

FRAME
BAY
SHELF
SWITCH
PANEL
UNIT
APPARATUS
PIECE PART
KS

CABLE RACK
GUARD RAIL
LADDER TRACK

CABLE
WIRE
STRAP
JUMPER
LOOSE
FORMED
TAGS
DROP
CONNECTION

021B TERMINOLOGY

FRAMEWORK
DESK
SWITCHBOARD
CONSOLE

DRAWINGS
AIDS
REFERENCES

PARALLEL CONNECTOR
BUS BAY
FUSE



021B

TERMINOLOGY

NOTICE

Not for use or disclosure outside the Bell System except under written agreement.

Issued By
Manager, Training (Bell Sales Division)
Western Electric Company, Incorporated

First Edition
First Printing, May 1973
Second Printing, December 1973
Third Printing, May 1974
Fourth Printing, December 1977



Developed by
The Bell Sales Division Training Organization
Western Electric Company, Incorporated
Dublin, Ohio

OBJECTIVES

At the completion of this course, you will be able to:

1. Given a list of description terms, identify whether the terms apply to apparatus or equipment as defined herein.
2. Given a list of items of material, determine whether the items are coded apparatus, piece parts, KS specifications, Outside Supplier, Equipment Specifications, Framework Assembly or Non-Standard Development.
3. Define the following terms:
 - A) bay
 - B) frame
4. Using the course manual as a reference aid and given items of wiring diagram information, determine whether the wiring requirements are normally provided by the manufacturing organization.
5. Using the course manual as a reference aid and given your assigned system, determine the type of framework normally provided in that system.
6. Using the course manual as a reference aid, determine the source of relevant information for the terminology contained in this course.

PURPOSE

The purpose of this course is to provide you with a ready reference to the various common terms you will encounter in studying the 021 series of courses.

TABLE OF CONTENTS

| <u>Subject</u> | <u>Page</u> |
|--|-------------|
| CENTRAL OFFICE EQUIPMENT TYPES | 1 |
| Switching Equipment | 2 |
| Transmission Equipment | 5 |
| Testing Equipment | 7 |
| Power Equipment | 9 |
| Framework and Cabling | 11 |
| COMMON INFORMATION | 13 |
| Apparatus Criteria | 16 |
| Equipment Criteria | 16 |
| APPARATUS | 17 |
| Piece Parts | 17 |
| Coded Apparatus | 18 |
| Apparatus Purchased from other Companies | 20 |
| Outside Suppliers Items | 20 |
| KS Specifications | 20 |

Table of Contents (Cont.)

| <u>Subject</u> | <u>Page</u> |
|---|-------------|
| EQUIPMENT | 26 |
| Equipment Specifications | 26 |
| Units | 28 |
| Switches | 31 |
| Shelves | 32 |
| Frame | 34 |
| Bay | 36 |
| Desks, Switchboards, Consoles Portable, and Printed Circuit Boards | 40 |
| Framework Assembly | 46 |
| Framework Types | 47 |
| Guard Rail | 57 |
| Non-Standard Development | 60 |
| CABLE AND WIRING | 63 |
| Wire | 63 |
| Connections | 66 |
| Providing the Wiring and Connections | 69 |
| Straps | 70 |
| Surface Wiring | 71 |
| Loose Wiring | 73 |

Table of Contents (Cont.)

| <u>Subject</u> | <u>Page</u> |
|----------------------------------|-------------|
| Standard Local Cable | 74 |
| Formed Cable - Switchboard Cable | 81 |
| Installer's Wiring | 83 |
| Switchboard Wire | 85 |
| Switchboard Cable | 86 |
| Cable Run | 88 |
| Cable Tags | 89 |
| Cable Rack | 90 |
| Drop | 92 |
| Surface Wiring | 95 |
| Loose Wiring | 95 |
| Sewed Forms | 96 |
| Distributing Frames | 106 |
| Terminal Strips | 109 |
| Jumpers | 109A |
| Power Cable | 112 |
| Bus Bar | 115 |
| Wiring Drawings | 116 |
| Non-Standard Development | 116A |
| Manufacturing Drawings | 117 |
| Wiring Symbols | 118 |

Table of Contents (Cont.)

| <u>Subject</u> | <u>Page</u> |
|--|-------------|
| ENGINEERING AIDS | 122 |
| Specification Form Aids | 123 |
| Specification Form Manual (SFM) | 123 |
| Specification Form Preplanned (SFP) | 123 |
| Specification Form Computer (SFC) | 124 |
| Engineering Forms General | 124 |
| Drafting Aid (DA) | 127 |
| Forms Catalog | 127 |
| Reference Aid (RA) | 127 |
| Reference Drawing (RD) | 128 |
| Questionnaires (E-Forms) | 128 |
| Order Blanks (E-Forms) | 129 |
| Common Language Translator (TR) | 129 |
| REFERENCES | 130 |
| Company Instructions (CI) | 130 |
| Systems Equipment and Standards Engineering Handbook (CI97.100) | 131 |
| Technical Design Manual (CI97.104) | 131 |

Table of Contents (Cont.)

| <u>Subject</u> | <u>Page</u> |
|---|-------------|
| Engineering Information Memorandum (EIM) | 131 |
| DCS's, CRI's and Switch Conversion Sheets | 132 |
| Bell System Practices (BSP) | 135 |
| Equipment Design Requirements (J Specifications) | 135 |
| Numbering Plan | 136 |
| Descriptive Information | 139 |
| Equipment Engineering Information | 139 |
| General Information | 139 |
| ORDERING APPARATUS | 145 |
| Apparatus Card Catalog | 145 |
| Rating | 145 |
| Notations | 148 |
| Terminology (Reflecting Status) | 149 |
| Mounting Plates | 154 |
| Dimensions | 154 |
| Drilling Information | 158 |
| Common Covers | 167 |
| Arranging and Ordering (Mounting Plates) | 169 |

Table of Contents (Cont.)

| <u>Subject</u> | <u>Page</u> |
|--------------------------------------|-------------|
| Procedure - Job Aid #1 | 170 |
| With Common Cover - Job Aid #2 | 175 |
| Without Common Cover - Job Aid #3 | 176 |

CENTRAL OFFICE EQUIPMENT TYPES

As you are now aware, your job will consist of one step in the process of providing central office telephone equipment to meet operating company requirements. You will be confronted with numerous new terms, words and concepts as you proceed through these courses and as you begin to do your job. This booklet is designed to assist you in making some sense of the terminology you will encounter.

When we in the telephone business speak of equipment, we usually categorize the equipment by the function that it serves in the central office. A typical way of categorizing this equipment is:

- Switching Equipment
- Transmission Equipment
- Testing Equipment
- Power Equipment
- Framework and Cabling

Switching Equipment

The broad term, switching equipment, refers to the various components of central office equipment which switch telephone calls, data and video from one customer to another or from one location to another.

Switching equipment provides the means for connecting a telephone or data terminal in one central office location to another telephone or data terminal served by the same central office (Intra-office switching). It also provides a method for connecting a telephone or data terminal from one central office location to the terminal of another central office (Inter-office switching).

Switching equipment is provided as a "system" of components that function together. These systems of components are thus called switching systems. The switching systems are named by the way in which they perform the switching function and by identifying numbers which reflect differences in design or function. The basic switching systems are:

- Manual

- Panel

- Step by Step

- Crossbar

- Electronic

Step-by-Step systems can be either:

#355A Step-by-Step

No. 1 Step-by-Step

Crossbar may be any of:

Crossbar No. 1

Crossbar No. 4A

Crossbar No. 4M

Crossbar No. 5

Crossbar Tandem

Electronic systems include:

Electronic Switching System No. 1 (ESS No. 1)

ESS No. 2

ESS No. 3

ESS No. 4

You will find out more about these switching systems in Course 021 BA. For now, you will want to refer to the picture of typical switching equipment in central offices shown in Figure 1.



ELECTRONIC



Switching Equipment



STEP-BY-STEP

PANEL



FIGURE 1

Transmission Equipment

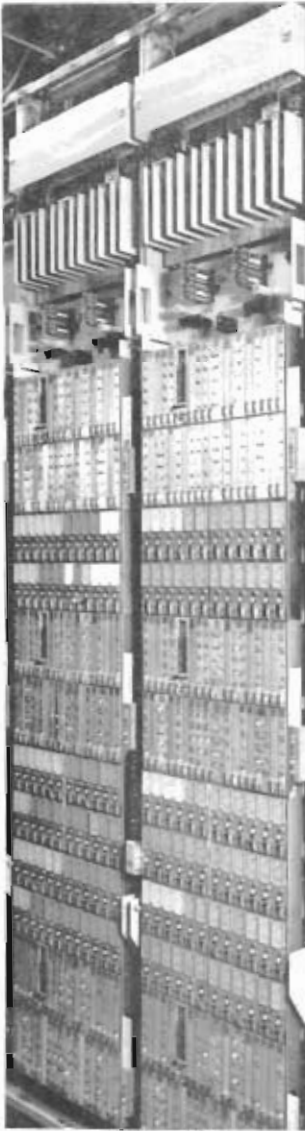
Equipment must be provided in central offices which will transmit signals, voice and data from one central office to another and, similarly, to receive these signals, voice and data. This equipment is broadly categorized as transmission equipment.

Transmission equipment is further classified as:

- Toll Terminal equipment
- Carrier
- Microwave
- Broadband

You will receive further information on carrier equipment in Course 021 BA. Typical transmission equipment is shown in Figure 2.

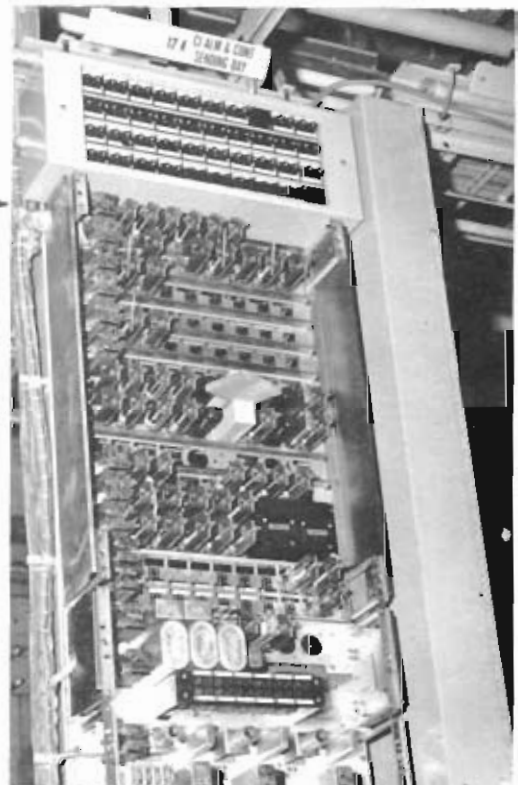
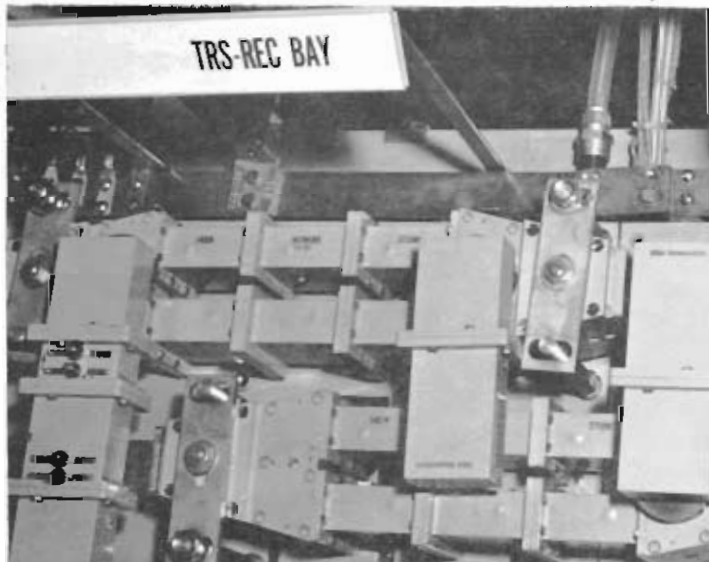
Transmission Equipment



CARRIER



MICROWAVE



Testing Equipment

You can appreciate that the equipment in central offices must be routinely checked to see that it operates within specified limits. The provision of central office equipment includes equipment to test and monitor and is catagorized as test equipment.

Test equipment is typically provided as portable test or permanently mounted, as shown in Figure 3.



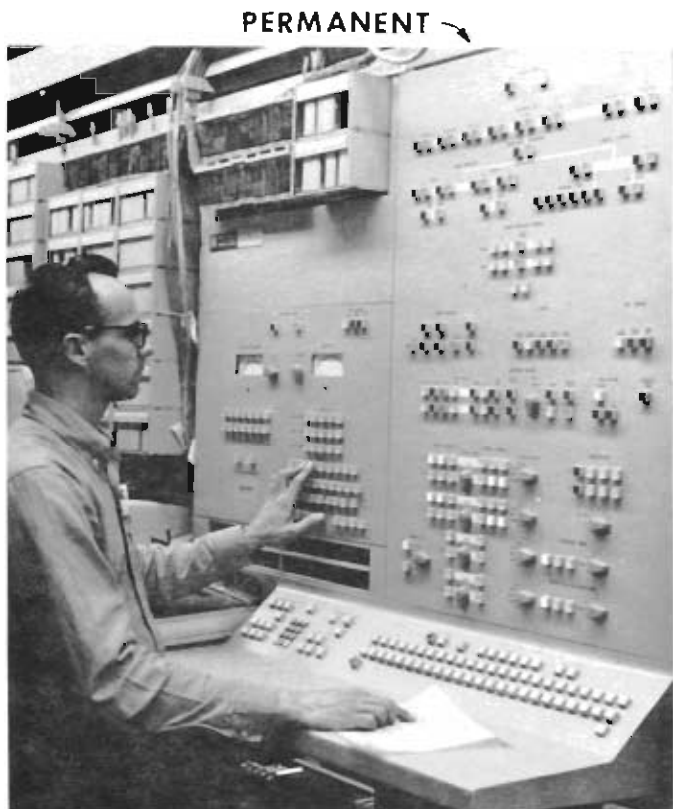
PORTABLE ↗



PERMANENT ↓



Testing Equipment



PERMANENT ↘



PORTABLE ↙



FIGURE 3

Power Equipment

Since most of the switching, transmission and test equipment within central offices is electrical or electronic in nature, a source of various potentials of power must be provided and connected.

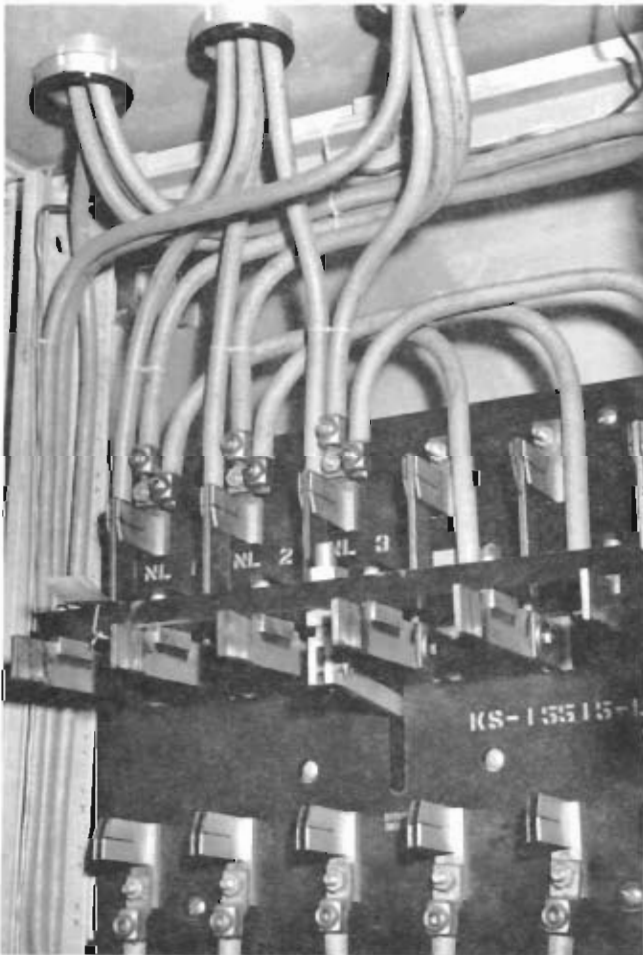
Power equipment is normally provided on a "regular" and on an "emergency" basis. Some of the types of power equipment are illustrated in Figure 4. The types usually represent power sources, distribution or control equipment.



CONTROL ↗

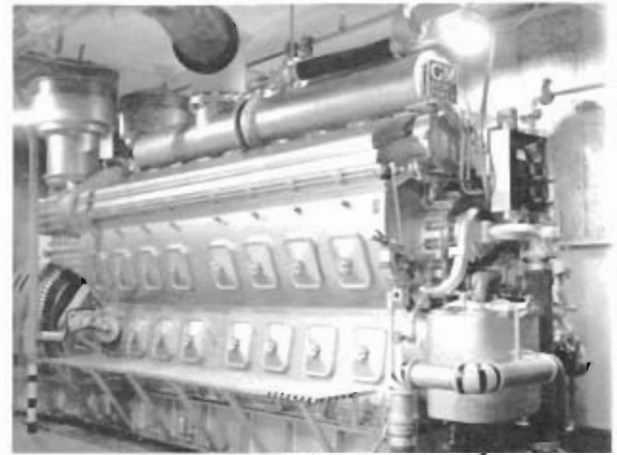


SOURCE ↗



Power Equipment

↙ DISTRIBUTION



EMERGENCY SOURCE ↘



SOURCE ↗

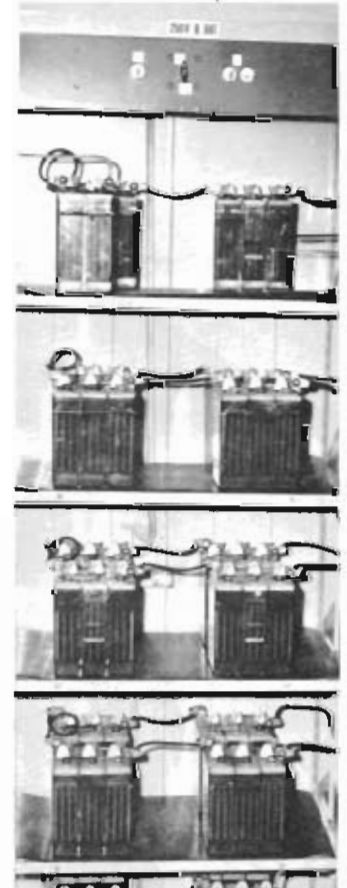
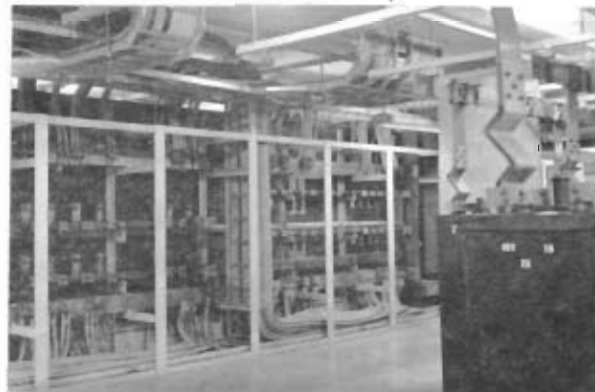


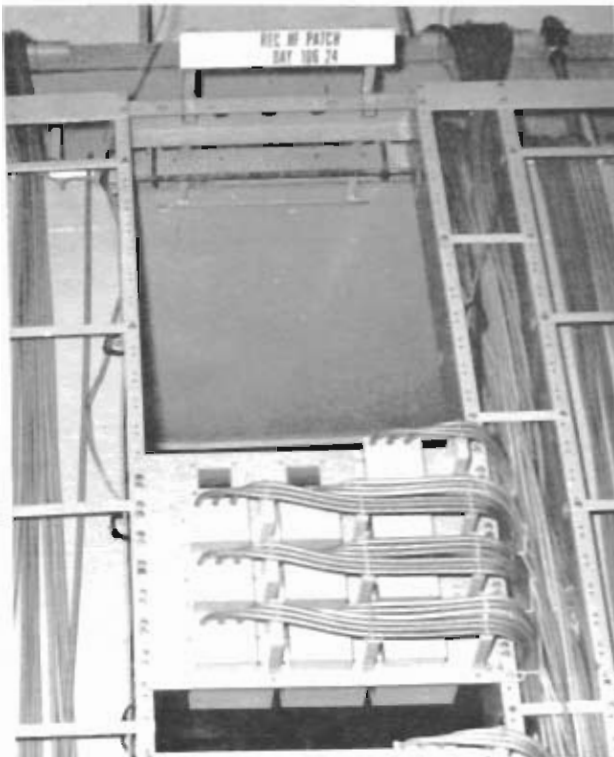
FIGURE 4

Framework and Cabling

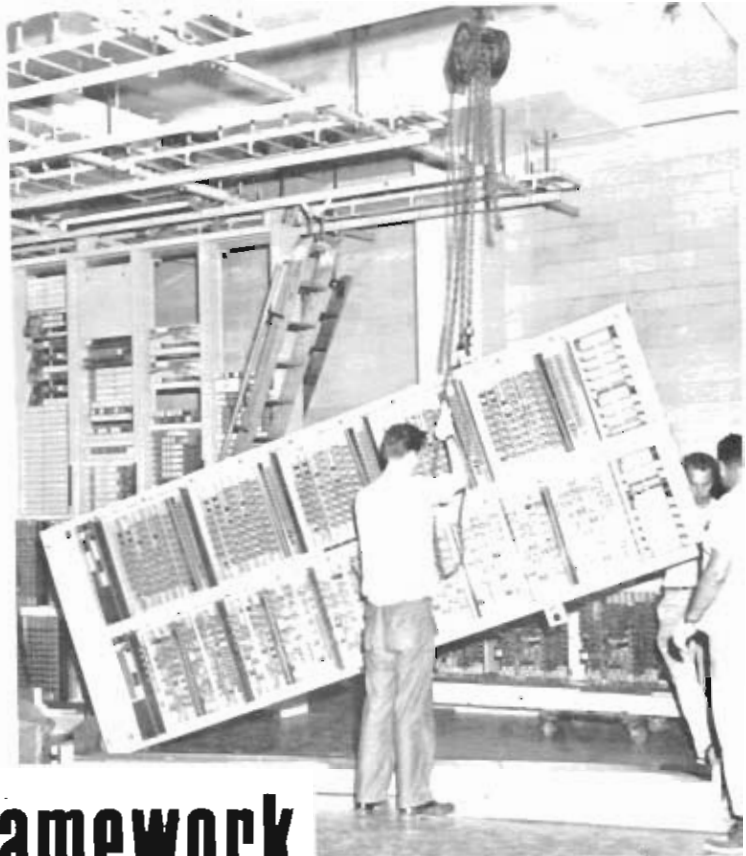
Equipment of all types must be arranged and supported in a central office building in a logical and practical manner. The hardware that is used to mount and support telephone equipment components is usually referred to as framework.

Since the components of switching and transmission equipment must function together as a system, electrical connections must be made between components. This is usually accomplished by wires or cables and is generally categorized as cabling.

Examples of hardware and cabling are shown in Figure 5.



FRAMEWORK & CABLING



FRAMEWORK

Framework and Cabling



FRAMEWORK



CABLING



FRAMEWORK & CABLING

FIGURE 5

COMMON INFORMATION

Regardless of how complex telephone equipment is in its final form, it must be designed and built from essential, basic components. Some of these componenets are strictly hardware whereas some are electro mechanical or electronic in nature. Just as your automobile consists of hundreds of thousands of components, telephone equipment is a combination of various components assembled to perform a function in the central office.

First, examine the picture shown in Figure 6 which gives you a sample of the kinds of simple components that can be used in central office equipment.

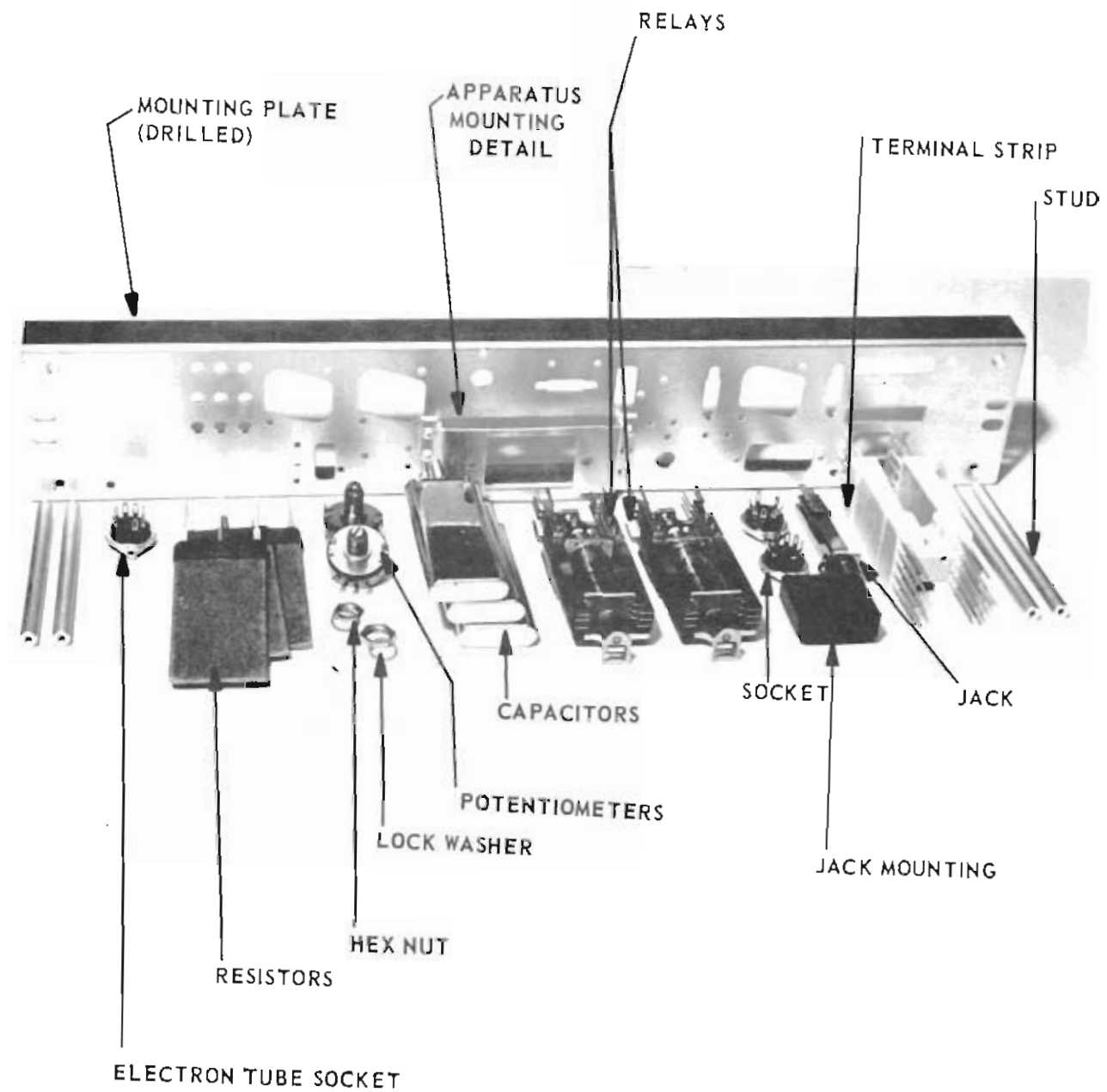


FIGURE 6 COMPONENTS

As you can see, there can be many components. Part of your job will involve selecting appropriate components, assembled in a way that the final form of the component assembly serves a useful function in the central office, and ordering that these components and assemblies be manufactured and supplied to a central office.

It will help if you can grasp a few important concepts about the materials that you will order.

Materials are broadly classified as being apparatus or equipment. To be classified as apparatus, the material must meet certain criteria. Similarly, to be classified as equipment, the material must meet other, usually converse, criteria.

Apparatus Criteria

1. It is a standardized unit with generally repetitive use in one or more systems.
2. It is mechanically and electrically interchangeable with previously manufactured products of the same code.
3. It is small, performs a single function and may not have wiring.
4. It is not likely to have changes that would require field modification.
5. It cannot or should not be modified or repaired while installed in its service location.
- *6. No drawings, circuit or descriptive, will be furnished to the customer.
- *7. No central office records are required by the customer nor can records be maintained.

- Note: 1. Bell Telephone Laboratories will code printed circuit board assemblies as apparatus or equipment in accordance with their initial application and use.
2. Equipment consist of assemblies of apparatus and/or other equipments wired in circuitry and packaged to perform a specific function.

*Significant Criteria

Equipment Criteria

1. It is a specifically designed assembly, packaged to perform a specific function in a system.
2. Equipment products are usually applied to customer facilities by direct wiring between associated products - not easily inter-changeable.
3. They will usually consist of functional circuits such as switching, identification, transmission or test circuits which form a part of a complete system.
4. In most cases there are options which will alter the function which are likely to be used by field modification.
5. Changes to improve existing characteristics, correct undersirable conditions or provide new operating features can be expected to be made on the products on the customer's premises.
- *6. Drawings, such as schematics, circuit descriptions, wiring and assembly drawings will be furnished for the customer to provide information to service and maintain the product.
- *7. Central office records will be maintained. In order to facilitate making changes and to provide a record of circuits contained in a central office, detailed records will be maintained by Regional Engineering (you) indicating quantity, features and location of each type of circuit.

*Significant Criteria

APPARATUS

Apparatus is identified in one of four ways depending upon its source and use. Western Electric is one source while many items of apparatus are purchased from other companies through the Western Electric Purchasing Organization.

Western Electric manufactured apparatus is classified as either coded apparatus or piece part.

Piece Parts

Piece parts are individual parts of equipment assemblies when the part is used in sufficient quantity to justify stocking and the preparation of special tools. A piece part may be either a single part or several parts assembled and carried in stock as one part.

