UNDERGROUND SYSTEM CONNECTION AND PROTECTION

Nowhere in the distribution of electric power are the problems of connecting conductors and protecting them and equipment against the effects of fault currents as complex as in underground systems. For more than 70 years, BURNDY engineers have worked closely with utilities to develop devices for connecting and protecting conductors and associated equipment in underground systems. These devices, with their inherent dependability and economy, have contributed to the rapid growth of underground systems throughout the country. To assist utility personnel in more effectively selecting and applying these devices, the engineering talent and experience of BURNDY have been pooled to prepare this technical section, and the catalog information that follows.

The devices are designed for use in both radial and network type underground systems. Radial systems (Fig. 1) distribute power economically except in high load density areas where a high degree of service reliability is required.

Network systems (Fig. 2) have become standard for AC power distribution where load density is high and service continuity must be assured under nearly all conditions. The improved equipment and methods which are described in this catalog have been designed to meet these secondary network system requirements and to reduce the cost of installation and maintenance.

Early Problems in Underground Connections

Despite the many advantages of underground distribution, a major problem was that of making connections in congested manholes or junction boxes. The necessary procedure—soldering conductors, taping joints, and wiping lead covered cable—was so complex, that it demanded considerable skill and was time consuming and costly. This involved procedure had to be repeated each time a service was added to a main. When completed, the multiple-branch joints were excessively bulky and their electrical and mechanical performance suffered from the shortcomings of soldered connections.

The installation of underground distribution made greater strides as those early connection methods gave way to specialized products and techniques developed by BURNDY at the request of, and in close collaboration with, engineers of leading utilities. These specialized connectors were easier and more economical to install, more compact, and more dependable electrically and mechanically.

For installation in conjunction with these connectors, BURNDY also developed products to protect the secondary system from the effects of fault currents. The continuing improvement of these products, based on field experience and laboratory research, is contributing to even greater dependability and economy in underground distribution.

Design Objectives in Connectors for Underground

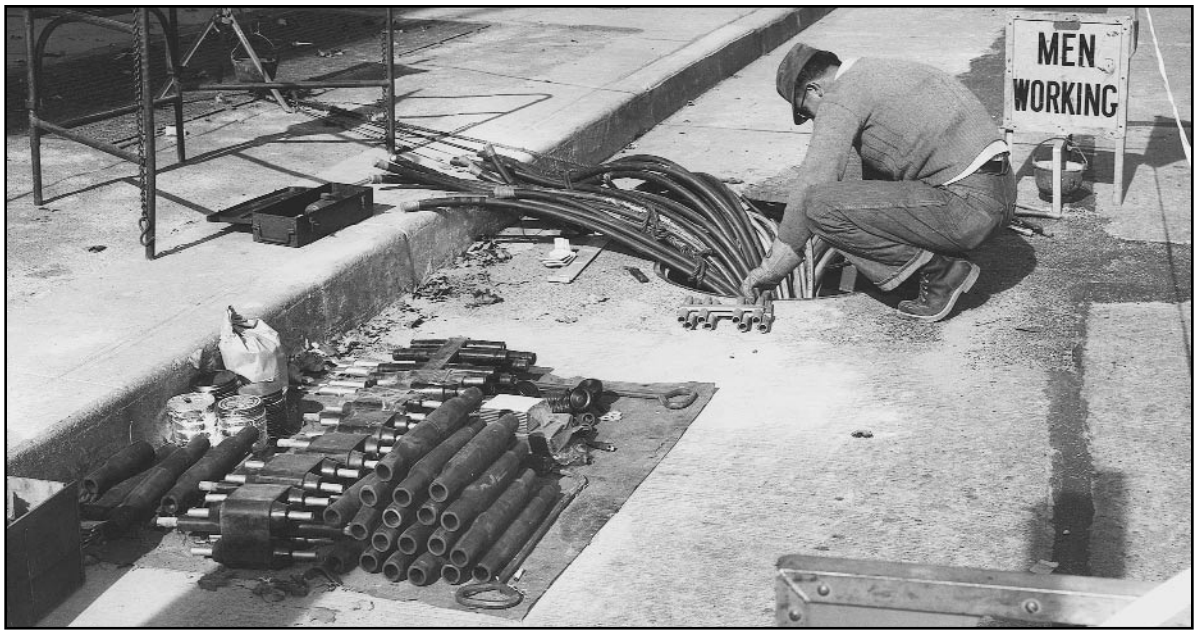
While each of the principal types of equipment described in the following pages has been designed to meet particular service requirements, all have several basic objectives in common:

Reliability: To minimize outages and their serious consequences in the high load density areas served by underground systems.

Ease of Installation: Compact for easy installation in the confined space of a manhole and transformer vaults. Mechanical connections that eliminate difficult solder joints.

Economy: By reducing the time and skill required for installation of a dependable, insulated compact connection.

Versatility: For permitting easier changes, expansion, and additional services with a minimum of system shutdown.



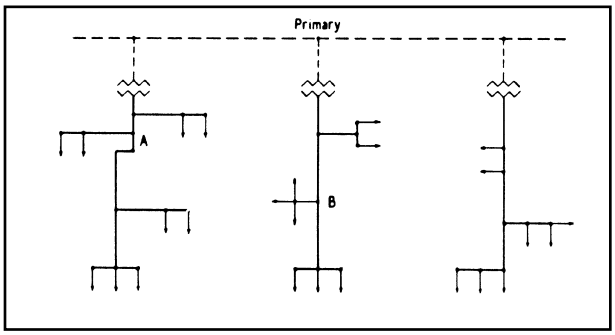


Figure 1 RADIAL SECONDARY DISTRIBUTION SYSTEM

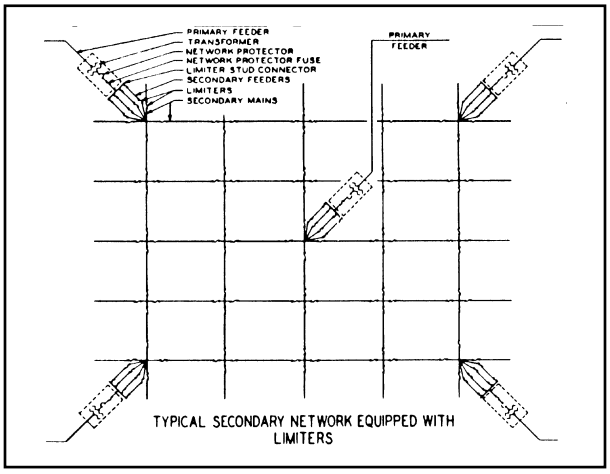


Figure 2

TYPES OF BURNDY UNDERGROUND CONNECTORS AND ACCESSORIES

The MOLE and HYCRAB

The most popular of the engineered connectors developed specifically for underground manholes and transformer vaults are the MOLE and the HYCRAB that provide for multiple connections at a single junction point of main, feeder, and service cables. Pre-insulated to eliminate extensive taping, these connectors are essentially bus bars with several cable outlets: mechanical installation in the MOLE, and compression installation in the HYCRAB.

Limiters and Fuses

To prevent “roasting” of cable insulation, resulting from fault current, BURNDY has developed cable limiters that are inserted in each secondary cable at all junction points. Network protector fuses have been designed to back up the protector breaker in the event of a malfunction during a transformer or primary cable fault. By coordinating the time current characteristics of the fuse with those of the cable limiters, the possibility of limiter blowing on primary faults is eliminated, which in turn reduces the fault finding task. Also, limiter, fuse, and cable insulation characteristics must be carefully coordinated to assure isolating a fault on the secondary before it can cause extensive damage or interrupt service in other sections of the secondary system.

