

TELEPHONE EE-108

Preliminary Instructions

WAR DEPARTMENT

WASHINGTON, 7-15-43

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TELEPHONE EE-108

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Manufactured by

CONNECTICUT TELEPHONE & ELECTRIC DIV.

Great American Industries, Inc.

MERIDEN, CONN.

TABLE OF CONTENTS

I. GENERAL DESCRIPTION

Paragraph

Purpose	1
Characteristics	2
Description	3

II. EMPLOYMENT

Preliminary Tests	4
Installation	5
Operation	6
Care	7
Repair and Replacement.....	8

III. DETAILED DESCRIPTION AND FUNCTIONING OF PARTS

Description of Circuit Elements.....	9
Circuit Descriptions	10

IV. SUPPLEMENTARY DATA AND LIST OF PARTS

Characteristics of Circuit Elements.....	11
List of Parts.....	12

TELEPHONE EE-108

Description and Instructions for Operation and Maintenance

I. GENERAL DESCRIPTION

1. **Purpose.**—The Field Telephone EE-108 is designed to provide communication without the use of batteries. The only energy used in such a transmission system is the sound energy of the voice talking into the microphone. Telephones of this type are designated as sound-powered telephones. Although this telephone operates on a principle different from ordinary carbon type telephones, Telephone EE-108 may be connected by metallic or grounded circuits composed of field wire, open-wire lines, or cable to the following types of circuits and equipment :

Sound-powered telephones

Local-battery (magneto) telephones such as Telephone EE-8-()

Local-battery (magneto) telephone switchboards.

2. **Characteristics.**—The talking and signaling range of the telephone varies with the type of line wire used, its condition, whether it is dry or wet, and whether it is on the ground or in the air. It will operate satisfactorily over a line having an attenuation of up to 26 db, which is equivalent to a length of 9 to 12 miles of type W-110-B field wire, depending on weather conditions, etc.

3. **Description.**—Telephone EE-108 (see Fig. 1) is contained in a leather case 9-9/16" x 7-11/16" x 3-1/2" with an adjustable carrying strap and weighs about 9½ pounds. The principal parts and those which possibly may require replacement are listed in Sect. IV, Par. 12, and the detailed description and functioning of important parts are given in Section III.

a. Case.—All elements of the telephone, except the handset, are mounted on a metal chassis which is fastened to the case by seven screws, several of which are visible in Fig. 1. This assembly of the chassis and the elements mounted on it is called the body. The cover is hinged at the back, overlaps the sides and front, and is fastened on the front with a

snap fastener. The space within the case not occupied by the body, is used for the handset (Fig. 2). Removal of the handset permits access to the lightning arrester.

- b. *Body*.—The body (see Fig. 3) is removed from the case by unscrewing the seven screws mentioned above and by lifting the body from the case. It is not necessary to remove the crank from the generator. On the front wall is pasted the wiring diagram shown in Fig. 6 and on the rear wall is pasted the schematic diagram shown in Fig. 5. The latter also includes the name of the manufacturer and the order number. The front and side walls may be removed as follows:

Unscrew the five screws holding the front wall to the chassis and remove the front wall; while holding the large gear of the generator firmly in the left hand, unscrew the crank with the right hand, beginning with a quick counter-clockwise jerk; unscrew the three screws holding the side wall to the body, and remove the side wall. Do not lose the rubber or "coprene" disc on the generator shaft. Fig. 3 shows the body with the front wall, crank, and side wall removed.

- c. *Terminal Plate*.—The terminal plate forms the top of the body. On it are mounted:
- 2 Binding posts TM-214 marked L1 and L2
 - 1 Binding post TM-215 marked G
 - 2 Terminals marked T1 and T2
 - 1 Screw eye
 - 1 Push button marked LINE TEST
- d. *Generator GN-38*.—Generator GN-38 is mounted insulated from the frame in the center part of the body.
- e. *Capacitor CA-355*.—Capacitor CA-355 is mounted below and to the right of the generator.
- f. *Ringer MC-131*.—Ringer MC-131 is mounted on the floor of the body and on the left of the capacitor.
- g. *Lightning Arrester*.—The lightning arrester assembly is mounted in the compartment outside of the body looking toward the handset compartment.

