

TELEPHONES FOR HAZARDOUS LOCATIONS

Technical
bulletin 626

CROUSE-HINDS COMPANY

Syracuse, N. Y.

and

AUTOMATIC ELECTRIC

Subsidiary of

GENERAL TELEPHONE & ELECTRONICS





Factory, development laboratories, and general office at Northlake, Illinois, U.S.A.

AUTOMATIC ELECTRIC COMPANY is an organization of designing, engineering, and manufacturing specialists in the fields of communication, electrical control, and allied arts. For more than sixty years the company has been known throughout the world as the originator and parent manufacturer of the Strowger Automatic Telephone System. Today Strowger-type equipment serves over 75% of the world's automatic telephones. The same experience and technique that have grown out of the work of Automatic Electric engineers in the field of telephone communication are also being successfully applied on an ever-increasing scale to the solution of electrical control problems in business and industry.

PRINCIPAL PRODUCTS

Strowger Automatic Telephone Systems—Complete automatic central-office equipment for exchange areas of any size, from small towns to the largest metropolitan networks.

Community Automatic Exchanges—Unattended automatic units for small rural or suburban areas, with facilities for switching into attended exchanges.

Automatic Toll Boards—An adaptation of Strowger principles to toll switching, resulting in simplification of operators' equipment and greater economy of operating and toll-circuit time.

Private Automatic Exchanges—Available in various capacities, with or without central-office

connections, and with facilities for special control services to meet the needs of the user.

P.B.X. Switchboards—A complete range of cordless and cord types for the modern business.

Telephone Instruments—Modern designs for automatic or manual exchanges, including the Monophone—the world's most attractive and efficient handset telephone.

Exchange Accessory Equipment—Auxiliary exchange and substation equipment, including manual desks, testing apparatus, transmission equipment, and all accessories needed for the operation and maintenance of the modern telephone exchange.

Makers also of electrical control apparatus for industrial, engineering, and public utility companies, telephone apparatus for railroads and pipe-line companies, private telephone systems of all types, electrical and communication devices for aircraft and airways control, and special communication apparatus for military and naval departments.

TELEPHONES FOR HAZARDOUS LOCATIONS

Technical
bulletin

626

AUTOMATIC ELECTRIC

Subsidiary of

GENERAL TELEPHONE & ELECTRONICS



Guide No. 400 I.O. February 25, 1958
Telephones for Use in Hazardous Locations.

E23702

Automatic Electric Co., Northlake, Ill.

Class I, Groups C and D; Class II, Groups E, F, and G.
Cat. Nos. ETDA20, ETDG20*, ETD20, ETWA20, ETWM20. Installation should be made in circuits with listed protector having two listed Jefferson No. 395-720 SAF-T-LAG thermal fuses rated 0.2 amp, 250 v. When voltages to which the telephone set may be exposed exceed 250, a listed protector having 7-amp fuses should be added.
*The catalog numbers of battery cases used with these telephones are ETG22 and ETG29.

Marking: Listee's name and catalog designation.

Reexamination Service—See General Information Card of above guide number.

This card replaces two cards, *E23702A* dated Oct. 16, 1953 and *E23702B* dated Aug. 26, 1955.

PRINTED
IN
U. S. A.

This card is issued by Underwriters' Laboratories, Inc.

Contents

PART I COMMON-BATTERY INSTALLATIONS

	PAGE
1. INTRODUCTION	1
2. TELEPHONE INSTRUMENTS	1
3. TELEPHONE UNITS	3
4. TELEPHONE INSTALLATIONS	5
5. TELEPHONE LINE PROTECTION	5
6. TELEPHONE INSTALLATION PROCEDURE	6
6.1 Installing Material	6
6.2 Precautionary Notes for Installers	7
6.3 Installation Procedures—Mechanical	9
6.31 Wall Installation without Auxiliary Signal	9
6.32 Wall Installation with Auxiliary Type ETR Bell Signal	9
6.33 Wall Installation with Auxiliary Power-Operated Signal	9
6.34 Panel Installations	11
6.35 Desk Installations	11
6.4 Directions for Wiring and Completing Telephone Installations	12
7. GROUNDING	14
7.1 Grounding Line Protector	14
7.2 Grounding Conduit System and Telephone Housing	16
7.3 Grounding for Grounded Ringing	16
8. FILLING THE SEALING CONDULETS	16
9. SERVICING PRECAUTIONS	16
9.1 Opening Unit Housings	16
9.2 Handset-Cord Assembly and Line Cord Assembly	17
9.3 Returning Telephone Installation To Service	17
9.4 Replacing Covers	17
10. INSTALLATION PROCEDURE WHEN LINE CUT-OFF SWITCH IS NOT USED	17

CONTENTS (cont.)
PART II
MAGNETO INSTALLATIONS

	PAGE
1. INTRODUCTION	19
1.1 Magneto Telephone Instruments	19
2. TELEPHONE LINE PROTECTION	19
3. TELEPHONE INSTALLATION PROCEDURE	19
3.1 Installing Material	20
3.2 Precautionary Notes for Installers	20
3.3 Installation Procedures—Mechanical	20
3.4 Directions for Wiring and Completing Telephone Installations	23
4. INSTALLATION OR REPLACEMENT OF DRY BATTERIES	24
5. SERVICING PRECAUTIONS	25
6. CONVERTING MAGNETO INSTALLATION TO COMMON-BATTERY MANUAL OPERATION	26



Fig. 1: Desk-Type Common-Battery Telephone for Hazardous Locations

PART I

COMMON-BATTERY INSTALLATIONS

1. INTRODUCTION

The telephones described in this publication are intended for use in hazardous locations where the surrounding atmosphere is, or may tend to become explosive in nature. They are so constructed, that the electrical portions of the telephone which sometimes spark slightly during operation, along with other current carrying parts, are enclosed in housings specially designed to meet the above described conditions.

To clarify; experience has demonstrated that it is impracticable to provide perfect gas-tight housings for electrical equipment. The required joints cannot be maintained in a permanently gas-tight condition and the explosive vapors will eventually enter a housing by slow diffusion through the joints or the pores in the metal. Vapors may also enter whenever the housings are opened for inspection and service. The housings are therefore constructed to withstand possible internal explosions of combustible vapors. By confining an explosion in this manner, the possibility of igniting the surrounding atmosphere is eliminated.

Other safety features of this type of telephone installation, include:

- (a) The use of special operating shaft bearings, tight housing joints, sealed cord entrances, etc., all designed for the prevention of flame escape during a possible internal explosion.
- (b) The enclosing of auxiliary telephone equipment in individual tight-jointed housings, and the use of sealing Condulets between the various housings. Sealing facilities are also employed wherever line or power wires enter the housings of these equipment units.
- (c) The use of threaded, rigid conduit on wire-runs in hazardous areas and the use of sealing Condulets for sectionalizing these runs every 50 feet. (The use of sealing Condulets as described above and in item b preceding, "localizes" possible internal explosions and prevents them from traveling through the conduit system to another location.)
- (d) The use of cut-off switches for disconnecting telephone line wires and power service wires (if used) from the telephone installation. (The "line cut-off switch" also shorts the instrument line wires and discharges the internal condensers so

that the instrument housing may safely be opened for inspection or service.)

These telephones for hazardous locations may be used with auxiliary loud bell, horn or siren signals which are especially suitable in locations where the noise level is high. The procedure for making or receiving calls with automatic or manual telephones of this nature is the same as that employed for ordinary telephones.

An optional method whereby the line cut-off switch can be omitted is explained in section 10.

2. TELEPHONE INSTRUMENTS

The telephone instruments employed in these installations are available in two types—one type is intended for desk use and the other for wall mounting (see Figures 1 and 2). The housings of both the desk and wall-mounting instruments are identical and consist of two

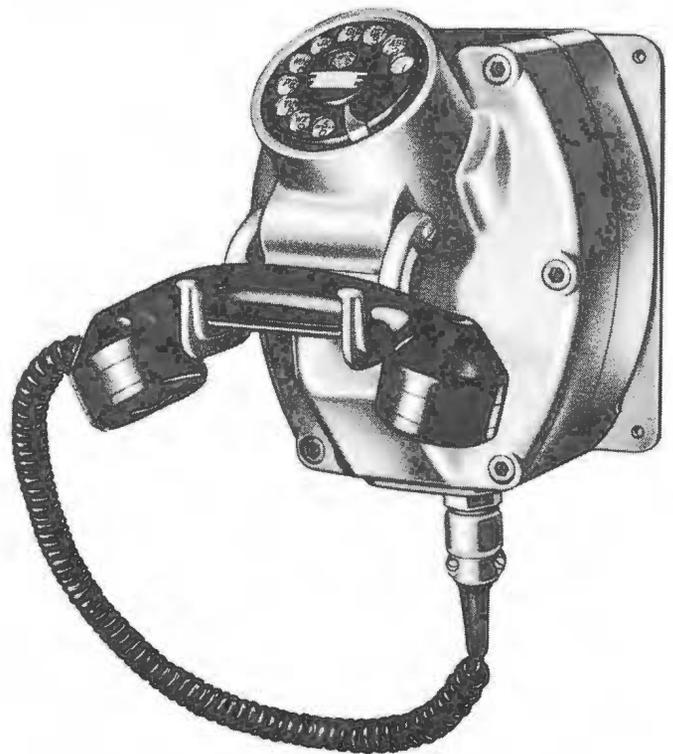
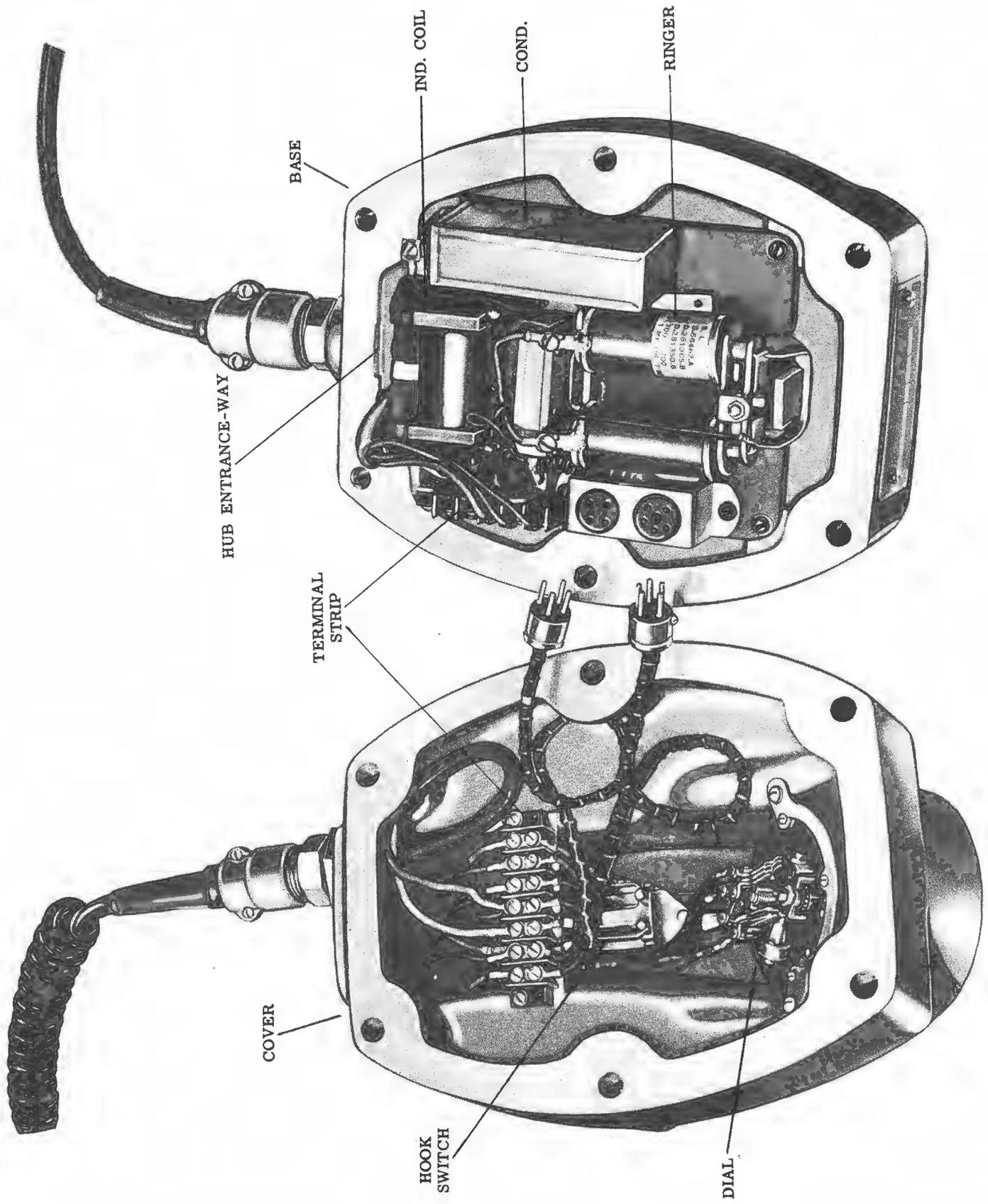


Fig. 2: Wall-Type Common-Battery Telephone for Hazardous Locations



COMMON-BATTERY INSTALLATIONS

cast aluminum sections (cover and base) which fit together to form a very tight joint. Six Allen-head bolts are employed for fastening the sections together. (An Allen wrench is furnished with each instrument.) Equipment within the instrument is mounted in both the cover and base. Flexible cabling from a terminal strip in the cover terminates in (2) plugs which fit to sockets in the base. This arrangement permits the sections to be taken apart for servicing or inspection without the necessity of disturbing or unsoldering the interior wiring (see Figure 3).

The base of the desk instrument is equipped with rubber feet to protect the surface upon which the instrument rests. The base of the wall-mounting instrument is equipped with a steel mounting plate which facilitates mounting to vertical surfaces (wall, pillar or panel). When mounted, the dial (or dial aperture) of the wall telephone, faces upward. A different cradle is provided on the wall instrument so that the handset may rest in a convenient horizontal position.

Both the desk and wall types are available with dials for automatic operation or without dials for manual operation. Where the dial mechanism is omitted, a metal plate covers the aperture normally occupied by the dial. All instruments incorporate a ringer with two-inch gongs. The gongs which are outside of the housing, are fastened to the underside of the base (Fig. 4). The associated clapper rod is activated through a special bushing in the base.

