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TECHNICAL BULLETIN
PAGER PHONES

INSTALLATION

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INTRODUCTION

The pager phones used in many underground coal mines are battery-operated, party-line telephones with provisions for loudspeaker paging. The system is two-wire, non-polarized, and is operated by self-contained batteries. Many of the individual units are certified as permissible.

Requirements for installation are specified in state and federal regulations, such as in the *Code of Federal Regulations,* Title 30, *Mineral Resources,* Part 75. The major federal regulations that affect communication in coal mines are noted below, with a brief description of the subject matter in each of the relevant paragraphs. Refer to the cited paragraphs of Title 30 for explicit details of these regulations. (This brief description is for reference purposes only.)

- *Minimum Requirements* (paragraphs 75.1600, 75.1713-2, and 75.1003-1)
  Approved telephone or two-way communication will be provided between the surface and each main shaft landing and each working section; to the nearest medical assistance; and shall be protected from contact with trolley wires or trolley feeder wires.

- *Installation Requirements* (paragraphs 75.516-2, 75.521, and 77.508-1)
  Communication wires will be supported on insulated hangers, attached to messenger cables, or buried, to protect against mechanical damage; installed opposite trolley wires; and insulated near power conductors . . . each cable will have lightning arresters within 100 feet of going below ground . . . and arresters will be provided wherever telephone wires enter a building.

- *Wire and Cable Requirements* (paragraphs 75.516-2, 75.517, and 75.521)
  Communication cable means two or more insulated conductors, covered by an additional abrasion-resistant covering; power wires and cables shall be adequately insulated and fully protected; and lightning arresters shall be connected to low-resistance grounds, more than 25 feet from neutral grounds.

This technical bulletin is based on: the requirements of Title 30; installation practice recommended by equipment manufacturers; the experience of repair personnel; industrial telephone communication experience; and Rural Electrification Authority (REA) practices.

A description of the many telephones available is included in the bulletin *Introduction;* the types of wire and cable to be used in these installations are described in the bulletin *Cable Selection;* and proper care and procedures for connecting and splicing the interconnecting cable are described in the bulletin *Splices and Connections.* The following text includes excerpts from those bulletins, to supplement the installation recommendations. Detailed information on each subject should be obtained from the individual technical bulletins.

MOUNTING

Pager phones are designed to be mounted on an upright support at the desired location. For convenience, the phone should be mounted five feet above the floor where there is no obstruction to using the handset or removing the cabinet front cover for servicing or battery replacement. In low coal situations, a suitable height for installation should be selected convenient to the normal operator's position at the site selected. About 12 inches of free space on each side of the phone should be provided for cabinet access. Four 1/4-inch or 5/16-inch holes are normally provided in a 6-inch x 10-3/4-inch pattern on a rear bracket, for mounting with lag screws, bolts, or spikes. The phone should be protected against direct exposure to dripping water and should not be allowed to rest in a puddle of water. The mounting location should be convenient to a work location and have a safe, unobstructed area for a worker to stand and use the phone. The phone must be in a location where the worker will not be in the path of moving vehicles or falling debris. Each telephone is normally well insulated, low voltages are used, and the current is limited to a safe value, but it is still good practice to provide an insulating mat or dry planking for the user to stand on.

CABLE

The cable wire size depends on a series of factors that include: the total number of telephones in an installation, the total length of cable run (distance between the farthest phones), the configuration of branch lines, available battery voltage, and the type of paging relay used. The interaction of these factors and their impact on the choice of wire size is discussed in the technical bulletin *Cable Selection.* The preferred cable, regardless of wire size, is a twisted pair of solid conductor wires, with individual insulation around each wire in the pair and an outer abrasion-resistant covering of waterproof, flame-retardant material.

Cable strung in an entry should be supported by insulated "J" hooks, or other suitable insulating hooks, spaced close enough to prevent excessive sag in the cable. Additional support can be provided at branch points or near each telephone location. This additional support and strain relief, as shown below, will reduce the hazards of broken cables and prevent undue strain on the connections to the telephone. The cable must be supported free of any standing water, protected from leaks or dripping water, and hung so it will not snag passing vehicles or personnel.