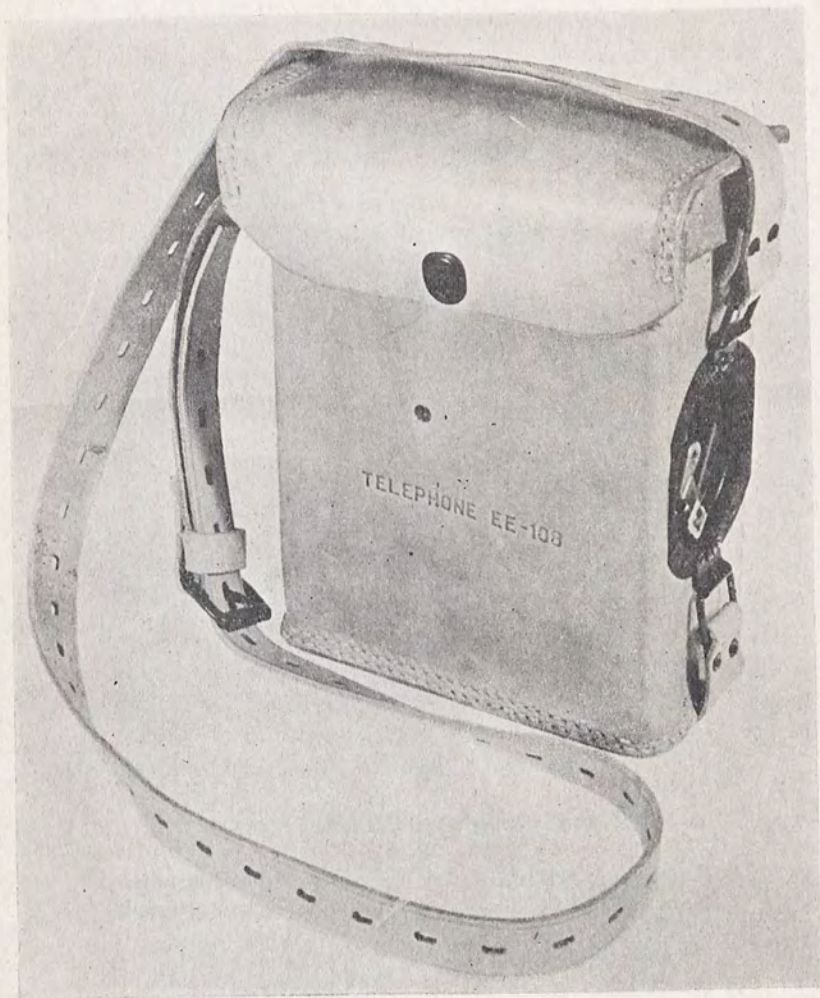


FIGURE 1. TELEPHONE EE-108

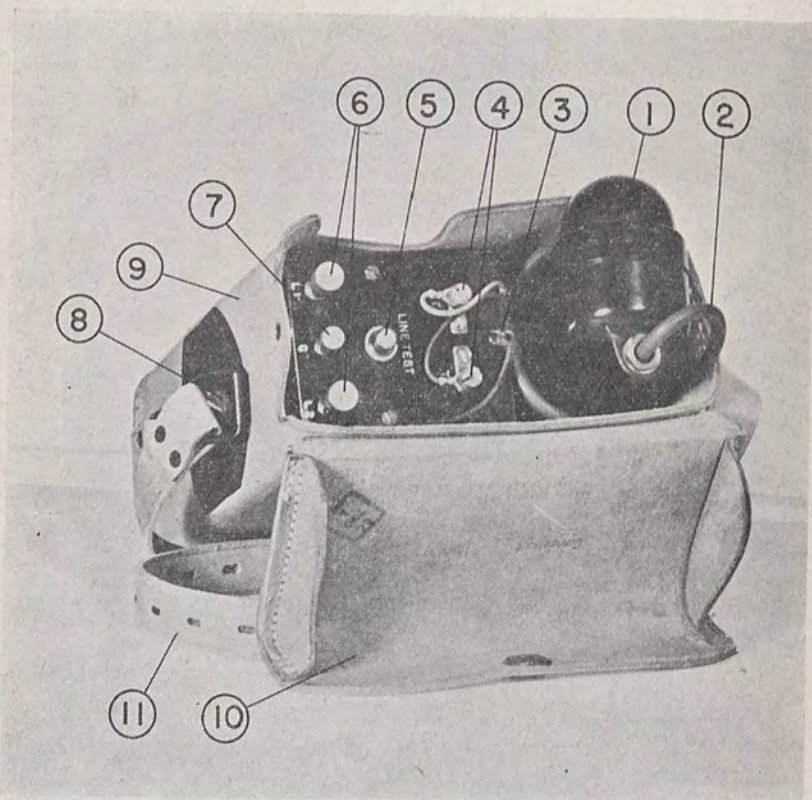


FIGURE 2. TELEPHONE EE-108, COVER OPEN.