Piece parts are usually restricted to the broad category called fasteners which includes ironwork, brackets, strips, supports, screws, nuts, washers, pins, etc. They are identified by a "P" prefix and an assigned numeric code. (Example: P137286 Hex Nut)

The "P" number not only is the identifying number for the piece part, it is also the number of the manufacturing drawing which shows how the part is made. "P" drawings are of two types:

Detail drawings - one for each individual part of an assembly or subassembly.

Partial assembly drawings - show how two or more parts are permanently joined together by shop operations of riveting, soldering, staking, welding, cementing, brazing, etc.

Note that "P" drawings are manufacturing drawings, normally not used by line engineering and not forwarded to the customer.

Coded Apparatus

All Western Electric manufactured apparatus, which is available for use in assemblies or as replacements, which is used in sufficient quantity to warrant stocking, is coded with an alpha-numeric code. (Example: AJ15 Relay, 18BG Registor, 189B Mounting Plate, 49C Capacitor)

Because of the numerous items of coded apparatus, it would be impossible to explain them here. A complete topical and description card listing of coded apparatus is provided in the Apparatus Card Catalog.

The Apparatus Card Catalog is an alpha-numerically arranged series of 5"x8" cards that provides apparatus ordering and manufacturing information. The cards are filed alphabetically by type of apparatus and either alphabetically or numerically within each type of apparatus. Consult the Table of Contents of this text under the "Ordering Apparatus" section for the pages giving further details and examples (Figures A, B, & C) of the Apparatus Card Catalog. Engineering considerations for the selection and use of coded apparatus are provided in the Systems Equipment and Standards Engineering (SE & SE) Handbook, CI 97.100, Section 3. This section includes extracts from the Apparatus Card Catalog and BSP's giving specific details on the apparatus that is more commonly used, such as Apparatus Blanks, Mounting Plates, Fuses, and Jacks.

Apparatus Purchased From Other Companies

When new apparatus items are required, a complex "make or buy" decision is made considering such factors as availability of a reliable source, cost comparisons and the time element. Should it be decided that it is more practical to purchase than to make, apparatus is obtained from other companies in one of two forms.

Outside Supplier's Items

When it is practical to utilize regular commercial products by other manufacturers, this is done. The information concerning description, code and dimensions is taken from the manufacturers catalog and is referenced in Western Electric drawings and specification by the manufacturers name and catalog number. (Examples: "20 AMP FUSE - TYPE AGS, Bussman Mfg. Co.", "#34402 Belden Hypalon 2 Ga.")

KS Specifications

When apparatus which is designed by Bell Telephone Laboratories is to be manufactured by an outside supplier, the manufacturing requirements are prepared in a KS specification. KS specifications are also prepared for commercially available products which must:

- 1) be modified
- 2) meet specific requirements
- 3) not be changed without Bell System approval.

(Example: KS 14174 L-1 Designation Pin) Although KS apparatus specifications are intended to furnish requirements to outside suppliers, these items may be manufactured by Western Electric. In this case, the KS specification does not lose its identity. If major changes are to be made and Western is to manufacture the item on a recurring basis, the KS specification may then be changed to coded apparatus.

To further illustrate the types of apparatus and their identity, refer to Figure 7.

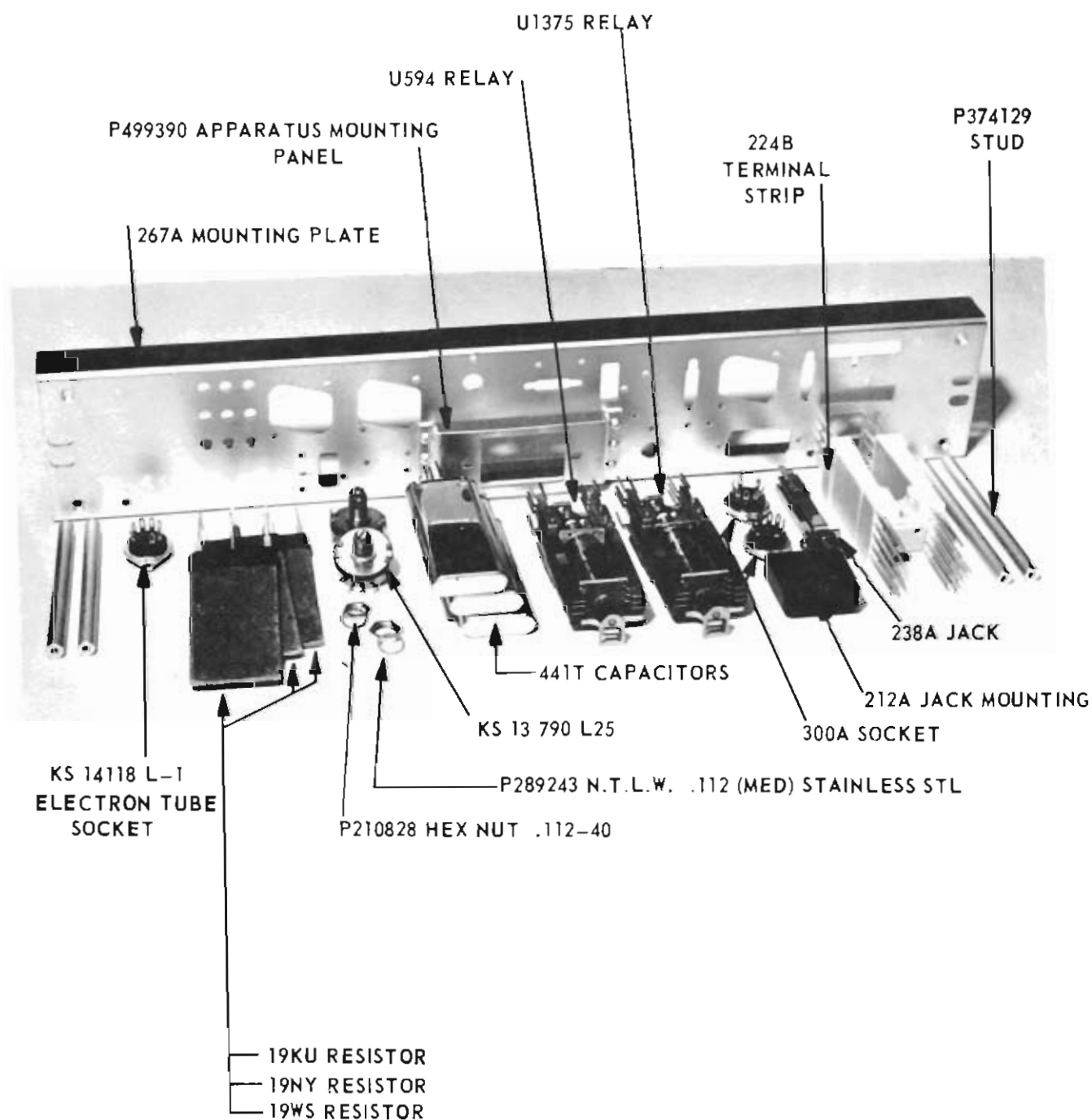


FIGURE 7 APPARATUS (IDENTIFIED)

Apparatus can be as simple as those items illustrated in Figure 7 or it may be as complex as a crossbar switch as shown in Figure 8.

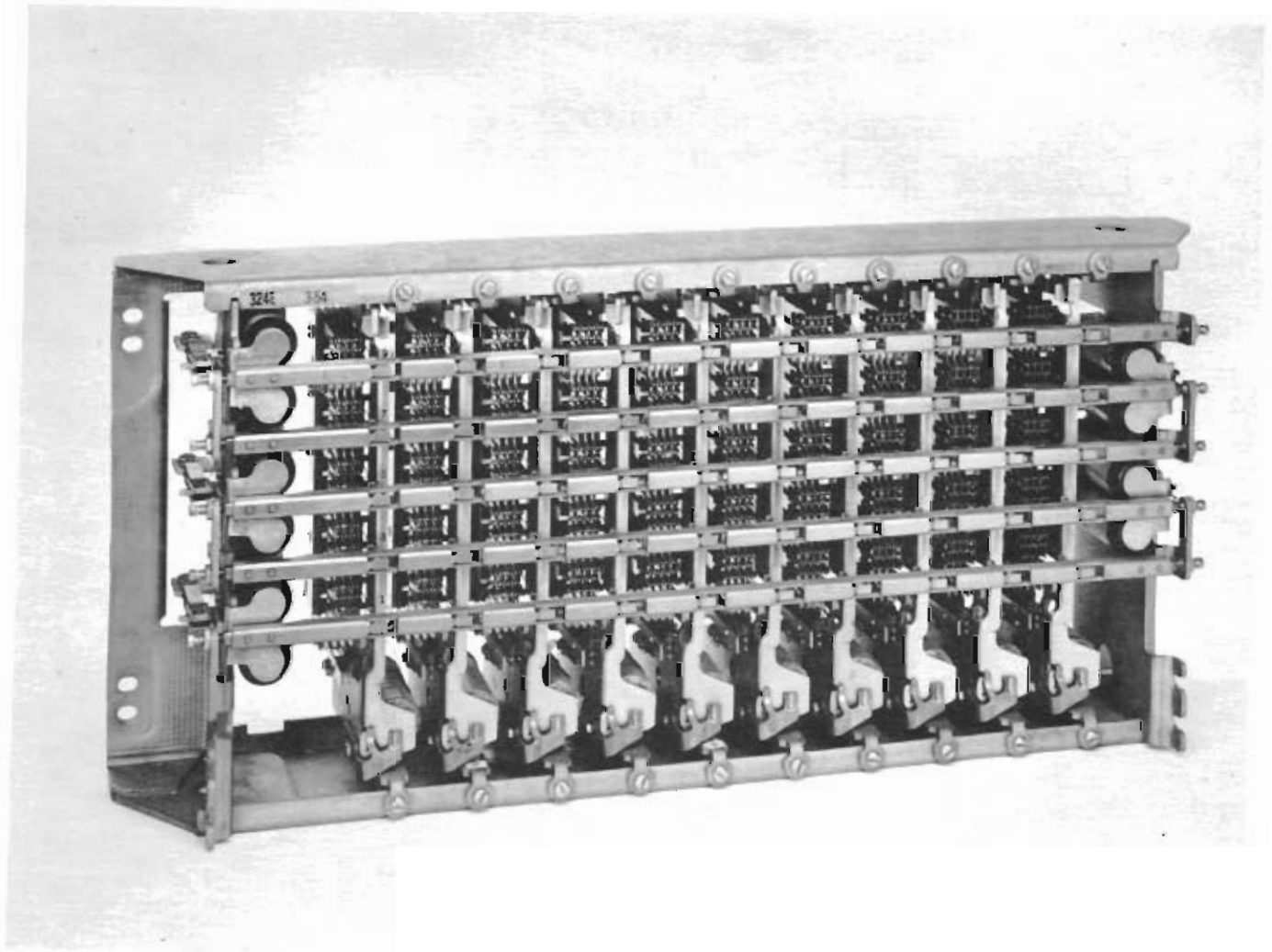


FIGURE 8 CROSSBAR SWITCH

Work Assignment No. 1

1. What are the four classifications of apparatus?

Piece Parts
coded Apparatus
KS Specifier
Outside Supplier Item

2. A complete topical listing of coded apparatus can be found in the Apparatus Card Catalog

3. What are the two "significant" criteria about apparatus?

No drawing, circuit or description
will be furnished to the customer
No C.O. records are required by customer
nor can records be maintained

Answers to Work Assignment No. 1

1. Piece Parts

Coded Apparatus

Outside Suppliers Items

KS Specification

2. Apparatus Card Catalog

3. No drawings will be furnished to customer.

No central office records are required.

If you had difficulty with any of these questions, consult with your administrator.

EQUIPMENT

A significant characteristic about equipment is that drawings are provided for engineering, manufacturing, installation and maintenance. Equipment is usually categorized as one of three types and the drawings correspond to these types.

Equipment Specification

Framework Assembly

Non-Standard Development

Equipment Specifications

Western Electric Company equipment specifications provide manufacturing requirements for the assembly and wiring of apparatus and framework parts into units of equipment which perform specific functions. These specifications are in drawing form and contain a list of material required and assembly and wiring requirements.

Figure 9 shows a front view of the same components you saw earlier in Figure 7. In this case, the components have been assembled together to perform the function of a Sequence Signaling Translator (SEQ SIG TRNSL).

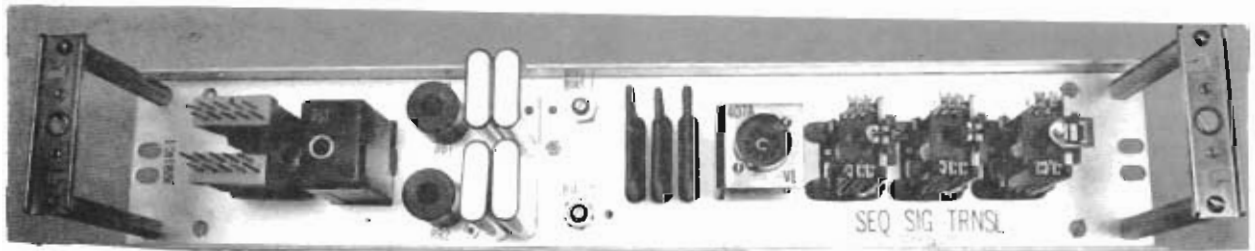


FIGURE 9 EQUIPMENT

The drawing which shows how these components are assembled and wired for this function is the equipment specification.

Equipment specifications are prepared for units, switches, shelves, frames and other equipment arrangements.

Unit

In general, a unit is the assembled material provided by an equipment specification arranged to mount on the vertical uprights of a Relay Rack bay or a frame.

Units are composed of mounting plates or panels, held together by mounting bars or framework when necessary, and the apparatus assembled and wired on them. A unit may be a single mounting plate like Figure 9, three or more mounting plates held together by mounting bars as in Figure 10 or a panel as shown in Figure 11.

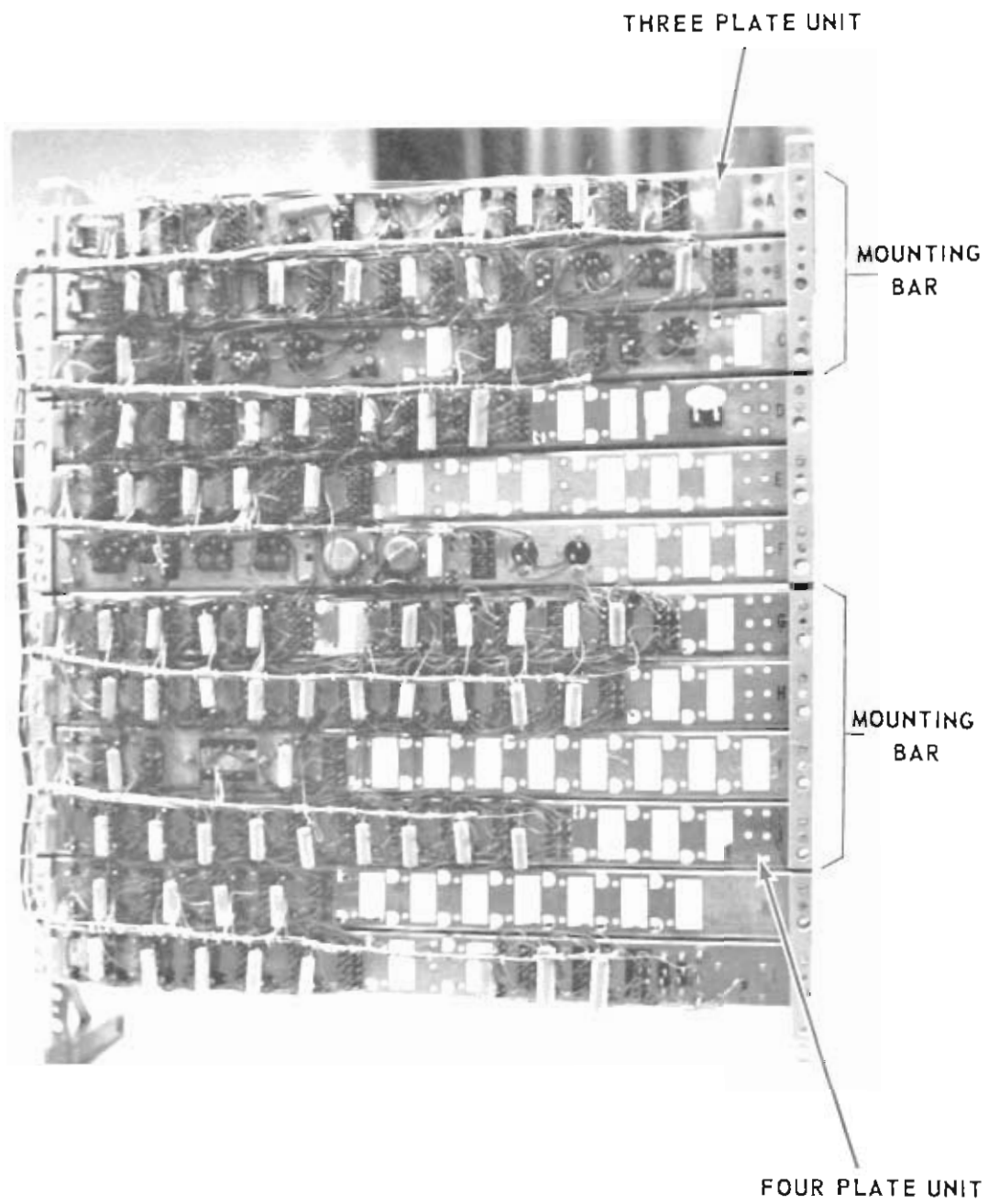


FIGURE 10 MULTI - PLATE UNITS

When apparatus must be mounted in a unit for which no standard mounting plate is available, a panel is used which is made to fit the situation.

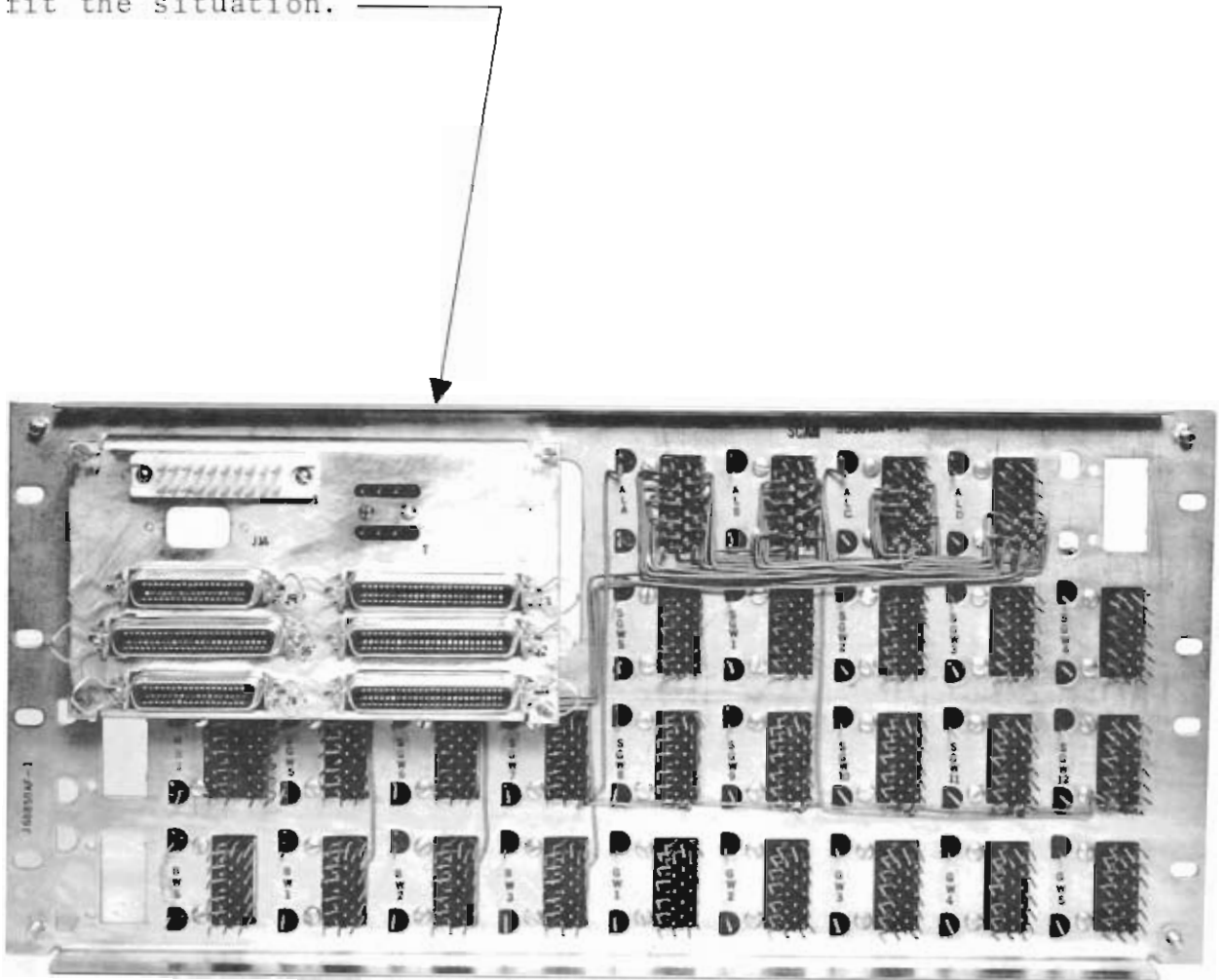


FIGURE 11 UNIT CONSISTING OF A PANEL

Switches

While some types of switches can have universal application and are classified as "apparatus" (See Figure 8), other types of switches are designed for specific functions and are illustrated on an equipment specification drawing. Figure 12 shows such a switch as used in Step-by-Step offices.

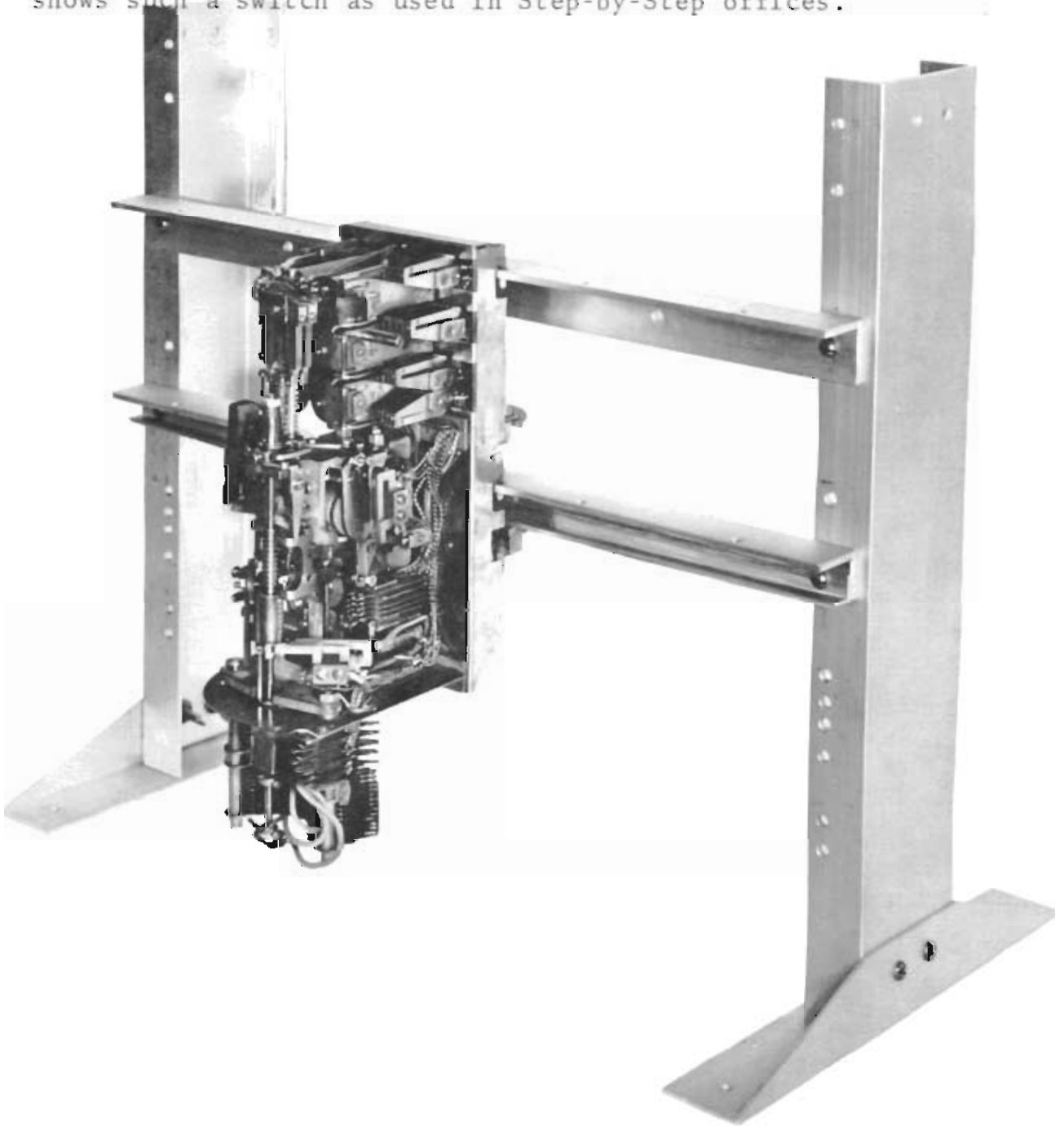


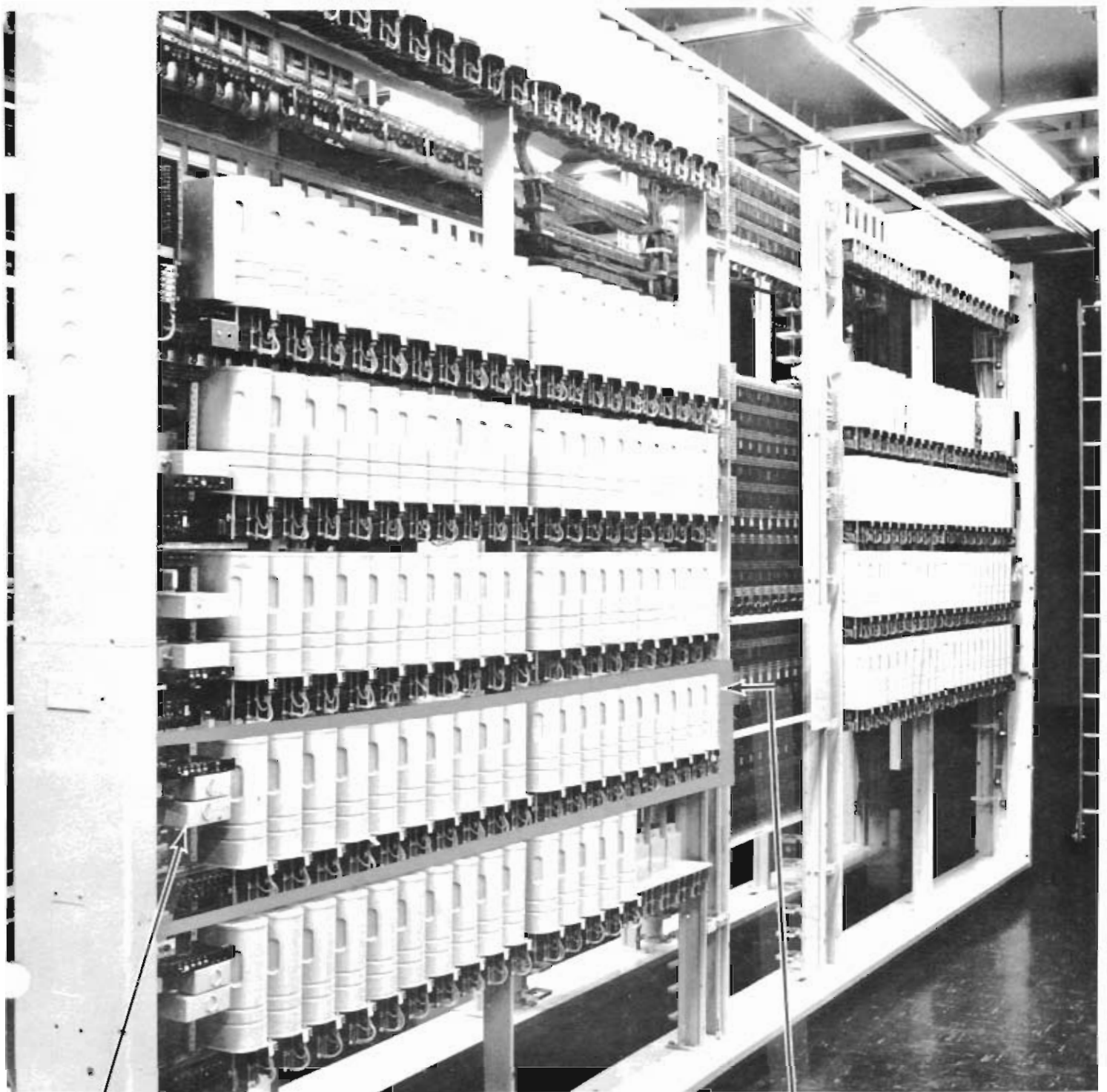
FIGURE 12 STEP-BY-STEP SWITCH

Shelves

Units have the characteristic of mounting on the vertical uprights of a bay or frame. Most Step-by-Step switches and some other types of equipment do not readily mount on these vertical uprights and must be supported by shelves.

A shelf usually performs two functions - support of the switches and provision of the apparatus and wiring that is common to several or all of the switches.

Figure 13 shows a Selector frame in a Step-by-Step office. Selector switches (with covers on them) are mounted on the shelves that extend from one vertical upright to another.



