

DEPARTMENT OF REGULATORY AGENCIES

STATE OF HAWAII

TITLE VI - PUBLIC UTILITIES COMMISSION

RULES FOR CONSTRUCTION OF
UNDERGROUND ELECTRIC AND COMMUNICATIONS SYSTEMS

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DEPARTMENT OF REGULATORY AGENCIES
STATE OF HAWAII

TITLE VI - PUBLIC UTILITIES COMMISSION

RULES FOR CONSTRUCTION OF
UNDERGROUND ELECTRIC AND COMMUNICATION SYSTEMS

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DEPARTMENT OF REGULATORY AGENCIES
TITLE VI - PUBLIC UTILITIES COMMISSION

RULES FOR CONSTRUCTION OF
UNDERGROUND ELECTRIC AND COMMUNICATION SYSTEMS

PART I - GENERAL PROVISIONS

10. AUTHORIZATION OF RULES

Chapter 104-15, Revised Laws of Hawaii, provides that the Commission shall have the power to make such rules as it deems necessary in the public interest and in the exercise of its powers and jurisdiction to carry out the provisions of Chapter 104 and any other law relating to the Commission.

11. PURPOSE OF RULES

The purpose of these rules is to formulate, for the State of Hawaii, uniform requirements for underground electrical supply and communication systems, the application of which will insure adequate service and secure safety to all persons engaged in the construction, maintenance, operation or use of underground electrical supply and communication systems and to the public in general.

12. APPLICABILITY OF RULES

These rules shall apply (a) to all underground electrical supply systems used in connection with public utility service; when located in buildings, the vaults, conduit, pull boxes or other enclosures for such systems shall also meet the requirements of any statutes, regulations or local ordinances applicable to such enclosures in buildings; (b) to all underground communication systems used in connection with public utility service located outside of buildings.

12.1 Construction, Reconstruction or Replacement

The requirements apply to all such systems and extensions constructed hereafter and shall become applicable also to such systems now existing or any portion thereof, whenever they are reconstructed or replaced.

An element added to an existing underground system shall meet all requirements of these rules, but will not require any change in elements already existing.

A. Services

Services may be added to existing plant without necessitating changes in the system from which they originate.

12.2 Maintenance

Systems shall be maintained in such condition as to secure safety to workmen and the public in general. Systems and portions thereof constructed, reconstructed, or replaced on or after the effective date of these rules shall be kept in conformity with the requirement of these rules.

12.3 Systems Constructed Prior to These Rules

The requirements of these rules other than the requirements specified in Rule 12.2, do not apply to systems or portions thereof constructed, reconstructed or replaced prior to the effective date of these rules. In all other particulars, such systems or portions of systems shall conform to requirements in effect at the time of their construction or replacement.

12.4 Reconstruction or Alteration

The Commission may order reconstruction or alteration of existing systems or portions thereof if found necessary for the purpose of safety to workmen or the general public.

13. SCOPE OR RULES

13.1 These rules are not intended as complete construction specifications, but embody only the requirements which are most important from the standpoint of safety and service. Construction shall be according to accepted good practice for the given local conditions in all particulars not specified in the rules.

13.2 Where any electrical supply or communication system construction is exposed above ground or grade, it shall conform to the Commission's General Order No. 6.

14. LIMITING CONDITIONS SPECIFIED

The requirements specified in these rules as to spacing, clearance, and strength of construction are limiting conditions expressed as minimum or maximum values as indicated. In cases where two or more requirements establish limiting conditions the most stringent condition shall be met, thus providing compliance with the other applicable conditions. Greater strength of construction and more ample spacings and clearances than herein specified may be desirable in some cases and may be provided accordingly if other requirements are not violated in so doing.

15. EXEMPTIONS OR MODIFICATIONS

15.1 Changes and Special Installations

If, in a particular case or a special type of construction, exemption from or modification of any of the requirements herein is desired, the Commission will consider an application for such exemption or modification when accompanied by a full statement of conditions existing and the reasons why such exemption or modification is asked and is believed to be justifiable. It is to be understood that, unless otherwise ordered, any exemption or modification so granted shall be limited to the particular case or special type of construction covered by the application. Where such proposed exemption or modification would result in the installation of a direct buried cable, duct, grounds, hand holes, manholes or services with clearances, depths or protection other than provided by these rules, a copy of such proposed exemption or modification shall be concurrently mailed to all utilities and local agencies or persons likely to be affected by such installation.

15.2 Experimental Installations

It is the intent of this rule to assist in advancements or changes in the art without mitigation of safety. For this purpose, experimental installations which deviate from one or more of these rules may be made provided:

- A. Precautions are taken to secure safety to property and to persons engaged in the construction, maintenance, and operation of underground systems, and to the public in general; and
- B. A full statement of the conditions involved in such experimental installation must be submitted to the Commission for approval of experimental modification of facilities or construction of any experimental facilities. Where such experimental construction would result in the installation of direct buried cable, duct, grounds, hand holes, manholes or services with clearances, depths or protection other than provided by these rules, a copy of such statement shall concurrently be mailed to all utilities, local agencies or persons likely to be affected by such installation.

15.3 Notification

For the purpose of keeping these rules up to date and reflecting the latest state of the art, the Commission shall, at appropriate times, advise interested parties of exemptions or modifications granted and notifications received under the provisions of Rules 15.1 and 15.2.

16. SAVING CLAUSE

The Commission reserves the right to grant relief from any of the provisions of these rules in specific cases when, in the Commission's opinion, public interest would be served by so doing.

Compliance with these rules is not intended to relieve a utility from any statutory requirements.

17. REQUIREMENTS FOR ALL SUPPLY AND COMMUNICATION SYSTEMS

The following rules apply to all supply and communication underground systems under all conditions.

17.1 Design, Construction, and Maintenance

All systems shall be of suitable design and construction for their intended use, regard being given to the conditions under which they are to be operated, and shall be maintained in a condition which will provide adequate service and secure safety to workmen, property and the general public.

The owners of such systems and their employees shall at all times exercise due care to reduce to a minimum the hazard of accidental injury to their own or fellow employees, to the public and other utilities, due to the presence of such systems.

All work performed on public streets and highways shall be done in such a manner that the operations of other utilities and the convenience of the public will be interfered with as little as practicable. Reasonable care shall be exercised to reduce the hazards to which employees, customers, or the general public may be subjected.

17.2 Inspection

Systems shall be thoroughly inspected by the operator on a regular basis or as required to determine that they are in good condition and insure compliance with these rules.

17.3 Location

Facilities shall be located with consideration for safety of property, the general public and persons engaged in the construction, operation and maintenance thereof (See Rule 17.1).

Compliance with these rules is not intended to relieve a utility of any location requirement of any Federal, State or County agency with respect to the use of public streets or highways.

17.4 Joint Use of Excavations and Facilities

Joint trenching and installation of facilities may be undertaken subject to the clearances stated in these rules. Nothing herein shall be construed as requiring joint trenching or as granting authority for installation of facilities in a trench excavated by or for another party without consent of such party.

17.5 Two or More Systems

Where two or more systems are concerned in any clearance, that owner or operator who last in point of time constructs facilities, shall establish the clearance required in these rules from other facilities which have been constructed previously.

17.6 Encroachments

Nothing in these rules shall be construed as permitting unauthorized occupancy, access to, connection to, rearrangement, or removal of underground supply or communication system facilities or any other underground facilities.

17.7 Location Information

Each party operating or owning facilities shall, upon request, provide information as to location of its underground facilities to any other party contemplating underground construction, or work, in the vicinity thereof. Provision of such information by a party will not relieve such other party of his responsibility to locate accurately such underground facilities and to exercise reasonable care during construction or work. If at any time damage or interruption to existing facilities should occur, said other party is enjoined immediately to report such damage to the party owning such damaged or interrupted facilities.

A. Records

The responsibility for the maintenance of necessary records to comply with this rule rests with the party owning or operating the facilities. Such records shall be available for inspection at all times by the Commission or the Commission Staff.

- (1) Service Conductor Cables and Ducts: Records are not required of supply system services of 0-750 volts or of communication system services provided such installation conforms to the standard location designated by the county or municipal government zoning requirements or other authorized location for underground utility services.

17.8 Identification of Manholes and Handholes

Manholes and handholes shall be marked as to ownership to facilitate identification by persons authorized to work therein and by other persons performing work in their vicinity.

17.9 Measurements

Measurement of clearances, separations, or depths shall be made from the nearest outer surface of the duct, or from the conductor covering where no duct exists. Such measurements to other objects shall be made from the nearest surface of such objects.

17.10 Backfill of Excavations

Backfill containing large rock, paving material, cinders, large or sharply angular substance, or corrosive material, shall not be placed in an excavation where such material may damage ducts, cables, or other substructures or prevent adequate compaction of the fill or contribute to corrosion of the ducts, cables or other substructures. All excavation and backfilling shall conform to the requirements of local city or county ordinances. (See Appendix B, Figs. 5, 6 and 7.)

17.11 Non-Conforming Mutual Consent Agreement Requirements

The Commission shall be furnished a copy of any non-conforming mutual consent agreements or other authorization from County, State or Federal agency or any other authorization agreements required by these rules, and shall be advised in writing on each installation that does not meet the minimum separation or depth requirements of these rules.

It is the intent of this rule that non-conforming mutual consent agreements shall be made only when emergency repairs or other conditions found in the field during construction or repair require said agreement in the interest of safety or other public interest where the situation does not permit prior approval of the Commission.

PART II

DEFINITIONS OF TERMS AS USED IN THESE RULES

- 20.1 BOND means an electrical connection from one metallic element to another for the purpose of minimizing potential differences and providing suitable conductivity for fault current or to mitigate leakage current and electrolytic action.
- 20.2 CABLE means an insulated conductor or a combination of insulated conductors which are enclosed in a sheath.
- A. BURIED CABLE means a suitably insulated cable installed directly in the earth (not in conduit or duct).
- 20.3 COMMISSION means the Public Utilities Commission of the State of Hawaii.
- 20.4 COMMUNICATION SYSTEM means an underground communication system including all of the subsurface and associated above ground structures, cables, ducts, manholes, equipment and appurtenances used for transmitting intelligence by electrical means. Circuits of a communication system not contained in grounded metallic sheathed or shielded cable shall not operate at more than 400 volts to ground or 750 volts between any two points of such circuit, nor shall the transmitted power exceed 150 watts; except that when operated at less than 150 volts, no limit is placed on the transmitted power.

Note: As limited above, with respect to voltage, power and cable shield or sheath; telephone, telegraph, messenger-call, clock, police, fire alarm, and traffic control circuits may be classified as circuits of a Communication System. Other circuits, not exceeding the above limitations, used for signal or control purposes may also be included.

- A. PUBLIC COMMUNICATION SYSTEM means a communication system used to provide communication service to the general public.
- B. PRIVATE COMMUNICATION CIRCUIT means a circuit used for private communication, signal, or control purposes in the operation of other facilities.
- C. RAILWAY SIGNAL CIRCUIT means those supply and communication circuits used primarily for supplying energy for controlling the operation of railway block signals, highway crossing signals, interlocking apparatus and their appurtenances. Railway signal circuits which operate at less than 400 volts to ground may be considered as private communication circuits provided that if the potential exceeds 150 volts between conductors, the power transmitted shall not exceed 150 watts.

C. RAILWAY SIGNAL CIRCUIT - continued

Where all the circuits and underground system are owned and operated by one utility, the potential between conductors carrying in excess of 150 watts may be increased to not more than 250 volts. Railway signal circuits not meeting the foregoing requirements shall be treated as circuits of a supply system. (Rule 23.3)

- 20.5 CONCURRENTLY INSTALLED means occurring at or about the same time by virtue of joint planning and agreement by two or more parties.
 - 20.6 CONDUCTOR means a wire, or combination of wires not insulated from one another, suitable for carrying electric current.
 - 20.7 CONDUIT means a duct or combination of ducts.
 - 20.8 COVER (TOP) means the distance between the uppermost surface of an underground cable or duct and grade (See Rule 21.4).
 - 20.9 DUCT means a fabricated tube for receiving and containing conductors and cables.
 - 21.0 DUCT SYSTEM means chambers, ducts and their related components used to enclose cables, conductors, and associated equipment.
 - 21.1 ELEMENT means a unit; or aggregation which functionally must be considered as a unit; of materials, circuits, or apparatus, separately or in any combination, which customarily is identified functionally by itself.
 - 21.2 ENCLOSED means surrounded by a case which will prevent accidental contact of a person with live parts.
 - 21.3 EXPOSED means that a live part can be inadvertently touched or approached nearer than a safe distance by any person. It is applied to parts not suitably guarded, isolated, or insulated.
 - 21.4 GRADE (or GROUND) means the surface (earth, roadway, sidewalk, landscaping, etc.) at the point in question. (See Appendix B, Figure 6)
 - 21.5 GROUNDED means connected to earth by an intentional ground connection or by an unintentional conducting path.
- A. EFFECTIVELY GROUNDED (EFFECTIVE GROUND) means permanently connected to earth through a ground connection or connections of sufficiently low impedance and having sufficient current-carrying capacity to prevent the building up of voltages which may result in undue hazard to connected equipment or to persons.

A. EFFECTIVELY GROUNDED (EFFECTIVE GROUND) - continued

If an impedance of less than 25 ohms is not obtained, the equivalent of a ground conductor not less than No. 6 AWG copper connected to two corrosion resisting rods, not less than $\frac{1}{2}$ inch in diameter and 8 feet in length and continuous throughout, driven to a minimum depth of 8 feet in the earth at not less than 6 foot centers, will be considered an effective ground for the purpose of these rules.

- 21.6 GUARDED means covered, shielded, fenced, enclosed or otherwise protected, by means of suitable covers or casings, barriers, rails or screens, mats or platforms, to reduce the probability of dangerous contact or approach by persons or objects to an energized element.
- 21.7 HANDHOLE means a permanent opening in the route of an underground system, usually smaller than a manhole, with a removable top and affording access to cable runs and associated apparatus. (See Appendix B, Figure 10)
- 21.8 INDEPENDENTLY INSTALLED means occurring at significantly different times and not relating to a mutual endeavor.
- 21.9 INTERCONNECTION means the electrical joining of circuits which are of different ownership.
- 22.0 ISOLATED means not readily accessible to persons unless special means for access are used.
- 22.1 JOINT TRENCH means a trench opened and closed as a mutual endeavor of two or more parties for joint occupancy. (See Appendix B, Figure 6)
- 22.2 LIVE PARTS means those parts which are electrically connected to points of potential different from that of the earth.
- 22.3 MAINTENANCE means the work done on any facility or element for the purpose of preserving its efficiency or physical condition in service.
- 22.4 MANHOLE means a chamber, in an underground system containing working space, large enough for a person to enter, which provides space and access for installation and maintenance of cables, transformers, or other equipment or apparatus. (See Appendix B, Figure 7)
- 22.5 PARKWAY means that area adjacent to a thoroughfare within a street or highway right of way not generally used for vehicular travel. (See Appendix B, Figures 6 and 7)

- 22.6 POLICE, FIRE ALARM, AND TRAFFIC CONTROL CIRCUITS means those cables and conductors utilized for the purpose of operating police, fire alarm, and traffic control systems.
- 22.7 PRACTICABLE means capable of being accomplished by reasonably available, economic, and workable means.
- A. Clearances and depths required by these rules shall be deemed impracticable only to the extent that reasonably unavoidable obstructions require a reduction in such clearances or depths in the immediate vicinity of such obstruction; or in those exceptional cases where the clearance otherwise required would, in particular and limited circumstances, create a condition less safe than a reduction of such clearance.
- 22.8 PROTECTION (MECHANICAL) means any suitable material placed above, below, or alongside an underground system or element thereof to limit mechanical stress thereon to safe working limits including allowance for other facilities, such as paving, or to serve as an impediment to accidental damage of the system.
- 22.9 RANDOM SEPARATION means no deliberate or required clearance or separation between facilities. (See Appendix B, Figure 5)
- 23.0 SERVICE(S) means cables, conductors and associated equipment used to connect a customer to an electrical supply or communication system.
- 23.1 SHIELDING (CABLE) means a conductive material surrounding a cable, not necessarily on the external surface thereof.
- 23.2 SIDEWALK means a paved surface intended primarily for pedestrian use. (See Appendix B, Figure 6)
- 23.3 SUPPLY SYSTEM means an underground electrical supply system including all of the subsurface and associated above-ground structures, conductors, services and appurtenances located on poles, on or in buildings or in electrical stations and which are used for transmitting and distributing electrical energy.
- Note: Communication, fire alarm, police, traffic control, signal and other circuits that operate in excess of the voltage, power and cable shield limitations for communication systems (Rule 20.4) are included in this definition.
- 23.4 THOROUGHFARE means any public or private highway, avenue, street, road, alley, or other place generally used for vehicular travel. (See Appendix B, Figures 6 and 7)

- 23.5 TRENCH (PERMANENT CABLE TRENCH) means a permanent trench with removable covering in which cables may be installed.
- 23.6 VAULT means an isolated fire resistant enclosure, either above or below ground, or in a building, large enough for a person to enter, and containing working space, in which transformers or other equipment may be installed and maintained.
- 23.7 VOLTAGE (or VOLTS) means the highest effective electrical potential between any two conductors of the circuit concerned except where, in certain rules, reference is made to the term "voltage (or volts) to ground."
- 23.8 WIRE GAUGE means a standard of measurement used for convenient nomenclature of the various sizes of wire.
- A. AMERICAN WIRE GAUGE (AWG) otherwise known as Brown and Sharpe (B&S) for copper, aluminum and other conductors.
 - B. BIRMINGHAM WIRE GAUGE (BWG) for iron and steel conductors.
- 23.9 WORKING SPACE means the space available for working safely on or around underground facilities for the purpose of construction, operation and maintenance. (See Appendix B, Figure 9)

PART III

REQUIREMENTS FOR SUPPLY SYSTEMS

30. GENERAL

The following rules cover construction requirements for supply systems. These rules are supplemented, in certain cases, by rules in other sections. Supply systems installed under these rules consist of, but shall not be limited to cables, conductors, fused devices, switches, transformers and associated equipment installed underground, on the surface and in buildings and may be buried or placed in ducts, conduits, manholes, handholes or a combination of these elements.

Terminating and access points for a supply system may be above or below ground and may be on or in buildings.

31. DUCT SYSTEMS

Open trenching, tunneling, boring, jacking, plowing, and submersion in water, either singly or in combination, are among the recognized methods of installing duct systems.

31.1 Definition (See Rule 21.0)

31.2 Maintenance and Inspection (See Rules 12.2 and 17.2)

31.3 Construction

Duct systems shall be constructed with adequate provision for safety of the workmen, safety of the general public, and the preservation of property.

