately by a comparison of these two readings.

b. If, in the previous test, both readings are the same, it is probable that both line wires are open at the same point. In this case measure, in a similar manner, the effect of capacity between ground and a line wire of another similar line circuit, of equal length, known to be in good operating condition. The distance to the open in the open circuit can be found by a comparison of the readings for the good wire and the open wire, as in *a* above.

c. In these tests, it is assumed that any equipment at the distant end has been disconnected, or that the equipment is known so that allowance can be made for any capacitors in that equipment. It is also assumed that the line is not grounded.

18. Test for crosses with lines carrying current.—Connect GND to ground and L-1 to one line wire. Operate key No. 3 to V. M. G. Operate key No. 4 to V. M. If the foreign line has its battery grounded, such as is usual in the case of a common battery telephone line or a telegraph line, a voltmeter deflection will be shown reading directly in volts. The value of this reading will serve to designate the type of circuit that has caused the trouble. If the voltmeter needle tends to move off scale in the direction of zero, immediately operate key No. 5 to V. M. R. to reverse the voltmeter. In making measurements of this nature some knowledge is necessary of the potentials that may be present on the line. The reason for this is that possible injury or destruction of the voltmeter may occur by connecting it to lines carrying high voltage. It should be remembered that many telegraph circuits have an applied voltage in excess of 100 volts. Consequently, if the needle goes off the scale, the tester should immediately restore key No. 3 to normal position to open the voltmeter circuit.

19. Test for crosses with other lines.—In addition to tests outlined in paragraph 18, it may be thought that two lines, A and B, are crossed. In this case L-1 is connected to one wire of line A, and L-2 to each side of line B in turn. Key No. 3 is operated to V. M. B. Change L-1 to the other wire of line A and repeat the test. A reading of the voltmeter in either or both cases shows a cross with one or both wires of line A. A similar test for crosses with grounded lines may be made, either by grounding L-2 or changing key No. 3 to V. M. G. and using L-1 and the ground rod as described in paragraph 20.

20. Measuring an external battery voltage.—Connect test clips from posts L-1 and L-2 to the battery the voltage of which is to be measured. Operate key No. 4 to V. M. and key No. 3 to V. M. B. The voltmeter is now connected directly across the line terminals L-1 and L-2, and will indicate potentials within the capacity of the

instrument. If the needle tends to move off scale at the zero end, operate key No. 2 to L. R. *Care should be observed not to expose the voltmeter to potentials beyond the range of the instrument (50 volts).*

21. Ringing tests for opens, shorts, or grounds.—This is a rapid means of testing a number of line circuits and is especially useful when a new system is being installed. To test for an open or a short, connect L-1 and L-2 to the desired line circuit. Operate key No. 1 to RING and rapidly turn the generator handle at the same time. If the line circuit is open, the buzzer will not sound and the generator will turn easily. If the line circuit is closed, or when central office or substation equipment is connected to the line circuit, the generator turns readily and the buzzer sounds. A high resistance short gives about the same test as a substation. If the generator turns hard and the buzzer also sounds, a short exists on the line circuit under test. The degree of drag experienced in turning the generator and the loudness of the buzzer may be taken as an estimate of the value of the resistance of the short. To test for grounds, change L-2 to a ground connection and proceed as indicated above. In making these tests it is best to operate the generator at a constant speed so that the buzzer, having once been adjusted, may function correctly. Too high a speed increases the frequency of the alternating current produced by the generator. It may be sufficiently high to prevent the operation of the buzzer and may thus give an inaccurate test.

22. To determine value of an unknown resistance.—Test set EE-65-(*) affords two methods of determining the value of an unknown resistance. Whether the first or second method should be used depends on the magnitude of the unknown resistance.

a. To determine value of insulation resistance.—(1) This method of testing is based on the principle that in any series circuit through which a fixed value of direct current is flowing, the potential across any given resistance is proportional to the value of the resistance. If the resistance of the voltmeter is known, the value of any other resistance may be calculated.

Let R = the resistance of the voltmeter (3,000 ohms for test set EE-65, and 50,000 ohms for test sets EE-65-A, -B, -C, -D, and -E)

Let BAT = the reading of the voltmeter when the test leads are short-circuited

Let V = the reading of the voltmeter when the test leads are connected to the unknown resistance, that is, the voltage across the voltmeter

Let X = the value of the unknown resistance

Then $BAT - V =$ voltage across the resistance

$$\text{Then } V : (BAT - V) :: R : X$$

$$\text{or } VX = (BAT - V)R$$

$$X = \frac{(BAT - V)R}{V}$$

(2) As the voltage of the battery falls off with age, the BAT reading (which is obtained with the test leads short-circuited) has to be checked frequently. In order to facilitate the above calculations on different conditions of the testing battery, a chart has been computed which is contained in the cover of the test sets EE-65-C, -D, and -E, and also in figure 23.

Example: The voltmeter reads 42 volts when the test leads are shorted (key No. 3 at V. M. B.). The voltmeter reading with the test leads connected to a metallic circuit will be 8 volts (key No. 3 at V. M. B.). The chart for insulation resistance indicates then a value of 0.213 megohms for the insulation resistance. This value could also be found from the formula as follows, assuming the use of any test set EE-65-A through -E, all of which have voltmeters of 50,000 ohms resistance. If a test set EE-65 is used, the voltmeter resistance of 3,000 ohms should be substituted in the formula—

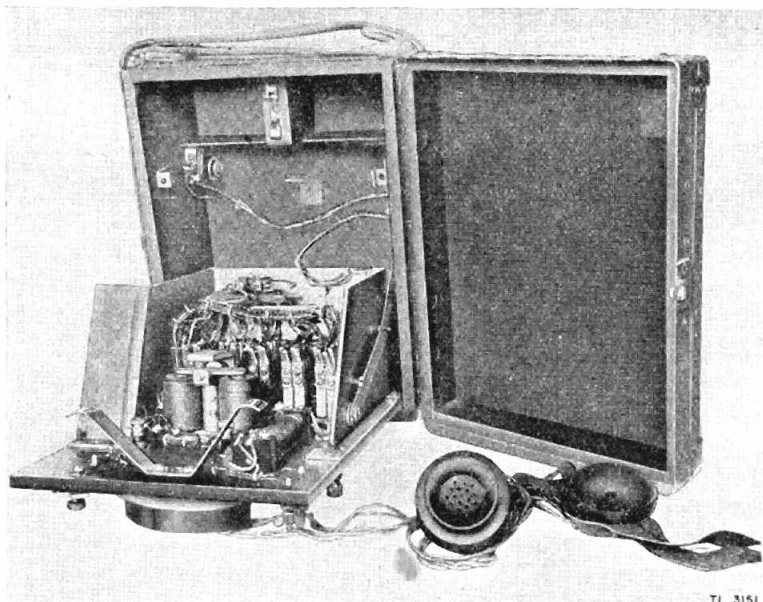
$$\frac{(42 - 8) (50,000)}{3,000} = 0.213 \text{ megohms}$$

(3) With a new battery, fairly accurate readings can be obtained for resistance values from 10,000 ohms to about 2 megohms.

b. To determine value of loop resistance.—Only test sets EE-65-C, -D, and -E are suitable for this test. In order to measure accurately the resistance of wire loops ranging from approximately 22 to 10,000 ohms, a circuit similar to the one used for insulation resistance measurements is used. This circuit consists of the testing battery in series with a resistance of 1,000 ohms and the unknown resistance of the loop, including the station or exchange at the remote end. By operating key No. 3 to V. M. B. and key No. 6 to V., the voltage (V.) across the 1,000 ohm resistor is read on the voltmeter. With key No. 6 at V. X. the voltage (V. X.) across the unknown resistance is measured. In a similar manner, the value of the loop resistance is determined by the formula—

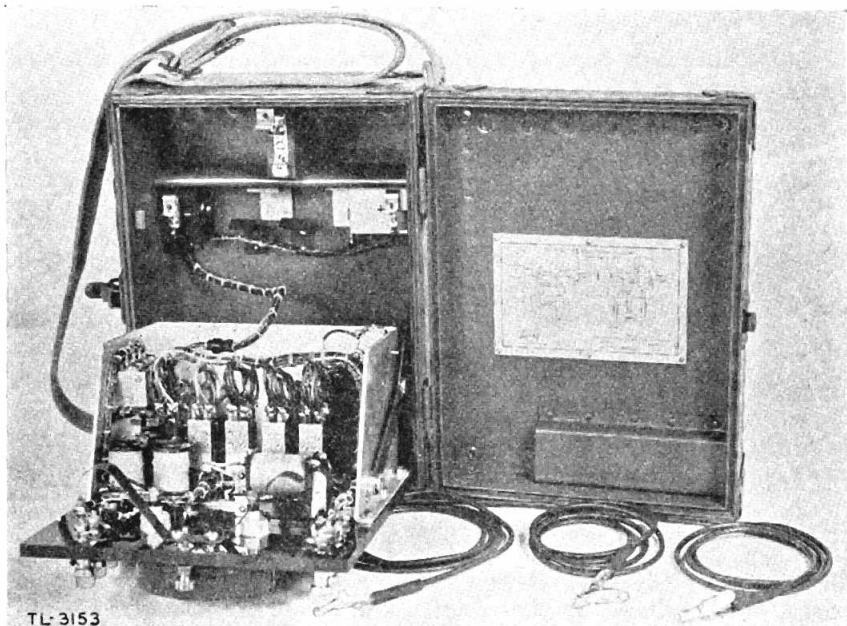
$$\text{Loop resistance} = \frac{V \cdot X}{V} \times 1,000 \text{ ohms}$$

In order to facilitate this calculation, a second chart has been computed which is reproduced on the circuit plate inside the cover of the test sets EE-65-C, -D, and -E, and in figure 23. Because of the excessive current drain from the testing battery, key No. 6 should be operated



TL 3151

FIGURE 4.—Interior of test set EE-65.