Two $\frac{3}{4}$ " conduit hubs are provided on the base of every telephone instrument. One extends from one end of the base and the other appears on the underside of the base (Fig. 4). The underside hub provides a convenient conduit entrance when it is desirable to panel-mount a wall-type telephone and bring the conduit through the panel to the instrument. A threaded plug is furnished with all instruments for sealing the unused hub.

The base section is reversible with respect to the top so that on a wall installation, for example, the incoming conduit may approach the end hub from above or below the telephone instrument. On a panel installation, where the conduit is brought through the panel to the underside hub, this (base reversing) feature permits the conduit to enter approximately 6" lower or higher on the panel without, of necessity, changing the panel location of the instrument (See Fig. 5).

Connection between the handset and the cover of both the wall and desk instruments, is made through a factory-sealed connector which threads into a hub in the cover. Connection between the desk instrument and the (required) line cut-off switch, which is usually mounted on any convenient vertical surface, is made through a flexible, heavily insulated line cord assembly equipped at each end with a factory-sealed connector. This line cord assembly is furnished with each desk instrument in standard 5-foot lengths but is available (upon request) in lengths up to 10 feet at no additional cost. One con-

ductor threads into the conduit hub in the instrument base and the other into a hub of the line cut-off switch (see item e, Sec. 6.2).

Connection between the wall-mounting instrument and line cut-off switch is rigid as these units are assembled together with conduit. Consequently, no line cord assembly is furnished with the wall-mounting telephone.

Provision is made for employing either metallic or grounded ringing with these telephones.

3. TELEPHONE UNITS

Basic telephone installations consist primarily of a telephone instrument and a line cut-off switch. These may be augmented with auxiliary loud signal units especially intended for noisy locations where the instrument-enclosed bell may not be adequately loud. The following units constitute the auxiliary signals:

- (1) Loud Bell (C-H type ETR)—operates on telephone ringing current in conjunction with instrument-enclosed bell.
- (2) Loud Bell (C-H type ESR)—a-c or d-c types, operates from 115 volt, commercial power.
- (3) Horn Signal (C-H type ETH)—a-c or d-c types; operates from 115 volt, commercial power.
- (4) Siren (C-H type ETH)—universal motor; operates from 115 volt, 60-cycle a-c or d-c commercial power.

Note: ESR bells and ETH horns are also available in other voltage ratings. Information will be supplied upon request.

All of the above listed units are encased in individual housings specially designed for hazardous locations. The type ETR bell unit, the ESR d-c bell unit, the ETH d-c horn unit and the siren unit, are shipped already assembled to junction Condulets in which wiring connections to the signals are easily made. (Leads from these loud signals are sealed in the hub of the signal housing and are brought down to the associated junction Condulet.) ESR a-c signals and ETH a-c horn signals do not require seals and the junction Condulet is omitted. The supply conductors are connected, instead, directly to binding screw terminals inside the signal unit housings.

Cut-off switch housings and auxiliary signal housings carry lugs which facilitate mounting of these units to vertical surfaces. All cut-off switches incorporate slotted controls which are operated with screw-drivers.

When auxiliary signals which require commercial power are employed, the following auxiliary units are required:

- (1) Power Relay (C-H type ETC)
- (2) Power Cut-Off Switch (C-H type ETS)

The coil of the power relay operates on the telephone ringing current and the relay contacts connect the

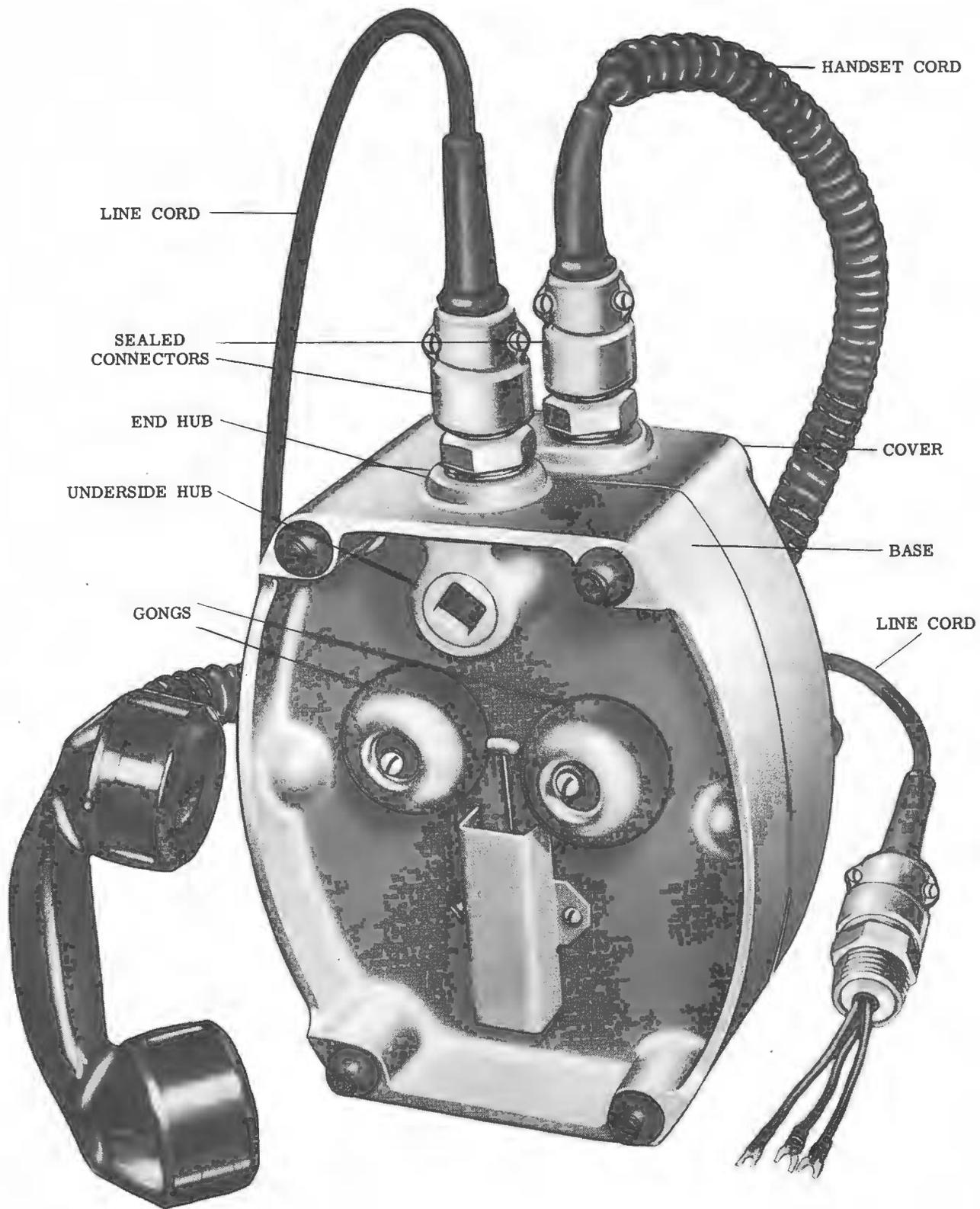


Fig. 4: Underside View—Desk Instrument

COMMON-BATTERY INSTALLATIONS

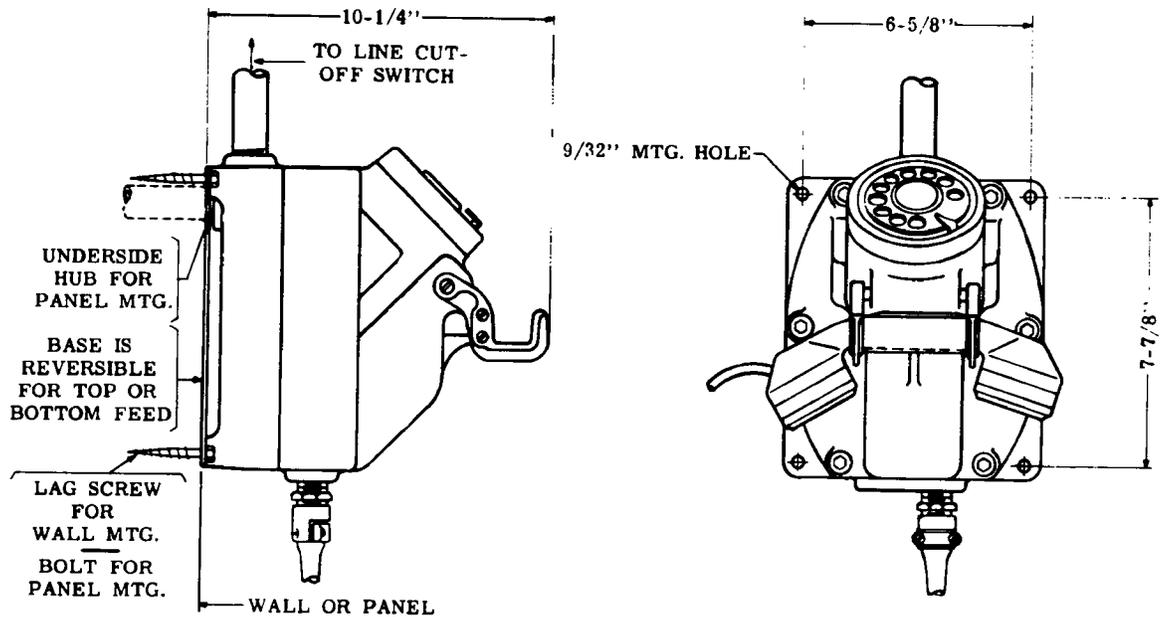


Fig. 5: Mounting Method for Wall Instrument

commercial power to the loud signal. The power cut-off switch is used to disconnect the commercial power from the relay contacts and auxiliary signal when the housings of any units in the installation are opened for service or inspection.

4. TELEPHONE INSTALLATIONS

With the telephone instrument and the line cut-off switch as the fundamental units, a variety of telephone installations can be assembled depending upon (1) whether desk, wall or panel mounting is desired, (2) whether automatic or manual service is required and (3) the type of auxiliary signal (if any) desired. The installations resulting from the various possible combinations, can be classified as follows:

Desk or Wall-Mounting Installations

- (1) Automatic (enclosed ringer only)
- (2) Automatic with Loud (Type ETR) Bell
- (3) Automatic with Loud (Type ESR) Bell
- (4) Automatic with (Type ETH) Horn Signal
- (5) Automatic with (Type ETH) Siren
- (6) Manual (enclosed ringer only)
- (7) Manual with Loud (Type ETR) Bell
- (8) Manual with Loud (Type ESR) Bell
- (9) Manual with (Type ETH) Horn Signal
- (10) Manual with (Type ETH) Siren

Installation procedure for either automatic or manual installations depends primarily on whether the instrument is desk or wall mounting, the type of auxiliary signal (if any) to be employed, and the location of the auxiliary signal with respect to the other equipment of

the installation. Generally, the line cut-off switch, power relay (if used) and power cut-off switch (if used) are assembled together in close proximity through the use of conduit or close nipples, plus the required sealing Condulets (see Fig. 7). (This assembly will also include the wall-mounting instrument unless the instrument is not to be mounted on the same surface as the other units.) The entire assembly is bolted to a suitable vertical surface. The auxiliary signal (if used) can be assembled beforehand to the other units with conduit if it is desirable to locate the signal near the ceiling, directly above the other units. It can also be mounted at a distance from the other units with conduit installed between.

The wall-mounting telephone instrument can be located directly below or above the line cut-off switch simply by taking advantage of the base reversing feature described in Section 2. When the wall instrument is to be mounted on a panel, the line cut-off switch and other units (if employed) can be located directly above or below the instrument as in the wall installation, or, these units can be mounted on the opposite side of the panel or on another vertical surface nearby.

Where a desk installation is involved, a flexible line cord assembly (see Sec. 2) connects the instrument to the line cut-off switch which is mounted on a nearby vertical surface along with the other units (if any). See Section 6 for installation procedures.

5. TELEPHONE LINE PROTECTION

Every telephone line is required to have adequate fuse protection to safeguard certain components in the associated telephone installation against dangerous overheating in case of excessive current on the line. Such a

condition could arise for example, from a possible cross with a power circuit. To conform to Underwriters' Laboratories specifications, the fuses employed must be rated at 0.2 amperes, 250 volts. A suitable fusing arrangement is provided by Automatic Electric's fuse block, Cat. No. S-8295.

Where any portion of a telephone line (such as an outdoor line) is exposed so that it is susceptible to possible lightning strikes or crosses with high tension power circuits that may exceed 250 volts, then an approved type of line protector is required, in addition to the fuses described above. Automatic Electric Company's 2000N protector Cat. No. S-8295 is suitable for this purpose. The protector and fuse block should be wired as shown in Figure 6 with the outside line wires connected to the fused end of the protector and the wires from the telephone installation connected to the fuse block.

Where the telephone line is not exposed or does not leave the building, the protector is not required. The line wires are instead brought directly to one side of the

not enter the conduit. The exposed wire between the Condulet (or weatherhead) and the fuse block should be as short as possible and so located that it is not likely to be damaged.

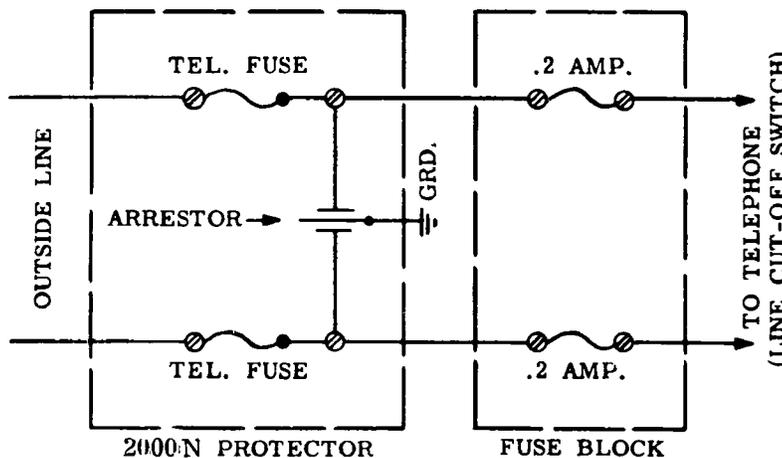
- (d) Use only 0.2 ampere fuses in fuse block.
- (e) All underground wiring is to be lead covered.
- (f) Observe precautions given in Section 6.2.

6. TELEPHONE INSTALLATION PROCEDURE

All NE Code Requirements and local ordinances governing the installation of electrical equipment in hazardous areas, should be carefully observed.

