173A TEST SET
SHEATH FAULT LOCATOR
DESCRIPTION AND USE

CONTENTS PAGE

1. GENERAL

1.01 This section covers the description and use of the 173A sheath fault locator.

1.02 This section is reissued to:

- Change Fig. 1, 2, 3, 4, and 6
- Delete reference to 175A Transmitter and 174A Receiver
- Add 173A Transmitter and 173A Receiver.

Revision arrows are used to emphasize the more significant changes.

1.03 The primary function of this test set is to pinpoint, from the surface, the location of sheath damage in buried PIC cables.

1.04 Additional functions are provided to identify the desired cable, trace its path, and indicate its depth below the surface.

1.05 Some important features of the 173A test set are:

(a) One person operation

(b) Continuous indication of the direction to the fault

(c) Both a cable tracing mode and a cable depth indication incorporated

(d) Audible and visual indications provided

(e) Minimum operator training

(f) Easy to use

(g) Lightweight and rugged

(h) High voltage batteries not required.

1.06 The typical distance limitation for pinpointing the location of sheath damage on buried cable is approximately 1 mile. The actual distance limitation depends upon a number of variables which are beyond the control of the user.

2. PRECAUTIONS AND WARNINGS

2.01 Exercise care to protect the test set from water damage as it is NOT waterproof.

2.02 Electrodes on the AT-8681 B ground probe (Section 634-220-505) are pointed and care should be exercised when using or storing the probe. Probe covers should be installed over the electrodes when not in use.

2.03 High voltage can exist at the output of the transmitter between the red and black cord when in the FAULT mode. A mild shock may be received even though the output is current limited to a low current level. Care should be exercised in handling these leads.

2.04 When working on joint buried plant, it is necessary to test the cable sheath using the C voltage tester as described in Section 081-705-102 before and after interrupting the sheath continuity.

3. DESCRIPTION

3.01 The 173A sheath fault locator test set is illustrated in Fig. 1.

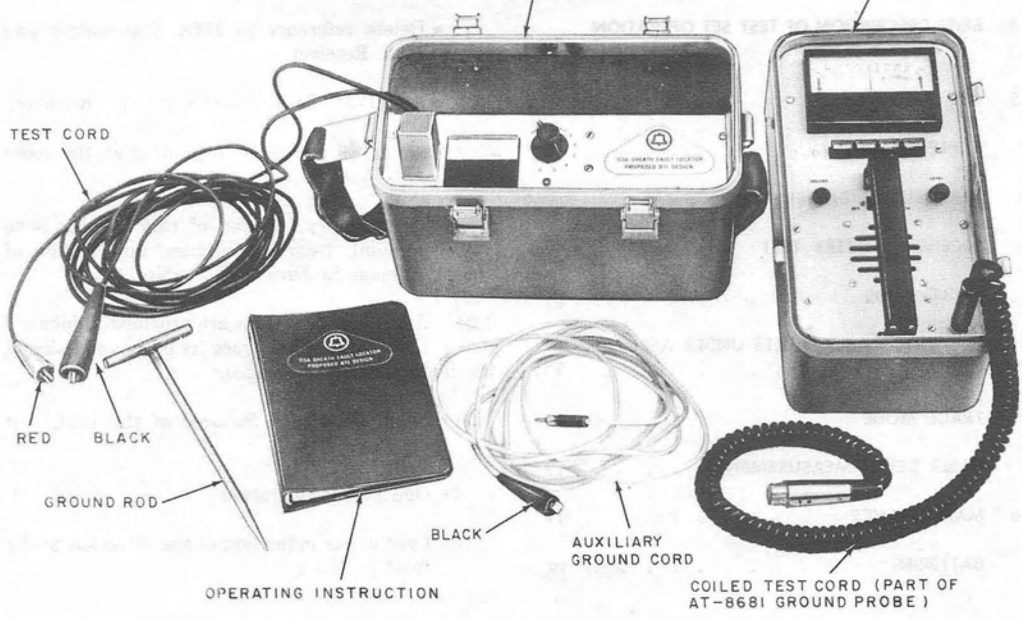


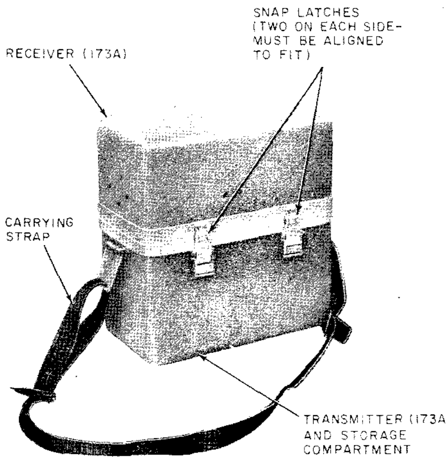
Fig. 1—▶173A Test Set◀

CASE

3.02 The 173A test set case is illustrated in Fig. 2.

TRANSMITTER

3.03 The transmitter is housed in the bottom half of the case. The ♦173A♦ test set (transmitter) is illustrated in Fig. 3.



