

STATION PROTECTION AND GROUNDING

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1. GENERAL

1.01 This section contains general information pertaining to station protection, identification, installation and maintenance of protectors. It is reissued to update information.

1.02 Station protectors prevent damage to station equipment from abnormally high voltages or currents. (Fig. 27) Station protection is

required at all stations served by open or multiple line wire and at stations served by exposed cable.



Service orders or other local instructions will specify whether or not station protection is required.

IMPROPER GROUNDING AND BONDING

MAY RESULT IN:

- Personnel Injury
- Damage to Premises and Equipment.



On all station visits, inspect ground wire, ground clamp, and ground tag. Change ground connection to use the best grounding medium present. Report any sub-standard 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 and lightning ground rods if available.

The telephone protector ground and the electrical service ground shall be interconnected.

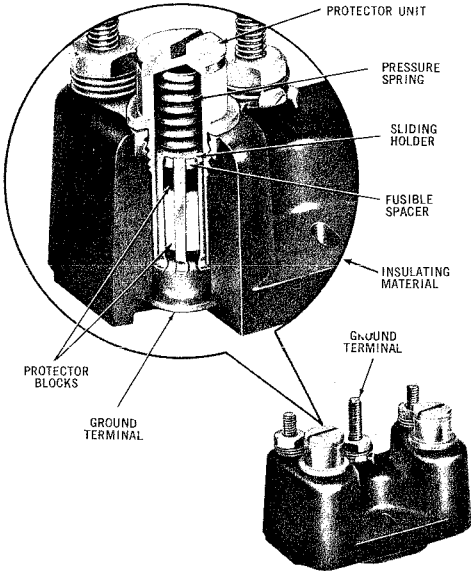


Fig. 1 — 123-Type Protector

2. DESCRIPTION OF STATION PROTECTORS

2.01 The 123A1A-Type Fuseless Protector (Fig. 1) employs a sliding holder arrangement (2B1A protector unit), which encloses one No. 32A and one No. 33B protector block and a low-melting alloy spacer. This assembly and a pressure spring are located inside the brass cap and, when operated, provide a high-current capacity, low-resistance contact between cap and ground terminal. The flexible fingers of the holder make contact with the ground terminal in the base which prevents the heavy fault currents from flowing through and damaging the contact pressure spring. This protector is recommended as first choice, where applicable, because of its high fault current capacity. It should be used on open or multiple line wire only when the proper grounding electrode is available. The later model of the 123-A1A protector has slotted mounting holes oriented 90 degrees to each other to facilitate the mounting and aligning of protector when the anchor holes are not perfectly centered.

TABLE A

PROTECTORS — FUSELESS AND FUSED

TYPE	PROTECTOR	USE	
		INDOOR	OUTDOOR
Fuseless	123A1A	x	(SEE NOTE) x
	QPL3A		
	116C 117B	x	x
Fused	98A 1093C	x	x

Note: For outdoor installation, a 150A cover is required.

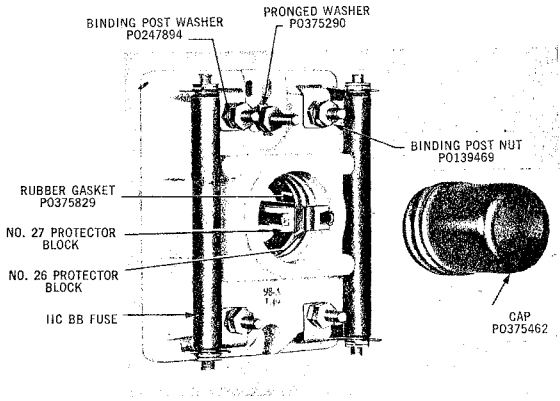


Fig. 2 — 98A Protector

2.02 98A Fused Protector (Fig. 2) consists essentially of a base of insulating material equipped with two No. 11CBB fuses and two each No. 26 and 27 protector blocks. The 98A Fused Protector is used only when conditions described in Paras. 7.02, 7.03 and 7.06 cannot be met.

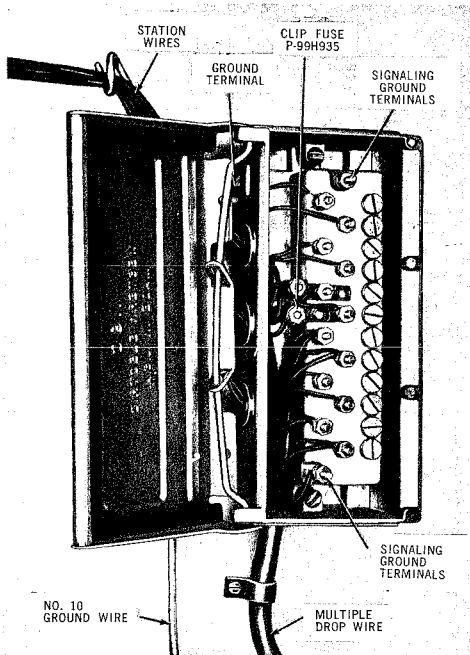


Fig. 3 - 116C Protector (Outdoor)

2.03 116C Fuseless Protector (Fig. 3) is arranged for fastening to mounting surface without requiring a separate mounting bracket. The signaling ground terminals are located at each end of the terminal block. It is equipped with 2A1A-3 mil. protector units.

2.04 116D is the same as the 116C Protector but is equipped with 2A1B-6 Mil. Protector Units.

2.05 117B Fuseless Protector, (Fig. 4) signaling ground terminals are located at each end of the terminal block. One of these terminals is arranged to permit installation of a No. 10 gauge wire for protector grounding purposes.

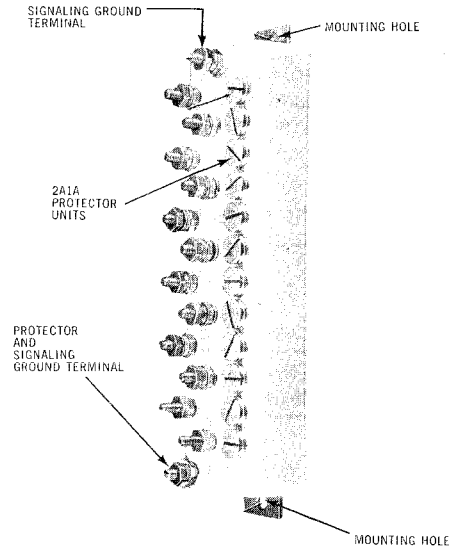


Fig. 4 - 117B Protector (Indoor)

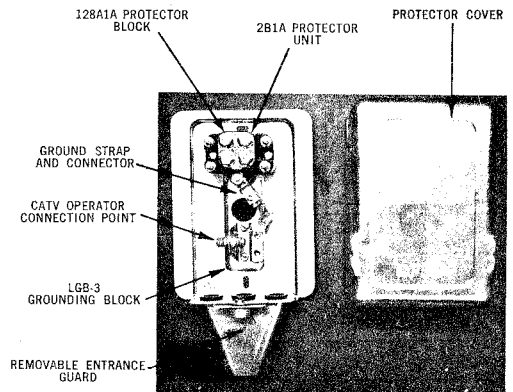


Fig. 5 - Protector QPL3A

2.06 The QPL3A Protector is an outside wall mounted protector (Fig. 5) consisting of a 128A1A-2 Two Station Protector and a coaxial

SECTION 460-100-400CA

LGB No. 3 Ground Block housed in a weatherproof metal box. It is intended for use with buried plant to provide test and ground connection points. This protector is equipped with four 2B1A Protector Units. For coaxial service wires when called for on engineering plans.

3. DESCRIPTION OF PROTECTOR MOUNTINGS AND ASSOCIATED EQUIPMENT

TABLE B
PROTECTOR CAPACITY OF BACKBOARDS

Type of Protector Installation	Backboard Type
123A1A — Single	171
123A1A — (2 or 3)	79

3.01 Backboards should be used only when required, for example, on uneven or insecure mounting surfaces. Choose backboard as indicated in Table B or a suitable alternate type.

