

## CUSTOMER PRODUCTS PROTECTION AND GROUNDS

### 1. GENERAL

**1.01** This section consists of information compiled from other sections on the installation and repair of station protection and grounding systems at the subscriber's premises. For detailed information refer to Section 460-100-100, 460-100-101, 460-100-200, and 460-100-201.

**1.02** This section is reissued to:

- Include the 123B1A protector
- Add a caution note to 9.01 on installing ground rods
- To rate protectors manufacture discontinued (MD) as shown in 16.05.

### 2. DESCRIPTION OF STATION PROTECTORS

**2.01** The 123A1A (Fig. 1), 123B1A (Fig. 2), and 128A1A-2 (Fig. 3) protectors provide protection against abnormal voltage and current for one or two pairs of wires at subscriber's premises. The 123B1A is recommended for use in areas where lightning activity results in high maintenance costs.

**2.02** The 116C (Fig. 4) outdoor and 117B (Fig. 5) indoor protectors provide protection for 6-pair multiple drop wire extending from metal sheath cable at the customer's premises.

**2.03** The 98AA (MD) protector (Fig. 6) provides protection for one pair of wires served from grounded metal sheath cables. It is not to be used at stations served by open wire.

**2.04** The 106CA (MD) protector (Fig. 7) is a 106C fused protector for one pair of wires, converted for fuseless operation by strapping out the 11CBB fuses with No. 213A (MD) connectors. It is not

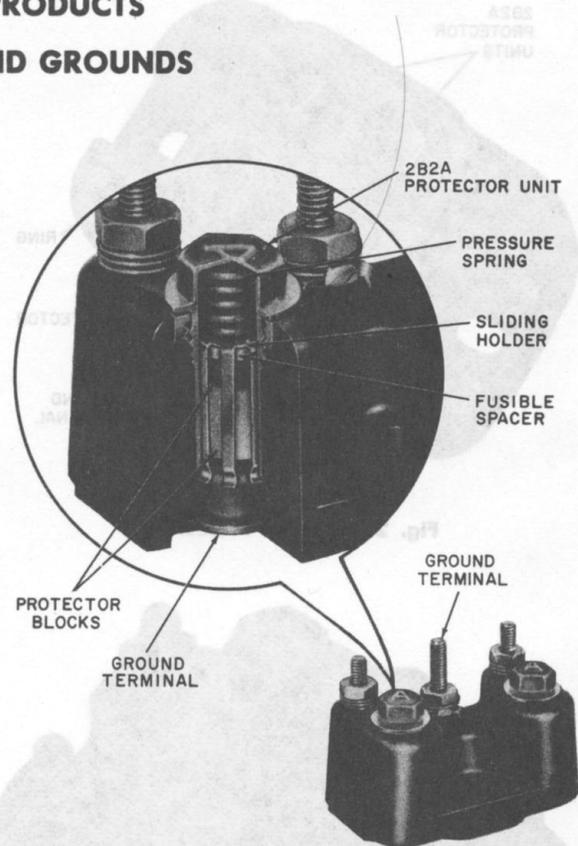


Fig. 1—123A1A Protector

to be used at stations served by open wire; use the 106C for open wire.

**2.05** Tables A, B, and C list fuseless and fused protectors, ground wire and backboard capacity for these station protectors.

**2.06** Table D shows proper protector grounding for various conditions of power service grounds. A No. 4 bare copper wire at least 20 feet long, encased in concrete or the grounded building iron framework, may be used for power service grounding instead of a ground rod.



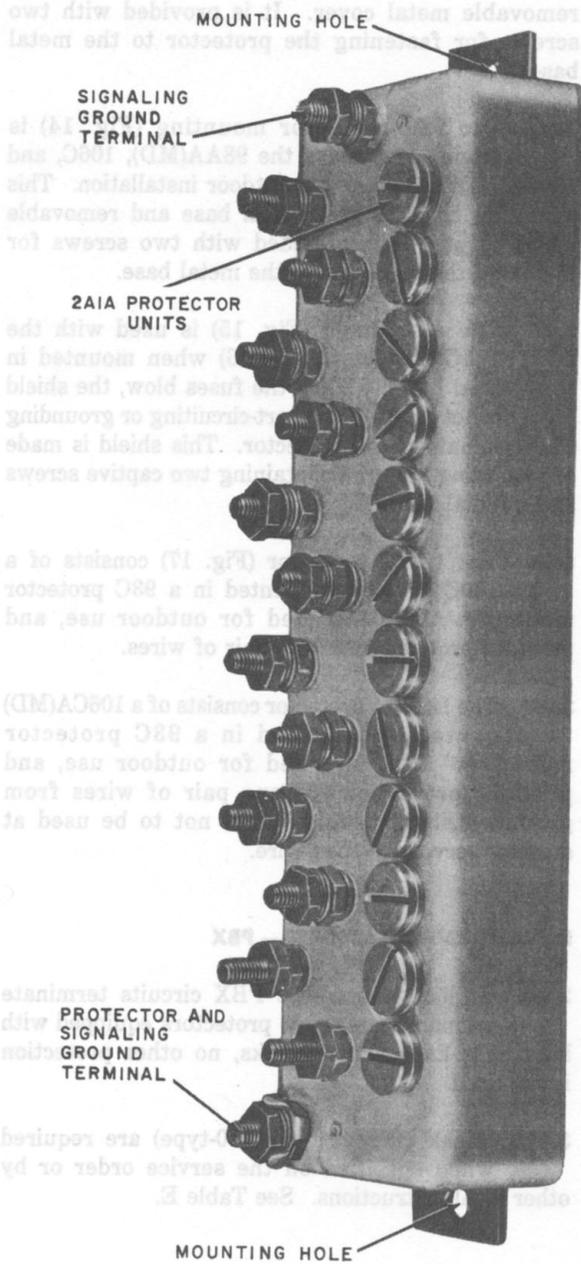


Fig. 5—117B Protector (Indoor)

3.04 The 150B cover (Fig. 11) snaps over a 123A1A, 123B1A, or 128A1A-2 protector. The 150B cover is made of gray simiflexible material and is intended as a protective covering for outdoor installation, or indoor installation when a protective covering is required.

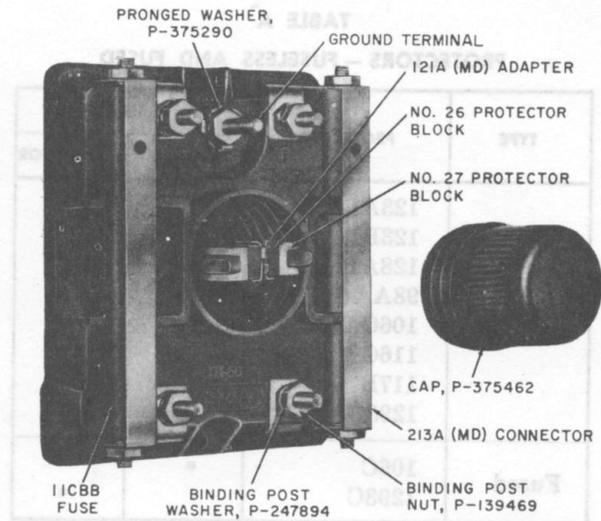


Fig. 6—98AA (MD) Protector

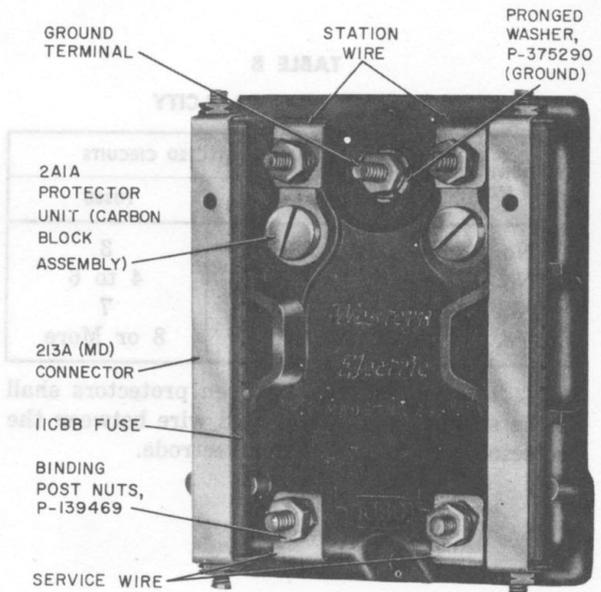


Fig. 7—106CA (MD) Protector

3.05 The 305A2 protector mounting (Fig. 12 and 13) is intended to house the 123A1A, 123B1A, or 128A1A-2 protector for outdoor installation. It is preferred over the 150B cover for extremely hot or cold temperatures. This protector mounting consists of a metal base and a

**TABLE A**  
**PROTECTORS — FUSELESS AND FUSED**

TYPE	PROTECTOR	USE	
		INDOOR	OUTDOOR
Fuseless	123A1A	•	*
	123B1A	•	*
	123A1A-2	•	*
	98AA (MD)	•†	
	106CA (MD)	•†	
	116C		•
	117B	•	
	1293CA		•†
Fused	106C	•	
	1293C		•

\*For outdoor installation, a 150B cover or 305A2 protector mounting is required.

†Fused type converted to fuseless operation.

**TABLE B**  
**GROUND WIRE CAPACITY**

GROUND WIRE SIZE	NO. OF PROTECTED CIRCUITS	
	FUSELESS	FUSED
No. 14	1	3
No. 12	2	4 to 6
No. 10	3 to 6	7
No. 6	7 or More	8 or More

*Note:* The ground wire between protectors shall be the same size as the ground wire between the protector and the grounding electrode.

**TABLE C**  
**PROTECTOR CAPACITY OF BACKBOARDS**

NO.	TYPE PROTECTOR	TYPE BACKBOARD
1 or 2	123 or 128	79
3 to 10	123 or 128	81
1	98 or 106	79
2 to 5	98 or 106	81

removable metal cover. It is provided with two screws for fastening the protector to the metal base.

**3.06** The 93C protector mounting (Fig. 14) is intended to house the 98AA(MD), 106C, and 106CA(MD) protector for outdoor installation. This mounting consists of a metal base and removable metal cover. It is provided with two screws for fastening the protector to the metal base.

**3.07** The 46A shield (Fig. 15) is used with the 106C protector (Fig. 16) when mounted in commercial boxes. When the fuses blow, the shield prevents hot gases from short-circuiting or grounding the terminals of the protector. This shield is made of insulating material containing two captive screws and a metal mounting strap.

**3.08** The 1293C protector (Fig. 17) consists of a 106C protector mounted in a 93C protector mounting. It is intended for outdoor use, and provides protection for one pair of wires.

**3.09** The 1293CA protector consists of a 106CA(MD) protector mounted in a 93C protector mounting. It is intended for outdoor use, and provides protection for one pair of wires from grounded sheath cable. It is not to be used at stations served by open wire.

#### INSTALLING PROTECTORS — PBX

**3.10** At locations where PBX circuits terminate on main frame type protectors equipped with heat coils and carbon blocks, no other protection is required.

**3.11** Sneak current fuses (60-type) are required when specified on the service order or by other local instructions. See Table E.

*Note:* 60-type fuses cannot be installed in pole-mounted NH-type terminals.

**3.12** When sneak current protection is required for pairs terminated on 116- or 117-type protectors 14A fuse holders are required. Fig. 18 shows the 14A fuse holder and Fig. 4 shows a 116C protector equipped with 14A fuse holders and 60-type fuses. Fig. 19 and 20 show 60-type fuses used with other type protector mountings and protectors.