WT.-13-3/4 POUNDS
DIM.-10-3/4 IN. X 5-3/4. X 11-1/2 IN.
MAT.-FIBER REINFORCED PLASTIC

Fig. 2—♦173A Test Set Case♦

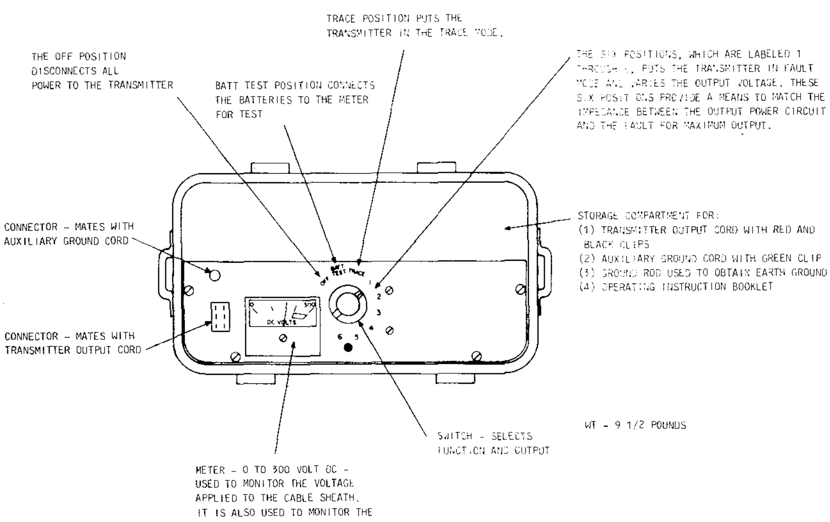


Fig. 3—♦173A Transmitter♦

RECEIVER

3.04 The receiver is housed in the top part of the case. The receiver is designed to be carried with one hand and the FUNCTION SWITCHES operated with the same hand. The ♦173A♦ test set (receiver) is illustrated in Fig. 4.

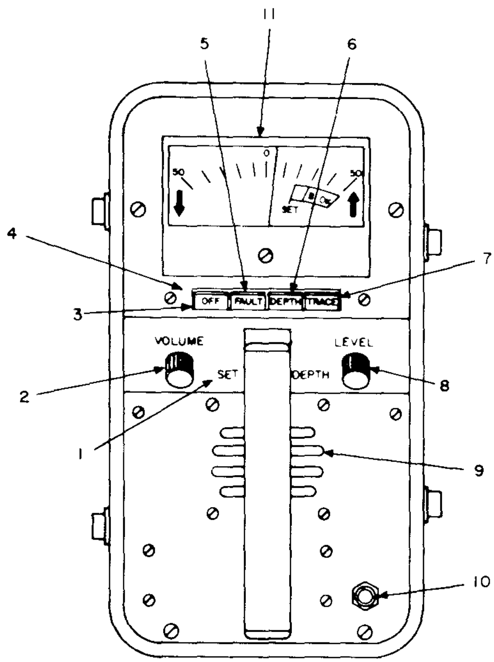


Fig. 4—♦173A Receiver♦

1. **SET-DEPTH Switch (Rocker-Type)—**

This switch is used in the depth measurement. The meter indication is doubled (increased 6 dB) by operating the switch from SET to DEPTH.

2. **VOLUME Control—**

This control is used to adjust the audible volume from the speaker.

3. **FUNCTION Switches—**

The row of switches, just below the meter, are the function switches. These switches are interlocked so that when one mode is selected, and that switch is depressed, the switch which was previously engaged is released. These switches are as follows:

4. **OFF-BATT—**

Depressing this nonlatching switch turns the receiver off. If this switch is depressed and held down, the condition of the battery is indicated on the meter.

5. **FAULT—**

Puts the receiver in FAULT mode to pinpoint the location of a sheath fault.

6. **DEPTH—**

The receiver is put in the DEPTH mode by operating this switch. In the DEPTH mode the distance between the cable and the ground surface is determined.

7. **TRACE—**

This switch is operated to put the receiver in the TRACE mode. In the TRACE mode the path of cable may be located.

8. **LEVEL Control—**

In depth measurement this control is adjusted to position the meter needle to the reference point on the meter scale.

9. **Speaker—**

Audible output from the speaker is available in all receiver modes as an aid and assurance to the operator that the system is working. The audible output is very useful in the TRACE mode where a null is used to trace the cable path.

10. **Jack—**

A jack is located on the front panel at the lower right. The test cord plug ♦from the AT-8681 B ground probe or a dummy phone plug◆ ***must*** be inserted into the jack at all times to enable the receiver ◆to operate. The cord must be removed before attempting to close test set.◆

11. Meter—

The meter is a zero-center reading type. It provides a visual indication of the cable tracing signal, the direction to the fault and the depth of the cable below the ground surface. It also indicates the conditions of the batteries.

RECEIVER ANTENNAS

3.05 The locations of the receiver antennas are shown in Fig. 5.

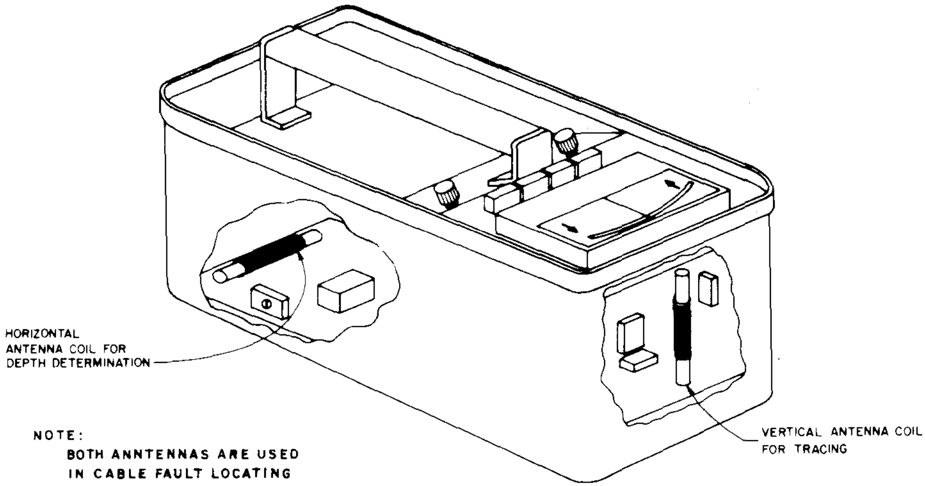


Fig. 5—Receiver Antenna Locations

AT-8681 B GROUND PROBE

3.06 The AT-8681 B ground probe (Fig. 6) is not part of the 173A test set. However, this ground probe, or an equivalent, must be used in the FAULT mode of operation.