It is suggested that all apparatus and material be unpacked and assembled at a nonhazardous location and brought to the installation site as required. Care should be exercised during installation work, to prevent possible sparks resulting from the rough handling of materials, tools, etc.

PROTECTION
REQUIRED ON
OUTSIDE LINES
ONLY.



FUSES REQUIRED
ON ALL LINES
TO CONFORM TO
UNDERWRITERS'
LABORATORIES
SPECIFICATIONS.

Fig. 6: Wiring Arrangements—Line Protector and Fuse Block

fuse block and the telephone wires as described above, to the other side of the fuse block. For those installations where a protector is required, however, make certain that the arrestor terminal is properly connected to a ground rod or grounded water pipe (see Sec. 7.1, "Grounding Line Protector").

Each protector and fuse block should be installed in accordance with the following specification:

- (a) Locate units in a safe (non-hazardous) area.
- (b) Mount in weather-proof housings.
- (c) Wiring between the telephone installation and the fuse block is to be enclosed in conduit (see Sec. 6.3, Installation). At the point where the conduit terminates (adjacent to fuse block) an obround Condulet, Crouse-Hinds Type A, B, or E, with two- or three-wire hole-cover, or an approved type of service entrance weatherhead may be used. If an obround Condulet is employed, the cover should face downward so that water will

6.1 Installing Material

Conduit, wire, sealing Condulets, line protectors, ground clamps, sealing compound and miscellaneous installing materials are to be provided by the purchaser unless otherwise specified. For ordering purposes this material may be identified from the following list:

- (a) Fuse block (Automatic Electric Company, Cat. No. S-8295) with fuses rated at 0.2 ampere, 250 volts. Line protector (Automatic Electric Co., 2000N protector) Cat. No. S-8295) required in addition to fuse block for protecting outside lines (see Section 5 preceding). This protector carries 7 ampere fuses rated at 500 volts.
- (b) 3/4" threaded, rigid steel conduit bearing Underwriters' Laboratories inspection label.
- (c) Sealing Condulet (Crouse-Hinds Cat. EZS-2) with female hub both ends, or sealing Condulet (Crouse-Hinds Cat. EZS-26) with female hub one end and male hub other end.

COMMON-BATTERY INSTALLATIONS

- (d) $\frac{3}{4}$ " union (Crouse-Hinds Cat. UNF 205) for joining conduit to conduit. $\frac{3}{4}$ " union (Crouse-Hinds Cat. UNY 205) for coupling sealed cord connectors to equipment hubs:
- (e) Ground clamp (Crouse-Hinds Cat. GCH-08).
- (f) Water meter shunt (for insuring effective grounding of water pipes on output side of water meter) Crouse-Hinds Cat. GCH-191.
- (g) Wire for making connections between the various equipment units wherever these connections are not required to carry 115-volt commercial power. This wire is available from A.E.Co. in a variety of colors and may be ordered under the following codes: 12/30-70 white, 12/30-70 black, 12/30-70 red, 12/30-70 green, 12/30-70 orange and 12/30-70 blue.
- (h) No. 19 gauge twisted duplex or triplex rubber-covered weather-proof telephone wire for connecting telephone installation to the fuse block and line protector. This wire is also known as "Bridle" or "Spider" wire and is available from A.E.Co. under Cat. No. S-7858 for duplex and S-7860 for triplex.
- (i) Two #14 gauge rubber-covered wires for carrying 115-volt commercial power wherever required in the installation. Wire should have 600-volt insulation and carry Underwriters' Laboratories inspection label on each coil. Outer braids of wires should be colored white and black respectively to comply with identification requirements of the National Electrical Code.
- (j) Solderless Connector (H.B. Sherman Cat. #502).
- (k) Miscellaneous material such as pipe clamps, bolts, lag screws, wood screws, rubber tape, friction tape, rosin core solder, etc.
- (l) Fibre (Crouse-Hinds Chico X) for making the dams in sealing Condulets, and sealing compound (Crouse-Hinds Chico A) for making the seals. See Section 8 entitled "Filling the Sealing Condulets." EZS type, $\frac{3}{4}$ size sealing Condulets require approximately $\frac{1}{16}$ ounce of Chico X fibre for damming each Condulet hub and approximately 6 ounces of Chico A compound for making the seals (1 ounce of "set" Chico A compound is approximately equivalent to 1 cubic inch). Fibre and sealing compound are available in packages of different sizes as follows:

Chico X Fibre		Chico A Compound	
Pkg. No.	Net Wt.	Pkg. No.	Net Wt.
1	$\frac{3}{8}$ oz.	2	9 oz.
2	$\frac{3}{4}$ oz.	3	1 lb.
3	1 oz.	23	2 lbs.
4	2 oz.	05	5 lbs.
5	4 oz.	5	10 lbs.
6	8 oz.		
7	1 lb.		

Also available are combination packages of sealing compound and fibre as follows:

Package Number	Contains
A4	1 lb. compound $\frac{3}{4}$ oz. fibre
A24	2 lbs. compound 2 oz. fibre

6.2 Precautionary Notes for Installers

- (a) Use only $\frac{3}{4}$ " threaded, rigid steel conduit bearing Underwriters' Laboratories inspection label.
- (b) Each conduit joint must be pulled up tight with at least five full threads engaged.
- (c) Conduit system and desk telephone housing must be thoroughly grounded. See Section 7, "Grounding."
- (d) Insert a sealing Condulet (EZS-2) in the conduit-run at every point where the conduit enters or leaves a hazardous area. (The National Electrical Code requires that a seal shall be located in each conduit leaving the hazardous area. Also, there shall be no box, coupling or fitting in the conduit between the seal and the point at which the conduit leaves the hazardous area.)
- (e) Where a union is required in the conduit-run, use one similar to UNF 205 listed in Section 6.1, item d. Also, for desk installations, a line cord assembly is employed to connect the instrument directly to the line cut-off switch (or battery box in the case of magneto installations—see Part II). To prevent undue twisting of the cord when the sealed cord connector is screwed into the switch or battery box hub, and the untwisting entailed thereafter, a union similar to UNY 205 may be employed to couple the sealed cord connector to the hub.
- (f) When that part of any conduit-run which is in a hazardous area, is more than 50 feet long, insert additional sealing Condulets (EZS-2) at 50-foot intervals.
- (g) Wire splices are to be made only in junction Condulets or in housings of units (cut-off switches, power relay) where the covers are removable. Wire splices must not be located in sealing Condulets.
- (h) In making splices, the use of Sherman #502 solderless connectors is recommended. Insulate the splice with rubber and friction tape wrappings.
- (i) On making wire connections to the various devices, especially where the wire terminals of the device are not readily accessible, be sure to leave sufficient slack wire within each respective housing so that the device can be easily removed from the housing for inspection and servicing. This is particularly important where wire entrances are to be sealed (in housing hubs or sealing Condulets) on completion of the installation.

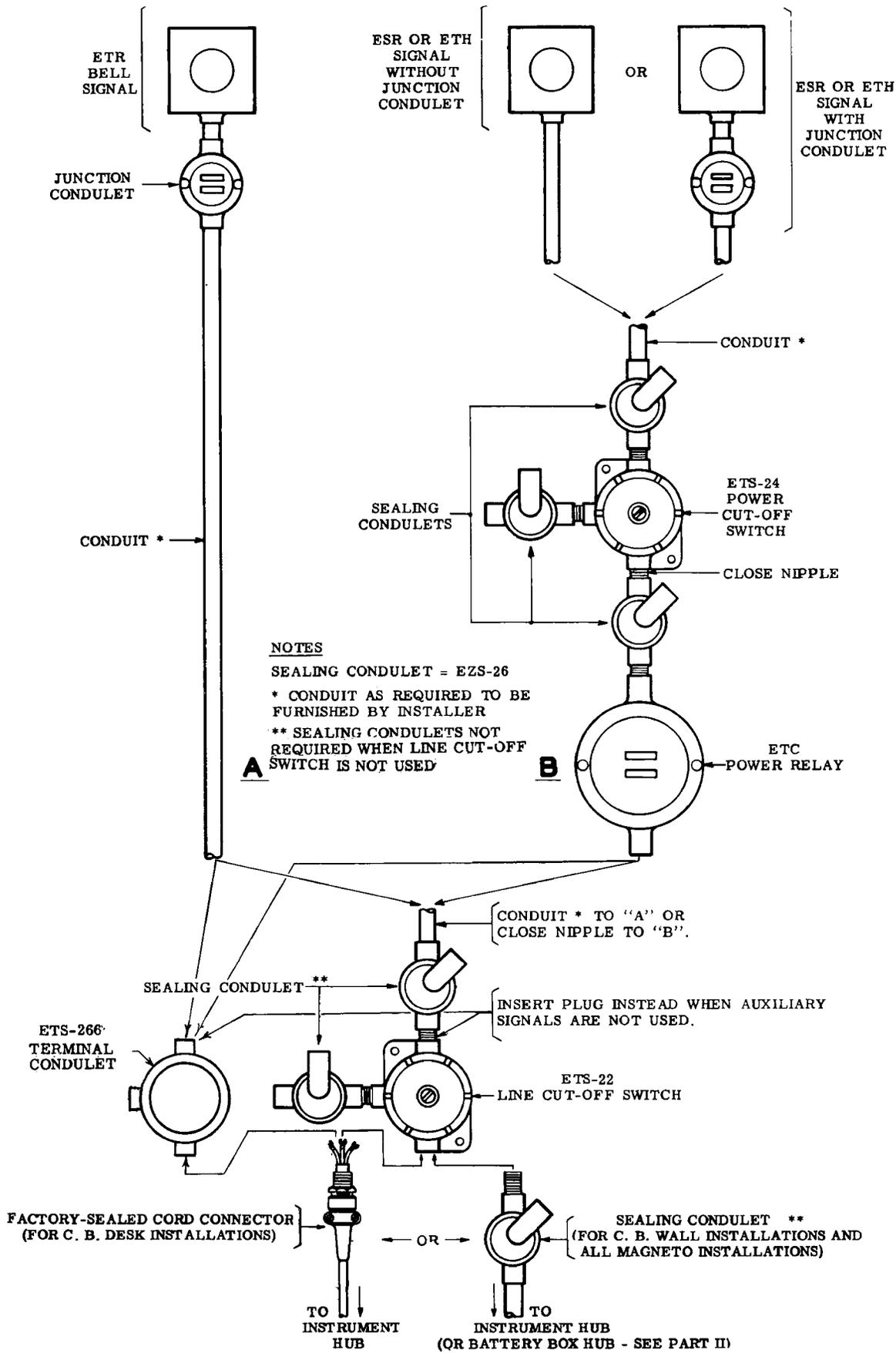


Fig. 7: Assembly of Equipment Units

COMMON-BATTERY INSTALLATIONS

6.3 Installation Procedures—Mechanical

(Refer to Figures 5 and 7 for all explanations.)

6.31 Wall Installation without Auxiliary Signal

Units employed: (1) Wall-mounting instrument (2) line cut-off switch.

- (a) Determine desirable location for instrument.
- (b) Using the instrument and its associated mounting plate as a template, mark off the four, $\frac{3}{32}$ " mounting holes on the desired vertical surface.
- (c) Drill the required four holes in the mounting surface.
- (d) Screw an EZS-26 sealing Condulet into the side and bottom hubs of the line cut-off switch. The male hubs of these Condulets fit the cut-off switch hubs. Seal the top (unused) hub of the line cut-off switch with the threaded plug provided for this purpose.
- (e) Screw a short length of conduit (about 10 inches) into the bottom sealing Condulet on the line cut-off switch.
- (f) Grasp the cut-off switch-conduit assembly and screw the other end of the conduit into the end hub of the instrument base to make the instrument-switch assembly.
- (g) Fasten the instrument-switch assembly to the wall by means of the mounting plate on the instrument base and the mounting lugs on the cut-off switch housing. Use lag screws and other suitable fasteners. The assembly can be mounted so that the cut-off switch is located either above or below the instrument since the cover of the instrument is reversible on the base and can be made to assume the correct position for use.
- (h) Install fuse block and line protector in accordance with the instructions given in Section 5.
- (i) Install conduit between the fuse block and the sealing Condulet at the side hub of the line cut-off switch. Observe precautions given in Section 6.2.
- (j) Ground both conduit system and line protector as outlined in Section 7.
- (k) Install wiring and complete installation as outlined in Section 6.4.

6.32 Wall Installation with Auxiliary, Type ETR Bell Signal

Units employed: (1) Wall-type instrument (2) line cut-off switch (3) loud bell (Type ETR) signal.

- (a) Follow steps a, b, and c of Section 6.31.
- (b) Screw an EZS-26 sealing Condulet into each of the three hubs of the line cut-off switch. The male end of the sealing Condulet fits to the switch hub.
- (c) Follow steps e and f of Section 6.31 to make the instrument-switch assembly.

(d-1) If the loud signal is to be located in a vertical line above the instrument:

- (1) Screw a length of conduit into the sealing Condulet atop the line cut-off switch. The length of conduit employed here depends on the intended distance between the cut-off switch and the signal. Ordinarily, it is desirable to locate the signal at, or close to the ceiling.
- (2) Screw the bell signal assembly onto the other end of this conduit to complete the instrument-switch-signal assembly. (The ETR bell signal assembly consists of a bell signal and junction Condulet — see Section 3. It is the junction Condulet, therefore, which screws to the conduit.)
- (3) Bring this assembly to the desired location and fasten it securely to the supporting wall or pillar by means of the mounting plate on the instrument and the lugs provided on the cut-off switch and signal housings. Use lag screws or other suitable fasteners.