**TABLE D  
PROTECTOR GROUNDING**

POWER CONDITIONS			
A1 — MGN System on acceptable metallic water pipe A2 — MGN System on ground rod (concrete encased electrode, metal structure) B1 — Non-MGN System on acceptable metallic water pipe B2 — Non-MGN System on ground rod (concrete encased electrode, metal structure) C — Power not grounded at premises D — No power			
WATER PIPE	POWER CONDITION	WHAT TO DO FOR PROPER PROTECTOR GROUNDING	FIG.
Acceptable metallic water pipe (at least 10 feet in moist soil)	A1 or B1	Ground protector to metallic water pipe or to power service conduit or ground wire.	23
	A2 or B2	Ground protector to metallic water pipe and bond power to water pipe.*	24
	C or D	Ground protector to metallic water pipe (if C, refer to 7.02).	25
Metallic interior water piping not acceptable because of plastic entrance, insulating joints, etc.	A2	Ground protector to MGN ground rod, power service conduit, or ground wire. Bond with No. 6 station ground wire to metallic water pipe.*	26 or 27
	B2	Ground protector to best available ground or telephone ground rod. Bond to power ground rod, power service conduit, or ground wire, and interior metallic water pipe with No. 6 station ground wire.*	28 or 29
	C or D	Ground protector to best available ground or ground rod, bond to interior metallic water pipe using same size station ground wire as protector ground wire (if C, refer to 7.02).	30
No metallic water pipe or not possible to connect to metallic water pipe	A2	Ground protector to MGN power ground rod, power service conduit, or ground wire.	31 or 32
	B2	Ground protector to telephone ground rod and bond with No. 6 station ground wire to power ground rod, power service conduit, or ground wire.	33 or 34
	C or D	Ground protector to best available ground (if C, refer to 7.02).	35

**Note:** Verify existing power and telephone bonding and grounding. If they meet these requirements, no further action is required.

\*Bond to water pipe only if power is not already bonded.

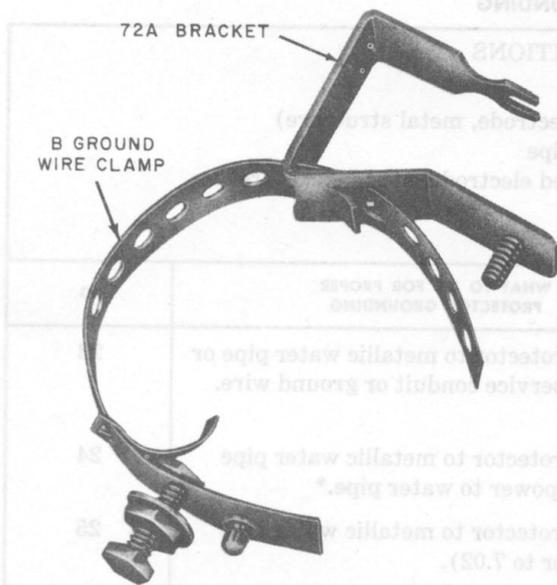


Fig. 8—B Station Ground Wire Clamp Through Slot in 72A Bracket

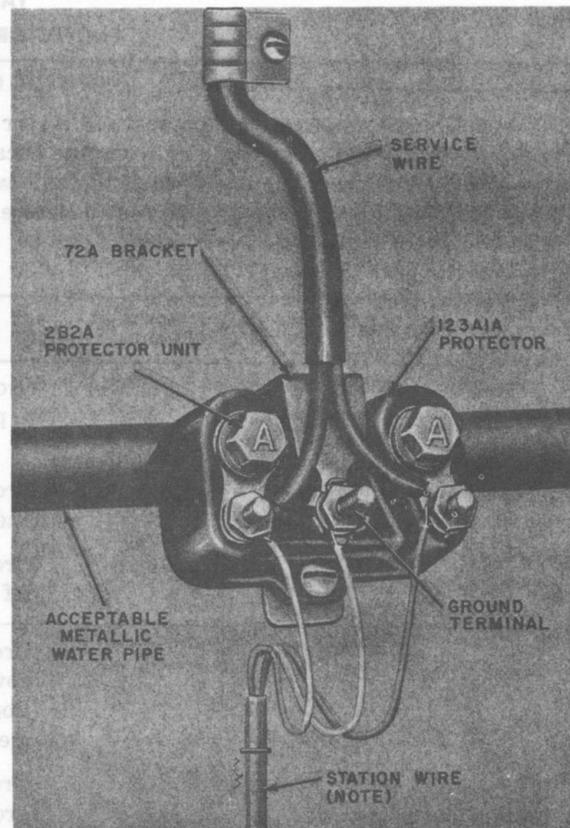
#### 4. GROUNDING (Fig. 21 Through 36)

4.01 On visits to previously installed stations, inspect the grounding system. Systems not properly grounded must be changed to meet the current grounding and bonding requirements.



*The telephone protector ground, the interior metal water pipe, and the electrical service ground shall be bonded together.*

4.02 When available, a public metallic water pipe provides the preferred grounding medium. A private metallic water system with at least 10 feet of buried metallic pipe is an acceptable grounding medium and is preferred to a ground rod. Connect the ground wire to the metallic cold water pipe at a point where normal maintenance of water meters, pumps, or the installation of insulating sections for reducing vibrations will not interrupt the circuit to ground or common bonding to power ground. When the power is grounded to an acceptable metallic water pipe, ground protector to the power service conduit or ground wire. This is important to avoid running long telephone ground



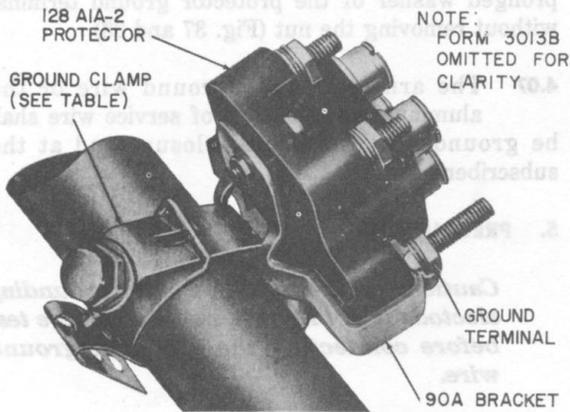
NOTE:  
STATION WIRE CLAMP NOT SHOWN,  
FORM E-3013B OMITTED FOR CLARITY.

Fig. 9—123A1A Protector Installed on a Metallic Water Pipe

wires to water pipe when a power grounding electrode is close by.

4.03 When the interior metallic cold water pipe is insulated from the buried water system by an insulating joint or when the water system is nonmetallic, the interior metallic water piping is not an acceptable ground and an alternate method (Table D) must be employed. The alternate selected ground (the nearest power ground rod, power conduit, or power ground wire) shall always be bonded to the interior metallic cold water piping system.

4.04 The MGN (multigrounded neutral) of a power system is an acceptable ground but MGN systems are not universally used. A power



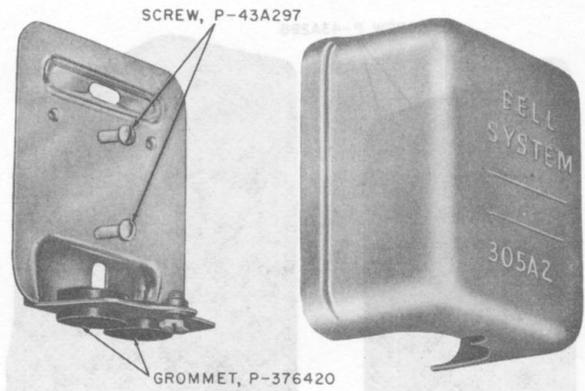
**Fig. 10—123B1A or 128A1A-2 Protector Installed on a Metallic Water Pipe**



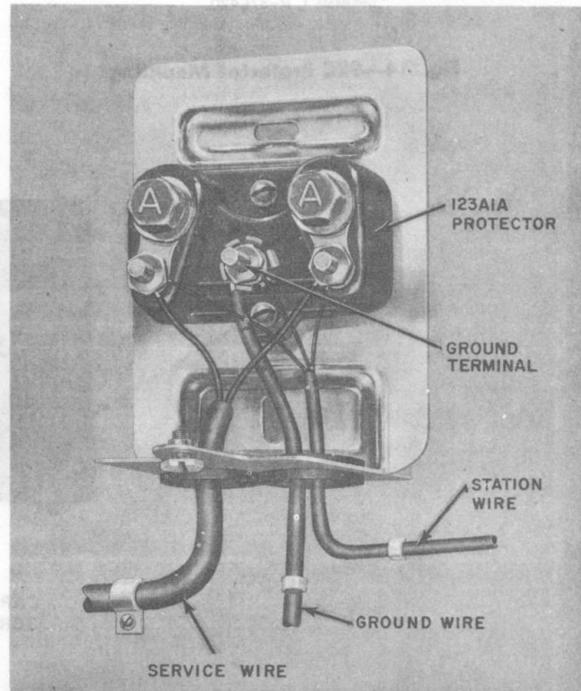
**Fig. 11—150B Cover**

company may have adopted the MGN as its standard on new or rearranged construction and still have a portion of its plant operating without a MGN. To properly use this section, it is necessary to know in any given situation whether the power system is MGN. This information shall be obtained through supervisory channels.

**4.05** Whenever possible, use a 72A or 90A bracket to ground a fuseless protector. If a ground wire is necessary, the run should be short, straight, and if possible a continuous piece of wire.



**Fig. 12—305A2 Protector Mounting**



**Fig. 13—123A1A Protector Installed in 305A2 Protector Mounting**

**4.06** F-Connectors are used to bond the aluminum or steel shield of service wire or the armor wire of underground wire to a 123A1A, 123B1A, or 128A1A-2 protector. The F-Connector has a spade-type tip which can be placed under the

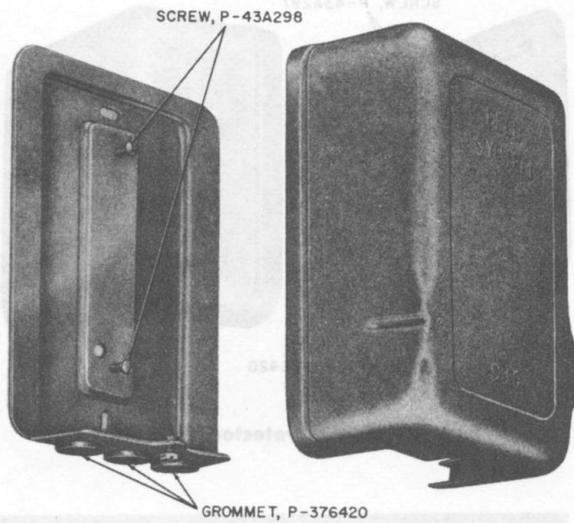


Fig. 14—93C Protector Mounting

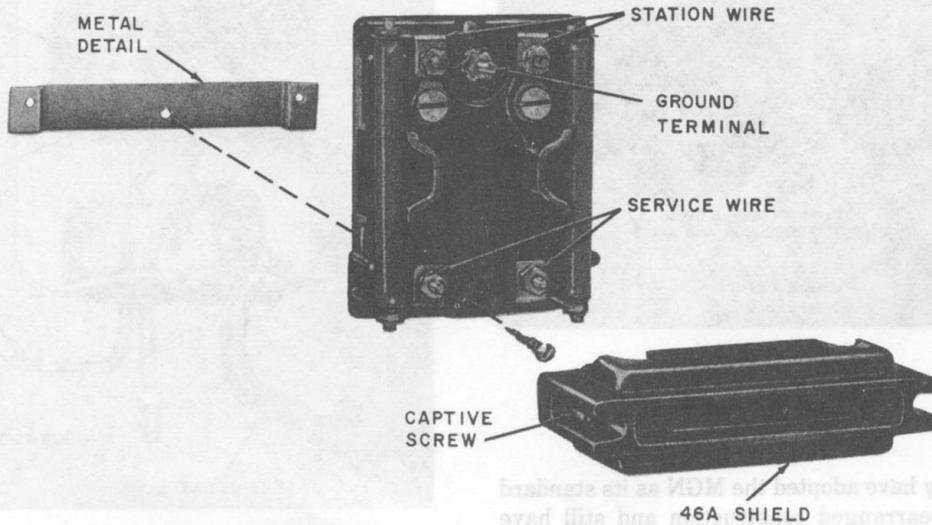


Fig. 15—Installation of 46A Shield

pronged washer of the protector ground terminal without removing the nut (Fig. 37 and 38).