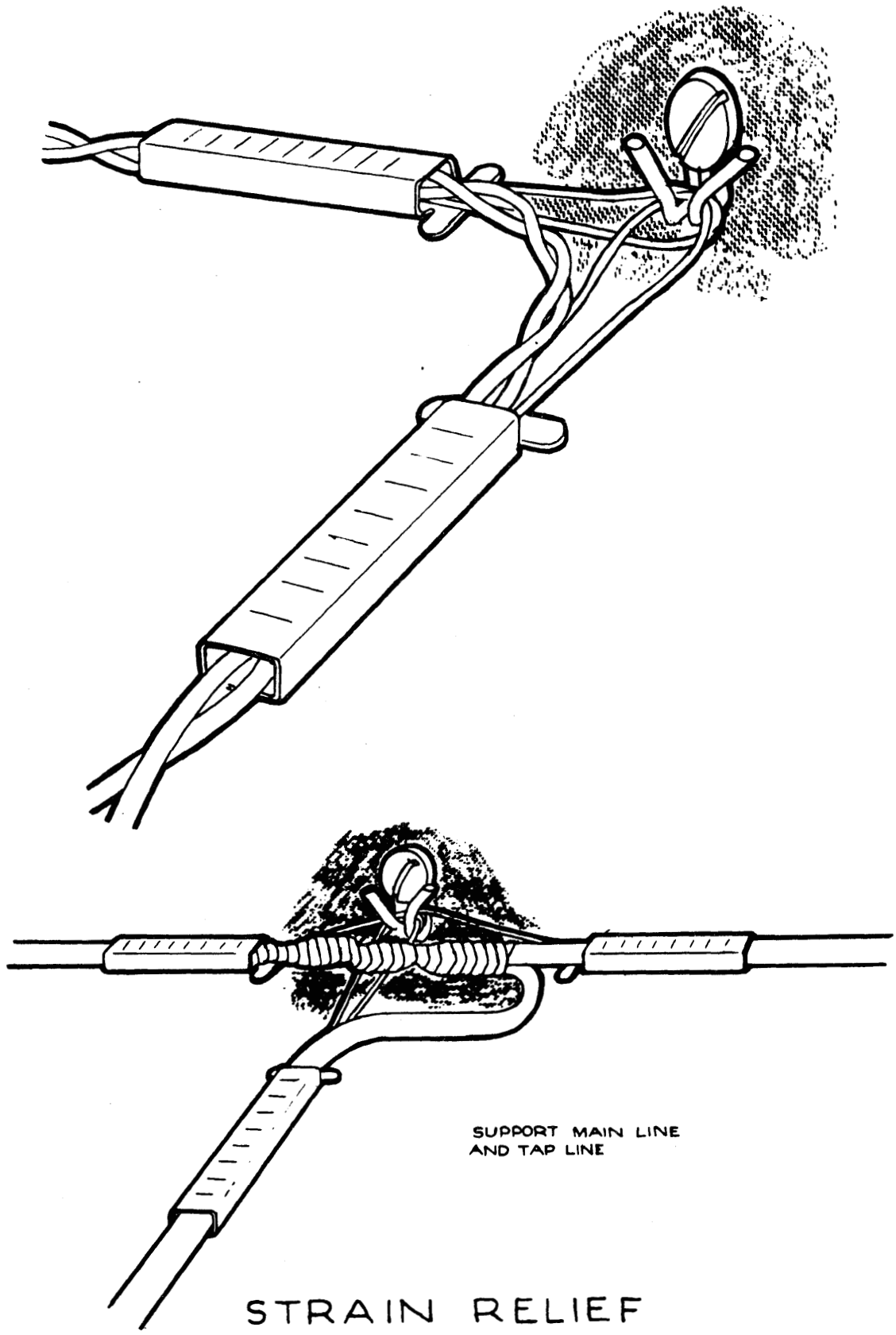
The branch cable, where it connects to the telephone, should be slack and formed into a "drip loop" near the phone installation, as shown below.

Cable installed in track entries should be hung on the side of the entry that is free of trolley wires and trolley feed wires. Telephone cable should *not* run close to power conductors, but if that is necessary it should cross the power line at a sharp angle to reduce the length of cable that is close to the power conductor. Additional insulation and support, such as running the cable in a slit length of plastic pipe, should be provided at points where the telephone cable must pass over a power conductor or trolley wire. The additional protective insulation should extend at least four feet to either side of the crossing point.