TABLE C
GROUND WIRE CAPACITY, CLAMP TYPE

GROUND WIRE SIZE	NO. OF PROTECTED CIRCUITS		CLAMP
	FUSELESS	FUSED	
No. 14	1	3	Station Ground Clamp
No. 12	2	6	
No. 10	6	7	
No. 6	7 or More	8 or More	2B
No. 0			3B

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

TABLE D
CONNECTORS

WIRE SIZE	TYPE	USE
No. 6 to 8 Solid or Stranded	22031	Bridging
No. 3 - Stranded No. 2 - Solid	22031	Bridging
3/16" Max. Opening	35301F	Terminating
5/16" Max. Opening	35401F	Terminating
24 - 26 Gauge	B Wire Connector	Bridging

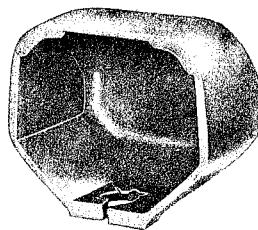


Fig. 6 — 150A Cover

3.02 150A Cover (Fig. 6) is used as a protective covering for the 123 type protector when mounted outdoors or in a dusty location. When this cover is used, the protector is mounted directly on the mounting surface. There is no code assigned to the combination of a protector and the 150A cover.

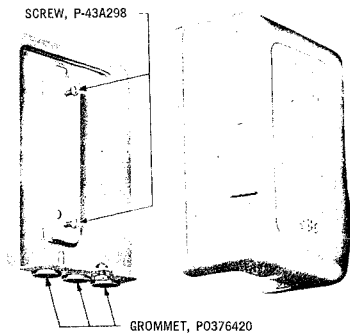


Fig. 7 — 93C Protector Mounting

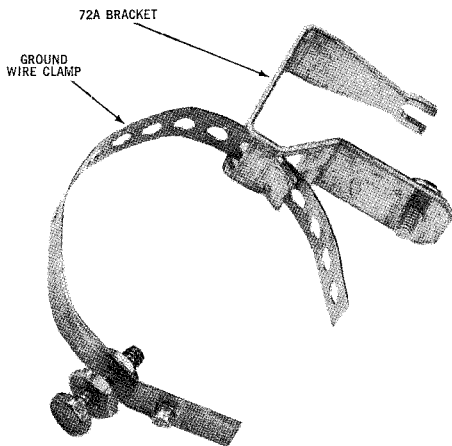


Fig. 8 — Station Ground Wire Clamp Through Slot in 72A Bracket

3.03 93C Protector Mounting (Fig. 7) consists of a metal base and removable metal cover. It is intended to house the 98-type protector for outdoor installation and is furnished with two screws for fastening protector to base. When equipped with a 98-type protector it is coded 1093C.

3.04 The 72A Bracket (Fig. 8) is used to mount a 123A1A protector on an acceptable metallic cold water pipe or to a power stack by means of a station ground clamp (Figs. 13 and 14).

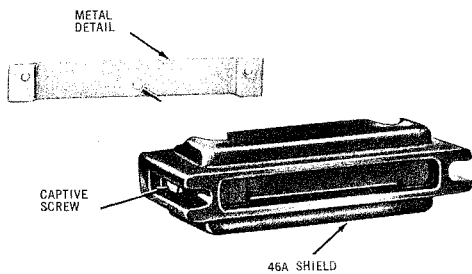


Fig. 9 — 46A Shield

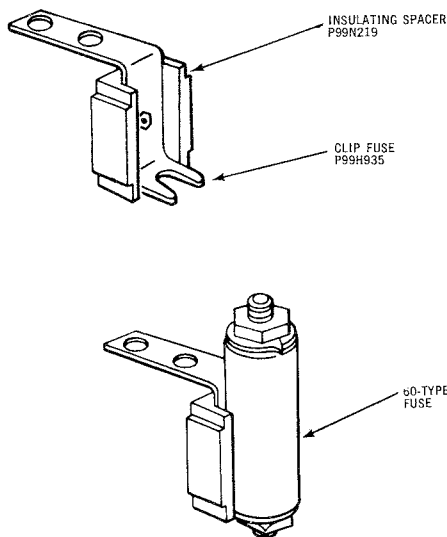


Fig. 10 — 60 Type Fuse, Fuse Clip and Spacer

3.05 The *46A Shield* (Fig. 9) consists of a shield of insulating material containing two captive screws and a metal mounting strap.

3.06 The 46A Shield is used with the 98A Protector when mounted in commercial boxes. When the fuses blow, the shield prevents hot gases from short-circuiting or grounding the terminals of the protector.

TABLE E
60-TYPE FUSES

Fuses	Current (Amperes)		Colour of Shell
	For 3 Hrs.	For Less Than 210 Sec.	
60A	.350	.500	Red
60D	.350	.500	Red
60E	1.25	1.800	Black
60G	.500	.750	Grey

3.07 *Sneak Current Fuses (60-type)* (Fig.10) are required when specified on the service order or by other local instructions.

3.08 When sneak current (60-type fuses) protection is required for pairs terminated on 116- or 117-type protectors, and 5555 Connecting Blocks use Insulating Spacer P99N219 and Fuse Clip P99H935, see Table E for type of fuse required.

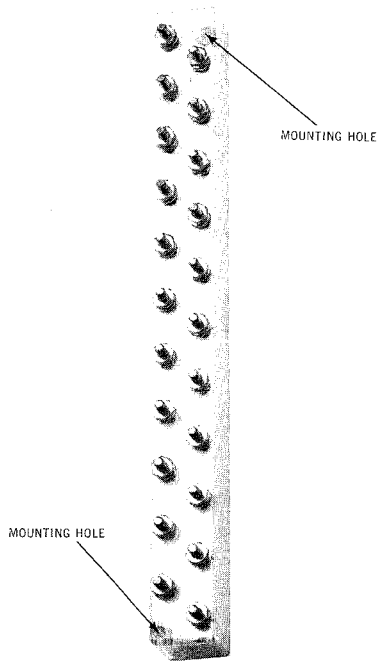


Fig. 11 — Connecting Block 5555

3.09 The *Connecting Block 5555* (Fig. 11) is an eleven pair terminal connecting block. The mounting holes are at the top right corner and the bottom left corner. It is used to mount 60 type fuses where several circuits require sneak fuse protection.

4. INSTALLATION OF STATION PROTECTORS

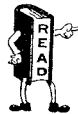
General

4.01 Consider the following when locating protectors:

- Accessibility (avoid placing where a ladder is necessary for installation or maintenance).

- Location of telephone, protector ground, and entrance for drop or block wire.
- Appearance (avoid locations on fronts of buildings or in living quarters).
- Dry and well-ventilated locations when mounted inside or underneath buildings.
- A caution tag, Form 1622 may be placed at each protector to warn workmen against disturbing, concealing or removing the equipment.

4.02 The protector shall be located in or on the building, as near as practicable to the point where the conductors enter.



Special protection arrangements for station sets located in explosive atmospheres or autotrailers are included in the section covering such installation.

WARNING: Where services are to be installed in power stations, information should be obtained through your supervisor from the engineering department.

TABLE F
FASTENERS FOR MOUNTING

Apparatus	Fasteners
Protectors	No. 8 RH wood screws, or equivalent
Protector Mountings	No. 8 RH galvanized wood screws, or equivalent
116C Protector	No. 14 RH galvanized wood screws, or equivalent
117B Protector	No. 10 RH wood screws, or equivalent
5555 Connecting Block	No. 8 RH wood screws

Fastening Protectors and Mountings

4.03 123A1A protectors may be mounted securely in any position except when using a 72A bracket on a pipe where there is a possibility of condensation. In this case do not mount the protector on the underside of the pipe.

4.04 Except when mounted on a horizontal surface the 1093C protector should not be mounted with fuses parallel to the ground.

4.05 Fasteners are indicated in Table F. All screws and fasteners shall be of sufficient length to *mount securely*.

Installing 123 Type Protectors

4.06 Terminate line and inside wires on protectors so that the ring conductors (single-tracer or red wires) shall be connected to the right side of the protector (on ceilings, the right side as viewed from the inside wiring end of the protector).