31.4 Clearance and Depths

The clearance between supply system ducts and other underground structures shall be as great as practicable and the minimum distance between the top covering of these ducts and the pavement or other surface under which they are constructed shall be as follows:

A. Clearance from Foreign Substructures (Except Communication Systems)

- (1) Independently Installed: Duct systems for supply cables, when independently installed, shall be separated from gas, water, oil, or other pipe systems or other foreign substructures, by a minimum clearance of at least 12 inches when paralleling and by at least 6 inches when crossing. Wherever

(1) Independently Installed - continued

possible in new construction, parallel clearance shall be 36 inches or more to permit adequate working space for maintenance or repair of said systems.

- (2) Concurrently Installed: Duct systems for supply cables, when concurrently installed with gas, water, oil or other pipe systems, or other foreign substructures, shall be installed with the separation required by Rule 31.4A(1).

B. Clearance from Communication Systems

- (1) Independently Installed: Duct systems for supply cables, when independently installed, shall be separated from communication duct systems and buried cables or conductors by not less than 3 inches of concrete, 4 inches of brick masonry, or 12 inches of earth.
- (2) Concurrently Installed: Duct systems for supply cables, when concurrently installed with communication duct systems, shall be installed with separation required by Rule 31.4B(1). (See Rule 41.4B(2)).

C. Depth

Ducts carrying supply cables and conductors shall be at a depth below the surface under which they are located to provide cover as required by the circuits they contain (See Rule 33.4) and as further determined by related circumstances described below.

- (1) Railroads: The top of supply system duct structures shall be located below the base of the lowest rail at a depth of not less than 30 inches in the case of street railroads and not less than 42 inches in the case of other railroads.
- (2) Thoroughfares: Supply duct systems in thoroughfares shall be installed with not less than 21 inches of cover. Where it is not practicable to obtain such cover, it may be reduced provided the duct material itself, or additional mechanical protection installed, has sufficient strength to protect the duct system from injury by traffic; and only with the consent and approval of the County, State, or Federal agency with authority over construction within said thoroughfare. (See Rule 17.11 and 33.4D(1))

- (3) Sidewalks and Parkway Areas: Ducts carrying supply cables under sidewalks or parkways shall have not less than 18-inch cover when containing circuits energized at 750 volts or less, and not less than 21-inch cover when containing circuits energized in excess of 750 volts. In either instance the minimum cover may be reduced if adequate mechanical protection is provided and only with the consent and approval of the County, State, or Federal agency with authority over construction within said thoroughfare. (See Rule 17.11 and 33.4D(1))
- (4) Private Property: Ducts carrying supply cables and conductors on private property shall have not less than 18-inch cover when containing circuits energized at 750 volts or less, and not less than 21-inch cover when containing circuits energized in excess of 750 volts. In either instance the minimum cover may be reduced if adequate mechanical protection is provided. (See Rule 17.11 and 33.4D(1))
- (5) Open Ditches, Bridges, Trestles, Viaducts, and Similar Structures: Supply systems shall be provided with suitable mechanical protection when suspended across an open ditch or when carried on, in, under, or on the side of a bridge, viaduct, trestle or similar structure.

Supply systems suspended below or at the side of bridges shall be adequately supported at suitable intervals to suspend safely the combined weight of the cable and conduits.

Conduit and ducts shall be provided with expansion couplings or other means of compensating for the contraction, expansion, or other movement of the duct system or of the bridge or other supporting structure.

D. Maintaining Clearances and Depths

- (1) Any person or agency performing surface or sub-surface construction in the vicinity of supply duct systems is enjoined to maintain the minimum clearances from, and the depths of, the existing systems as required by these rules.
- (2) If minimum clearances and depths cannot be maintained, then the person or agency causing changes is enjoined to notify the owner of the duct system before proceeding with the construction.

(3) Under the provisions of this rule, a previously installed system may be maintained with less than the top cover required by other applicable rules of this section provided the system is protected in accordance with Rule 33.4D(1).

(4) Rule 17.11 shall also apply.

31.5 Risers and Other Above-Ground Terminations

A. Poles

Supply system risers on poles shall be installed in accordance with General Order No. 6 of this Commission. (See Rule 13.2)

B. Other Above-Ground Terminations

Supply duct systems, suitably protected, may terminate above ground or in buildings, in enclosures designed for the purpose, in pad-mounted transformers, in pedestals, or in other suitable terminal facilities. (See Appendix B, and Rule 13.2)

C. Services (See Rule 33.5C)

D. Clearances from Railroad Tracks

Clearances of above-ground terminations and facilities adjacent to railroad tracks shall be in accordance with the provisions of the National Electrical Safety Code. (See Appendix C, Figure 1).

31.6 Sealing Service Laterals

Lateral ducts for services to buildings, through which gas or water may enter buildings, shall be plugged or sealed.

32. MANHOLES AND HANDHOLES

The provisions of this rule relating to manholes shall also be applicable to vaults and trenches.

32.1 Definitions (See Rules 22.4 and 21.7)

32.2 Maintenance and Inspection (See Rules 12.2 and 17.2)

32.3 Material and Strength

The materials, design and construction of manholes, handholes, and other underground boxes shall be such as to provide sufficient strength to sustain, with a suitable margin of safety, the loads which may reasonably be imposed on them. Manholes and handholes in street areas which are subject to vehicular traffic shall be constructed to withstand H-20-44 highway loading as designated by the American Association of State Highway Officials.

No person shall build or rebuild any subway, manhole, chamber or underground room, used or to be used, to contain, encase, cover, or conduct any wire, cable, or appliance to conduct or handle electricity unless the floor of the subway, manhole, chamber, or underground room is made of stone, concrete, or brick. This rule does not apply to any subway, manhole, chamber, or underground room within which it is not intended or required that any human being perform work or labor or be employed. (See Appendix B, Figure 9)

32.4 Size and Shape

Manholes shall be constructed to provide sufficient working space so that the cables and equipment therein can be properly and safely installed, supported, operated, and maintained.

No persons shall build or rebuild any subway, manhole, chamber, or underground room used or to be used to contain, encase, cover, or conduct any wire, cable, or appliance, to conduct or handle electricity, unless such subway, manhole, chamber, or underground room has an inside measurement of not less than four feet at the maximum points between the side walls thereof, and between the end walls thereof, and not less than five feet at all points between the floor and the top or ceiling thereof, or if circular in shape, at least four feet diameter inside measurement and not less than five feet at all points between the floor and ceiling thereof. This section does not apply to any such subway, manhole, chamber, or underground room, within which it is not intended or required that any human being perform work or labor or be employed. This rule does not apply where satisfactory proof is submitted to the Commission that it is impracticable or physically impossible to comply within the space or location so designated by the proper municipal authorities. (See Appendix B, Fig. 9 & Rule 17.11)

Handholes shall be of sufficient size to house safely the required cables, splices, connectors and associated apparatus. Cables shall be arranged so that they can be safely installed and maintained.

32.5 Openings

No manhole access opening shall be less than 26 inches in diameter if circular in shape or 26 inches by 24 inches if rectangular in shape. Safe access shall be provided from the opening to the floor or other working surface. (See Appendix B, Figure 9)

32.6 Drainage

Drainage of manholes into sewers shall not be permitted without specific prior approval of the appropriate city or county governmental agency as required by law or ordinance. (See Rule 17.11)

32.7 Covers

Manholes and handholes, while not being worked in, shall be securely closed by covers of sufficient strength to sustain such loads as may reasonably be imposed upon them and arrangement shall be such that a tool or appliance shall be required for their opening and cover removal. Covers shall be properly marked for easy identification. (Also see Rule 17.8, and Appendix B, Figure 9)

32.8 Location

Manhole locations shall be such that the opening will provide safe access and shall be so located that future maintenance work will cause minimum interference with the normal flow of vehicular traffic. In no case may the nearest edge of the opening at the surface be less than 3 feet from any rail of any railroad or streetcar track. (Also see Rule 31.5D, and Appendix B, Figure 9)

This rule does not apply where satisfactory proof is submitted to the Commission that it is impracticable or physically impossible to comply with this rule within the space or location so designated by proper authorities. (See Rule 17.11)

32.9 Ventilation

Manholes containing transformers shall be provided with means of ventilation adequate to prevent transformer temperatures in excess of those at which the transformer may be safely operated.

32.10 Foreign Pipes

Foreign pipes shall be excluded from passing through the working space within manholes, however foreign pipes may be imbedded within the manhole structure. (Also see Rule 17.6 and Appendix B, Figure 9)

32.10 Foreign Pipes - continued

Foreign pipes shall be relocated by mutual consent of the parties involved. Where such relocation is not practicable, and where satisfactory proof is submitted to the Commission that it is impracticable or physically impossible to comply with this rule, foreign pipes may be allowed within the working space, provided they are satisfactorily guarded.

32.11 Incidental Wiring and Facilities

Incidental wiring and auxiliary facilities installed in manholes and vaults shall be suitable for the purpose intended. (See Appendix B, Figure 9)

32.12 Explosion Protection

Due care shall be taken to force-ventilate all manholes to disperse any explosive or noxious gases before workmen enter the manhole.

33. CABLES AND BURIED CABLES

The following rules cover the requirements for material, construction, installation, maintenance, inspection, clearances, and depths for cables installed under these rules.

Nothing in these rules shall be construed as prohibiting cables directly buried, installed in pipes and ducts at the site, pre-assembled in ducts prior to installation, installed in tunnels, shafts, or cable trenches, or placed on or under the surface of bodies of water.

33.1 Definitions. (See Rules 20.2, 20.6 and 20.2A)

33.2 Maintenance and Inspection. (See Rules 12.2 and 17.2)

33.3 Material

A. Conductors

(1) General: Conductors shall be of copper, aluminum, or other metal of suitable electrical and mechanical properties.

(2) Size: Conductors shall be of sufficient size to carry the estimated maximum load current without deterioration of the insulation.

B. Insulations

- (1) Voltage Rating: Insulation applied over the conductor shall be of a voltage rating adequate to withstand the operating voltage and be suitable for the operating conditions.
- (2) Materials: Insulation materials may be, but are not limited to, oil impregnated paper, rubber, plastics and varnished cambric.
- (3) Splices and Joints: Insulation applied in the field, such as for splices and joints, shall provide electrical properties equivalent to the insulation of the cables being joined.

C. Shielding

- (1) General: Shielding or equivalent shall be required for all cables operating at 5,000 volts or more, except that shielding shall not be required for series street lighting circuits operating at less than 7,500 volts.
- (2) Materials: Shielding may consist of, but is not limited to, metallic tape, braid, wire and sheaths, or combinations of wires and conducting sheaths.
- (3) Fault Current: Shielding and the associated ground system shall be capable of carrying fault currents which may be imposed on it by the associated system.
- (4) Jacket: Where desirable, a nonmetallic jacket may be installed over the cable shielding.

33.4 Clearances and Depths

The clearance between supply buried cables and other buried cables, ducts, pipes and structures independently installed shall be as great as practicable and the minimum distance between the top of permanently installed supply buried cables and the surface under which they are installed shall be as follows:

A. Separation from Other Buried Cables, Ducts, Pipes and Other Structures

- (1) From Other Supply Buried Cables.
 - (a) Independently Installed: Supply buried cables, when independently installed, shall be separated, from other supply duct systems or buried cables or conductors by not less than 3 inches of concrete, 4 inches of brick masonry or 12 inches of earth.

- (b) Concurrently Installed: Supply buried cables, when concurrently installed with other supply cables in duct, duct systems, or buried cables or conductors, shall be installed with separation required by Rule 33.4A(1)(a). Cable installed in an existing duct shall be considered a concurrent installation.
- (2) From Communication Systems.
- (a) Independently Installed: Supply buried cables, when independently installed, shall be separated from communication duct systems and buried communication cables or conductors by not less than 3 inches of concrete, 4 inches of brick masonry or 12 inches of earth.
 - (b) Concurrently Installed: Supply buried cables, when concurrently installed with communication duct systems and buried communication cables or conductors shall be installed with separation required by Rule 33.4A(2)(a). Cable installed in an existing duct shall be considered a concurrent installation. (See Rules 41.4B and 43.3B)
 - (c) Random Separation: Supply buried cables, when concurrently installed and with mutual agreement of the parties involved, may have random separation from communication cables or duct systems as provided in Rule 43.3B(1).
- (3) From Foreign Substructures. (Except Communication Systems)
- (a) Independently Installed: Supply buried cables, when independently installed, shall be separated from gas, water, oil, or other pipe systems, or other foreign substructures, by a minimum clearance of at least 12 inches when paralleling and by at least 6 inches when crossing. Wherever possible in new construction, parallel clearance shall be 36 inches or more to permit adequate working space for maintenance or repair of said systems.
 - (b) Concurrently Installed: Supply buried cables, when concurrently installed with gas, water, oil, or other pipe systems, or other foreign substructures, shall be installed with the separation required by Rule 33.4A(3)(a). Cable installed in an existing duct shall be considered a concurrent installation.

B. Depth Below Base of Rail

The tops of all supply buried cables shall be located below the base of the lowest rail at a depth of not less than 30 inches, in the case of street railroads, and not less than 42 inches, in the case of other railroads.

C. Depths

Supply buried cables shall be installed at a minimum depth below the surface under which they are located as follows except as provided in Rule 33.4D.

- (1) Sidewalks, Parkways and Private Property (750 Volts or Less): 18 inches for supply buried cables that operate at a potential of 750 volts or less.
- (2) Thoroughfares (750 Volts or Less): 21 inches for supply buried cables that operate at a potential of 750 volts or less.
- (3) 751 Volts to 35,000 Volts: 21 inches for supply buried cables that operate at potentials of 751 to 35,000 volts.
- (4) Above 35,000 Volts: 36 inches for supply buried cables that operate at potentials above 35,000 volts.

D. Exceptions

- (1) Mechanical Protection: Lesser depths than those listed in Rule 33.4C may be used where suitable mechanical protection is employed. Suitable mechanical protection shall consist of the following or their equivalents:
 - (a) Steel conduit or plastic pipe made of rigid unplasticized polyvinyl chloride having the properties and dimensions specified in Type II, High Impact, Normal Chemical Resistance in United States Commercial Standard No. CS 207-60 with a minimum wall thickness of 0.15 inches.
 - (b) A layer of concrete at least 3 inches in thickness above the cable or duct.
 - (c) Cable armor of No. 12 BWG steel wire closely wound or two layers of steel tape each 0.020 inches thick.

(2) Terminations, Splices, or Other Points of Access: Lesser depths than those listed in Rule 33.4C are permitted where buried cables and conductors rise for terminations or splices or where access is otherwise required.

(3) Exceptions for Construction within thoroughfares, sidewalks, or parkways shall be allowed only with the consent and approval of the County, State, or Federal agency with authority over construction within said thoroughfare. (See Rule 17.11)

33.5 Above Ground Installations

A. Riser Cables

Riser cables and conductors on poles shall be installed in accordance with General Order No. 6 of this Commission. (See Rule 13.2)

B. Terminations and Enclosures

Supply cables and conductors may terminate above ground, on or in buildings, in enclosures designed for the purpose, in pad-mounted transformers, in pedestals, or in other guarded locations. (See Rule 13.2)

C. Services

Services may terminate on or in buildings when the portion on or in such buildings is protected in accordance with Rule 33.4D(1).

D. Clearances from Railroad Tracks

Clearances of above-ground supply system terminations and facilities adjacent to railroad tracks shall be in accordance with the National Electrical Safety Code. (See Appendix C, Figure 1)

33.6 Arrangements in Manholes, Vaults, and Enclosures

A. Accessibility

Cables and conductors in manholes, handholes, permanent cable trenches, or other similar enclosures shall be reasonably accessible to workmen and working space shall be available at all times. (See Appendix B, Figure 9)

33.7 Grounding and Bonding

A. Cable Sheaths and Shields

Metal sheaths and shields of supply cables shall be grounded and bonded in accordance with Rule 36.5.

34. EQUIPMENT

The following rules cover the requirements for installation of equipment in manholes, building vaults, rooms, or other enclosures and self-contained surface-mounted equipment.

34.1 Maintenance and Inspection (See Rules 12.2 and 17.2)

34.2 Equipment in Manholes, Vaults, Rooms and Other Enclosures

Equipment shall be so arranged as to provide reasonable accessibility to personnel and working space for the safe operation, maintenance, and replacement of said equipment.

A. Fused Devices

Fused devices shall be so located that they are readily accessible and may be safely operated and re-fused and so that the blowing of the fuse will not endanger persons.

B. Sectionalizing switches shall be so located that they may be operated, maintained, or replaced from a readily and safely accessible place.

They shall be so installed that the center of the grip of the operating handle when in its highest position will not be more than $6\frac{1}{2}$ feet above the floor or other standing surface. Switches with viewing windows shall be so installed that the center of the viewing window will be not more than $6\frac{1}{2}$ feet above the floor or other standing surface.

C. Transformers

Transformers operating at more than 600 volts, other than current and potential transformers and transformers which constitute a component part of other apparatus and which conform to the requirements of such apparatus, shall be readily accessible for operation, inspection, maintenance, and replacement.

Transformers shall be installed in such a manner as to permit safe operation, maintenance, or replacement of other equipment.

34.3 Self-Contained Surface-Mounted Equipment

Equipment installed partially or completely above the ground surface and not enclosed by a vault, room or fence shall conform to the following:

A. Strength

The equipment case or enclosure shall be secured in place and be of sufficient strength to resist entrance or damage to the equipment by unauthorized persons.

B. Guarding Live Parts

Compartments and enclosures which will, during normal operation, contain exposed live parts shall be designed and installed to prevent a person from passing a wire or other conducting material into such compartment from the outside when it is closed. This requirement is not intended to prevent normal work operations such as fishing ducts and installing cable.

C. Locking

Compartments and enclosures shall be made secure against entry by unauthorized persons by means of locks or other suitable means.

D. Clearance From Buildings

Transformers and other electrical equipment containing oil shall be so located and installed to conform to appropriate local codes or ordinances.

Equipment not containing oil need have no specific clearance from buildings and may be incorporated into the building structure.

34.4 Grounding and Bonding (See Rule 36.5)

34.5 Guarding Live Parts (See Rule 35.2)

35. MARKING AND GUARDING

35.1 Identification of Cables

Cables operating at a voltage in excess of 750 volts shall be permanently and clearly identified by metal tags or other suitable non-destructible means to indicate their operating voltage and the circuit with which they are normally associated at each manhole or other commonly accessible location of the underground system.

35.2 Guarding Live Parts

Live parts shall be enclosed, isolated, guarded, or insulated to prevent accidental contact. (See Rules 21.2, 22.0, and 21.6 for definitions of "enclosed," "isolated," and "guarded.")