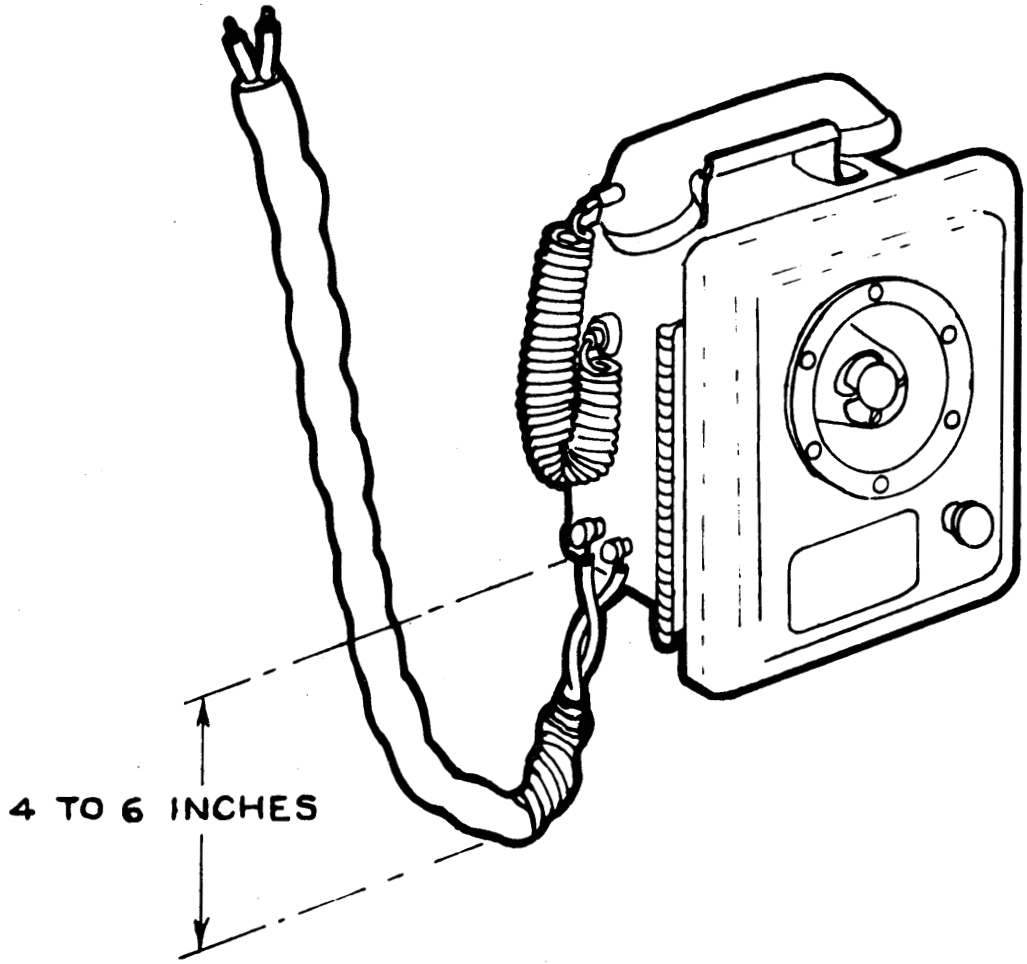
If telephone cables are installed in bore holes that contain non-armored power cable, either the telephone cable or the power cable *must* be armored or protected at both the top and bottom of the bore hole with insulating transformers. However, because the pager phone is a d-c paging system, the use of insulating transformers is impractical, so the only choice is to provide armor protection to either the power cable or the telephone cable in this situation.

Lighting protection must be provided for telephone circuits where the wire and cable go underground. Details of lightning protection are given in the technical bulletin on *Circuit Protection.*

Many telephones used underground, particularly those used at the working face, are subject to periodic relocation. To allow for this, and to reduce the problems associated with repeated cable splicing, some convenient length of wire (say, 500 feet) should be included as part of the branch line. The extra wire can be kept reeled, or neatly coiled in a bundle and secured with a few wraps of plastic electrical tape. The extra wire should be hung near the telephone in a place free of dripping water or water accumulation, and should be supported by an insulated hanger that is isolated from power or trolley wires.