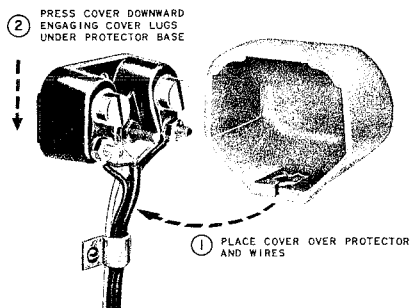


Fig. 12 — Installation of 123A1A Protector with 150A Cover

4.07 When using a 150A Cover, it is recommended that all wires be brought together under a common clamp as a last attachment located approximately 2 inches below the protector (Fig. 12). Because of the size of the snap-on cover, it is also recommended that the finished lengths of insulated conductors from the outer jacket be somewhat less than that which is normally allowed.

4.08 To remove the 150A Cover from a mounted protector, grasp the sides of the cover with the thumb and forefinger and at the same time apply pressure with the middle finger at the central tapered portion in an upward direction. When the cover lugs clear the base of protector, the cover may be lifted off.

4.09 Installation of the 123 Type Protector and 150A Cover is shown in Fig. 12.

4.10 When it is necessary to multiple fuseless or fused protectors, there should be 1 inch separation when horizontally mounted and 2 inches separation when vertically mounted.

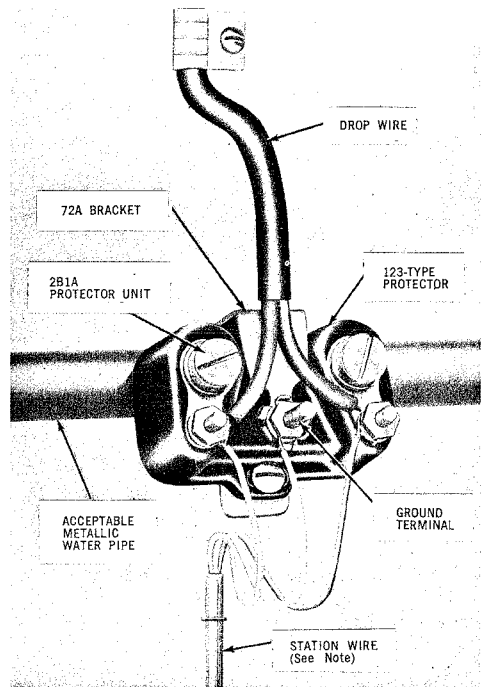


Fig. 13 — 123 Type Protector Installed With 72A Bracket

4.11 Place ground wire clamp through slots in 72A Bracket shown in Fig. 8 and attach ground wire clamp to pipe in usual manner. Remove screw from 72A Bracket and slide protector

into place, making sure the notched portion of the clamp is under the pronged washer of the protector ground terminal. Place screw through mounting hole in protector and into threaded hole in the bracket. Tighten mounting screw and protector ground terminal nut thoroughly. A protector mounted in this manner is grounded through the 72A Bracket and eliminates the use of station ground wire. (See Fig. 13.)

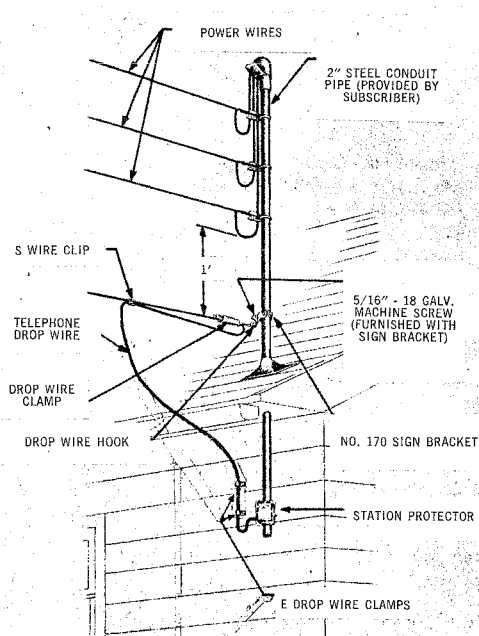


Fig. 14 — 123 Type Protector Installed on Power Stack With 72A Bracket

Precautions To Be Taken When Attaching Protector To Power Stack

4.12 Attachment to the power stack can *only* be used in areas with a multi-ground electrical system, *only* when this type of system has been identified by immediate supervision.

4.13 The power stack must be tested with the Z Voltage Tester before proceeding with work operations.

4.14 Remove paint and oxidization from power stack in the immediate area of the protector to ensure a good ground.

4.15 Observe location of the power service drops in order to avoid body contact. Wear insulating gloves and "Z" Protective Cap when making attachment to the fixture. Obtain a separation of at least one foot between telephone and power wires.

4.16 Using a 72A Bracket and a Station Ground Wire Clamp, install the protector in the manner described in Para. 4.11 of this practice. Place a 150A Cover over the protector and wires. This method of installation will result in the protector being mounted 90° from the normal position. Place a drip loop in the drop wire to prevent water running into the protector. Locate the protector on the power stack as close as possible to the point of entry into the building to reduce the amount of exposed station wire. (See Fig. 14.)

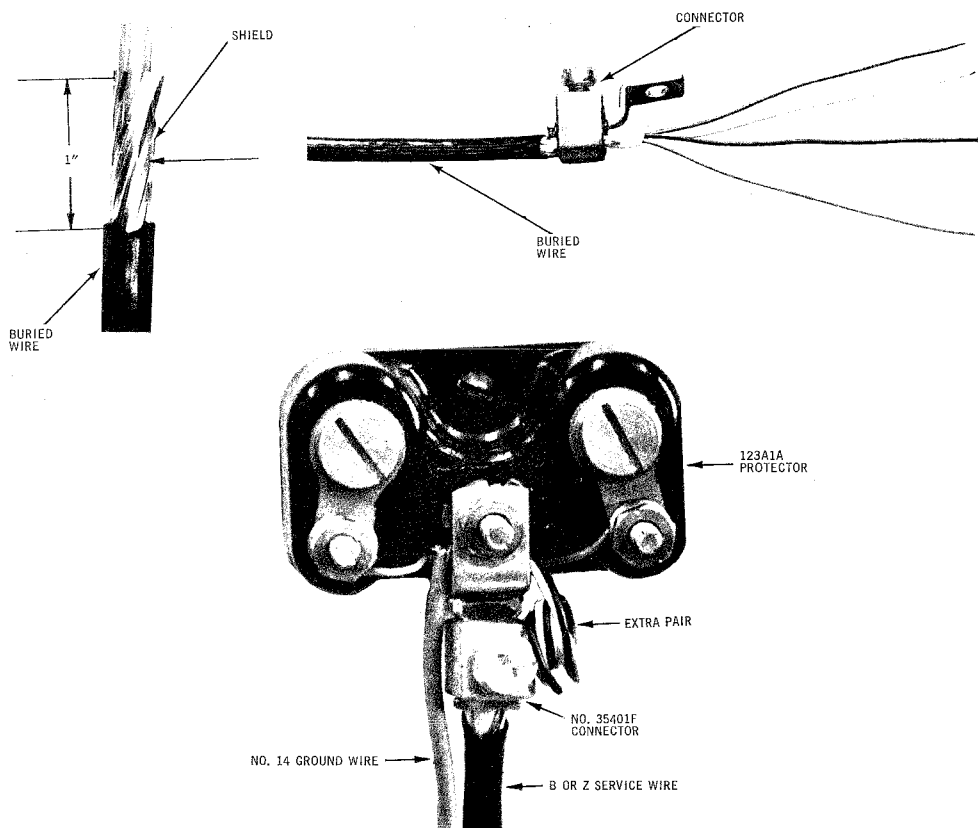


Fig. 15 — Buried Installation With 123 Type Protectors

Buried Wire Installation

4.17 The shield of the buried wire shall be grounded at the distribution terminal and at the subscriber's premises in all instances. The placing forces shall make the initial ground connections, at both the distribution terminal and at the subscriber's premises, at the time the wire is placed.

4.18 Install the 123 type Protector and mark the location of the 35401F Connector. Leave a minimum of 6 inches of wire beyond this location.