35.3 Warning Signs

Warning signs indicating high voltage shall be installed on an interior surface, or barrier if present, inside the entrance of vaults, manholes, handholes, pad-mounted transformer compartments, and other above ground enclosures containing exposed live parts above 750 volts. Such signs shall be clearly visible to a person in position to open any such access door, other opening, or barrier. Warning signs shall be of corrosion resistant metal or plastic or other non-destructible material. Warning signs shall be required for above ground installations to conform to General Order No. 6.

35.4 Manhole Covers (See Rule 32.7)

36. GROUNDS AND NEUTRALS

36.1 Definitions (See Rule 21.5)

36.2 Maintenance and Inspection (See Rules 12.2 and 17.2)

36.3 Neutral Conductors

A. Material

Neutral conductors shall be of copper or other corrosion-resistant material if bare, and may be of aluminum or other conductor material if suitably protected from corrosion.

B. Size

Neutral conductors shall be of the size required to carry the estimated current to which they may be subjected. As a minimum they shall have a cross sectional area of approximately 50 per cent or more of the area of the largest related phase conductor, if of the same material. If the neutral conductor is of material having different conductivity from the phase conductors, such 50 per cent requirement shall be adjusted upwards or downwards inversely as the ratio of the conductivities of each material. In no case shall neutral conductors be smaller than the equivalent of No. 6 AWG Copper.

36.4 Ground or Earth as a Conductor

The grounding of the neutral or any other conductor in direct current supply systems or in a single phase or polyphase supply systems is permitted for the purpose of stabilization and protection, and not for normal use as a return or circuit conductor except as portions of circuits used in applying impressed current cathodic protection.

36.5 Grounding and Bonding of Conductors and Equipment

A. General

Supply conductors and equipment of the following types shall be bonded in manholes and at other locations where conductors and equipment are accessible and in proximity to one another, and shall be grounded in accordance with Rule 36.5C:

- (1) Transformer Windings: Transformer windings not exceeding 250 volts (except those used exclusively for energizing street lighting circuits and those used exclusively for energizing signal and track circuits) shall be effectively grounded at the points specified in the following:
 - (a) Single Phase Systems:
 - 2-wire 120 volt: one conductor.
 - 2-wire 240 volt: intermediate point or, if not available, one conductor.
 - 3-wire 120/240 volt: mid point.
 - (b) Two Phase Systems:
 - 3-wire 240 volts: point common to both windings.
 - 4-wire 120/240 volt: mid point on one phase.
 - 4-wire 240 volt)
 - 5-wire 120/240 volt): mid points of both windings connected together.
 - (c) Three Phase Systems:
 - 3-wire Delta 120 or 240 volt: mid point of one winding or, if not available, a point common to two windings.
 - 3-wire and 4-wire Star 120, 208, 240, or 120/208 volt, and 3-wire T or Scott 240 volt: point common to all windings or, if not available, one conductor.
- (2) Supply Circuits 0-750 Volts: Neutral conductors of 0-750 volt supply circuits.

- (3) Supply Circuits More than 750 Volts: Neutral conductors of supply circuits of more than 750 volts.
- (4) Metal Sheaths, Shields and Pipes: Metal sheaths and shields of supply cables and metal pipes and conduits enclosing supply cables, except as provided by Rule 36.5B.
- (5) Metal Cases Supply Equipment: Metal cases of transformers, switches, and other supply equipment.
- (6) Above-Ground Metal Enclosures: Above-ground metal enclosures in which supply conductors are terminated.
- (7) Lightning Arresters.

B. Exception

Metal sheaths and shields of cables and pipes of pipe-type cables may be sectionalized, and/or not bonded to other grounded equipment and conductors in commonly accessible locations as required by Rule 36.5A, in order to mitigate corrosion or to limit induced circulating currents; provided that each run of such sheath, shield, or pipe is effectively grounded and the induced voltage thereon does not exceed 25 volts to ground under normal operating conditions.

C. Grounding Methods

Conductors and equipment required by Rule 36.5A to be grounded shall be effectively grounded by one or more of the following methods:

- (1) Burial in Earth: Bare neutral conductors, metallic cable sheaths and shields, metal pipes and metal conduits may be grounded by burying them directly in the earth.
- (2) Grounding Electrodes: Conductors and equipment may be grounded by connections at one or more locations to driven ground rods or other suitable grounding electrodes. (See Rule 21.5A)
- (3) Bonding: Conductors and equipment may be grounded by bonding at one or more locations to conductors or equipment grounded in accordance with Rule 36.5C(1) or Rule 36.5C(2).

D. Grounding and Bonding Conductors

- (1) Material: Conductors used for bonding and grounding connections shall be of copper or other corrosion resistant material, or shall be suitably protected against corrosion.
- (2) Conductivity: Conductors used for bonding and grounding connections shall have sufficient conductivity to carry the fault currents that may be imposed upon them by the associated system, and in no case less than the conductivity equivalent of No. 6 AWG Copper.
- (3) Method of Attachment: Grounding and bonding conductors shall be attached by means of suitable lugs, pressure connectors, clamps, welds, or other suitable means. Clamps shall not be used for direct attachment to lead sheaths of cables.

PART IV

REQUIREMENTS FOR COMMUNICATION SYSTEMS

40. GENERAL

The following rules cover construction requirements for communication systems. These are supplemented in certain cases by rules in other sections.

40.1 Construction Methods

Communication systems for public use constructed under these rules may consist of, but shall not be limited to, directly buried cables and conductors, cables and conductors installed in conduit, manholes and handholes, tunnels, or a combination of these elements. Open trenching, tunneling, boring, jacking and plowing, either singly or in combination, are among the recognized methods of installation of communication systems. Terminating and access points for lines and services may be above or below grade.

41. DUCT SYSTEMS

41.1 Definition (See Rule 21.0)

41.2 Maintenance and Inspection (See Rules 12.2 and 17.2)

41.3 Construction

Duct systems shall be constructed with adequate provision for safety of workmen, safety of the general public and the preservation of property.

41.4 Clearances and Depths

The clearance between duct systems of communication lines for public use and other underground structures independently installed shall be as great as practicable, and the minimum distance between the top covering of these ducts and the pavement or other surface under which they are constructed shall protect the system from injury by traffic as follows:

A. Clearance From Foreign Substructures (Except Supply Systems)

- (1) Independently Installed: Ducts carrying communication cables and conductors for public use, when independently installed, shall be separated from gas, water, oil, or other pipe systems, by a minimum clearance of at least 12 inches when paralleling and by at least 6 inches when crossing. Wherever possible

(1) Independently Installed - continued

in new construction, parallel clearance shall be 36 inches or more to permit adequate working space for maintenance or repairs of said systems.

(2) Concurrently Installed: Ducts carrying communication cables and conductors for public use, when concurrently installed with gas, water, oil, or other foreign substructures shall be installed with separation required by Rule 41.4A(1).

B. Clearance From Supply Systems

(1) Independently Installed: Ducts carrying communication cables and conductors for public use, when independently installed, shall be separated from supply duct systems and buried cables or conductors by not less than 3 inches of concrete, 4 inches of brick masonry, or 12 inches of earth.

(2) Concurrently Installed: Ducts carrying communication cables and conductors for public use, when concurrently installed with supply duct systems, shall be installed with separation required in Rule 41.4B(1).

Where ducts of either system are not of rigid material, or the supply cables or conductors are buried, the separations of Rule 41.4B(1) apply. In lieu of this requirement, the provisions of Rule 43.3B(1) for random separation may be applied.

C. Depths

Ducts carrying communication cables and conductors for public use shall be constructed at a depth to provide not less than 18 inches of cover below the surface under which they are located, except as otherwise provided in these rules.

(1) Railroads: The top of communication system duct structures shall be located at a depth of not less than 30 inches, in the case of street railroads, and not less than 42 inches, in the case of other railroads, below the base of the lowest rail.

Where physical conditions will permit, and suitable materials are used and the parties agree, a maximum of two communications system ducts may be installed beneath railroad tracks without any form of protection at a minimum depth of 18 inches below the base

(1) Railroads - continued

of the lowest rail unless the worked ballast section of the roadbed exceeds 18 inches, in which case the ducts shall be laid below the ballast section. (See Rule 17.11)

(2) Thoroughfares: Communication duct systems in thoroughfares may be installed with not less than 18 inches of cover. Where it is not practicable to obtain such cover, it may be reduced provided the duct material itself, or additional mechanical protection conforms to Rule 33.4D(1); and only with the consent and approval of the County, State, or Federal agency with authority over construction within said thoroughfare. (See Rule 17.11 and 33.4D(1)).

(3) Sidewalks and Parkway Areas: Communication duct systems located in sidewalk areas may be installed immediately under the sidewalk material. Systems located in parkway areas shall be installed with not less than 12 inches of top cover unless adequate mechanical protection in addition to the duct material itself is provided; and only with the consent and approval of the County, State, or Federal agency with authority over construction within said thoroughfare. (See Rule 17.11 and 33.4D(1)).

(4) Private Property: Communication duct systems on private property shall be installed to provide not less than 12 inches of top cover.

(5) Open Ditches, Bridges, Trestles, Viaducts, and Similar Structures: Communication duct systems, when supported by bridges, trestles, viaducts, or similar structures shall be enclosed in the structure or otherwise protected from mechanical damage if the duct material itself does not inherently provide such protection. The design and interval of supports shall be such as to sustain, with a suitable margin of safety, the maximum load to which the supports will be subjected. Where necessary, provision shall be made for expansion, contraction or other movement of the duct system, or the bridge or other supporting structure.

D. Maintaining Clearances and Depths

- (1) Any person or agency performing surface or subsurface construction in the vicinity of communication duct systems is enjoined to maintain the minimum clearances from, and the depths of, existing systems as required by these rules.
- (2) If minimum clearances and depths cannot be maintained, then the person or agency causing changes is enjoined to notify the owner of the duct system before proceeding with the construction.
- (3) Under the provision of this rule, a previously installed system may be maintained with less than the top cover required by other applicable rules of this section provided the duct material itself or additional mechanical protection conforms to Rule 33.4D(1).
- (4) Rule 17.11 shall also apply.

41.5 Risers and Other Above Grade Terminations

A. Poles

Risers of communication duct lines on poles shall be installed in accordance with General Order No. 6 of this Commission. (See Rule 13.2)

B. Other Above Grade Terminations

Communication duct systems may terminate above grade on or in buildings, in housings designed for the purpose, in pedestals, or other terminal facilities. (See App. B and Rule 13.2)

C. Clearances from Railroad Tracks

Clearances of above ground terminations and facilities adjacent to railroad tracks shall be in accordance with the provisions of the National Electrical Safety Code. (See Appendix C, Fig. 1)

41.6 Sealing Service Laterals

Lateral ducts for services to buildings, through which gas or water may enter buildings, shall be plugged or sealed.

42. MANHOLES AND HANDHOLES

The provisions in this rule relating to manholes shall also be applicable to vaults and trenches.

42.1 Definitions (See Rules 22.4 and 21.7)

42.2 Maintenance and Inspection (See Rules 12.2 and 17.2)

42.3 Materials and Strength

The materials, design, and construction of manholes, handholes, and other underground boxes shall be such as to provide sufficient strength to sustain, with a suitable margin of safety, the loads which may reasonably be imposed on them. Manholes and handholes in street areas which are subject to vehicular traffic shall be constructed to withstand H-20-44 highway loading as designated by the American Association of State Highway Officials. No person shall build or rebuild any subway, manhole, chamber or underground room, used or to be used, to contain, encase, cover, or conduct any wire, cable, or appliance to conduct or handle electricity unless the floor of the subway, manhole, chamber, or underground room is made of stone, concrete or brick. This rule does not apply to any subway, manhole, chamber, or underground room within which it is not intended or required that any human being perform work or labor or be employed. (See Appendix B, Fig. 9)

42.4 Size and Shape

Manholes shall be constructed to provide sufficient working space so that the cable and equipment therein can be properly and safely installed, supported, operated and maintained. No person shall build or rebuild any subway, manhole, chamber, or underground room used or to be used to contain, encase, cover, or conduct any wire, cable, or appliance, to conduct or handle electricity, unless such subway, manhole, chamber, or underground room has an inside measurement of not less than four feet at the maximum points between the side walls thereof, and between the end walls thereof, and not less than five feet at all points between the floor and the top or ceiling thereof, or if circular in shape, at least four feet diameter inside measurement and not less than five feet at all points between the floor and ceiling thereof. This section does not apply to any such subway, manhole, chamber, or underground room, within which it is not intended or required that any human being perform work or labor or be employed. This rule does not apply where satisfactory proof is submitted to the Commission that it is impracticable or physically impossible to comply within the space or location so designated by the proper municipal authorities. (See Appendix B, Fig. 9 and Rule 17.11)

42.4 Size and Shape - continued

Handholes shall be of sufficient size to house safely the required cables, splices, connectors and associated apparatus. Cables shall be arranged so that they can be safely installed and maintained.

42.5 Openings

No manhole access opening shall be less than 26 inches in diameter if circular in shape or 26 inches by 24 inches if rectangular in shape. Safe access shall be provided from the opening to the floor or other working surface. (See Appendix B, Fig. 9)

42.6 Drainage

Drainage of manholes into sewers shall not be permitted without specific prior approval of the appropriate city or county agency as required by law or ordinance. (See Rule 17.11)

42.7 Covers

Manholes and handholes, while not being worked in shall be securely closed by covers of sufficient strength to sustain such loads as may reasonably be imposed upon them, and arrangement shall be such that a tool or appliance shall be required for their opening and cover removal. Covers shall be properly marked for easy identification. (Also See Rule 17.8 and Appendix B, Fig. 9)

42.8 Location

Manhole locations shall be such that the opening will provide safe access and shall be so located that future maintenance work will cause minimum interference with the normal flow of vehicular traffic. In no case may the nearest edge of the opening at the surface be less than 3 feet from any rail of any railroad or streetcar track (also see Rule 41.5C and Appendix B, Fig. 9).

This rule does not apply where satisfactory proof is submitted to the Commission that it is impracticable or physically impossible to comply with this rule within the space or location so designated by proper authorities. (See Rule 17.11)

42.9 Foreign Pipes

Foreign pipes shall be excluded from passing through the working space within manholes; however, foreign pipes may be imbedded within the manhole structure. (Also See Rule 17.6 and Appendix B, Fig. 9)

42.9 Foreign Pipes - continued

Foreign pipes shall be relocated by mutual consent of the parties involved. Where such relocation is not practicable, and where satisfactory proof is submitted to the Commission that it is impracticable or physically impossible to comply with this rule, foreign pipes may be allowed within the working space, provided they are satisfactorily guarded.

42.10 Explosion Protection

Due care shall be taken to force-ventilate all manholes to disperse any explosive and noxious gases before workmen enter the manhole.

43. BURIED CABLES AND CONDUCTORS

43.1 Definitions (See Rules 20.2A and 20.6)

43.2 Maintenance and Inspection (See Rules 12.2 and 17.2)

43.3 Clearances and Depths

Buried communication cables and conductors for public use shall be subject to the same clearance and depth requirements as specified for duct systems in Rules 41.4A, 41.4C and 41.4D. In addition, separations from supply system ducts and buried cables or conductors shall be as follows:

A. Independently Installed

Buried communication cables and conductors, when independently installed, shall be separated from supply system ducts and buried cables or conductors by not less than 3 inches of concrete, 4 inches of brick masonry, or 12 inches of earth.

B. Concurrently Installed

Buried communication cables and conductors, when concurrently installed, and with mutual agreement of the parties involved, may have separations from supply system ducts and buried cables or conductors less than those specified in Rule 43.3A as follows: (See Rule 17.11)

- (1) Random Separation from Buried Supply Cables and Conductors of Not Over 300 Volts to Ground: No physical separation of supply and communication systems is required when the supply circuit includes an effectively grounded neutral conductor and the maximum voltage to ground of the circuit does not

- (1) Random Separation from Buried Supply Cables and Conductors of Not Over 300 Volts to Ground - continued

exceed 300 volts provided that all grounded conductors, sheaths, or shields of each system appearing at connecting or terminating points are bonded and such bonds of the two systems are interconnected wherever practicable. (See App. B, Fig. 5)

43.4 Risers and Other Above Grade Terminations

Risers and other above grade terminations of buried communication lines shall comply with the same requirements as specified for duct lines in Rule 41.5 of these rules. (See Appendix C, Fig. 1)

44. CONDUCTORS OF DIFFERENT SYSTEMS

44.1 Separation of Supply and Communication Systems

Communication cables and conductors for public use shall not occupy the same duct, manhole, handhole, or other underground splicing chamber with supply cables or conductors unless separated from the supply cables or conductors by a partition constructed of brick, concrete, tile or other suitable material. When such a partition is installed, separate access to each compartment shall be provided by means of divided covers or equivalent construction. (See Appendix B, Fig. 9)

This rule does not apply to utility tunnels, subways, or permanent cable trenches provided that supply cables and conductors of over 750 volts are either enclosed, guarded, installed in grounded metallic conduit, or have continuous grounded metallic sheath. Grounded metallic cable sheaths of the supply and communication systems need not be bonded. The cables and conductors of the supply and communication systems must be separately supported.

44.2 Special Cases

The provisions of Rule 44.1 do not apply in those cases where cables or conductors of either supply or communication systems enter the other system's underground structure for the purpose of providing service or interconnecting communication facilities.

45. PRIVATE COMMUNICATION CIRCUITS

45.1 Definition (See Rule 20.4B)

45.2 Maintenance and Inspection (See Rules 12.2 and 17.2)

45.3 Supply Private Communication Cables and Conductors

A. Depths

Ducts, cables and conductors of private communication systems are subject to the same depth requirements as those of public communication systems.

B. Occupancy with Public Communication Systems

Private communication cables and conductors owned and operated by supply utilities shall not occupy the same duct, but may enter the same manhole or other underground splicing chamber which is occupied by a communication system for public use for the purpose of interconnection.

C. Occupancy with Supply Systems

Private communication cables and conductors owned and operated by supply utilities may occupy the same duct or duct systems and other underground structures of supply systems.

45.4 Other private Communication Cables and Conductors

Private communication cables and conductors, other than those treated in Rule 45.3 may, with permission of the structure owner, occupy the same duct systems and manholes or other underground structures with communication systems for public use provided that they comply with all these rules applying to communication systems for public use.

46. POLICE, FIRE ALARM, AND TRAFFIC CONTROL CIRCUITS

46.1 Definition (See Rule 22.6)

46.2 Maintenance and Inspection (See Rules 12.2 and 17.2)

46.3 Occupancy with Public Communication Systems

Police, fire alarm, and traffic control circuits may, with permission of the structure owner, occupy the same duct systems and manholes with public communication systems provided that they comply with all these rules applying to public communication systems.