- | | |
|----------------------|--------------------|
| 1. Handset | 7. Ground terminal |
| 2. Handset cord | 8. Generator crank |
| 3. Screw eye | 9. Case |
| 4. Handset terminals | 10. Cover |
| 5. Push-button | 11. Strap |
| 6. Line terminals | |

- h. Handset.*—The handset is shown in Fig. 3 (connected to the body) and in Fig. 4 (disassembled). It consists of the following parts:

Cord, which is a rubber covered cord containing two rubber covered conductors colored black and white. These conductors at one end of the cord are connected to terminals T1 and T2. It makes no difference which conductor is connected to which terminal. Stay cords are fastened at both ends. The cord is fastened to the handle also by means of a packing gland with a rubber packing.

The handle which contains suitable terminals, capacitors, connections between its parts, and the handset switch in the transmitter circuit.

The receiver element which is held in the handle by the retaining ring together with the receiver ear cap.

The transmitter element which is held in the handle by the retaining ring together with the molded mouthpiece. The receiver and transmitter elements are identical and can therefore be interchanged.

II. EMPLOYMENT

4. **Preliminary Tests.**—Open the case, remove the handset therefrom, and see that the conductors of the cord are properly connected to terminals T1 and T2 and that the stay cord is securely fastened to the screw eye. If the tests indicated below are not satisfactory see Par. 5.
- a. Transmitter and Receiver.*—Holding the receiver to the ear, blow steadily into the transmitter while alternately operating and releasing the handset switch. The sound should be heard strongly in the receiver when the switch is in its operative position (pressed down) but not when the switch is in its released position.
- b. Generator and Ringer Circuit.*—Holding the receiver to the ear, turn the generator clockwise rapidly for several turns. It should turn easily. The ringer should not ring. Short-circuit L1 and L2 and again turn the generator. It should now turn hard as though a drag had been placed on it and the ringer should not ring. Turn the generator again, but this time press the push-button marked LINE-TEST.

SIGNAL CORPS

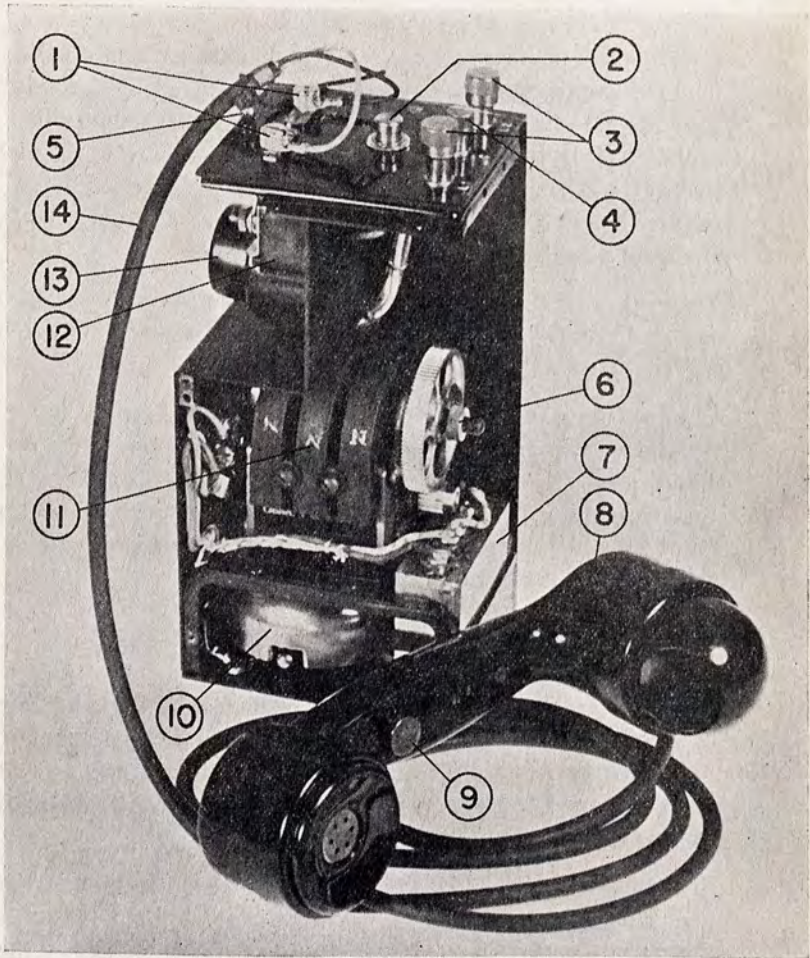


FIGURE 3. TELEPHONE EE-108 BODY ASSEMBLY, SIDE PLATES REMOVED.