**4.07** The armor of underground wire or the aluminum or steel tape of service wire shall be grounded at the buried closure and at the subscriber's location.

**5. PRECAUTIONS**

*Caution: If the condition of the grounding electrode is not known, make a voltage test before connecting the protector ground wire.*

**5.01** Test the power company ground rod, ground wire, cabinet, meter box, etc, with a B voltage tester as prescribed in Section 460-300-109 of the Bell System Practices. The voltage test shall be as prescribed for vertical power ground wires or metallic conduit. *If the grounding*

F-connectors are used to bond the aluminum or steel shield of service wire or the armor wire of underground wire to a 12BA1A, 12BA1A, or 12BA1A-2 protector. The F-Connector has a spade-type lip which can be placed under the

company may have adopted the MGN as its standard on how or rearranged the MGN, and still have a portion of its plant operating without a MGN. To properly use this section, it is necessary to know in any given situation whether the power system is MGN. This information shall be obtained through supervisory channels.

Whenever possible use a 12A or 30A protector to ground a fuseless protector. If a ground wire is necessary, the run should be short, straight, and if possible a continuous piece of wire.

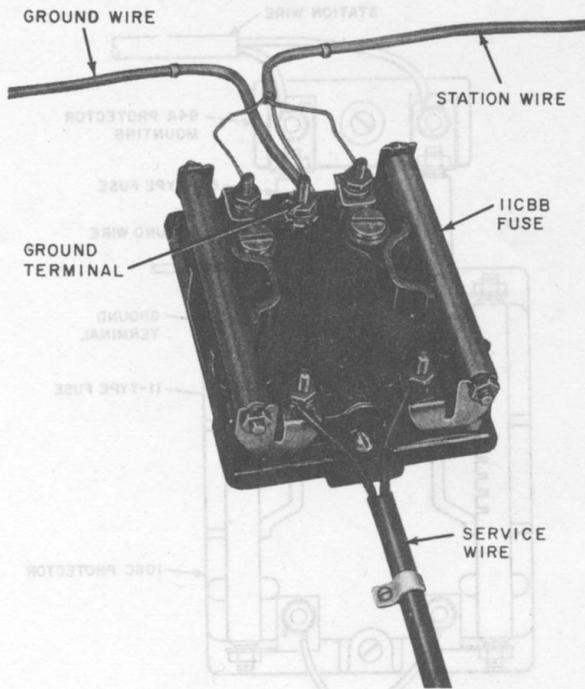


Fig. 16—106C Protector

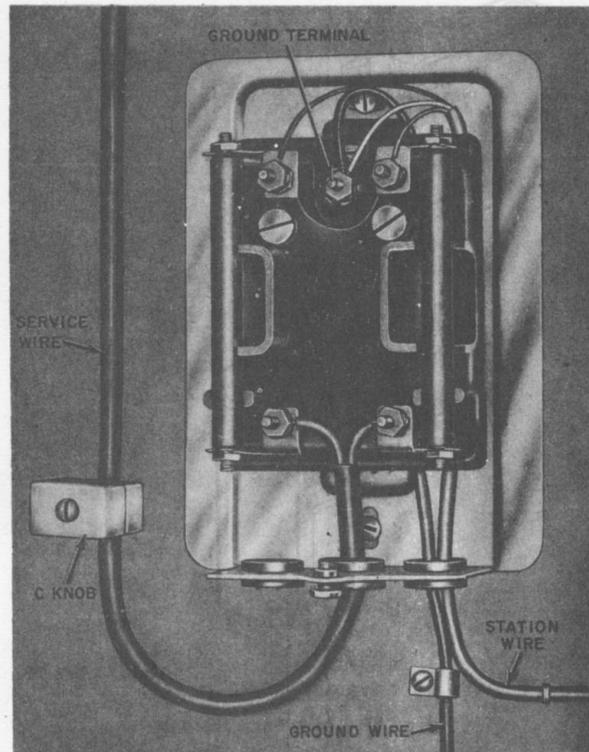


Fig. 17—1293C Protector

*mediums are energized, proceed no further with the work.* Report this condition to the proper supervision so that the power company or customer-owned power system may be informed of the situation.

**5.02** Do not attach ground wires to the interior of any service entrance box, fuse box, meter box, etc.

**5.03** Due to corrosive action, do not attach ground wire to power service aluminum ground wire, aluminum conduit, aluminum service boxes, etc.

**5.04** Do not attach ground wire to gas pipes.

**5.05** Stations located at power company stations, or in an explosive atmosphere, or connected to foreign communication circuits usually require special protection. These installations are covered in other sections of the Bell System Practices.

**5.06** At radio or television stations connect the protector ground to the radio or television station ground.

TABLE E  
60-TYPE FUSES

FUSES	CARRYING CURRENT (AMPERES)	COLOR OF SHELL
60A	0.350	Red
60D	0.350	Red
60E	1.250	Black
60F	0.179	Red
60G	0.500	Gray
60H	0.179	Red
60J	0.600	Gray

**6. INSTALLATION OF STATION GROUND CLAMPS (Fig. 39)**

**6.01** The ground clamp should be located at an accessible point where it will not be subject

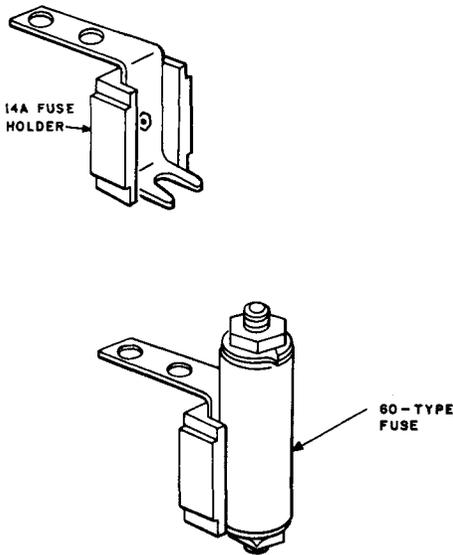


Fig. 18—14A Fuse Holder

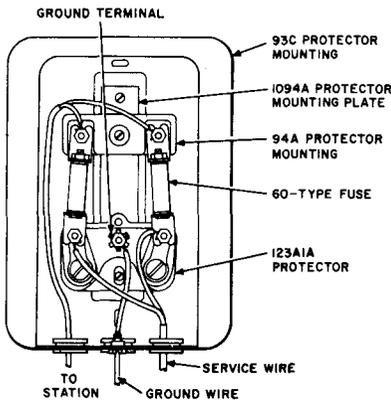


Fig. 19—Fuseless Protector Equipped With 60-Type Fuses—Outdoor Installation

to excessive movement or vibration and where it will least likely be damaged by plumbers or other workmen. If the pipe is insecure or subject to vibrations, tape the ground wire to the pipe in close proximity of the ground clamp.

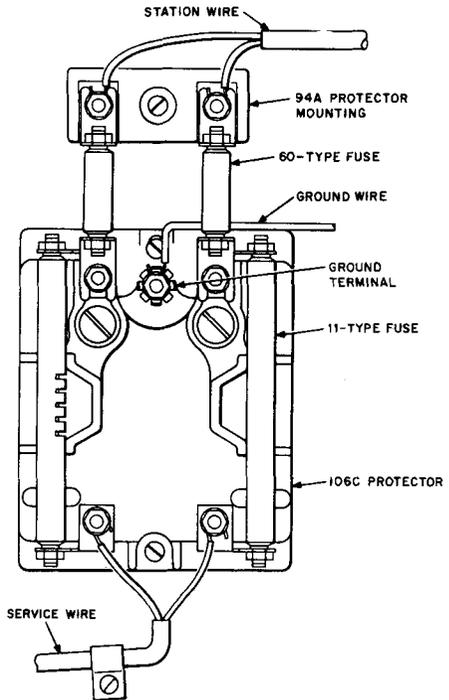


Fig. 20—60-Type Fuses Used With 94A Protector Mounting and 106C Protector

6.02 Where insulating joints are found (usually at meters, pumps, valves, etc), the ground clamp should be installed at a point where the insulating joint will not break continuity to ground. Where pumps, meters, etc, may be removed for seasonal overhaul, the ground clamp should be installed at a point where the continuity to ground will not be broken.

6.03 Make certain that the surface of the metallic pipe to which the ground clamp is being fastened is free of paint, rust, etc.

6.04 Form E-3013B (Fig. 40) should be placed at all ground wire terminations to warn people not to disturb the clamp or wire.