TL-3153

FIGURE 5.—Interior of test sets EE-65-A and -B.

only as briefly as possible. This key is nonlocking in both operated positions and is provided with a red handle.

23. To determine capacity between two wires (ballistic capacity test).—This method can be used for roughly determining the location of an open or break in the line and is referred to in paragraph 16. To calibrate the set more accurately, proceed as follows:

a. Check the voltage of the test battery by operating key No. 3 to V. M. B. with test leads L-1 and L-2 short-circuited.

b. Connect a $0.1=\mu\text{f}$ capacitor to the testing leads L-1 and L-2. Operate key No. 3 to V. M. B. and key No. 2 to L. R. and back to normal. Read and record the momentary deflection of the needle.

c. If a battery voltage of 40 is assumed and the momentary deflection produced by a $0.1=\mu\text{f}$ capacitor is 3 volts, a table can be made as shown below:

$$0.1 \mu\text{f} = 3 \text{ volts}$$

$$0.2 \mu\text{f} = 6 \text{ volts}$$

$$0.3 \mu\text{f} = 9 \text{ volts}$$

$$0.4 \mu\text{f} = 12 \text{ volts}$$

d. An application of the test described above can best be understood by a practical problem. An unknown capacitor was tested, the voltmeters momentary deflection being 7.5 volts. What is its capacity?

Let C = the value of the standard ($0.1=\mu\text{f}$)

Let C' = the unknown value.

Let D = voltmeter reading on standard.

Let D' = voltmeter reading on unknown.

Then $C : C' :: D : D'$

Substituting

$$0.1 : C' = 3 : 7.5$$

$$C' = \frac{.1 \times 7.5}{3} = .25 \mu\text{f}$$

e. This same principle can be applied to the location of an open in a metallic line. If the distance, in feet or miles, between the two stations is known, the approximate location of the open may be determined. The equipment at the terminal station must be disconnected. Test the circuit for a ground or a short and if it is clear proceed as follows:

Connect test lead from post L-1 to one line wire.

Ground the terminal marked GND. and operate key No. 3 to V. M. G.

Operate key No. 4 to V. M. and back to normal, reading the momentary deflection of the voltmeter at the same time. Next change the other line wire to L-1. Read the momentary de-

flection of the voltmeter. Then the distance to the fault can be computed.

Let D = voltmeter reading on first line wire.

Let D' = voltmeter reading on second line wire.

Let L = distance between stations.

Let X = distance to fault.

Then $D : D' :: L : X$

$$X = \frac{D'L}{D}$$

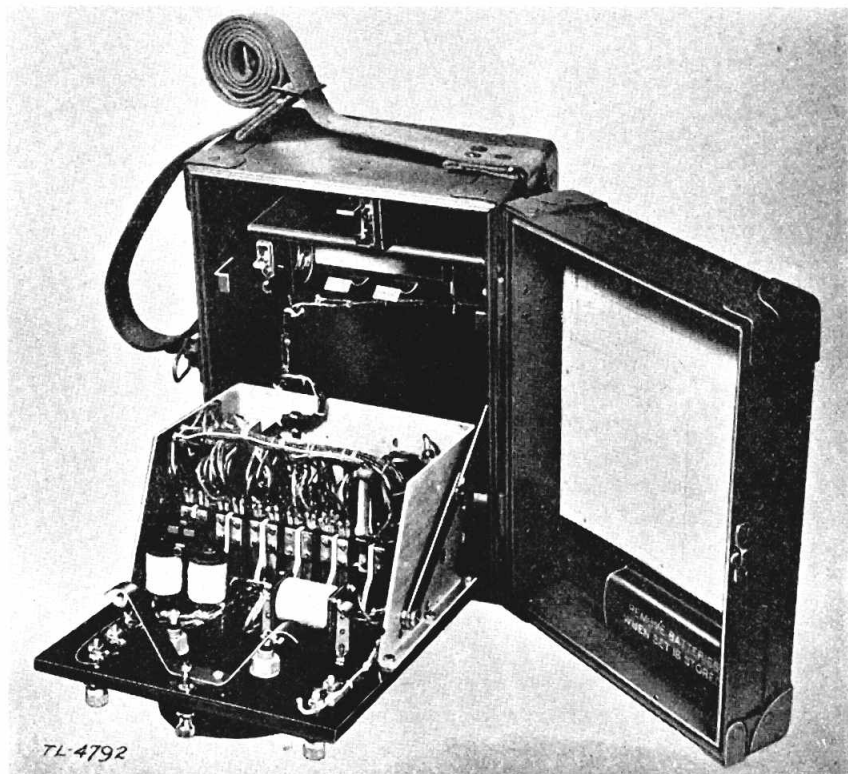


FIGURE 6.—Interior of test sets EE-65-C, -D, and -E.

This test gives an indication of the capacity between each wire and the earth but is only an approximate location test.

24. Procedure in testing for an unknown fault.—In testing for an unknown fault the original report of the trouble will, in most cases, classify it under one of the headings given in section IV. The most difficult case is the report “line out of order.” Assume that such a report has been made on a given telephone line, the procedure would be as follows:

- a.* Make a voltmeter test to see if the line circuit is open or closed.
- b.* Test for grounds.
- c.* Open the line at the central office protector frame and test toward the switchboard to see that the drop or signal functions properly.

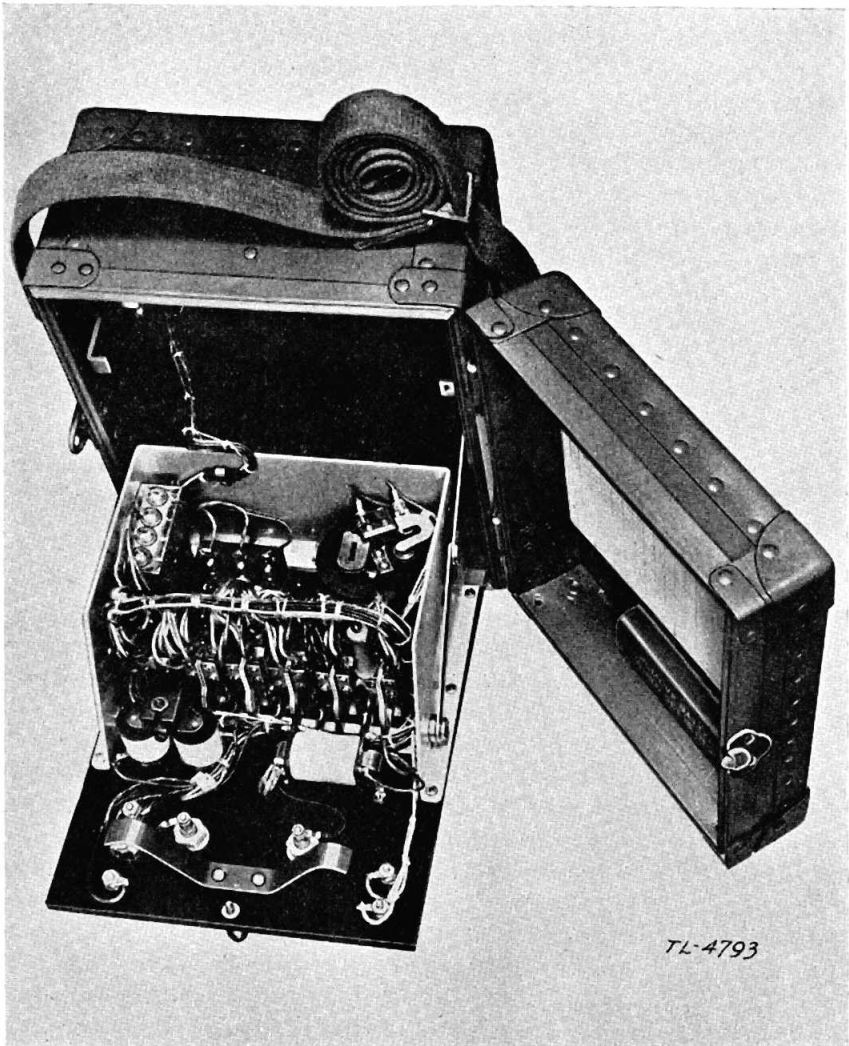


FIGURE 7.—Interior of test sets EE-65-C, -D, and -E—top view.

- d.* Test toward substations and try to place a call. After ringing, set the keys for test for continuity of a metallic circuit (par. 13). Observe the voltmeter and if a deflection is shown after ringing, immediately change the keys to the position for “talk to local battery substa-

tion." If no answer is obtained when this test is made, wait a few moments, ring the substation again, and observe the voltmeter. If the needle is again deflected, the trouble is at the station instrument, the most likely place being in the transmitter circuit. If trouble shows on other tests, it is evident that line trouble exists. For efficient testing, a very complete record of the cables, lines, and instrument equipment is necessary; and in addition, a general knowledge of outside conditions such as adjacent foreign wire circuits, pole line lay-outs, etc.

25. Precautions during operation.—As the voltmeter is designed for a maximum voltage of 50 volts d-c, the test set should not be used for measurements on lines carrying more than this voltage. Because of the excessive current drain from the testing battery, key No. 6 should be operated only as briefly as possible. For this purpose this key is nonlocking in both operated positions and is provided with a red handle. Remove batteries when set is to be stored.