STRAIN RELIEF



DRIP LOOP

CONNECTIONS

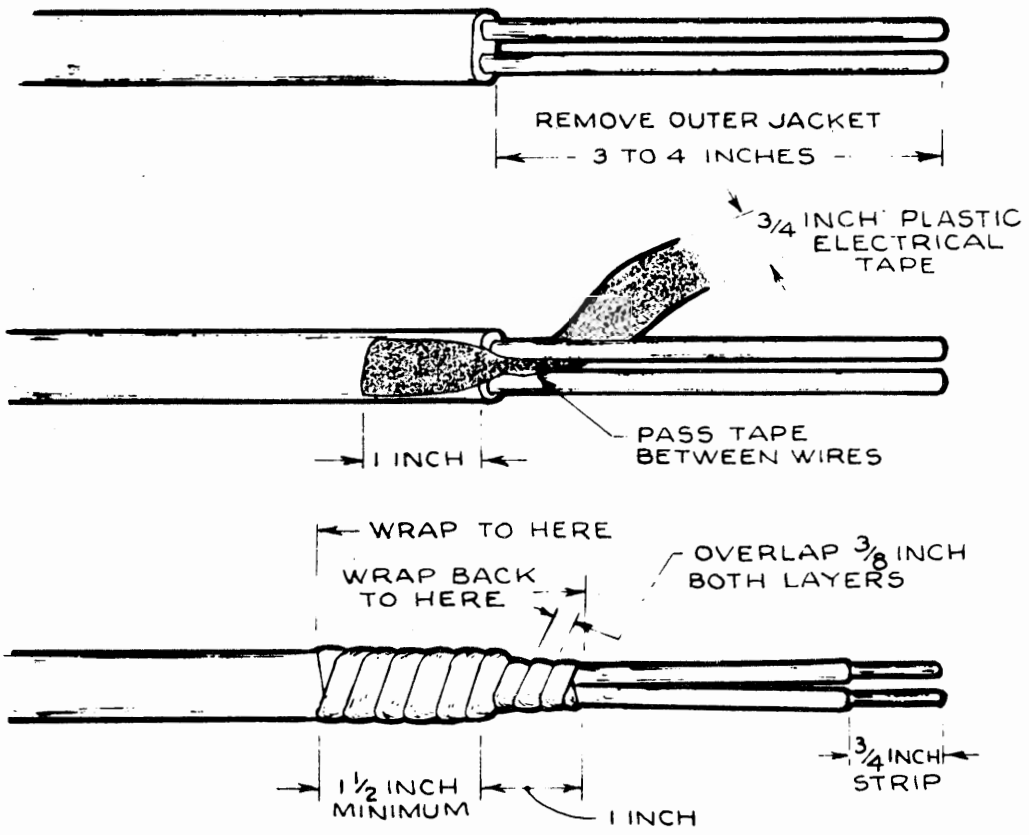
For handling convenience, the branch, tap, drop line, or connecting cable to each individual telephone, can be a lighter wire gauge than that of the main cable. Each connection to the main line should be a good electrical and mechanical joint, protected by a careful double wrap of plastic electrical tape. Detailed illustrations for a variety of recommended connecting schemes are included in the technical bulletin *Splices and Connections.*

Connections at the phone cabinet depend on each manufacturer's design and on individual state or local requirements. A majority of the phones provide two exposed spring-loaded terminals for the attachment or connection to the wires. For proper connection, first strip the insulation away from each conductor in the pair, then seal off the exposed area of the cable with plastic electrical tape to keep out moisture, as shown below. Then insert one of the exposed conductors in each of the cabinet terminals, as shown in the figure. Some states, such as Pennsylvania, do not allow the use of exposed terminals at the face area of gassy mines. For such applications, some phones are equipped with twist-lock connectors at the end of a short cable. Each connector is mated with a similar connector on the drop or branch line to complete the installation, as shown below. In either type of installation, there should be a drip loop below the cabinet to prevent condensate from running down the cable and into the cabinet.