SHELF WITH
TWENTY SWITCHES

APPARATUS COMMON TO ALL THE SWITCHES ON THE SHELF

FIGURE 13 STEP-BY-STEP SELECTOR
FRAME WITH SHELVES & SWITCHES

Frame

When the assembled and wired components of an equipment specification are large enough to warrant providing the vertical supporting framework as part of the equipment specification, the product is called a frame. Each frame is the supporting structure for system parts which perform a function in that system. The frame is given a name which is consistent with either its total function or the main component name.

Examples:

An equipment specification provides for framework and apparatus wired to serve as an Identifier. The frame is called an Identifier Frame.

An equipment specification provides for framework and apparatus wired to serve as a Traffic Usage Recorder. The frame is called a Traffic Usage Recorder Frame.

The equipment specification for a frame will show a front and side view of the frame and its component parts which may be switches, units and other apparatus. An example is Figure 14.

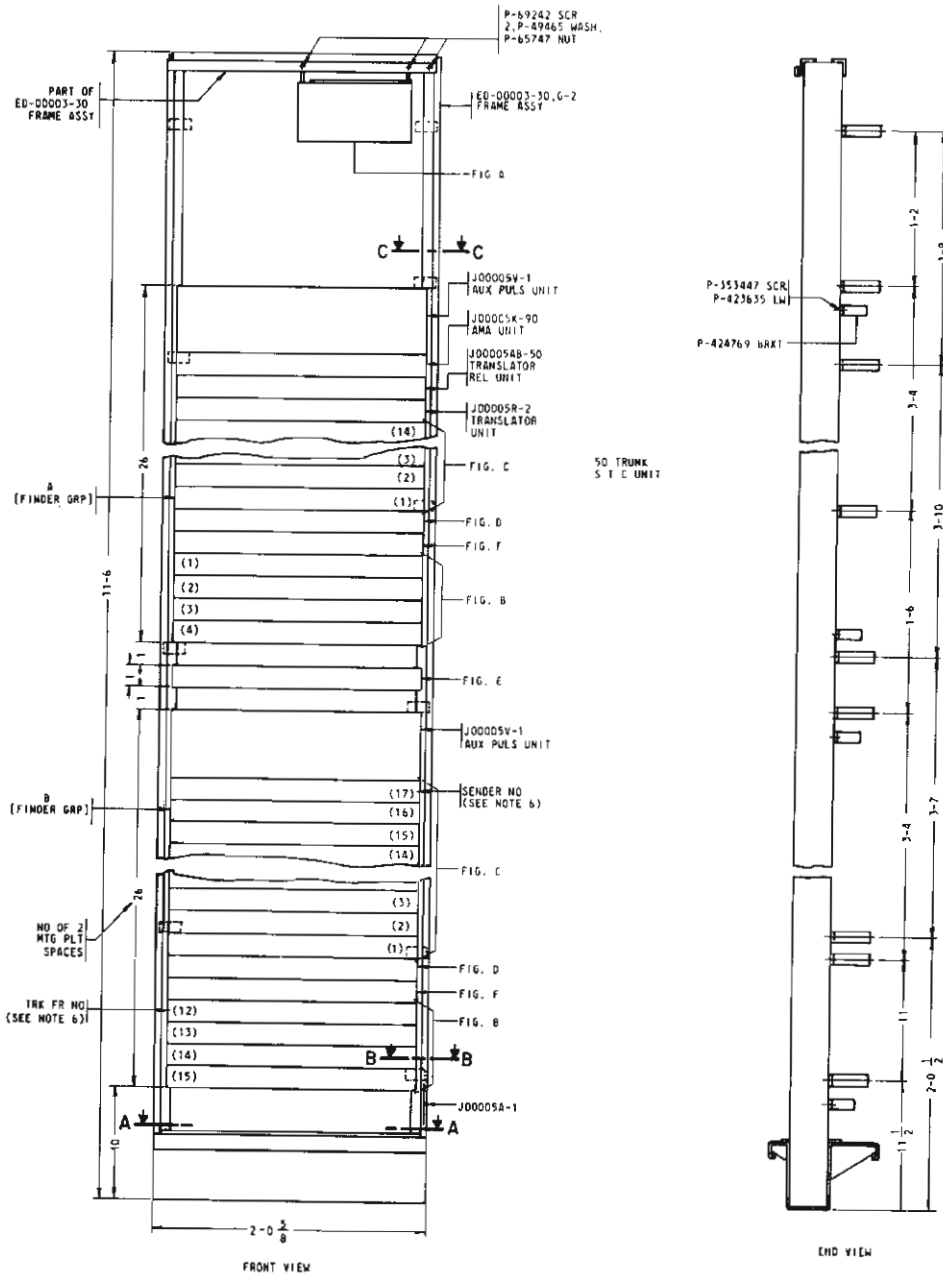


FIGURE 14 TYPICAL FRAME

Bay

A frame may consist of one or more bays. A bay is that portion of a frame between any two vertical uprights of the framework. Figure 14 shows a single bay frame. Figure 15 shows a comparison between single bay, double bay (2) and triple bay (3).

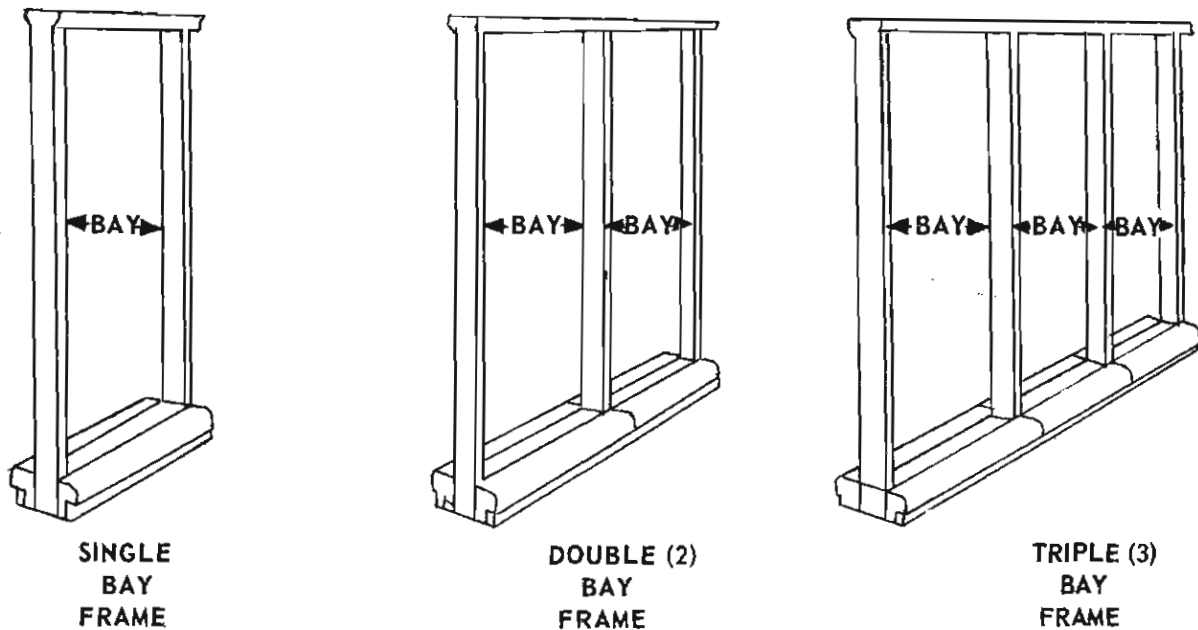


FIGURE 15 SINGLE, DOUBLE AND TRIPLE
BAY FRAMES

A better perspective of what these would look like as assembled from the equipment specification can be obtained by referring to Figures 16, 17 and 18.



TRUNK TEST FRAME

FIGURE 16 SINGLE BAY FRAME

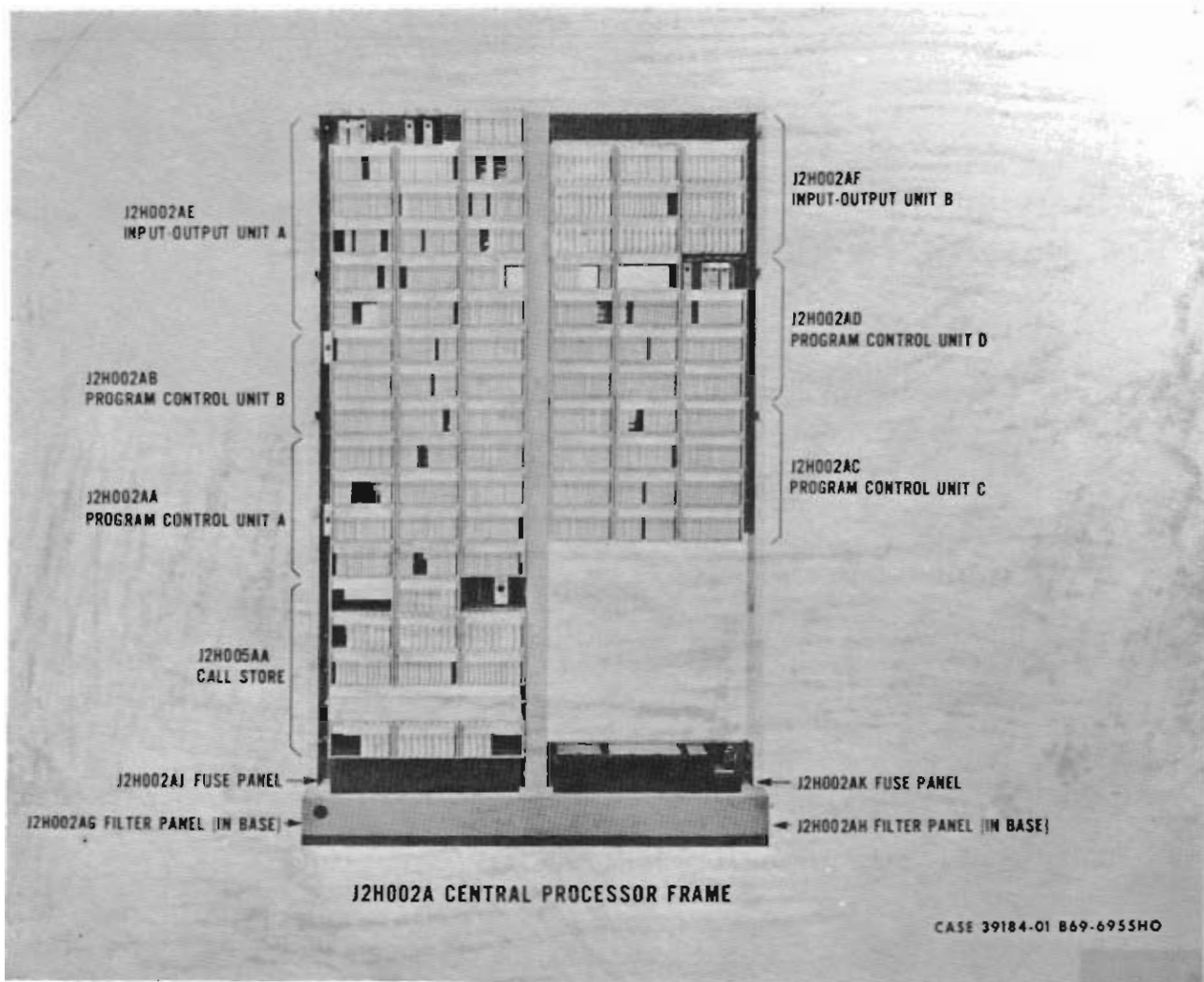
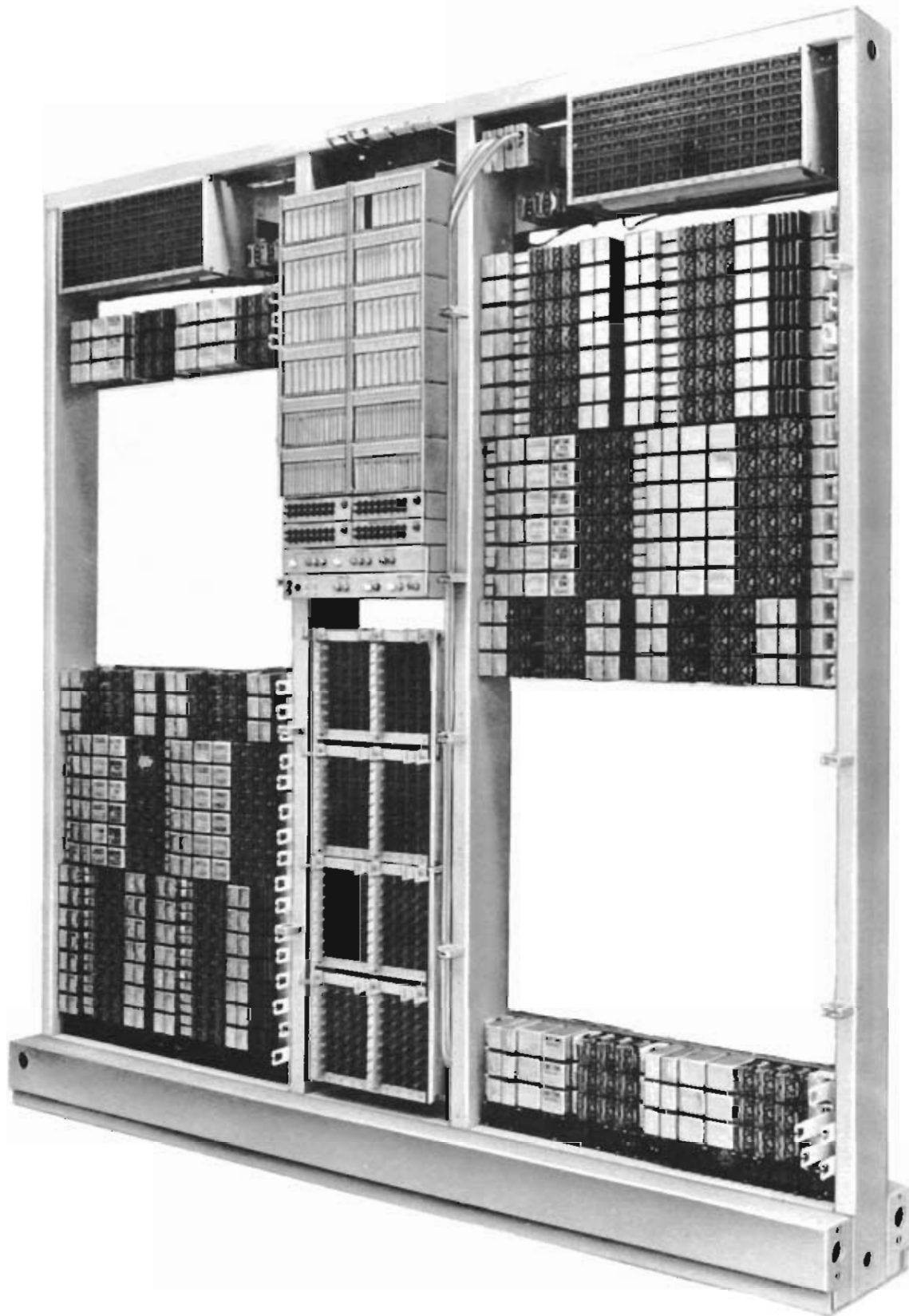


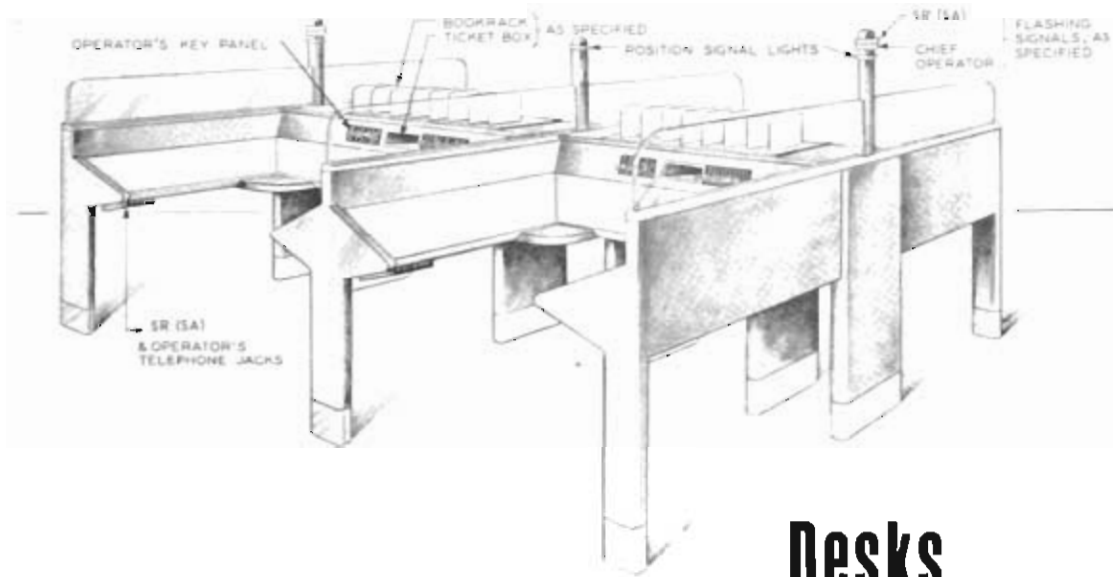
FIGURE 17 DOUBLE BAY FRAME



UNIVERSAL TRUNK AND JUNCTOR FRAME

FIGURE 18 TRIPLE BAY FRAME

That equipment that is not mounted on these vertical uprights may be located in Desks, Switchboards, Cabinets and Consoles or Portable Wagons as seen on the following pages.



Desks



FIGURE 19 DESKS



Switchboards

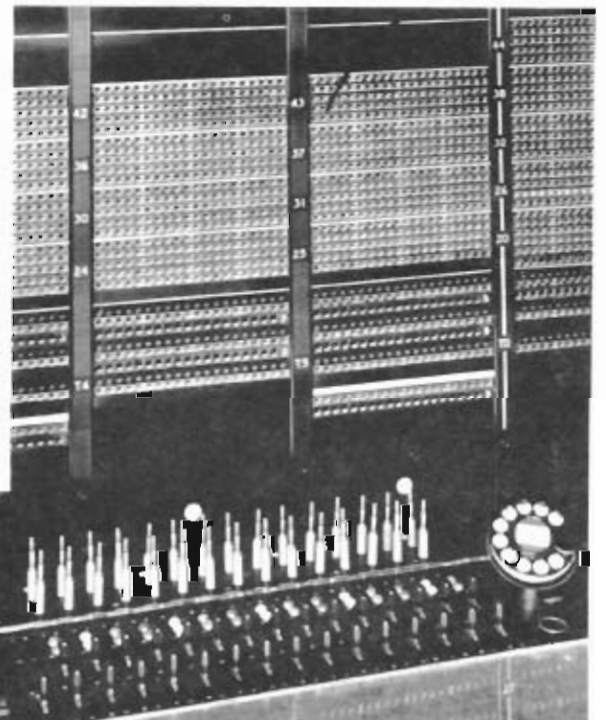


FIGURE 20 SWITCHBOARDS

Cabinets

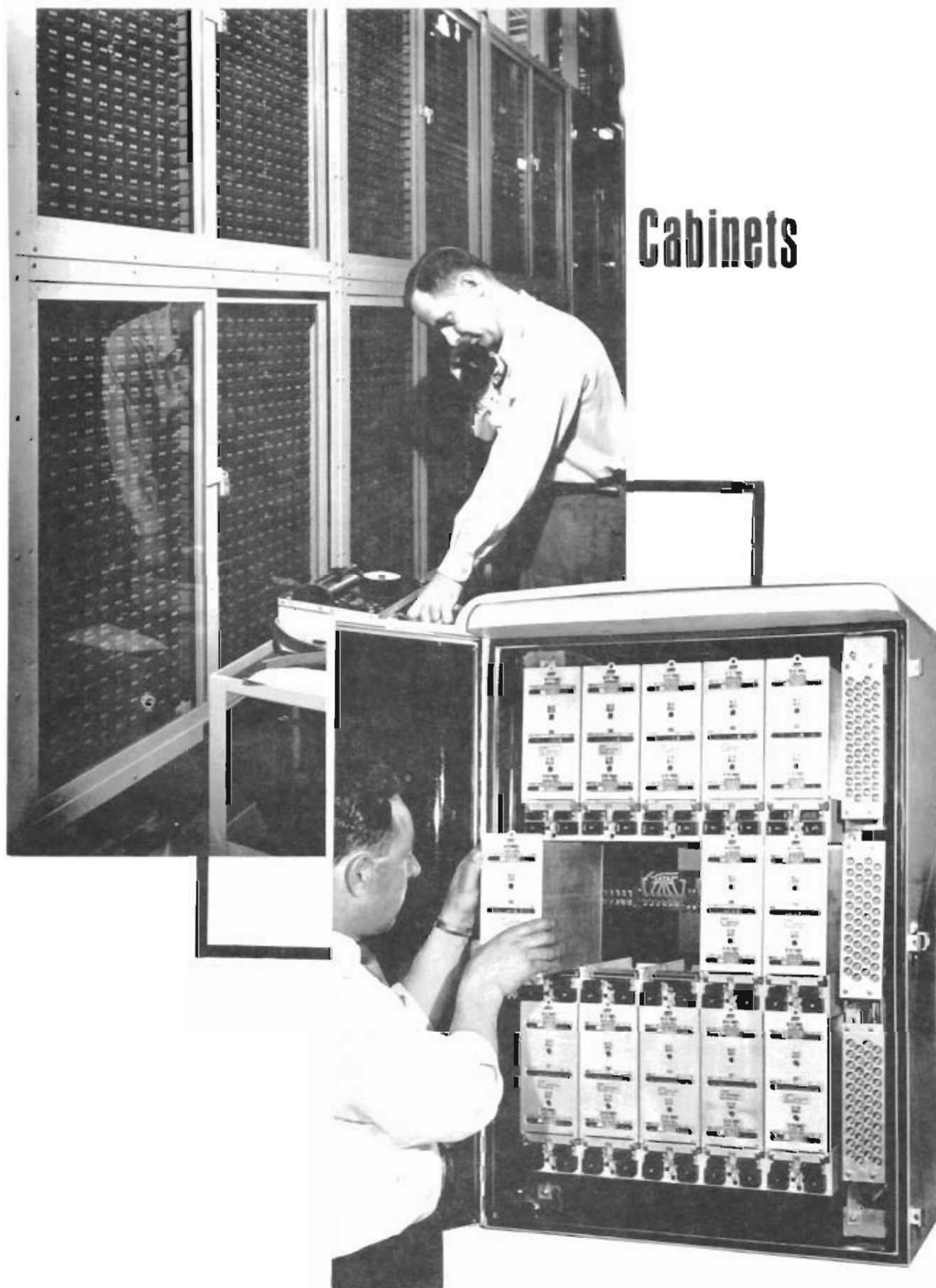


FIGURE 21 CABINETS

Desks, Switchboards, Consoles, Portable, and Printed Circuit Boards



Portable Wagons or Carts

Consoles



FIGURE 22 CONSOLES, PORTABLE WAGONS
OR CARTS

Special Consideration

As noted earlier, printed circuit board assemblies can be classified as coded apparatus or equipment by their first application and use. Notice the 80A, 82A and 84A circuit board apparatus on an equipment specification circuit pack in Figure 23.

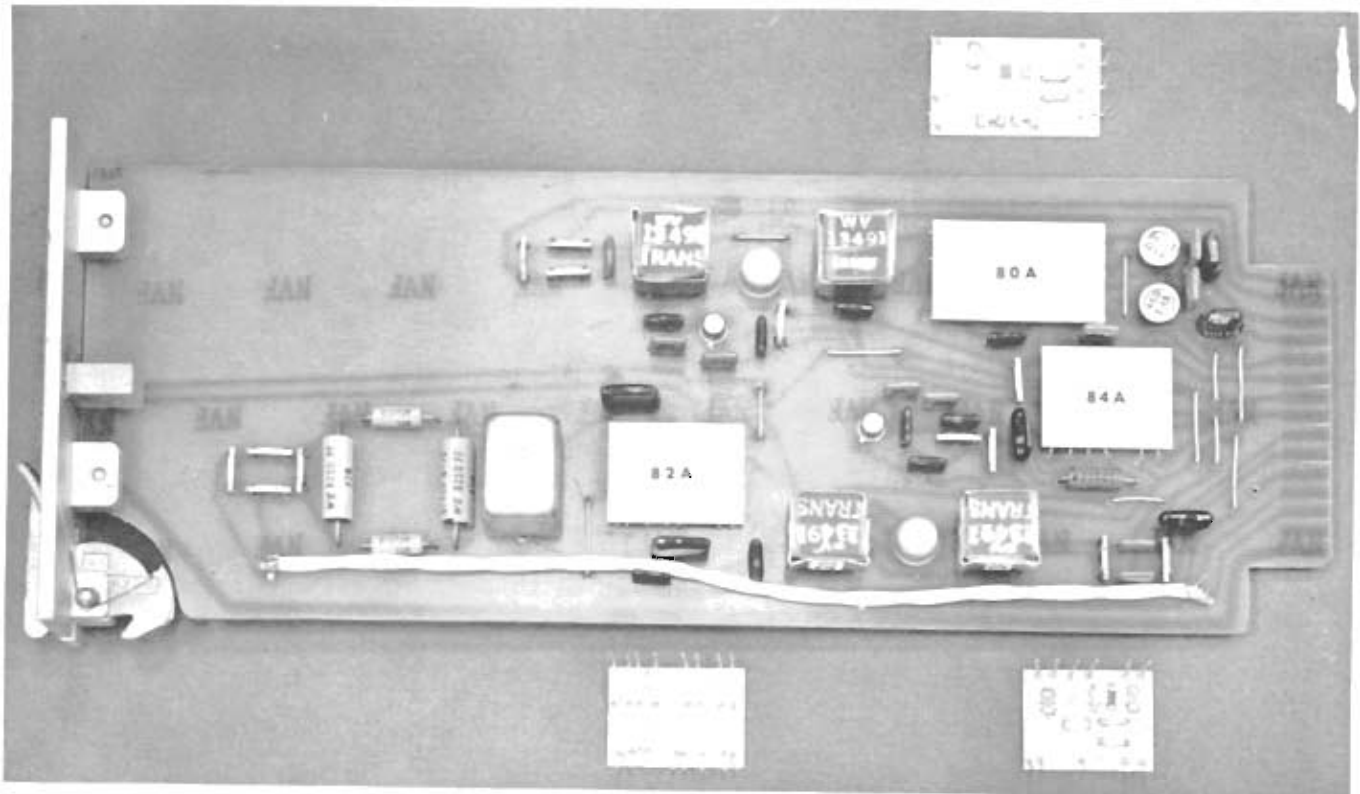


FIGURE 23

Equipment Specifications are drawings. Coded letters and numbers identify the drawings as follows:

"J" drawings for units, shelves, frames and some of the other items of assembly and wiring. (Example: J99235A-1 TEST UNIT)

"ED" drawings for small wired units like Step-by-Step switches and units which mount like switches. (Example: ED-33013-30 LINEFINDER SWITCH)

"H" drawings for equipment which has not been coded as "J" or "ED" by Bell Telephone Laboratories but is prepared by Western Electric. (Example: H-909-657 PERMANENT SIGNAL SWITCH)

Detailed descriptions of these drawings and how you will use them are provided in Course 021 CA. Drawing number information is provided in the SE & SE Handbook, CI 97.100 Section 19.

Framework Assembly

The actual ironwork provided in equipment specifications has to be assembled and bolted, glued, welded, etc. by manufacturing. A framework assembly drawing provides views showing the manner in which all parts of a frame, bay, desk, cabinet, etc. are assembled. The framework may be metal, wood or a combination of both.

The framework provided in an equipment specification will be assembled according to the framework assembly drawing shown on that equipment specification.

Some framework is assembled in manufacturing but is not equipped with apparatus and wiring. Other types of framework are not assembled until they reach the field where the installer does the work.

The framework associated with each desk, cabinet or console is so unique in each case that we will not cover it in detail here. Framework for vertical uprights which mount units is common in all central offices and warrants further discussion.

When the framework is arranged to mount miscellaneous plates and units but is not part of frame, it is called a Relay Rack.

Relay Racks are not named for specific functions like frames are. They are usually referred to as "Miscellaneous Relay Racks" or "Relay Rack bays".

Framework Types

Regardless of whether the framework is in a frame or in a relay rack, certain characteristics can be identified. First, there is a typical framework. Then, the several kinds of ironwork used to make framework. These are all illustrated in Figures 24 to 30.

FIGURE 24
TYPICAL FRAMEWORK

The majority of all telephone equipment is mounted in some form of "Framework". Framework usually consists of two vertical metal uprights that support the various types of equipment.