SECTION III

FUNCTIONING OF PARTS AND CIRCUITS

	Paragraph
Functioning of parts-----	26
Theory-----	27
Wire-----	28

26. Functioning of parts.—The following is a brief explanation of the functioning of the main parts contained in test set EE-65-(*).

a. Generator GN-38.—When cranked at a speed of approximately 200 rpm, the generator produces ringing current of approximately 16 cycles per second at a no-load voltage of 90 volts. The spring assembly which is part of the generator is constructed in such a way that, in normal condition, it connects the buzzer across the line terminals; when the generator is cranked, however, the output of the generator is connected across these terminals in series with the buzzer.

b. A-c buzzer.—This is a polarized buzzer, the windings of which have a total d-c resistance of approximately 80 ohms. It will operate with a minimum of 5 milliamperes ringing current.

c. Capacitor CA-355 (test sets EE-65-A through -E).—This capacitor consists of three sections of 0.2-, 0.5-, and 0.3- μ f, respectively, of which the two last-mentioned are used in the circuit. Its main purpose is to keep direct current from entering the telephone receiver.

d. Coil C-105 (induction coil).—(1) *Test sets EE-65-A through -E.*—The purpose of this coil is to match the impedance of the carbon transmitter to that of the line and at the same time provide an anti-sidetone circuit. The principle of this circuit is that voice currents set up in the transmitter are prevented from reaching the receiver of

the same hand set by means of a balanced transformer circuit. Part of the balancing circuit consists of the resistance wire contained in winding 3-4 of the coil.

(2) *Test set EE-65.*—A similar induction coil of two elements is used as an impedance matching unit, and to induce talking currents in the line circuit. The antisidetone circuit is not used in this set.

e. Coil C-158 (holding coil, test sets EE-65-C, -D, and -E only).—The purpose of this coil is to provide a d-c path through the test set if used in connection with common battery switchboards. The d-c resistance of the coils is 100 ohms, and its impedance is high enough to prevent currents of voice frequency from entering the coil.

f. Voltmeter 1F-93.—This voltmeter has a full scale deflection of 50 volts and an accuracy of ± 1 percent. For test set EE-65-A through -E, the voltmeter resistance is 50,000 ohms. The voltmeter used on the EE-65 has a resistance of 3,000 ohms, and all computations involving voltmeter resistance should be made only after the proper value of meter resistance is used. As the voltmeter is of the moving coil type, it will not indicate a-c voltages.

27. Theory.—In figures 8, 9, and 10, the general wiring scheme of the sets is shown. From the wiring diagram and the corresponding key designations, the actual physical positions of the various items of equipment in the set and their electrical positions in the various testing circuits can readily be seen. Note that in the circuit diagrams, movement to the right of the key cams corresponds to an actual upward movement of the key handles. The various circuits which can be set up will be discussed below in detail. In the functional diagrams later referred to, the active part of the circuits is shown in bold lines, thus indicating the path of the current.

a. Ringing circuit.—Key No. 1 at RING establishes the ringing circuit (see figs. 11 and 12). To trace this circuit, start at L-1, go through the upper left-hand contact of key number 1, through the automatic switch on the generator shaft, generator, low-resistance buzzer, and through the lower left-hand contact of key No. 1, to the post L-2. This forms a series circuit, containing the magneto generator and buzzer, connected to the L-1 and L-2 terminals.

b. Talking and listening circuits.—Key No. 1 at LISTEN sets up a talking and listening circuit (see figs. 13 and 14). This circuit may be traced in the same manner as indicated in *a* above. Note that this time the contact of the right-hand section of the ring-listen key is spread outward, closing the battery circuit of the transmitter. The current variations set up by the transmitter produce corresponding voltage variations in the secondary circuit through the action of the induction coil. The particular antisidetone circuit used in test sets

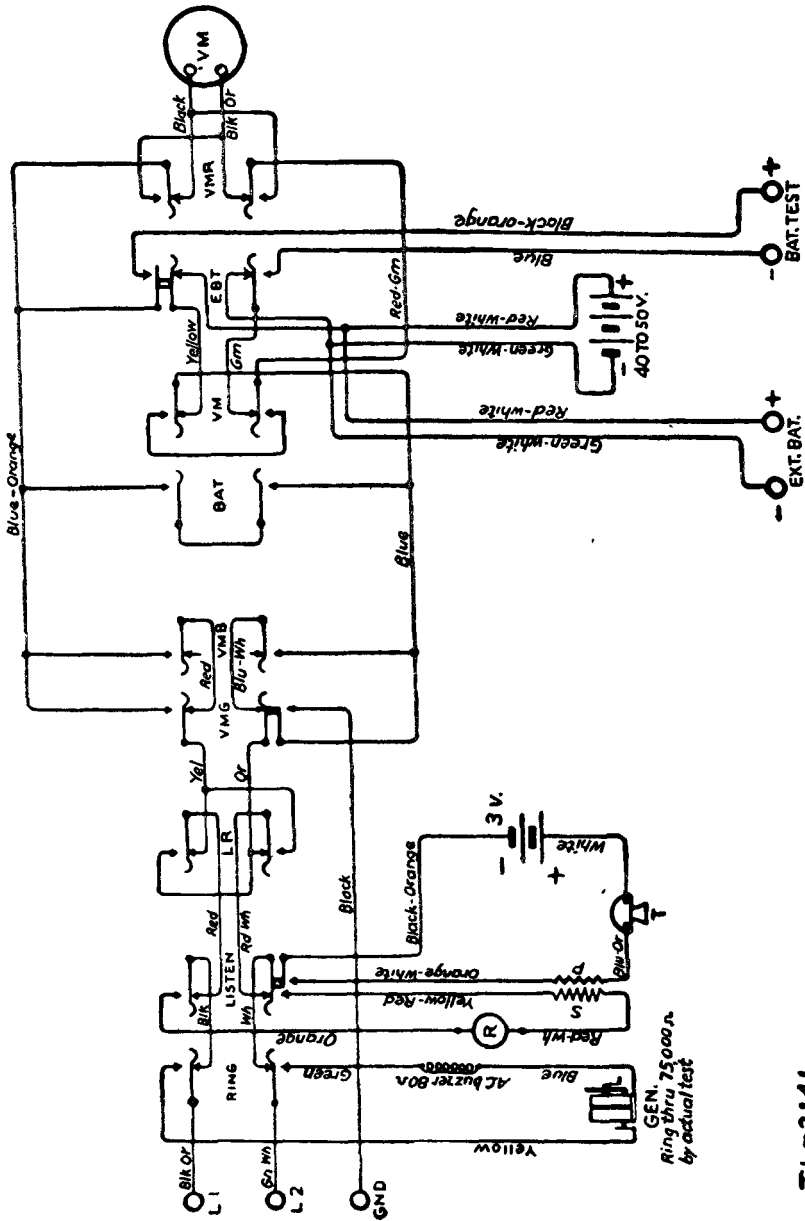


FIGURE 8.—Circuit diagram, test set EE-65.

TL-3141

EE-65-A through -E applies only a small fraction of the talking voltage to the receiver, whereas all of the talking voltage is applied to the receiver in the case of the EE-65.

c. Continuity test and external resistance test circuit.—In order to trace the circuit employed in testing the continuity of an external circuit and in determining the value of unknown resistance as described in paragraph 22, assume that key No. 3 is at V. M. B., thus connecting the battery and the voltmeter in series across the line terminals (see figs. 16 and 17). On test sets EE-65-C, -D, and -E, the V.—V. X. key (No. 6) is actuated to the V. position for measure-