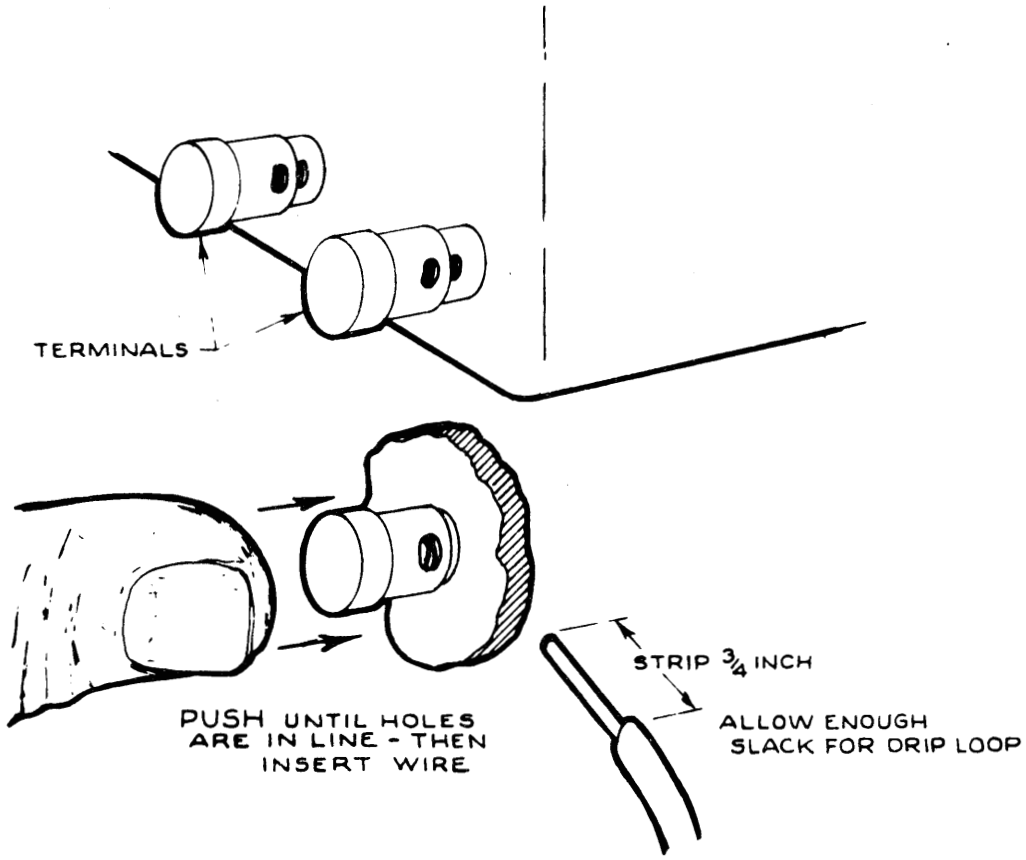
BATTERIES

Replacement

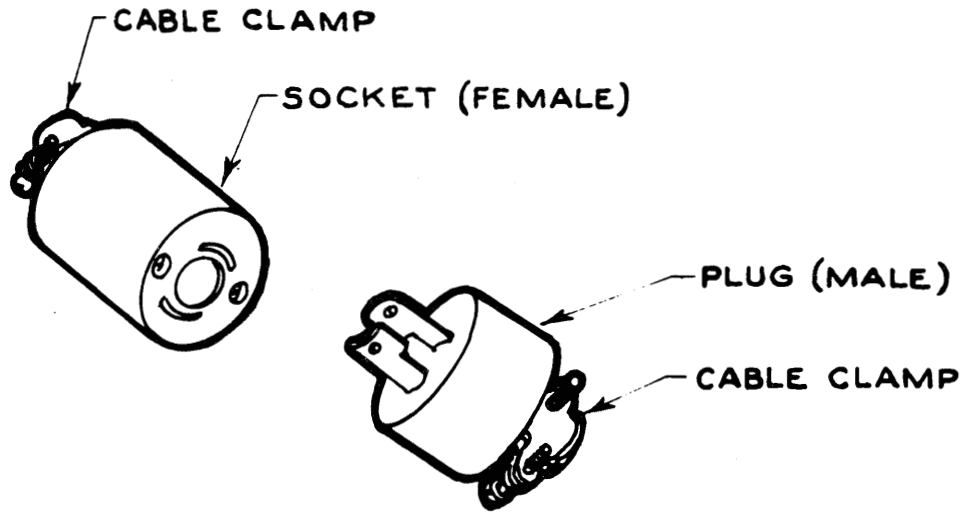
Pager phones are usually operated by one (or two) 12-volt, dry-cell batteries, NEDA No. 923 or No. 926 (National Electronic Distributors Association). To install batteries, open the pager phone cabinet and inspect the batter compartment. Remove the old battery by loosening the retaining clamp, and either unscrew the battery terminals to release the battery wires or remove the battery plug, depending on the battery type. Remove the battery, and carefully wipe out the battery compartment to remove dirt and residual moisture. Place a fresh battery in the compartment, and secure the retaining clamps tight enough to restrain the battery without crushing or bending the battery case. Reconnect the battery wires, being careful to observe the polarity markings noted on the case. If the plug-connector type is used, do not force the connector. Correct polarity is maintained when the larger connector pin fits in the larger hole. The difference in pin sizes is not great, so a mismatch *can* be forced. If the connector does not mate easily, reverse it and try again without forcing. After replacing the battery, close the cabinet and mark the date of battery replacement either on the outside of the cabinet or in a continuing log.



CABLE END SEALING



PUSH TERMINALS



TWIST-TO-LOCK CONNECTOR

CAUTION: Pager phone circuits are normally designed to provide sufficient current limiting with the specified battery. If other battery types are used – such as the nickel-cadmium rechargeable type or one of the alkaline, long-life, high-current varieties, the circuit may not be able to limit the available current to a safe value.

Testing

Battery life is not easy to predict, because of the many operating variables that affect the average current drain. Voltmeter measurement of a battery can be made as described in the Technical bulletin *Testing – Part I.* In general, the batteries in a telephone system that are used many times a day may have to be replaced every four to six weeks, while a telephone system that is seldom used may keep its batteries at usable strength for four to six months.

Each battery change should be recorded, either on the telephone cabinet or in a central log. Experience gained over a period of time will help predict when a battery in a particular phone is reaching the end of its useful life. Periodic verification of battery status at each phone should be made with a voltmeter and recorded in the log. When the battery voltage drops to a value that is 75 to 80% of the installed level, then it should be replaced. For example: for a 12-volt battery, the replacement level is about 9 volts.

FUSES

Fuses are provided in pager telephones as an added precaution against excessive current in the external circuit. Current-limiting circuitry is normally provided in the telephone, but the fuse is an additional safeguard. No provision is made in most phones to store a spare fuse. It is good practice to tape two additional spare fuses to the inside of the cabinet when the phone is first installed. Then, the correct fuse will be available at the phone if it is needed.