- | | |
|----------------------|----------------------------|
| 1. Handset terminals | 8. Handset |
| 2. Push-button | 9. Handset switch |
| 3. Line terminals | 10. Ringer |
| 4. Ground terminal | 11. Generator |
| 5. Screw eye | 12. Lightning arrester |
| 6. Generator Shaft | 13. Lightning arrester cap |
| 7. Capacitor | 14. Handset cord |

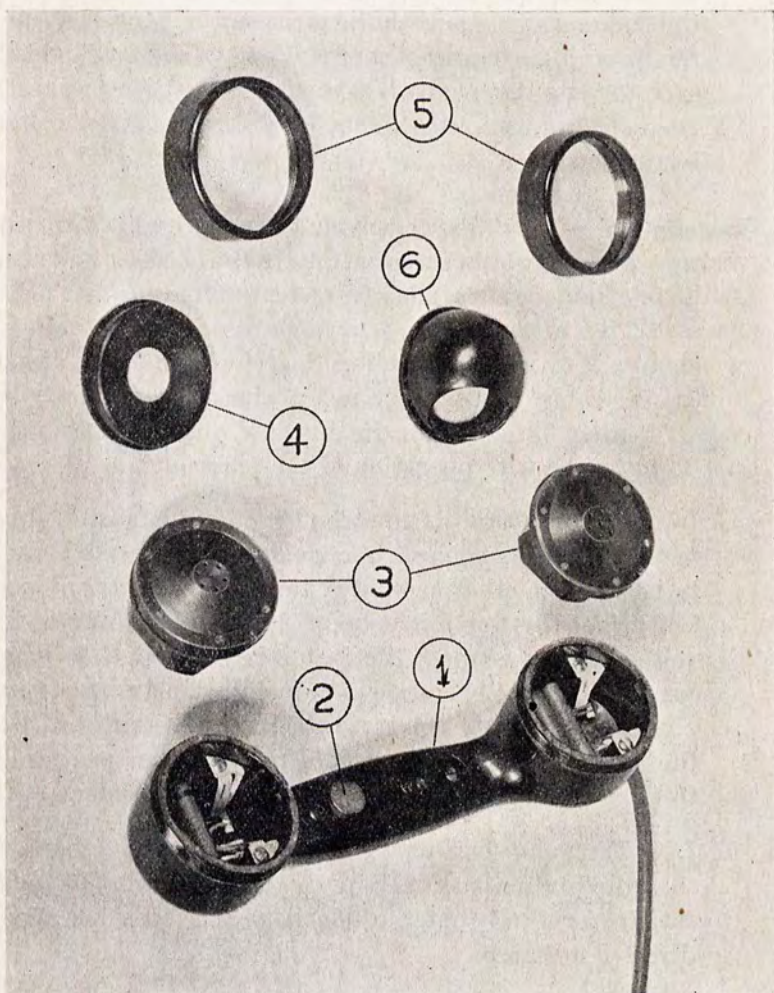


FIGURE 4. HANDSET OF TELEPHONE EE-108, DISASSEMBLED.

- | | |
|--------------------------------------|-------------------|
| 1. Handle | 4. Ear cap |
| 2. Handset switch | 5. Clamping rings |
| 3. Transmitter and receiver elements | 6. Mouthpiece |

The ringer should now ring strongly and the drag on the generator should be much less. Remove the short circuit. If the ringer still rings with the push-button depressed, check the lightning arrester elements. Remove cover of lightning arrester and remove both elements. Repeat ringing test. If ringer is now quiet the lightning arrester elements should be replaced.