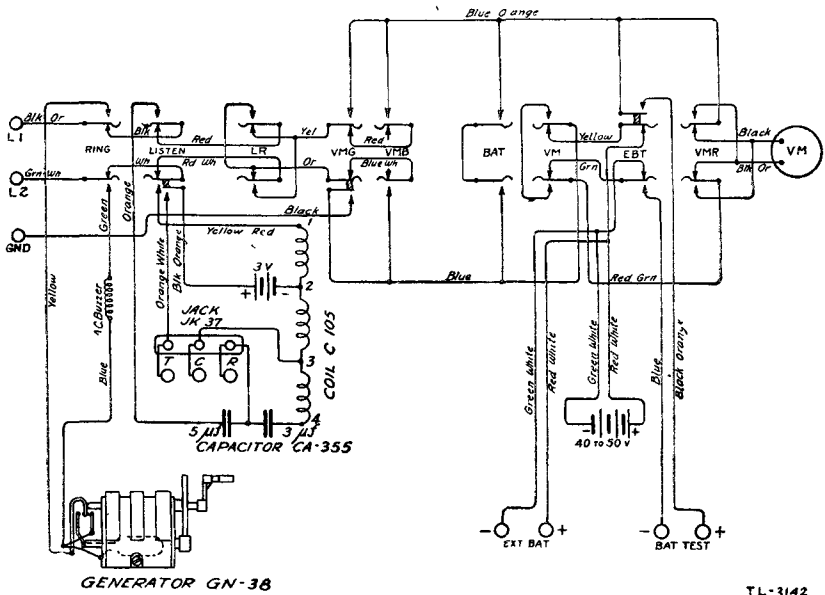


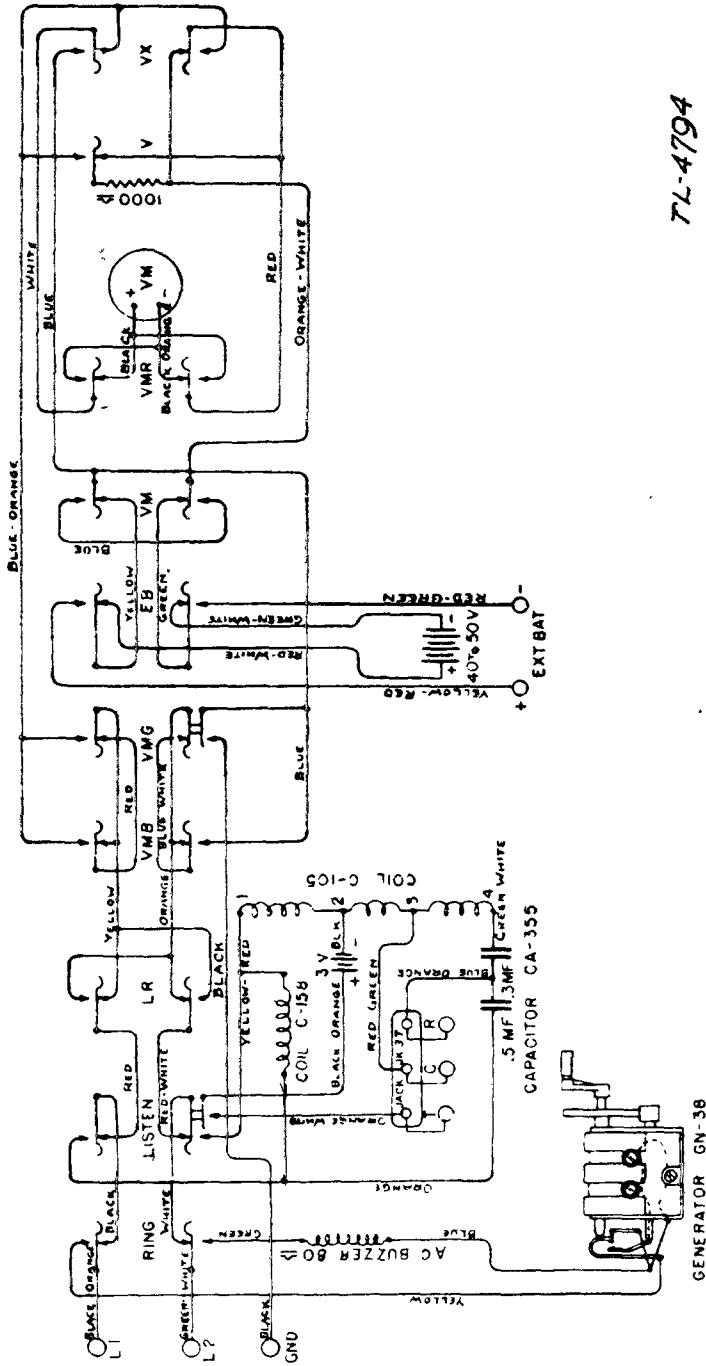
FIGURE 9—Test sets EE-65-A and -B—circuit diagram

TL-3142

ment of loop resistances. The circuit then consists of a battery, a 1,000-ohm resistor, and the external circuit, as shown in figure 18.

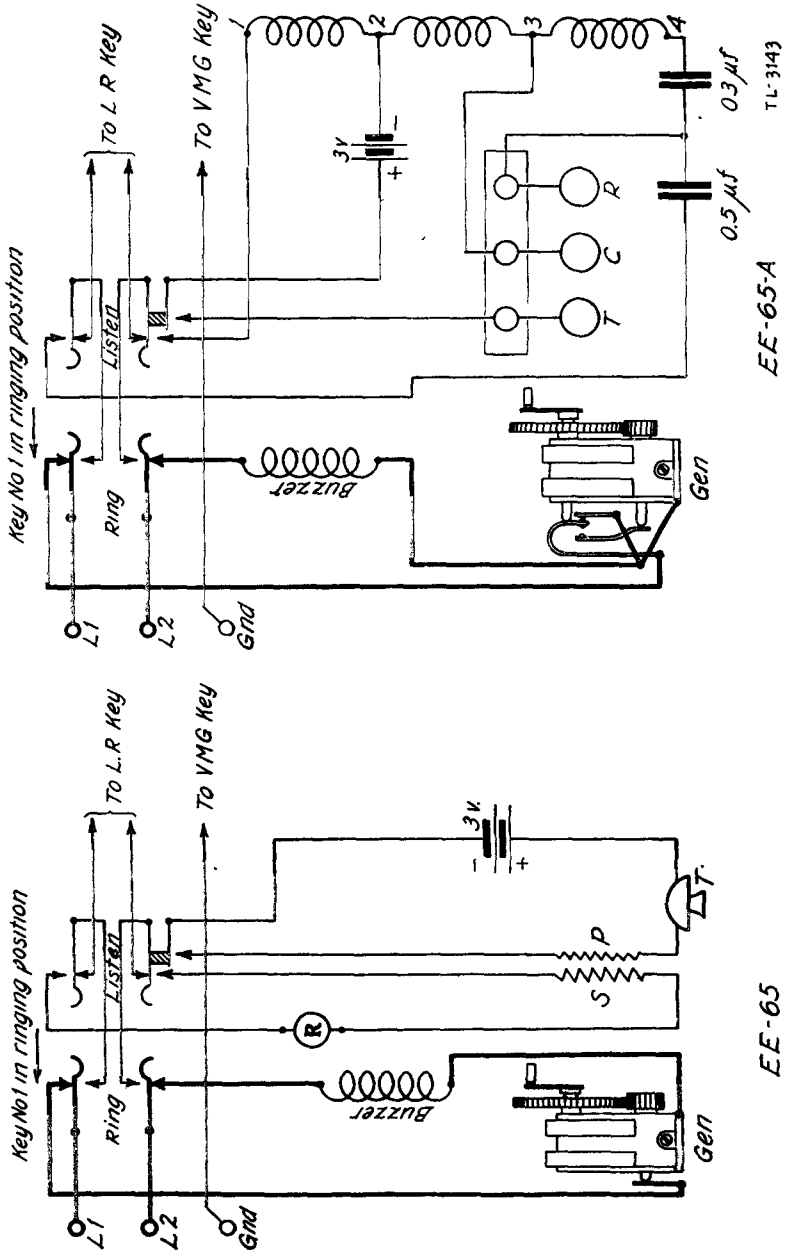
d. Circuit for testing for grounds and for crosses.—In this circuit (see figs. 19 and 20) the testing battery and the voltmeter are connected in series across the L-1 and GND terminals. The key operation is covered in paragraphs 15 and 19.

e. Circuit for testing for crosses between two lines, one of which carries current.—This circuit (see figs. 21 and 22) is similar to the one used in *d* above except that key No. 4 is operated in the V. M. position. This change cuts off the test battery and closes the voltmeter circuit directly across the L-1 and GND terminals. Therefore a foreign potential can be measured by the voltmeter.



TL-4794

FIGURE 10.--Test sets EE-65-C, -D, and -E--circuit diagram.



EE-65-A

EE-65

FIGURE 11 — Ringing circuits, test sets EE-65, EE-65-A, and -B.

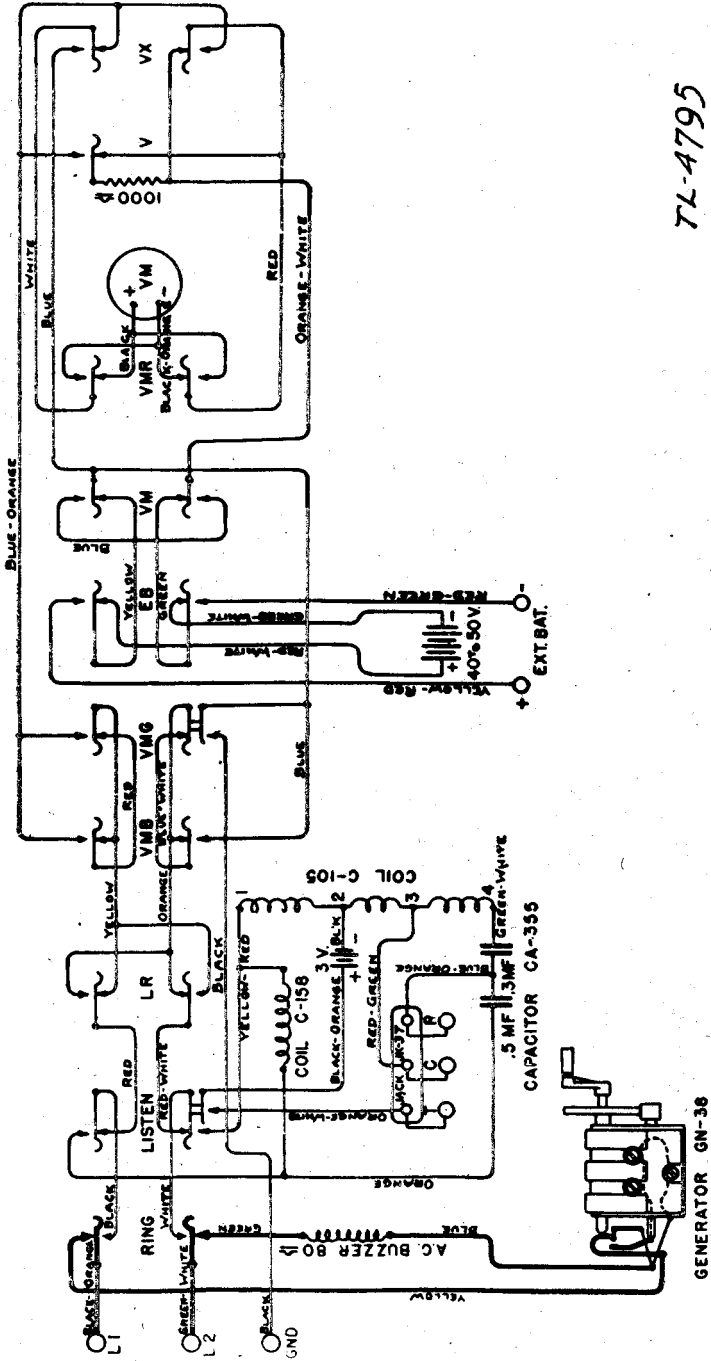


FIGURE 12.—Ringing circuits, test sets EE-65-C -D, and -E.