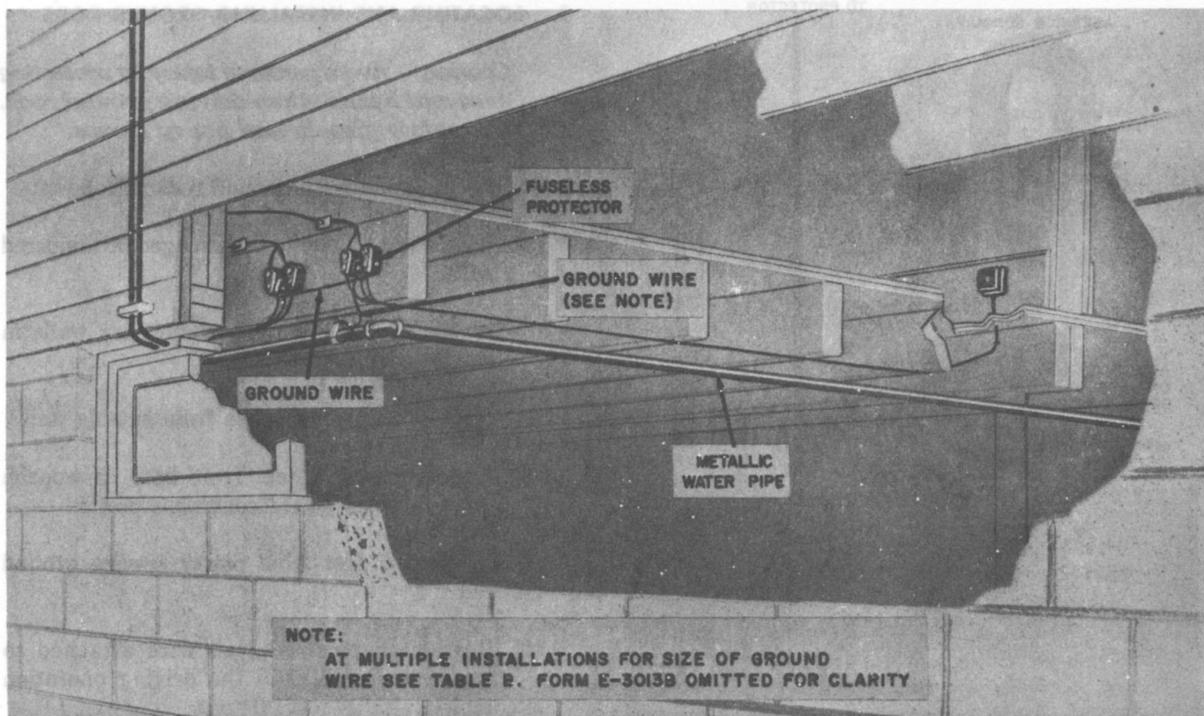


Fig. 21—Ground Wire Run, Fuseless Protector

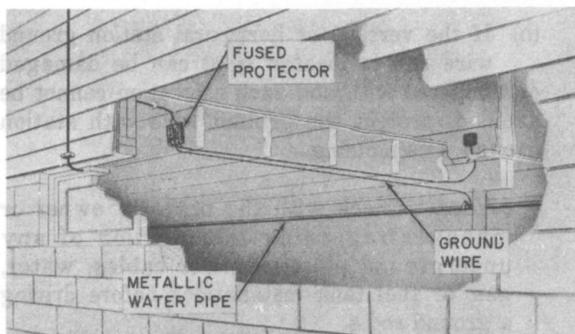


Fig. 22—Ground Wire Run, Fused Protector

## 7. BONDING OF POWER AND TELEPHONE GROUNDS

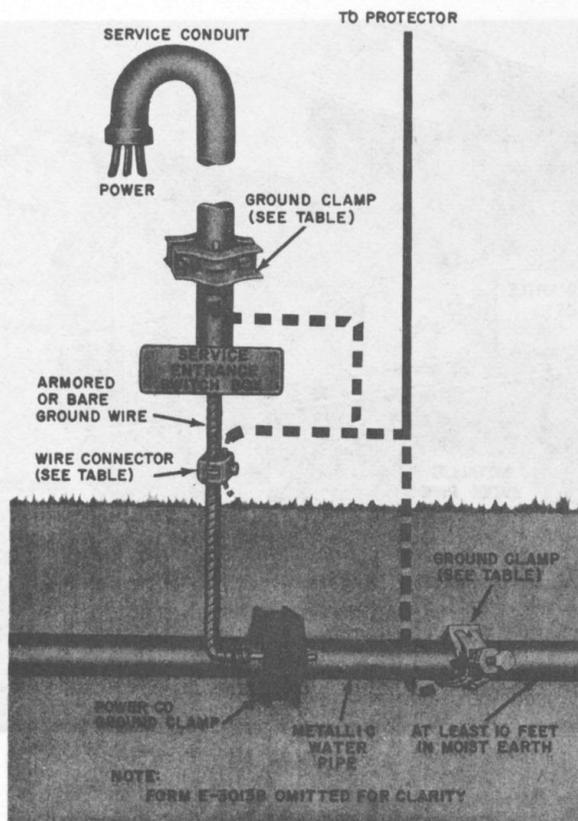
**7.01** When a situation exists where the power and telephone grounds are not common, the following corrective arrangements shall be made:

- (a) If an acceptable public or private water system is available and the power service

is grounded to a ground rod, connect the telephone protector to the metallic water system. In addition, a No. 6 station ground wire shall be bonded to the interior metallic water pipe and the power ground rod.

- (b) If the power service and the telephone protector are connected to separate ground rods, bond the two rods together as shown in Fig. 28 and 29.

**7.02** The customer's telephone service may be installed where a power ground is not provided. However, the customer should be informed immediately of the need for a power ground and should be requested to notify the Telephone Company when the ground has been provided. *The procedure for notifying the customer shall be covered by local instructions.* Where telephone service is already being furnished and there is no power ground, the same procedure should be followed. When installing telephones at contractor shacks, trailers, etc. and an acceptable metallic cold water pipe is not available, the telephone protector must be connected to a telephone



**Fig. 23—Power Grounded to Acceptable Water System**

ground rod. This ground rod must be bonded to a power ground rod as soon as the power ground rod has been installed and connected.

## 8. SELECTION OF SIGNALING GROUND

**8.01** When signaling ground is required, the protector ground should be used as first choice. Ground strips connected to grounded sheath cables are suitable for signaling grounds.

**8.02** When commercial power is connected to telephone apparatus, the signaling ground shall be bonded to the protector ground, at the protector, or by using the same grounding electrode. When commercial power is not connected to telephone apparatus, it is desirable to bond protector and signaling ground; however, it is not required.

## 9. LOCATING AND INSTALLING GROUND RODS

**Caution:** Avoid personal injury by protecting eyes and hands when driving ground rods. Use safety glasses and heavy gloves.

**9.01** Locate and install ground rods as follows:

- (a) Where least likely to be damaged or tampered with.
- (b) As near as is practical to masonry walls in earth-floor basements.
- (c) Approximately 12 inches from outside wall.
- (d) Approximately 2 feet from base of wooden poles or posts where conditions permit.
- (e) At least 6 feet from power service ground rod.
- (f) Do not unspiral the tail wire attached to the ground rod until the driving operation is complete.
- (g) Drive ground rods until the top of the rod is approximately 3 inches below ground level. Increase depth where damage from digging is likely.
- (h) If the vertical or horizontal station ground wire run is located so it can be damaged or tampered with and such a location cannot be avoided, protect the ground wire with station ground wire molding.

**Note:** Check with the property owner or manager regarding the location of any underground electric power cables, water, gas, or fuel tank installations before driving a ground rod.

**9.02** Inspect ground rods before and after driving to make certain that tail wires are not broken. If the tail wire is broken, replace with another rod, or use a ground clamp of the proper size as listed in Table F.

**9.03** After the ground rod is installed, No. 14 station ground wire is spliced to the tail wire with a 0.064 brass sleeve. Press the sleeve six times, three times each side of center. Do not tape splice. When a larger size of ground wire

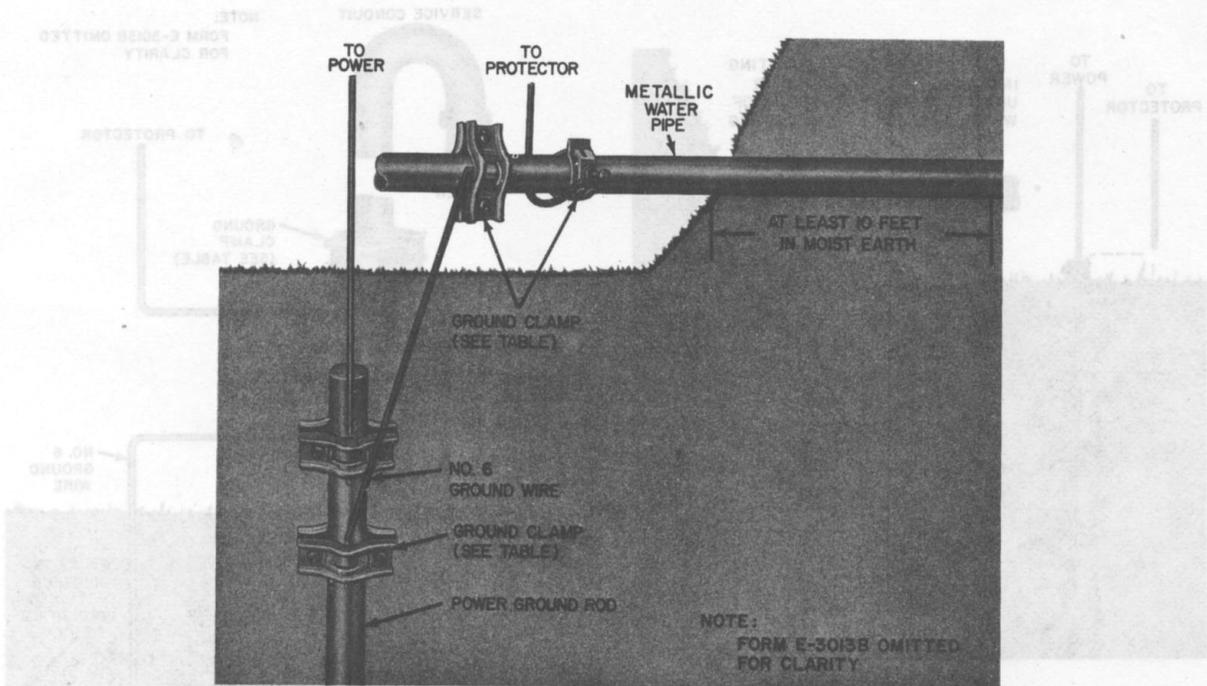


Fig. 24—Grounding to Metallic Water System—Power on Ground Rod at Premises

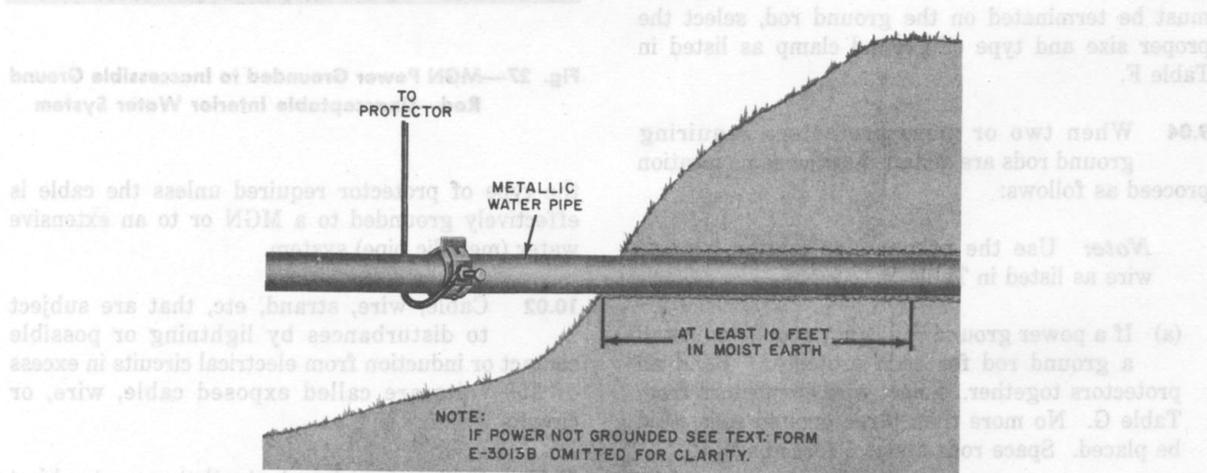
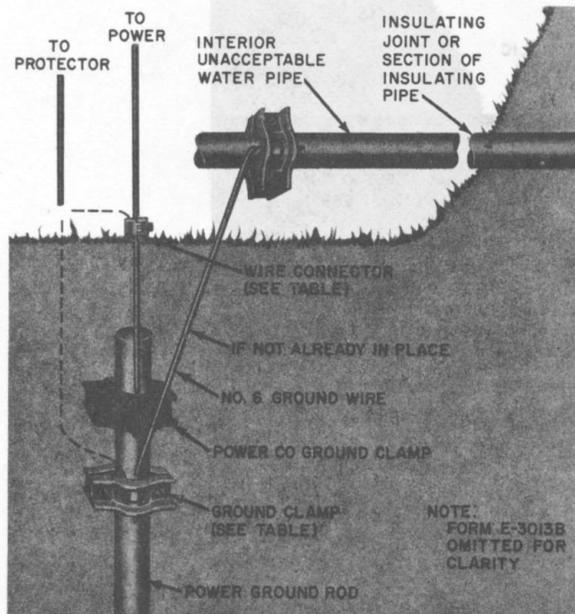


Fig. 25—Grounding to Metallic Water System—Power not Grounded at Premises



**Fig. 26—MGN Power Grounded to Ground Rod—Unacceptable Interior Water System**

must be terminated on the ground rod, select the proper size and type of ground clamp as listed in Table F.