4.19 Cut off the exposed armour on B or Z Service wire to a point 1 inch from the outer jacket. (Fig. 15) Remove the inner jacket leaving about $\frac{1}{8}$ inch beyond the end of the armour.

4.20 Insert the wire into the 35401F Connector centering the armour in the barrel. Tighten the bolt with a screwdriver. (See Fig. 15).

4.21 Place the pronged washer on the ground lug between the ground wire and the connector. Place the brass washers and nut on top of the connector and tighten the nut with the 216B or equivalent tool. (See Fig. 15).

Installation Of The QPL3A Protector

4.22 The QPL3A Protector should be located directly over the entrance trench and attached to the outside wall of the subscriber's house at a height of 3 to 5 feet above ground level.

4.23 Terminate the service wires on the connecting block as indicated in this section. Ground the armored shield to the ground lug of the protector.

4.24 A number 10 Ground Wire must be connected from the ground lug of the QPL3A to an appropriate ground.

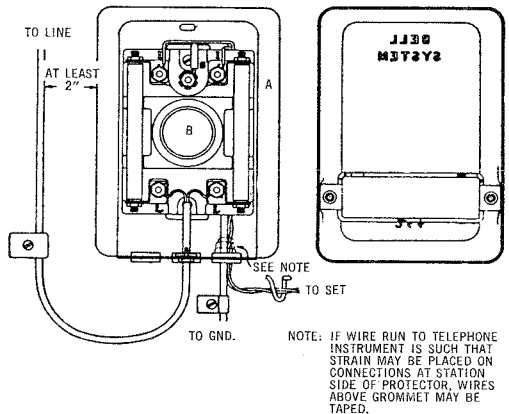
4.25 Connect the CATV Service Wire to the LGB3 Grounding Block as indicated in Section 462-405-205 of Bell Canada Practices.

Installation Of The 116 And 117 Protectors

4.26 The 116C Protector (Fig. 3) is served by a multiple drop wire, but can also be served by separate drop or block wires. All drop and block wire conductors must be terminated during the initial installation. Place the individual wires under the bottom nut of each binding post. Station wires should be terminated between the washers below the top nut. A ground terminal is provided on the rear of the protector and the signaling ground posts are internally bonded to it.

4.27 The 117B Protector is wired the same as the 116C Protector, except for the ground connection. The ground wire on the 117B is placed

underneath the pronged washer on one of the ground posts (Fig. 4). A No. 10 ground wire should be used to ground the 116C, or 117B Protector.



A—11C-BB Fuses (must have centre slots).

Turn slots so that they face the base.

B—Cap (PO375462).

Fig. 16 — Installation of 1093C Protector

4.28 The 1093C Protector consists of a 98A Protector mounted in 93C Protector Mounting. Installed as shown in Fig. 16.

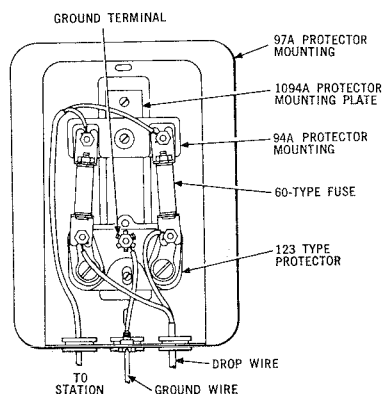


Fig. 17 — Fuseless Protector and 60-Type Fuses

Sneak Current Fuse Installation

4.29 Sneak current fuses (60 type) are not required with protectors associated with residence systems, wiring plans, or key equipment. They shall, however, be provided on special service and leased lines when specified on the service order or by other local instruction.

4.30 Where sneak current fuses are required a 94A Protector in a 97A Protector Mounting is used and connected between the protector and the station.

4.31 60 type fuses and 94A Protector Mountings must be mounted on an incombustible surface. Use 97A Protector Mounting (Fig. 17) if surface is combustible.

4.32 The 94A Protector Mounting consists of a porcelain base equipped with clips for mounting two No. 60-type fuses (sneak current fuses). When specified, they may be mounted with 123A1A protectors. Two 60-type fuses are placed between the protector and 94A protector mounting. Mount 123A1A Protector with code inverted (Fig. 17).

4.33 When sneak current (60-type fuses) protection is required for pairs terminated on 116- or 117-type protectors. PO99H935 fuse clips and Insulating Spacer P99N219 are required.

4.34 When sneak fuses (60 type) are required with a 98A Protector, the 94A Protector Mounting is installed directly above the 98A Protector. The 60 type fuses with fuse clips are used to interconnect the protector and the mounting together. The station is connected to the 94A mounting side of this arrangement.

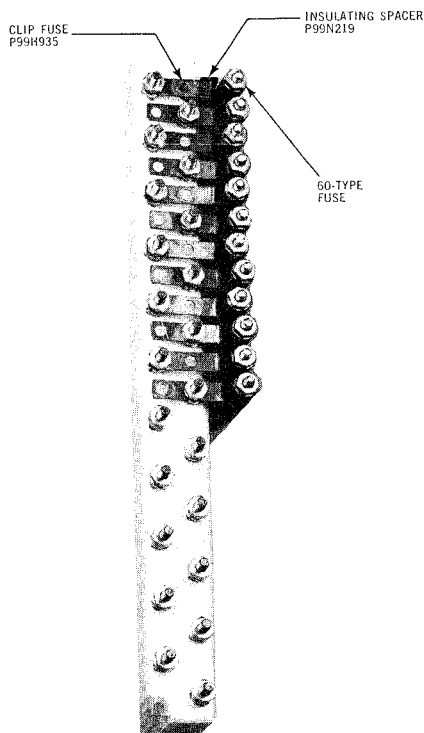


Fig. 18 — Connecting Block 5555 Equipped With 60-Type Fuses, Clip Fuse P99H935 and Insulating Spacer P99N219

4.35 The Connecting Block 5555 should be installed where several circuits require sneak fuse protection. Equip this connecting block with 60 type fuses, Clip Fuse P99H935 and Insulating Spacer P99N219 as shown. This connecting block should be used only where additional protection is required for sneak currents and the normal protector block operation has been provided. (Fig. 18)

5. GROUNDING OF STATION PROTECTORS

5.01 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 and the electrical service ground shall be interconnected.

5.02 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. The telephone protector ground must be located on premises.

5.03 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 (Para. 5.15) must be employed. The alternate selected ground shall always be bonded to the interior metallic cold water piping system which would then be an acceptable protector ground.

5.04 When an insulating joint, pump or water meter separates the interior system from an acceptable water system a bond using No. 6 ground wire must be placed to provide continuity between the two systems. The interior system would then be an acceptable protector ground.

5.05 The term "Multigrounded Neutral Power System" means a power system where the neutral of the transformer is grounded, and where the neutral conductor strung along with the phase conductors is grounded at frequent intervals (at least four ground connections in each mile of line). This term is abbreviated as MGN.

5.06 The MGN (multigrounded neutral) type power system is an acceptable ground but it is not in general use in all areas. A power company may have adopted the MGN as its policy on new or rearranged construction and still have a portion of its plant operating without a multigrounded neutral. To properly interpret 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.

5.07 Whenever possible, use a 72A 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. 19).

Precautions

5.08 *Before connecting the protector ground wire, test the power company ground rod, ground wire, cabinet, meter box, etc, with a Z Voltage Tester as prescribed in Section 620-105-010 of the Bell System Practices.* The voltage test shall be as prescribed for vertical power ground wires or metallic conduit. If the grounding 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.