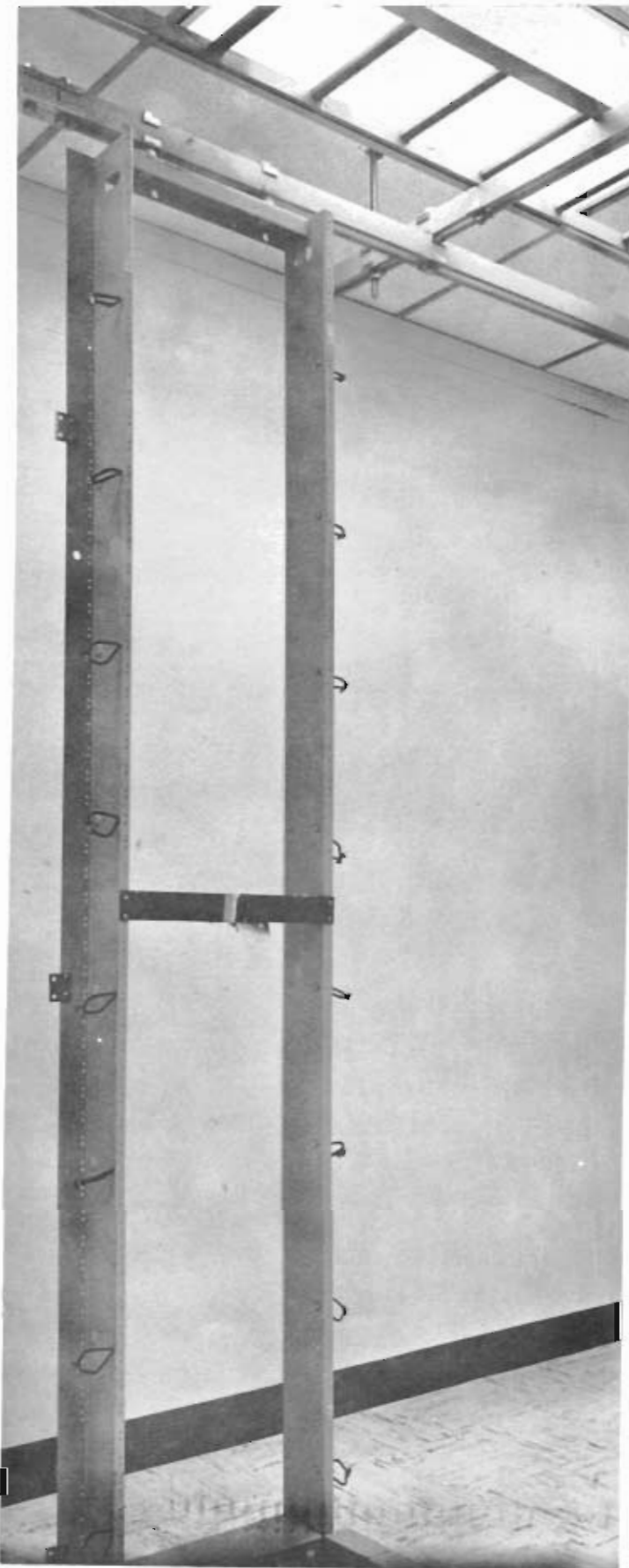


FIGURE 25 BULB ANGLE
FRAMEWORK

Bulb Angle Bay framework
usually used to mount equip-
ment for No. 1 and No. 4
Crossbar frames, Fuse Bays
and Interrupter frames and
for Miscellaneous Relay
Racks.

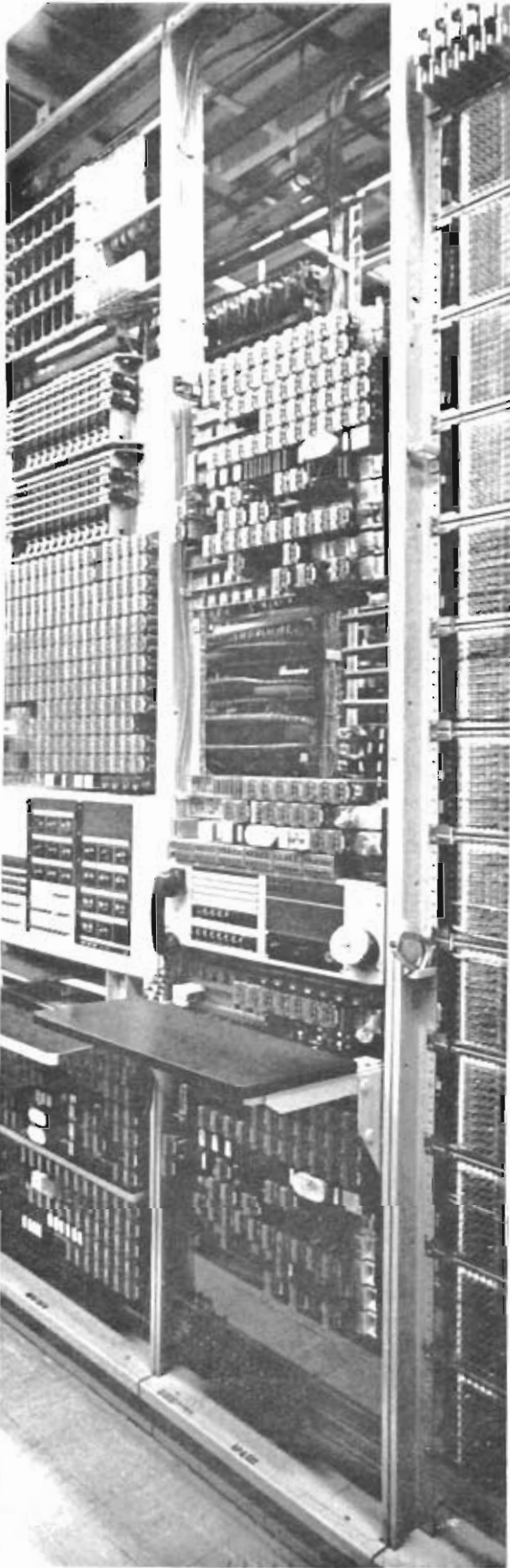
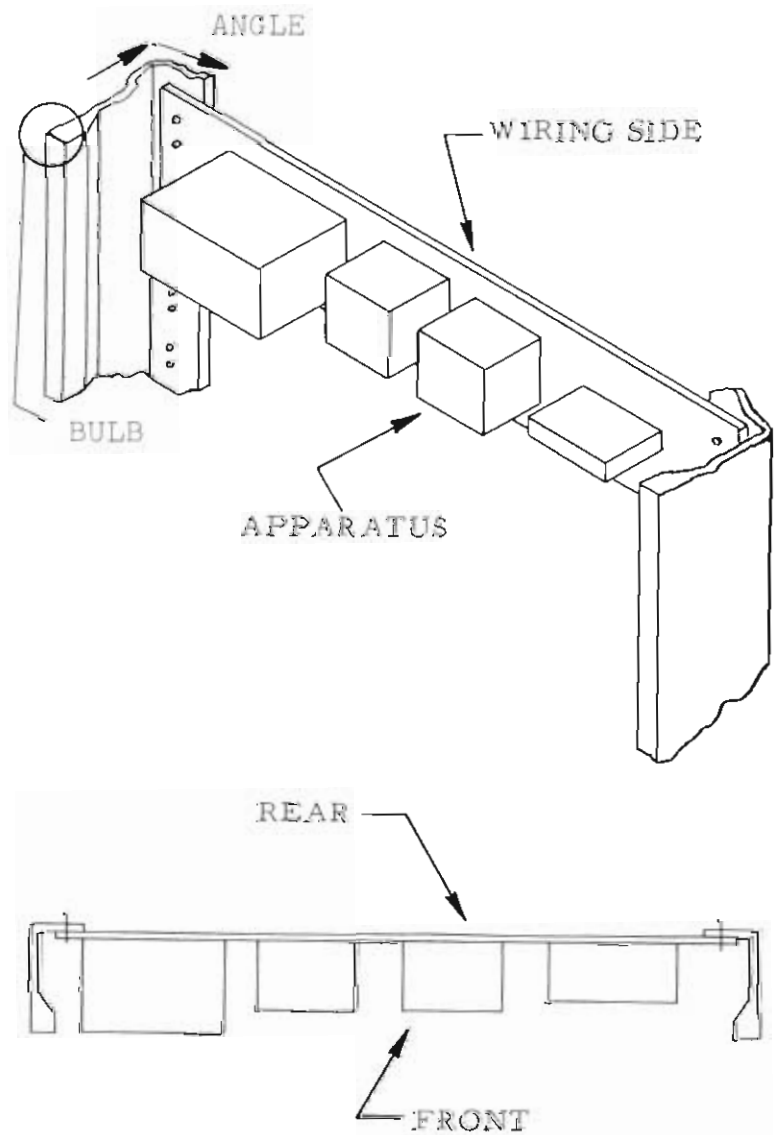


FIGURE 26 CHANNEL TYPE
FRAMEWORK

Formerly used for miscellaneous
relay racks, Panel, Step-by-
Step and miscellaneous Power
equipment.

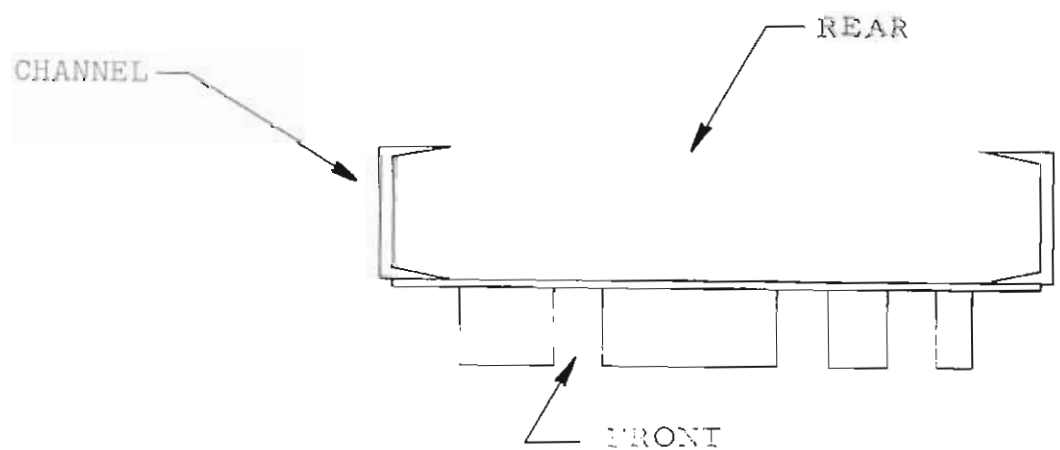
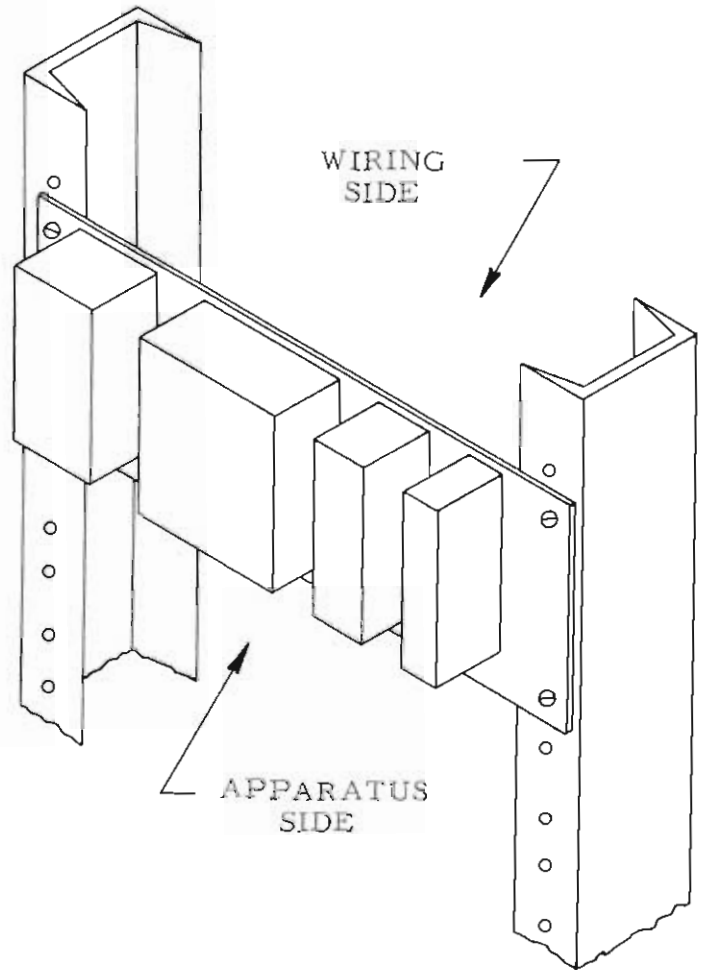
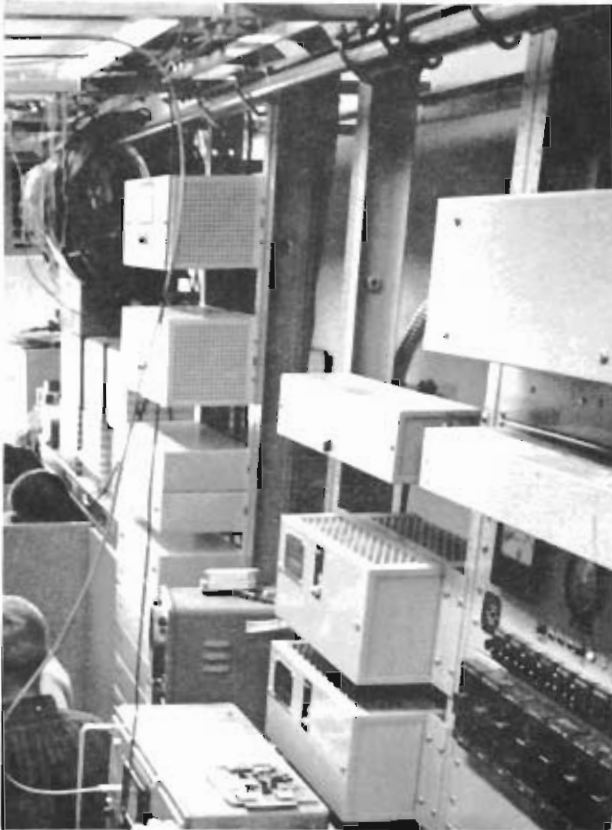
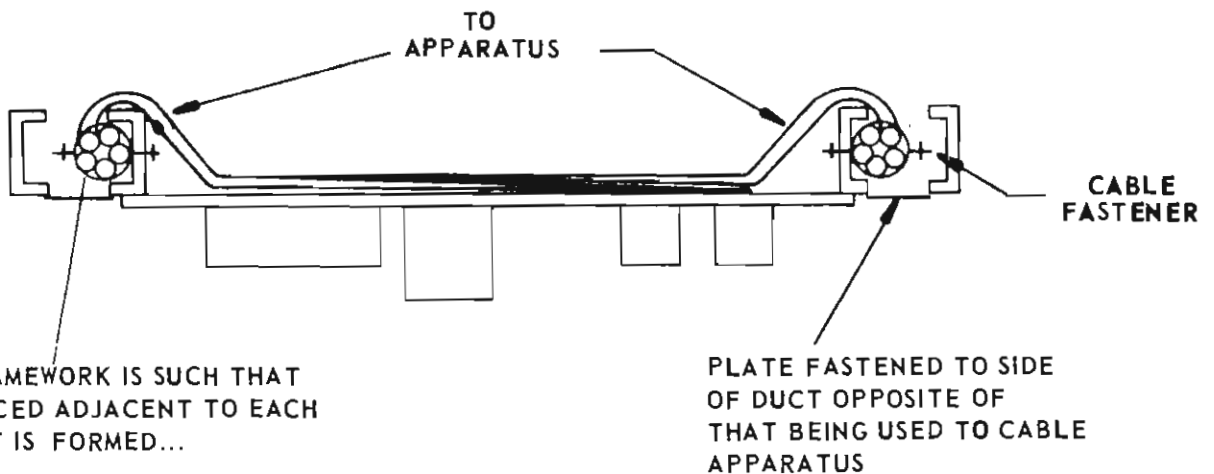
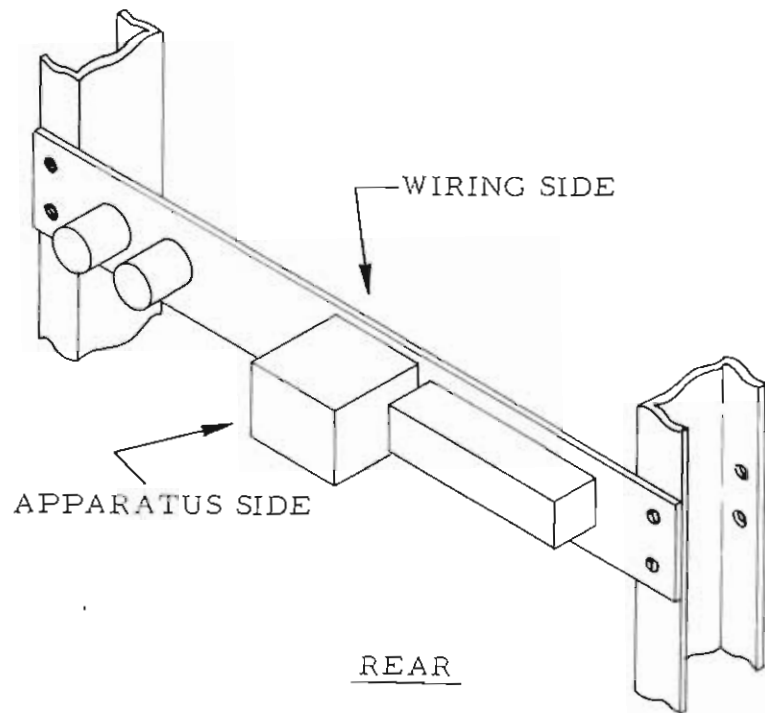
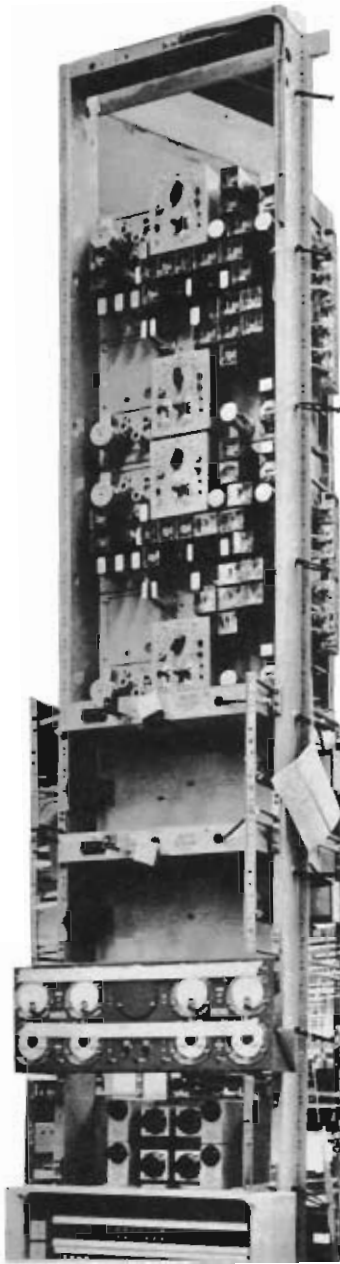


FIGURE 27 UNIVERSAL DUCT TYPE
FRAMEWORK

Formerly used primarily in Carrier and Microwave offices to support equipment. Apparatus may be mounted on front or rear and wired accordingly.



DUCT TYPE FRAMEWORK IS SUCH THAT WHEN IT IS PLACED ADJACENT TO EACH OTHER...A DUCT IS FORMED...

PLATE FASTENED TO SIDE OF DUCT OPPOSITE OF THAT BEING USED TO CABLE APPARATUS

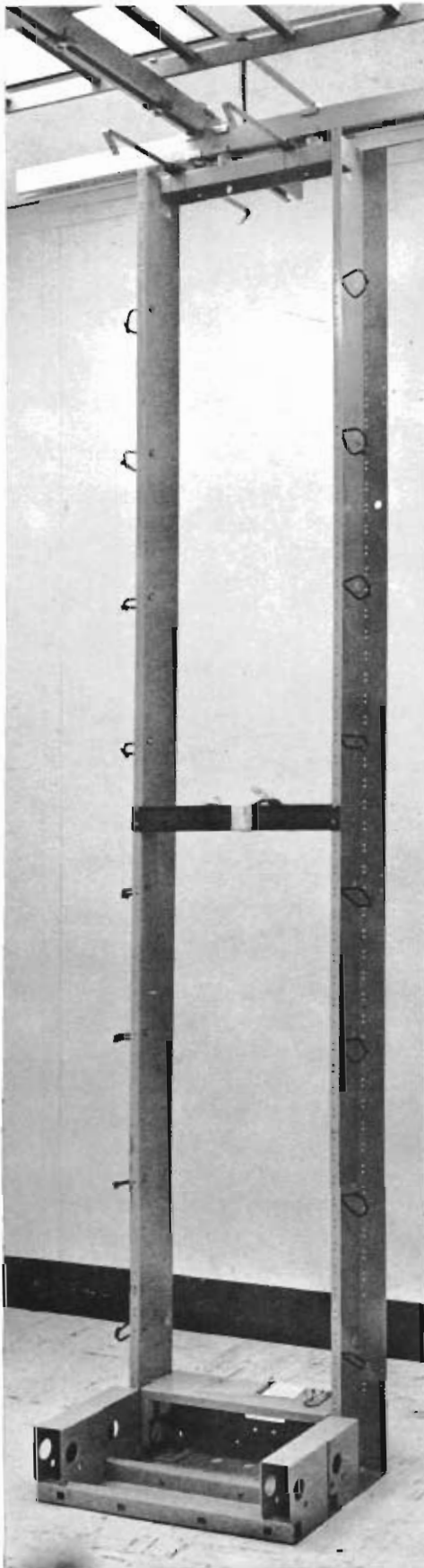
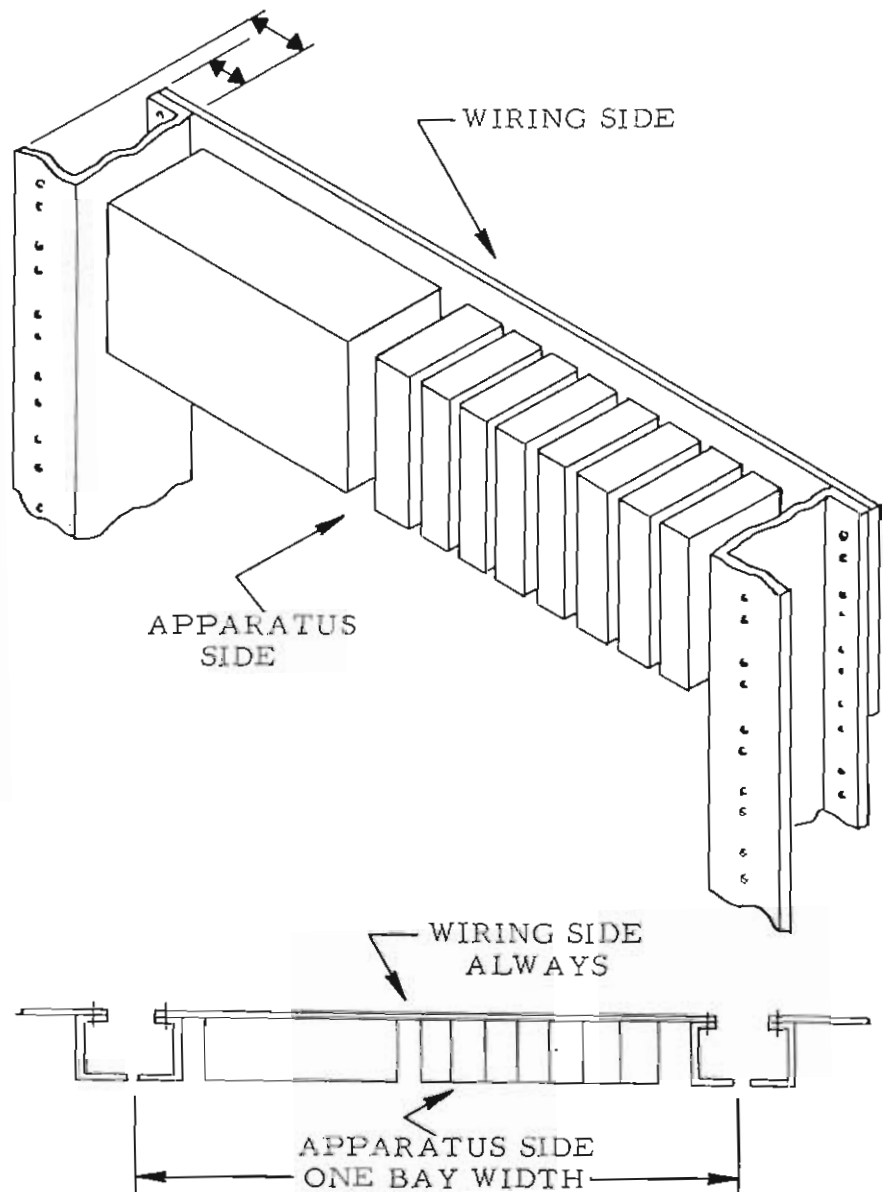


FIGURE 28 DUCT TYPE FRAMEWORK

UNEQUAL FLANGE is the latest version of duct framework. The primary difference from the equal flange duct is that wiring must be done on the short flange side.



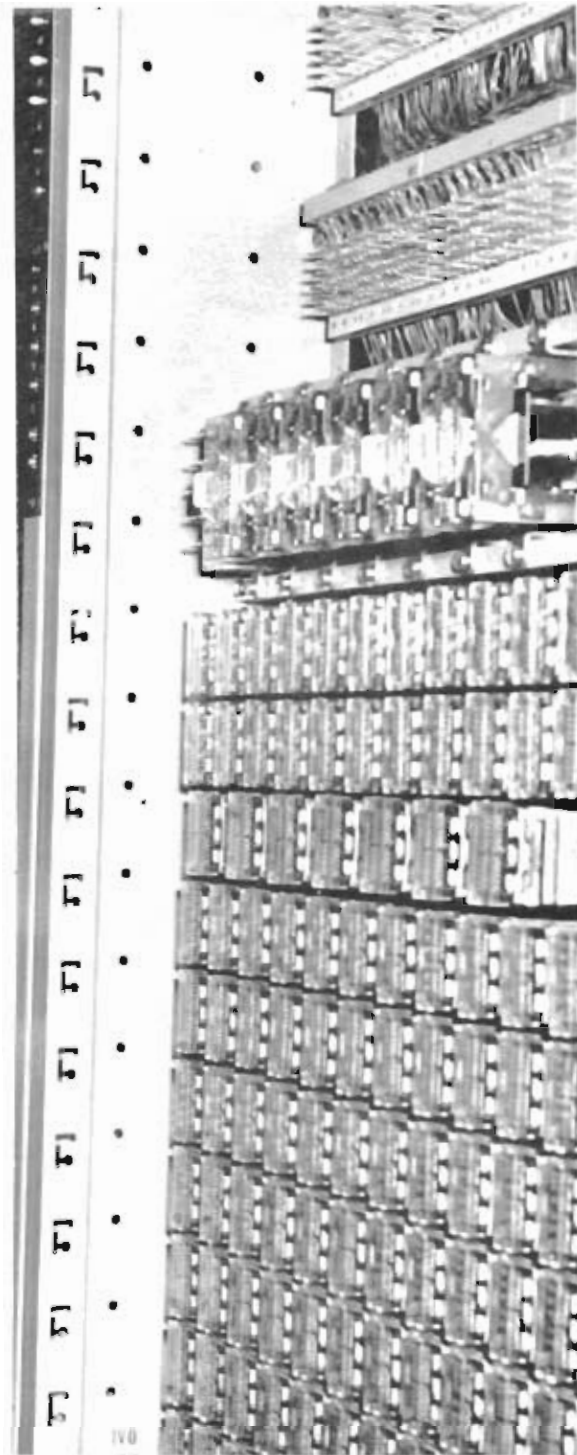
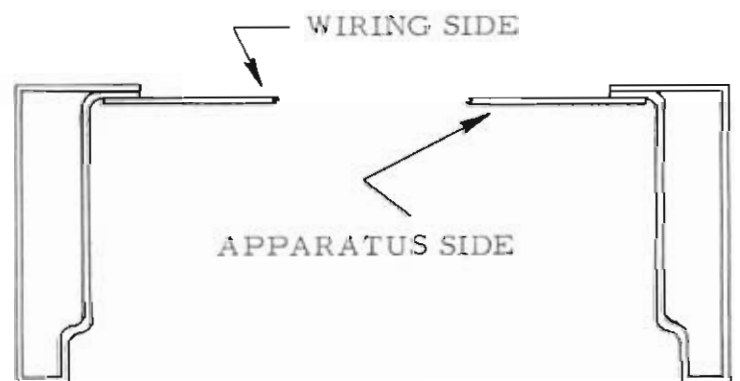
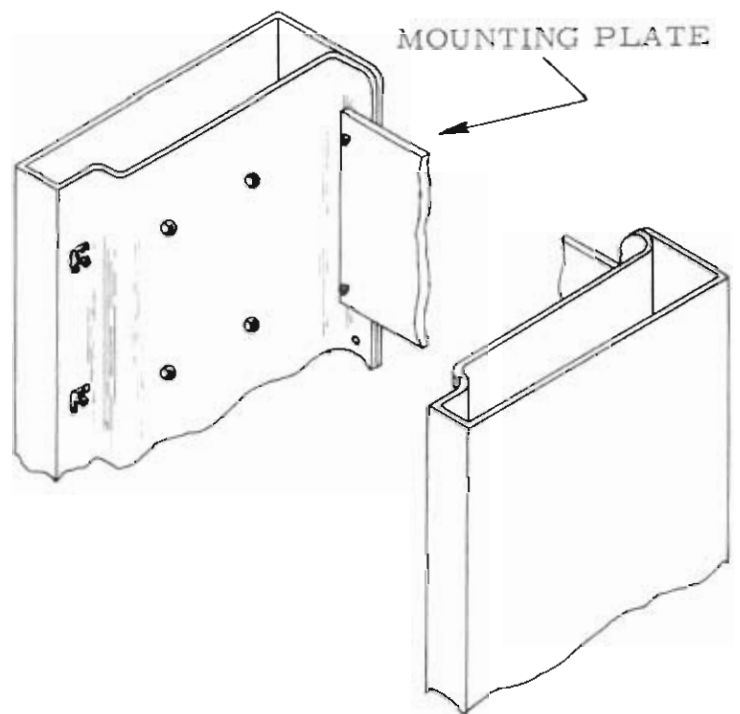


FIGURE 29 NO. 5 CROSSBAR FRAME-
WORK - this sheet metal type is
used exclusively for No. 5 Cross-
bar equipment and has not been
applied to any other system.
This type is commonly referred to
as "Box Type Framework".