**9.04** When two or more protectors requiring ground rods are installed at the same location proceed as follows:

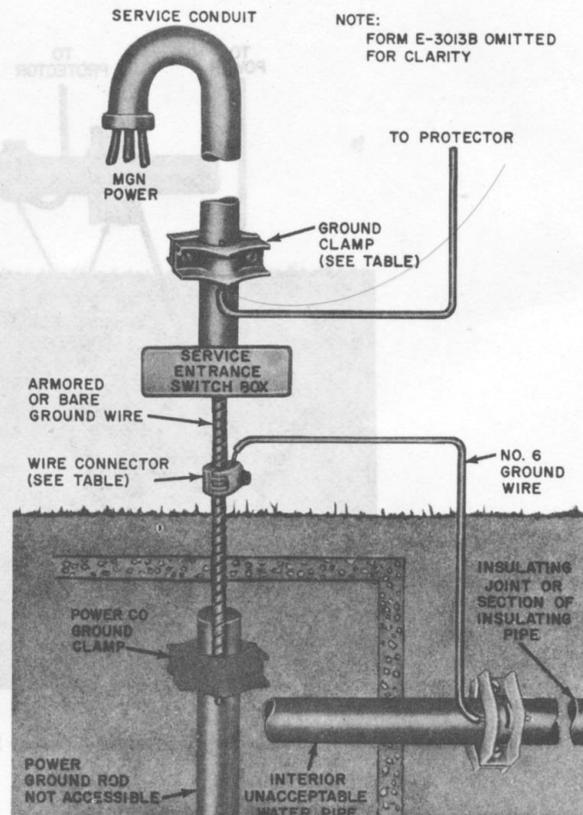
**Note:** Use the proper size station ground wire as listed in Table B.

(a) If a power ground rod is not available, install a ground rod for each protector. Bond all protectors together. Select wire connectors from Table G. No more than three ground rods need be placed. Space rods about 6 feet apart.

(b) If a power ground rod is available, one telephone ground rod is sufficient. Bond all protectors together and bond telephone ground rod to power ground rod (Fig. 28).

## 10. CABLE PROTECTION

**10.01** Isolated sections of aerial cable are considered as open wire for the purpose of determining



**Fig. 27—MGN Power Grounded to Inaccessible Ground Rod—Unacceptable Interior Water System**

the type of protector required unless the cable is effectively grounded to a MGN or to an extensive water (metallic pipe) system.

**10.02** Cable, wire, strand, etc, that are subject to disturbances by lightning or possible contact or induction from electrical circuits in excess of 300 volts are called exposed cable, wire, or circuits.

**10.03** Cable, wire, strand, etc, that are not subject to disturbances by lightning or electrical circuits in excess of 300 volts are called unexposed cable, wire, or circuits.

## 11. FUSELESS STATION PROTECTION AND REQUIREMENTS (AERIAL OR BLOCK CABLE)

**11.01** If exposed drop or block wires are to be connected to unexposed cables at 49-type

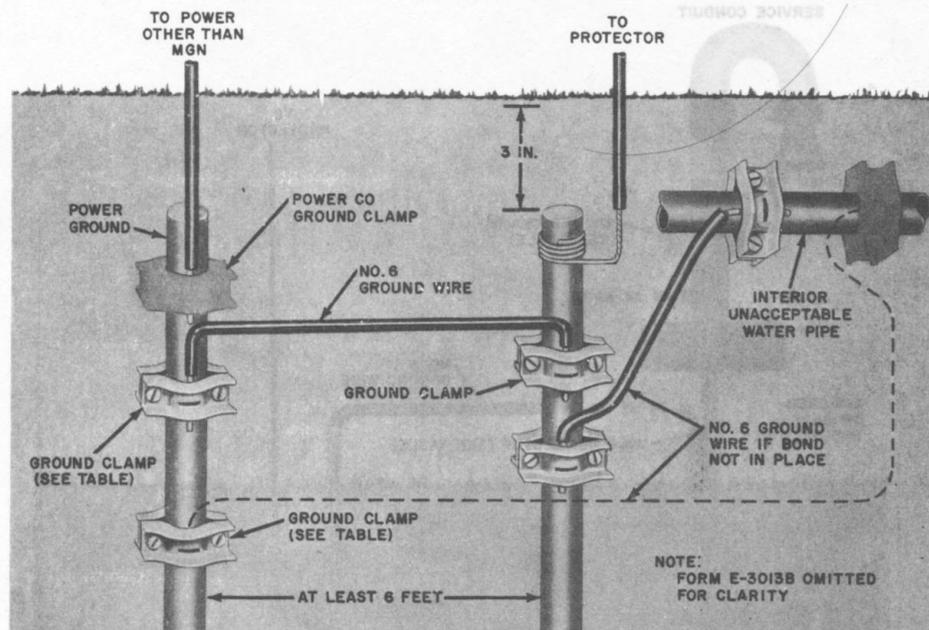


Fig. 28—Power Other Than MGN Grounded to Ground Rod—Unacceptable Interior Water System

terminals, equip the terminals for station protection. To do this, use 3A2B-3 terminal blocks. Remove the 2A1B protector units and the stud and sleeve assemblies and replace with P-13A683 stud and sleeve assemblies and 2A1A protection units. Protectors will also be required at the station end.

**11.02** Fuseless station protectors shall be used at all stations served by a cable with a grounded metal sheath or shield, such as lead, alpeh, stalpeh, etc. When drop wire is to be joined to a cable pair, a fusible link is required at the aerial junction as outlined in 13.01.

**11.03** Fuseless protectors shall be installed when single-pair drop wire is used at stations served by open or multiple wire when the protector can be grounded (see Table D) as follows:

- (a) A metallic cold water pipe having at least 10 feet buried
- (b) A metallic cold water pipe bonded to a MGN system
- (c) Service ground of a MGN power system

(d) Metallic service entrance conduit (except aluminum) bonded to the service entrance box of a MGN system.

**Note:** If one of these grounds is not available, a fused-type protector must be used.

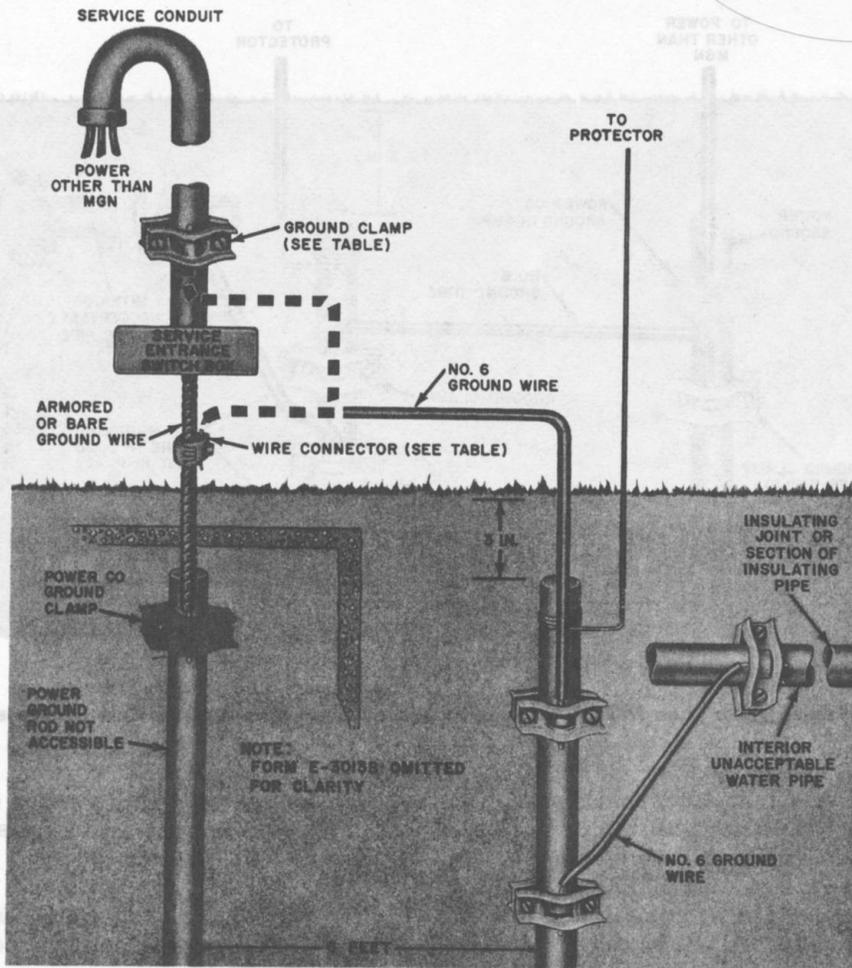
**11.04** Subject to the grounding restrictions outlined in 11.03, the fuseless protector may be used as follows:

(a) At any station served by open wire where bridling to C drop wire is through D or E block wire fusible link (bridling wire)

(b) At stations where C drop wire is directly connected to urban wire

(c) Where C drop wire is connected through D or E block wire fusible link to rural wire.

**Note:** The bridling between drop wire and open wire or rural wire must consist of at least 2 feet of D or E block wire.



**Fig. 29—Power Other Than MGN Grounded to Inaccessible Ground Rod—Unacceptable Interior Water System**

**11.05** A fuseless protector must not be used with multiple drop wire when the stations are served by open or multiple wire.

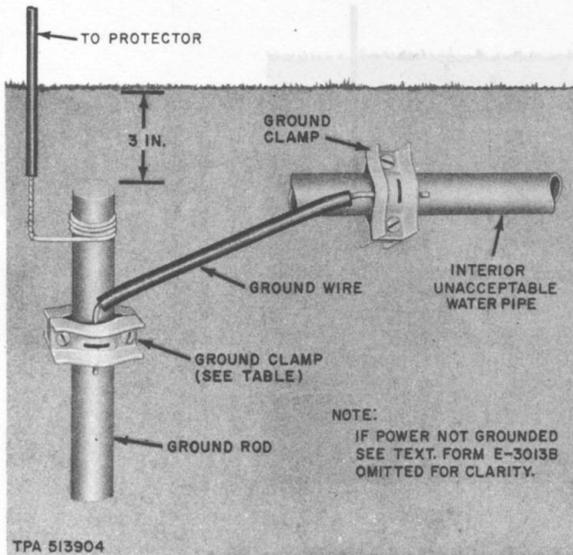
*Note:* A fuseless protector can be used with multiple drop wire fed from a grounded metal sheath or shielded cable.

**11.06** Drop wire from an unexposed cable terminal into an exposed area exposes both the subscriber station and the distribution cable. Fuseless protectors are required at both ends of the drop. When drop is to be joined to a cable pair, a fusible link is required as outlined in 13.01 (b).