46.4 Occupancy with Supply Systems

Police, fire alarm and traffic control circuits may, with permission of the structure owner, occupy underground structures of supply systems. Circuits so installed shall not enter underground structures of public communication systems except for the purpose of authorized interconnection of communication facilities.

A P P E N D I C E S

A P P E N D I C E S

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B. Typical Illustrative Diagrams of Rules	44
C. Clearance From Railroad Tracks	63

APPENDIX "A"

Summary of Dimensions, Clearance and Depth
Requirements

These tables summarize the requirements of certain rules and are to be used as a guide only for the application of such rules. Under no conditions shall the tables be given precedence over the rules as written.

<u>Table No.</u>	<u>Title</u>	<u>Page</u>
I	Clearance and Depth Requirements for Supply and Communication Systems	42
II	Miscellaneous Dimensions and Clearance Requirements for Supply and Communication Systems	43

TABLE I
CLEARANCE AND DEPTH REQUIREMENTS
FOR SUPPLY AND COMMUNICATION SYSTEMS

CASE NO.	NATURE OF CLEARANCE OR DEPTH	REQUIREMENTS**	REFERENCE RULES
	<u>Clearances</u>		
1	Cables when independently installed*	3" concrete, 4" brick, or 12" earth	33.4A(1)(a), 33.4A(2)(a), 43.3A
2	Cables when concurrently installed*	No separation required when parties mutually agree. For random separation see Rule 43.3B(1).	33.4A(1)(b), 33.4A(2)(b), 43.3B
3	Cables and Ducts from Foreign Sub-structures (Except Supply or Communication Systems) when independently installed.	12" when paralleling and 6" when crossing.	31.4A(1), 33.4A(3)(a) 41.4A(1), 43.3A
4	Cables and Ducts from Foreign Sub-structures (Except Supply or Communication Systems) when concurrently installed.	No separation required when parties mutually agree. For random separation see Rule 43.3B.	31.4A(2), 33.4A(3)(b) 41.4A(2), 43.3B
5	Separation of Communication and Supply duct systems independently installed.	3" concrete, 4" brick or 12" earth.	31.4B(1), 41.4B(1)
6	Separation of Communication and Supply duct systems concurrently installed.	No separation required when parties mutually agree and both systems are in rigid ducts.	31.4B(2), 41.4B(2)
	<u>Depths</u>		
7	Depth of Cables and Ducts under railroads.	30" below street railroads, 42" below other railroads.	31.4C(1), 33.4B, 41.4C(1), 43.3
8	Depths of Supply Cables and Ducts	0-750 volts: 21" below Thoroughfares. 18" elsewhere (Sidewalks, Parkways and Private Property) 751-35,000 volts: 21". Above 35,000 volts: 36"	31.4C, 33.4C, 33.4D
9	Depths of Communication Cables and Ducts	18" below Thoroughfares. 12" elsewhere (Sidewalks, Parkways and Private Property)	41.4C, 43.3

*For definition of independently and concurrently installed see Rules 20.5 and 21.7

**Clearances and depths shown may be reduced under certain conditions -- See referenced rules. For measurement of clearances see Rules 17.9 and 17.11

TABLE II
 MISCELLANEOUS DIMENSIONS AND CLEARANCE REQUIREMENTS
 FOR
 SUPPLY AND COMMUNICATION SYSTEMS

CASE NO.	NATURE OF CLEARANCE	REQUIREMENTS***	REFERENCE RULES
1	From railroad tracks of risers and other above-ground terminations.	National Electrical Safety Code	31.5D, 33.5D 41.5C, 43.4
2	Size and shape of manholes.	Minimum inside dimensions shall be 4 feet by 5 feet high.	32.4, 42.4
3	Manhole openings.	Not less than 26" in diameter or 26" x 24" rectangular.	32.5, 42.5
4	Manhole location.	Manhole openings shall not be less than 3' from any railroad rail.	32.8, 42.8
5	Sectionalizing Switches.	Maximum height of operating handles and viewing windows: 6-1/2 feet.	34.2B
6	Oil filled equipment.	Conform to appropriate local code or ordinance.	34.3D

***Dimensions and clearances shown may be reduced under certain conditions -- See referenced rules and 17.11.

APPENDIX "B"

Typical Illustrative Diagrams of Rules

These diagrams illustrate the requirements of certain rules and are to be used as a guide only for the application of such rules. Under no conditions shall these diagrams be given precedence over the rules as written.

<u>Figure No.</u>	<u>Title</u>	<u>Page</u>
1	Illustrative Diagram - Clearance and Depth Requirements for Supply and Communication Systems	45
2	Typical Residential Supply and Communication System-Direct Buried or Preassembled Cables-in-Ducts	46, 47
3	Typical Commercial Supply System-Cables installed in ducts	48, 49, 50
4	Typical Communication System-Cable installed in duct	51
5	Cross section-Random Separation of Buried Cable	52
6	Cross section-Supply and Communication System Concurrent installations	53
7	Cross section showing independent installations	54
8	Cross section-Permanent Cable Trench	55
9	Typical Manhole	56
10	Separation of Supply and Communication Systems-Handholes	57
11	Typical Single-Phase Pad-Mounted Transformer	58
12	Typical Three-Phase Pad-Mounted Transformer	59
13	Typical Joint Supply and Communication Pedestal	60
14	Typical Low Voltage Service Termination at Building	61
15	Grounding of Transformer Windings	62

APPENDIX "D"

ILLUSTRATIVE DIAGRAM
CLEARANCE AND DEPTH REQUIREMENTS
FOR
SUPPLY AND COMMUNICATION SYSTEMS

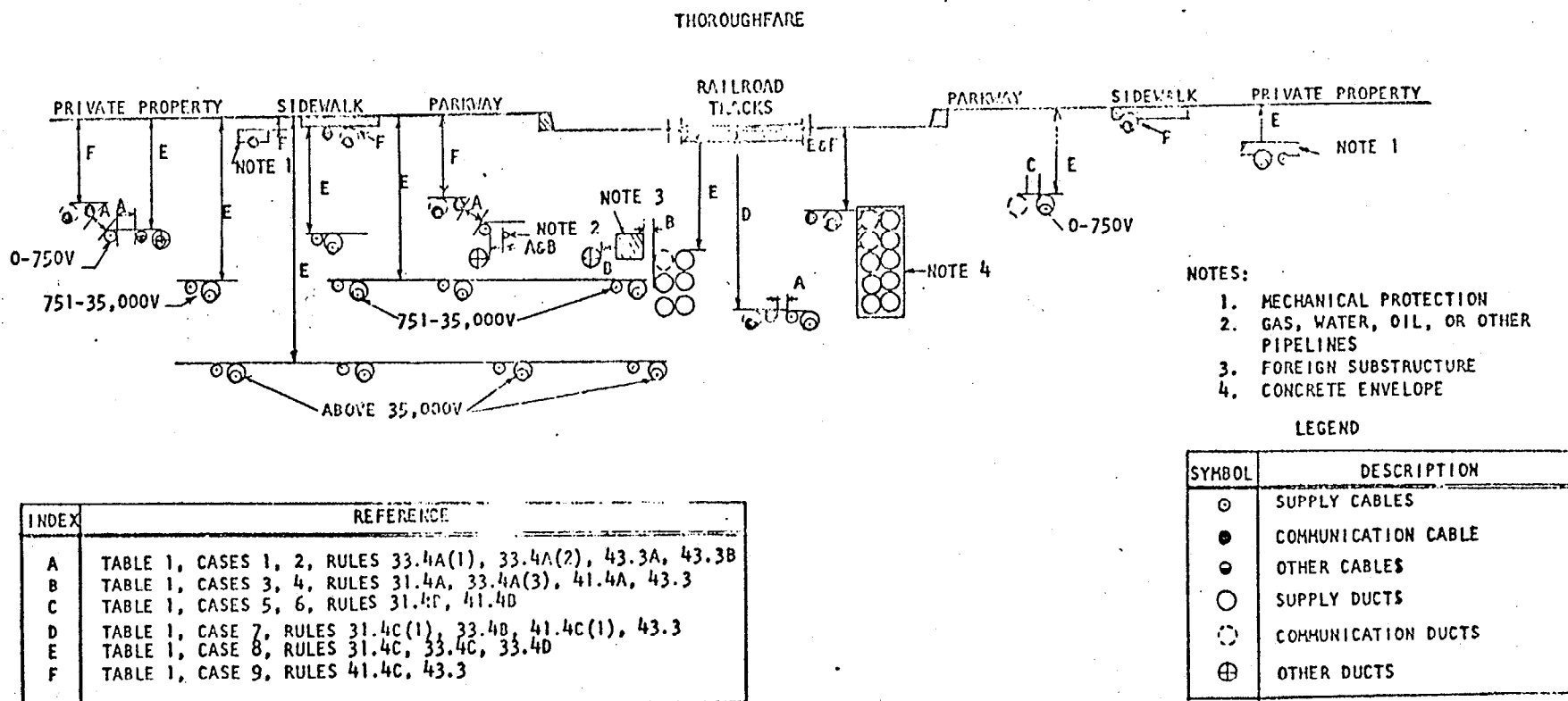
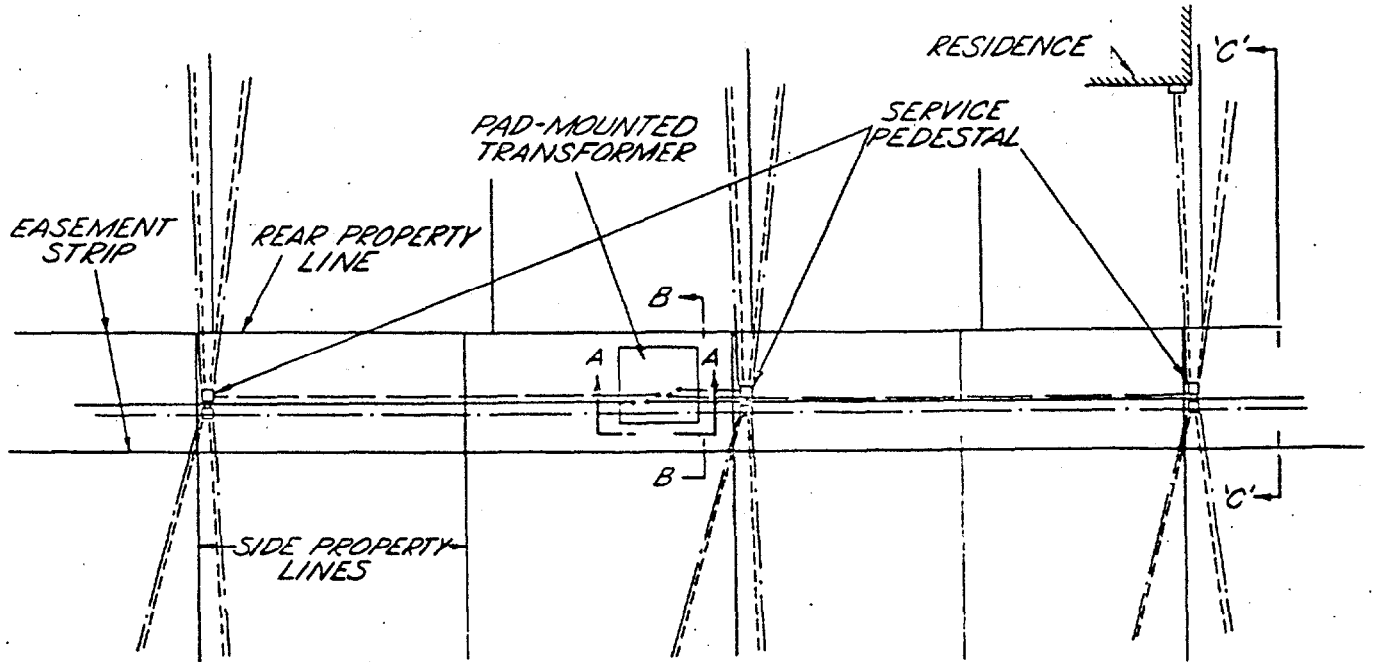


FIGURE 1

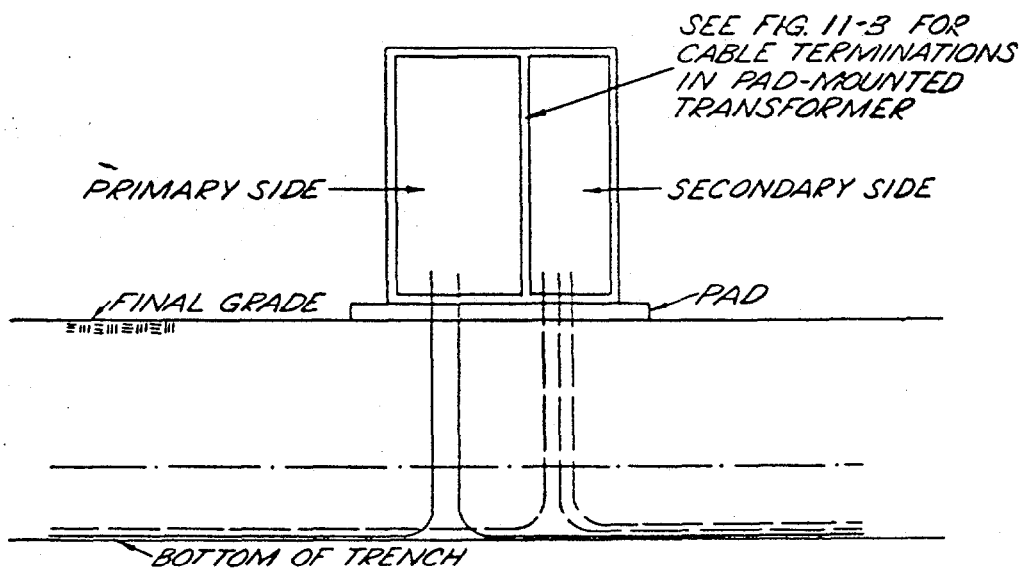
TYPICAL RESIDENTIAL SUPPLY AND COMMUNICATION SYSTEM
 DIRECT BURIED OR PREASSEMBLED CABLES-IN-DUCTS



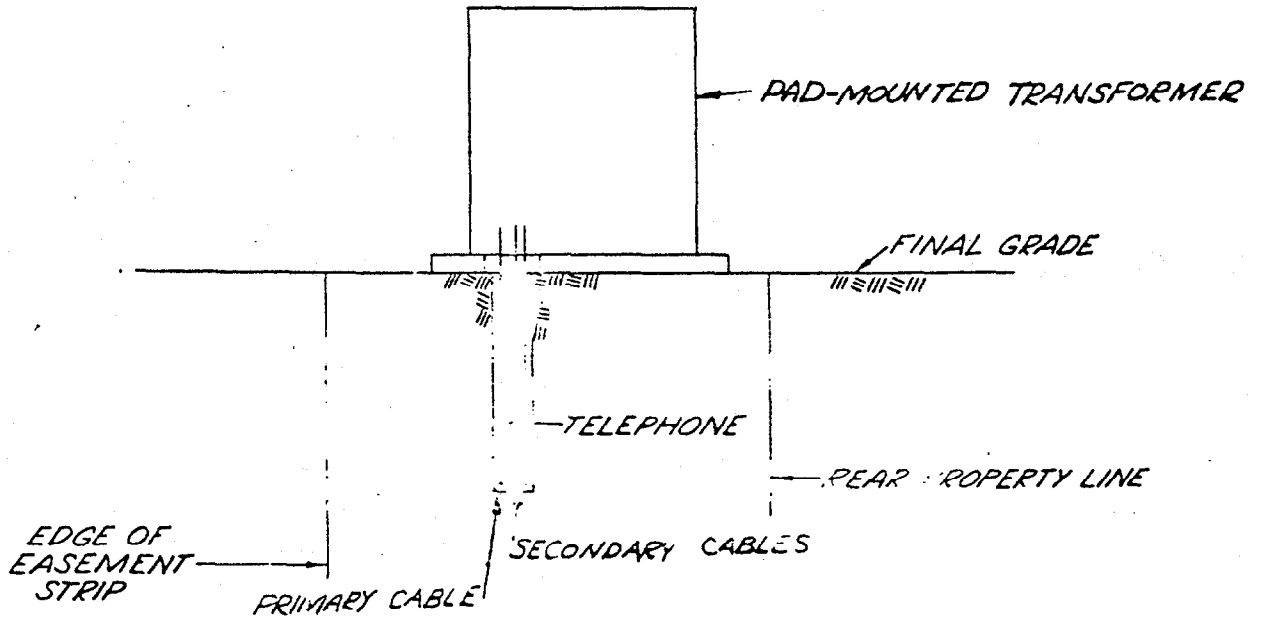
CABLE LEGEND

- PRIMARY
- SECONDARY
- - - - - SERVICE CONNECTION
- TELEPHONE

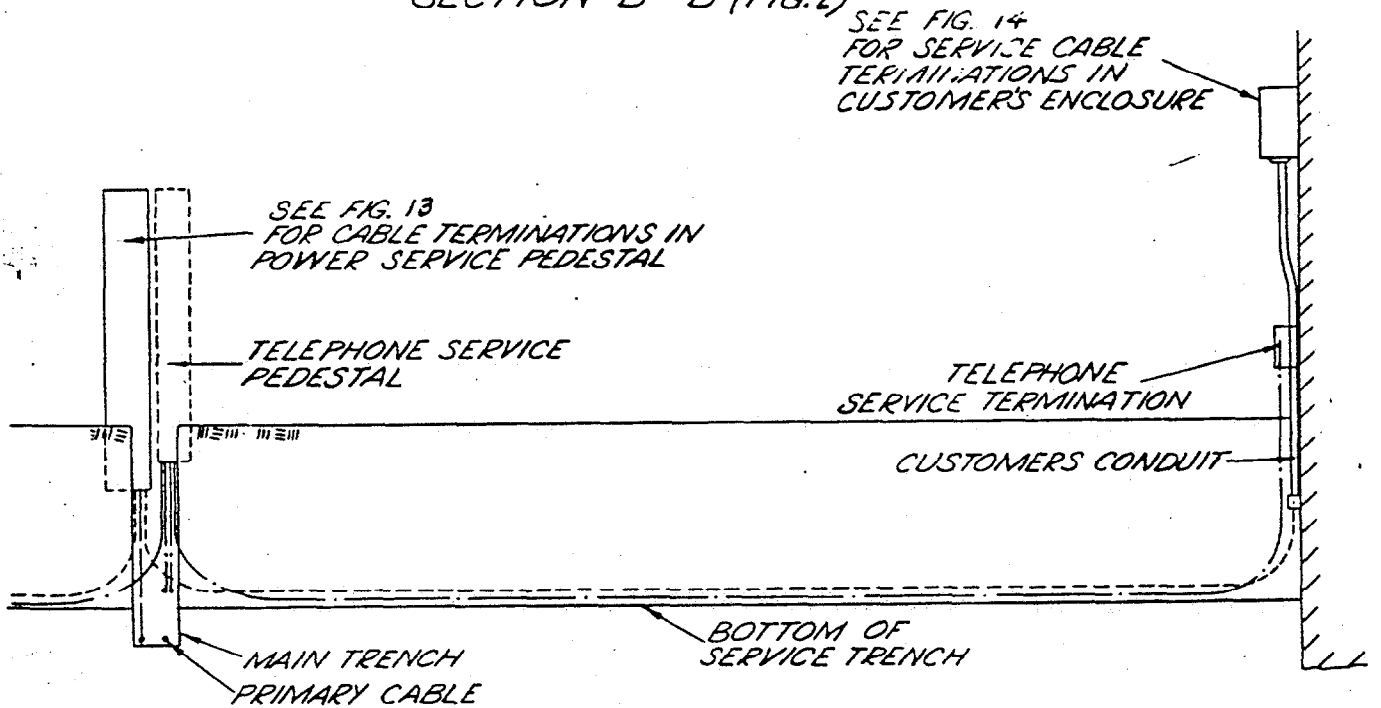
TYPICAL PLAN
 FIG. 2



SECTION A - A (FIG. 2)