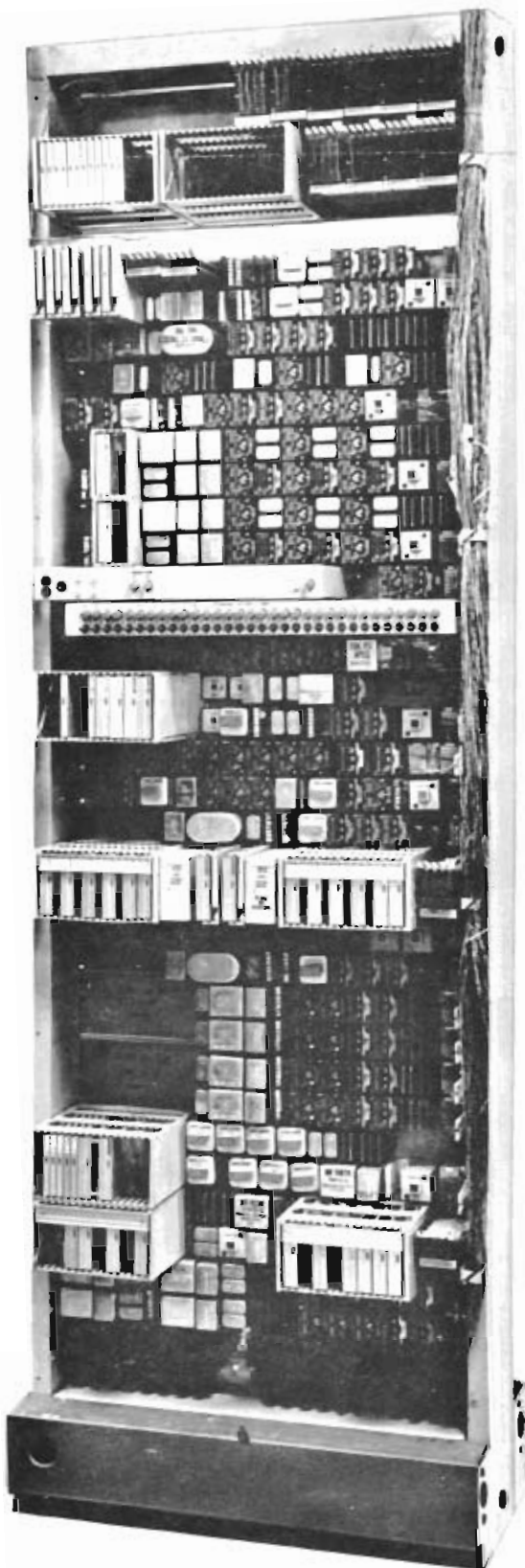


FRONT

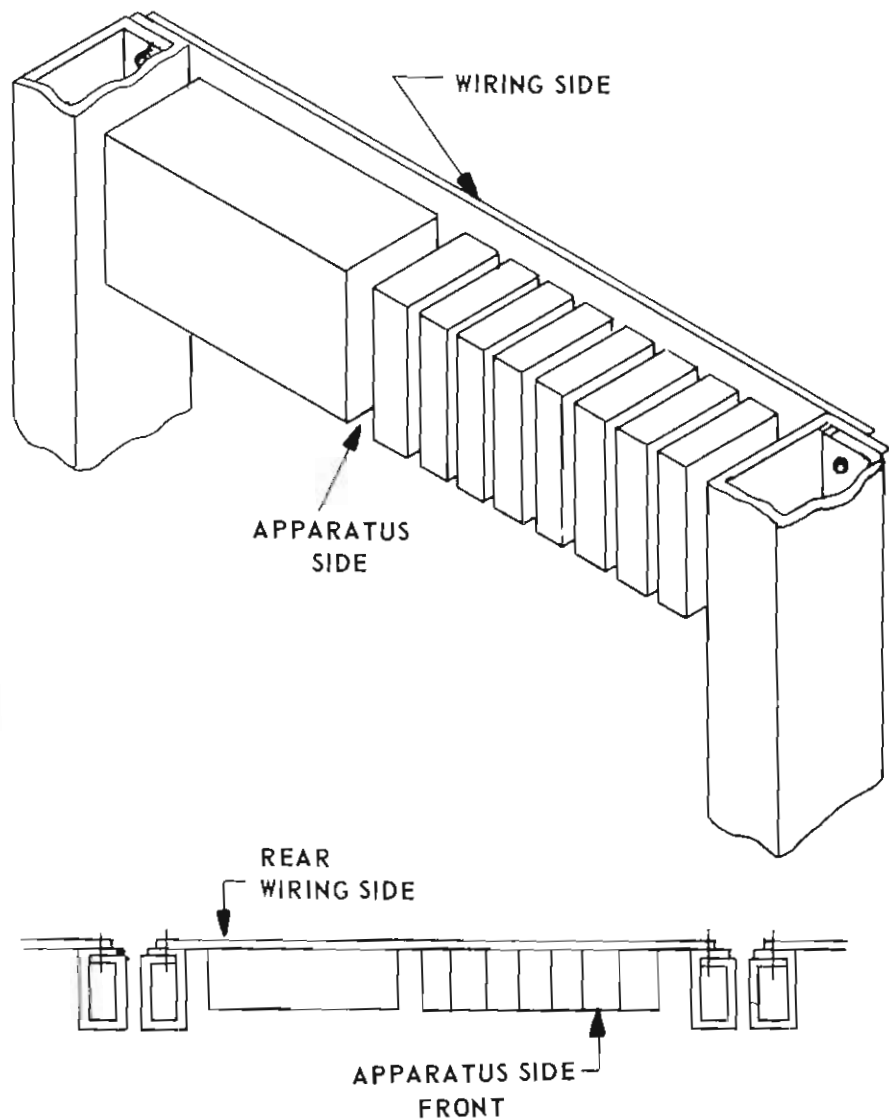
TOP OR PLAN VIEW

FIGURE 30

ESS FRAMEWORK - this is also sheet metal type and is used for ESS, ETS and TSPS equipment in most cases.



MISCELLANEOUS TRUNK FRAME



You can associate the various types of framework with the different switching systems, i.e.

| | |
|---------------------------------|---|
| Toll | - Bulb Angle, Channel, Universal Duct, Unequal Flange Duct |
| ESS | - ESS Framework |
| No. 5 Crossbar | - No. 5 Crossbar Framework |
| No. 1 Crossbar | - Bulb Angle |
| Crossbar Tandem | - Bulb Angle |
| Step-X-Step | - Bulb Angle or Channel (old) |
| Electronic Translator System | - ESS Framework |
| No. 4 Crossbar | - Bulb Angle |

The heights and widths of framework are also relative to particular systems. The height of a framework is measured from the floor line to the top of the frame.

| | |
|----------|------------------------------|
| 7' - 0" | |
| 9' - 0" | are common framework heights |
| 11' - 6" | |
| 10" | |
| 10 1/2" | are common framework widths |
| 1' - 0" | |

Examine the following:

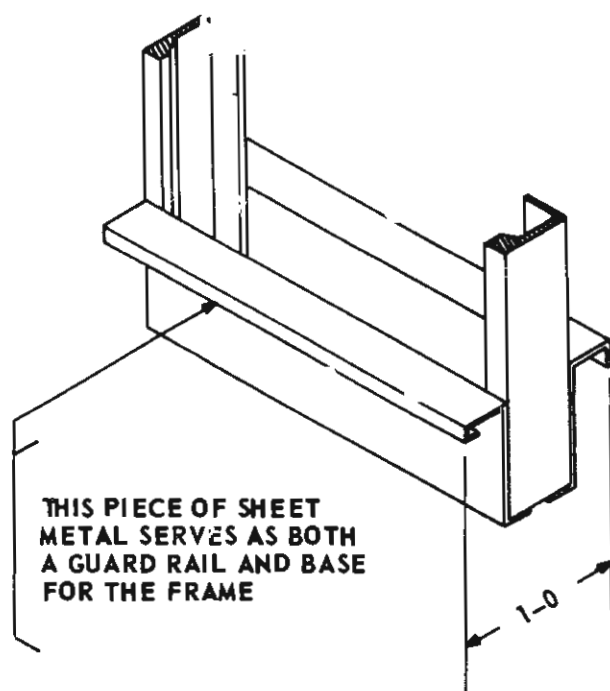
| <u>System</u> | <u>Height</u> | <u>Width</u> |
|----------------|---------------|--------------|
| ESS | 7' - 0" | 1' - 0" |
| No. 5 Crossbar | 11' - 6" | 10 1/2" |

| <u>System</u> | <u>Height</u> | <u>Width</u> |
|--------------------------------------|----------------------------------|---------------|
| No. 1 Crossbar | 11' - 6" | 10" |
| Crossbar Tandem | 11' - 6" | 10" |
| Step-By-Step No. 1 (Large Office) | 11' - 6" | 1' - 0" |
| Step-By-Step 355 (Small Office) | 9' - 0" | 1' - 0" |
| Electronic Translator System | 7' - 0" | 1' - 0" |
| No. 4 Crossbar | 11' - 6" | 10" |
| Toll | 7' - 0", 9' - 0", 11' - 6" | 10" & 1' - 0" |

The width of framework is measured by its guard rail width at the bottom of the framework.

Guard rails are of 2 distinct types.

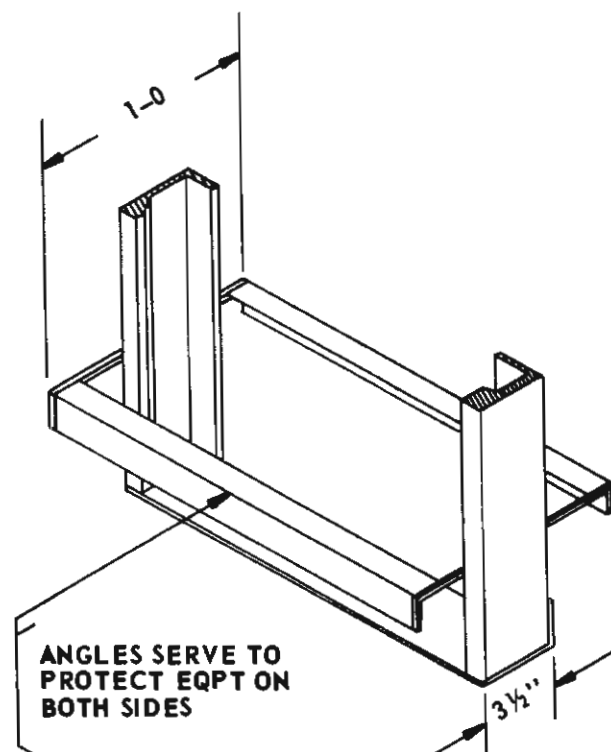
- 1) Sheet Metal (Figure 31)
- 2) Angle (Figure 32)



(CROSS-SECTIONAL ISOMETRIC VIEW)

FIGURE 31

SHEET METAL GUARD RAIL



(CROSS-SECTIONAL ISOMETRIC VIEW)

FIGURE 32

ANGLE TYPE GUARD RAIL

What the guard rail looks like is represented in the view of a frame being installed as shown in Figure 33.

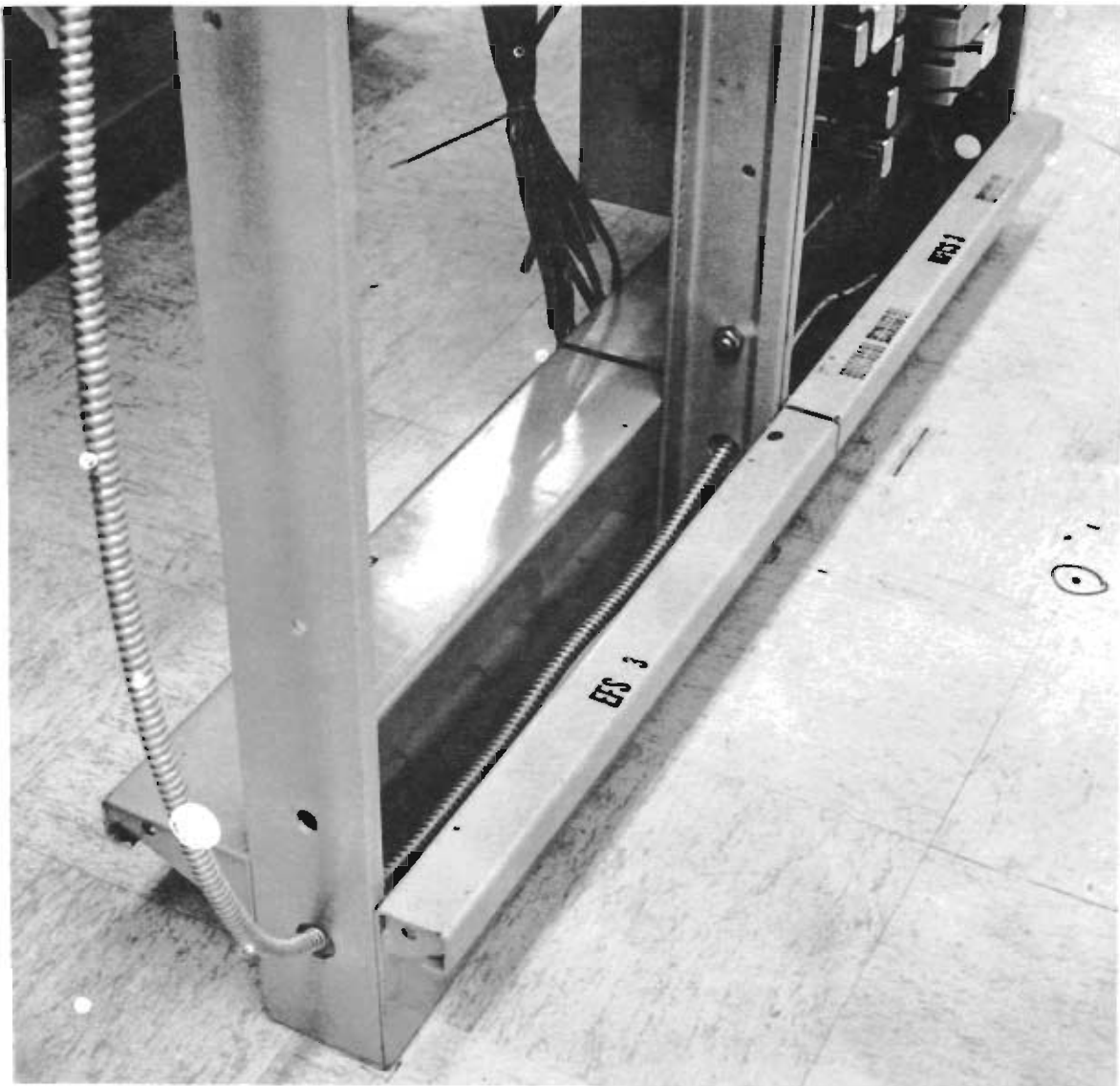
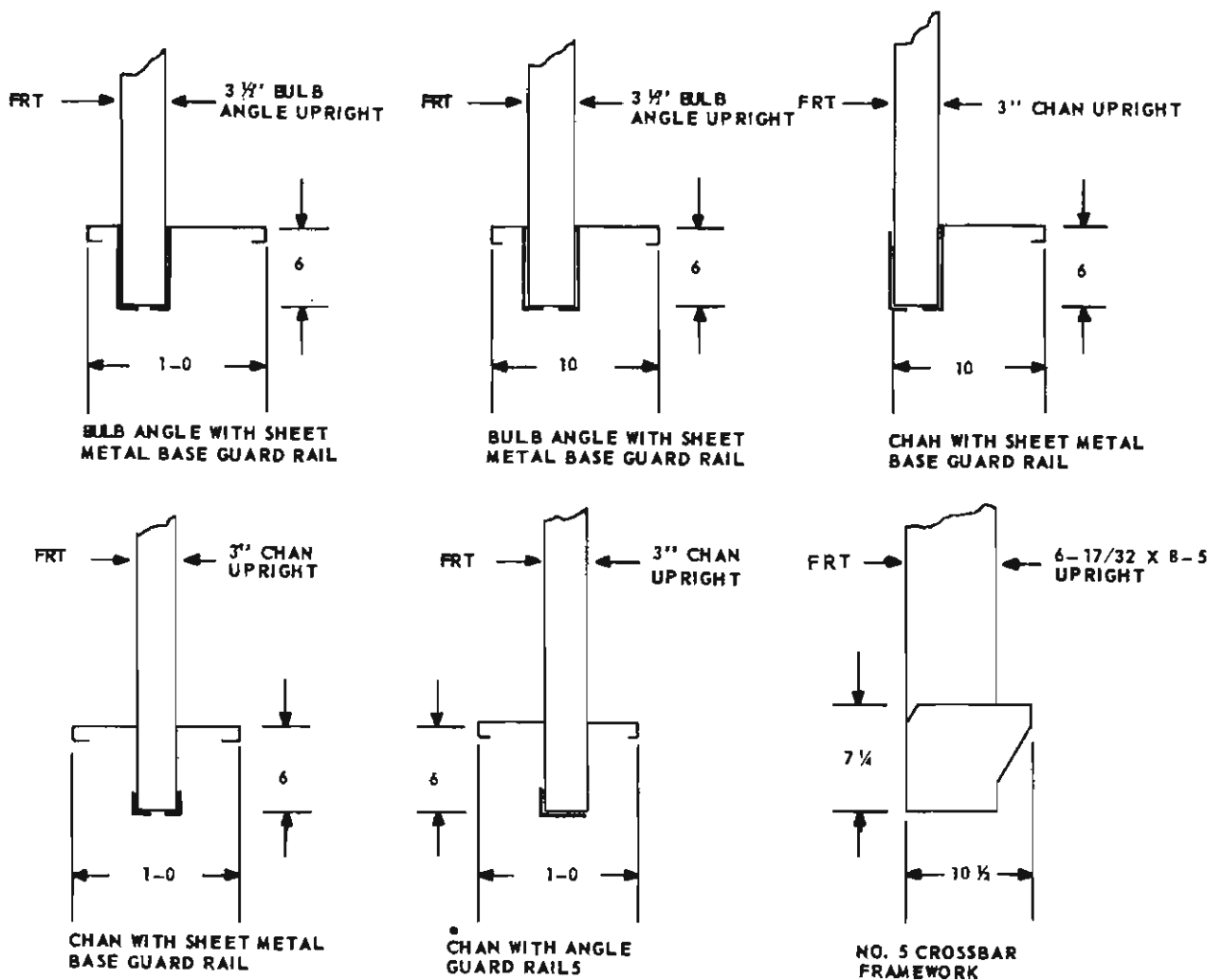


FIGURE 33 GUARD RAIL

The following sketches may help you to associate various guard rail widths with the different types of framework.



(END VIEWS LOOKING AT BASE)

Framework Assembly drawings are either "ED" drawings or "H" drawings.

"ED" drawings are made from corresponding Bell Telephone Laboratories design. (Example: ED-91837-71 Relay Rack Assembly)

"H" drawings are made for framework assemblies not directly associated with BTL design. (Example: H-592-666 Relay Rack Assembly)

These two drawings are also thoroughly described in Course 021 CA.

Non-Standard Development

Should an Operating Company require the design of equipment which is to have only limited or special application, Western Electric undertakes to design the appropriate drawings.

"NJ" drawings are equipment specifications similar in format to the standard "J" drawing.

"NE" drawings are framework assembly drawings similar in format to the standard "ED" drawing.

Work Assignment No. 2

1. The two "significant" characteristics about equipment are:

Drawings are furnished
to the customer
office records are
maintained

2. "J" drawings are which? (Cross out one)

a. Equipment Specification

~~b. Framework Assembly~~

3. If you do not yet know which system you will be working in, ask your administrator. The system is Toll.

What type of framework is used in your system?

Bulb Angle, Channel, Unicosal/Duct, Unequal Flange Duct

4. What is a bay? ^{portion of frame} the area between two
vertical uprights of iron of the
framework

Answers to Work Assignment No. 2

1. Drawings will be furnished the customer.

Central office records must be maintained.

2. Equipment Specification

3. Refer to page 57.

4. That portion of a frame between any two vertical irons of the framework.

If you had difficulty with any of these questions, consult with your administrator.

CABLE AND WIRING

Wire

One of the obvious items you have not yet encountered in this course is the method of interconnecting the various electromechanical and electronic components in a central office.

The basic element of providing connections between electrical components is a solid copper or copper alloy conductor or wire. The conductor is insulated with a fabric or plastic covering.

| | |
|---|--|
| <p>The most common gauges of wire used in central offices are:</p> <p>_____ 20 (larger of three)</p> <p>_____ 22</p> <p>_____ 24 (smaller of three)</p> | <p>The most common types of wire (insulation) are:</p> <p>C (Double acetate, cotton, lacquered)</p> <p>BU (Polyvinyl chloride)</p> <p>BH (Polyvinyl chloride, cotton, lacquered)</p> |
|---|--|

Gauge and insulation type are expressed by combining the two.

Examples:

22C

22BU

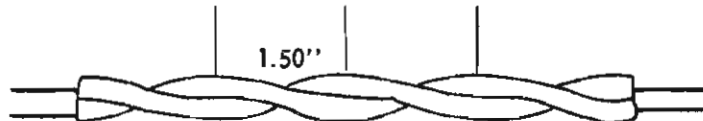
24BH

Conductors are normally provided as "singles", "pairs" or "pairs and singles".

A single is one conductor.



A pair is two conductors, twisted together with one twist each 1.50 inches.



Pairs and singles are merely combinations of the quantity of pairs and singles necessary to meet specific requirements.

Pairs are required whenever the two leads which carry voice signals are wired or cabled from one location to another.

So that the individual conductor may be distinguished one from another, the insulation is provided in different colors. The more common colors and the abbreviations you will see that designate these colors are:

| | |
|--------|----|
| Blue | BL |
| Orange | O |
| Green | G |
| Brown | BR |
| Slate | S |

| | |
|--------|----|
| White | W |
| Red | R |
| Black | BK |
| Yellow | Y |

These colors may be combined in fabric covered wire by a mixed combination of colored threads.

BL - W

O - G

BL - W - R

G - BR - R

S - W - R

Plastic insulated wires are often provided in combination of colors by using colored dots and dashes on solid color background.

| <u>Color</u> | <u>Description</u> |
|--------------|--|
| BL 1W | A blue wire with single white dots spaced about 3/4 inch apart. |
| BL 2W | A blue wire with two white dots spaced about 1/8 inch apart; the distance between pairs of dots is about 3/4 inch. |
| BL 3W | A blue wire with white dashes about 1/4 inch long spaced about 3/4 inch apart. |

Connections

Individual conductors are connected to terminals on apparatus.

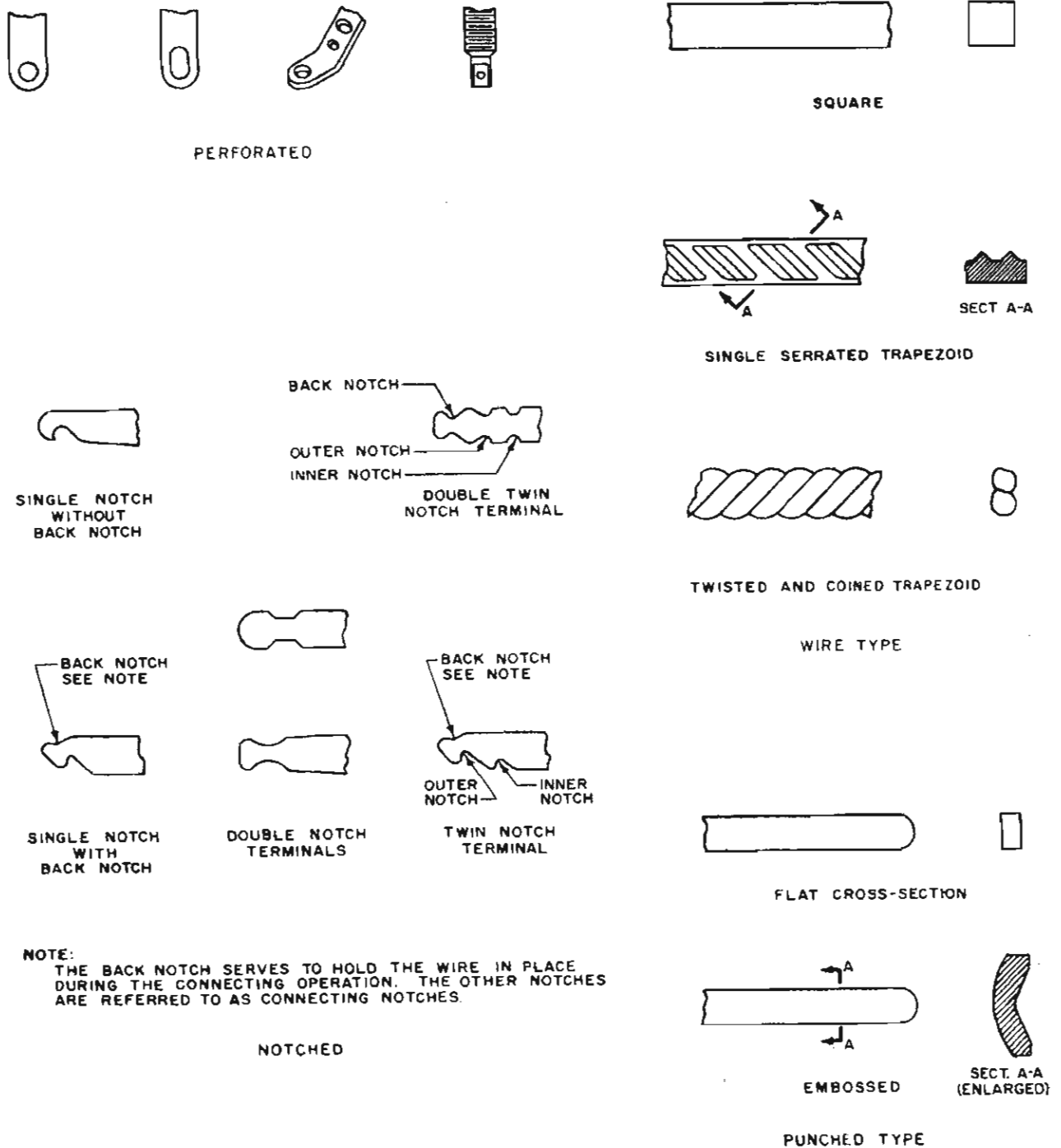


FIGURE 34 TYPES OF APPARATUS TERMINALS

Some connections are made by bending or wrapping the wire on the terminals and soldering it.

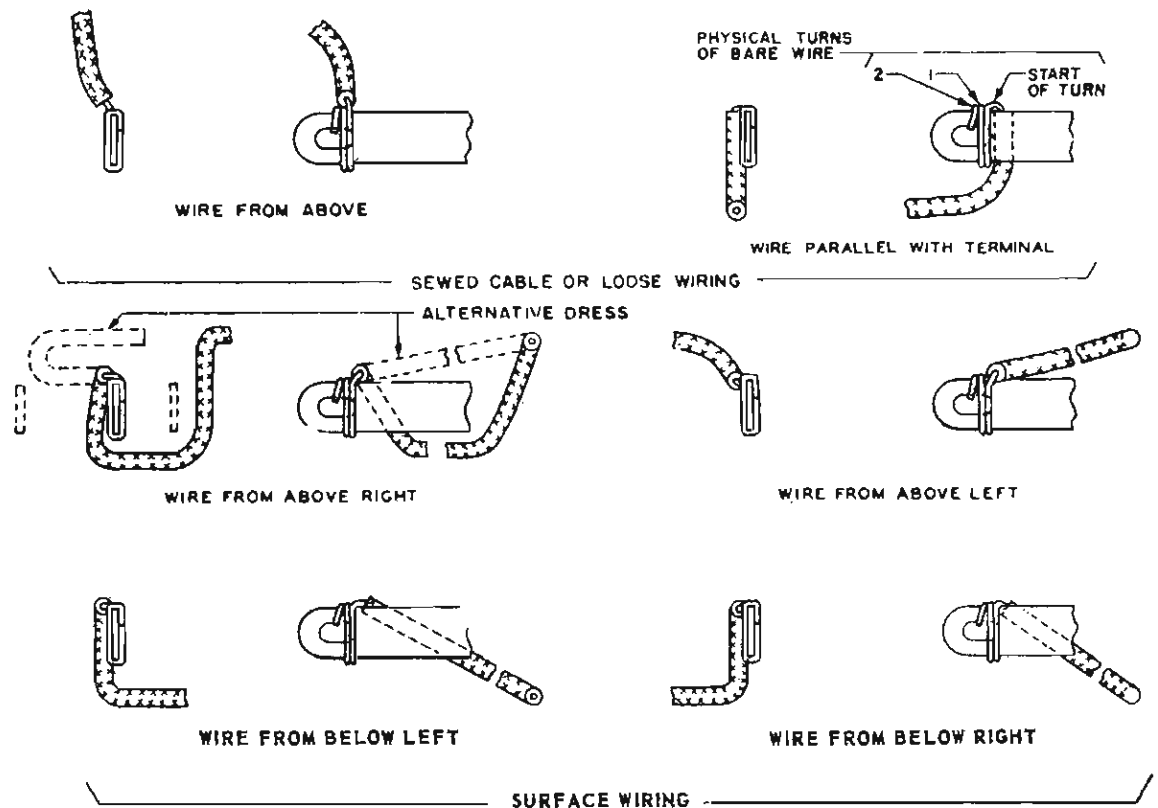


FIGURE 35 SOLDERED-WRAPPED CONNECTIONS -
PERFORATED TERMINALS -
SOLDER NOT SHOWN

Other connections are made by using a wire wrapping tool as illustrated in Figure 36. This procedure results in a satisfactory connection without the need for solder as shown in Figure 37.