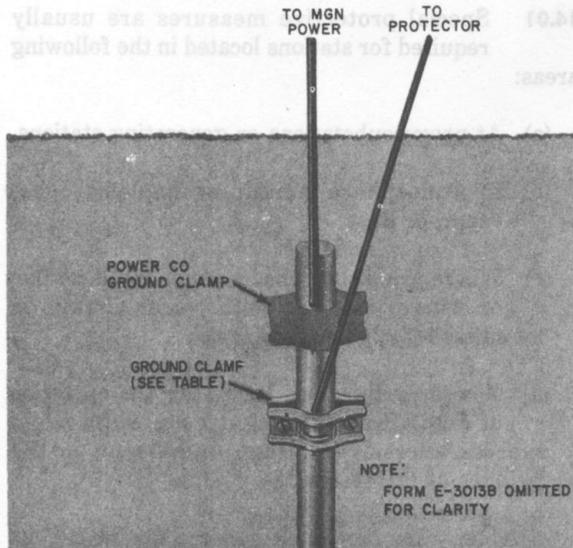
**11.07** Cable protection is required at terminals in exposed cables where the drop wire is exposed. Typical wall and pole installations using protectors for cable protection with terminals is shown in Fig. 41 through Fig. 45.

**12. FUSED STATION PROTECTION AND REQUIREMENTS (AERIAL OR BLOCK CABLE)**

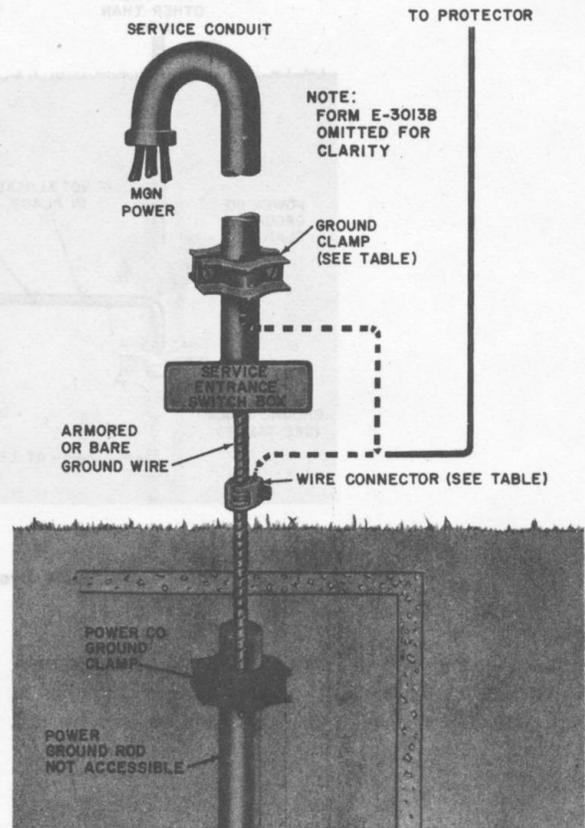
**12.01** When the grounding requirements or bridling requirements outlined in 11.03 or 11.04 cannot be followed, a fused-type protector must be used.



**Fig. 30—Power not Grounded on Premises—Unacceptable Water Pipe**



**Fig. 31—MGN Power Grounded to Ground Rod—No Water Pipe or Connection to Pipe Not Possible**



**Fig. 32—MGN Power Grounded to Inaccessible Ground Rod—No Water Pipe or Connection to Pipe Not Possible**

**13. STATION PROTECTION AND REQUIREMENTS (BURIED AND UNDERGROUND)**

13.01 Fuseless station protectors may be used with buried distribution cable connected to exposed cable as follows:

- (a) When 24- or 26-gauge cable is so located that it will serve as a fusible link.

*Note:* Either 24- or 26-gauge cable can be used as fuse cable in lieu of 7-ampere fuses at stations and central offices for protection of circuits exposed to power contact (fusible link).

- (b) When the buried distribution cable is 19- or 22-gauge and no fuse cable has been placed,

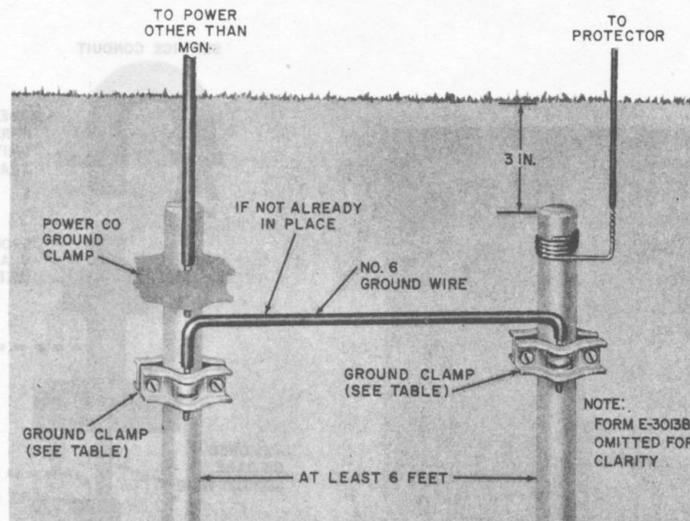


Fig. 33—Power Other Than MGN Grounded to Ground Rod—No Water Pipe

a minimum of 8 inches of either 24- or 26-gauge wire must be placed at the junction point as a fusible link between the service wire and buried cable.

**Note:** B wire connectors should be used to join the fine gauge wire (24- or 26-gauge conductors) used as a fusible link to the service wire and buried distribution cable.

**13.02** When the requirements outlined in 13.01 cannot be met, a fused-type protector must be used.

**13.03** Bond the aluminum shield or armored wire of buried service wire to the ground terminal of the protector by means of the F-Connector. The aluminum shield or armor wire is bonded to the terminal housing by means of an AT-7796X connector (Fig. 46).

**13.04** Service drops joined to exposed underground cable pairs will require the same type protectors as drop wire joined to exposed aerial cable pairs (see 11.03).

#### 14. STATIONS REQUIRING SPECIAL PROTECTIVE MEASURES

**14.01** Special protective measures are usually required for stations located in the following areas:

- (a) At power substations or generating stations
- (b) In atmosphere containing explosive gas, vapor, or dust
- (c) Where privately owned circuits are in conflict or where joint use with power circuits is not suitable for general joint use
- (d) Where facilities are leased for the operation of FOREIGN signaling circuits which might impress excessive voltage or current on the facilities of the system.

**Note:** The protection required for the circuits listed in (a) through (d) are covered in Division 502 and will be on the service order. If it is not, consult your supervisor.

**14.02** Outdoor stations served by exposed conductors usually require only fuseless protectors.

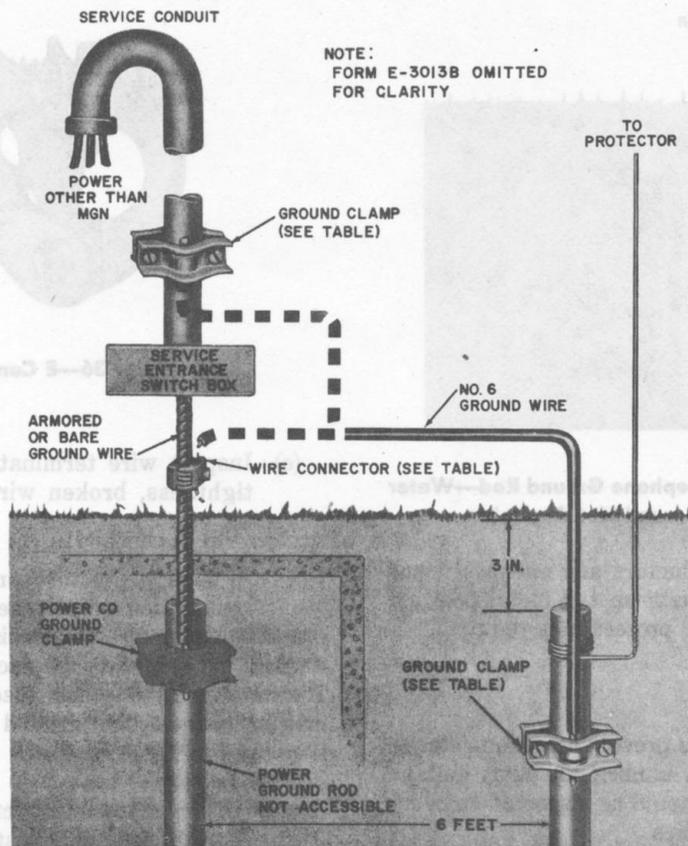


Fig. 34—Power Other Than MGN Grounded to Inaccessible Ground Rod—No Water Pipe

14.03 There are some stations where protectors and special grounding arrangements are necessary, as follows:

(a) **Coin Telephones:** If the drop or line wire is exposed between the cable terminal and telephone, protectors are required.

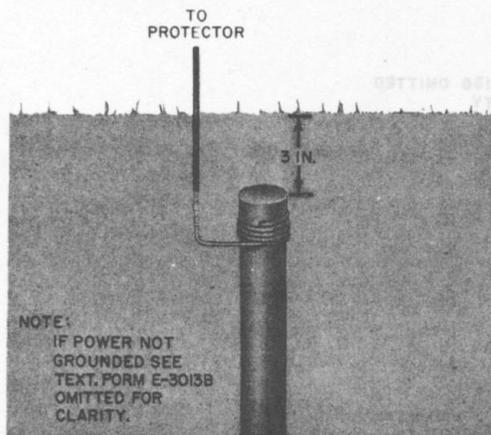
(b) **Stations on Wood Poles:** If possible, install the stations on a pole having a vertical ground wire connected to a MGN. When a MGN is not available and the station is served from a metal sheath cable, the protector is grounded to a ground rod. If the station is served from open or multiple wire, ground the protector to a ground rod following local instruction.

**Caution:** Do not install a station on a pole having a power vertical ground wire for lightning protection unless the ground wire is connected to a multigrounded neutral.

(c) **Stations on Metal Poles:**

**Caution:** Do not install stations on metal poles that support power circuits (open wire or in conduit) of 300 volts or more unless the pole is grounded to a multigrounded neutral or a metallic cold water pipe.

- (1) Fuseless protectors are required on metal poles supporting power circuits of 300 volts or more.
- (2) When the conductors are exposed and the power circuits on the metal pole are 300 volts or less and the pole is bonded to a MGN or low impedance ground, such as a metallic cold water pipe, a fuseless protector is required.
- (3) When the conductors are exposed and the power circuits on the metal pole are 300 volts or less, a fused protector is required.



**Fig. 35—Grounding to Telephone Ground Rod—Water Pipe or Power Ground Not Available**

- (4) When the conductors are unexposed and the power circuits on the metal pole are 300 volts or less, no protection is required.

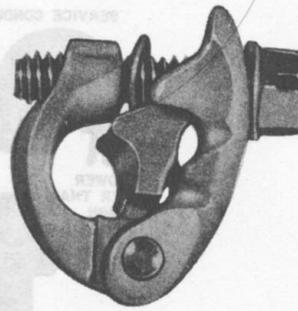
## 15. MAINTENANCE

**15.01** Station protectors prevent damage to station equipment from abnormally high voltage or current. Protectors should be inspected on every visit to customer's premises.