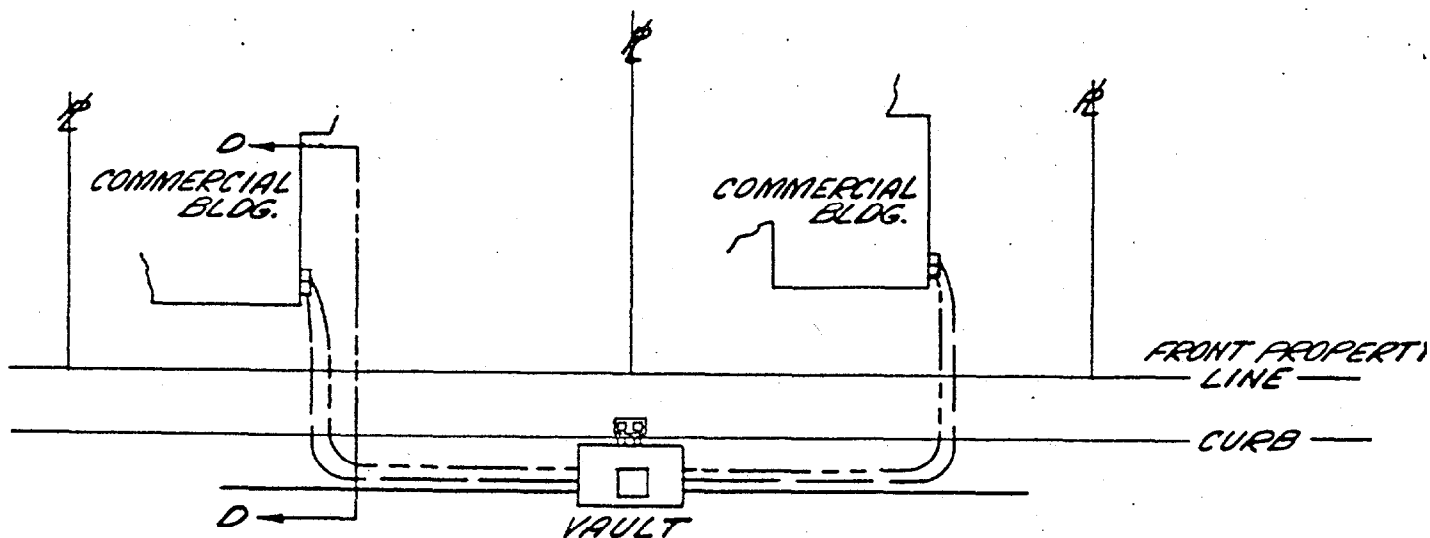


SECTION B - B (FIG. 2)



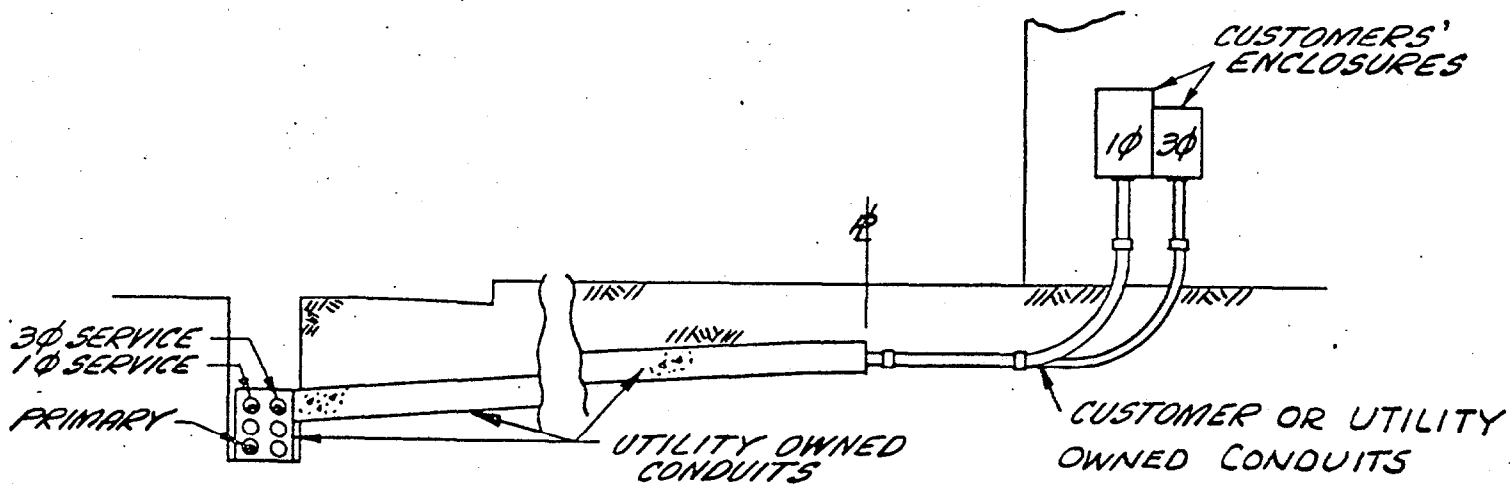
SECTION C - C (FIG. 2)

TYPICAL COMMERCIAL SUPPLY SYSTEM CABLES INSTALLED IN DUCTS

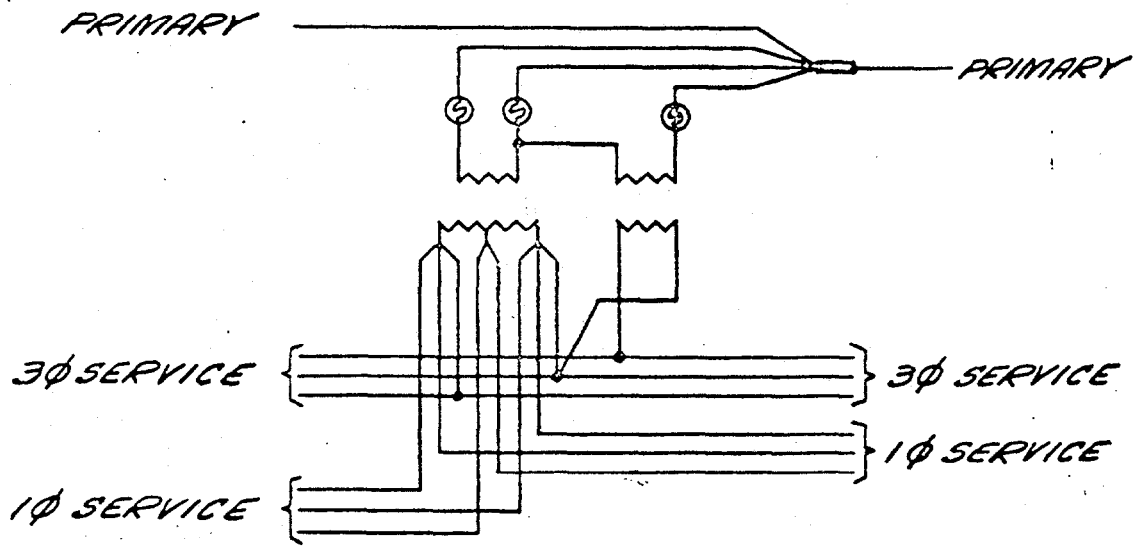


CABLE LEGEND:
—— PRIMARY
—— 1 ϕ SERVICE
- - - 3 ϕ SERVICE

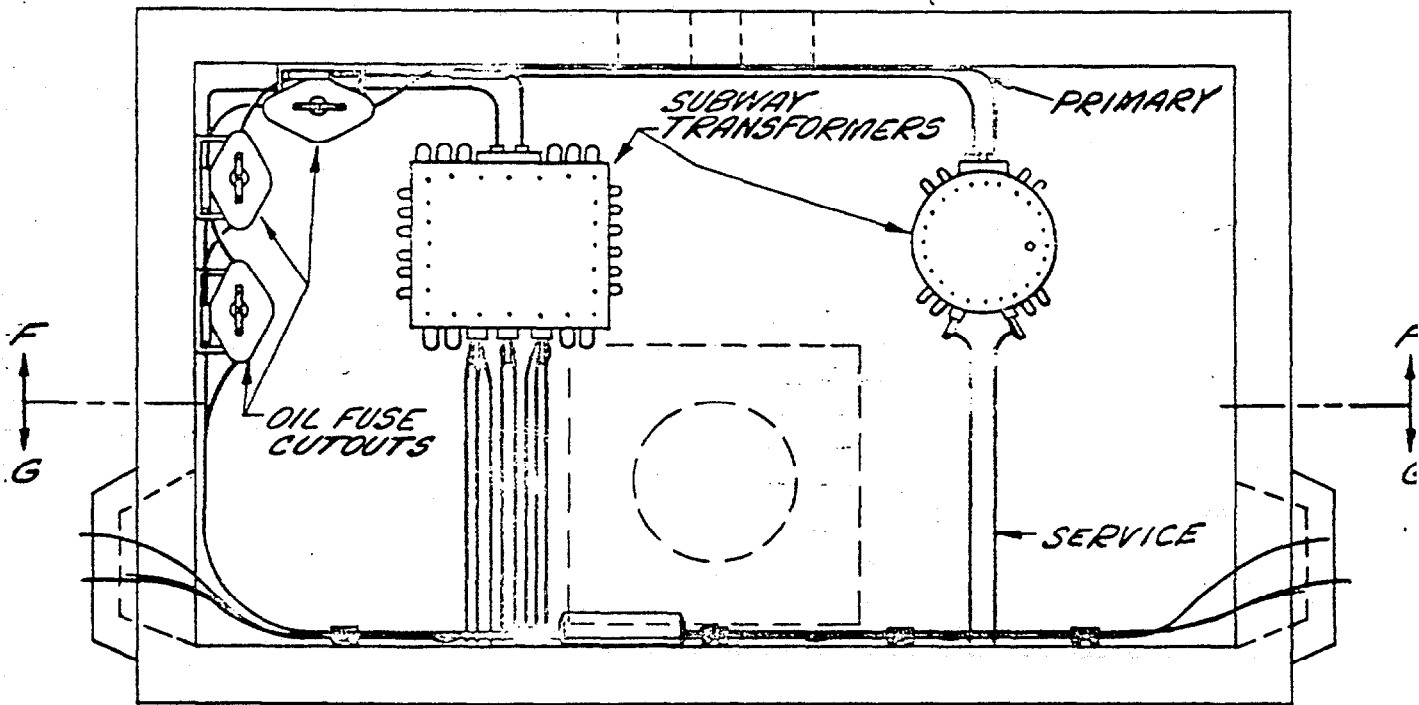
TYPICAL PLAN
FIG. 3



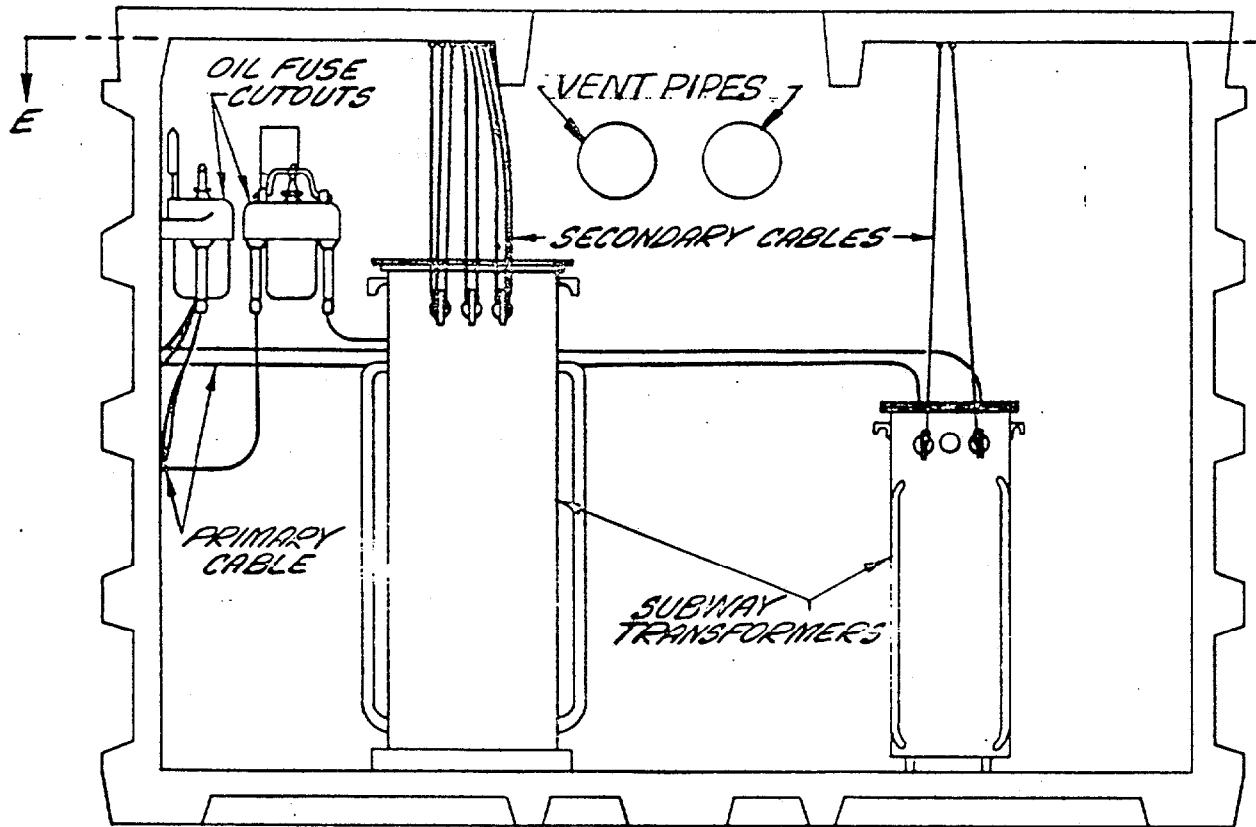
SECTION D-D (FIG. 3)



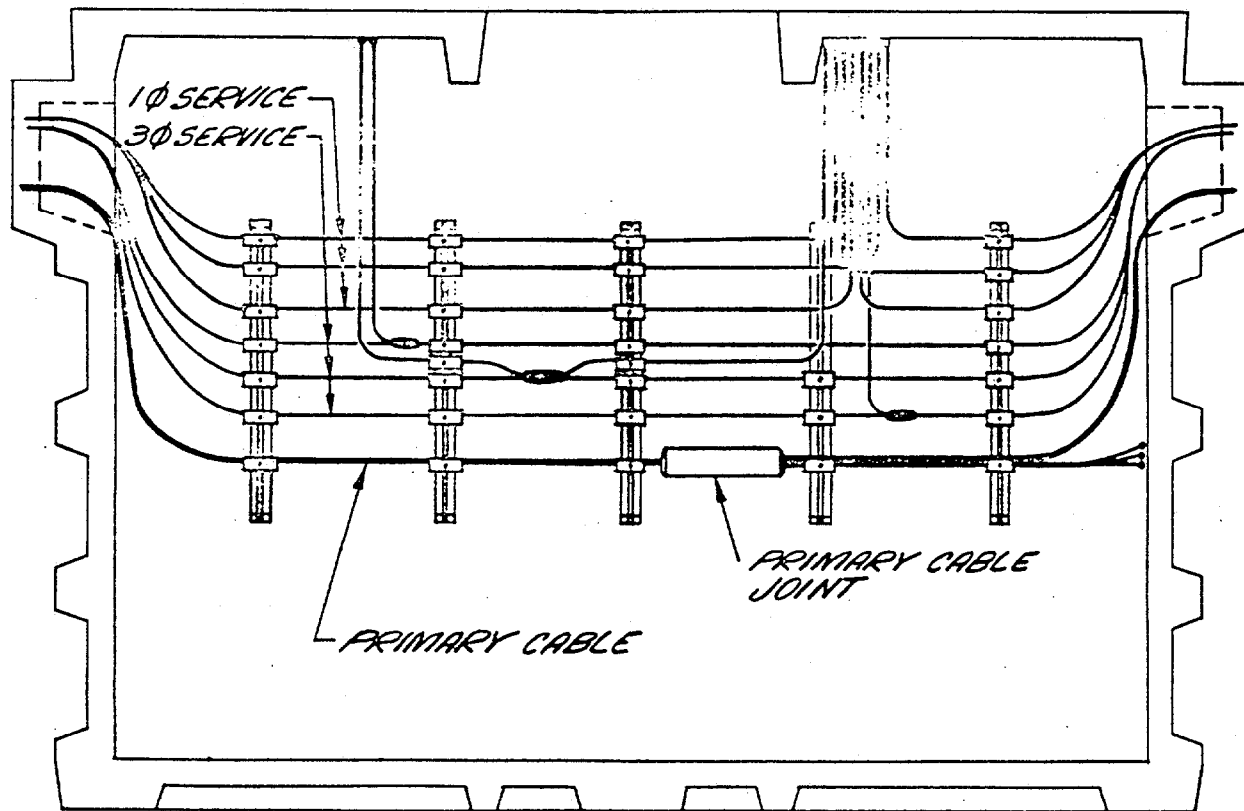
WIRING DIAGRAM (FIG. 3)



SECTION E-E (FIG. 3)



SECTION F-F (FIG. 3)



SECTION G-G (FIG. 3)