AMPLIFIER LOUDNESS

Each pager phone has a loudspeaker, powered by its own internal amplifier, that is switched on by the d-c paging signal. The available audio power is about 5 watts, which is adequate to be heard above most mine noises. Many telephones have a volume control for the speaker. During installation, the speaker should be oriented, and the volume set, to ensure adequate coverage in the area.

During set-up, have another person page from a distant location to the phone being installed. Adjust the volume control to the desired level during the paging. The telephone cabinet should be positioned to direct maximum sound to the work area.

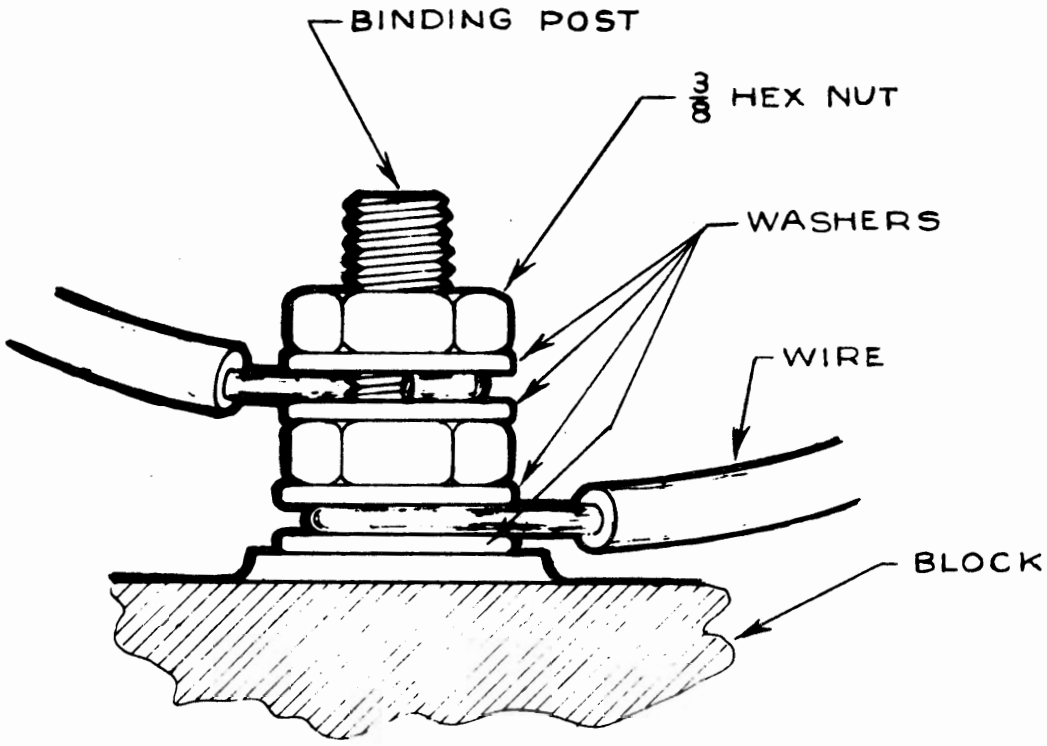
SWITCHING DISTRIBUTION

In some mines, it has been found that a total party-line system is not desirable. In these installations, some sort of switchboard set-up is provided at a central site, such as the dispatcher's location. Then, certain sections, or specific phone locations, are isolated and wired separately to the switching center. To call *within* one of these branches, the normal procedure is used. To call a station *outside* such a branch, or to call a special phone set in a single circuit, the call must go through a switchboard.

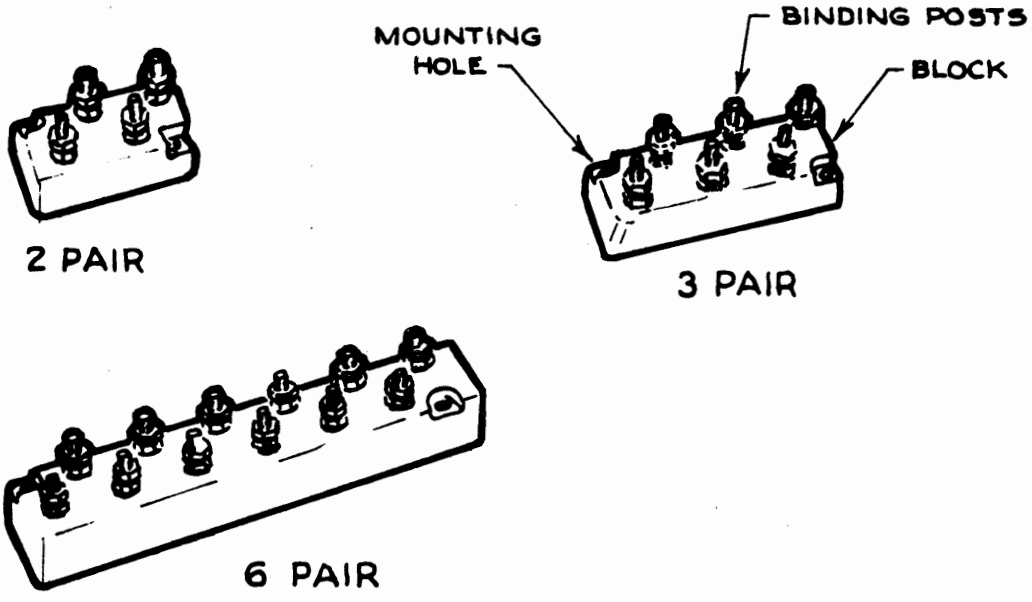
The equipment used for this switching function is quite often modified public-service telephone-type equipment. Because the pager phone is a d-c system, care must be taken to ensure that the switching system provides a continuous circuit for both wires in each cable. If the switching unit contains "loading coils," they should be removed. Each of the loading coils will load the phone line as if it was another phone.