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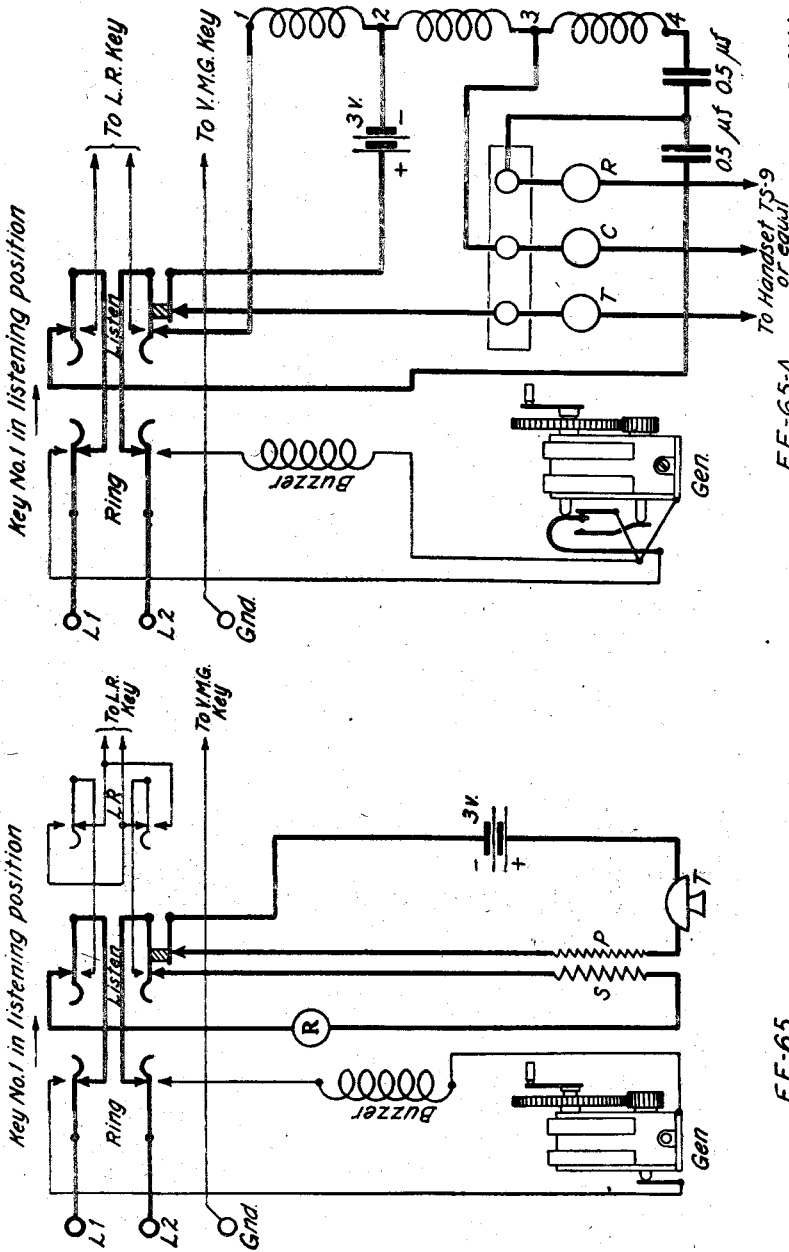


FIGURE 13.—Talking and listening circuits, test sets EE-65, EE-65-A, and -E.

EE-65

EE-65-A

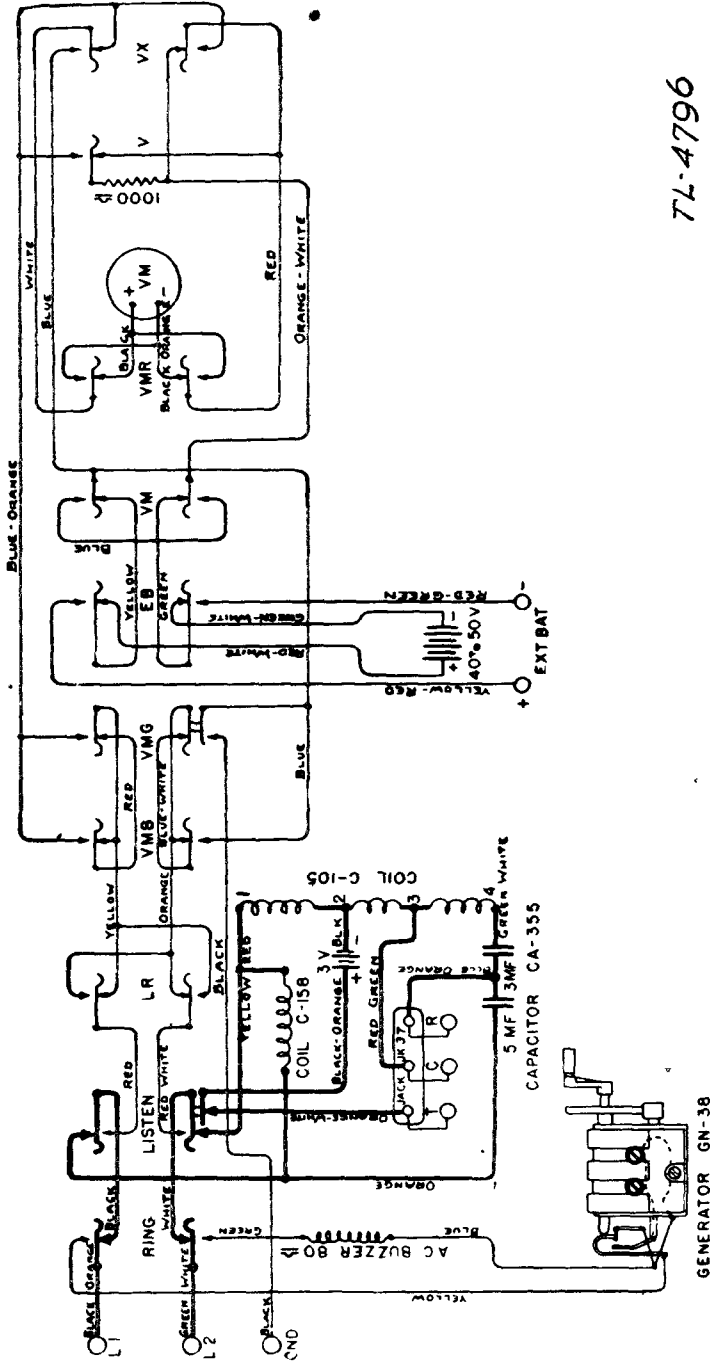


FIGURE 14—Talking and listening circuits, test sets EE-65-C, -D and E.

GENERATOR GN-38

71-4796

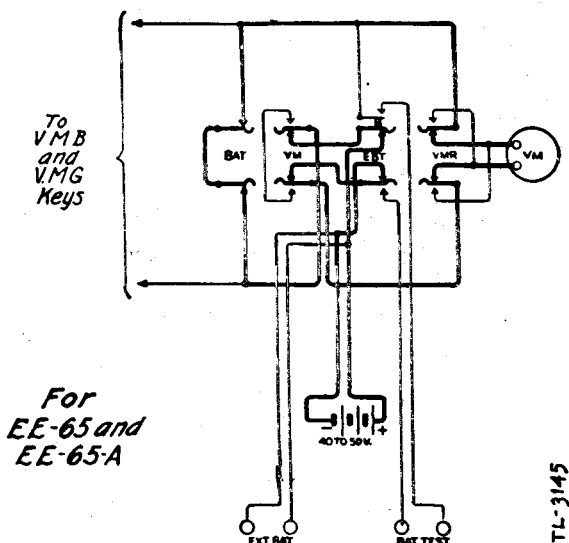


FIGURE 15.—Circuit for measuring voltage of testing battery, test sets EE-65, EE-65-A, and -B.

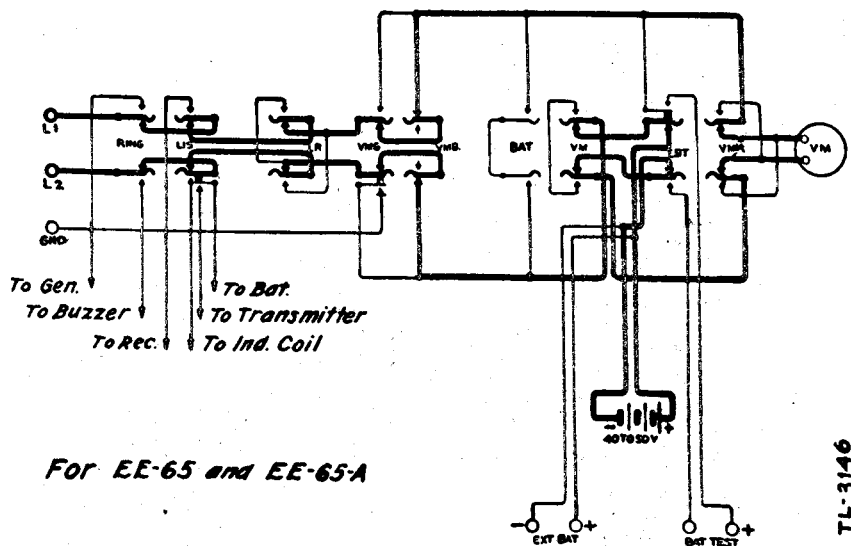
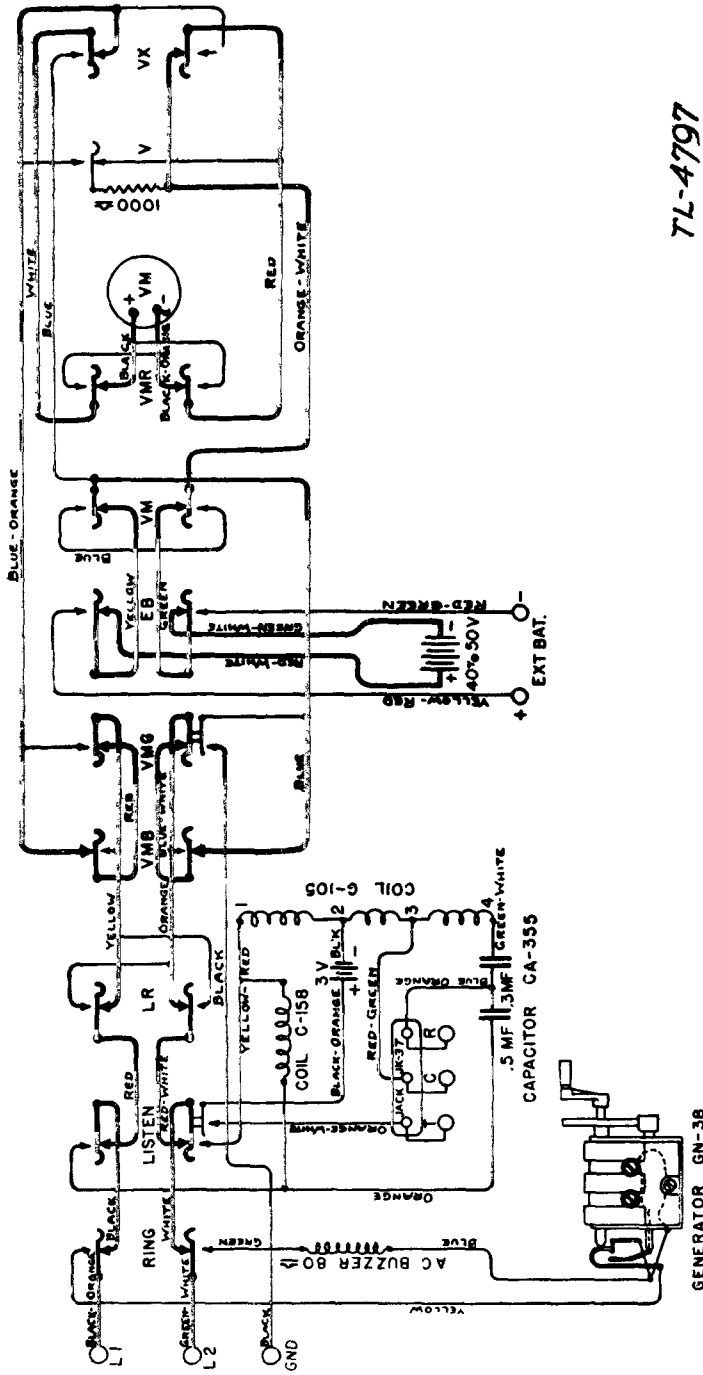