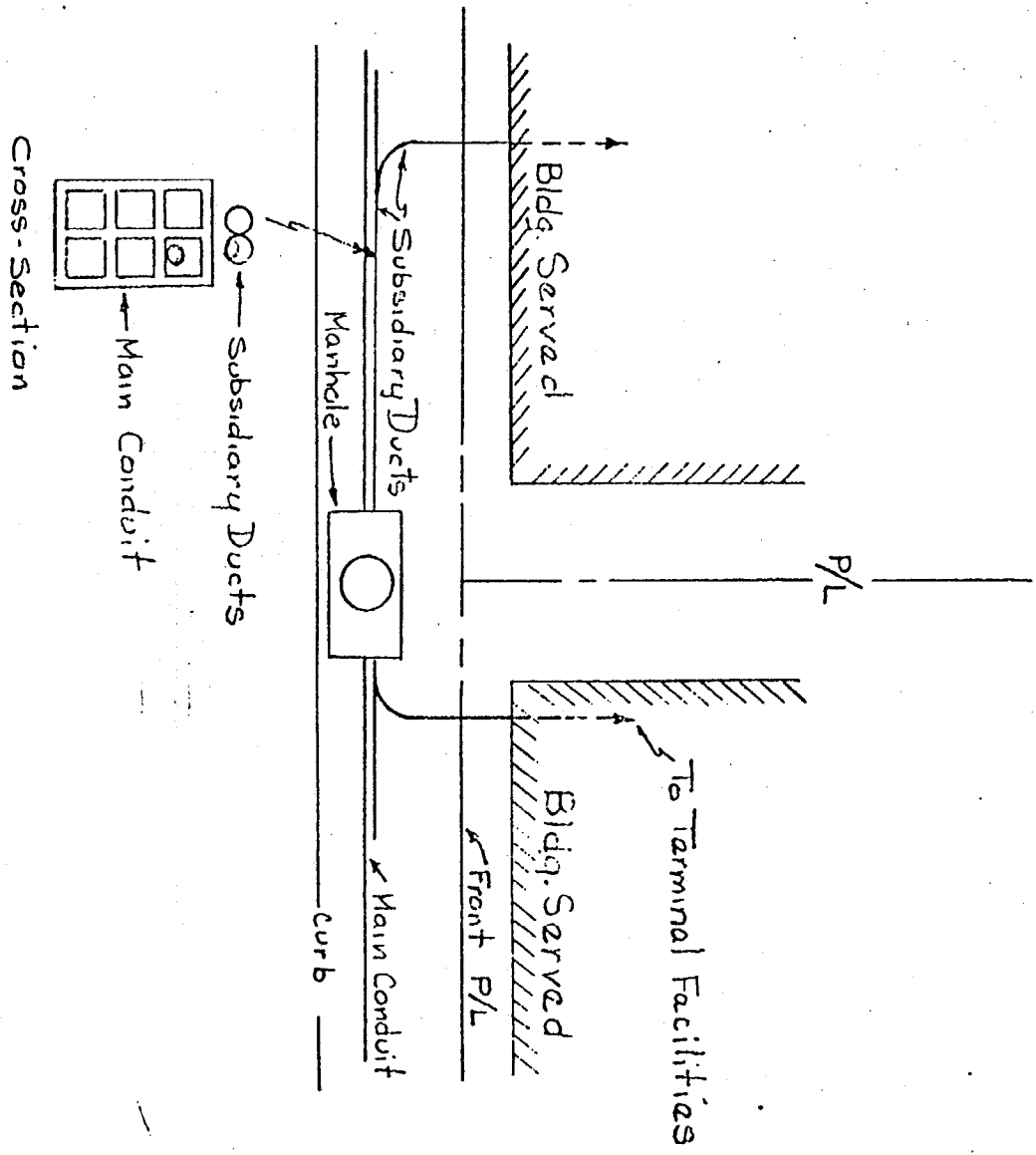
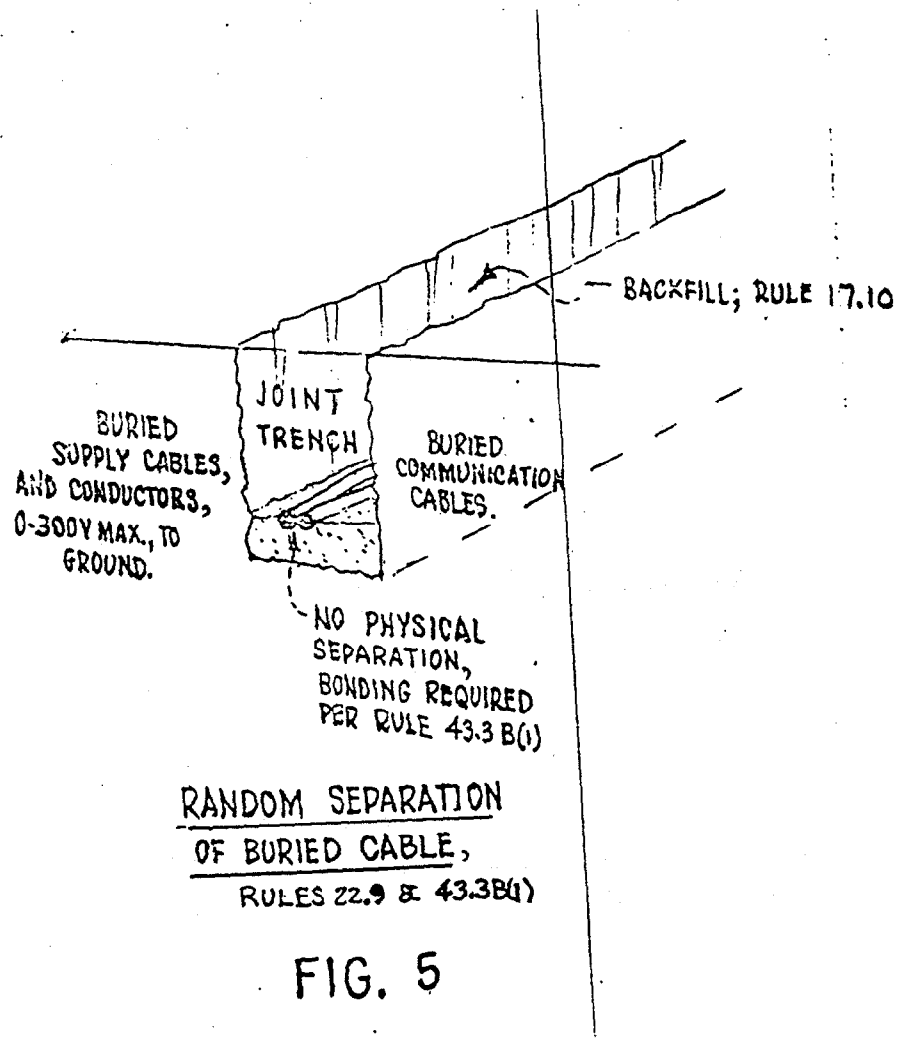
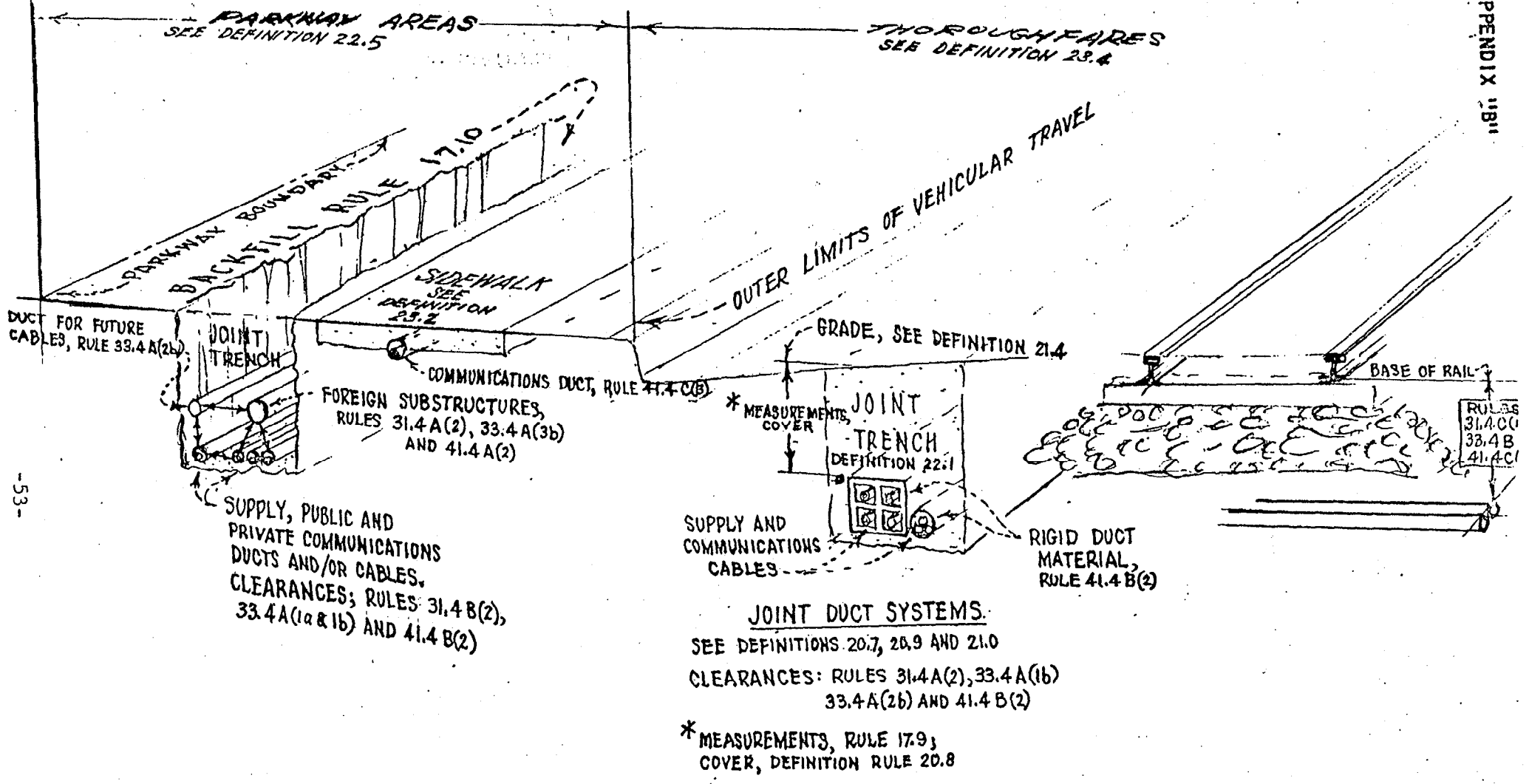


Fig 4

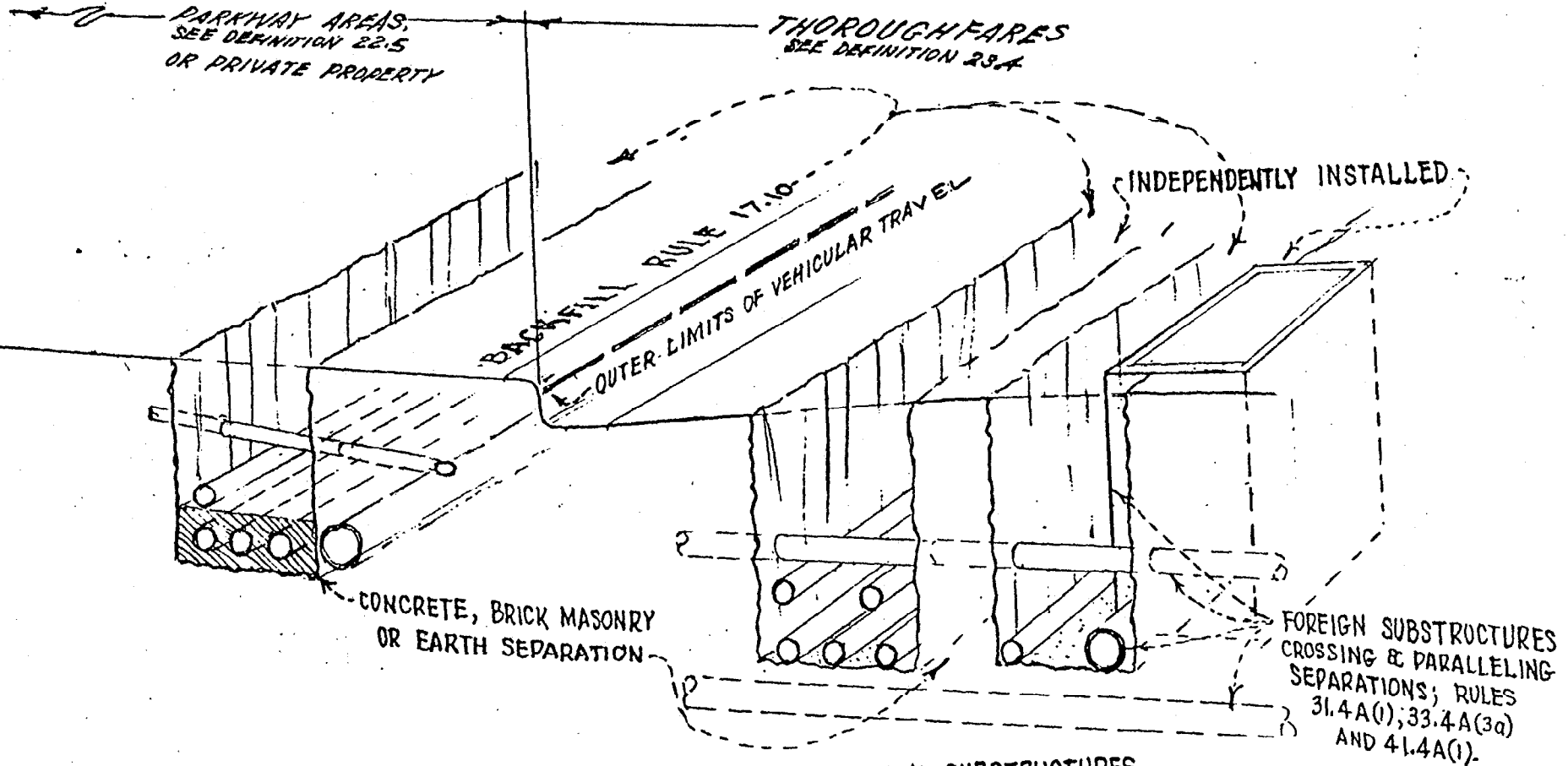
Typical Communication System
Cable Installed in Ducts





CONCURRENT INSTALLATIONS

FIG. 6

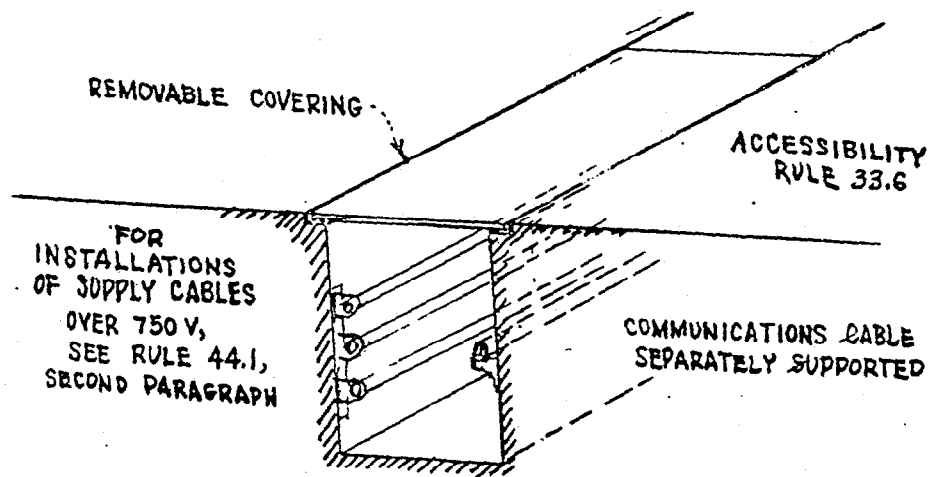


SEPARATIONS OF SUPPLY SYSTEMS FROM FOREIGN SUBSTRUCTURES AND COMMUNICATIONS SYSTEMS: RULES 31.4 A(1), 31.4 B(1), 33.4 A(1a, 2a & 3a), 41.4 A(1), 41.4 B(1) AND 43.3 A.