5. **Installation.**—Install the telephone in an upright position in a manner providing convenient access to the handset and crank. If the telephone is suspended from a tree trunk or tent pole by means of the strap, tie the telephone to prevent swinging. A wooden rack or seat for holding the telephone firmly in position is desirable, if it is to be installed semipermanently on a table or other flat surfaces. In this case place the strap so as not to interfere with operation of the telephone.
 - a. *Line Connections.*—If the telephone is to be installed on a metallic circuit, connect one conductor of the line circuit to L1 and the other conductor to L2. If there is any possibility that the line might be affected by lightning or high voltage wires connect the terminal marked G to a good ground. If the telephone is to be installed in a ground return circuit, connect the conductor of the line circuit to L1 and the conductor from the ground rod or other good ground to L2, or the reverse, whichever is more convenient.
 - b. *Line Testing.*—This paragraph is based on the assumption that the preliminary tests prescribed in Par. 4 have been satisfactory and that the telephone has been installed as directed in Par. 5.

In order to test that the line is properly terminated by a telephone at the remote end proceed as follows:

Crank generator with the push-button marked LINE TEST pressed down. The bell should ring more or less strongly, depending on the length of the line; the longer the line the weaker the ring. This test is not always reliable on long lines of Wire No. 110B. If the ringer rings very loud the line is probably shorted. If the ringer does not ring at all the line is open.

6. Operation.

- a. *To Signal.*—Turn the generator rapidly for several turns.
 - b. *To Talk and Listen.*—Hold the handset with the receiver to the ear and the transmitter close to the lips. While talking press down the handset switch and talk directly into the transmitter; while listening only, release the switch as this will somewhat improve the receiving sensitivity of the instrument. If one forgets to press the push-button while talking, the transmitter is dead and no message is transmitted over the line. This condition is easily noticed by the absence of a “sidetone” in the receiver.
 - c. *To Ring Off.*—When the conversation is completed on a call established through a switchboard ring off by two or three sharp turns of the generator. This informs the switchboard operator that the connection is no longer desired or that a new connection is desired. After ringing off, if a new connection is not desired, replace the handset in the case.
 - d. *To Close Station.*—Remove the connections from L1 and L2 and the ground terminal G. Fold the handset cord loosely into folds about as long as the handset. Place the folds along-side the handset and insert the handset, receiver end first, into the case as shown in Fig. 2.
7. **Care.**—Protect the telephone from the weather as far as practicable when installed and place in a cool dry spot when not installed. Do not permit dirt to accumulate on any part of the telephone. This applies particularly to terminals, binding posts, and contacts. Keep all wire connections and screws tight.
8. **Repair and Replacement.**—In general, units which do not possess trained repair men and proper facilities for repair should exchange a defective telephone for a serviceable one and should not attempt repair or replacement beyond the mechanical repair of the case, the tightening of loose connections and repair of broken connections, and the replacement of screws, crank, cord, and handset. Some of the troubles likely to occur are listed below together with suggestions for their correction by units possessing such repair men and facilities (see Figs. 5 and 6 or similar diagrams pasted on the body).

SIGNAL CORPS

- a. *Ringer Does Not Operate.*—First, examine the generator spring contacts and if necessary adjust and clean same; second, adjust the ringer. The gong may be adjusted with respect to the clapper by removing the ringer from the body and loosening the gong clamping screws on top of the gong. The best adjustment is obtained when the clapper bell bounces away from the projections after impact, leaving the gong free to vibrate over its normal frequencies.
- b. *Generator.*—If the generator does not deliver output (see Par. 4b and 5), clean and adjust the spring contacts of the generator switch. The generator bearings are lubricated with a nonfluid lubricant giving lubrication over a temperature range from -40°F. to the highest temperatures encountered. No other lubricant other than the one mentioned should be used.
- c. *Transmitting and Receiving.*—If tests show the transmitting and receiving circuits to be in trouble, the trouble can still further be localized by connecting the telephone being tested to a telephone that is known to be serviceable. By transmitting from the telephone being tested to the serviceable telephone, the transmitter circuit of the former can be tested. By transmitting from the serviceable telephone to the telephone being tested, the receiving circuit of the latter can be tested. Trouble in the handset should be rare and the handset should not be disassembled, as indicated below, unless the trouble is definitely localized in the handset. In order to localize the trouble, try the handset from a serviceable telephone on the telephone being tested or try the handset being tested on a serviceable telephone. Under no circumstances will the handset be disassembled in the field to any greater extent than is permitted in the paragraphs below, or than is necessary to replace an unserviceable cord, switch, transmitter element, receiver element, or their connections.
- d. *No Transmission.*—Inspect the cord terminals at the telephone. Inspect and, if necessary, clean and adjust the handset switch. Inspect the cord terminals in the handset. To do this, unscrew the transmitter retaining ring and remove the mouthpiece and transmitter element, whereupon access

is had to the cord terminals. If trouble is localized in the transmitter element replace it with a new one.