*Inspect ground wire, ground clamp, and ground tag. Change ground connection to use the best grounding medium present. Report any substandard conditions to supervision for later correction. If the best medium available is a ground rod, make sure that the telephone rod is bonded to the power ground rod.*

- (a) Replace protectors, protector units, fuses, mountings, and associated parts which are defective or are in poor condition.
- (b) If No. 26 protector block used with 98A (MD) protector is excessively pitted, turn over on opposite side, if in good condition. If both sides are pitted, replace protector block.
- (c) Replace all 2-type protector units that ground the line.
- (d) Replace converted 98A (MD) protector, if the line remains grounded, with new protector blocks.



**Fig. 36—E Connector**

- (e) Inspect wire terminations at protector for tightness, broken wire, corrosion, foreign matter, etc.

**15.02** Fused protectors on stations served by grounded metal sheath cable should be converted when the station is visited except when it would be necessary to place a new ground wire. The number of converted fuseless protectors which may be connected to ground wire of various sizes is covered in Table B.

**15.03** When station protectors served by metal sheath cable are in locations where atmospheric corrosion is a problem, use a 123A1A, ♦123B1A, ♦ or 128A1A-2 fuseless protector and 150B cover in place of a converted protector and associated protector mounting.

**15.04** Early model 123- and 128-type protectors are equipped with 2B1A or 2B2A protector units. These units are similar except for the metal caps. The 2B1A has a slotted screw type cap and the 2B2A has a 3/8-inch hexagonal head metal cap which requires a 216B tool for removal.

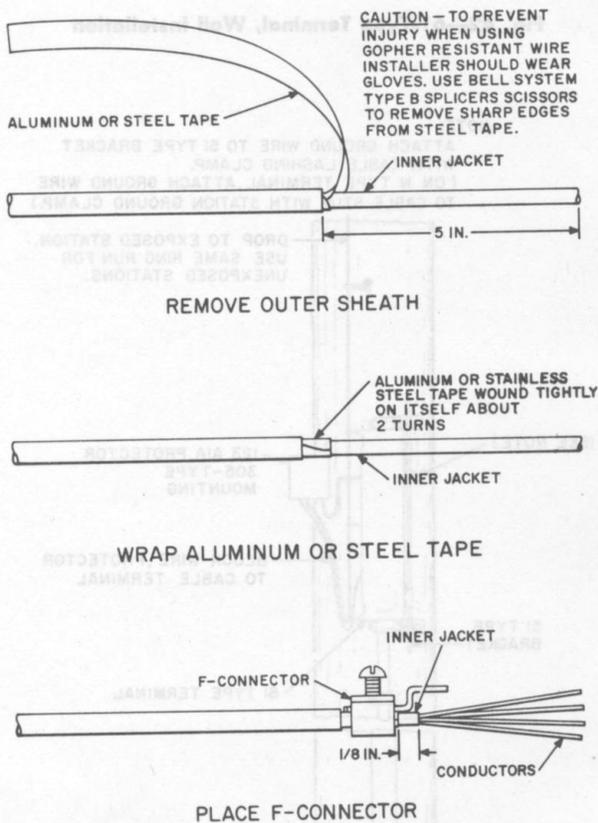
**15.05** ♦The 123B1A protector uses two 6B1A protector units (460A electron tubes) in parallel with two 2B2A protector units. In areas exposed to heavy lightning activity where grounded carbon blocks must be frequently replaced, the 123B1A protector will provide more reliable service than the 123A1A as the gas tubes which do not become permanently grounded assume most of the duty.♦

**15.06** The stud and sleeve assembly of 106A station protectors may become damaged due to heavy power or lightning surges. This will be

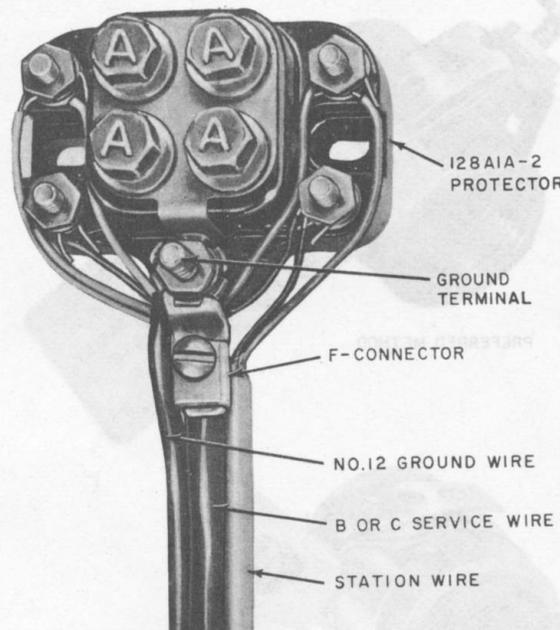
evidenced by the end of the stud and sleeve assembly becoming pitted and burned or by the lack of spring tension in the assembly.

**15.07** A KS-16646 tool is required to remove damaged stud and sleeve assemblies and to insert the replacement (Fig. 47). Replacement should not be attempted on 106CA (MD) or 111A (MD) protectors.

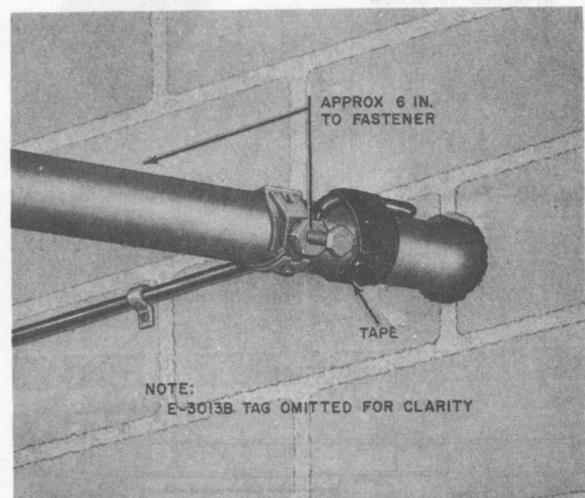
**15.08** The P-13A683 stud and sleeve assembly (Fig. 47) is used in station protectors using 2A1-type protector units and is tinned to ensure a low-resistance path through the protector.



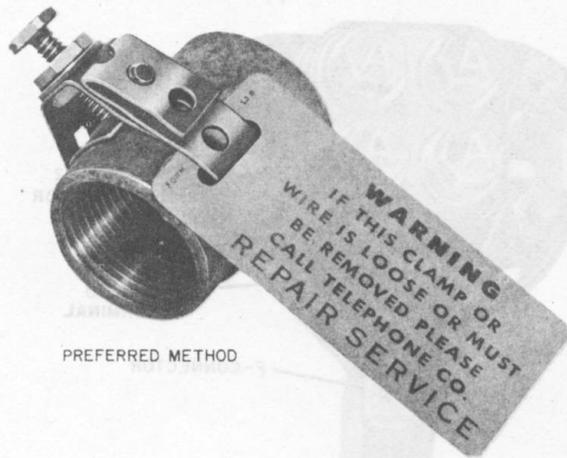
**Fig. 37—Preparing Standard B or C Service Wire for Bonding of Aluminum Shield or Gopher Resistant Steel Shield**



**Fig. 38—Service Wire on Protector**



**Fig. 39—Typical Ground Clamp Installation**



PREFERRED METHOD



FORM E-3013B ATTACHED TO SCREW

Fig. 40—Form E-3013B Attached to B Station Ground Clamp

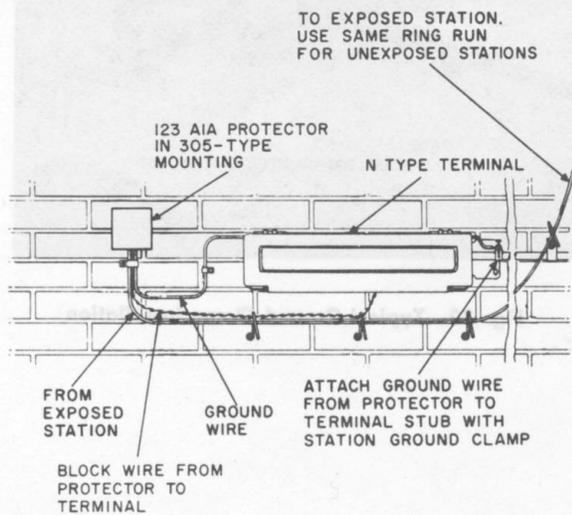


Fig. 41—N-Type Terminal, Wall Installation

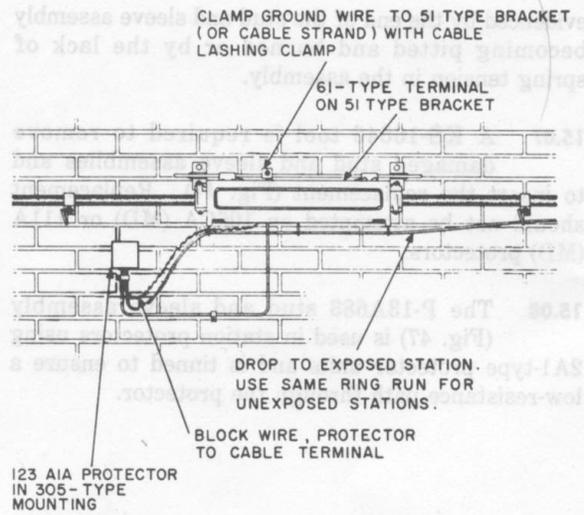


Fig. 42—61-Type Terminal, Wall Installation

NOTE:

ATTACH GROUND WIRE TO 51 TYPE BRACKET WITH CABLE LASHING CLAMP. (ON N TYPE TERMINAL, ATTACH GROUND WIRE TO CABLE STUB WITH STATION GROUND CLAMP.)