(d-2) If the loud signal is to be mounted at a distance from the instrument:

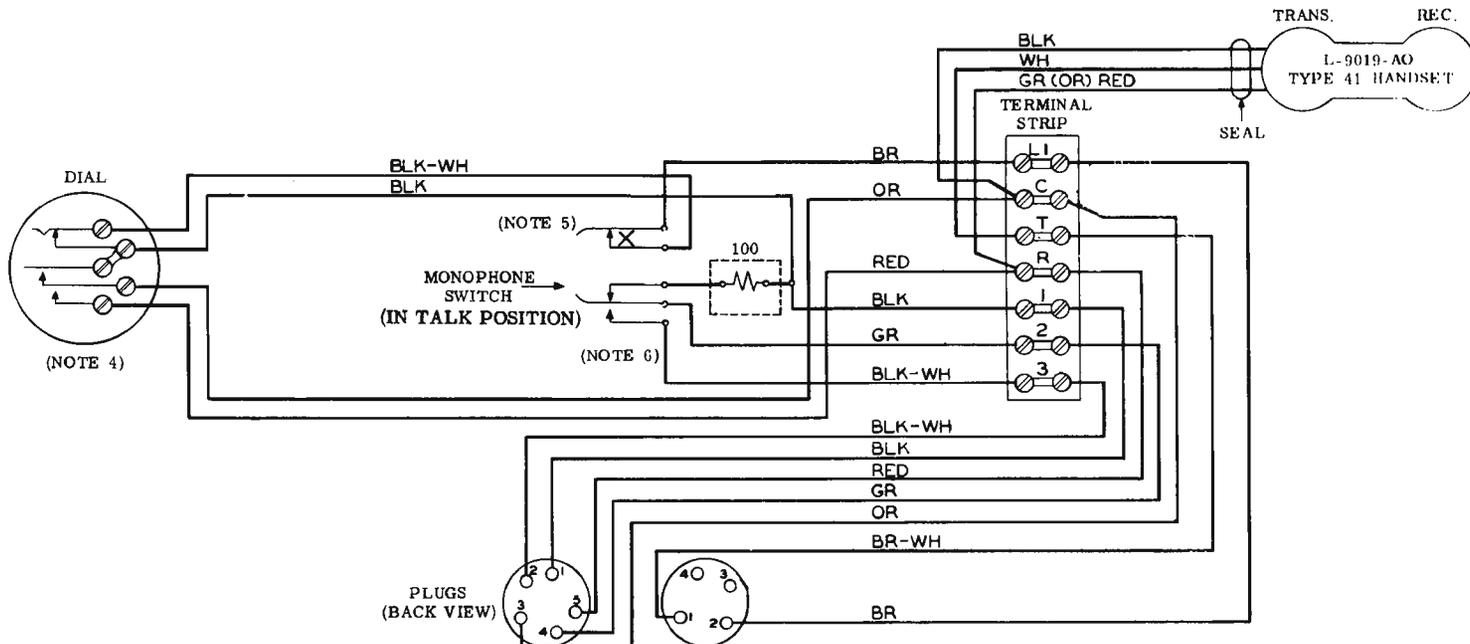
- (1) Bring the instrument-switch assembly to the desired location and fasten it to wall or pillar. See item "g" of Section 6.31.
- (2) Fasten the bell signal assembly to the wall (or pillar) at the desired distant location.
- (3) Install conduit between the junction Condulet of the bell signal and the sealing Condulet atop the line cut-off switch. Observe the precautions given in Section 6.2.

(e) Follow steps h, i, j and k of Section 6.31.

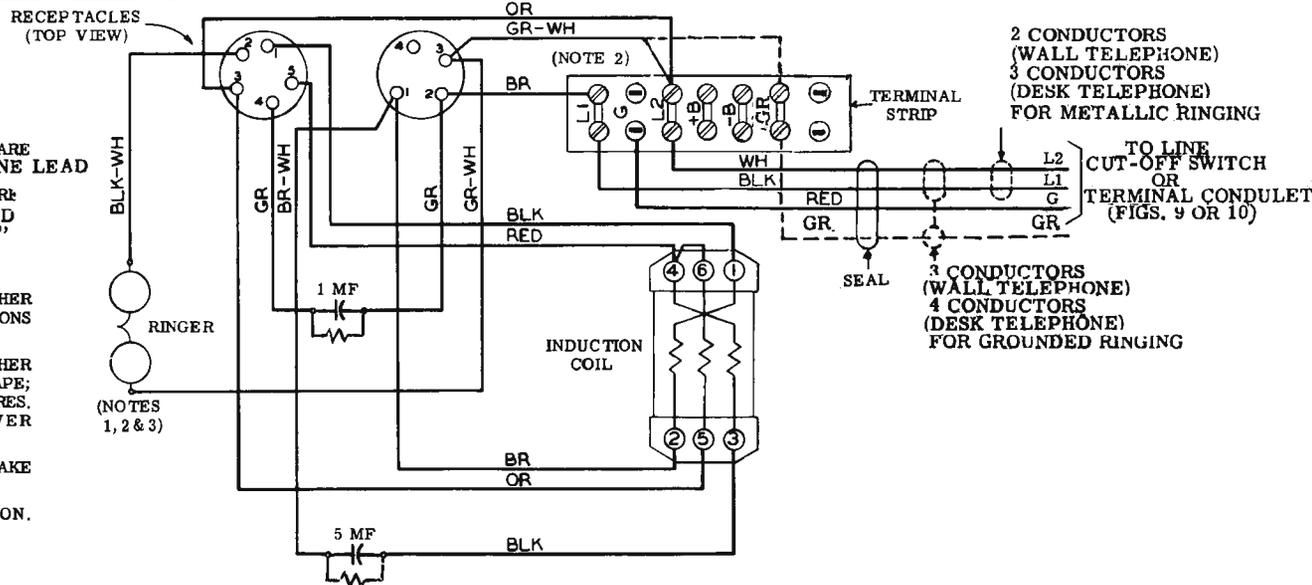
6.33 Wall Installation with Auxiliary Power-Operated Signal

Units employed: (1) Wall-type instrument (2) line cut-off switch (3) type ESR bell, or type ETH horn or siren (4) power relay (5) power cut-off switch.

- (a) Follow steps a, b and c of Section 6.31.
- (b) Follow step b of Section 6.32.
- (c) Follow steps e and f of Section 6.31 to make the instrument-switch assembly.
- (d) Screw EZS-26 sealing Condulets into the top hub of the power relay housing, and into the top and side hubs of the power cut-off switch housing.
- (e) Screw a $\frac{3}{4}$ inch close nipple into the sealing Condulet atop the power relay. Grasp the power relay housing and screw the other end of this nipple into the bottom hub of the power cut-off switch to complete the relay-power switch assembly.



**COVER
BASE**



NOTES

- 1 - FOR METALLIC RINGING, RINGER LEADS ARE CONNECTED AS SHOWN. TAPE "GR" LINE LEAD
- 2 - FOR GROUNDED RINGING, MOVE GR-WH WIRE TO "GR" ON BASE TERMINAL BLOCK AND CONNECT "GR" LINE LEAD TO "GR" TERMINAL.
- 3 - IF BELLS TAP WHEN DIALING FROM ANOTHER TELEPHONE ON LINE, REVERSE CONNECTIONS AT RINGER TERMINALS.
- 4 - WHEN NO DIAL IS USED, CONNECT TOGETHER LUGS OF BLK AND BLK-WH WIRES AND TAPE; TAPE INDIVIDUAL LUGS OF OR AND RED WIRES. THEN TUCK ALL WIRES UNDER COVER TERMINAL STRIP.
- 5 - CONTACTS "X" TO BREAK FIRST AND MAKE LAST.
- 6 - SPRINGS SHOWN IN TALKING POSITION.

2 CONDUCTORS
(WALL TELEPHONE)
3 CONDUCTORS
(DESK TELEPHONE)
FOR METALLIC RINGING

TO LINE
CUT-OFF SWITCH
OR
TERMINAL CONDULET
(FIGS. 9 OR 10)

3 CONDUCTORS
(WALL TELEPHONE)
4 CONDUCTORS
(DESK TELEPHONE)
FOR GROUNDED RINGING

Fig. 8: Wiring Diagram—Common-Battery Instrument

COMMON-BATTERY INSTALLATIONS

- (f) Screw a $\frac{3}{4}$ inch close nipple into the bottom hub of the power relay housing. Grasp the relay-power switch assembly and screw the other end of this nipple into the sealing Condulet atop the line cut-off switch to complete the instrument-line switch-power relay-power switch assembly.
- (g-1) If loud signal is to be located in a vertical line above the instrument:
- (1) Screw a length of conduit into sealing Condulet atop the power cut-off switch. The length of conduit employed here depends on the intended distance between the power cut-off switch and the auxiliary signal. Ordinarily, it is desirable to locate the signal at, or close to the ceiling.
 - (2) Screw the loud signal assembly onto the other end of this conduit to complete the instrument-line switch-power relay-power switch-signal assembly. Where the signal is equipped with a junction Condulet, this conduit will screw to the bottom hub of this Condulet. Where the signal has no Condulet, the conduit screws directly to the signal hub.
 - (3) Bring this complete assembly to the desired location and fasten it securely to the supporting wall or pillar by means of the instrument mounting plate (using the holes previously drilled in the wall) and the lugs on the housings of the various units. Use lag screws or other suitable fasteners.
- (g-2) If loud signal is to be mounted at a distance from the instrument:
- (1) Fasten the instrument-line switch-power relay-power switch assembly securely to the supporting wall or pillar by means of the instrument mounting plate (using the holes previously drilled in the wall) and the lugs on the housings of the various units. Use lag screws or other suitable fasteners.
 - (2) Fasten the auxiliary signal to the wall (or pillar) at the desired distant location.
 - (3) Install conduit between the hub of the distant signal and the sealing Condulet atop the power cut-off switch. If the signal is equipped with a junction Condulet, the conduit will be brought, instead, to the Condulet hub.
- (h) Install conduit between sealing Condulet at side hub of power cut-off switch and a source of 115-volt d-c or 60 cycle, single phase a-c commercial power depending on the signal requirements. Observe precautions given in Section 6.2.
- (i) Follow steps h, i, j and k of Section 6.31.

6.34 Panel Installations

Where the wall-type instrument is to be panel mounted, the procedures given in Sections 6.31, 6.32 or 6.33 are generally applicable, providing the other equipment units are to be located on the same side of the panel as the instrument.

When it is desirable to mount the line cut-off switch and other equipment units (if any) in a different location such as a nearby wall, or on the side of the panel opposite from the instrument, the conduit from these units can be brought through the panel to the underside hub of the instrument (see Fig. 5). A recommended procedure for this type of installation is as follows:

- (a) Determine location of the instrument on the panel.
- (b) Unscrew the 6 Allen-head bolts in the cover of the instrument and lift the cover. Remove the cabling plugs from the sockets in the base—then remove the cover.
- (c) Remove the threaded plug from the underside hub in the base and insert it in the end (unused) hub.
- (d) Using the base and its associated mounting plate as a template, mark the panel with the four $\frac{9}{32}$ " mounting holes and the underside hub entrance-way. If it is desirable to have incoming conduit enter at the highest possible level without changing the intended location of the instrument, position the base when marking, so that the underside hub is "up" with respect to the floor.
- (e) Drill the five holes in the panel. Make certain the hole for the underside hub entrance-way is sufficiently large ($1\frac{1}{4}$ inches) to pass $\frac{3}{4}$ inch conduit.
- (f) Fasten the base to the panel with bolts.
- (g) Screw EZS-26 sealing Condulets into the line cut-off switch hubs. Condulets are required only on the side and bottom hubs when auxiliary signals are not employed. Assemble the line cut-off switch to the other units (power relay, power switch, signal—if used) following, in general, the instructions given in Sections 6.32, 6.33 and Figure 7 for the respective types of installations.
- (h) Mount the line cut-off switch and the units (if any) assembled to it, at the desired location (back of panel or nearby wall, etc.).
- (i) Install conduit between the bottom sealing Condulet of the line cut-off switch and the underside hub of the panel-mounted instrument base.
- (j) Follow steps h and i of Section 6.31. Also follow step h of Section 6.33 if required.
- (k) Follow steps j and k of Section 6.31 to complete the installation.

6.35 Desk Installations

Where a desk installation is desired, the line cut-off switch and other units (if any) are assembled (see Fig. 7) and then mounted on any surface (wall or pillar) convenient to the desk. If the desk is centrally located so that no vertical mounting surfaces are adjacent, then the line cut-off switch may be mounted on the side of the desk. In this instance, the other units (if any) can be separately assembled and mounted a distance away on a suitable vertical surface with conduit installed between these units and the line cut-off switch.

Regardless of the arrangement chosen, the desk instrument is connected to the line cut-off switch by means of a flexible line cord assembly which has a threaded, factory-sealed connector at each end. This cord assembly is furnished with one end already attached to the instrument. The connector at the other end of this cord screws directly into the lower hub of the line cut-off switch, no sealing Condulet being required (see item e, Sec. 6.2).

The procedure for assembling the line cut-off switch to the other units (if any) and for installing the required conduit to these units is the same as indicated in Sections 6.31, 6.32, 6.33 and Figure 7 depending on the respective types of installation desired (signal, no signal, location, etc.). Directions for installing the necessary wiring and for completing the installation are given in Section 6.4 below.

6.4 Directions for Wiring and

Completing Telephone Installations

The wiring procedure for a given telephone installation depends principally upon the number of units employed in the installation. Accordingly, three wiring procedures are presented below to conform with the three principle unit assemblages as follows: (1) Instrument and line cut-off switch, (2) Instrument, line cut-off switch and auxiliary (type ETR) bell signal, (3) Instrument line cut-off switch, power relay, power cut-off switch and power operated auxiliary signal. In general these three procedures parallel each other, the main differences occurring in the number of wiring steps required. See Section 9.1 for instructions regarding the removal of housing covers.

6.41 Wiring Procedure for Installation Consisting of Instrument and Line Cut-Off Switch

- (a) Turn line cut-off switch to "Off" position. Remove cover from housing, then remove switch from housing.
- (b) Remove fuses from fuse block and line protector.
- (c) Unscrew the 6 Allen-head bolts in the cover of the wall or panel-mounting instrument, lift the cover and remove the cabling plugs from the sockets in the base; then remove the cover. (Removal of the cover may have already been accomplished in the case of certain panel installations — see Section 6.34.) It is not necessary to remove the cover of the desk type instrument unless grounded ringing, which necessitates a wiring change, is required.
- (d-1) *For the wall installation* requiring metallic ringing, pull two wires (one black — one white, see item g, Section 6.1) through the conduit between the instrument base and line cut-off switch. If grounded ringing is to be employed, use three wires colored white, black and red (or green) respectively.
- (d-2) *For the desk installation*, insert the wires at the free end of the line cord assembly into the line cut-off switch housing through the bottom hub of

this housing. Then screw the threaded connector into this hub (see item e, Sec. 6.2). These line cord leads are colored white, black, red and green respectively.