3.07 For more information on the ground probe, see Section 634-220-505.

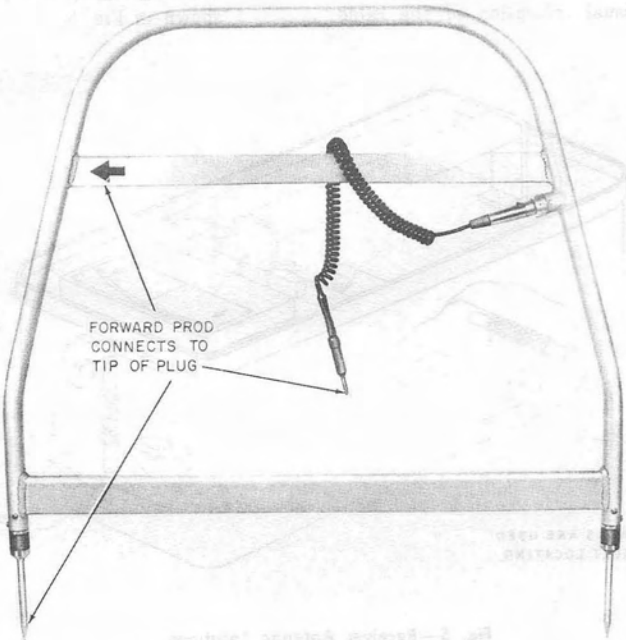


Fig. 6—♦AT-8681 B Ground Probe♦

4. BRIEF DESCRIPTION OF TEST SET OPERATION

4.01 In operation, the transmitter imposes a combined pulsed dc and RF signal on the buried cable shield from which the normal ground connections have been removed. The RF signal creates a magnetic field (Fig. 7) which is used to identify, trace, and determine the depth of the cable while the pulsed dc signal generates earth currents (Fig. 8) between the shield-earth contact at the sheath damage and the ground rod at the transmitter. This earth current produces a voltage gradient (Fig. 8) which is greatest at the fault and at the ground rod. Two probes attached to a tubular aluminum frame are inserted in the earth at intervals and the voltage between the probes measured by the receiver. From this measurement, the receiver indicates the direction to the fault and identifies the fault location when it is reached.