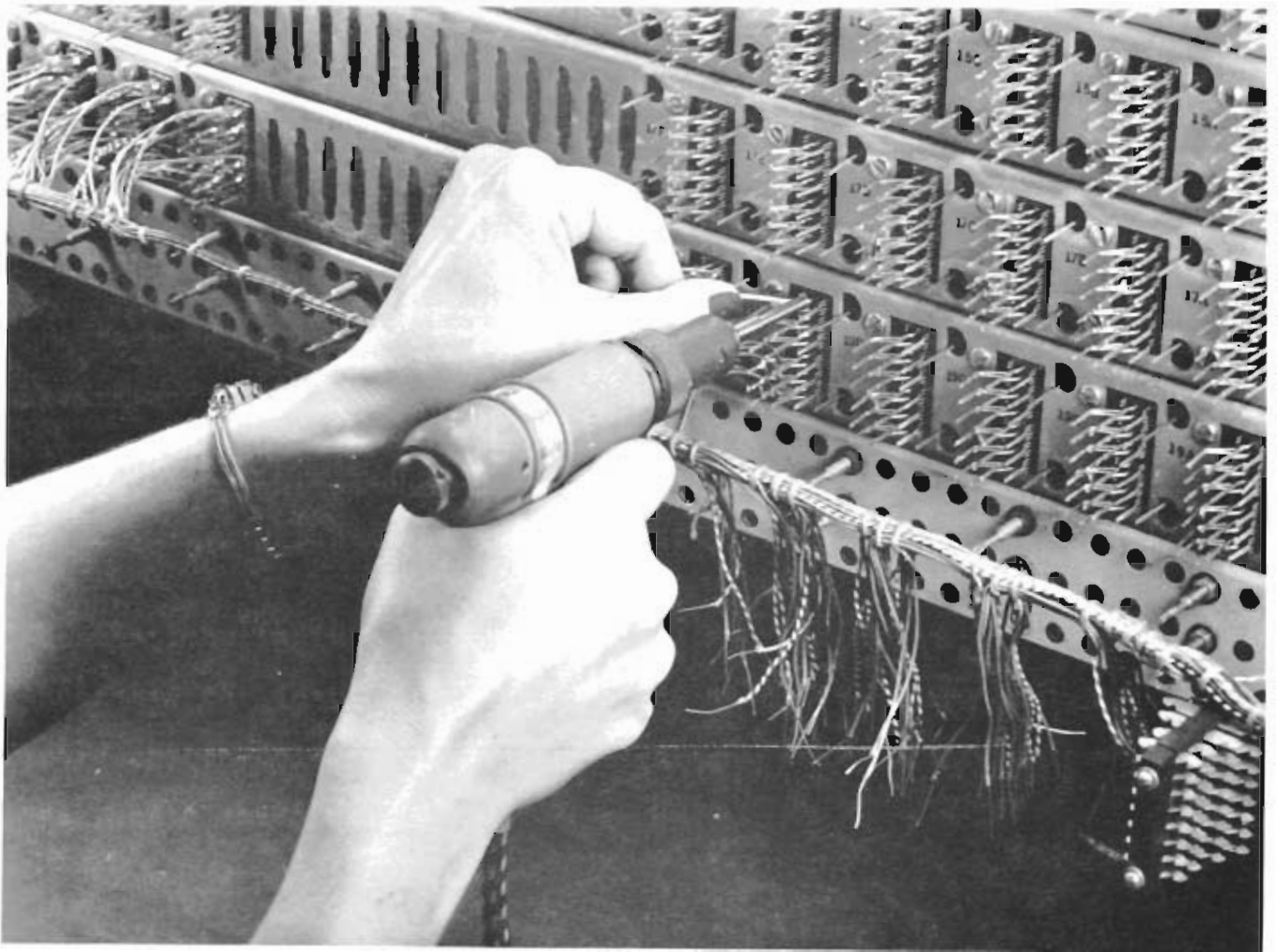


FIGURE 36 WIRE WRAPPING PROCEDURE

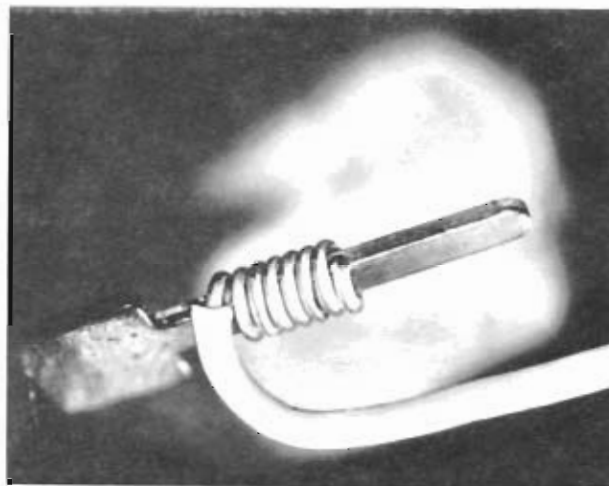


FIGURE 37 SOLDERLESS WRAPPED CONNECTION (SWC)

Whenever you see the term "SWC" in reference to an apparatus terminal, it means SOLDERLESS WRAPPED CONNECTION.

"Non-SWC" refers to a SOLDERED CONNECTION.

This distinction will be important to you in that type BU wire is normally provided for SWC apparatus terminals and type C wire for Non-SWC apparatus terminals.

Providing the Wiring and Connections

Some of the wiring and its connection for componenets is provided by Manufacturing when making equipment specifications. The more common types of wiring normally provided in the shop are:

- Straps
- Surface Wiring
- Loose Wiring
- Standard Local Cable
- Formed Cable

While the installer may at times provide these types, he will normally be concerned with providing:

- Loose Wiring
- Switchboard Wire
- Switchboard Cable
- Power Cable
- Jumpers

The next few pages illustrate these terms.

Straps

Straps are usually used to provide multiple connections of common leads between terminals of the same piece of apparatus or adjacent pieces of the same type of apparatus. The straps may be bare wire or insulated wire.

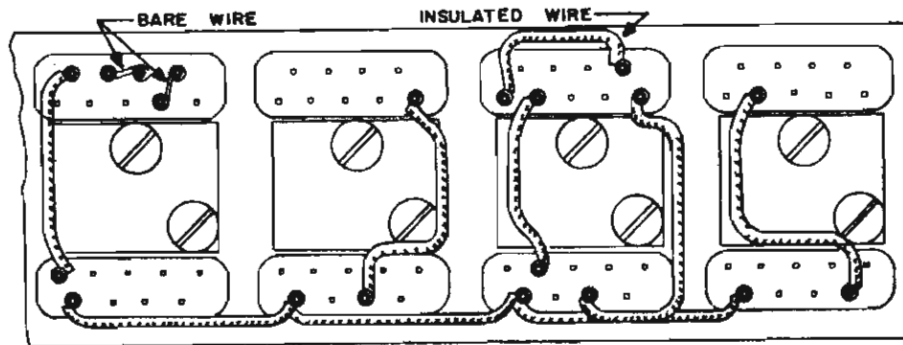


FIGURE 38 U-, Y-, AND SIMILAR TYPE RELAYS

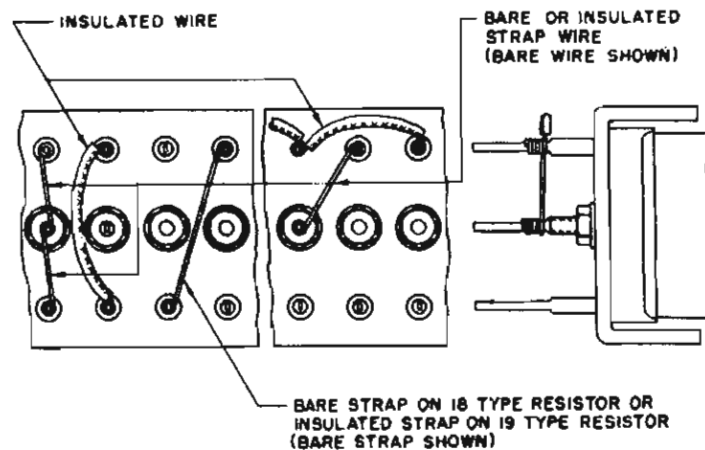


FIGURE 39 STRAPS ON 18 AND 19 TYPE RESISTORS

Surface Wiring

Surface wiring is wiring within a unit that is run loose and dressed near or against the mounting plate or panel on the rear. Refer to Figures 40 and 41. Surface wiring is Red for battery leads, Black for ground and Green for all other.

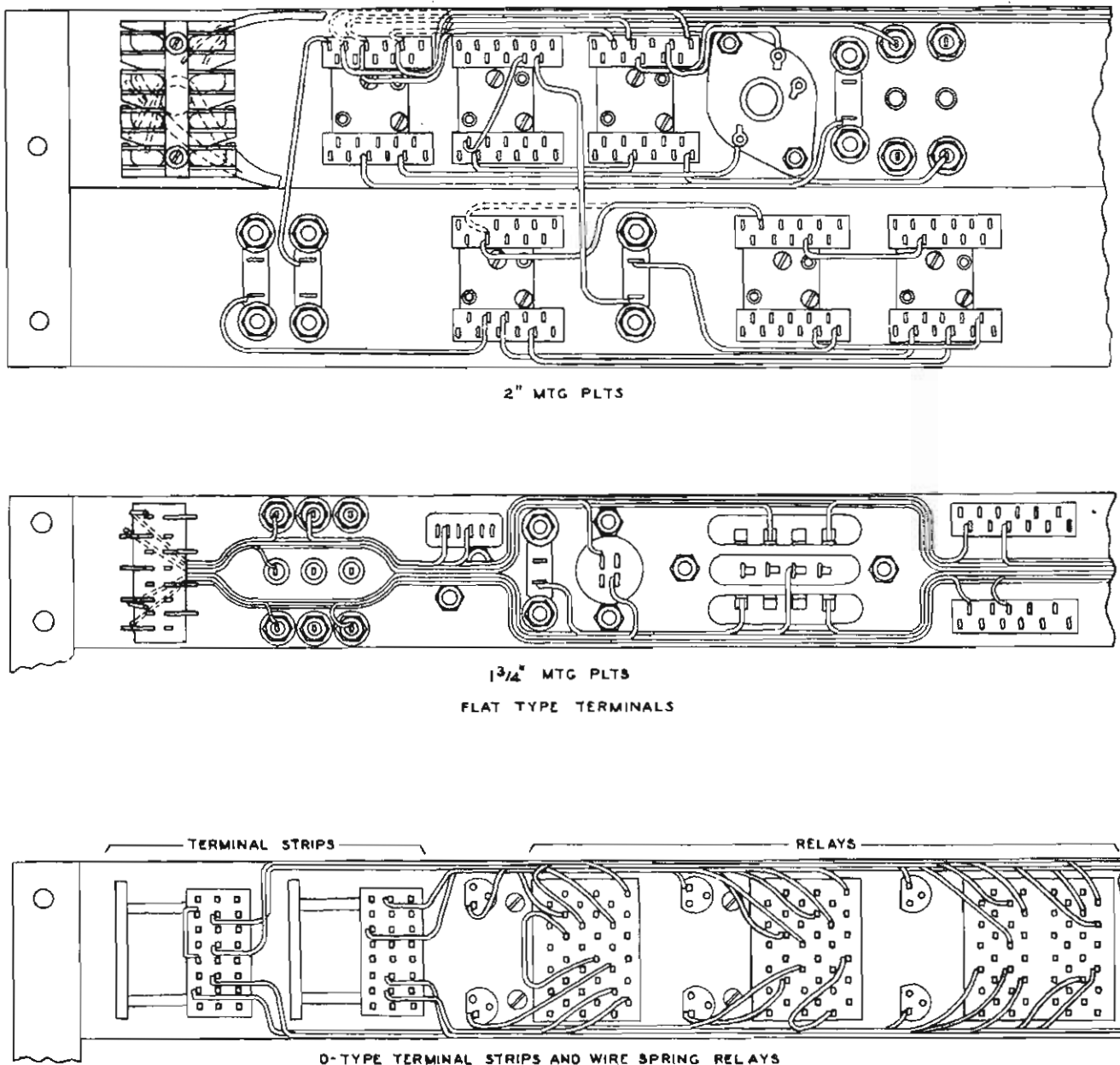


FIGURE 40 SURFACE WIRING - ARRANGEMENT OF WIRING IN PATHS - 1-3/4 AND 2-INCH MOUNTING PLATES

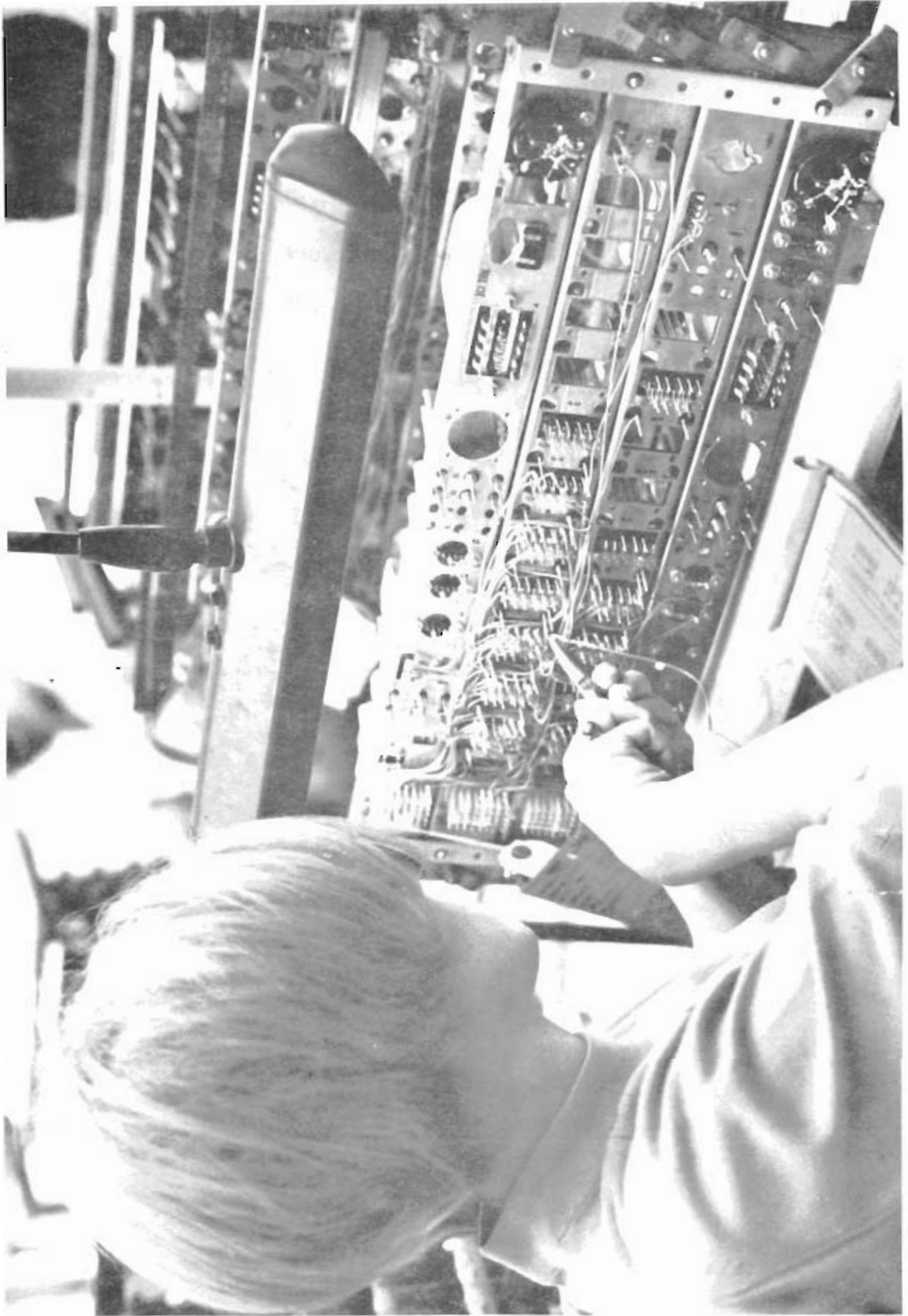


FIGURE 40 SURFACE WIRING OF A 4 PLATE MOUNTING UNIT

Loose Wiring

Loose wiring is wired within a frame or unit that is held in place by fanning rings, other retaining devices or ties.

Figure 42 is an example.

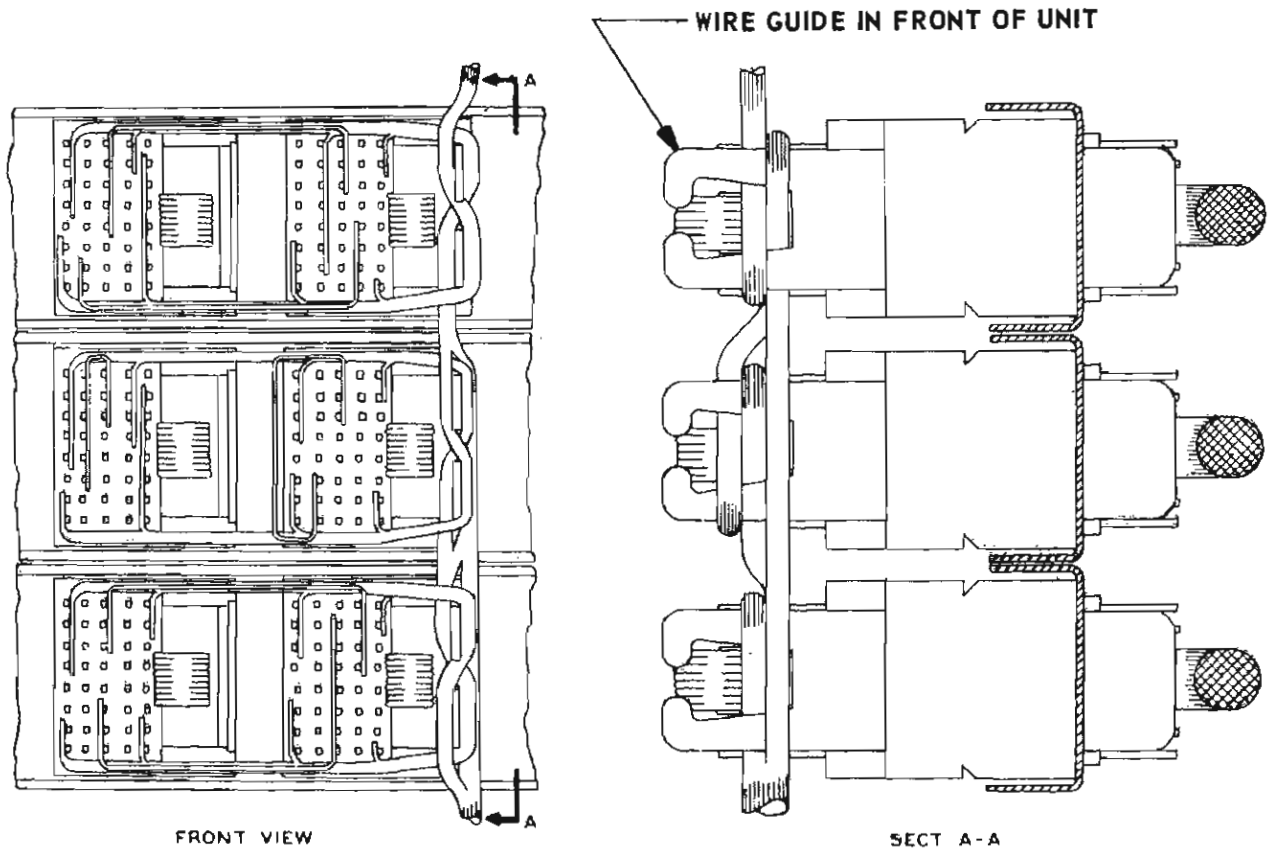


FIGURE 42 LOOSE WIRING ON FRONT (APPARATUS SIDE) OF D-TYPE TERMINAL STRIPS

Loose wiring is often provided on the rear of units and frames. It can be distinguished from surface wiring in that it follows standard color codes rather than just being red, black and green.

Standard and Local Cable

When equipment specifications for larger units, and especially frames, involve a large number of conductors, surface wiring is not practical. Instead, all of the conductors are formed together into a local cable which is then mounted on the frame or unit and connected.

The complexity of a local cable can best be illustrated by showing how it is prepared in the shop. All local cables are not this large but the principle is the same.

Figures 43 to 49 illustrate the manufacturing process.



FIGURE 43 FORMING BOARD

Shop personnel hammering nails used to guide the path of the cable on forming board. A drawing is placed on the forming board and is used as a pattern. The pattern is identical to the layout of the apparatus and terminals of the frame for which the local cable is being made.

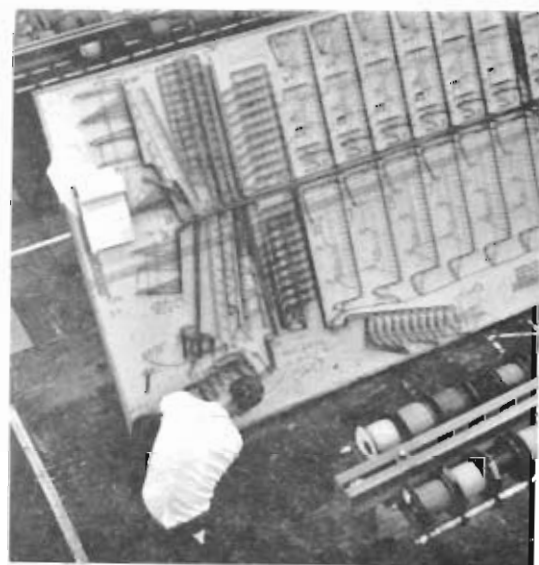


FIGURE 44 LOCAL CABLE FORMATION

Shop personnel in different stages of forming leads to different apparatus positions on a forming board.



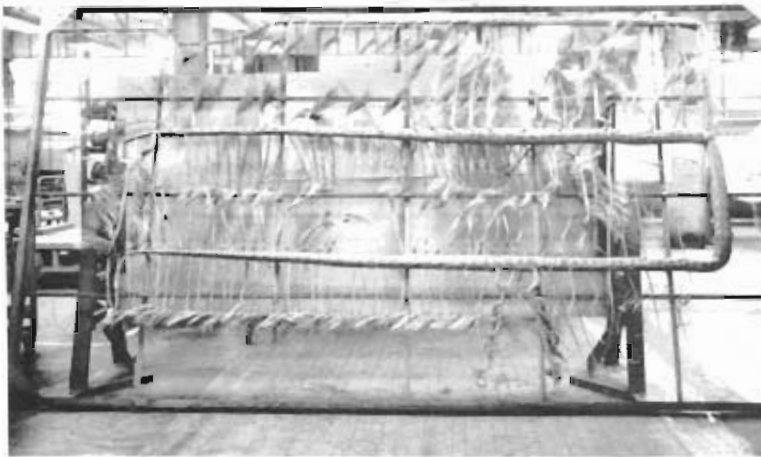
FIGURE 45 SEWING THE LOCAL CABLE FORM

An example of how the individual leads are secured together in forms using waxed linen thread.



FIGURE 46 STRIPPING ENDS OF LEADS

After forming, individual leads are cut to size and insulation stripped off in one operation.



The formed cable is off
the board ready for assembly.

FIGURE 47
A LOCAL CABLE

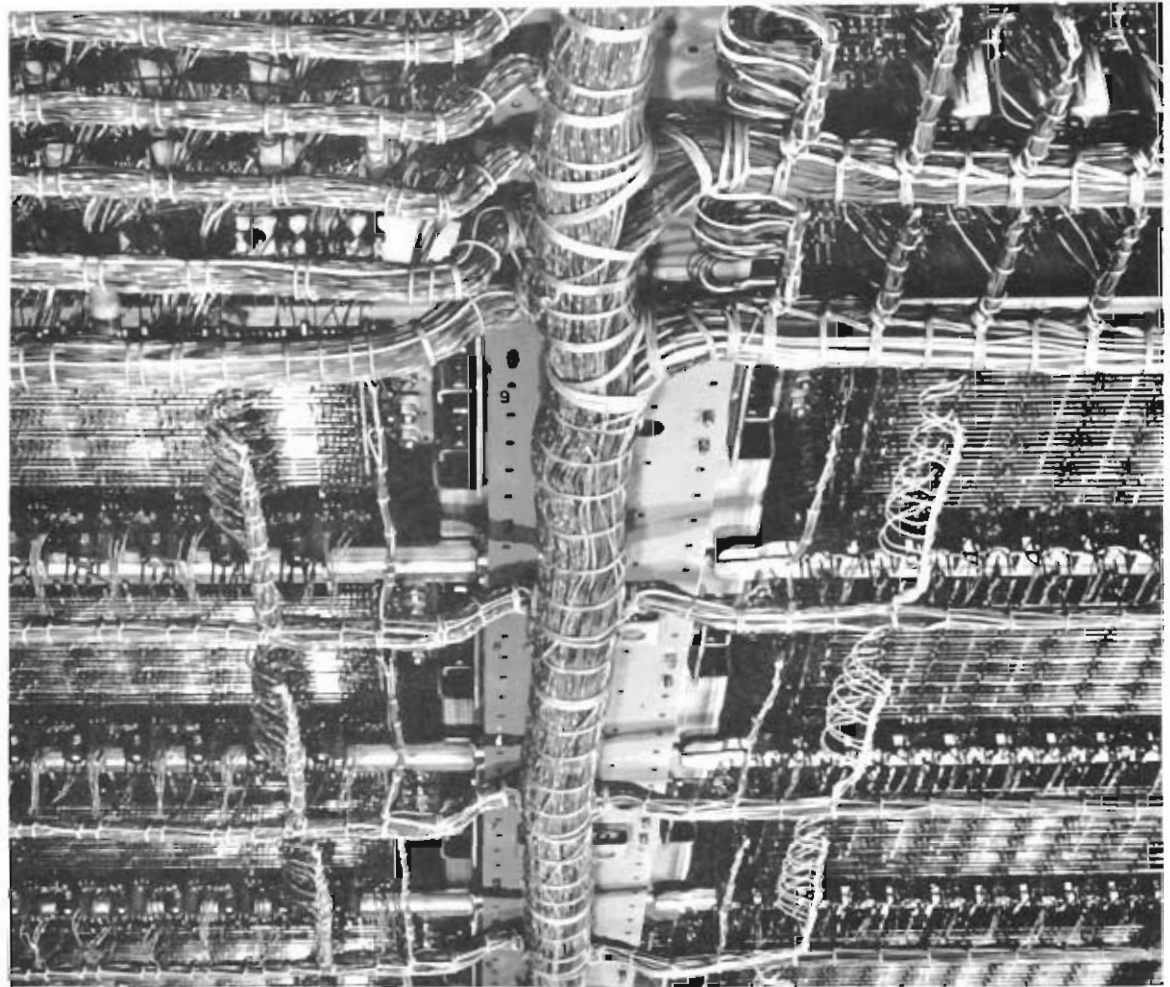


FIGURE 48

Formed Cable assembled on a frame.



FIGURE 49 CONNECTING CABLE ENDS

Manufacturing personnel connecting local cable forms to equipment using a "Wire Wrap Tool" on "SWC" terminals.

Formed Cable

Up to this point, the wiring types that you have seen are confined to use within a unit or frame. Sometimes it is necessary for the shop to provide a predetermined length of cable which will be installed between two different frames in the office. Any cable that is to "run" outside of the framework must be provided with an outside cover of insulation to protect the individual conductors.

Any cable with a plastic or fabric sheath or covering is called switchboard cable, the cable that is run between frames. When one or both ends of the cable is to be formed (similar to the way local cable is formed) the resulting cable is called "formed switchboard cable" or formed cable.

In formed cable provided by manufacturing, the outer sheath or covering is removed from the conductors as far as necessary and the individual leads are sewed into the required form. Once the cable is formed, it is shipped to the job site where the installer will "run" and connect it.

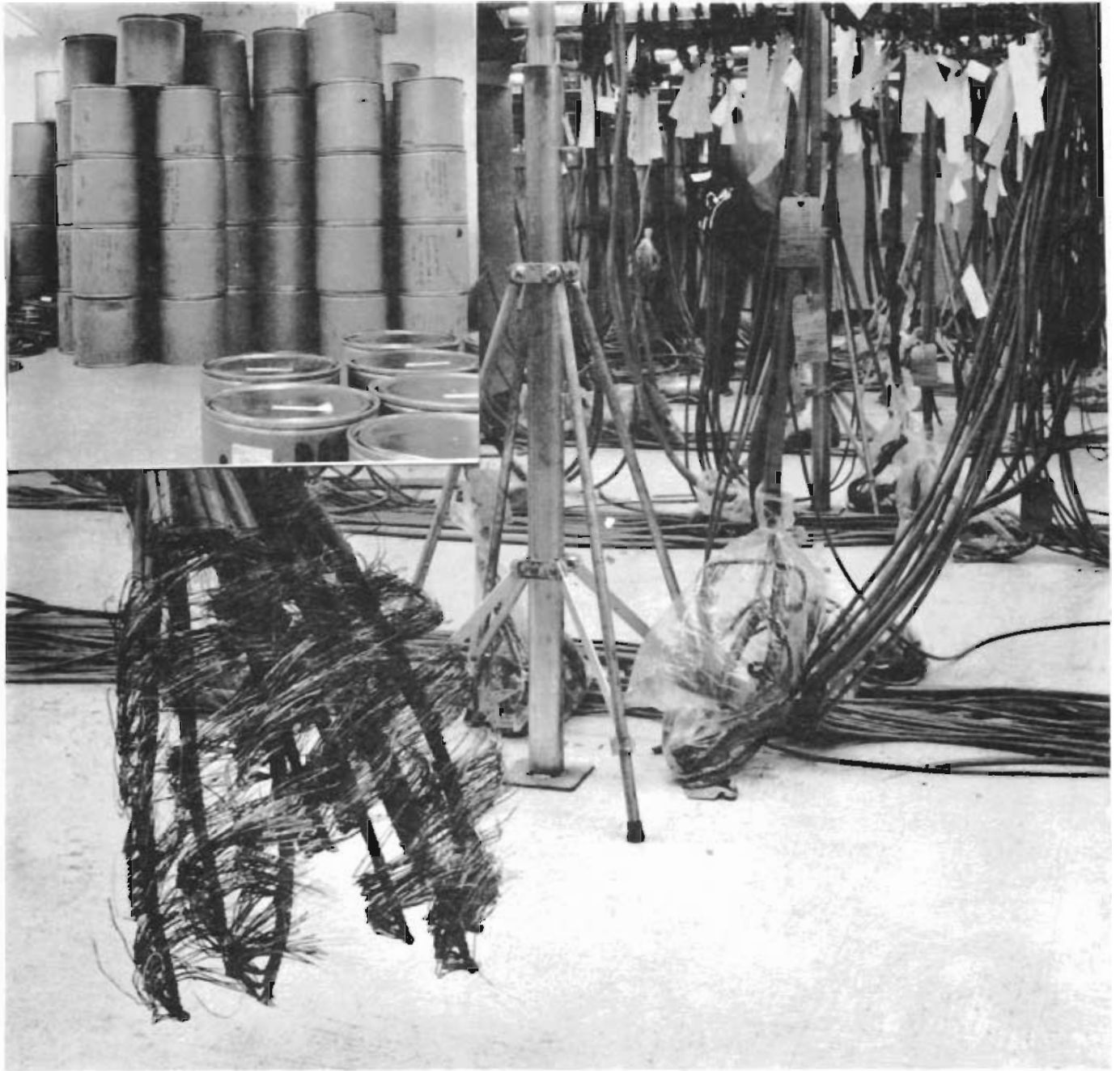


FIGURE 50 FACTORY FORMED CABLE

The factory formed ends are normally protected with clear plastic until they are connected. The formed cables are shipped in the containers shown in the upper left of Figure 50.