High Capacity Limiter 200,000 Amperes at 600 Volts

The BURNDY High Capacity Limiter is designed to economically protect electrical distribution systems from the destructive effect of high energy faults. The increasing number of 600 volt secondary network installations for industrial and commercial applications demand a cable limiter that can safely interrupt 200,000 amperes (symmetrical available) and one that will also completely coordinate with the higher voltage nework protector fuses.

Available fault currents as high as 200,000 amperes rms at 600 volts across the fusible elements have been interrupted during tests on the BURNDY High Capacity Limiter. The power factor during these tests was less than 15%, thereby imposing the most difficult clearing conditions. No external distrubance is experienced upon clearing fault currents from the "float" value to 200,000 amperes. The quartz filler absorbs the intense energy gererated by interrupting the fault current. The quartz fuses into tubular fulgurites, with a high dielectric strength, and forms an insulating barrier between the melted link sections. This action prevents restrike of the internal arc. The rugged glass melamine housing provides a vessel that completely contains the developed energy.

The carefully developed time-current characteristics and rigid manufacturing tolerances assure proper coordination with the network protector fuses and the insulation damage characteristics of 4/0, 250, 350, 500 and 750 kcmil cable.

The High Capacity Limiter is available in four variations to accommodate a variety of installation practices. The Type HYS cable sockets at both ends, which allow for indenting to the cable ends with a hydraulic BURNDY HYPRESS. The HYAO has an off-set lug on one end which permits back-to-back mounting on bus bar.

For those installations where BURNDY Moles are used for manhole junctions or transformer vault buses, the Type HYM permits a replaceable connection of the limiter directly to the Mole outlet at one end and a compression cable connection at the other.

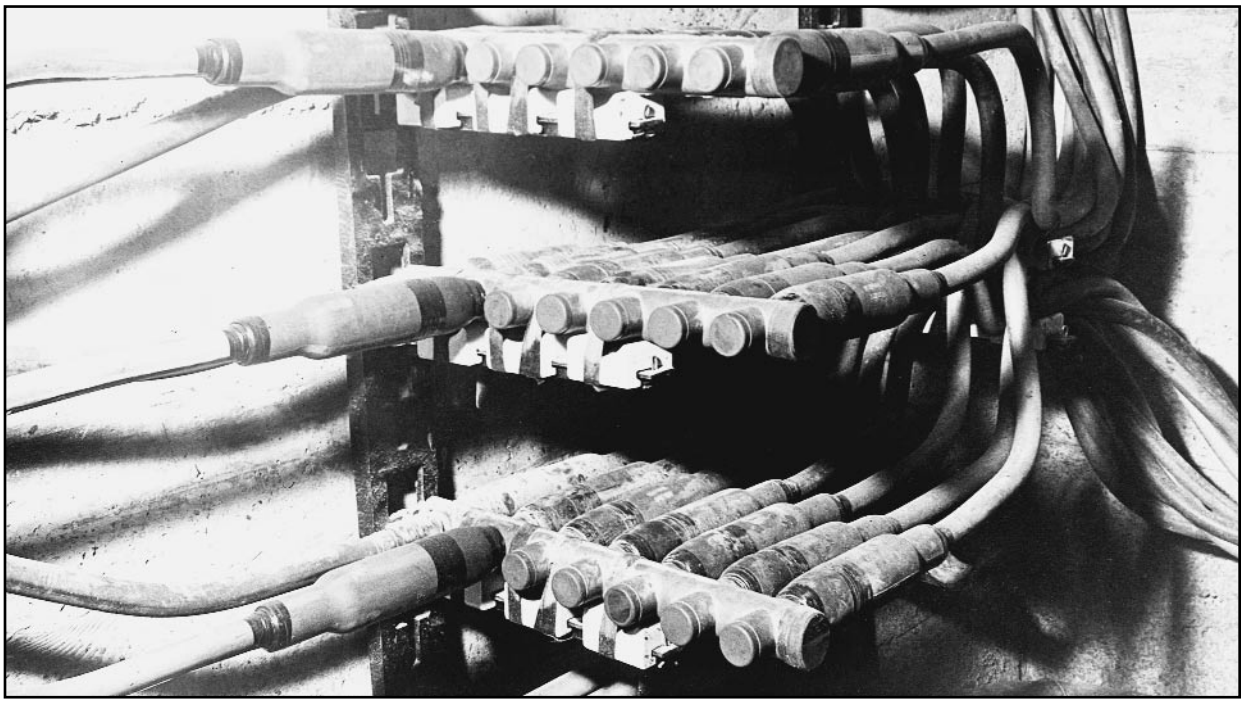
Modern electrical distribution systems require low cost protection to safeguard costly equipment and quickly isolate faults, so that the undamaged portions of the system may function normally. BURNDY High Capacity Limiters assure positive, economical protection when installed in properly designed systems.