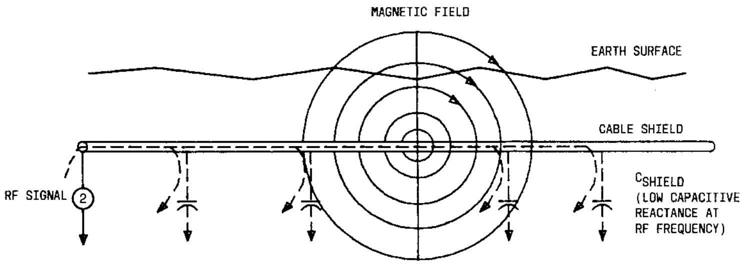


Fig. 7—Buried Cable Magnetic Field With High Frequency Source and Far End Open

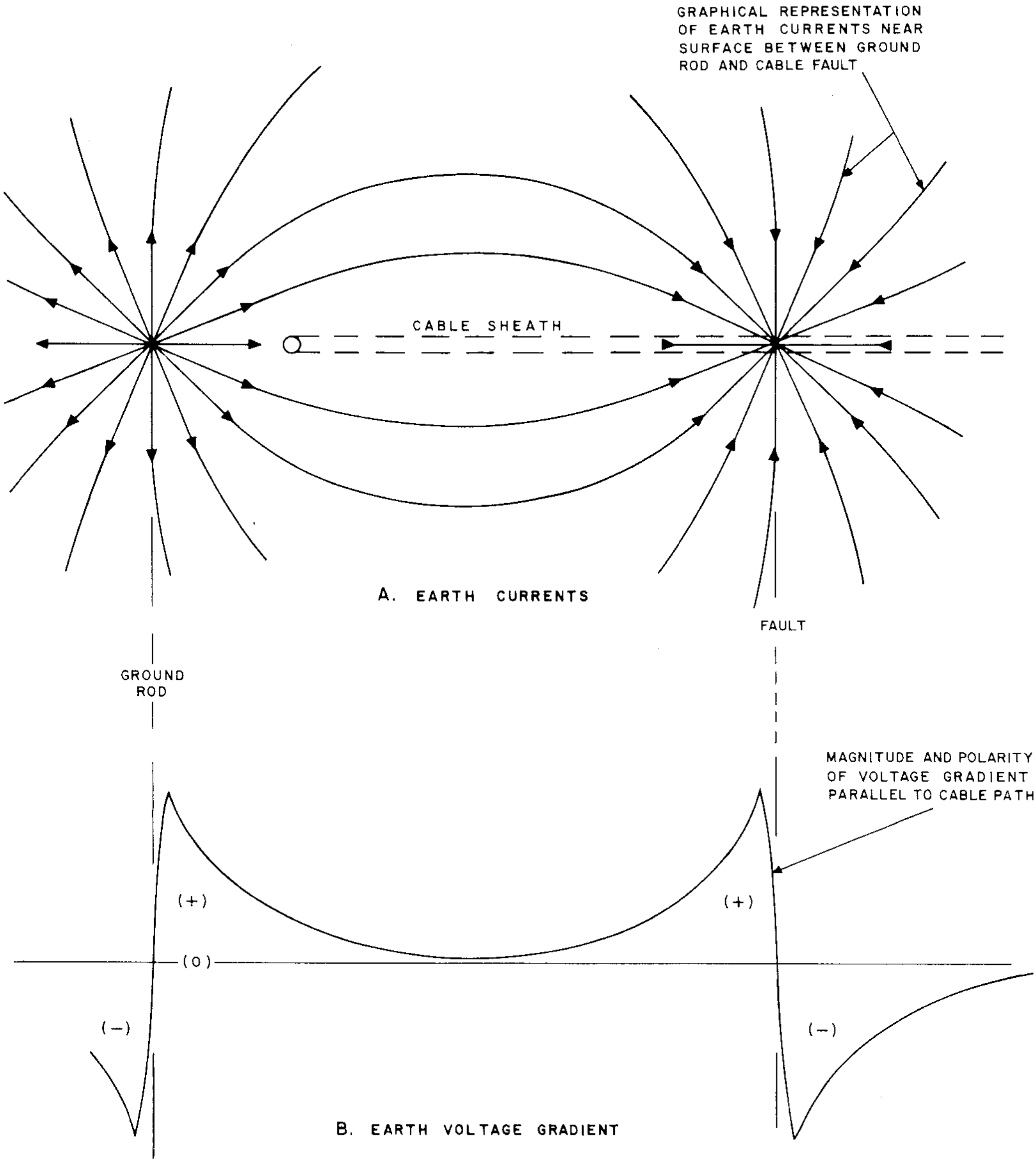


Fig. 8—Earth Currents—Earth Voltage Gradient

5. USE

CABLE TESTING

5.01 Before attempting to locate buried cable sheath faults, tests should be made to determine if such faults exist.

> ***WARNING: When working on joint buried plant it is necessary to test the cable sheath using the ▸C◂ voltage tester as described in Section 081-705-102 before and after interrupting the sheath continuity.***

5.02 Disconnect the shield/ground bonds at each end of the cable section and measure the shield-to-earth resistance with an ohmmeter.

> ***Note:*** The 173A will usually pinpoint all significant faults in a section without individually digging up and isolating the faults. However, the preferred method is to dig and isolate the worst (lowest resistance) faults first and then retest the cable. If the isolated section contains buried splice cases or other intentional grounds, these will usually indicate a lower resistance than a typical sheath fault. Since the grounded splice case looks like a low resistance fault, it is easy to locate.

5.03 The 173A will usually locate shield/ground faults as high as several megohms. The resistance of a particular type fault will vary according to soil and moisture conditions. Therefore, it is not possible to pick a universally acceptable fault resistance threshold which indicates a significant fault. However, 500,000 ohms have been found to be a reasonable threshold value. Most physical sheath damage will have a fault resistance lower than 500,000 ohms and most lightning induced pinholes will be much higher.

5.04 Sometimes a sheath fault will be indicated by the ohmmeter but the 173A shows no fault in the section. This is caused by a resistance fault between shield and conductor(s) in wet PIC cable when the moisture is not due to sheath damage. When this condition exists there is usually a dc, or foreign battery, voltage on the shield. Check for foreign battery on the shield by reversing the ohmmeter polarity. If the ohmmeter indicates a significant difference in reading for opposite polarity, then there is dc voltage on the shield and the true fault resistance is somewhere between the two readings. Treat this type trouble as a conductor fault and use a bridge type instrument to locate it.

TRANSMITTER BATTERY TEST

5.05 Insert the test cord connector into the mating transmitter connector. This activates the battery saver switch.

5.06 Turn the transmitter switch to BATTERY TEST position. The condition of the battery is indicated on the meter. If the meter reads to the left of the BATT OK area on the scale, replace the batteries. (See Part 6.)

RECEIVER BATTERY TEST

5.07 Insert the coiled test cord plug (part of AT-8681 ground probe) or dummy phone plug into the receiver jack. This activates the battery saver switch.

5.08 Depress and hold the BATT TEST switch on the receiver. The condition of the battery is indicated on the meter. ➧If the needle of the meter reads at the midpoint or lower of BATT OK area, replace the batteries (see Part 6).➧

WARNING: High voltage can exist between the red and black cord when the transmitter is in the FAULT mode. Even though the output is current limited to a low current level, a mild shock may be received. Care should be exercised in handling these leads.

Note: In the FAULT mode a cable fault can be pinpointed in ***addition*** to the ***option*** of tracing the cable. In the TRACE mode ***only*** the cable path can be traced.

5.09 Transmitter connections with step-by-step procedures are shown in Fig. 9.

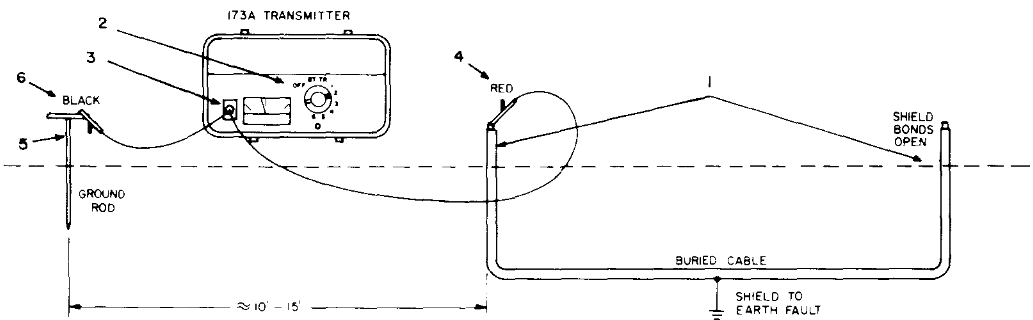


Fig. 9—Transmitter Connections

1. Isolate the cable shield at each end of the section.

2. Set the transmitter switch to the OFF position.

3. Insert the connector, which is on the end of the red and black cord, into the mating transmitter connector.

4. Connect the red test clip of the test cord from the transmitter to the cable shield.

5. Insert the ground rod into the ground in a direction opposite to the suspected direction of the cable path (if possible) and 10 to 15 feet from the end of the cable section. This avoids the possibility of missing faults at or very near to the pedestal. If it is not possible to place the ground rod behind the pedestal, place it to one side.