FIGURE 16.—Continuity test and external resistance test circuit, test sets EE-65, EE-65-A, and -B.



TL-4797

Figure 17.—Continuity test and insulation resistance test circuit, test sets EE-65-C, -D, and -E.

GENERATOR GN-38

TL-4798

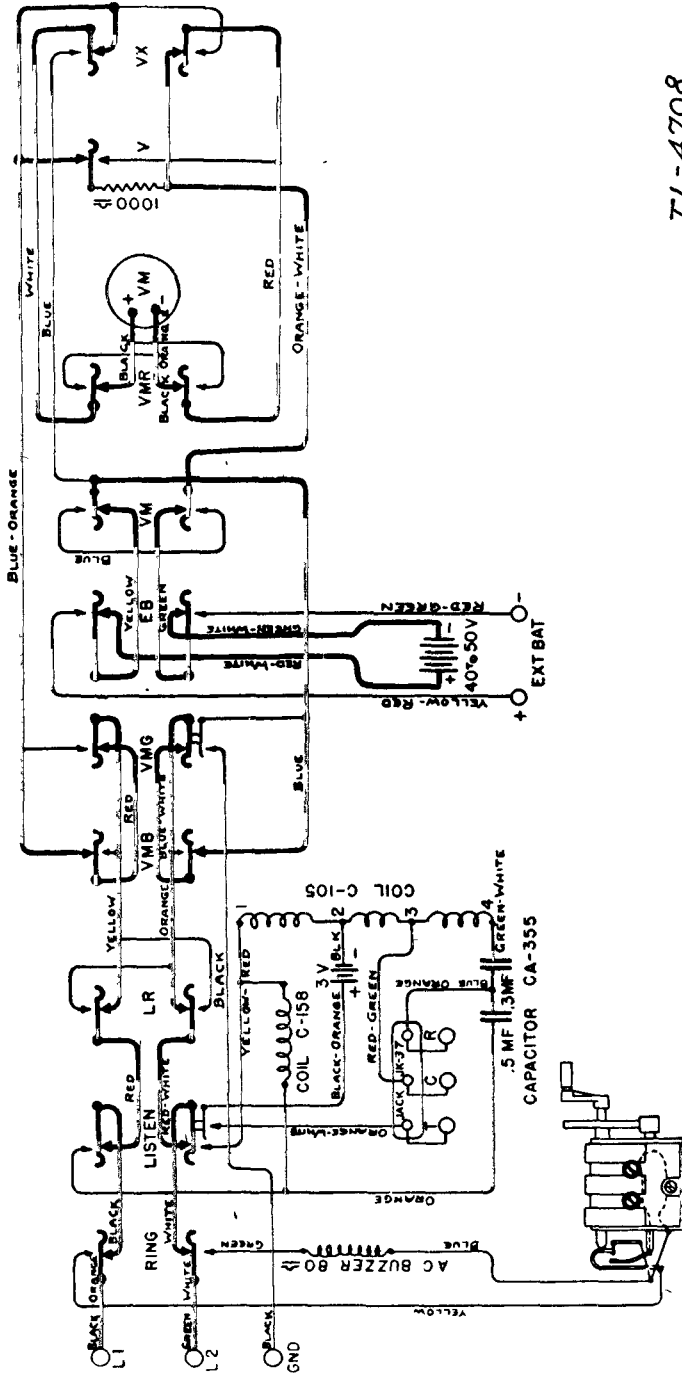


FIGURE 18—Loop resistance test circuit (key No. 6 at V position) test sets EE-65-C, -D, and -E.

28. Wire.—Resistance and weights of wires and cables most commonly used by the Signal Corps for communication purposes are given in paragraph 32. The resistance given there is approximate at a temperature of 68° F. (20° C.) and will be greater for a higher temperature and less for a lower temperature.

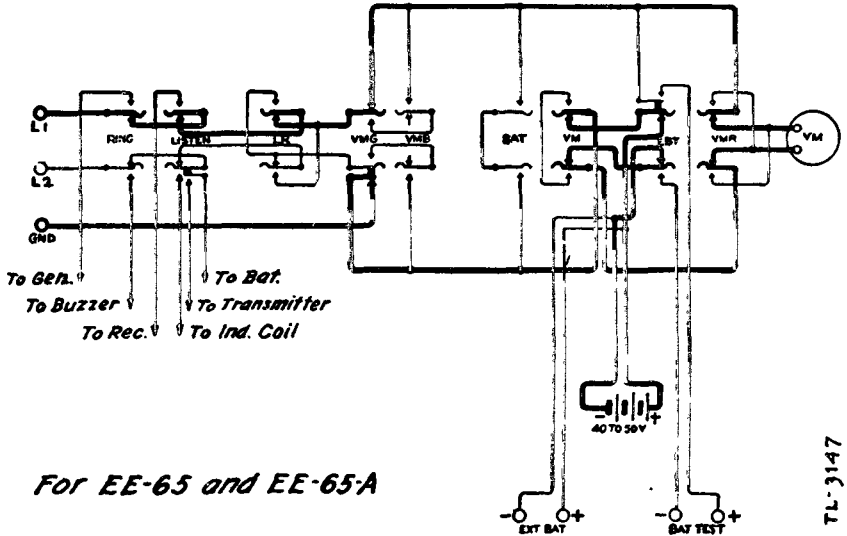


FIGURE 19.—Circuit for testing for grounds, test sets EE-65, EE-65-A, and -B.

SECTION IV

MAINTENANCE

	Paragraph
Adjustments for field upkeep.....	29
Location of components.....	30
Removal and assembly of parts.....	31

29. Adjustments for field upkeep.—Figures 4, 5, 6, and 7 show the set box open for removal of the batteries or servicing. In addition to the tests described in paragraph 8, the following tests should be made in order to locate any trouble inside the test set:

a. Connect a 1,000-ohm bell that is in adjustment (or a serviceable telephone EE-8-A) across the test leads from posts L-1 and L-2. Operate ringing key No. 1 and turn the generator crank, observing the action of the buzzer. If the buzzer and the bell do not respond, release the ringing key, operate key No. 3 to V. M. B. This shows whether the test leads are open or closed. A reading of the voltmeter signifies that the trouble is in the ringing key circuit. Key out of adjustment would be the most likely cause. If the station bell