Compression Connectors

BURNDY HYDENT compression type connectors, and installation tools, have been designed for splicing and terminating copper as well as aluminum underground cables, in both primary and secondary circuits. BURNDY tools and dies are custom designed to produce sound electrical, and mechanical joints on BURNDY connectors. The use of BURNDY’s matched tools and connectors assures optimum results.

Residential Underground

The trend toward improvement in neighborhood appearances, and the elimination of storm outages, tree trimming, etc. has created the need for residential underground distribution. To meet these needs, BURNDY offers: Mechanical type pre-insulated multi-conductor terminal connectors for submersible transformer locations; and compact multiconductor connectors for above ground transformer and enclosures. For service taps, BURNDY offers: Pre-insulated, multi-conductor compression and mechanical connectors; and a range taking compression connector for below grade service. Power pedestals for direct burial, above ground application, and conduit systems are offered. Residential Underground Fuse Block assembly with replaceable fuse for each service cable is also available.



Connectors for Aluminum
For systems where aluminum is used, connectors especially designed for aluminum conductors are available in bolted and compression types: HYCRAB, HYPLUG, HYREDUCER, and HYSOCKET. Aluminum conductors can be connected to standard MOLES by using HYPLUG adapters.

Multiple Outlet Connectors
The increasing use, in modern electrical distribution systems, of junction points where several relatively large cables must be connected has brought about the development of Burndy MOLE line equipment to speed up and simplify the making of such connections. The modern tendency toward network systems, not only in underground utility practice, but also in industrial wiring has greatly increased the number of multi-connection joints.

The Burndy MOLE and HYCRAB connectors are insulated bus bars with multiple connector outlets for service cables, secondary mains, or equipment leads. In the MOLE, clamping action secures conductors to the connector; in the HYCRAB, connections are made by indenting with a compression tool. Both lines of insulated connectors offer the following basic advantages:

1. Ease and Economy of Installations: The ease and reduction of time required to make and insulate dependable multi-connections greatly reduces the cost of installation. The compact design makes maximum use of space and provides for simplified racking.

2. Versatility for System Modification: The MOLE and HYCRAB are designed to accommodate the standard secondary main and service cables, and permit easy modification or later additions. The numerous available connector configurations permit a wide variety of arrangements of cables and equipment connections. The 600 volt rating of the MOLE and HYCRAB insulation provides for efficient operation at all standard utilization voltages.

3. Efficient, Dependable Performance: The MOLE and HYCRAB connectors assure permanent, high conductivity connections, good moisture seal, and insulation that resists the severest condition encountered in underground installations.

MOLE and HYCRAB Insulation
The location in vaults and manholes often exposes these connectors to immersion in water, chemical, and other contaminants, as well as to heat from overload or fault currents. The MOLE and HYCRAB insulations provide electrical, mechanical, and thermal properties essential to assure the service continuity of underground distribution systems.

Recognizing the importance of proper connector insulation, Burndy established performance specifications exceeding those of 600 volt cable insulation.