- e. *No Reception.*—Inspect all cord connections. The receiver element is accessible by unscrewing the receiver retaining ring and removing the ear cap. If trouble is localized in the receiver element replace it with a new one.
- f. *Emergency.*—If only one serviceable (transmitter or receiver) element is available, place it in the receiver cavity of the handset. Transmission of a reduced quality can be obtained by talking into the receiver (do not press handset switch).

III. DETAILED DESCRIPTION AND FUNCTIONING OF PARTS

9. Description of Circuit Elements.

- a. *Handset.*—The handset contains a sound powered transmitter and a receiver. Transmitter and receiver are essentially alike and, therefore, are interchangeable. Transmitter and receiver elements are moisture-proof. They give high fidelity response and are operative over a wide temperature range.
- b. *Operating Principle of Transmitter and Receiver.*—Transmitter and receiver consist of two Alnico magnets with pole shoes of magnetically soft material. An armature is free to vibrate in the air gap between those pole pieces and is connected rigidly to a metal diaphragm. The armature is further surrounded by a coil which connects to the contact posts in the bakelite dust cover of the instruments. The cavities formed by the retainer rings and molded mouth-piece and receiver ear cap, respectively, are part of the acoustical system which is coupled to the diaphragm.

Principle of Transmitter.—Sound waves impinging on the diaphragm of the transmitter element impart motion to the diaphragm and the armature which is polarized by the field of the permanent magnets. Movement of the armature results in changes of the mag-

netization of the armature whereby electrical voltages are induced in the coil surrounding same.

Principle of Receiver.—Currents flowing in the coil of the receiver bring about changes in the magnetization of the armature which moves in accordance with these. The movement of the armature is transmitted to the diaphragm which emits sound waves perceptible to the ear.

It will be noted that in the transmitter cavity of the handset are mounted two tubular paper condensers of $.05\mu\text{f}$ each, and in the receiver cavity one condenser of $.05\mu\text{f}$. The purpose of these condensers is to improve the frequency response of both transmitting and receiving circuit which results in higher intelligibility.

- c. *Generator.*—The generator has three cobalt steel permanent magnets arranged on two field poles about an armature (see Fig. 3). The generator switch consists of spring contacts which in normal position connect the ringer across the line, but which upon rotation of the crank, disconnect the ringer and handset and place the output of the generator across the line. The crank handle folds into the metal-faced recess on the right side of the case.
- d. *Ringer.*—The ringer is of the single gong type. The ringer coils, armatures, and clapper are mounted inside the gong. When energized by ringing current the armature operates the clapper about a pivot to strike alternately two internal projections of the gong rim.
- e. *Capacitor.*—The capacitor consists of several sections, two of which are used; namely a 2 mfd. section between terminals 1 and 2, and a $.8\ \mu\text{f}$ section between terminals 2, 3, and 4. The functions of these elements are given in the next paragraph.

10. Circuit Descriptions (see Figs. 5 and 6).

- a. *Transmitting Circuit.*—The transmitting circuit is established by pressing the push-button in the handset handle. Then the transmitter, receiver, and $.8\ \mu\text{f}$ element of the

capacitor are connected in a circuit in which the impedance of these elements match the characteristic impedance of the average line. The condenser element is to keep any d.c. away from the transmitter and receiver elements. Except for the amount of current which flows through the receiver (and the negligible amount flowing through the ringer), the electrical energy created in the transmitter flows into the line and to the remote station.

- b. *Receiving Circuit.*—With the switch in the handset released practically the entire line current (with the exception of the negligible amount flowing through the ringer) flows through the receiver. The receiver is again matched closely to the line impedance in order to assure the best utilization of the incoming voice energy. If the handset switch is unintentionally pressed while listening, reception is still possible although it will be slightly weaker. It is therefore advisable to always release the push-button while listening.
- c. *Signaling Circuit.*—The 2 μf condenser element in series with the ringer prevents d.c. from biasing the ringer in case the line carries d.c. In normal condition line terminals L1 and L2 are connected to the ringer and its series condenser so that the bell rings whenever the generator is cranked at the remote station. The .8 μf section of the condenser limits the ringing current through the receiver circuit of the handset and permits the permanent connection of the listening circuit across the line.