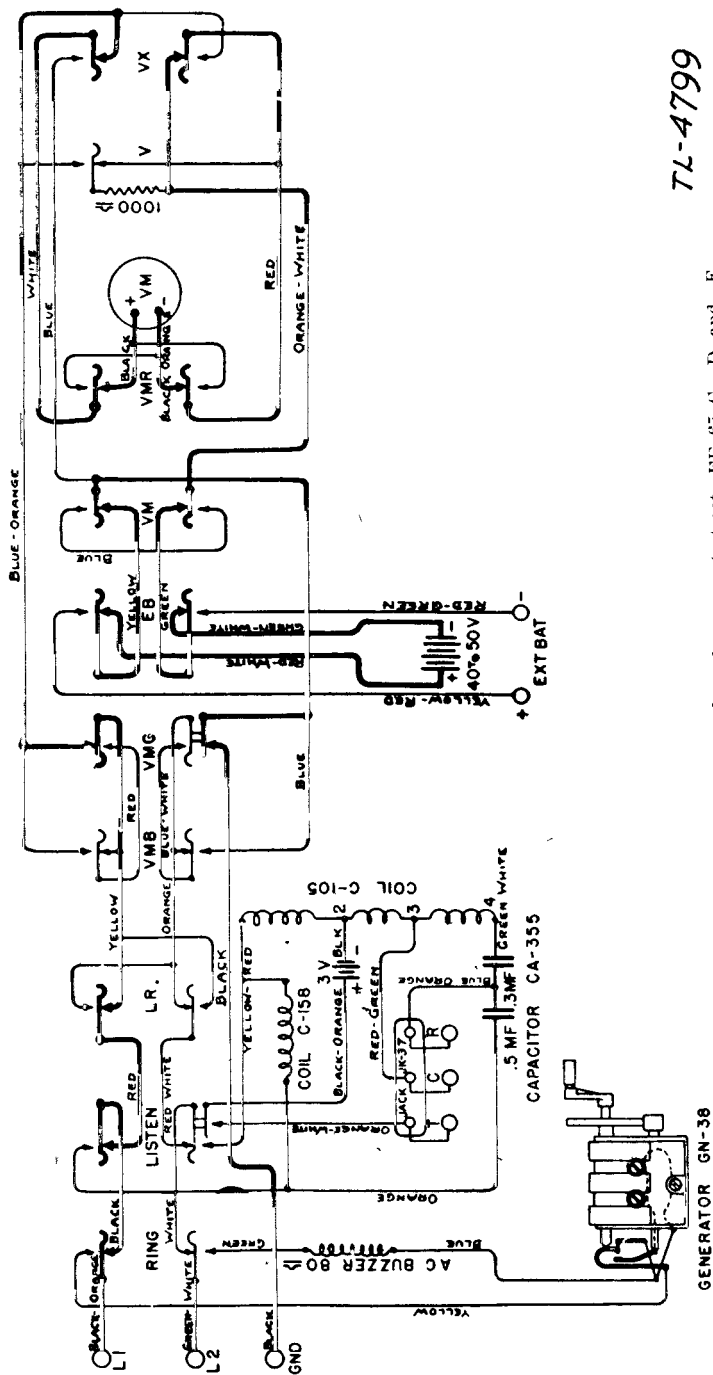


Fig. 20.—Circuit for testing for grounds and crosses, test sets EE-65-C, -D, and -E.

TL-4799

responds and the buzzer does not, adjust the buzzer by means of the two lock nuts on the vertical supporting posts until the buzzer operates satisfactorily.

b. When the test battery voltage falls to 38, new batteries should be installed. If new batteries BA-2 are not available, a temporary external battery can be substituted by connecting 30 dry cells in series to the post marked EX. BAT.

c. Connect three or four dry cells in series to the leads from post L-1 and L-2. Operate key No. 4 to V. M., and if the voltmeter shows a reading, this part of the circuit is functioning properly.

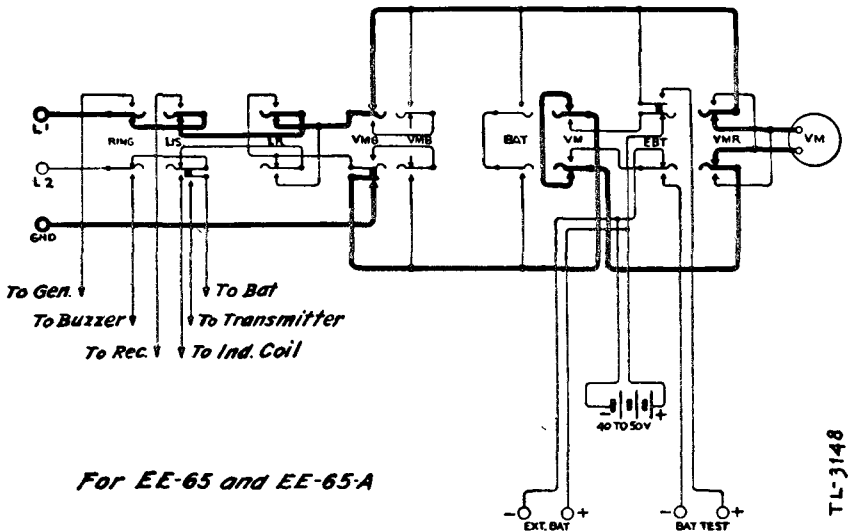
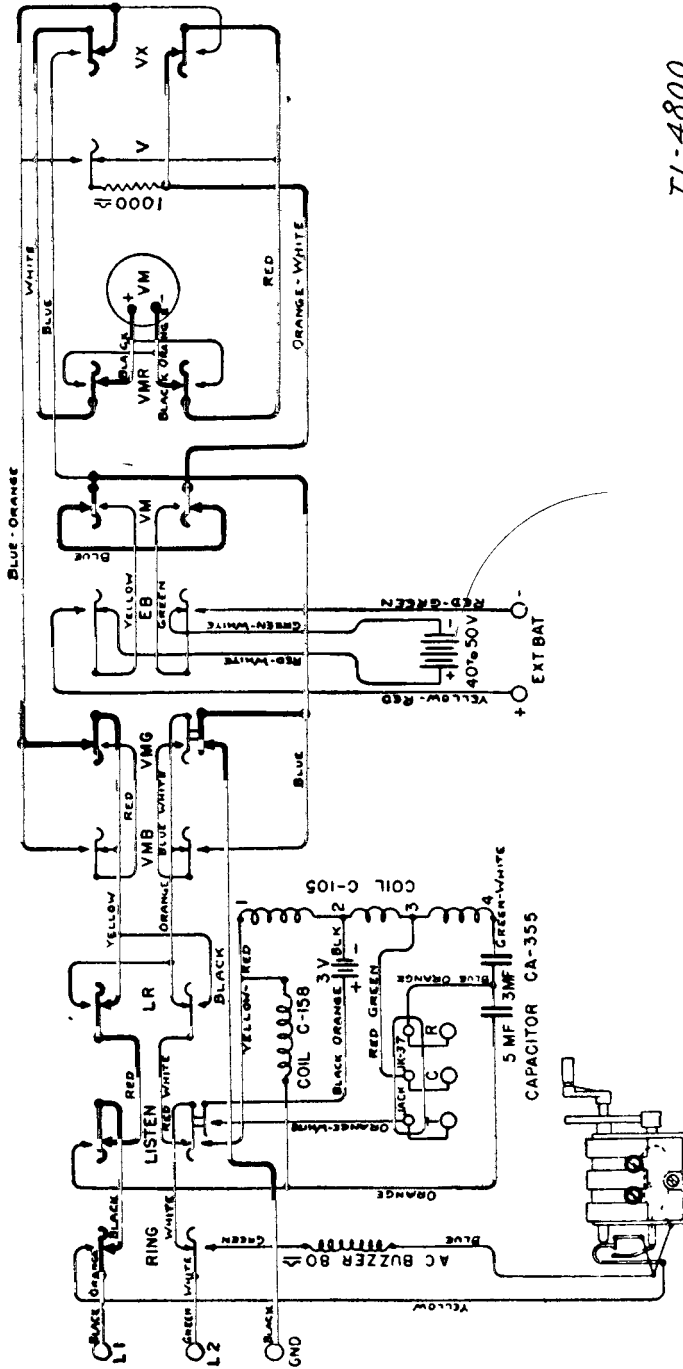


FIGURE 21.—Circuit for testing for crosses between two lines, one of which carries current, test sets EE-65, EE-65-A, and -B.

d. Connect the ground rod to the test lead from post L-1. Operate key No. 3 to V. M. G. If this circuit is working properly the voltmeter reading should show the same deflection as in *c* above.

e. This completes the check tests on the set and only occasional tests of this nature should be necessary. The most probable troubles that will develop in the set are battery and cord troubles. Care should be used to see that no strain is placed on the cord terminals by using the reinforcement provided for this purpose. No part of the test set requires lubrication.

30. Location of components.—The approximate physical location of the individual components is indicated in the wiring diagram. All wiring connections can easily be traced using the color code shown therein.

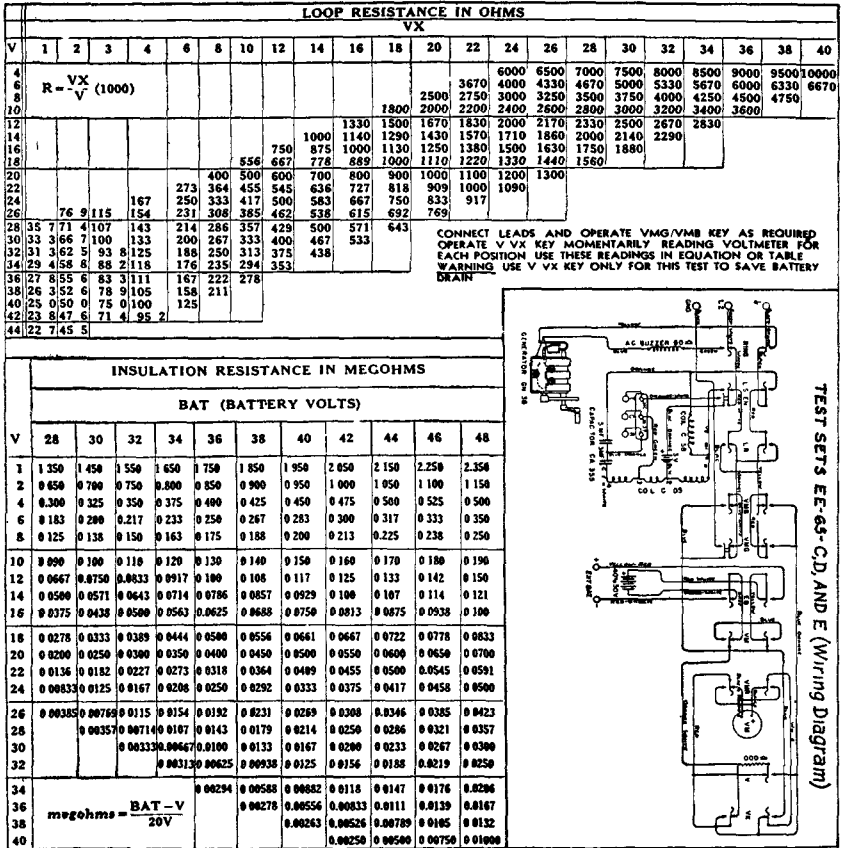


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GENERATOR GM 38
 FIGURE 22—Circuit for testing for crosses between two lines one of which carries current test sets EE-65-C -D and -E

31. Removal and assembly of parts.—If replacements for repair of parts other than those discussed in paragraph 29 are necessary, proceed as follows:

a. To remove voltmeter.—Disconnect the black-orange wires and remove the mounting nuts in the back of test panel. The voltmeter can then be pulled out. Be sure not to lose washers. In an emergency, voltmeter IF-93 can be replaced without difficulty with volt-



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FIGURE 23—Tables for loop and insulation resistance, test sets EE-65-C, -D, and -E

meter IF-92, which is employed in the older test sets EE-65 and EE-65-A and -B.

b. To remove keys.—Remove top and bottom screw on plate of each key visible in front of panel. Keys can then be pulled through the panel for inspection and adjustment of the contact springs. In order to remove keys completely, the harness wires have to be disconnected from the soldering lugs.

c. To remove coils and buzzer.—These parts may be removed by loosening the mounting screws visible from the front of panel. In the case of the buzzer, the clamp for the test leads has to be removed first.

d. To remove generator GN-38.—Disconnect wires and remove crank. Generator can then be removed by taking out the four screws visible from the side of the chassis.

e. To remove capacitor CA-355.—After loosening the screws visible from the side of the chassis, the capacitor can be slid out. The test set EE-65 does not contain a capacitor.