GENERAL

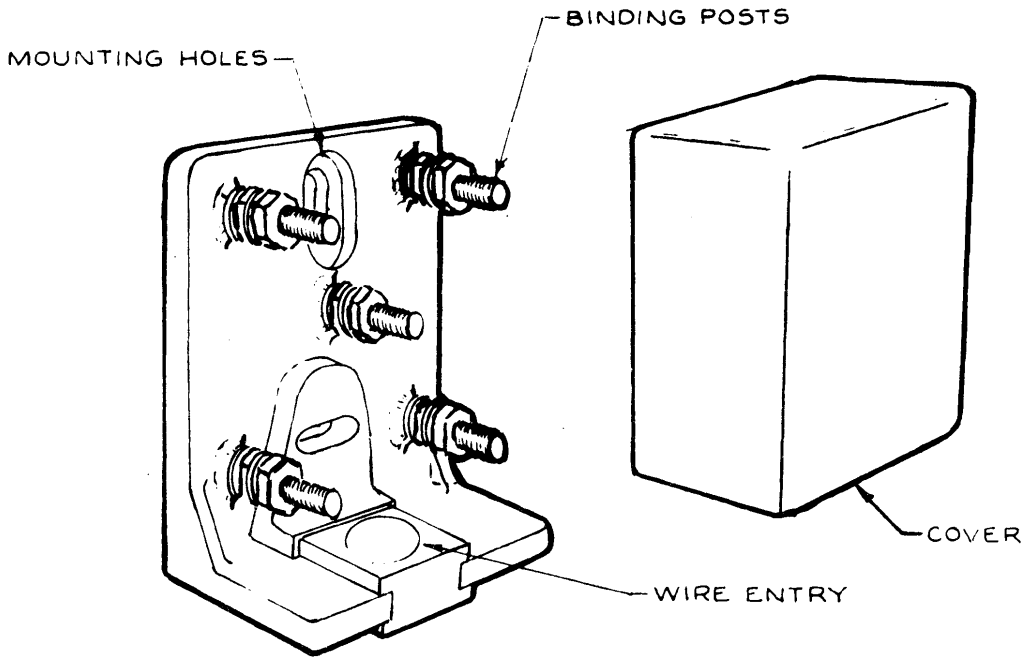
The design of cable runs, branching and interconnections depends on individual mine topography and communication needs. Choice of wire or cable size depends on the type of phones, number of phones, total distance, and combination of branch schemes for a particular mine, as described in the technical bulletin *Cable Selection.* Most phone locations are fixed, except those in the face area that must move as work progresses. A number of portable telephones are becoming available that can be used with existing installations, if provision is made for an easy tap into the line. At major junction points, terminal strips or open splice boxes, such as those shown below, are the ideal method of providing for temporary connection of a portable telephone.