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

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

5.11 Do not attach ground wire to gas pipes.

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

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

TABLE G
PROTECTOR GROUNDING

A1 — MGN System on acceptable metallic water pipe A2 — MGN System on ground rod B1 — Non-MGN System on acceptable metallic water pipe B2 — Non-MGN System on ground rod 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 preferably to metallic water pipe. Second choice to power service conduit or third choice power service ground wire.	24
	A2 or B2	Ground protector to metallic water pipe and bond power ground rod to water pipe	25
	C or D	Ground protector to metallic water pipe (if C, refer to Para. 5.18)	26
Metallic interior water piping not acceptable because of plastic entrance, insulating joints, etc. Note: If the insulating joint has been bypassed by a No. 6 ground wire or if the interior water system has been bonded to the power ground the interior system would be considered an acceptable protector ground.	A2	Ground protector to MGN ground rod. Bond with No. 6 station ground wire to metallic water pipe. If ground rod not accessible ground to power service conduit or ground wire	28 or 29
	B2	Ground protector to best available ground or telephone ground rod. Bond to power ground rod and interior metallic water pipe with No. 6 station ground wire. If power ground rod is not accessible bond to power service conduit or ground wire.	30 or 32
	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 Para. 5.18)	33
No metallic water pipe or not possible to connect to metallic water pipe	A1 or B1	Ground Protector to power service conduit or power service ground wire.	35
	A2	Ground protector to MGN power ground rod, or, if ground rod is not accessible, ground protector to power service conduit or ground wire.	34 or 35
	B2	Ground protector to telephone ground rod and bond with No. 6 station ground wire to power ground rod.	36
	C or D	Ground protector to best available ground (if C, refer to 5.18)	39

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

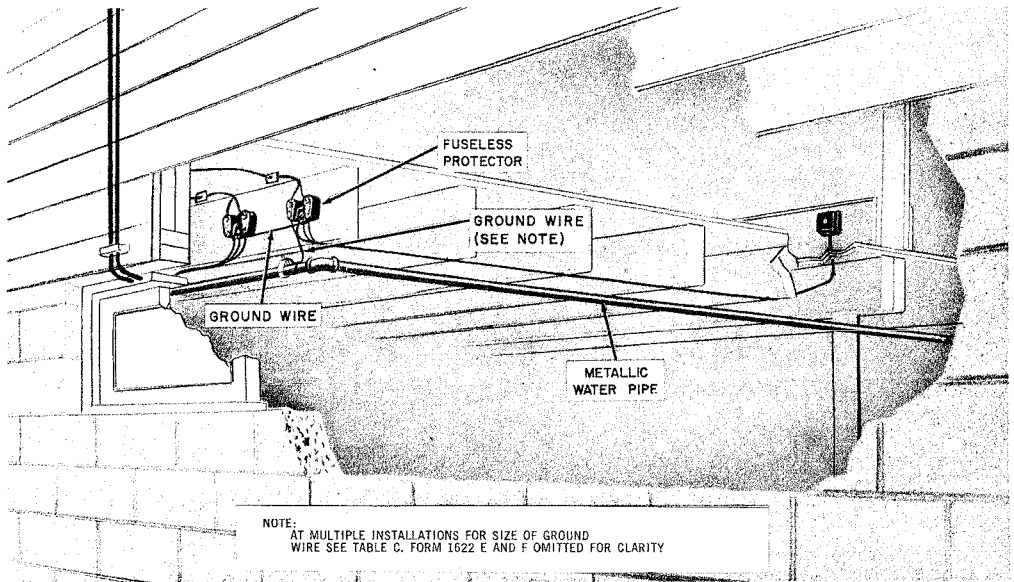


Fig. 19 — Ground Wire Run-Fuseless Protector

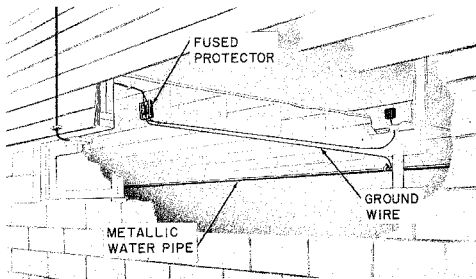


Fig. 20 — Ground Wire Run-Fused Protector

Installation of Station Ground Clamps

5.14 The ground clamp (Fig. 21) should be located at an accessible point where it will not be subject to excessive movement or vibration and where it will least likely be damaged by plum-

bers or other workmen. If the pipe is insecure or subject to vibrations, tape the ground wire to the pipe in close proximity to the ground clamp. (Fig. 22).

5.15 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. However, after placing No. 6 bond wire which would not have to be removed during servicing, the interior system would provide a suitable protector ground.

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

5.17 Form 1622E or 1622E and F (Fig. 23) should be placed at all ground wire terminations to warn people not to disturb the clamp or wire.

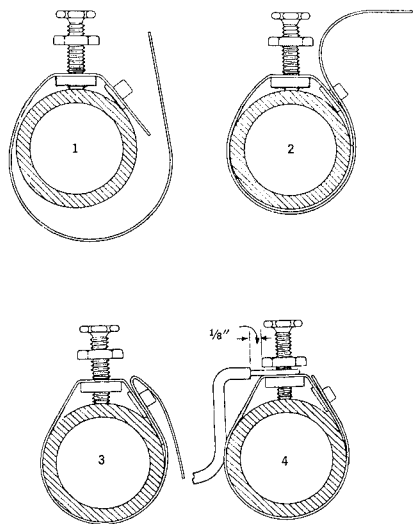


Fig. 21 — Station Ground Clamp Installation

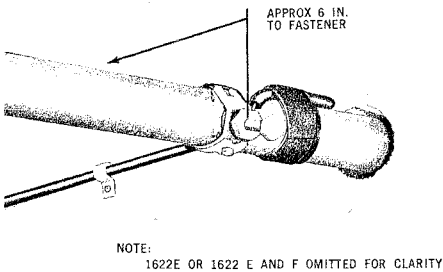


Fig. 22 — Typical Ground Clamp Installation

TABLE H
GROUND WIRE SIZES

PROTECTOR		GROUND WIRE SIZE
TYPE	NUMBER	
98A	3	No. 14
123A1A	1	No. 14
123A1A	2	No. 12
116C or 117B	1	No. 10
QPL3A	1	No. 10

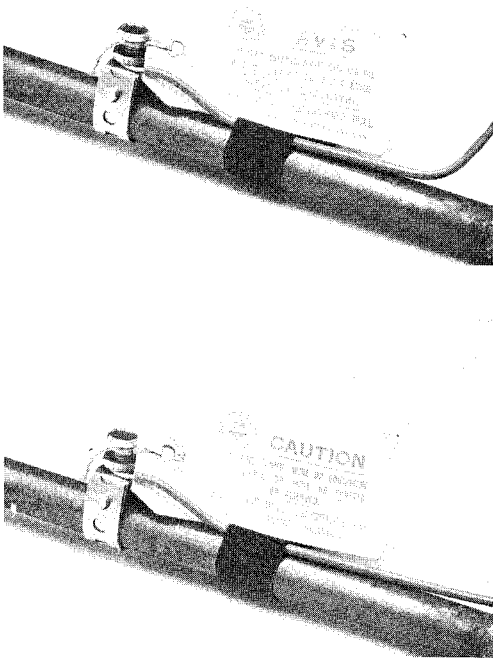


Fig. 23 — Tag 1622E and F Attached to Station Ground Clamp

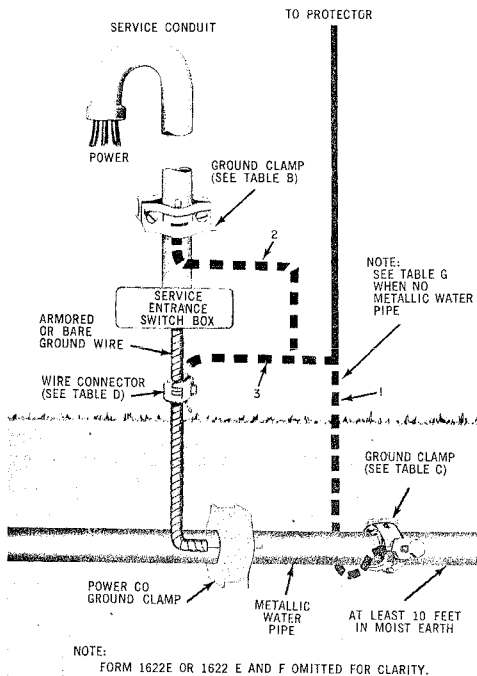


Fig. 24 — Power Grounded to Acceptable Water System

Bonding of Power and Telephone Grounds

5.18 When a situation exists where the power and telephone grounds are not common, the following corrective arrangements should 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 should be bonded to the interior metallic water pipe and the power ground rod. (Fig. 30)
- (b) If the power service and the telephone protector are connected to separate ground

rods, bond the two rods together as shown in Fig. 36.