When the generator is cranked it is connected directly to the line terminals L1 and L2 as the generator switch changes over.

- d. *Line Testing Circuit.*—If the push-button marked LINE TEST is pressed and the generator cranked, a series circuit is established which essentially consists of the generator, ringer, and the 2 μf section of the condenser, and the line. This circuit is arranged so that a ringing signal and speech may still be received with the push-button depressed, as long as the generator is not being cranked. A 400-ohm resistor shunts the ringer and condenser, thereby adjusting the sensitivity of the line testing circuit so that

up to a line length of approximately 6 miles it is possible to determine whether the line is open or terminated at the remote end.

- e. *Lightning Arrester*.—The lightning arrester consists of a bakelite base, two sets of elements, holding brackets and cover. Each set of elements consists of a carbon block and a properly spaced counterelectrode. The elements are accessible after pulling off the metal cover. The lightning arrester elements are always connected across the line and to ground as shown on the diagram, Fig. 5. The elements present an infinite resistance to voltages up to 300 volts between each line and ground. For voltages exceeding 600 volts they present a very small resistance so that such surge voltages will be effectively kept from entering into the telephone. For changing lightning arrester elements see Section II, Par. 4b.

IV. SUPPLEMENTARY DATA AND LIST OF PARTS

11. Characteristics of Circuit Elements.

a. *Receiver and Transmitter*.

Average motional impedance	800 ohms
D-C resistance	60 ohms

b. *Generator*.

D-C resistance of armature (approximate)	400 ohms
Gear ratio, crank to armature (approximate)	1 to 5
Output frequency at 1,000 rpm of armature (200 rpm of crank)	16 cycles
Output current at above speed :	
Resistance load, ohms	Current, ma
200	81
1,000	45
10,000	8.1
Open circuit voltage (approximate)	90 volts

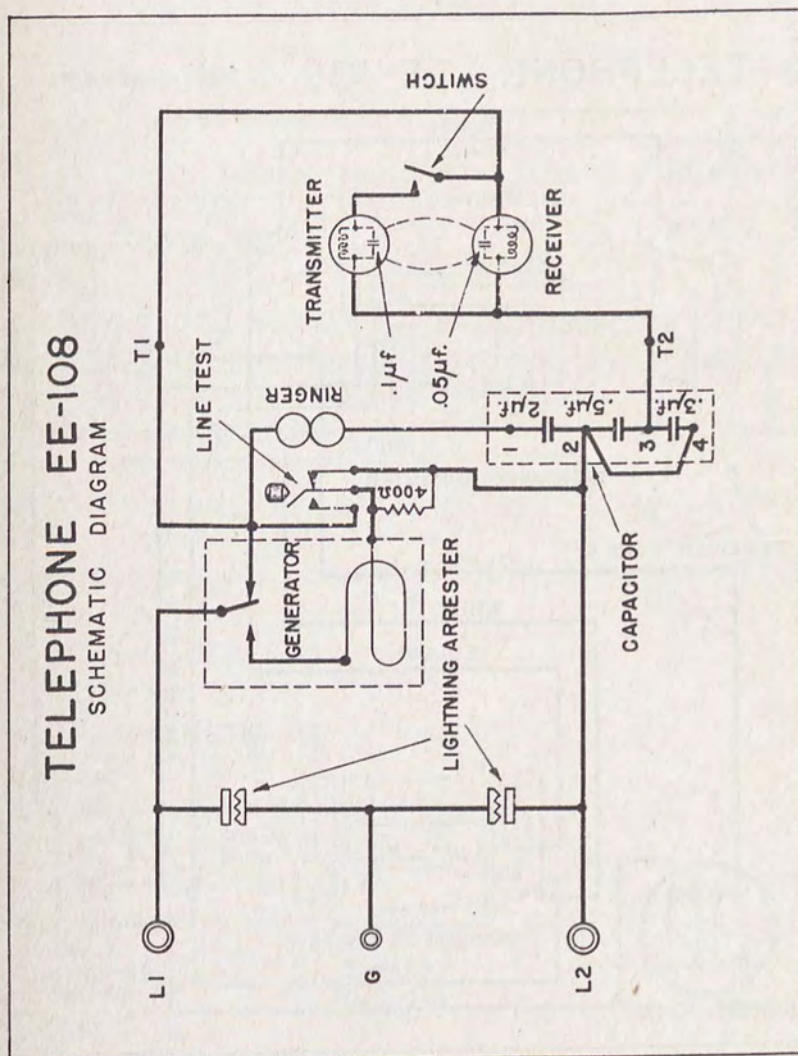


FIGURE 5. TELEPHONE EE-108, SCHEMATIC DIAGRAM.