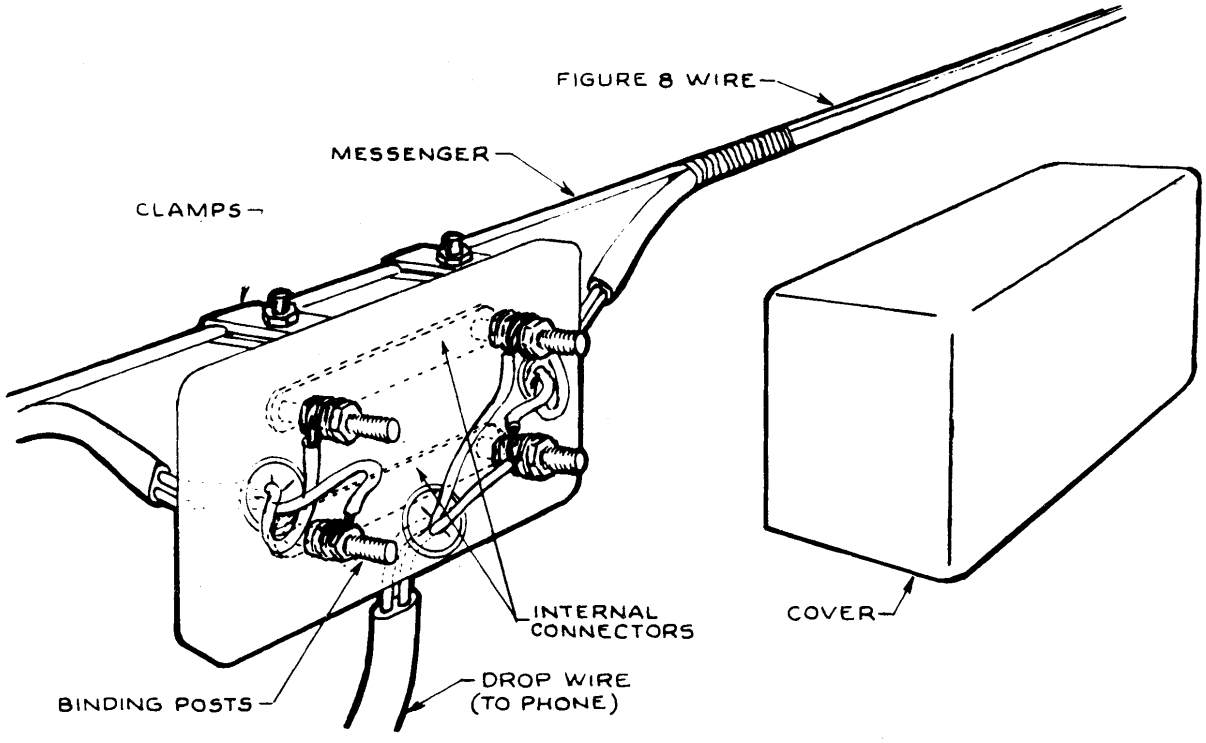
BINDING POST DETAIL



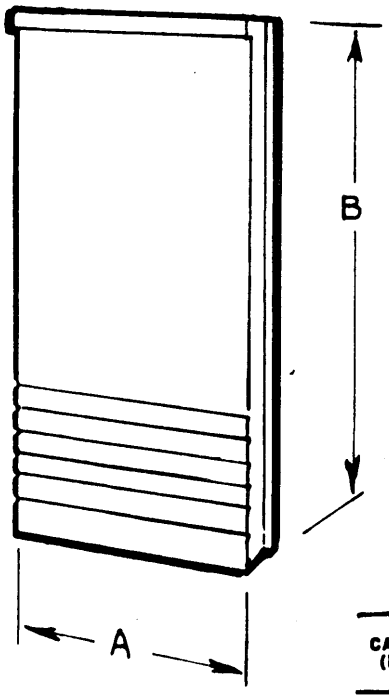
TERMINAL BLOCKS

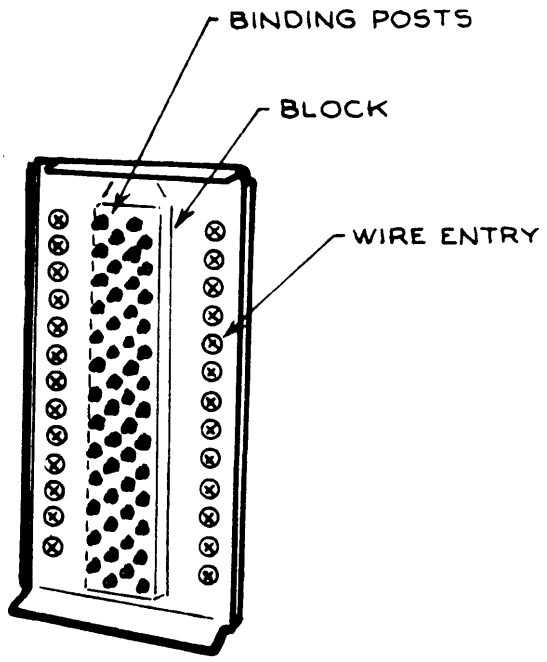


TWO PAIR TERMINAL BLOCK



DROP WIRE TERMINAL BLOCK





26 PAIR TERMINAL
(COVER REMOVED)

These pole mounted Wire Terminals are used as distribution points for either the jacketed Figure 8 or the non-jacketed multiple-pair distribution wires.

CAPACITY (PAIRS)	DIMENSION, INCHES		
	A	B	DEPTH
6	4⅜	13¼	2½
11	4⅜	18½	2½
12	4⅜	18½	2½
16	4⅜	18½	2½
18	8⅞	17½	2⅜
26	8⅞	17½	2⅜

MULTI-PAIR WIRE TERMINALS