INDEPENDENT INSTALLATIONS

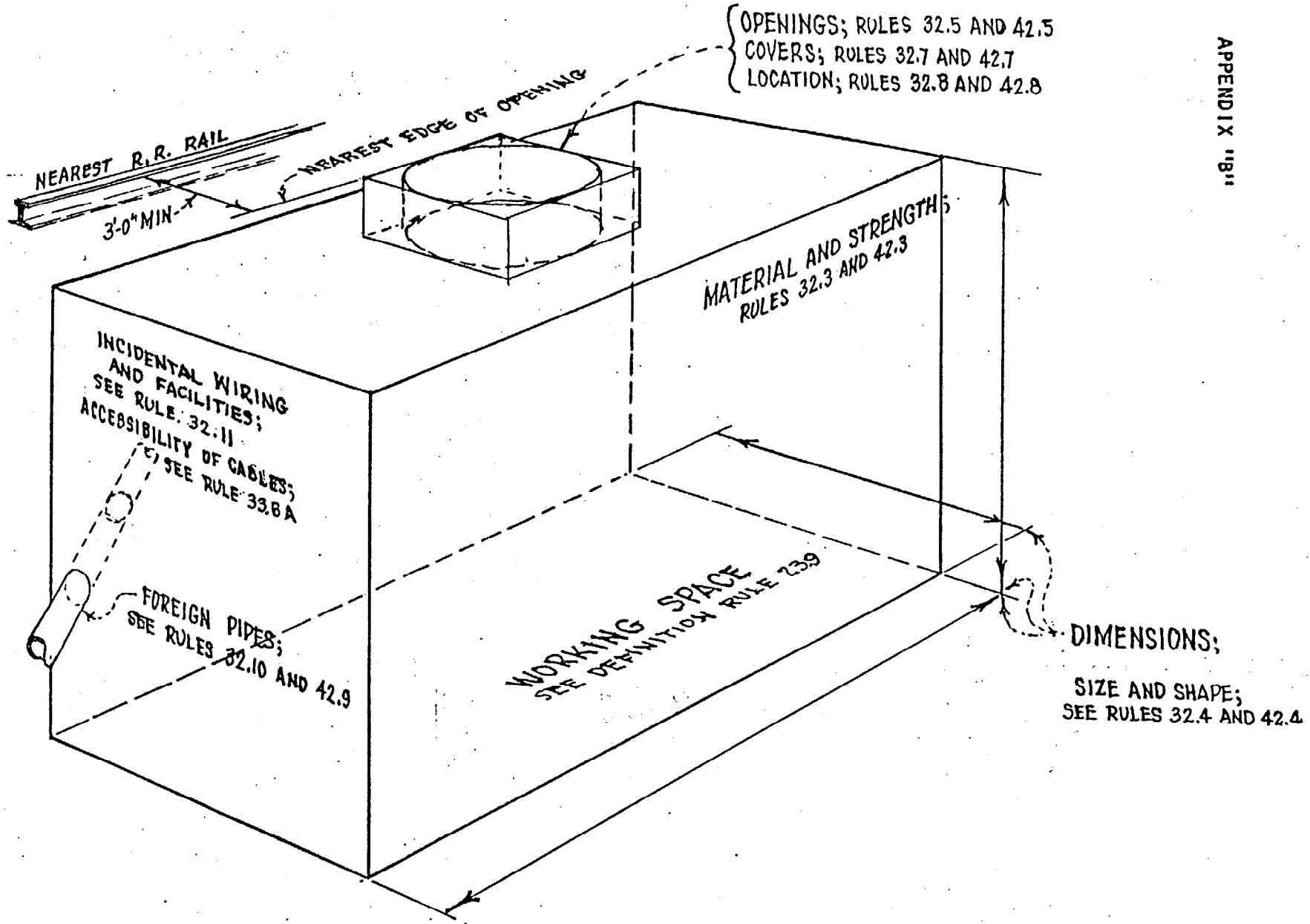
-54-

APPENDIX "B"



PERMANENT CABLE TRENCH
SEE DEFINITION 23.5

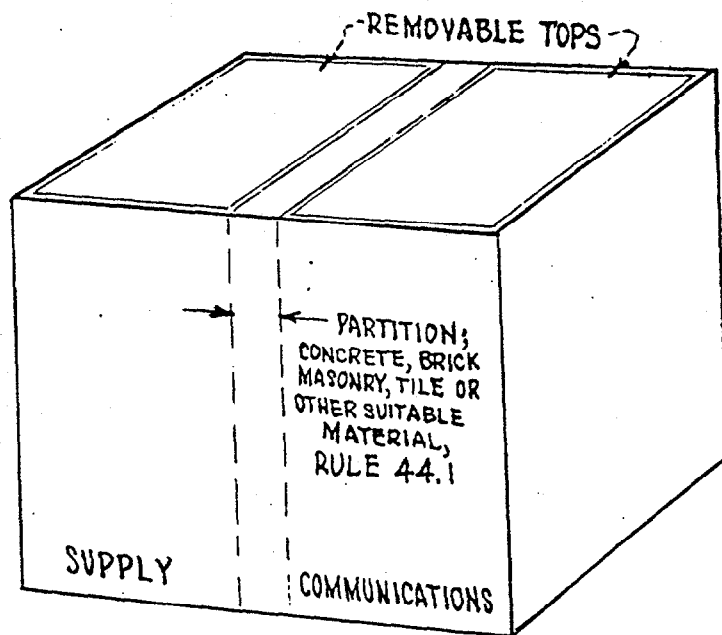
FIG. 8



-56-

MANHOLES
SEE DEFINITION, RULE 22.4 AND 32.