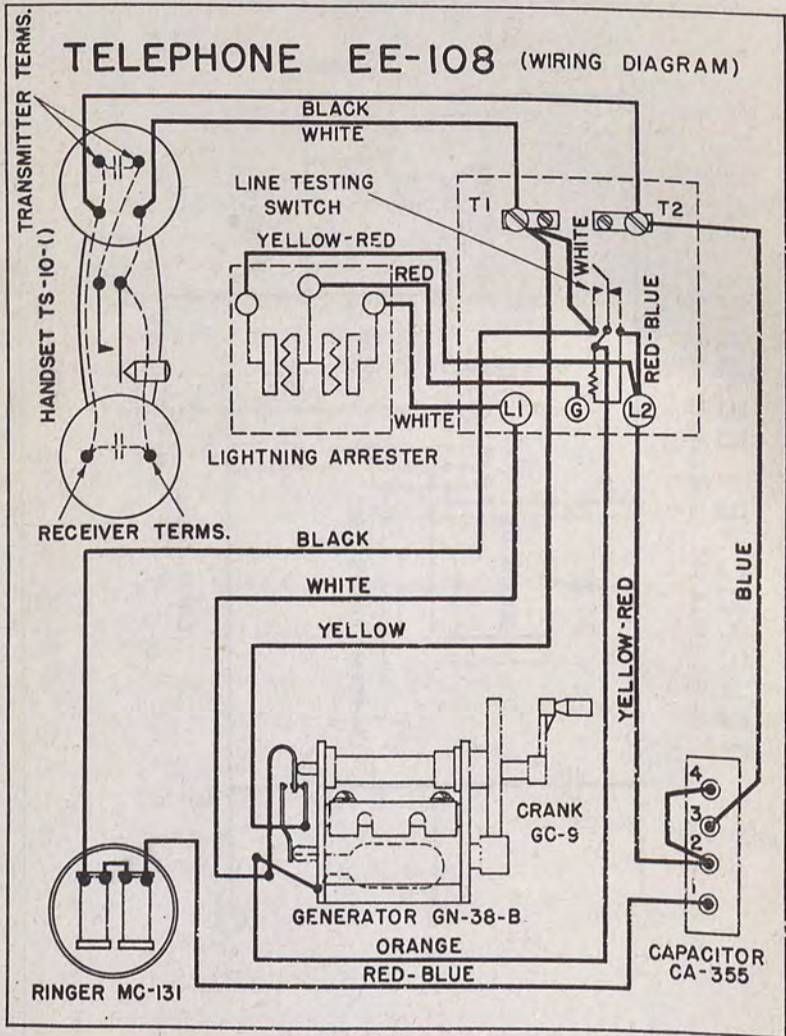


FIGURE 6. TELEPHONE EE-108, WIRING DIAGRAM.

c. Ringer.

D-C resistance (2 coils in series) (approximate)	1,300 ohms
Inductance (approximate)	3.0 henries
Impedance at 1,000 cycles approximate)	18,750 ohms

12. **List of Parts.**—In this list the parts which are interchangeable with similar parts of the telephone EE-8-() are preceded by an asterisk (*).

<i>Quantity</i>	<i>Description</i>
1	*Leather case assembly complete with carrying strap.
2	*Machine screws No. 6-32, 1/2" long, button head, brass, dull black nickel finish (for case).
4	*Machine screws No. 6-32, 7/16" long, flat head, brass, dull black nickel finish (for case).
1	*Machine screw No. 6-32, 5/16" long, flat head, brass, dull black nickel finish (for case).
1	*Strap assembly complete with buckle, D-rings, and clips.
1	Handset, sound powered.
1	*Capacitor CA-355.
1	*Generator GN-38.
1	*Ringer MC-131.
1	*Crank GC-9.
2	*Binding Posts TM-214.
1	*Binding Post TM-215.
1	Lightning Arrester.
1	Push-button (Line Testing).
2	Terminals (T1 and T2).