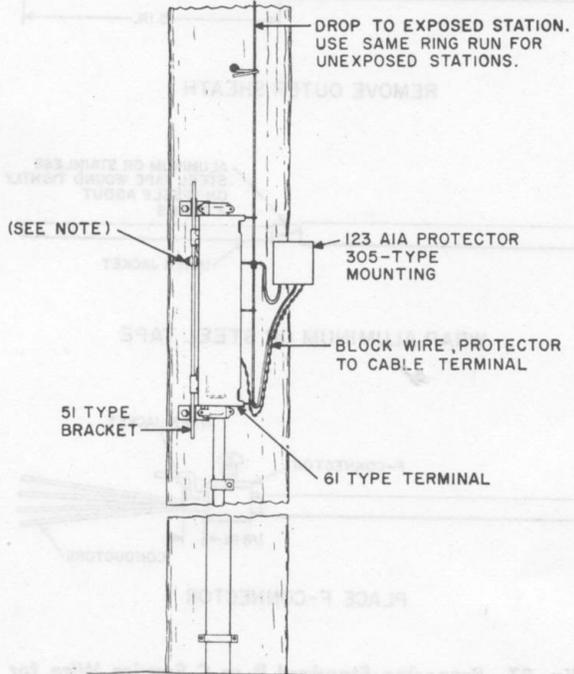


Fig. 43—N- or 61-Type Terminal, Pole Installation

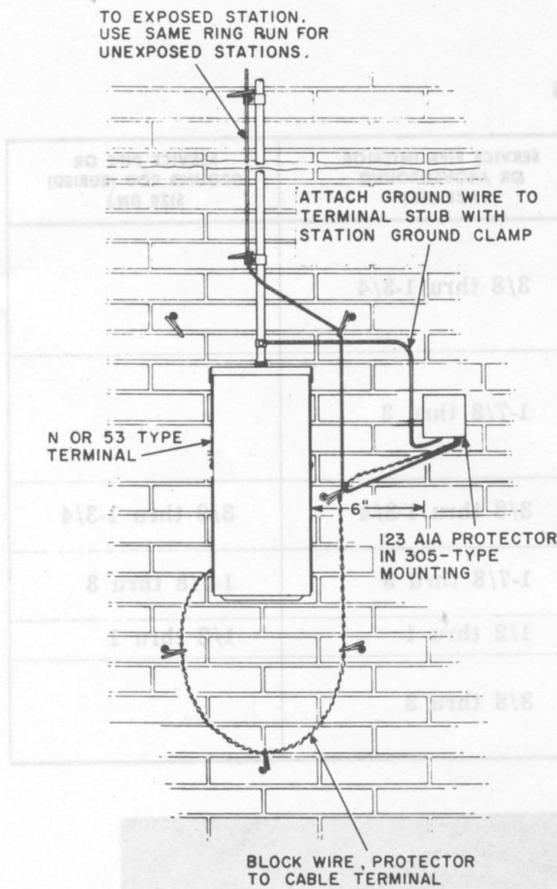


Fig. 44—N- or 53-Type Terminal, Wall Installation

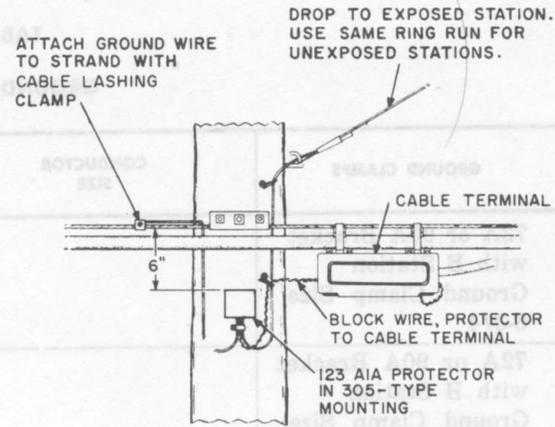


Fig. 45—N-Type Terminal, Strand Installation

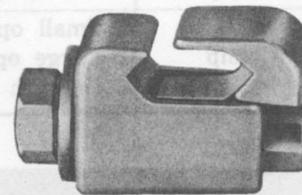


Fig. 46—AT-7796X Connector

**16. CONVERSION OF 98A (MD) AND 106C PROTECTORS TO FUSELESS OPERATION**



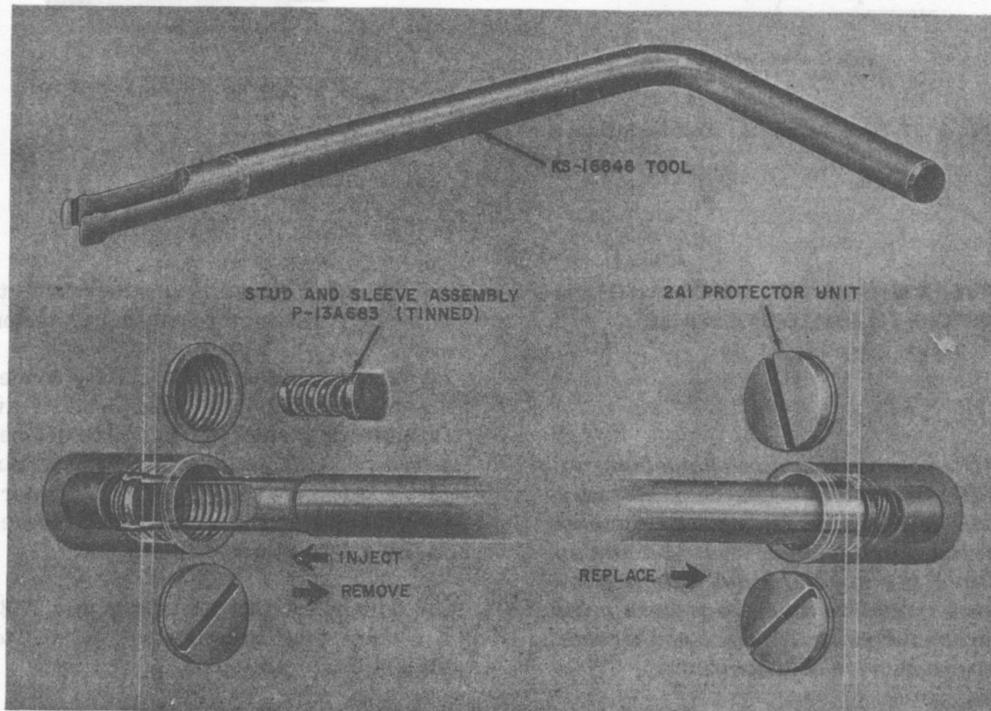
*When converting station protectors on SSM (Special Safeguarding Measures) and/or SSP (Special Service Protection) lines, arrangements must be made to have the special lines taken out of service before doing any work on the protector, since this work could readily cause service interruptions.*

16.01 The following adapters and connectors (Fig. 48) are used in converting protectors:

- (a) The 120A adapter and 211A connector are rated MD but may be used, if available, from existing stocks. They may not be used to convert 98A (MD) protectors manufactured prior to 1939 because the 120A (MD) adapter will not fit over the larger ground electrode employed in these earlier protectors.
- (b) The 121A (MD) adapter and 213A (MD) connector may be used, if available, to convert all 98A (MD) protectors.

**TABLE F**  
**GROUND CLAMPS**

GROUND CLAMPS	CONDUCTOR SIZE	SERVICE PIPE INTERIOR OR ABOVEGROUND SIZE (IN.)	SERVICE PIPE OR GROUND ROD (BURIED) SIZE (IN.)
72A or 90A Bracket with B Station Ground Clamp Size 6-3/4		3/8 thru 1-3/4	
72A or 90A Bracket with B Station Ground Clamp Size 12-1/2		1-7/8 thru 3	
B Station Ground Clamp Size 6-3/4	No. 14, 12, or 10	3/8 thru 1-3/4	3/8 thru 1-3/4
B Station Ground Clamp Size 12-1/2	No. 14, 12, or 10	1-7/8 thru 3	1-7/8 thru 3
B Ground Clamp	No. 8, 6, or 4	1/2 thru 1	1/2 thru 1
L Ground Clamp	Small opening No. 6 Large opening No. 4 through 1/0	3/8 thru 3	



**Fig. 47—KS-16646 Tool**

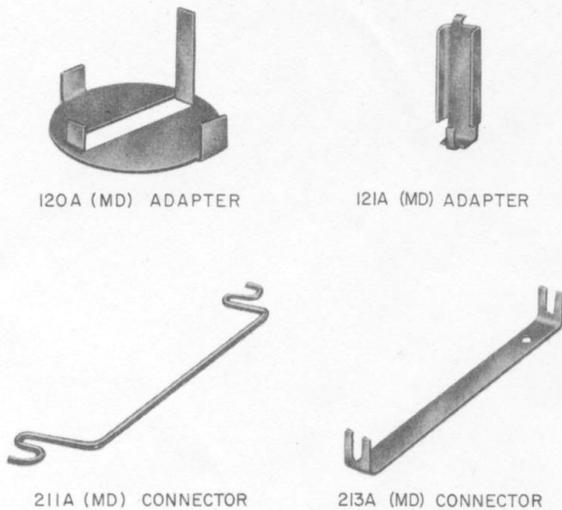


Fig. 48—Adapters and Connectors

**16.02** For conversion of 98A (MD) protectors that are in service, see Fig. 49 and 50. Connectors may be omitted as specified in 16.04(a).

**16.03** For conversion of 106C protectors to fuseless operation (106CA), two connectors are required except where connectors are used to convert 106C protectors, they are installed in the same manner as for 98A protectors; no adapters are required. *The 106A protector cannot be converted to fuseless operation because of insufficient current-carrying capacity.*

**16.04** Alternate methods of converting to fuseless operation are:

- (a) The 98A (MD) protector may be converted by connecting line wires directly to station side of protector if they are of sufficient length. The connectors may be omitted. The 120A (MD) or 121A (MD) adapter(s) must still be used.
- (b) The 106C protector may be converted by connecting line wires directly to station side of protector if they are of sufficient length. The connectors may be omitted. No adapters are necessary.

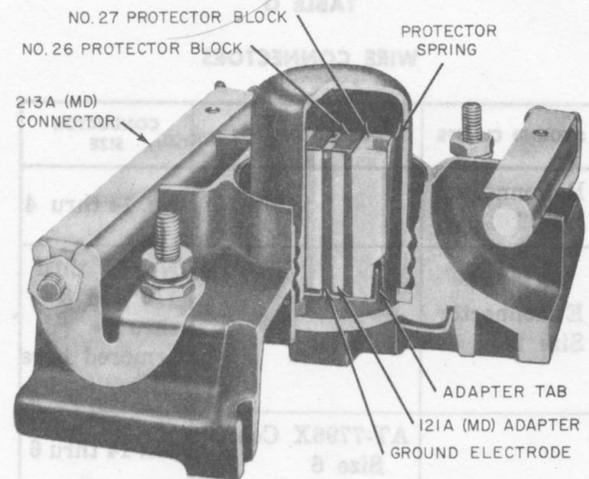


Fig. 49—Converted 98A (MD) Protector Using 121A (MD) Adapters and 213A (MD) Connectors

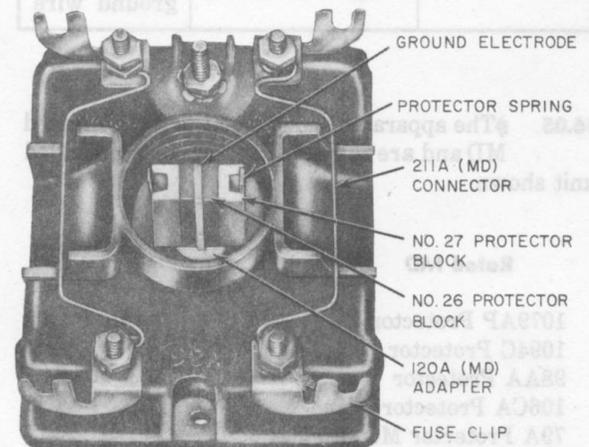


Fig. 50—Converted 98A (MD) Protector Using 120A (MD) Adapters and 211A (MD) Connectors

**TABLE G**  
**WIRE CONNECTORS**

GROUND CLAMPS	WIRE CONNECTOR	CONDUCTOR SIZE
E Connector Size 1		No. 14 thru 4
E Connector Size 2		No. 14 thru 1/0 and 8 thru 4 armored bare wire
	AT-7796X Conn. Size 6	No. 14 thru 6
	AT-7796X Conn. Size 4	No. 8 thru 4
	AT-7796X Conn. Size 2	No. 6 thru 2
	Blackburn PAC 3	No. 2 or 4 aluminum to
	Fargo GA 610 C	No. 6 or 8 ground wire

**16.05** The apparatus shown below have been rated MD and are replaced by the recommended unit shown.

**Rated MD**

1079AP Protector  
1094C Protector  
98AA Protector  
106CA Protector  
79A Protector Mounting  
80A Protector Mounting  
213A Connector  
121A Adapter  
2B1A Protector Unit

**Recommended Replacement**

106C Protector  
94A and 94B Protector Mounting  
123A1A Protector  
123A1A Protector  
106C Protector  
106C Protector  
123A1A Protector  
123A1A Protector  
2B2A Protector Unit