- (e) Pull one pair or 3 conductors of #19 weatherproof telephone wire (without splices—see item h, Section 6.1) through the line circuit conduit which extends from the line cut-off switch and associated sealing condulet to the fuse block terminals. Connect these wires to the proper terminals of the fuse block and ground if ground ringing is employed. See Section 5.
- (f) In the instrument base, connect the wires just installed, to the terminals on the base terminal strip as indicated in Figure 8. Note that for grounded ringing an additional green lead is connected to terminal "GR" of the base terminal strip, the green-white ringer lead is moved to terminal "GR". (Desk type instruments are furnished wired for metallic ringing. No additional internal connections are therefore required unless grounded ringing is to be employed. In this case, it is only necessary to relocate the green-white ringer lead as described above and in Figure 8. Where metallic ringing is to be employed for the desk installation, however, make certain that the lug at the line-switch end of the green line cord lead, is properly insulated.) Replace the instrument cover on the base taking care to insert the cabling plugs into the base sockets. Make certain that the cabling between these sections does not foul up into the dial mechanism or the ringer movement.
- (g) Connect the wires from the instrument and the wires from the fuse block to the line cut-off switch as shown in Figure 9 (metallic ringing) or Figure 10 (grounded ringing). It should be noted that the rear terminals of the line cut-off switch are first connected with a copper jumper as shown. The switch is then remounted in the housing and the incoming wires connected. Replace cover on line switch housing and make certain switch is in "Off" position.
- (h) Fill all sealing Condulets with approved sealing compound. See Section 8, "Filling the Sealing Condulets."
- (i) Before placing telephone in service, first check to see that; (1) the covers of all housings are securely in place, (2) all unused conduit hubs are plugged and (3) all sealing Condulets (in the conduit system and between units) are sealed and plugged.
- (j) Replace fuses of the fuse block and protector and turn line cut-off switch to "On" position.

6.42 Wiring Procedure for Installation Consisting of Instrument, Line Cut-Off Switch and Bell Signal (Type ETR)

- (a) Follow steps a, b and c of Procedure 6.41.

COMMON-BATTERY INSTALLATIONS

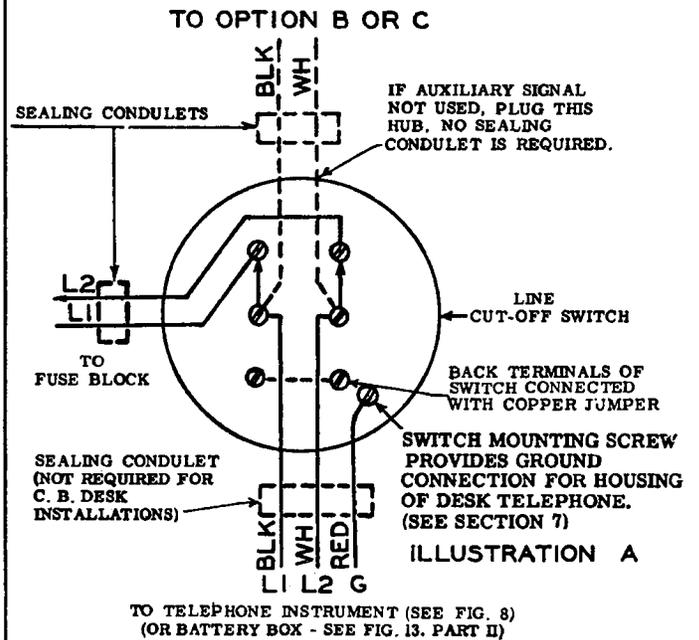
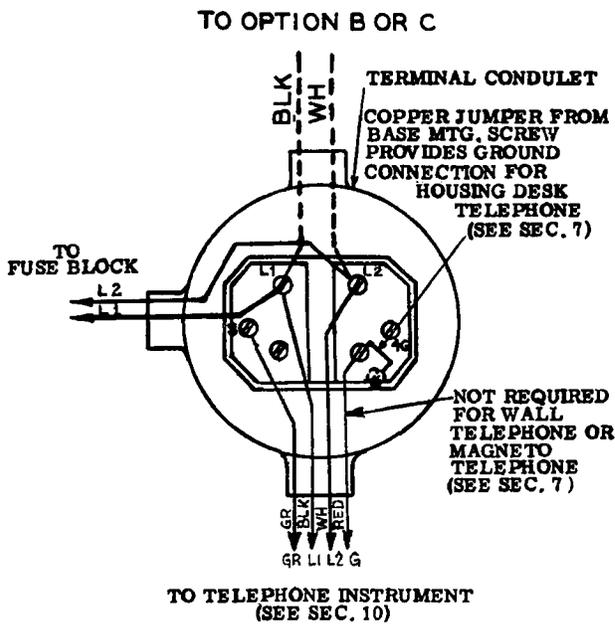
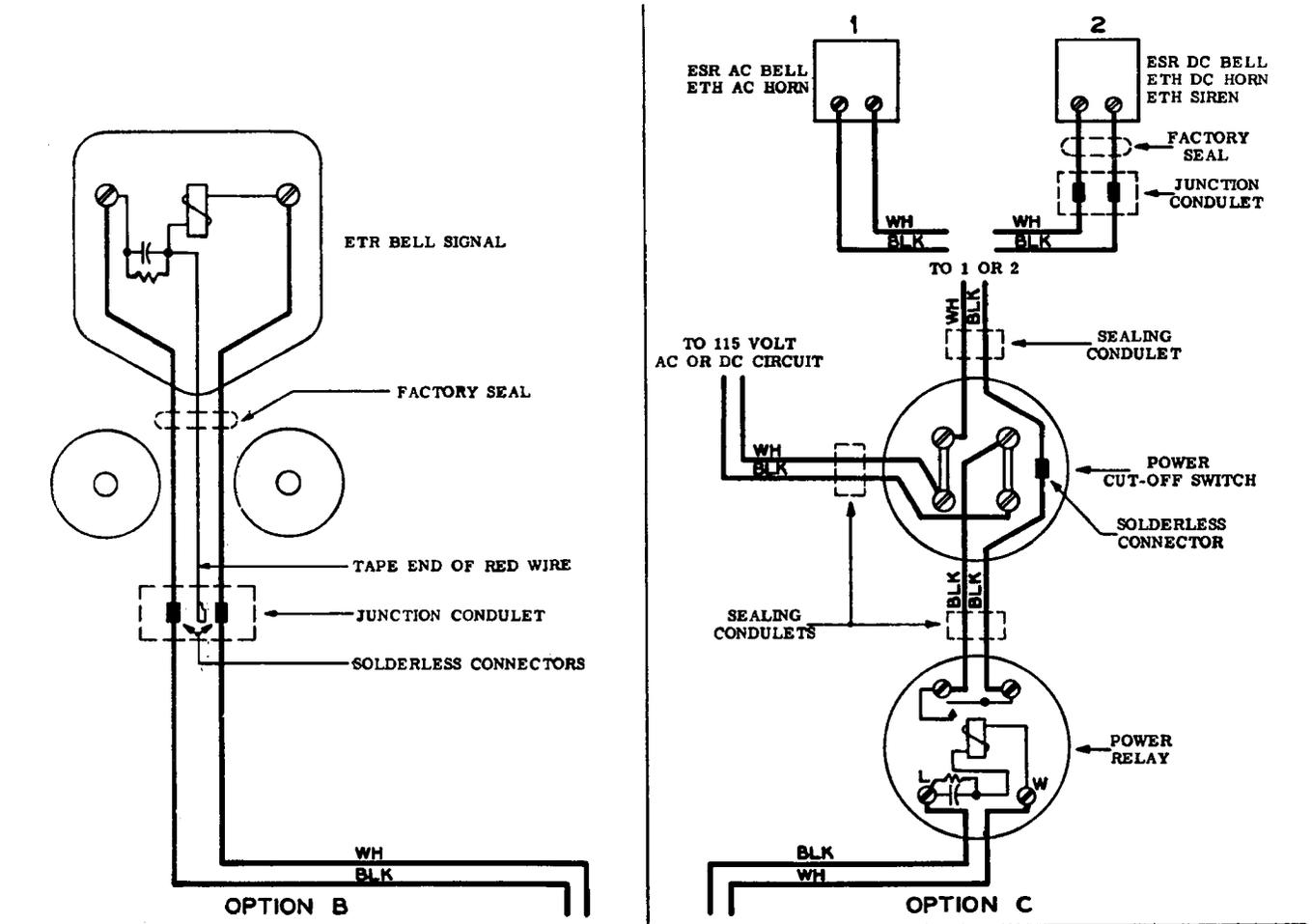


Fig. 9: Wiring Plan—Metallic Ringing

- (b) Remove cover from junction Condulet of bell signal and pull out the ends of the bell signal wires. Tape the end of the red wire as it is not employed.
 - (c) Follow steps d, e and f of Procedure 6.41.
 - (d) Pull two wires (without splices) from the line cut-off switch housing to the junction Condulet of the bell signal. These wires should be colored white and black respectively — see Section 6.1, item g.
 - (e) Splice the wires just extended to the junction Condulet, to the loud signal wires in the Condulet. Connect these wires color to color by means of two Sherman #502 solderless connectors. Insulate the two splices with rubber and friction tape wrappings. Locate the splices carefully in the junction Condulet and replace the Condulet cover.
 - (f) Connect the wires from the instrument, the fuse block and auxiliary signal, to the line cut-off switch as shown in Figure 9 (metallic ringing) or Figure 10 (grounded ringing). It should be noted that the rear terminals of the line cut-off switch are first connected with a copper jumper as shown. The switch is then remounted in the housing and the incoming wires connected. Replace cover on line switch housing and make certain that switch is in “Off” position.
 - (g) Follow steps h, i and j of Procedure 6.41.
- 6.43** Wiring Procedure for Installation Consisting of Instrument, Line Cut-Off Switch, Power Relay, Power Cut - Off Switch and Power - Operated Auxiliary Signal
- (a) Follow steps a, b and c of Procedure 6.41.
 - (b) Remove covers from power relay housing, power cut-off switch housing and junction Condulet of loud signal. Remove power relay and power cut-off switch from respective housings. Pull out the ends of the loud signal wires from the junction Condulet. (If loud signal is not equipped with junction Condulet, remove cover from signal housing — see Section 9.1 — and remove signal mechanism.)
 - (c) Follow steps d, e and f of Procedure 6.41.
 - (d) Pull two wires colored white and black respectively (see item g, Section 6.1) from the line cut-off switch housing to the power relay housing.
 - (e) Pull two #14 black wires (item 1, Section 6.1) from the power relay housing into the power cut-off switch housing.
 - (f) Remove fuses from the 115-volt commercial power source so that the power circuit will be “dead” while work is being performed.
 - (g) Pull two #14 wires (one black—one white, item i, Section 6.1) through the conduit which extends from the side hub of the power cut-off switch to the 115-volt commercial power source. Connect the two #14 wires to the power fuse terminals. Connect the black wire to the “live” terminal and the white wire to the “ground” terminal.
 - (h) Pull two #14 wires (one black—one white, item i, Section 6.1) from the power cut-off switch housing into the junction Condulet of the loud signal. If the loud signal is not equipped with a junction Condulet, pull these wires directly into the signal housing.
 - (i) Follow step e of Procedure 6.42 where signal is equipped with junction Condulet. If signal is not equipped with a junction Condulet, connect the wires just extended to the signal housing (see item h above) to the binding screw terminals on the signal mechanism. Replace mechanism in signal housing and replace cover on housing (see Section 9.4).
 - (j) Connect 4 of the 6 leads now in the power cut-off switch housing to the power cut-off switch as shown in Figures 9 or 10. Observe wire colors when making these connections. Then splice the black lead from the signal junction Condulet (or signal proper) to a black lead from the power relay. Use a Sherman #502 solderless connector. This connection should be insulated with rubber and friction tape. Remount power cut-off switch in housing and replace cover. Make certain switch is in “Off” position.
 - (k) Connect the 4 leads in the power relay housing, to the power relay as shown in Figures 9 or 10. Observe wire colors when making connections. Remount power relay in housing and replace cover on housing.
 - (l) In the line cut-off switch housing, connect the wires from the power relay, fuse block and instrument, to the line cut-off switch as shown in Figure 9 (metallic ringing) or in Figure 10 (grounded ringing). It should be noted that the rear terminals of the switch are first connected with a copper jumper as shown. The switch is then remounted in the housing, and the incoming wires connected.
Replace cover on the housing. Make certain switch is in “Off” position.
 - (m) Follow steps h and i of Procedure 6.41.
 - (n) Replace fuses of fuse block and protector and the power service supply, then turn line cut-off switch and power cut-off switch to “On” position.

7. GROUNDING

7.1 Grounding Line Protector

Connect the ground terminal of each telephone line protector to a low resistance ground such as an underground water pipe system. Use insulated wire of not less than #14 gauge. Run the ground wire as directly as possible — avoid sharp bends — make no other attachments to the ground wire—make certain that the ground wire is located so as to be protected from mechanical injury.