6. Connect the black clip to the ground rod.

7. Place the transmitter switch in the desired mode of operation.

5.10 An employee connecting the transmitter to the cable shield is shown in Fig. 10.

Fig. 10—Connecting Transmitter

FAULT MODE

5.11 Connect the transmitter per paragraph 5.09 and Fig. 9. While rotating the switch clockwise through the numbered positions, ➧listen to the tone from the receiver and observe the voltage increase on the meter. First, listen to the tone with the transmitter switch in TRACE position. It should be clear, rapid pulsing tone. Next, rotate the switch clockwise while listening to the tone and observing the transmitter meter. If the tone remains unchanged and, the meter decreases when the switch is rotated to a higher number, set the switch to the lower number where the meter peaked. If the tone pulse rate slows and becomes distorted, either set the switch to a lower position or replace the batteries.➧

5.12 Connect the AT-8681 B ground probe (or equivalent) to the receiver using the coiled test cord. Hold the receiver in one hand and the frame in the other.

5.13 The ground probe ***must*** be held so the cord leading from the frame to the receiver is on the rear portion of the tubular frame (Fig. 6). ***If the AT-8681 B ground probe is used, the arrow on the frame must point in a forward direction.***

> ***Note:*** If the ground probe is held in an opposite way than outlined in paragraph 5.13, all meter fault readings will be reversed.

5.14 Depress the receiver FAULT switch and adjust the receiver VOLUME control for a comfortable level.

> ***Note:*** The LEVEL control has no effect in the FAULT mode because the receiver gain is automatically controlled in this mode.

5.15 Insert the ground probe into the earth about 2 or 3 feet from the ground rod. The arrow on the ground probe frame must point away from the ground rod.

> ➧***Note:*** The frame of ground probe MUST NOT come in contact with earth.➧

5.16 An employee locating a sheath fault is shown in Fig. 11.

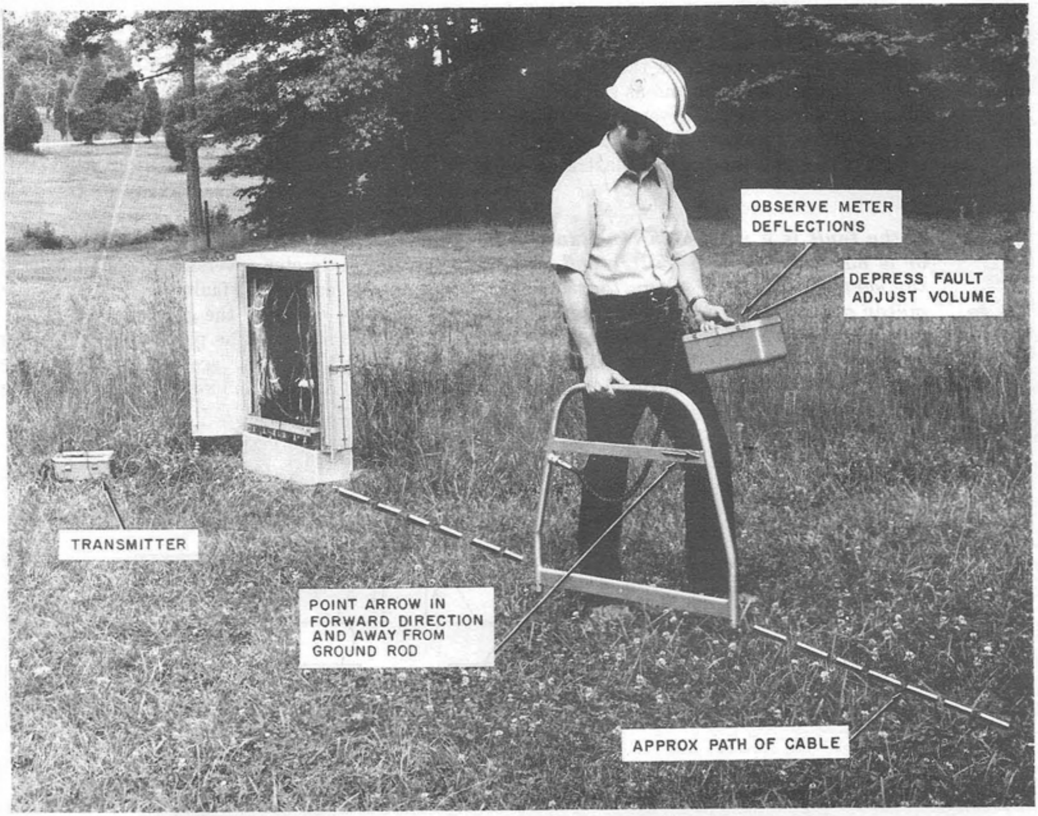


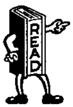
Fig. 11—Locating Sheath Fault

5.17 The zero center reading receiver meter is labeled with an arrow pointing away from the operator on the right-hand side and an arrow pointing toward the rear on the left side. When the meter deflects to the right, it indicates that the fault is in front of the operator. When the meter deflects to the left it indicates that the fault has been passed and is toward the rear. The meter deflection and the arrows will tell the operator which direction to go to get to the fault.