Installer's Wiring

Unlike the wiring provided within the frame by Manufacturing, most of the wiring provided by the installer is between frames or bays. Each functional circuit in the office is an essential part of the system and must therefore be connected to the other parts of the system.

Connections between component parts of a system are accomplished either by direct connection or connection through a distributing frame. These two methods are illustrated in Figures 51 and 52.

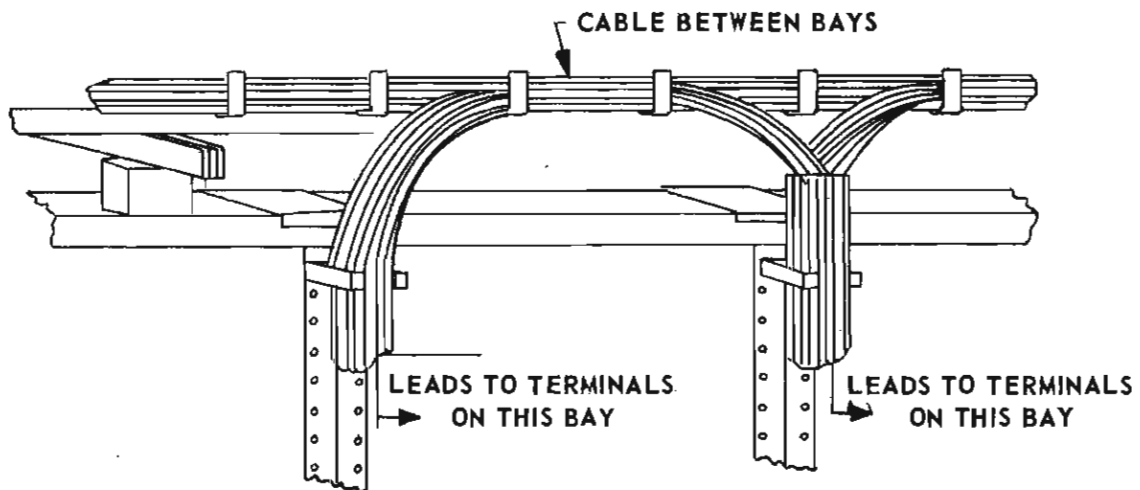


FIGURE 51 DIRECT CONNECTIONS - CABLE BETWEEN TWO DIFFERENT RELAY RECKS OR FRAMES

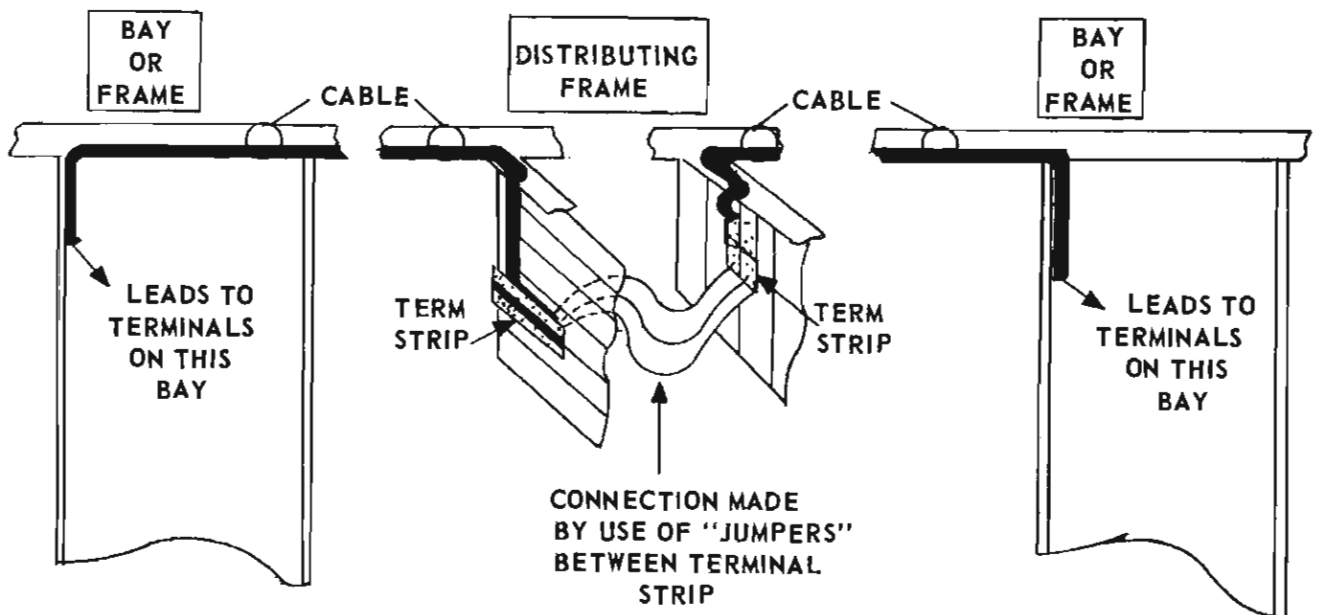


FIGURE 52 CONNECTIONS THROUGH A DISTRIBUTING FRAME

These two methods of interconnection, direct and through a distributing frame, bring about several terms of importance.

Switchboard Wire

Switchboard wire is color-coded wire such as that used in local cable or loose wiring. Although the installer will be required to install loose wiring on Relay Racks and frames, he will also run switchboard wire between bays or frames. This is done when four or less leads are required.

When the installer runs switchboard wire between bays or frames he, and you, will identify this wire by the number of conductors and gauge as follows:

Code S, P, T or Q plus the gauge which can be 16, 20, 22 or 24.

| | |
|-------------|---------------------------|
| One lead | S16 or S20 or S22 or S24 |
| Two leads | P16, or P20 or P22 or P24 |
| Three leads | T16 or T20 or T22 or T24 |
| Four leads | Q16 or Q20 or Q22 or Q24 |

Switchboard Cable

When more than four leads are required between bays or frames, the installer will run switchboard cable. You will specify the "code" of cable required for each condition by selecting the proper code from Sections 890 and 891 of the SE & SE Handbook.

Codes of cable are based on first selecting the proper wire type:

- type "C" for non SWC terminal connections, and
- type "BU" for SWC terminal connections.

Type C wire is used in "M" type cable. Type BU wire is used in "A" type cable. See the examples:

Examples: 182M = cable with type C wire
 182A = cable with type BU wire

Once the wire type is determined, the proper gauge is selected; then the number of pairs and/or singles required for the circuit being cabled. All of the leads in a switchboard cable are color coded in accordance with the standard colors but this normally isn't of much concern to you since you will have selected the proper cable code based on

- wire type (C or BU)
- gauge (16, 20, 22, 24)
- number of pairs and singles required.

The installer will use the different colors to keep track of connections at both ends of the cable. Figure 53 illustrates what a cable end would look like to the installer.

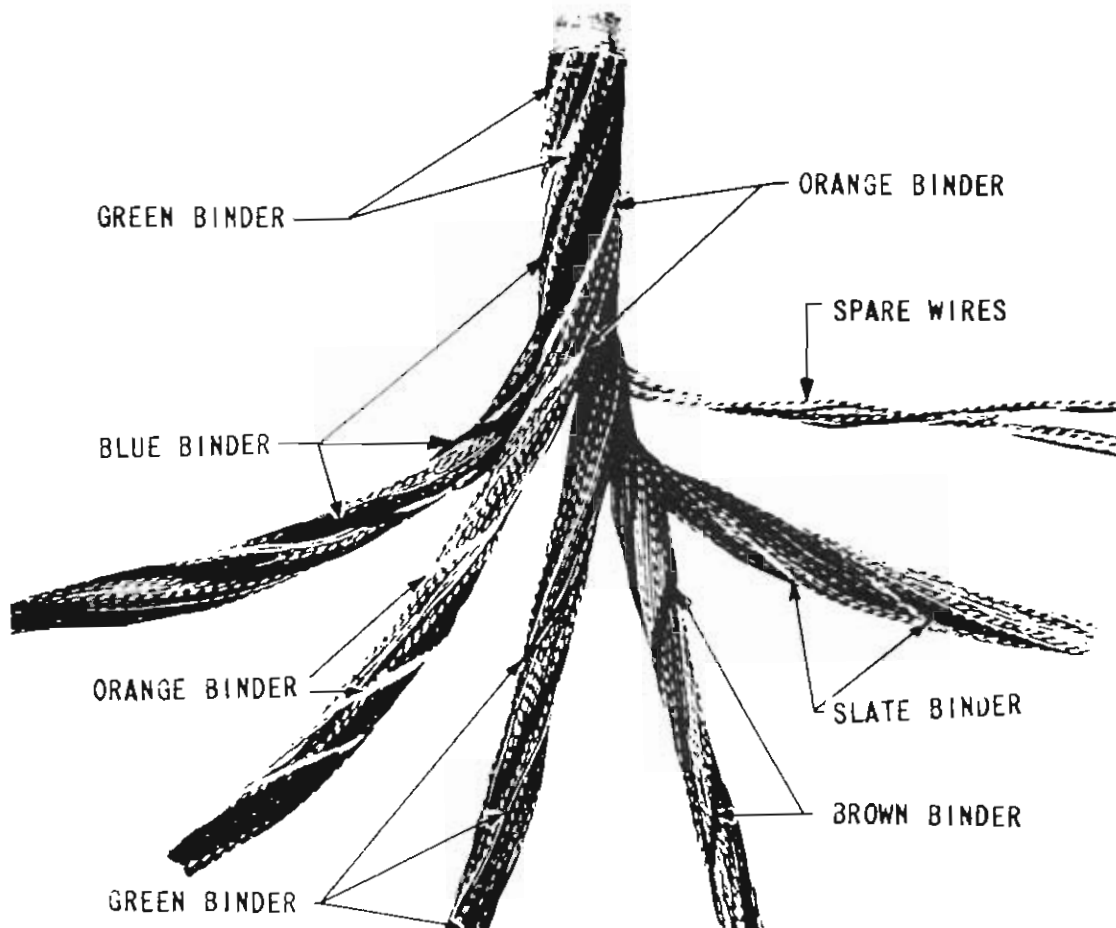


FIGURE 53 COLOR CODED LEADS AND UNITS
IN CABLE

Cable Run

In the process of engineering, preparing specifications, you will prepare the cable runs that the installer will eventually make. In doing so, you will specify where the cable is to run from and where it will run to.

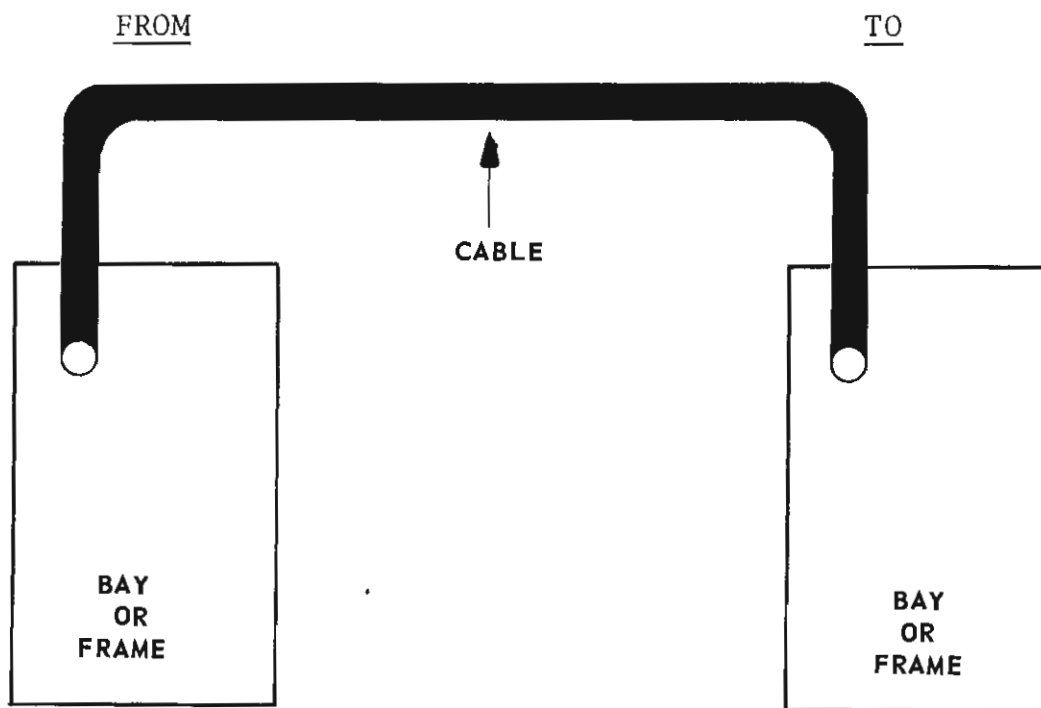


FIGURE 54 CABLE RUN

You identify the from end by specifying (1) which bay or frame, (2) where on that bay or frame.

You identify the to end by specifying (1) which bay or frame, (2) where on that bay or frame.

The detailed information about cable runs is provided in Course 021 EA-ED and the SE & SE Handbook, Section 48.

[illegible]

FIGURE 55 CABLE TAGS

Cable Rack

Cables and wires run between bays, and frames must be supported and held in place. The ironwork provided in a central office to hold cable is called cable rack. It can either be "bar type" or "ladder type" as shown in Figure 56.

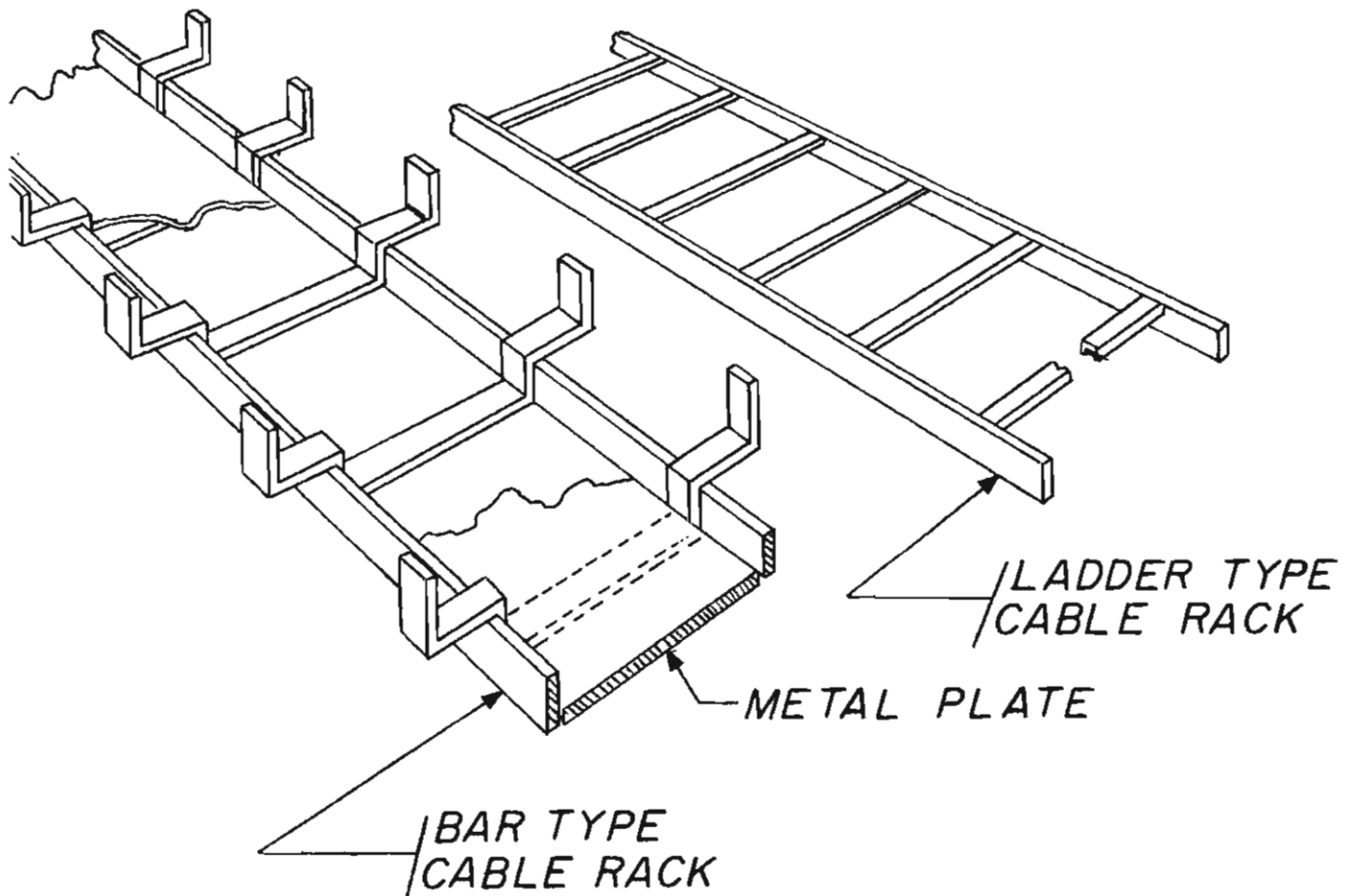


FIGURE 56A CABLE RACK TYPES

Ladder type cable rack, extending to a cable hole in the ceiling, is shown in Figure 56B. (View of cable rack before installation of cables.)

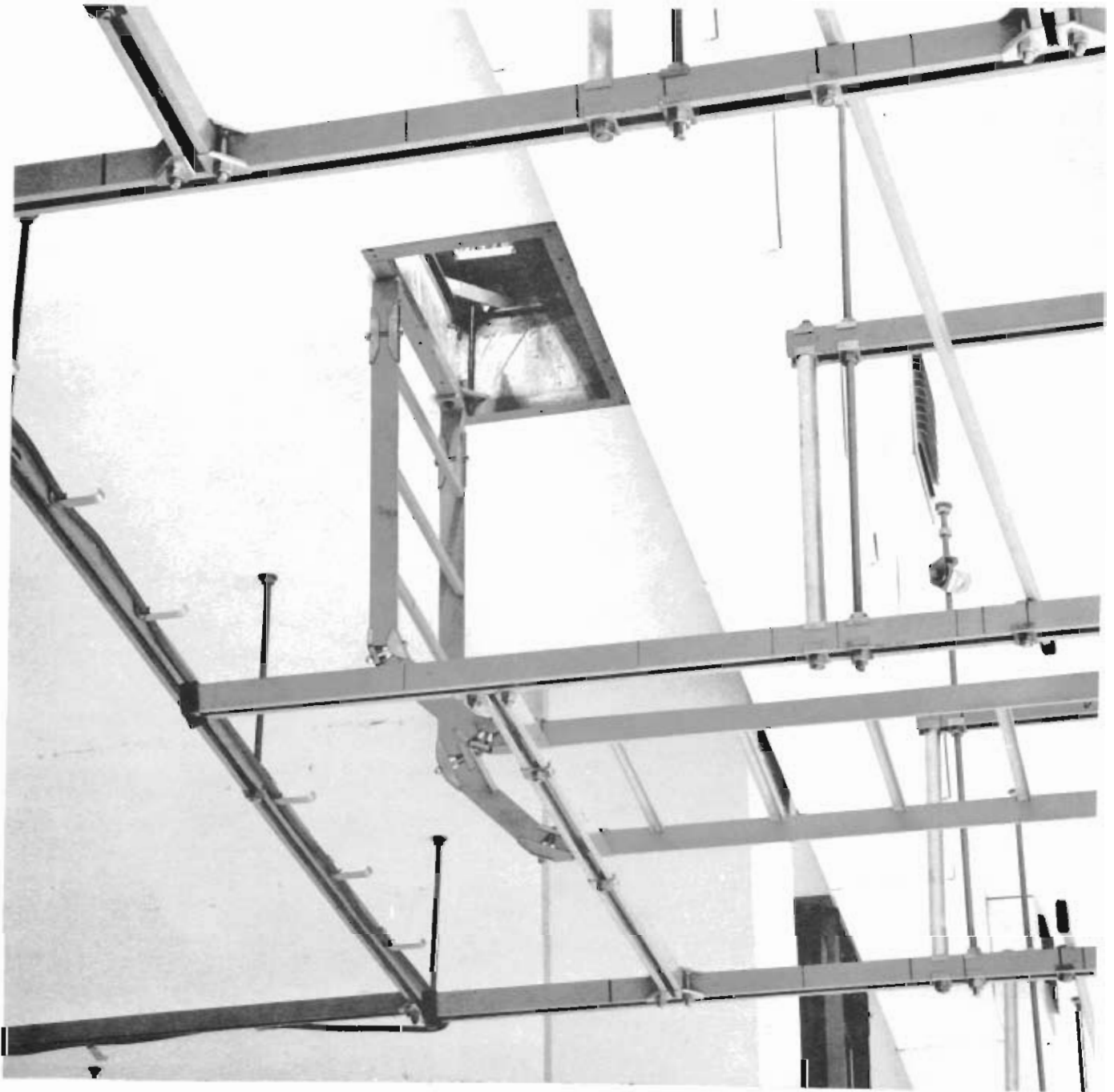


FIGURE 56B LADDER TYPE CABLE RACK

Cable rack may run parallel with the frame lineup or perpendicular. Both, over aisle and cross aisle are shown in Figure 57. It is also possible to have over frame cable rack.

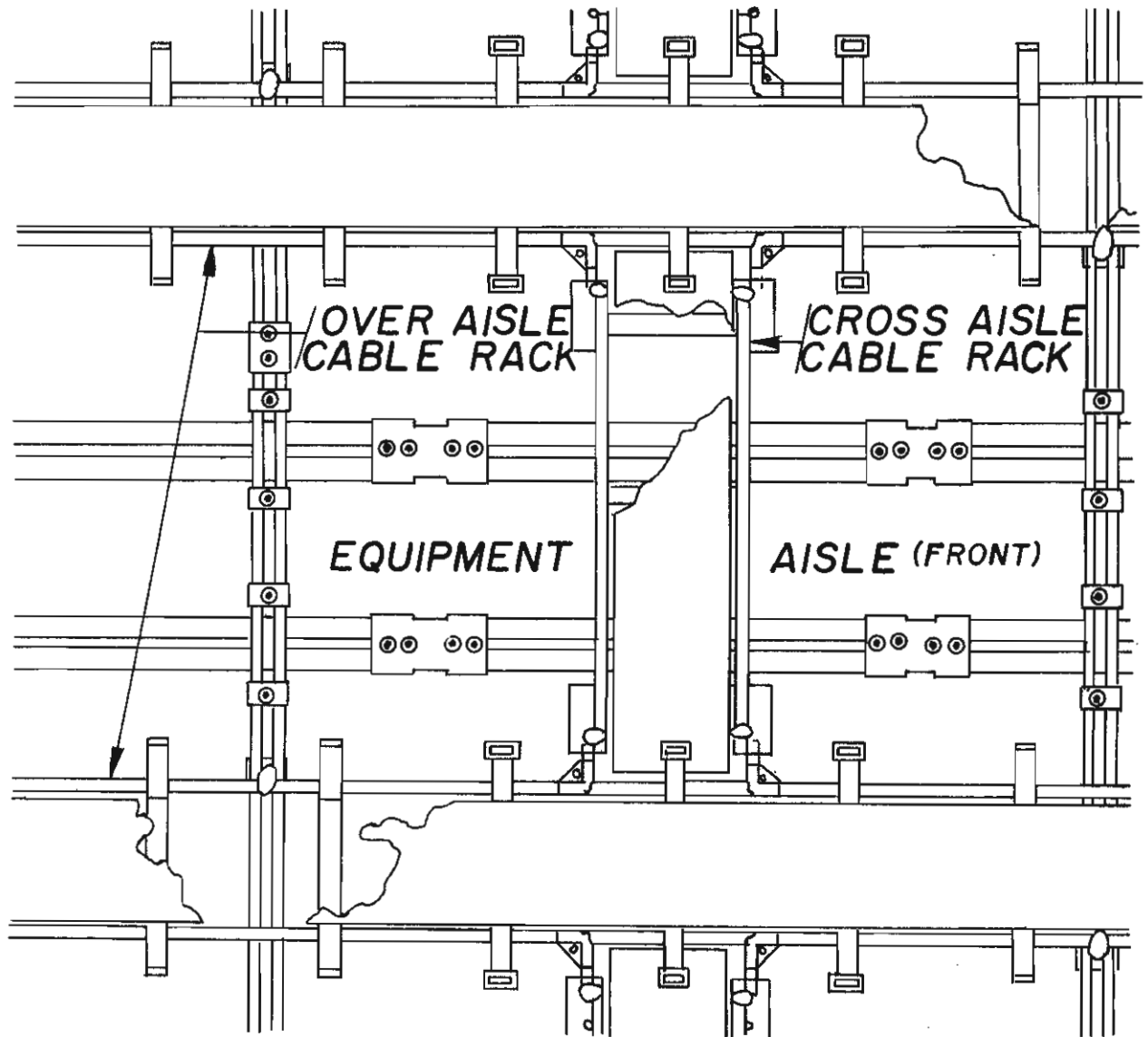


FIGURE 57 OVER AISLE & CROSS AISLE CABLE RACK

Over aisle (from left to right) and cross aisle (junctioning from the right) are illustrated in Figure 58 which shows a view of the cable rack before the frames or cables are installed.

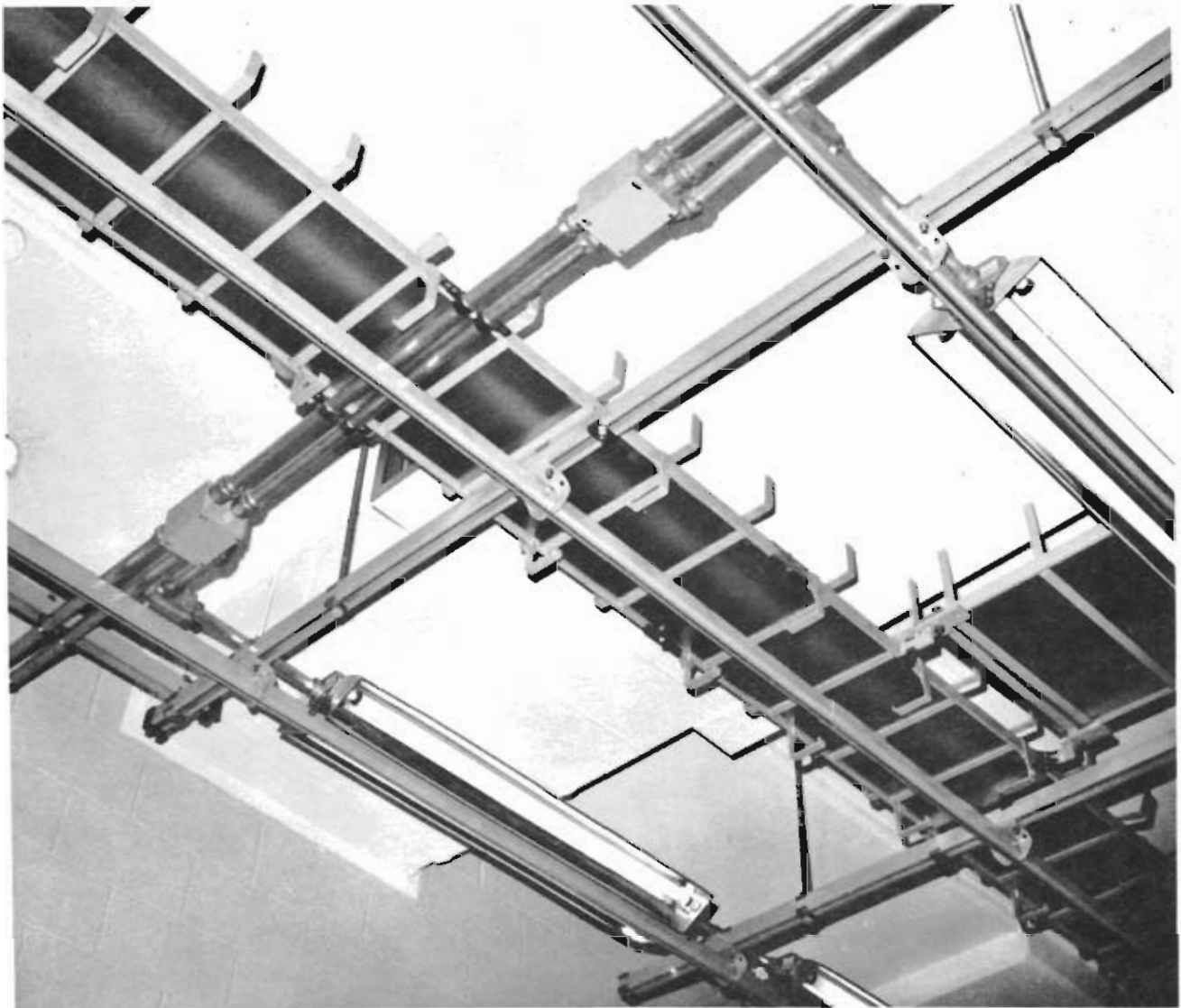


FIGURE 58 BAR TYPE RACK BEFORE
FRAME INSTALLATION

The cable runs are laid in the cable rack and "drop" over the side to the equipment on the bay or frame. This concept of "drops", the cable distance from the cable rack to the apparatus terminals is illustrated in Figure 59 through 62.