Attach the ground wire to the water pipe with an approved ground clamp—see item e, Section 6G. Secure

COMMON-BATTERY INSTALLATIONS

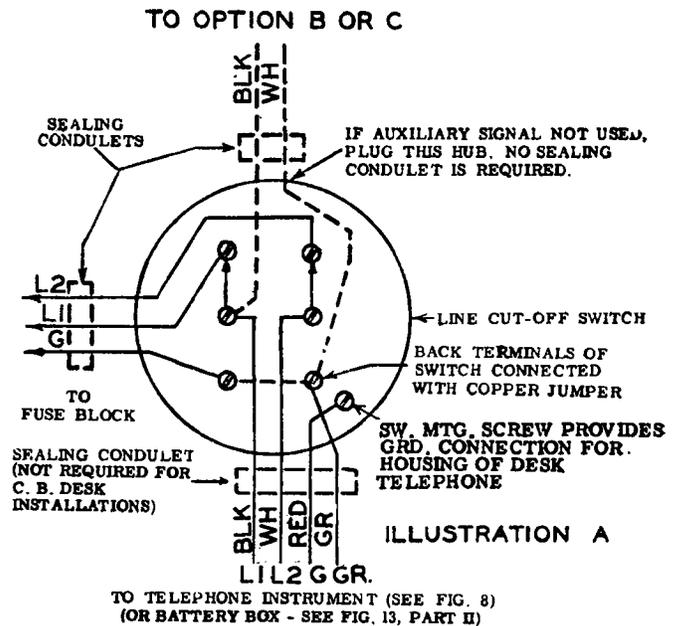
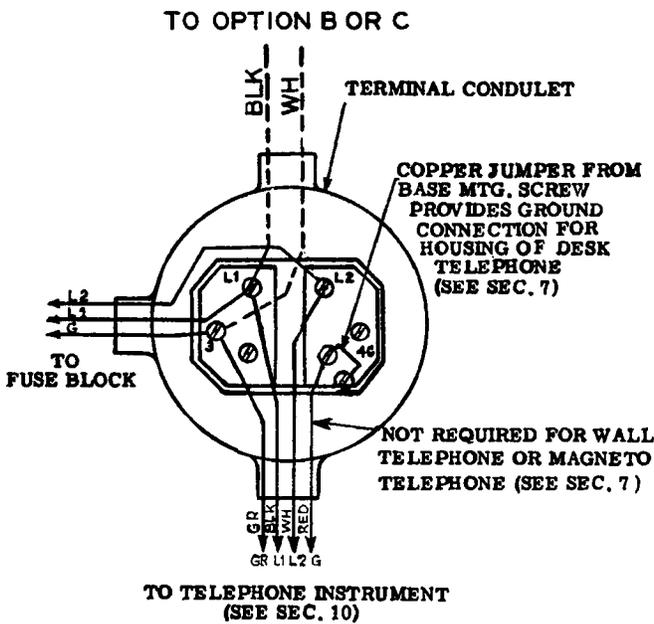
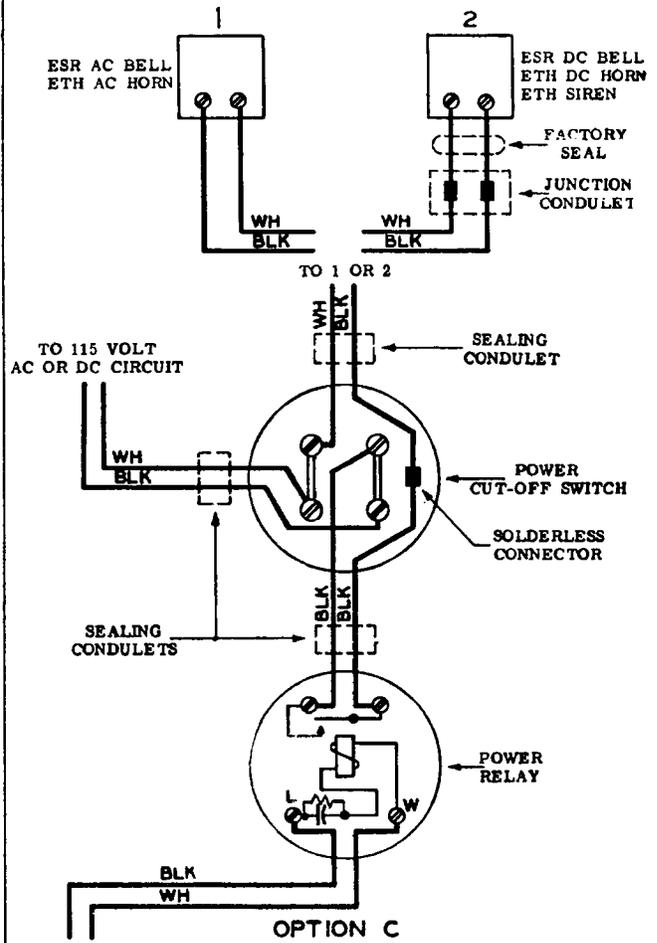
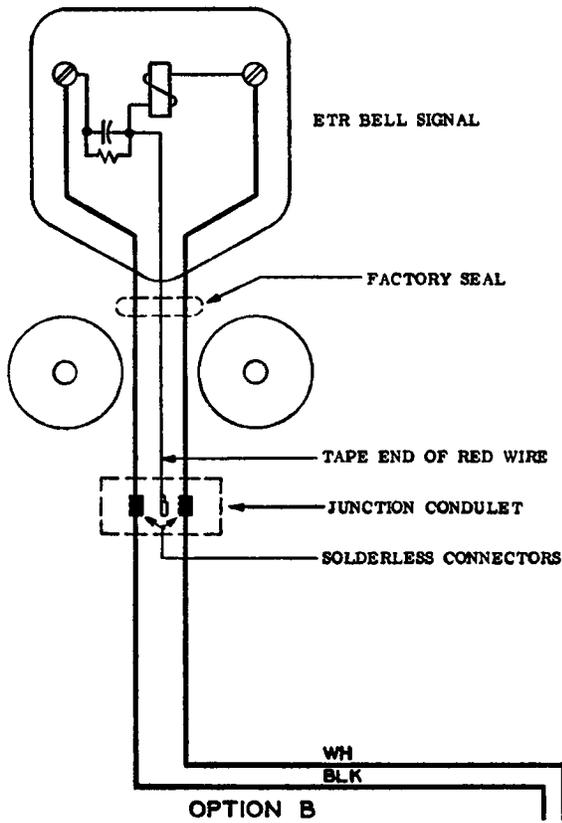


Fig. 10. Wiring Plan—Grounded Ringing

the ground wire to the ground clamp and attach the clamp to the street side of the water meter. Clean the surface of the water-pipe thoroughly before attaching the clamp.

If the street side of the water meter is not readily accessible, or is located at too great a distance from the line protector, the connection may be made on the building side of the water meter to the nearest available water pipe. In this case, however, it is necessary to insure a good ground to the water pipe network on the building side, by shunting the water meter. A meter shunt for this purpose is listed in Section 6.1, item f. This shunt consists of two ground clamps connected together with two feet of #4 Copperweld wire. To shunt the meter, simply attach one clamp of the assembly to the water pipe on each side of the meter. Make certain the pipes have been properly cleaned beforehand.

7.2 Grounding Conduit System and Telephone Housing

The conduit system associated with the telephone installation must also be thoroughly grounded. This is generally accomplished by grounding the line circuit conduit in a manner similar to that outlined in Section 7.1 above. Use a ground clamp to connect the ground wire to the conduit.

When several telephone installations have been made in one locale and the conduit systems of each are not interconnected metallically at any point, it is necessary to ground each system separately. Where two or more conduit systems have conduit-runs adjacent to each other, these runs may be bonded together with pipe clamps and wire. It is then necessary to ground only one system as the other systems receive ground at the point of bonding.

Since the telephone has no metallic connection with the grounded conduit system it is necessary to ground its housing by means of a third conductor (red) in the line cord. The connection is made as shown in figures 9 and 10.

7.3 Grounding for Grounded Ringing

The grounded conduit should not carry any circuit currents; hence for ground ringing it is required that a third conductor be carried through the conduit along with two line leads, from a grounded terminal in the fuse block. Ground can be obtained in a manner similar to that described in Section 7.1 above. A terminal is provided on the fuse block for this purpose. The fourth conductor (green) in the line cord of the desk telephone should be terminated as shown in figure 10.

8. FILLING THE SEALING CONDULETS

EZS-2 and EZS-26 sealing Condulets are fitted with threaded covers which incorporate filling tubes. The filling tube can be brought into position for filling, by simply turning the cover, regardless of the angle at which the Condulet is mounted. A threaded plug is furnished to close the filling tube on the Condulet cover. Before filling the Condulet with an approved sealing

compound, it is necessary to place a dam around the wires in one or both hubs of the Condulet, in order to prevent the sealing compound from running out into the connecting conduits. It is obviously not necessary to dam the Condulet hub from which the conduit extends upward. The most suitable material for making the dams, is a fairly long fibre asbestos or the specially prepared fibre "Chico X" listed in Section 6.1, item 1.

To make a dam, remove the Condulet cover and pack the fibre or other material tightly around and between the wires in the Condulet hub. A small hard stick makes a convenient tool for packing the material solidly so that compound will not pass through. Each hub requires about $\frac{1}{16}$ ounce of Chico X fibre. Caution: Before pouring the compound, make certain that sufficient slack wire has been left in the equipment housings (cut-off switches, power relay, etc.) so that these devices may be removed for inspection or servicing without difficulty after the seals have been made.

To fill the sealing Condulet, replace the cover on the Condulet and completely fill the Condulet with compound through the filling tube. Then close the tube immediately by inserting and tightening the threaded plug.

Use an approved type of compound such as the "Chico A" listed in Section 6.1, item 1. This is mixed with water and is available in packages or cans of several sizes. About 6 ounces of compound are required for each Condulet. Directions for mixing are furnished on each package.

9. SERVICING PRECAUTIONS

9.1 Opening Unit Housings

It is imperative that the greatest care be exercised in "de-activating" the entire telephone installation before attempting to open any of the unit housings for service or inspection. To insure safety, therefore, all operations outlined in the following instructions must be carried out in the exact sequence specified before any of the housings are opened:

- (a) With a screw driver turn the line cut-off switch to "Off" position. This disconnects the line wires from the telephone and discharges the instrument condensers.
- (b) Remove fuses from fuse block and line protector to make the line wires to the line cut-off switch "dead".
- (c) When the installation is equipped with a power cut-off switch, turn this switch to "Off" position with a screw driver. This disconnects the 115-volt commercial power source from the associated power relay and auxiliary signal. Also, remove the fuses from the 115-volt power service supply to make the power wires to the power cut-off switch, "dead".

Any or all units of the telephone installation may now be opened with safety. Units equipped with threaded (screw-on) covers such as cut-off switches, relays, auxiliary bell signals and junction Condulets, are easily

COMMON-BATTERY INSTALLATIONS

opened by means of a screw driver employed as a ram or lever against the bosses on the covers.

Horn signals are disassembled by loosening a set screw and removing the large threaded clamping ring. The complete horn mechanism may then be removed from the housing.

To remove the covers from siren signals, remove the six machine screws which fasten the cover to the signal unit housing. These screws are on the periphery of the cover and are not to be confused with other (smaller) screws that may be on the cover assembly. Covers of the siren signals are recessed somewhat into the housing with a very small clearance and may tend to bind. Gently rocking the cover from side to side will help to break the air seal and allow the cover to be worked off.

To remove the cover of the instrument, first unscrew the 6 Allen-head bolts in the cover. Then lift the cover, pull the cabling plugs from the base sockets — then remove the cover.

9.2 Handset-Cord Assembly and Line Cord Assembly

The handset and cord, code #L-9019-AO has been specially designed for use with these telephones. The cord is sealed in the handset during manufacture and cannot be replaced on site. Do not attempt repairs on the handset and do not replace the handset-cord assembly with a standard type. It is advisable to keep one or more of these special assemblies on hand as spares. Order from Automatic Electric Company under the above designated code number. When an assembly has developed faults, replace with a new assembly and send the old one to Automatic Electric Company for repair.

To remove the handset-cord assembly from the instrument, first de-activate the entire installation as described in Section 9.1. Then remove the cover of the instrument. Disconnect the handset cord from the terminal strip in the cover. Unscrew the factory-sealed connector from the hub and remove the entire handset-cord assembly.

If the line cord assembly of the desk type instrument should become damaged, de-activate the installation as described in 9.1, remove the cover of the instrument and remove the line cord assembly from the instrument base in the same manner as described above. (Factory-sealed connectors on the line cord assembly ordinarily screw directly into the hubs.) Also, open the line cut-off switch housing and disconnect the line cord leads from the switch terminals. Then unscrew the cord connector from the hub of the cut-off switch housing (see item e, Sec. 6.2).

To re-install the handset-cord assembly or the line cord assembly, simply follow the procedure above in reverse. Insert the leads at the ends of the cords through the hubs and into the housings. Screw the connectors into the respective hubs. Then connect the cord leads to the proper terminals and replace the covers.

9.3 Returning Telephone Installation To Service

To insure safety in returning a telephone installation to

service after it has been de-activated for repairs or inspection, the following instructions must be carried out in the exact sequence specified.

- (a) Make certain that all covers have been replaced on all units of the installation.
- (b) Replace fuses in fuse block and line protector.
- (c) Where the installation employs 115-volt commercial power (for certain auxiliary signals) replace fuses at the power service supply. Also, turn the power cut-off switch to "On" position with a screw driver.
- (d) Turn the line cut-off switch to "On" position with a screw driver. The telephone may now be used for making or receiving calls.

9.4 Replacing Covers

Cover threads should be treated occasionally with Crouse-Hinds "STL" thread lubricant or equivalent to prevent seizing. When replacing recessed covers such as appear on the siren signal housings, see that no particles of dirt or grit adhere to the joint surfaces of the housing and cover. Replace cover carefully and without much pressure or otherwise the cover may bind. Gently rocking the cover from side to side will prevent binding and assist in releasing the air trapped in the housing. Tighten cover screws, where used, uniformly.

10. INSTALLATION PROCEDURE WHEN LINE CUT-OFF SWITCH IS NOT USED

All telephone and loud signal circuits incorporate "bleeder" resistors for the purpose of discharging the internal condensers, thus making the use of the line cut-off switch, mentioned in the preceding pages, optional.

To open the line it is necessary to remove the fuses from the fuse block and protector located outside the hazardous area. Where the line cut-off switch normally serves as a junction for line wires from the fuse block and line cord from the desk telephone or connections from auxiliary signals, an ETS-266 terminal conduit can be used in place of the ETS-22 line cut-off switch. Connections to the terminal conduit are similar to those for the cut-off switch (see figures 9 and 10).

The terminal conduit is equipped with three hubs (the same as the line cut-off switch) and line cord, line leads and auxiliary signal leads enter in the same manner (See figure 7). With the use of the terminal conduit it is not necessary to insert sealing condulets at each hub used, but merely bring the conduit directly to the terminal conduit.

In case of a wall installation with no auxiliary signals, either common battery or magneto, it is possible to omit both the line cut-off switch and terminal conduit, bringing the line conduit directly into the telephone hub or battery box hub.

Various installation procedures covered in the preceding pages should be followed and wherever "line cut-off switch" is referred to it can be interpreted as "line cut-off switch or terminal conduit."



Fig. 11: Desk-Type Magneto Instrument

PART II

MAGNETO INSTALLATIONS

1. INTRODUCTION

Magneto-type telephones are also available for use in hazardous locations where common-battery service is not available or economically practical. These telephone installations embody the same constructional principles described for the common-battery variety in Part I (see Introduction) and afford the same protection against possible ignition of explosive atmospheres. Instruments for these installations are available in both the desk and wall-mounting types. The procedure for installing these telephones is closely similar to that employed for the common-battery types (see Part I, Sec. 4). The prime difference exists in the use of a Type ETG-29 battery-box for the magneto installation. This unit is introduced in the unit assemblage between the instrument and line cut-off switch.

Auxiliary loud signals (see Part I, Sec. 3) may also be incorporated into the basic magneto installation (magneto instrument, battery box and line cut-off switch). The variety of magneto telephone installations resulting therefrom may be classified as follows:

Desk or Wall-Mounting Installations

- (1) Magneto (enclosed ringer only)
- (2) Magneto with Loud (Type ETR) Bell
- (3) Magneto with Loud (Type ESR) Bell
- (4) Magneto with (Type ETH) Horn Signal
- (5) Magneto with (Type ETH) Siren

The signals named under items 3, 4 and 5 in the above list, are power operated. Installations incorporating these signals, therefore, require the inclusion of two additional units; (1) power relay (CH Type ETC) and (2) power cut-off switch (CH Type ETS). See Part I, Section 3.