5.18 Proceed along the approximate path of the cable, inserting the probe into the ground every few steps.

Note: The meter indication is very rapid once the probe is inserted into the ground. This process may be continued at a near normal walk without stopping.

5.19 As the operator proceeds along the cable path, away from the transmitter, the meter deflection will decrease. However, as the fault is approached the signal will increase and as the fault is passed the meter deflection will reverse sharply. The receiver indications for various ground probe positions relative to the fault location are illustrated in Fig. 12.



If the fault is a very high resistance or is not near the transmitter end of the section, then it is likely that the meter deflection will be very small (or undetectable) over some part of the distance between the ground rod and the fault. However, so long as the cable path is followed, the operator will not be misled and the meter indication will increase as the fault is neared.

5.20 The sensitivity of the 173A is such that a null or zero reading directly over the cable is difficult to achieve. The meter indication will usually reverse for probe movements of fractions of an inch.

5.21 When the meter reverses for small ground probe movements, the fault is on a perpendicular line through the center of the ground probe frame. The actual spot may then be pinpointed by tracing the cable path through the area or by turning the probe frame 90 degrees and repeating the locating process (Fig. 12).

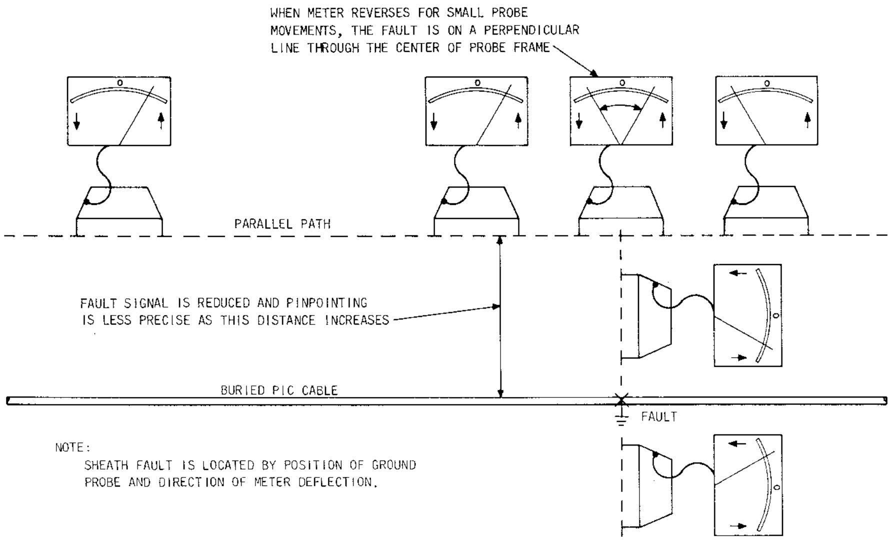


Fig. 12—Direction to Sheath Fault

LOCATING CABLE FAULTS UNDER ASPHALT OR CONCRETE

5.22 When the buried cable is located beneath a concrete or asphalt roadbed, it is possible to locate the sheath damage by walking with the receiver and ground probe along the shoulder of the road. A reversal in the meter deflection will occur when the FAULT has been passed. This point can than be marked along the shoulder of the road and then the exact location of the cable can be determined with the receiver unit in the trace mode. When the cable is located under large areas of asphalt or concrete (such as parking lots) sheath faults cannot be easily pinpointed. Penetration of the surface is required. With asphalt this can sometimes be accomplished by driving two nails into the surface 2 to 3 inches deep and connecting the receiver to the nails. ▶A suggested method of making this connector is to strap a wire from each nail to each probe end and connect the receiver to the probe.◀ Spacing the nails 30 to 40 feet apart initially is recommended with smaller spacing used as the fault is localized.

TRACE MODE

5.23 Connect the cable and transmitter as in Fig. 9.

> ***Note:*** The 173A test set is designed to allow cable tracing, depth determination, and sheath fault pinpointing by switching to the desired function on the receiver. It is not necessary to change either the cable connections or transmitter controls. However, the transmitter has a TRACE position for conservation of battery life when fault location is ***not*** required.

5.24 Turn the transmitter switch to TRACE or a numbered position as required.

5.25 Insert the plug, which is on the end of the coiled test cord into the receiver jack. This allows the receiver to be turned on.

> ***Note:*** If the fault location is ***not*** desired, the probe frame will not be needed. The probe end of the test cord can be looped through the receiver handle for convenience.

5.26 Depress the TRACE button.

5.27 Hold the receiver horizontally and adjust the volume control for a comfortable level.

> ***Note:*** There is interaction between the VOLUME and LEVEL controls because the LEVEL control sets the receiver gain which affects the audio output. The usual practice is to hold the receiver to one side of the cable and, starting from fully counterclockwise, rotate the LEVEL control a few turns until the meter goes off scale. Now, set the VOLUME control.

5.28 Slowly swing the receiver back and forth over the cable path (Fig. 13 and 14). The audio signal and meter indication decrease to near zero directly over the cable and increase to maximum to either side of the cable path. The cable can now be traced by noting the position of the signal minimum (null) as the operator walks over the cable path.

5.29 If the tracing signal becomes too weak in tracing long cables, connect the auxiliary ground cord between the green jack on the transmitter and the shield of the adjacent cable section or the pedestal ground. This allows a lower resistance ground for the RF tracing signal but does not affect the fault locating signal. Cable tracing near the pedestal will not be as accurate with this method.