MULTIPLE OUTLET CONNECTORS (CONTINUED)

MOLE and MOLE Accessories
The Burndy MOLE is a multi-cable connector that consists of a pre-insulated copper bus bar with threaded outlets that permit a minimum of two cables to be connected by means of a socket, nut, and cone assembly (ILL. A). The clamping action of the socket, nut and cone assembly on the cable develops high contact pressures that maintain joint conductivities greater than 100% of the continuous conductor. A compression socket that is threaded into the MOLE insert is also available. The MOLE design affords exceptional versatility in four ways:

1. MOLE outlets can be plugged-off until needed for the addition of cables.
2. Installed cables can be easily removed.
3. Cable sizes can be increased by changing the socket, nut and cone assembly.
4. The number of outlets may be increased by joining MOLES with a MOLE coupler.

Insulation
The copper bus bar insert is encased in a molded insulating jacket that eliminates crotch taping. The thickness of the jacket prevents any possibility of the insert weight to cause the insulation at the supports to flow away at the high temperatures of fault conditions.

Ratings
MOLES are rated at 1500, 2000, 2500, and 3000 amperes, based on the maximum current the insert cross-section can carry. Each outlet can carry the full rated current of the cable connected to it.

To avoid exceeding the insert rating, the cables should be arranged in such a manner that most current flows directly across the insert. (See Illustration B)

Installation
Cables are connected to the MOLE by means of a socket, nut and compression cone assembly. The socket is threaded into the

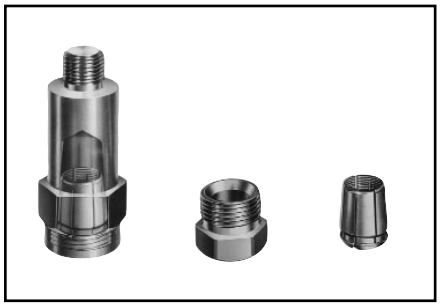


ILLUSTRATION A

MOLE insert. The stripped cable end is inserted into nut and compression cone, and then into the socket where it is securely clamped by tightening the nut. The joint is then sealed watertight in one of three ways:

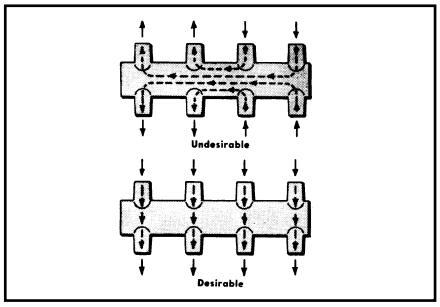


ILLUSTRATION B

Taping; MOLE Outlet Insulating Sleeves, sealed with a minimum of taping; or Notape MOLE Sleeve, sealed to the cable and mole insulation by two non-corrosive hose clamps.

Tests under flooding and other adverse conditions demonstrate that such joints are impervious to water.

Accessories
A socket, cone and nut assembly is screwed into each MOLE outlet to which a cable is to be connected. The socket has a tapered recess into which the clamping nut forces the cable and the compression cone. The cone is slotted to controlled widths and depths for maximum flexibility, and its inside surface is serrated for low contact resistance and high pullout strength.

A compression socket is available that threads directly into the MOLE outlet and provides a compression sleeve for connecting the cable with HYPRESS tools.

Plugs seal MOLE outlets not in use. The MOLE is delivered with one-fourth of its outlets sealed with plugs. Additional plugs may be ordered.

MOLE couplers facilitate system expansion by joining additional MOLES to those already installed. Couplers are easily installed in end or side outlets of the MOLE, and make connections that are effective both electrically and mechanically.

Continued

MULTIPLE OUTLET CONNECTORS (CONTINUED)

BURNDY Manufactures a complete line of Networking products.

For more information on these specialized BURNDY NETWORK UNDERGROUND products, please contact our Customer Satisfaction Center at: 800-346-4175 or write us at:

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