- (c) If lightning ground rod present, it must be bonded to telephone ground rod. (See Fig. 31).

5.19 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 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.

5.20 Where there is a television mast ground, and there is no common grounding of the mast, power and telephone services on a metallic water pipe system, advise the customer of the desirability of interconnecting this ground and others on the premises.

Selection of Signal Ground

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

5.22 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 medium. When commercial power is not connected to telephone apparatus it is desirable to bond protector and signaling ground; however, it is not required.

Locating And Installing Ground Rods

5.23 *Precautions to be taken when installing ground rod.*

1. Avoid personal injury by protecting eyes and hands when installing ground rod.
2. Due to the increasing use of buried power cables, it is essential that the following precautions be observed:
 - (a) During the installation of a ground rod, insulating gloves must be worn.
 - (b) After installing the ground rod, and before connecting the ground wire to the rod, test the rod with the Z Voltage Tester to ensure that it is not energized.
 - (c) If a ground rod is found to be energized, proceed no further with this work. Place some protection to guard the public and notify supervision.

5.24 Locate and install ground rods as follows:

- (a) Where least likely to be damaged or tampered with.
- (b) As near as 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, or lightning ground rod. (Fig. 30 and 31).
- (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.

5.25 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 C.

5.26 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 6 times, 3 times each side of center. Do not tape splice. When a larger size of ground wire must be terminated on the ground rod, select the proper size and type of ground clamp as listed in Table C.

5.27 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 C.

- (a) If a power ground rod is not available, install a ground rod for each protector. Bond all protectors together. No more than 3 ground rods spaced at least six feet apart need to be placed.
- (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. 36).

5.28 Multiple station protectors, such as the 116, or 117 type, may be connected to any of the grounds shown in Table G but should not be connected to a single telephone ground rod unless the rod is bonded to the power system ground rod. If a power ground rod is not available, a multiple station protector may be connected to an array of three telephone ground rods, spaced at least 6 feet apart and bonded together with No. 6 station ground wire.

5.29 Where the telephone ground wire is near a walk or other thoroughfare and such a location cannot be avoided, protect the wire with $\frac{1}{2}$ in. Half-Round Wood Moulding to a height of approximately 8 ft. above the ground.

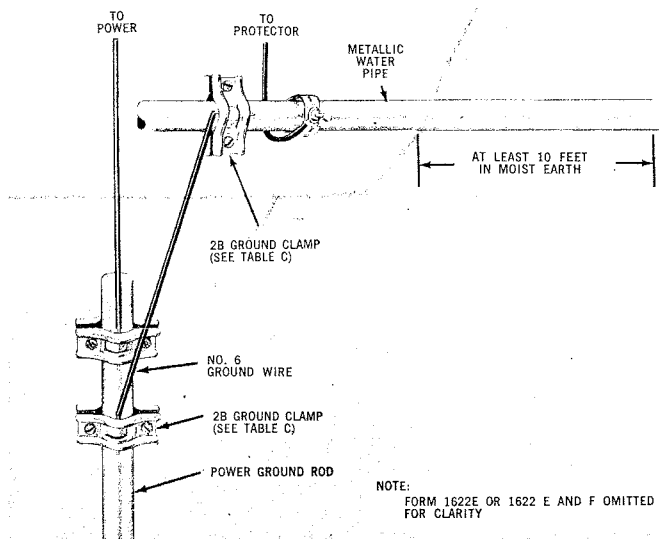


Fig. 25 — Grounding to Metallic Water System—Power on Ground Rod at Premises

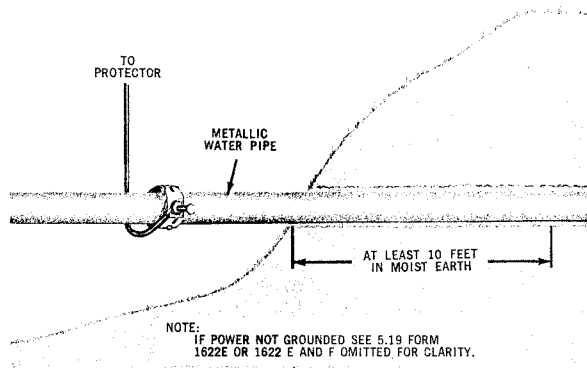


Fig. 26 — Grounding to Metallic Water System—Power if Any Not Grounded at Premises