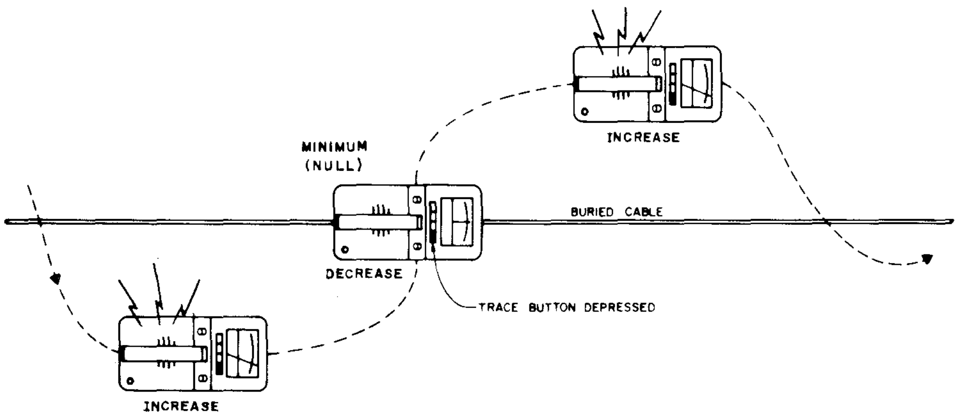


Fig. 13—Audio Signal and Meter Indication During Cable Tracing

Fig. 14—Tracing Cable Path

CABLE DEPTH MEASUREMENTS

5.30 The cable DEPTH measurement is taken as follows:

(1) The transmitter connections and adjustments are the same as for the trace or fault mode.

Note: The plug on the end of the coiled test cord MUST be inserted into the receiver jack. This turns the receiver on.

(2) Locate the exact cable path in the area where the cable depth measurement is to be made.

(3) Depress the DEPTH pushbutton switch.

(4) Position the SET-DEPTH switch to SET.

(5) Place the receiver on the ground directly over the cable with the handle parallel to the cable path.

(6) Adjust the LEVEL control until the meter pointer is directly over the SET mark.

(7) Position the SET-DEPTH switch to DEPTH. The meter indication will increase.

(8) Raise the receiver vertically until the meter reading decreases to the SET mark.

(9) The depth of the cable is then the same as the distance from the ground surface to the bottom of the receiver.

5.31 An employee measuring the cable depth is shown in Fig. 15.

Fig. 15—Measuring Cable Depth

6. MAINTENANCE

6.01 Maintenance is limited to testing and replacing the batteries. It is not feasible to attempt any field adjustment or repair.

BATTERIES

6.02 Transmitter power is provided by two 6 volt NEDA ▶908◀ batteries with coil spring terminals. Receiver power is provided by two 6-volt KS-15998 batteries.

RECEIVER BATTERY REPLACEMENT (Fig. 16)

6.03 To remove the receiver from the case:

(1) Remove the six panel mounting screws used to fasten the receiver panel to the case.

CAUTION: The receiver is still attached to the case by a ribbon cable and connector on the inside.

(2) Slowly lift the meter end of the receiver partly out of the case.

(3) The ribbon cable connector may be disconnected at the switch end of the cable.

(4) Hold the meter end high and slowly slide the rear end of the receiver forward and out.

6.04 ***To install new batteries*** follow the directions given in the decal which is on the battery holder.

6.05 Replace the batteries with type KS-15998 (NEDA type 713). The following are equivalent battery types:

EVEREADY* 773
Ray O Vac** 713
Burgess*** 5540
RCA VS 029

*Registered trademark of Union Carbide Corp.

**Registered trademark of RAY-O-VAC Division of ESB, Inc.

***Registered trademark of Burgess Division of Gould, Inc.

6.06 Before replacing the receiver in the case, test the batteries by inserting the test cord plug into the receiver jack and depressing and holding the OFF switch. The meter needle should be in BATT OK (green) area.

6.07 To replace the receiver in the case:

(1) Insert the battery end of the receiver into the case.

(2) Reconnect the ribbon cable connectors. Observe the correct polarity of the cable by matching the position of the arrows on the connectors.

(3) Then replace the meter end of the receiver into the case.

(4) Replace the six mounting screws which hold the receiver panel and case together.