Provision is made in these installations, for either metallic or grounded ringing. The wall-type instruments are shipped wired for metallic ringing but a simple wiring change accomplishes the conversion to the grounded plan. Desk instruments are ordinarily wired for metallic ringing and are equipped with the corresponding line cord. However, if grounded ringing is specified a different line cord is provided and the instrument wiring modified accordingly before shipment. Installations may also be converted to common-battery manual service (see Sec. 6).

1.1 Magneto Telephone Instruments

Figure 11 reveals the similarity of construction between the magneto and common-battery type telephones. As with the latter, the magneto telephone also consists of two cast aluminum sections (cover and base) held together with six Allen-head bolts (see Part I, Sec. 2). The base of the magneto instrument is physically identical with that of the common-battery type while the cover is dissimilar in that it carries no dial or dial aperture but instead, is designed to house the magneto. The magneto is actuated by a crank, the shaft of which is keyed to the magneto shaft. The magneto shaft works in a special tight bushing; the crank shaft and this bushing also form a very tight joint.

Hub locations and base-mounting arrangements are the same as stated for the common-battery telephone (Part I, Sec. 2). Connection between the desk instrument and battery box is made through a flexible, heavily insulated cord assembly equipped at the ends with factory-sealed connectors (Fig. 12). A 5-conductor cord is furnished as standard equipment and provides facilities for metallic ringing. A 6-conductor cord assembly, required if grounded ringing is to be employed, is obtainable upon request.

A line cord assembly is not furnished with the wall-mounting instrument since it is assembled to the battery box with conduit or a close nipple and the wiring is thereafter completed through these vessels. The wiring diagram of the magneto instrument is given in Figure 13.

2. TELEPHONE LINE PROTECTION

Each telephone line must be equipped with an approved type of fuse block and line protector as a safeguard against lightning discharges and possible external crosses with power circuits. Install these units in accordance with the instructions given in Part I, Section 5.

3. TELEPHONE INSTALLATION PROCEDURE

All NE Code Requirements and local ordinances governing the installation of electrical equipment in hazardous areas, should be carefully observed.

It is suggested that all apparatus and material be unpacked and assembled at a non-hazardous location and brought to the installation site as required. Care should

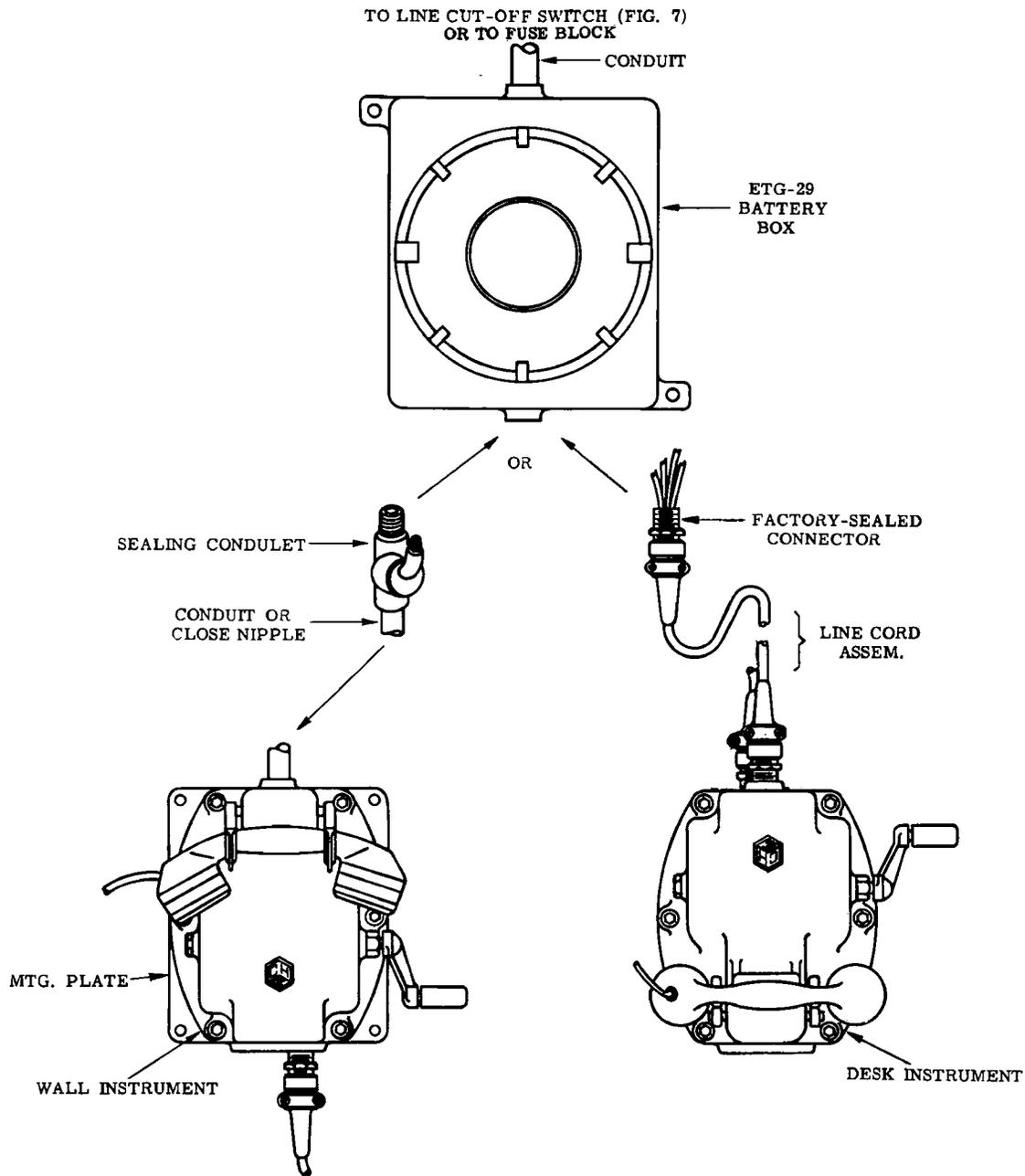


Fig. 12: Assembly of Battery Box to Desk or Wall Instrument

be exercised during installation work, to prevent possible sparks resulting from the rough handling of materials, tools, etc.

3.1 Installing Material

All installing material such as conduit, sealing Condulets, protectors and other materials, are to be provided by the purchaser unless otherwise specified. For ordering purposes, this material may be identified from the list given in Part I, Section 6.1. In addition to the supplies listed in this section, the following material will be required for magneto installations:

- (a) 3-volt telephone battery; use Burgess #4F2H or Ray-O-Vac #386-C.

3.2 Precautionary Notes for Installers

The precautions listed in Part I, Section 6.2 must be observed when a magneto-telephone installation is made.

3.3 Installation Procedures—Mechanical

The procedures for assembling and installing the various magneto installations closely parallels those given for the corresponding common-battery installations in Section 6.3 of Part I. In fact, the assembly of equipment units (indicated by Figure 7) is virtually the same. The essential difference arises from the inclusion of the battery box in the basic installation. This unit is introduced between the instrument and line cut-off switch.

It is assembled to the line cut-off switch (and accompanying units, if any—Figures 7 and 12) with conduit (or close nipples) and a sealing Condulet.

Conduit is also employed to assemble the wall-mounting instrument to the battery box and the entire unit assemblage is mounted on a suitable vertical surface (see Part I, Sec. 4). In a desk installation, however, the instrument is associated with the battery box (and accompanying units) by means of a flexible line cord equipped with the proper terminations. The base reversing feature of the magneto instrument offers the same advantages outlined for wall or panel installations in Part I, Section 2.

The information following gives mechanical installation procedures for the various wall, panel and desk installations. Wherever these procedures follow those given in Part I and it is convenient to do so, the reader will be referred to the applicable sections. Refer to Figures 7 and 12 for all procedures.

3.31 Wall Installation without Auxiliary Signal

Units employed: (1) Wall-mounting instrument (2) battery box (3) line cut-off switch.

- (a) Determine desirable location for instrument.
- (b) Using the instrument and its associated mounting plate as a template, mark off the four 9/32" mounting holes on the desired vertical surface.
- (c) Drill the required four holes in the mounting surface.
- (d) Screw an EZS-26 sealing Condulet into the bottom hub of the battery box. (Screw the Condulet into the top hub of the battery box if the equipment units are to appear below the instrument.)
- (e) Screw a short piece of conduit (2 to 4 inches) or a close nipple into the sealing Condulet now in one hub of the battery box.
- (f) Grasp the battery box and screw the other end of this conduit (or nipple) into the end hub on the instrument-base to make the instrument-box assembly.
- (g) Screw EZS-26 sealing Condulets into the side and bottom hubs of the line cut-off switch. Seal the top (unused) hub with the threaded plug provided for this purpose.
- (h) Screw a short length of conduit (about 10 inches) into the bottom sealing Condulet on the line cut-off switch.
- (i) Grasp the cut-off switch-conduit assembly and screw the other end of the conduit into the remaining hub on the battery box to make the instrument-box-switch assembly.
- (j) Fasten the instrument-box-switch assembly to the wall by means of the mounting plate on the instrument base (using holes previously drilled in the wall) and the mounting lugs on the battery box and cut-off switch. Use lag screws or other

suitable fasteners. The entire assembly can be mounted so that the battery box and switch are either above or below the instrument (see step d) since the instrument cover is reversible on the base and can be made to assume the correct position for use.

- (k) Install fuse block and line protector in accordance with the instructions given in Section 5 of Part I.
- (l) Install conduit between the fuse block and the sealing Condulet at the side hub of the line cut-off switch. Observe precautions given in Section 6.2 of Part I.
- (m) Ground both conduit system and line protector as described in Section 7 of Part I.
- (n) Install wiring and complete installation as outlined in Section 3.4.

3.32 Wall Installation with Auxiliary (Type ETR) Bell Signal

Units employed: (1) Wall-mounting instrument (2) battery box (3) line cut-off switch (4) loud (type ETR) bell signal.

- (a) Follow steps a to f of Section 3.31.
- (b) Screw EZS-26 sealing Condulets into all three hubs of the line cut-off switch.
- (c) Follow steps h and i of Section 3.31 to make the instrument-box-switch assembly.
- (d) Follow the general procedure of steps d-1 or d-2 of Section 6.32 in Part I to make and mount the instrument-box-switch-signal assembly.
- (e) Follow steps k, l, m and n of Section 3.31 to complete the installation.

3.33 Wall Installation with Power-Operated Auxiliary Signal

Units employed: (1) Wall-mounting instrument (2) battery box (3) line cut-off switch (4) type ESR bell or type ETH horn or siren (5) power relay (6) power cut-off switch.

- (a) Follow steps a to f of Section 3.31.
- (b) Follow step b of Section 3.32.
- (c) Follow steps h and i of Section 3.31 to make the instrument-box-switch assembly.
- (d) Follow the general procedure of steps d, e, f and g-1 or g-2 in Section 6.33 of Part I to make and mount the instrument-box-line switch-power relay-power switch-signal assembly.
- (e) Follow step h of Section 6.33 in Part I.
- (f) Follow steps k, l, m and n of Section 3.31 to complete the installation.

3.34 Panel Installations

Where the wall type instrument is to be panel mounted, the procedures given in Sections 3.31, 3.32 or 3.33 are

generally applicable providing the other equipment units are to be located on the same side of the panel as the instrument.

When it is desirable to mount the battery box, line cut-off switch and other equipment units (if any) in a different location, such as a nearby wall or on the side of the panel opposite from the instrument, the conduit from these units can be brought through the panel to the underside hub of the instrument (see Fig. 5).

The procedure for accomplishing this type of installation is very similar to that given in Section 6.34 of Part I except that the magneto installation requires a battery box. The installation can therefore be made as follows:

- (a) Follow steps a to f of Section 6.34 in Part I.
- (b) Assemble the battery box to the line cut-off switch and other units (if any) following, in general, the instructions given in Section 3.31, 3.32, 3.33 and Figure 7 for the respective types of installations.
- (c) Mount the battery box and units assembled to it, at the desired location (back of panel or nearby wall, etc.)
- (d) Install conduit between the sealing Condulet at the bottom hub of the battery box and the underside hub of the panel-mounted instrument base.
- (e) Follow steps k and l of Section 3.31; also step h of Section 6.33 in Part I if required.
- (f) Follow steps m and n of Section 3.31 to complete the installation.

3.35 Desk Installations

Where a desk installation is involved, the battery box, line cut-off switch and other units (if any) are assembled (see Figs. 7 and 12) and mounted on a vertical surface convenient to the desk. If the desk is centrally located so that no vertical mounting surfaces are adjacent, then the battery box can be mounted on the side of the desk. The line cut-off switch and other units (if any) can be assembled together and mounted a distance away on a suitable vertical surface with conduit installed between these units and the battery box.

In either case, the desk instrument is connected to the battery box by means of a flexible line cord assembly incorporating a factory-sealed connector at each end. This cord assembly is furnished with one end already attached to the instrument. The connector at the other end of this cord, screws directly into a hub of the battery box, no sealing Condulet being required (see item e, Sec. 6.2 of Part I).

The procedure for assembling the battery box to the line cut-off switch and other units (if any) is the same as indicated in Sections 3.31, 3.32, 3.33 and Figures 7 and 12 depending on the particular type of installation desired. Directions for installing the necessary wiring and for completing the installation, are given in Section 3.4 below.

3.4 Directions for Wiring and Completing Telephone Installations

The wiring procedure for a given telephone installation depends principally upon the number of units employed in the installation. Accordingly, three wiring procedures are presented below to conform with the three principle unit assemblages as follows: (1) Instrument, battery box, line cut-off switch (2) Instrument, battery box, line cut-off switch, bell (Type ETR) signal (3) Instrument, battery box, line cut-off switch, power relay, power cut-off switch and power-operated auxiliary signal. In general, these three procedures parallel each other, the main differences occurring in the number of wiring steps required. Furthermore, each of these procedures parallels the procedure given for the respective common-battery installation in Part I (Sec. 6.4) except for the additional wiring steps incurred by the inclusion of the battery box in the assemblage. When convenient, therefore, reference will be made to Part I where procedures are identical. See Section 9.1 of Part I for instructions regarding the removal of housing covers. Refer to Figures 9, 10 and 13 for wiring procedures.