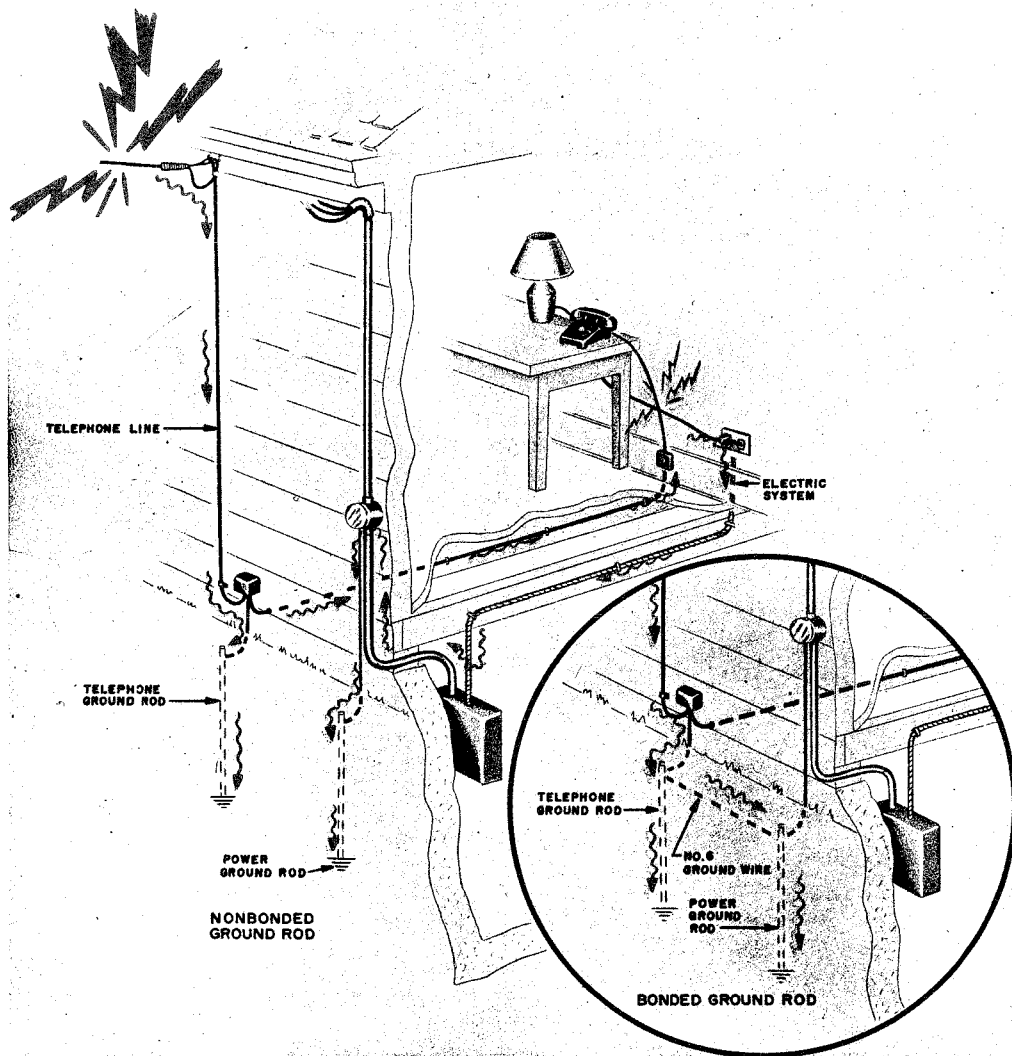


Fig. 27 — Effects of Bonding and Grounding

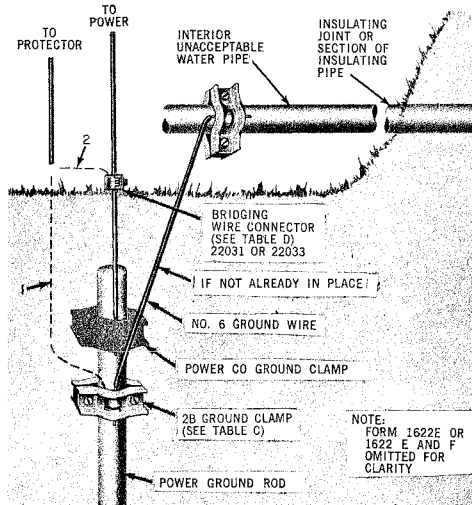


Fig. 28 — MGN Power Grounded to Ground Rod — Unacceptable Interior Water System

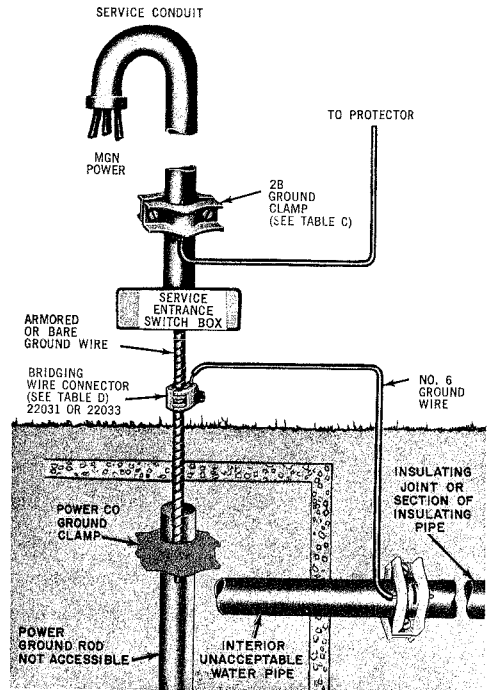


Fig. 29 — MGN Power Grounded to Inaccessible Ground Rod—Unacceptable Interior Water System

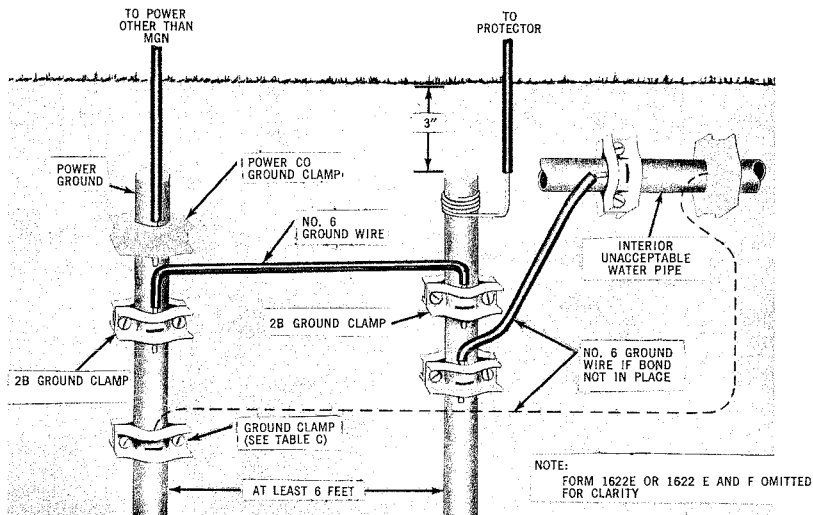


Fig. 30 — Power Other Than MGN Grounded to Grounded Rod Unacceptable Interior Water Pipe

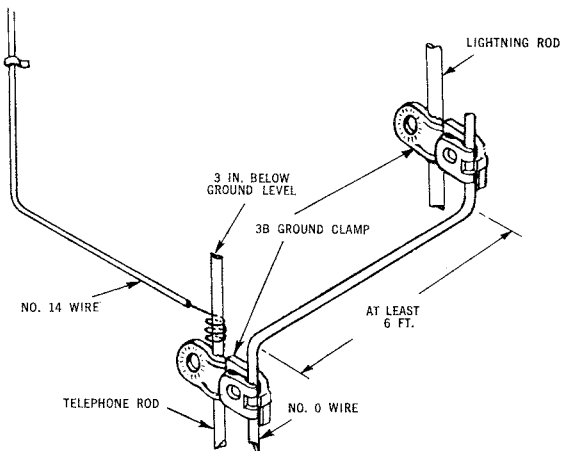


Fig. 31 — Bond to Lightning Rod

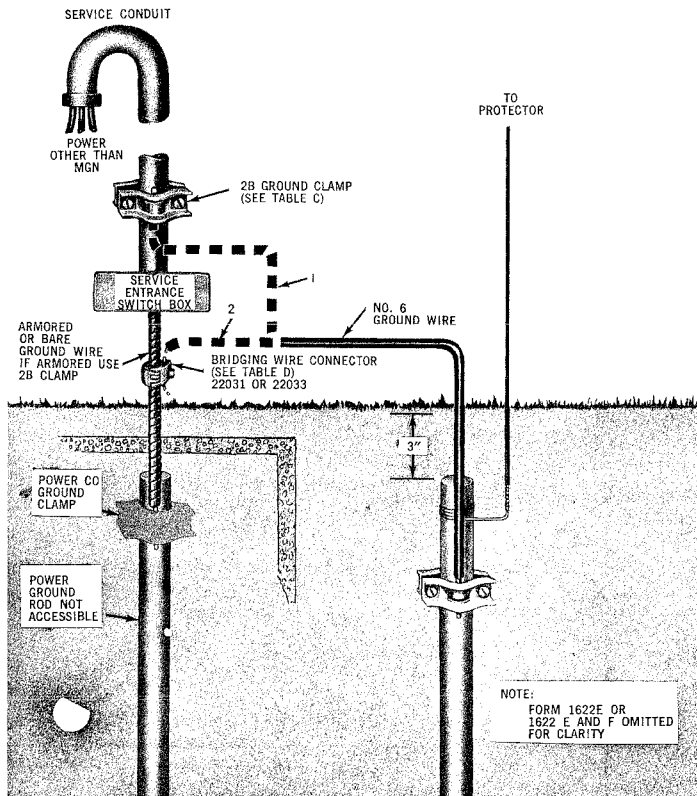


Fig. 32 — Power Other Than MGN Grounded to Inaccessible Ground Rod

6. CABLE PROTECTION

6.01 Isolated sections of aerial cable are considered as open wire for the purpose of determining the type of protector required unless the cable is effectively grounded to a multigrounded neutral or to an extensive water (metallic pipe) system.

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

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

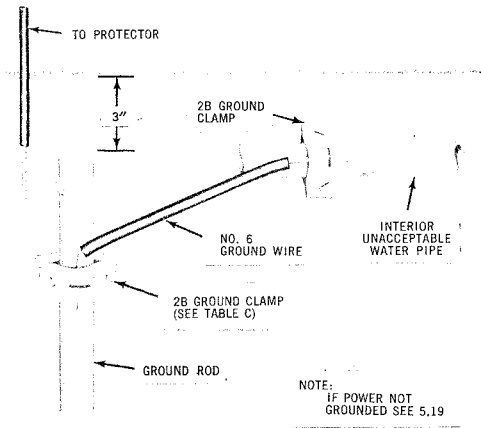


Fig. 33 — Power Not Grounded on Premises—Unacceptable Water Pipe

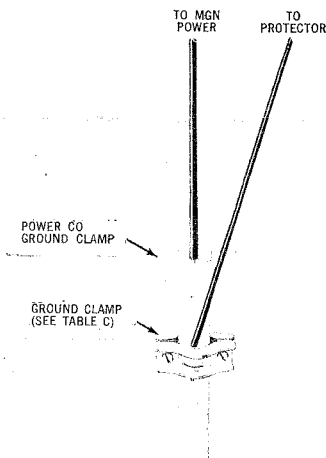


Fig. 34 — MGN Power Grounded to Ground Rod—No Water Pipe—Connection to Pipe Not Possible