SECTION V

SUPPLEMENTARY DATA

	Paragraph
Table of resistances and weights of wires and cables.....	32
List of replaceable parts.....	33
Table of resistances.....	34
Manufacturers and their addresses.....	35

32. Table of resistances and weights of wires and cables.

	Weight per mile	Resistance per mile of single con- ductor
Hard-drawn bare copper wire:	<i>Pounds</i>	<i>Ohms</i>
No. 8 A. W. G.	264	3. 4
No. 9 A. W. G.	209	4. 3
No. 10 A. W. G. (or No. 12 N. B. S.) (wire W-74)	166	5. 4
No. 12 A. W. G.	104	8. 5
No. 14 N. B. S.	104	8. 5
Galvanized iron wire:		
No. 9 B. W. G. (wire W-75)	312	15
No. 10 B. W. G.	258	19
No. 12 B. W. G.	179	29
No. 14 N. W. G. (wire W-76)	99	49
Bronze, No. 17 A. W. G. (single, solid wire W-74)	33	95
Outside distributing, twisted pair, copper clad, solid, No. 17 A. W. G. (wire W-38)	240	96
Outside twisted pair, solid, No. 14 A. W. G. (wire W-50)	375	14
Parallel drop wire, copper clad steel or bronze tinned, solid, No. 17 A. W. G. (wire W-108)	216	94
Field, 11-strand (10 steel, 1 copper):		
Single (wire W-39)	90	52
Twisted pair (wire W-40)	184	53
Field, 7-strand:		
Twisted pair (5 steel, 2 copper) (wire W-110)	132	130
Twisted pair (4 steel, 3 copper) (wire W-110-B)	132	95

	Weight per mile	Resistance per mile of single con- ductor
Outpost wire, 7-strand (3 steel, 4 bronze):	<i>Pounds</i>	<i>Ohms</i>
Single (wire W-43)	63	161
Twisted pair (wire W-44)	130	164
Buzzer (2 steel, 1 copper) (wire W-45)	26	340
Assault wire, 7-strand (6 steel, 1 copper), twisted pair (wire W-130)	32	317
Cable, paper-insulated, lead-covered:		
No. 19 A. W. G., 10 pair (commercial article)	4, 225	46
No. 22 A. W. G., 10 pair (commercial article)	2, 798	92
Cable, rubber-insulated, rubber-covered:		
No. 19 A. W. G., 5 pair (cable WC-534)	649	46
No. 19 A. W. G., 10 pair (cable WC-535)	1, 146	46

33. List of replaceable parts.—*a. Components.*—The following components are supplied as parts of test sets EE-65-C, -D, and -E.

	<i>Dimensions</i>	<i>Weight</i>	
		<i>(lb.)</i>	<i>(oz.)</i>
Set box with shoulder strap	11" x 9" x 7½"	7	½
Test unit consisting of—			
Test panel, on the front side of which are mounted—			
1 voltmeter IF-93			11
6 keys, average			4
8 binding posts TM-145-A, each			½
1 jack JK-37			3½
3 cords CD-478 (test) with test clips TI-137, total	5'3" long		5¾
And on the back side of which are mounted—			
A a c buzzer			7
1 coil C-105			5½
1 coil C-158			5½
1 resistor			
Chassis, on which are mounted—			
1 generator GN-38 with crank GC-9		2	2
1 capacitor CA-355			5

The following parts are required for operations in addition to those supplies:

- 2 batteries.
- 2 batteries BA-30 (size D flashlight cells).
- 1 hand set TS-9-() or head set HS-30-() with cord CD-605 and chest set TD-1.

b. Replaceable parts.—Test sets EE-65-A through -E.

Ref. No.	Stock No.	Name	Description	Function	Drawing No.	
					Manufacturer's	Sig. C.
		Generator GN-38	3-bar magneto	Source for ringing current. For GN-38.		SC-D-816-N.
		Crank GC-9	80 ohms.	Testing		SC-D-1797-C.
		A-c buzzer	Replacement for a-c buzzer.			SC-A-988-A.
		Ringer coil				
		Induction coil C-105	C. T. & E.	Talking circuit.		SC-D-2877-G.
		Holding coil C-158	C. T. & E.	Calling circuit.		SC-D-2878-E.
		Capacitor CA-355	T. D.			SC-D-2990-C.
		Voltmeter IF-93	Marion	Testing		
		Jack JK-37	Stromberg			
		Key	C. T. & E. #997-X	Ring-listen	C. T. & E. IC-1453	
		Key	C. T. & E. #1777-A	Line reverse (L. R.)	C. T. & E.	
		Key	C. T. & E. #1777-A	Voltmeter reverse (V. R.)	TC-775	
		Key	C. T. & E. #995-X	VMG/VMB	C. T. & E. TC-775	
		Key	C. T. & E. #1778-A	VM/EB	C. T. & E. IC-1451	
		Key	C. T. & E. #2214-X	VX/V	C. T. & E. TC-774	
		Resistor	H.-H. 1000 ohms. ±1%, 2½ w.	Instrument resistor	C. T. & E. IC-1546	

Ref. No.	Stock No.	Name	Description	Function	Drawing No.	
					Manufacturer's	Sig. C.
		Cord CD-478	C. T. & E. #1034-X-G	Test lead	{ C. T. & E. IC-1457	{ SC-D-6591-B.
		Cord CD-478	C. T. & E. #1034-X-1	Test lead	{ C. T. & E. IC-1457	{ SC-D-6591-B.
		Cord CD-478	C. T. & E. #1034-X-2	Test lead	{ C. T. & E. IC-1457	{ SC-D-6591-B.
		Binding post TM-145-A	Eby	Panel terminals	{ C. T. & E. ID-2163	{ SC-D-530-L.
		Battery clip	C. T. & E. #946-X	{ Retaining batteries BA-30		
		Double Fahnestock clip	C. T. & E. #998-X	Connecting battery BA-2		
		Single Fahnestock clip	C. T. & E. #999-X	Connecting battery BA-2		
		Battery spring	C. T. & E.	Retaining battery BA-30		
		Terminal lugs	P-MacG.	Soldering connections		SC-D-1791-D-19.

34. **Table of resistances.**—Value of X (resistance) with corresponding values of V' (voltmeter reading) with test battery of 40 volts (see par. 22).

V' -volts	EE-65; voltmeter resistance, 3,000 ohms X -ohms	EE-65-A; voltmeter resistance, 50,000 ohms X -ohms	V' -volts	EE-65; voltmeter resistance, 3,000 ohms X -ohms	EE-65-A; voltmeter resistance, 50,000 ohms X -ohms
1.....	117, 000	1, 950, 000	13.....	6, 230	104, 000
2.....	57, 000	950, 000	14.....	5, 570	93, 000
3.....	37, 000	617, 000	15.....	5, 000	83, 300
4.....	27, 000	450, 000	16.....	4, 500	75, 000
5.....	21, 000	350, 000	17.....	4, 050	67, 600
6.....	17, 000	283, 000	18.....	3, 660	61, 100
7.....	14, 140	236, 000	19.....	3, 320	55, 260
8.....	12, 000	200, 000	20.....	3, 000	50, 000
9.....	10, 330	172, 000	25.....	1, 500	30, 000
10.....	9, 000	150, 000	30.....	1, 000	16, 700
11.....	7, 900	132, 000	35.....	428	7, 140
12.....	7, 000	117, 000	40.....	0	0

35. **Manufacturers and their addresses.**—The complete names and addresses of manufacturers mentioned in columns 4 and 6 of the preceding table are as follows:

C. T. & E.....	Connecticut Telephone & Electric Corp.	70 Britannia Street, Meriden, Conn.
T. D.....	Tobe Deutschmann Corp.....	Canton, Mass.
Eby.....	Hugh H. Eby, Inc.....	4700 Stenton Avenue, Philadelphia, Pa.
H.-H.....	Hardwick-Hindle, Inc.....	Newark, N. J.
Marion.....	Marion Electrical Instrument Co.	Manchester, N. H.
Stromberg.....	Stromberg-Carlson Telephone Mfg. Co.	Carlson Road, Rochester, N. Y.
P-MacG.....	Patton-MacGuyer Co.....	17 Virginia Avenue, Providence, R. I.

[A. G. 062.11 (12-22-42).]

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:

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

DISTRIBUTION:

B 1, 2, 4, 6, 17 (2); R 1, 2, 4-6, 17 (3); Bn 11 (2); IBn 1, 4-6, (5); IC 2, 4-6, 17 (3); 11 (5).

(For explanation of symbols see FM 21-6.)