3.41 Wiring Procedure for Installation Consisting of Instrument, Battery Box and Line Cut-Off Switch

- (a) Turn line cut-off switch to "Off" position. Remove covers from switch and battery box housings. Remove cut-off switch from housing.
- (b) Remove fuses from fuse block and line protector.
- (c) Unscrew the 6 Allen-head bolts in the cover of the wall (or panel) instrument; lift the cover and remove the cabling plugs from the sockets in the base; then remove the cover. (Removal of the cover may have already been accomplished in the case of certain panel installations—see Section 3.34.) It is not ordinarily necessary to remove the cover of the desk-type instrument because it is furnished with wiring arranged for metallic ringing or grounded ringing as specified.
- (d-1) *For the wall installation* requiring metallic ringing, pull four wires colored black, white, red and green, respectively (see item g, Section 6.1 in Part I) through the conduit between the instrument and battery box. *For grounded ringing*, use five wires colored black, white, red, green and orange (or blue) respectively.
- (d-2) *For the desk installation* insert the wires at the free end of the line cord assembly into the battery box through the remaining open hub in this housing. Then screw the threaded connector into the hub (see item e, Sec. 6.2 of Part I). The 5-conductor line cord, furnished as standard equipment, provides facilities for metallic ringing. A 6-conductor line cord is provided for grounded ringing. Cord leads are color coded as indicated in item d-1 above, the sixth conductor being blue.
- (e) In the instrument base, connect the wires just installed to the terminals on the base terminal

strip as indicated in Figure 13. Note that for grounded ringing, the green-white ringer lead is moved to terminal G of the base terminal strip. (Desk-type magneto instruments are regularly furnished with the 5-conductor line cord and are wired for metallic ringing. When specified, a 6-conductor cord is provided and the instrument is wired for grounded ringing. No internal wiring changes are therefore required.) Replace the instrument cover on the base, first taking care to insert the cabling plugs into the base sockets. Make certain that the cabling between these sections does not foul up into the instrument mechanism (ringer movement, etc.).

- (f) Pull two wires colored black and white, respectively (see item g, Section 6.1, Part I) through the conduit between the battery box and line cut-off switch. For grounded ringing, use three wires colored white, black and red, respectively.
- (g) In the battery box, connect the wires from the instrument and the wires from the line cut-off switch to the terminal strip as shown in Figure 13. Observe color markings when making connections. (The lead represented by the broken line is required only for grounded ringing.) For the actual physical arrangement of the battery box, see Figure 14.
- (h) Pull one pair or 3 conductors of #19 weatherproof telephone wire (without splices—see item h, Section 6.1 of Part I) through the line circuit conduit extending from the line cut-off switch to the fuse block terminals. Connect the wires to the proper terminals of the fuse block and ground if ground ringing (see Section 5, Part I).
- (i) Connect the wires from the battery box and the wires from the fuse block to the line cut-off switch as shown in Figure 9 (metallic ringing) or Figure 10 (grounded ringing). It should be noted that the rear terminals of the line cut-off switch are first connected with a copper jumper as shown. The switch is then remounted in the housing and the incoming wires connected. Replace cover on line switch housing and make certain switch is in "Off" position.
- (j) Fill all sealing Condulets with approved sealing compound. See Section 8 of Part I, "Filling the Sealing Condulets."
- (k) Install battery in battery box according to instructions given in Section 4.
- (l) Before placing telephone in service, first check to see that; (1) the covers of all housings are securely in place, (2) all unused conduit hubs are plugged and (3) all sealing Condulets (in the conduit system and between units) are sealed and plugged.

- (m) Replace fuses of the fuse block and line protector and turn line cut-off switch to "On" position.

3.42 Wiring Procedure for Installation Consisting of Instrument, Battery Box, Line Cut-Off Switch and Type ETR Bell Signal

- (a) Follow steps a to h of Procedure 3.41.
- (b) Follow steps b, d, e of Procedure 6.42 in Part I.
- (c) Connect the wires from the battery box, the fuse block and auxiliary signal to the line cut-off switch as shown in Figure 9 (metallic ringing) or Figure 10 (grounded ringing). It should be noted that the rear terminals of the line cut-off switch are first connected with a copper jumper as shown. The switch is then remounted in the housing and the incoming wires connected. Replace cover on line switch housing and make certain that switch is in "Off" position.
- (d) Follow steps j, k, l and m of Procedure 3.41.

3.43 Wiring Procedure for Installation Consisting of Instrument, Battery Box, Line Cut-Off Switch, Power Relay, Power Cut-Off Switch and Power-Operated Auxiliary Signal

- (a) Follow steps a to h of Procedure 3.41.
- (b) Follow steps b and d through k of Procedure 6.43 in Part I.
- (c) In the line cut-off switch housing connect the wires from the power relay, fuse block and battery box to the line cut-off switch as shown in Figure 9 (metallic ringing) or Figure 10 (grounded ringing). It should be noted that the rear terminals of the line cut-off switch are first connected with a copper jumper as shown. The switch is then remounted in the housing and the incoming wires connected. Replace cover on line switch housing and make certain switch is in "Off" position.
- (d) Follow steps j, k, l and m of Procedure 3.31.
- (e) Replace fuses of power service supply, then turn power cut-off switch to "On" position.

4. INSTALLATION OR REPLACEMENT OF DRY BATTERIES

To install a battery in the battery box:

- (a) Make certain line cut-off switch is in "Off" position.
- (b) Fasten the handset in place on the instrument cradle (use rubber bands) so that it cannot be accidentally dislodged. (This precaution insures

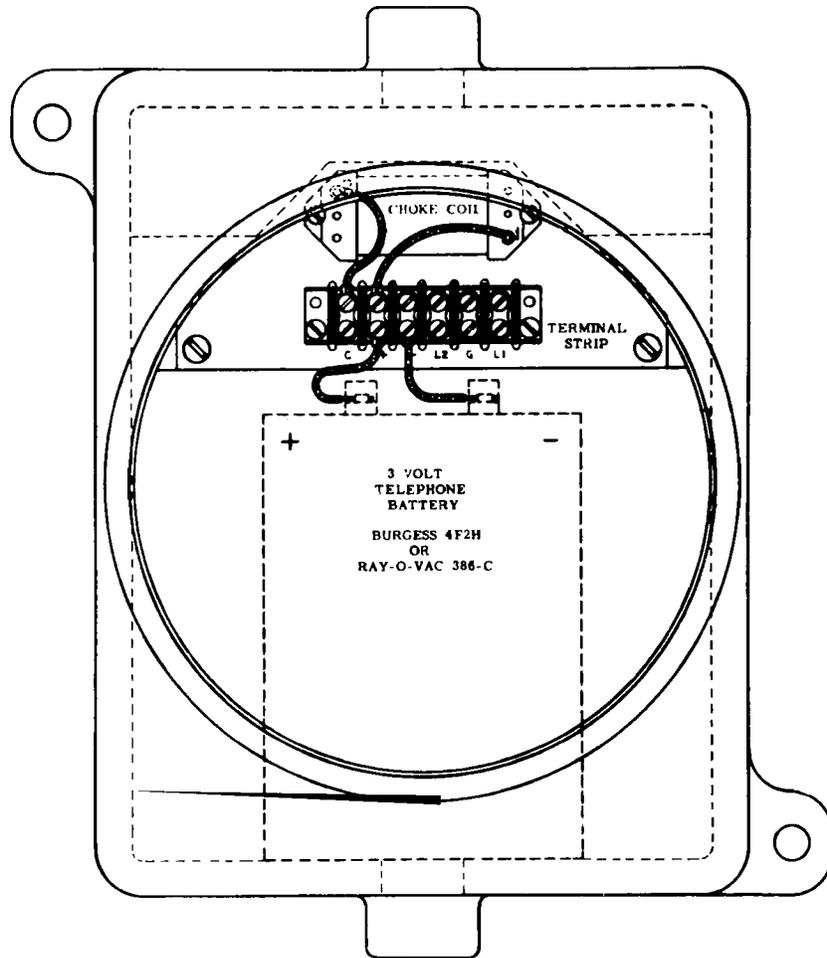


Fig. 14: Battery Box (Cover Removed)

an “open” in the circuit from the battery box through the instrument cradle switch contacts so that sparking cannot occur at the battery terminals while the leads to these terminals are being connected or disconnected.)

- (c) Remove cover from battery box if not already removed. Also disconnect and remove old battery if battery replacement is being made.
- (d) Place new battery in battery box and connect leads from terminal strip to battery terminals (Figs. 13 and 14).
- (e) Replace cover on battery box and tighten securely.
- (f) Turn line cut-off switch (and other switches if required) to “On” position to place installation in service.

5. SERVICING PRECAUTIONS

5.1 Opening Unit Housings

The entire telephone installation must be carefully “deactivated” before an attempt is made to open any of the unit housings for service or inspection. To insure safety,

therefore, the instructions below must be followed in the exact specified sequence before any of the housings are opened.

- (a) Follow steps a, b and c of Section 9.1 in Part I.
- (b) Remove magneto generator crank handle mounted on cover of instrument housing. (This is done to prevent accidental operation of the generator with the resultant possibility of sparking after the instrument housing has been opened.)
- (c) Proceed to disconnect battery as follows:
 - (1) Fasten the handset in place on the cradle (use rubber bands) so that it cannot be accidentally dislodged. (This precaution insures an “open” in the circuit from the battery box through the instrument cradle switch contacts so that sparking cannot occur at the battery terminals while the leads are being disconnected.)
 - (2) Remove battery box cover and disconnect leads to battery. The handset can now be removed from the cradle.

Any of all the other units in the installation can now be opened with safety. See Section 9.1 of Part I for instructions regarding removal of housing covers.

5.2 Handset-Cord Assembly and Line-Cord Assembly

The handset and cord assembly, code #L-9019-AO has been specially designed for use with these telephone installations. The cord is sealed in the handset during manufacture and cannot be replaced on site.

For instructions regarding replacement or repair of the handset-cord assembly or line-cord assembly, see Section 9.2 of Part I. **CAUTION:** If removal of either the handset-cord assembly or line-cord assembly is contemplated, follow the general plan of Section 9.2, Part I, but deactivate the installation according to the instructions given in Section 5.1 above. When replacement has been completed, re-activate installation as described in Section 5.3. With regard to removal of the line cord, it should be noted that in magneto installations, the line cord is connected from the instrument to the battery box as contrasted with the common-battery installation where the line cord connects directly to the line cut-off switch. Removal of the cord, however, is accomplished in the general manner described in Section 9.2 of Part I.

5.3 Returning Telephone Installation to Service

To insure safety in returning a telephone installation to service after it has been de-activated for repairs or inspection, follow the instructions below in the exact sequence specified:

- (a) Make certain that instrument cover is securely fastened on base.
- (b) Proceed to re-connect battery as follows:
 - (1) Fasten the handset securely in place on the cradle (with rubber bands) so that it cannot be accidentally dislodged (see step c, Section 5.1).
 - (2) Reconnect leads to battery.
 - (3) Replace cover on battery box. Handset fastenings may now be removed.
- (c) Follow steps a, b, c, and d of Section 9.3 in Part I, also replace crank handle of magneto generator. The installation may now be used for making or receiving calls.

5.4 Replacing Housing Covers

See Section 9.4 of Part I.

6. CONVERTING MAGNETO INSTALLATION TO COMMON-BATTERY MANUAL OPERATION

Conversion of the magneto installation to common-battery manual operation is easily accomplished in the following manner (see Fig. 13):

- (a) De-activate installation according to the instructions given in Section 5.1. Remove battery to non-hazardous location. Insulate ends of battery leads.
- (b) Within the instrument housing:
 - (1) Disconnect the brown and green-white leads from the generator terminals. Insulate lugs and tuck wires under cover terminal strip.
 - (2) Connect jumper between terminals B⁺ and L2 on base terminal strip.
- (c) Replace instrument and battery box covers and return installation to service according to the instructions given in Section 5.3. Do not replace generator crank handle.

AUTOMATIC ELECTRIC



Subsidiary of

GENERAL TELEPHONE & ELECTRONICS

Makers of Telephone, Signaling, and Communication Apparatus . . . Electrical Engineers, Designers, and Consultants

Factory and General Offices: Northlake, Illinois, U.S.A.

ASSOCIATED RESEARCH AND MANUFACTURING COMPANIES

Automatic Electric Laboratories, Incorporated Northlake, Illinois, U. S. A.
Automatic Electric (Canada) Limited Brockville, Ontario, Canada
Automatique Electrique, S.A. Antwerp, Belgium
Automatic Electric, S.A.T.A.P. Milan, Italy

DISTRIBUTOR IN U.S. AND POSSESSIONS

AUTOMATIC ELECTRIC SALES CORPORATION

Northlake, Illinois, U.S.A.
Sales Offices in All Principal Cities

GENERAL EXPORT DISTRIBUTOR

AUTOMATIC ELECTRIC INTERNATIONAL

INCORPORATED
Northlake, Illinois, U.S.A.

REGIONAL DISTRIBUTING COMPANIES AND REPRESENTATIVES

ARGENTINA, URUGUAY, PARAGUAY, CHILE, AND BOLIVIA

L. Pitigliani
Caixa Postal 9212
Sao Paulo, Brazil

EUROPE, NORTH AFRICA, AND NEAR EAST

Automatic Electric International, Inc.
40 Rue Du Rhone
Geneva, Switzerland

BELGIUM AND LUXEMBOURG AND NETHERLANDS

Automatique Electrique, S. A.
22 Rue du Verger
Antwerp, Belgium

FAR EAST

T. A. Logan
893-9 King's Road
North Point
Hong Kong

BRAZIL

Automatic Electric do Brasil, S.A.
Caixa Postal 9212
Sao Paulo, Brazil

ITALY

Automatic Electric S.A.T.A.P.
Via Bernina 12
Milan, Italy

CANADA

Automatic Electric Sales (Canada) Limited
185 Bartley Drive
Toronto 16, Ontario, Canada

MEXICO

Automatic Electric de Mexico, S.A.
Apartado Postal 20642
Mexico 6, D.F., Mexico

CENTRAL AMERICA

R. R. Sanders
Apartado 313
San Salvador, El Salvador

PERU AND ECUADOR

J. P. Maclaren
Apartado Aereo 3968
Bogota, Colombia

COLOMBIA

Automatic Electric de Colombia, S.A.
Apartado Aereo 3968
Bogota, Colombia

VENEZUELA

Automatic Electric de Venezuela, C.A.
Apartado 9361, Caracas, Venezuela

Other Sales Representatives and Agents Throughout the World