FIG. 9

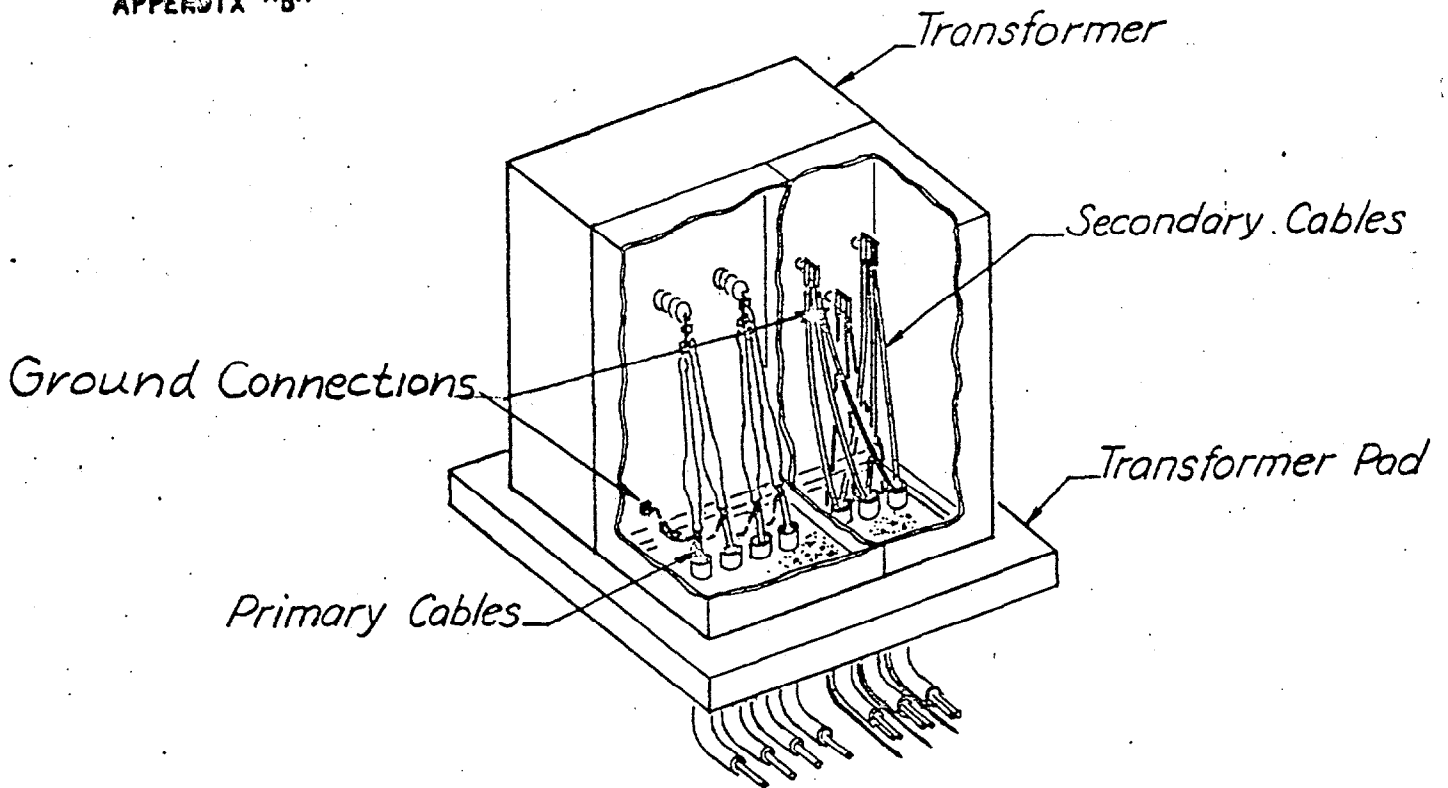


SEPARATION OF SUPPLY AND COMMUNICATION SYSTEMS

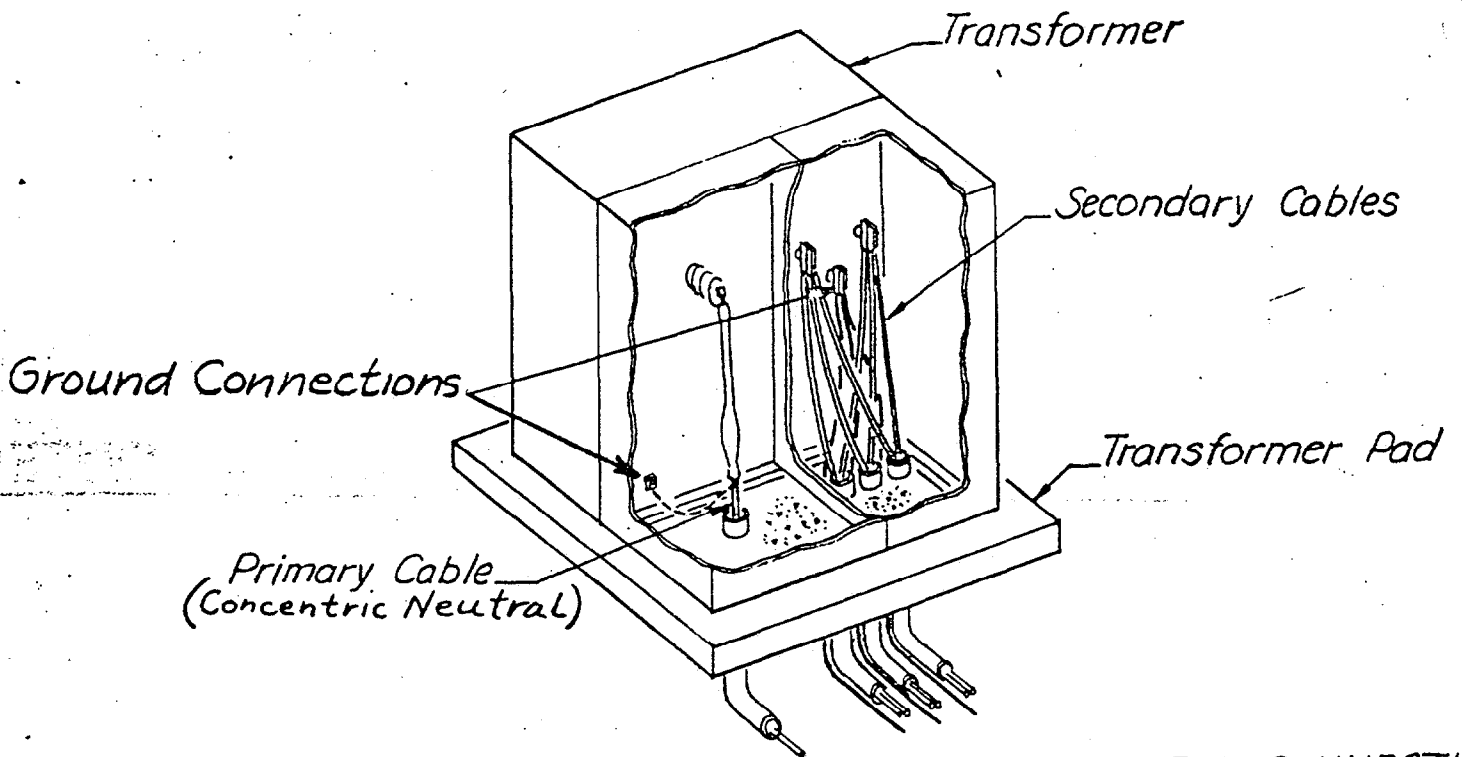
HANDHOLES

SEE DEFINITION, RULE 21.7

FIG. 10



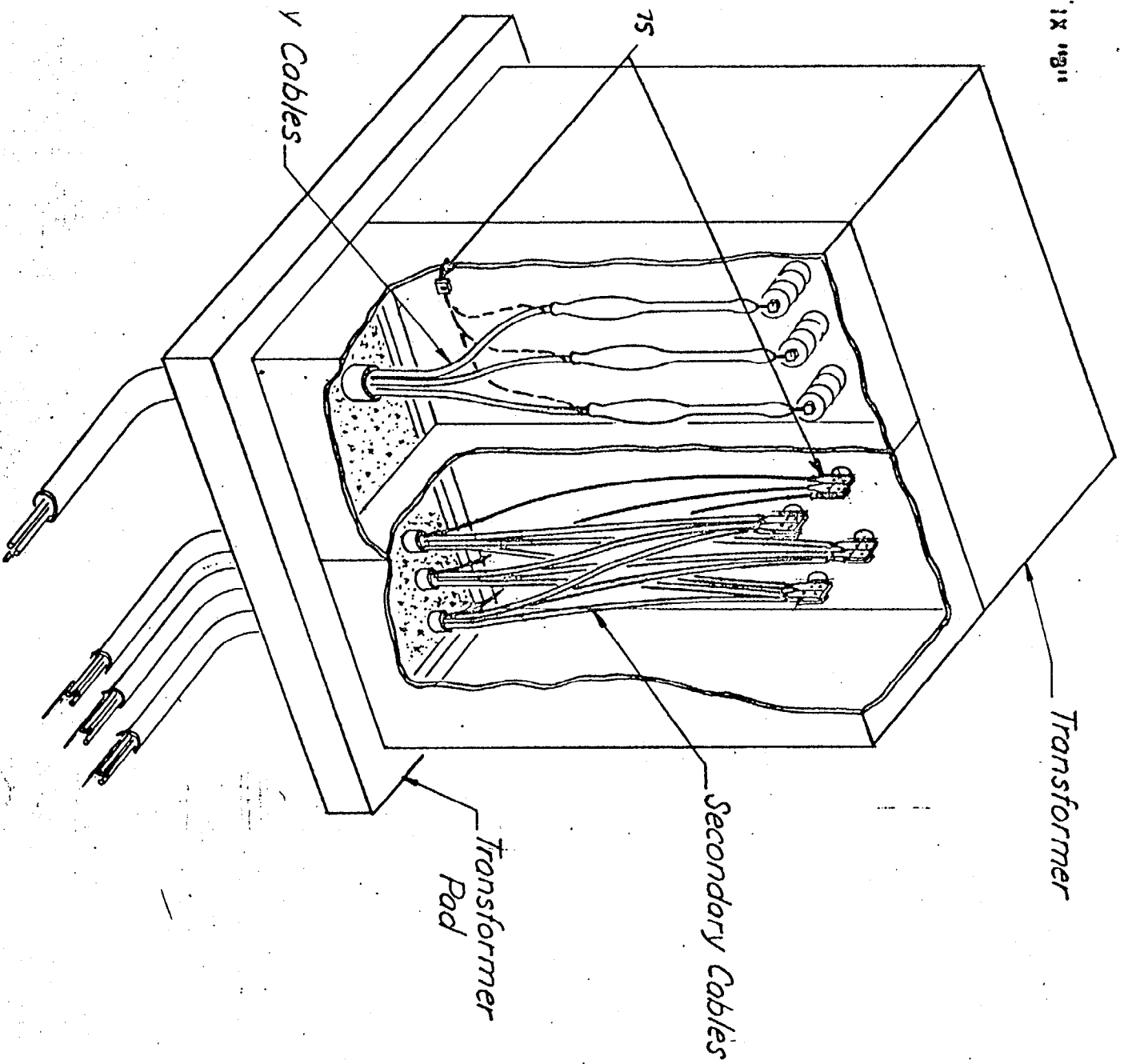
(A) TWO PRIMARY BUSHINGS FOR LINE-TO-LINE CONNECTION



(B) ONE PRIMARY BUSHING FOR LINE-TO-NEUTRAL CONNECTION

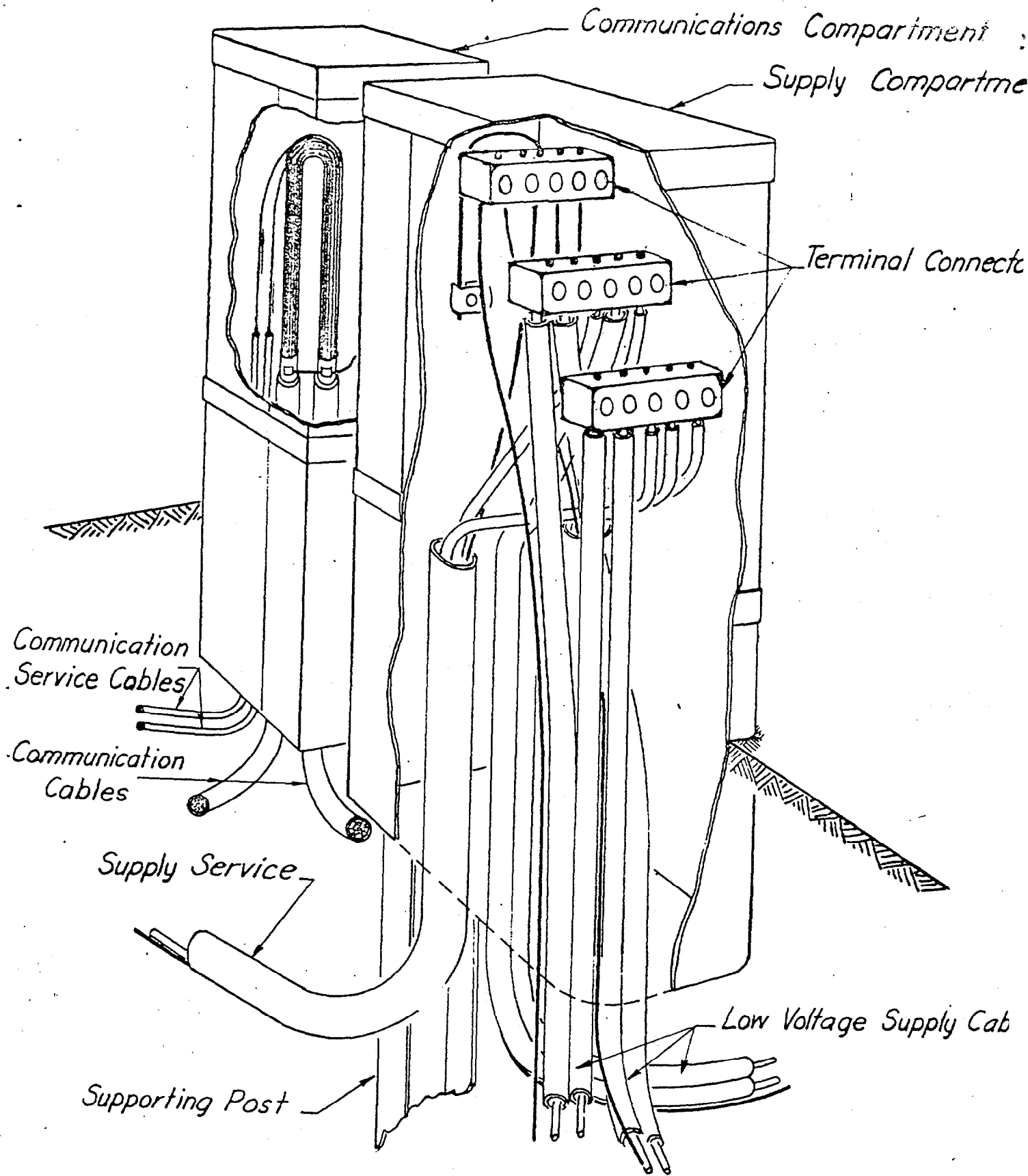
TYPICAL SINGLE-PHASE PAD-MOUNTED TRANSFORMER

FIG. 11



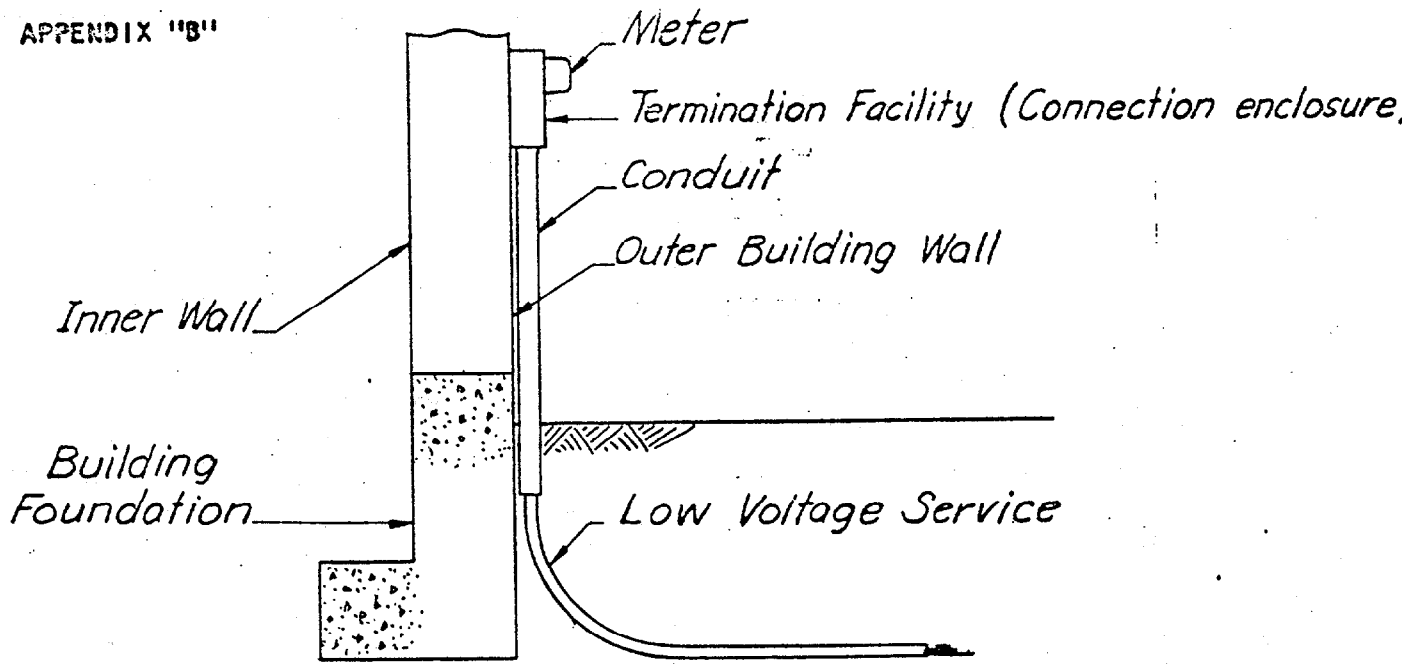
TYPICAL THREE-PHASE PAD-MOUNTED TRANSFORMER

FIG. 12

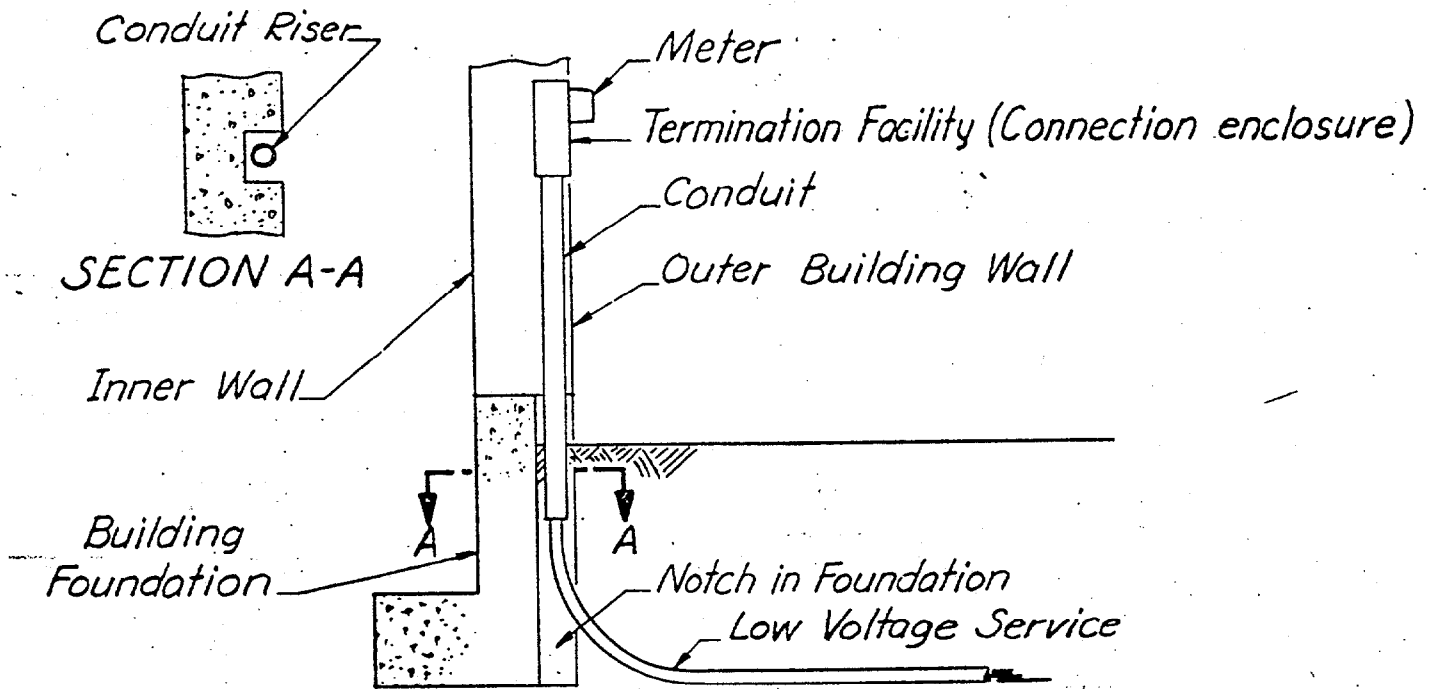


TYPICAL JOINT SUPPLY AND COMMUNICATION PEDESTAL

FIG. 13



(A)



(B)

(Alternate to (A) for Recessed Connection Enclosure)

TYPICAL LOW VOLTAGE SERVICE TERMINATION AT BUILDING

FIG. 14

GROUNDING OF TRANSFORMER WINDINGS

RULE 36.5-A1

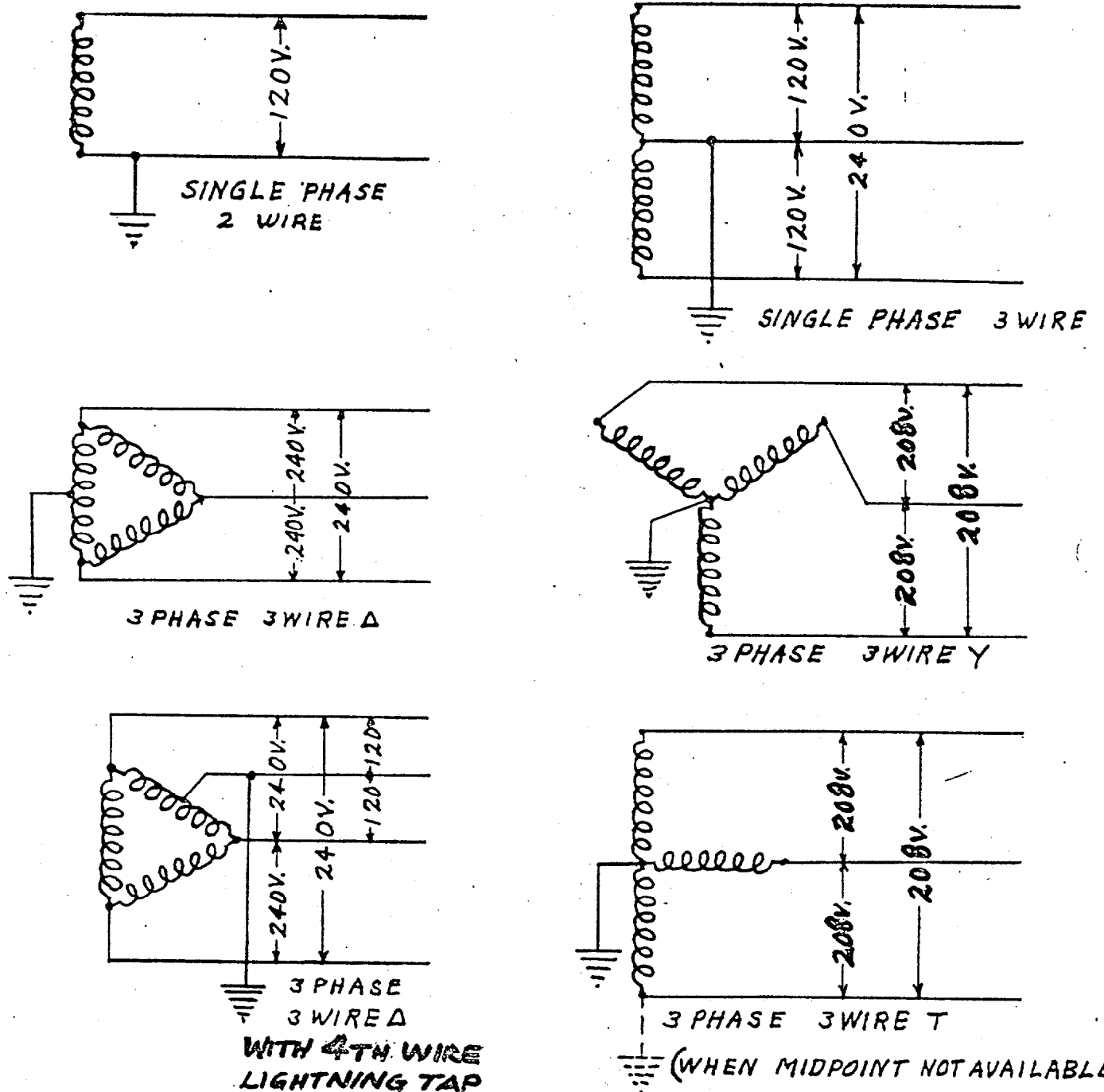


FIG. 15

APPENDIX "C"

Clearances From Railroad Tracks

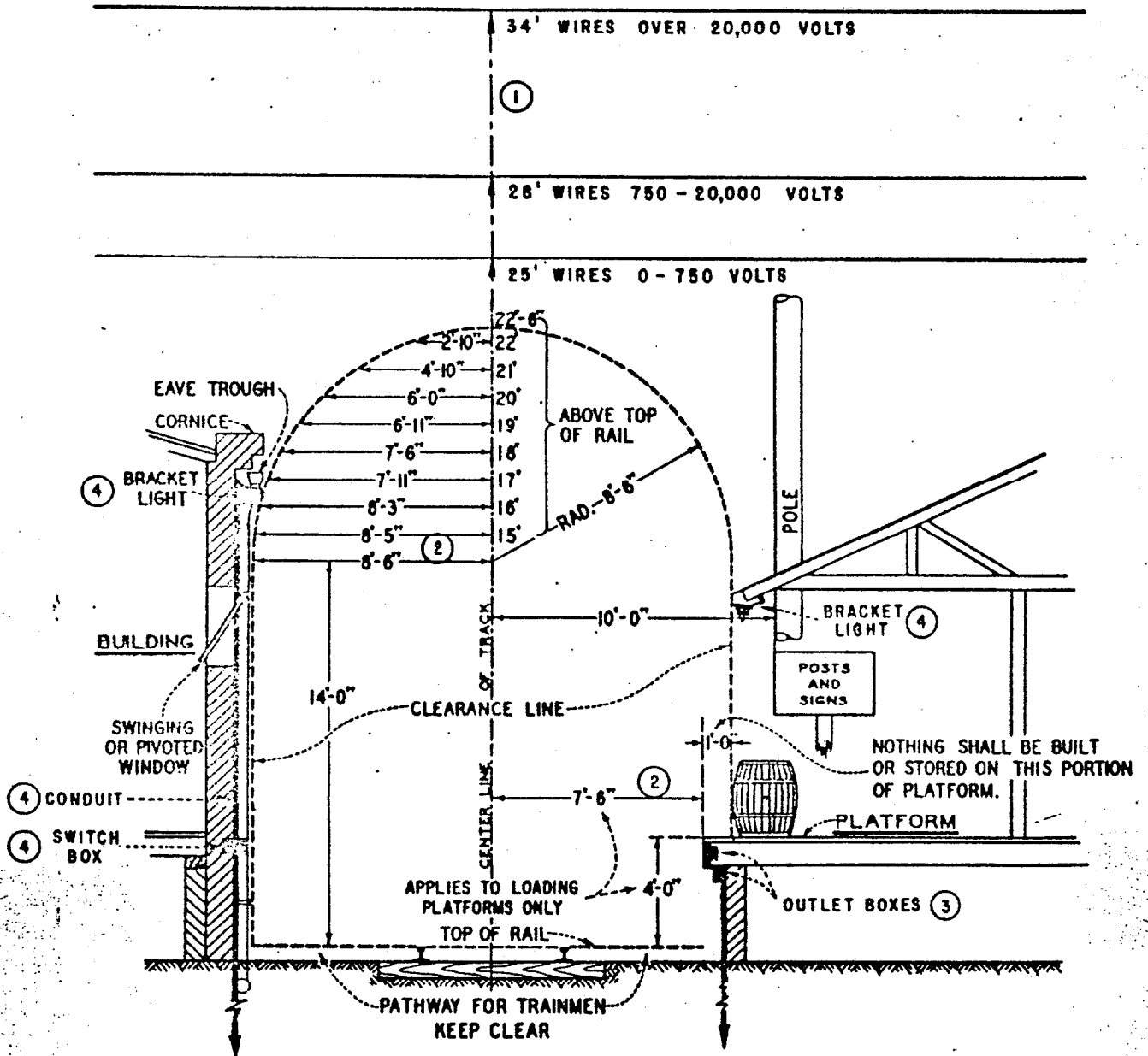
These diagrams illustrate the requirements of certain rules and are to be used as a guide only for the application of such rules. Under no conditions shall these diagrams be given precedence over the rules as written.

<u>Figure No.</u>	<u>Title</u>	<u>Page</u>
1	Typical Clearances For Above Ground Electrical Terminations Constructed Adjacent to Railroad Tracks	64
2	Typical Installations of Manhole Covers Adjacent to Railroad Tracks	65

APPENDIX "C"

TYPICAL CLEARANCES FOR ABOVE GROUND ELECTRICAL TERMINATIONS CONSTRUCTED ADJACENT TO RAILROAD TRACKS

RULES 31.5 B & D, 33.5 D, 41.5 C AND 43.4



NOTES

- ① OVERHEAD WIRE CLEARANCES SHALL CONFORM TO COMMISSION'S GENERAL ORDER NO. 6 OR AMENDMENTS THEREOF.
- ② ALL SIDE CLEARANCE DIMENSIONS ARE FOR TANGENT TRACK. IN GENERAL SIDE CLEARANCE FOR CURVE TRACK TO BE 1'-0" GREATER THAN THAT FOR TANGENT TRACK.
- ③ MAY BE RECESSED INTO AND FLUSH WITH FACE OF PLATFORM EXTENSION OR MAY BE PLACED ON PLATFORM WALL IF DOES NOT PROJECT BEYOND EXTENSION.
- ④ NO PART OF INSTALLATIONS MAY BE LESS THAN DEPICTED CLEARANCE AT EITHER PLATFORMS OR OTHER STRUCTURES.

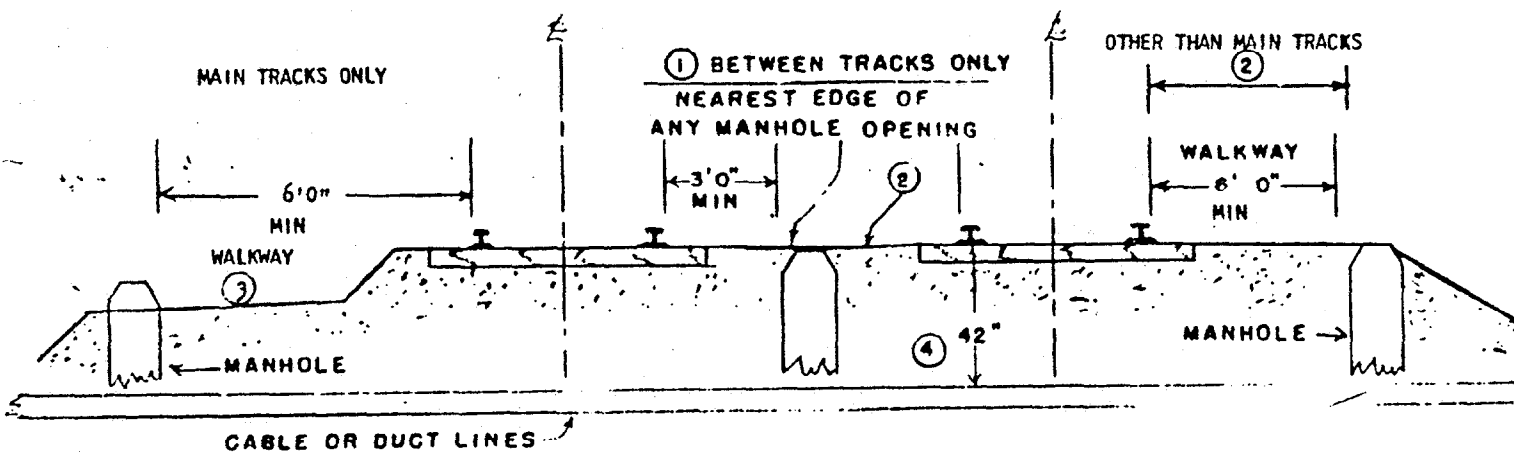
Fig. 1

APPENDIX "C"

TYPICAL INSTALLATIONS ADJACENT TO RAILROAD TRACKS

MANHOLES SEE RULES 31.5D, 32.8, 41.5C, AND 42.8

BELOW RAIL SEE RULES 31.4C(1), 33.4B, 41.4C(1)



NO SCALE

NOTES:

- (1) Nearest edge of manhole shall be not less than 3 ft. from nearest rail. When practicable, this distance should be increased to 6 ft.
- (2) & (3) If necessary to locate manhole covers less than 6 ft. from the rail, they shall be not lower than bottom of tie nor higher than top of rail and walkway surface shall be flush with top of cover and extended to top of ties or rail at a slope not in excess of 1 in. vertical to 8 in. horizontal in all directions of approach.
- (4) Rules 31.4C1, 33.4B and 41.4C1 permit modification for special circumstances by permission of Railroad. May be reduced to 30 in. for street railroads.

Fig. 2