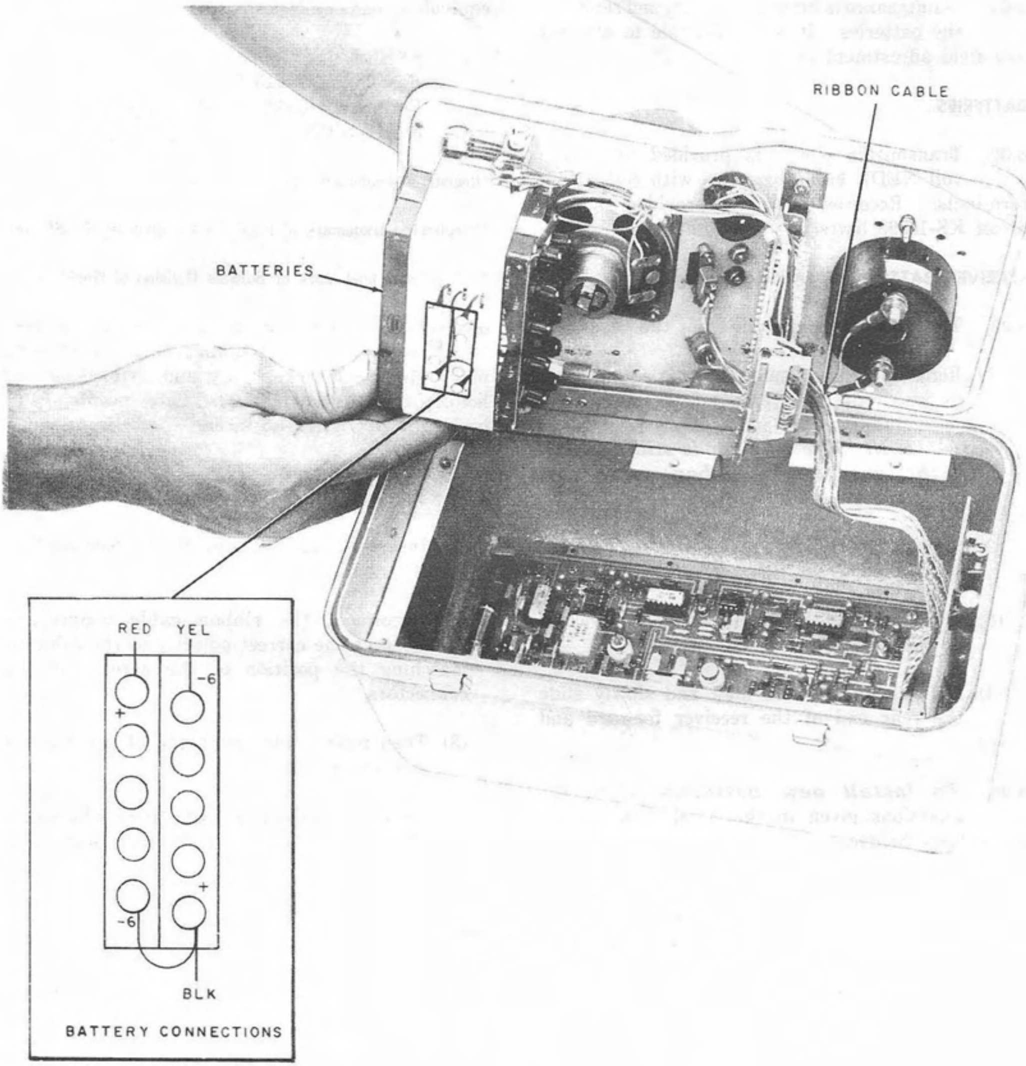


Fig. 16—Receiver Batteries

TRANSMITTER BATTER REPLACEMENT (Fig. 17)

6.08 To remove the transmitter from the case:

(1) Remove the four panel mounting screws located next to the case at the edge of the transmitter face plate.

(2) Tilt the transmitter panel forward and lift it up until the batteries are accessible.

(3) Remove the battery leads.

6.09 ***To install new batteries*** follow the directions given in the decal.

6.10 Replace the batteries with type NEDA ▶908.◀ The following are equivalent battery types:

Eveready ▶509◀
Ray O Vac ▶941◀
Burgess F ▶F4M◀
RCA VS ▶040C◀

6.11 Before replacing the transmitter in the case, test the batteries by inserting the test cord connector into the mating transmitter connector and placing the switch to BATT TEST position. The meter needle should be in BATT OK (green) area.

6.12 Replace the transmitter in the case. Refasten the transmitter to the case by replacing the four screws previously removed.

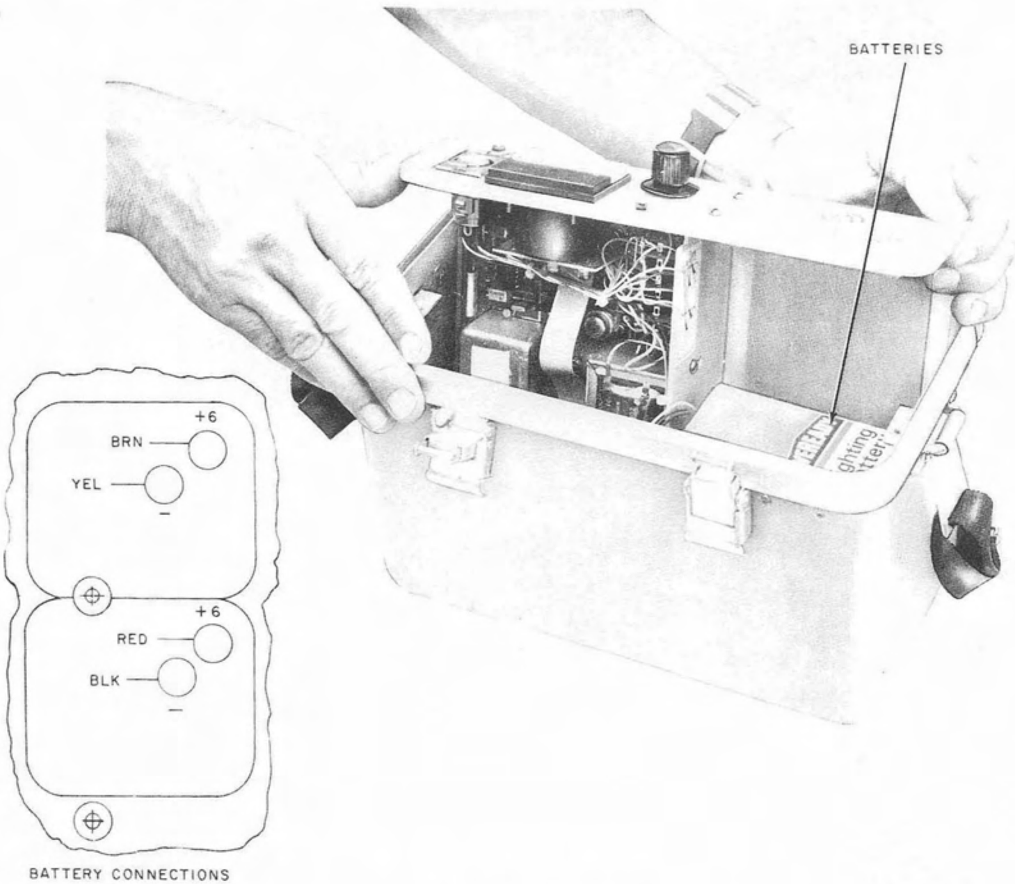


Fig. 17—Transmitter Batteries