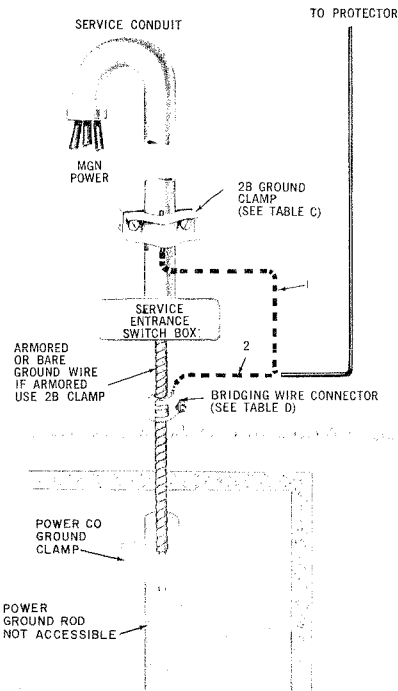


Fig. 35 — MGN Power Grounded to Inaccessible Ground Rod—No Water Pipe—Connection to Pipe Not Possible

7. STATION PROTECTION REQUIREMENTS (AERIAL OR BLOCK CABLE)

7.01 Fuseless station protectors should be used at all stations connected to a cable terminal served by a cable with a grounded metal sheath or shield, such as lead, alpth, stalpeth, etc. When a drop wire is to be joined *directly* to a cable pair a fusible link is required. (See Para. 7.03 for description of fusible link.)

7.02 The fuseless protectors should be installed when single pair drop wire is used at stations served by open or multiple wire when the protector can be grounded as follows:

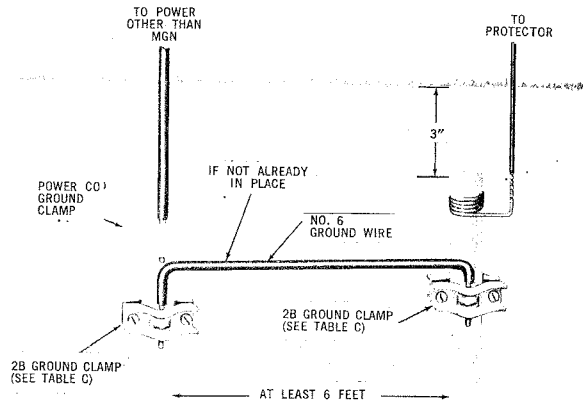


Fig. 36 — Power Other Than MGN Grounded to Ground Rod—No Water Pipe

- (a) A metallic cold water pipe having at least 10 feet buried.
- (b) A metallic cold water pipe bonded to a multigrounded neutral system.
- (c) Service ground of a multigrounded neutral power system.
- (d) Metallic service entrance conduit (except aluminum) bonded to the service entrance box of a multigrounded neutral system.

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

7.03 Subject to the grounding restrictions outlined in Para. 7.02, the fuseless protector is used as follows:

- (a) At any station served by open wire where bridling to NE drop wire is through Z block wire fusible link.
- (b) At stations where NE drop wire is directly connected to urban wire.
- (c) Where NE drop wire is connected through Z block wire fusible link to rural wire.

Note: The bridling between drop wire and open wire or rural wire must consist of at least two feet of Z block wire.

7.04 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 directly to a cable pair a fusible link is required as outlined in Para. 7.06.

Fused Station Protection And Requirements

7.05 When the grounding requirements or bridling requirements outlined in Paras. 7.02 or 7.03 cannot be followed; a fused-type protector must be used.

Station Protection And Requirements (Buried And Underground)

7.06 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.

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- (b) When the buried distribution cable is 19 or 22 gauge and a cable terminal with a fusible link is provided.

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).

7.07 When the requirements outlined in Para. 7.06 cannot be met, a fused-type protector must be used.

7.08 For any length of buried wire, bond the aluminum shield or armored wire to the ground terminal of the protector by means of the solderless connector. (See Table D).

7.09 Service drops joined to exposed underground cable pairs will require the same type protectors as drop wire joined to exposed aerial cable pairs.



Fig. 37 — Bridging Connector (See Table C)

8. STATIONS REQUIRING SPECIAL PROTECTIVE MEASURES

8.01 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, vapour, or dust.
- (c) Where privately owned circuits are in conflict or joint use with power circuits not suitable for general joint use.
- (d) When facilities are leased for the operation of FOREIGN signalling circuits which might impress excessive voltage or current on the telecommunication facilities.

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

8.02 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 multigrounded neutral. When a multigrounded neutral 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.

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 less than 300V and the pole is bonded to a multigrounded neutral 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 less than 300V and the pole is **NOT** bonded to a multigrounded neutral or low impedance ground such as a metallic cold water pipe, a fused protector is required.
- (4) When the conductors are unexposed and the power circuits on the metal pole are less than 300 volts, no protection is required.

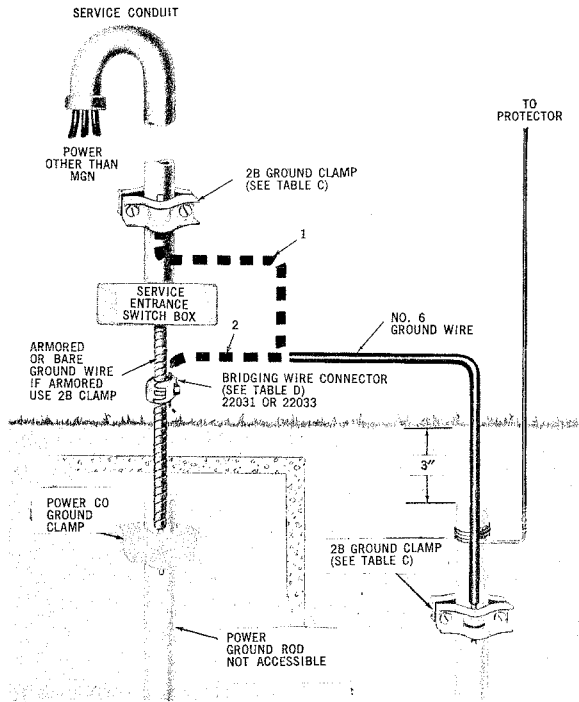


Fig. 38 — Power Other Than MGN Grounded to Inaccessible Ground Rod—No Water Pipe

Selection of Protector Units

8.03 If exposed drop or block wires are to be connected to unexposed cables at 49-type terminals, equip the terminals for station protection. To do this, use 3A1B-3 (F-53458) terminal blocks. Remove the 2A1B protector units and replace 2A1A protector units.

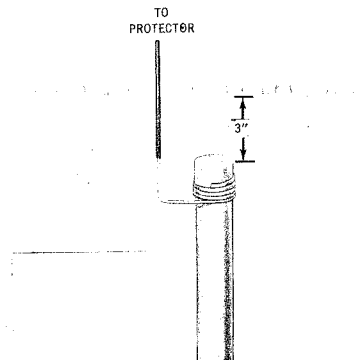


Fig. 39 — Grounding to Telephone Ground Rod—Water Pipe, Power Ground, or Metallic Structure Not Available

9. MAINTENANCE OF STATION PROTECTORS

9.01 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 the 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, and to the lightning rod if present.

- (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 protector is excessively pitted turn over on opposite side, if in good condition. If both sides are pitted, replace protector block.
- (c) Replace operated fuses on the 98A protector with No. 11CBB fuses using a 216B or an equivalent tool. Make certain the fuses are

installed with the slots facing into the wells located in the base.

- (d) Replace all 2-type protector units that ground the line. Defective units to be returned to storeroom.
- (e) Inspect wire terminations at protector for tightness, broken wire, corrosion, foreign matter, etc.

9.02 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 C.

9.03 When station protectors served by metal sheath cable are in locations where atmospheric corrosion is a problem, use a 123A1A fuseless protector and 150A cover in place of existing protector and associated protector mounting.

9.04 Model 123A1A-type protectors are equipped with 2B1A protector units (Fig. 1). These units may have a slotted screw type cap or a $\frac{3}{8}$ -inch hexagonal head metal cap which requires a 216B or equivalent type tool for removal.