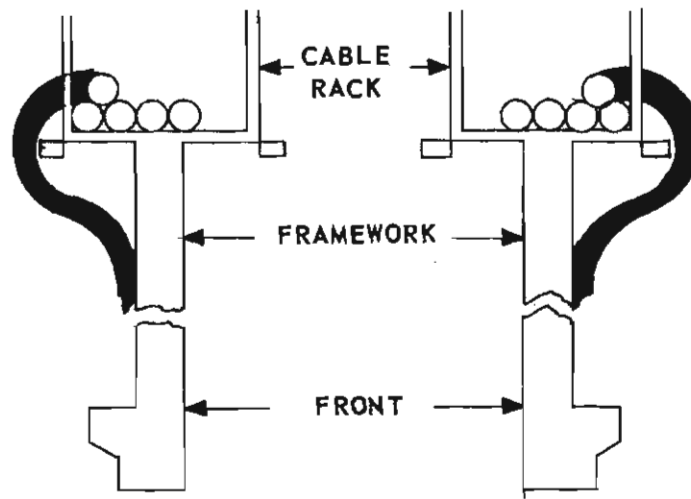


FIGURE 59 END VIEW OF FRONT AISLE SHOWING POSITION OF OVER FRAME CABLE RACK

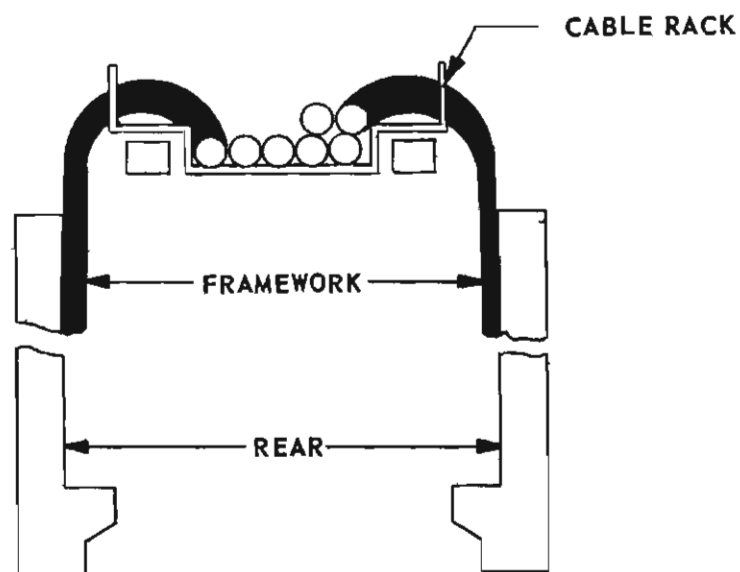


FIGURE 60 END VIEW OF REAR AISLE SHOWING POSITION OF OVER AISLE CABLE RACK



FIGURE 61 TYPICAL CABLE DROPPING
FROM CABLE RACK TO EQUIPMENT

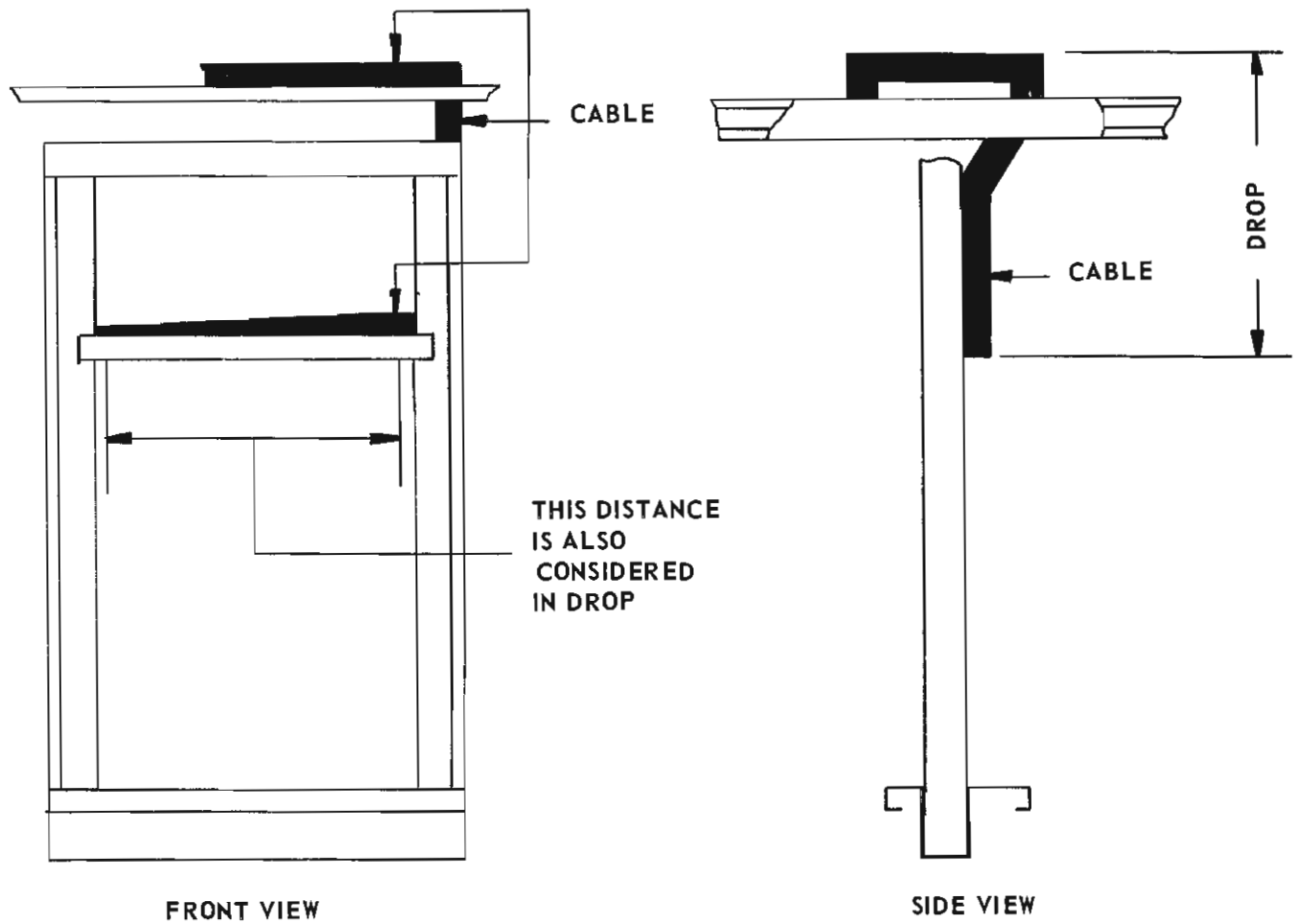


FIGURE 62 ILLUSTRATION OF A DROP

For those of you who will be concerned with the details of measuring drops, the information is covered in Course 021EC and Section 48 of the SE & SE Handbook.

Surface Wiring

The installer will usually only provide surface wiring when modifying units that exist in the office or to add circuit components to an existing unit. The installer would install the Red, Black or Green surface wire exactly the same as if it were done by Manufacturing, covered earlier in this course.

Loose Wiring

Similarly, the installer may do all of the loose wiring, add some or change loose wiring for a modification by placing the required wires in the fanning strips, retaining clips or other retainers provided on the unit or frame.

Sewed Forms

Sometimes it is required that the installer form the wires for a unit or frame by sewing them together similar to the way local cable is made. This is illustrated in Figure 62.

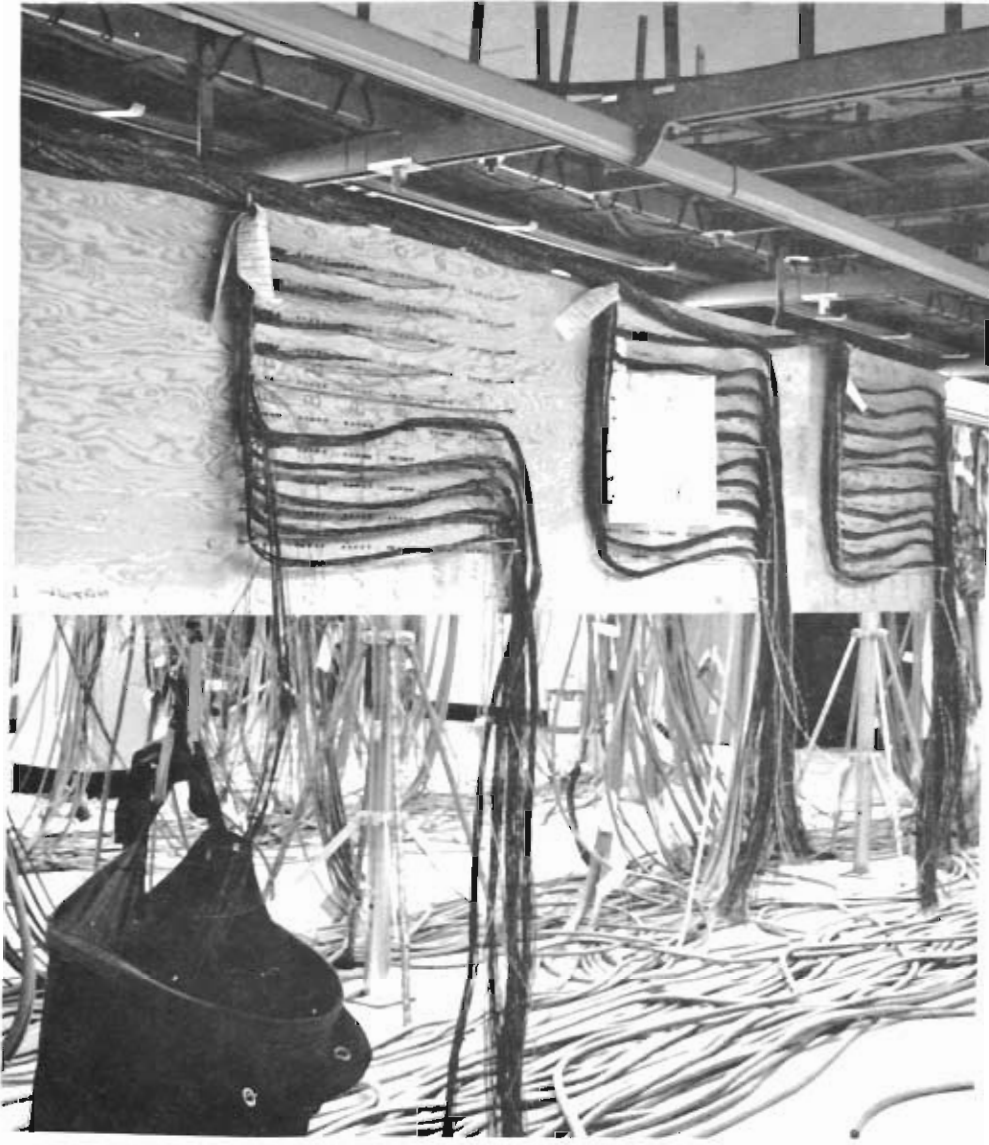


FIGURE 62 INSTALLER FORMED CABLE

The overall installation of wires and cables is illustrated in Figure 63 to 71.



FIGURE 63

Tagged Cable runs in place prior to the installation of bay framework.

With the switchboard cables in place, the frames and relay racks are then moved in.

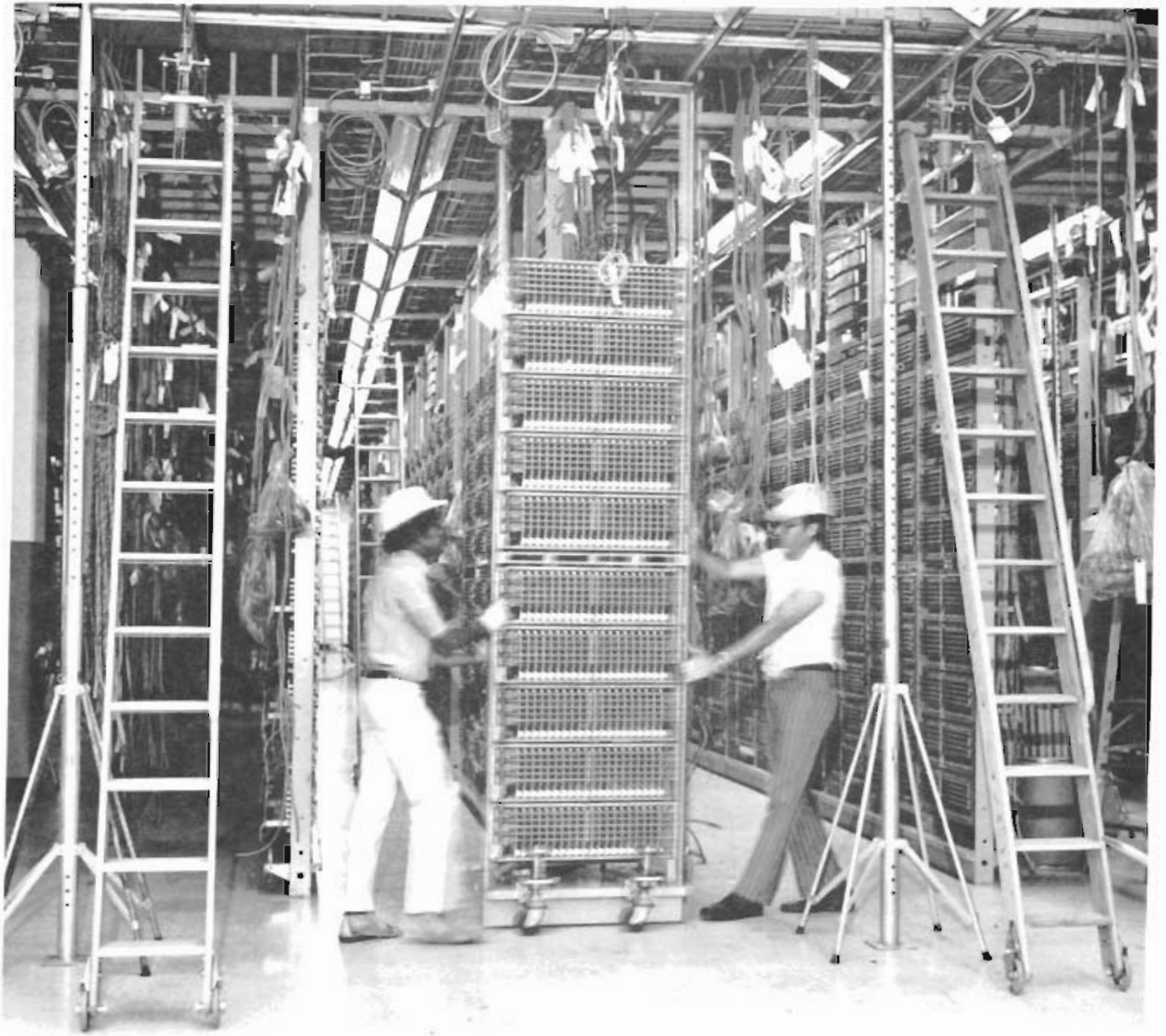


FIGURE 64 FRAMES BEING MOVED INTO PLACE AND PERMANENTLY INSTALLED

As the frames are installed, the cable is ready for connection to the equipment.

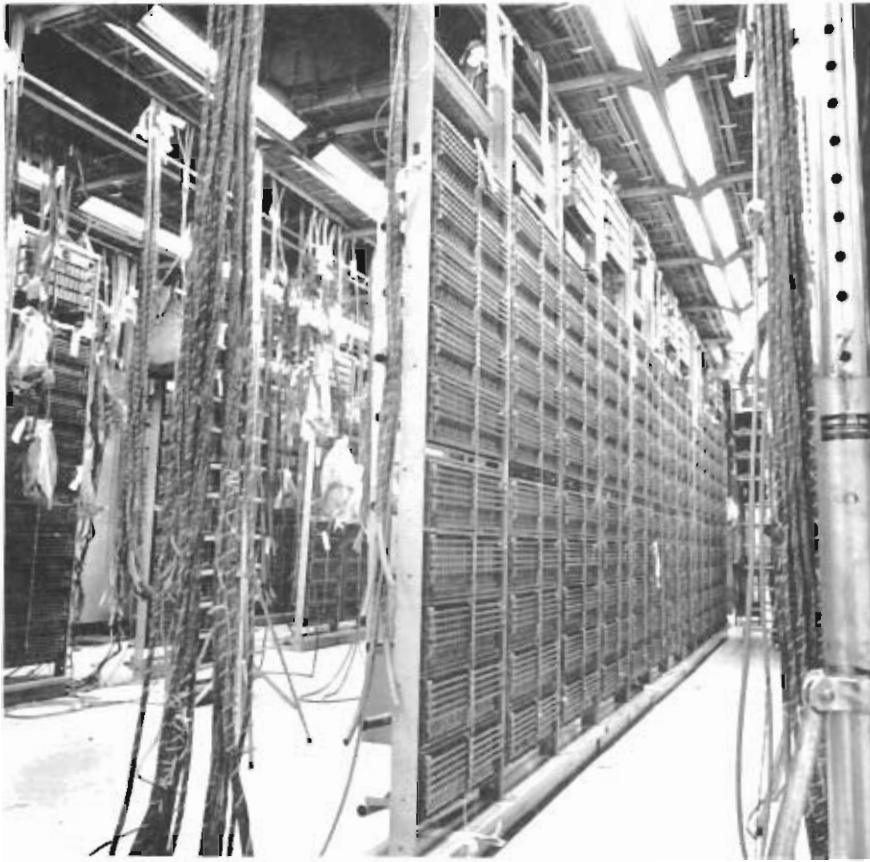


FIGURE 65

Frames being installed (Bays are temporarily held in place with straps until they can be secured).



FIGURE 66

Installer checking information on cable tags as it relates to connecting cables to the equipment.

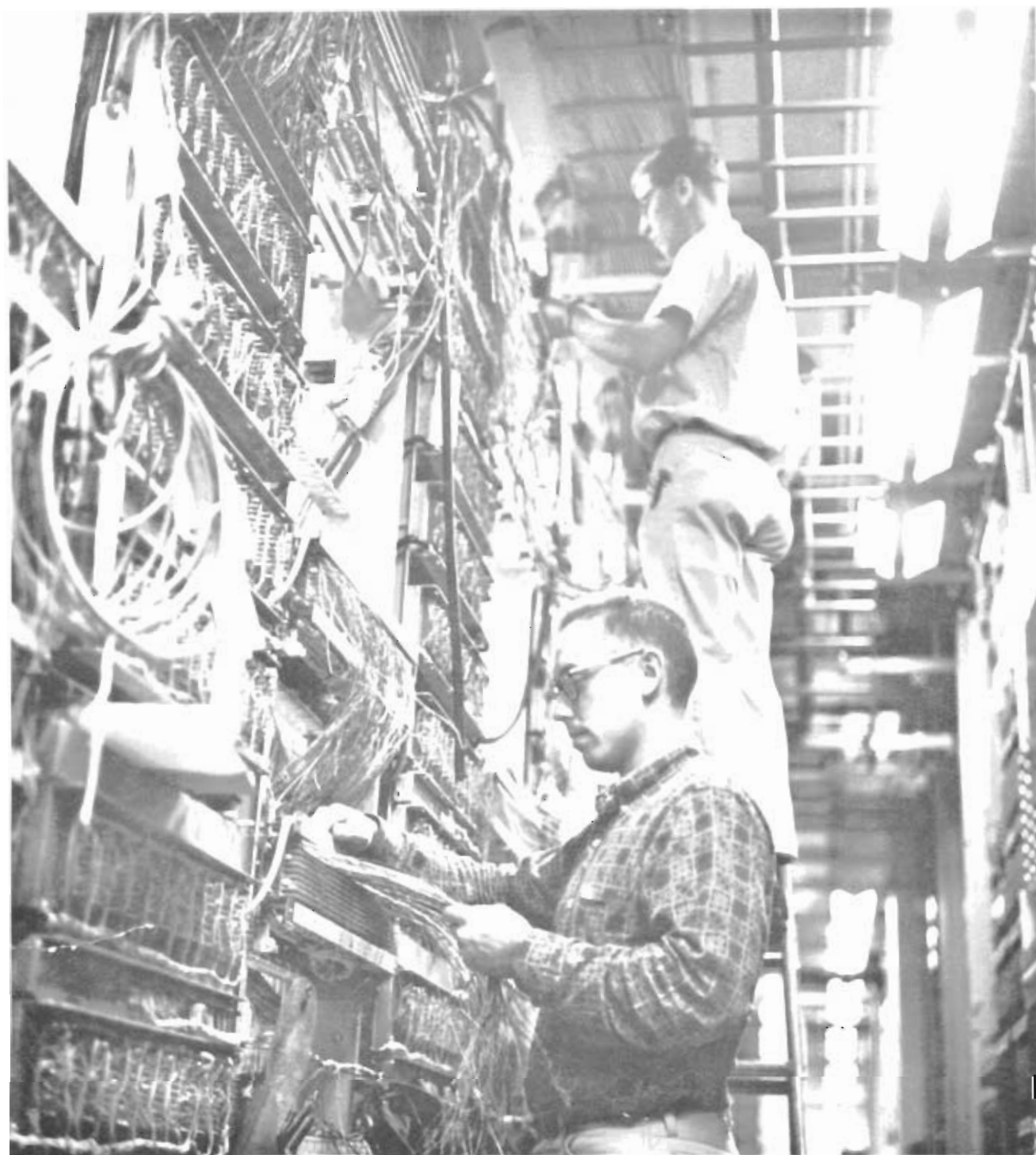


FIGURE 67

Installers pulling conductors through terminal strip fanning holes.



FIGURE 68

Installer separating individual conductors by colors prior to running leads to individual apparatus positions.



FIGURE 69

Installer running individual leads to apparatus position.

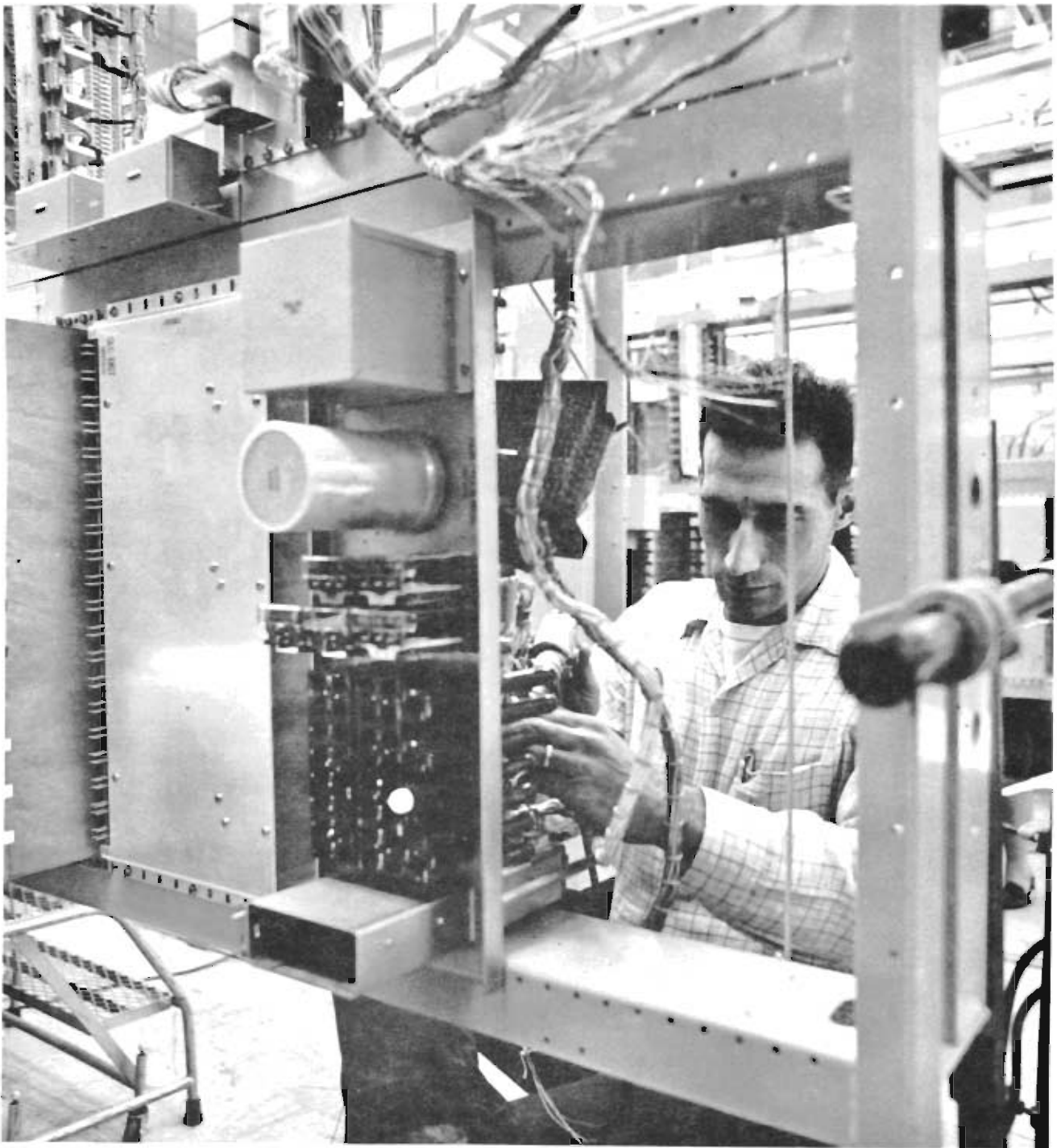


FIGURE 70

Looking from the equipment side where the installer is connecting individual leads to apparatus terminals using wire wrap connector.

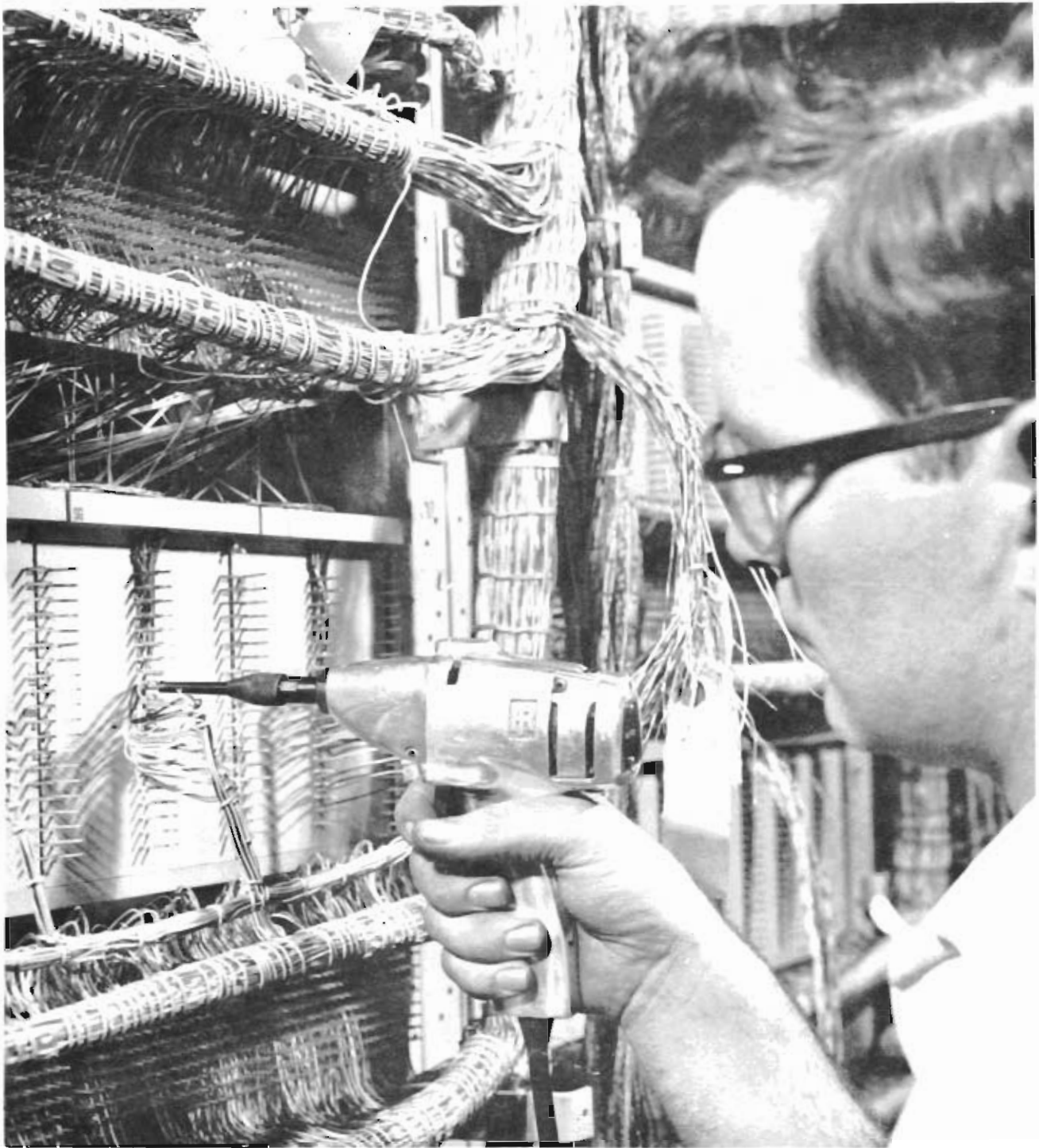


FIGURE 71

On wiring side of a frame the installer putting on individual leads that project out from a formed cable.

Distributing Frames

Several times the term "distributing frame" has been mentioned. As illustrated in Figure 52, a distributing frame is provided when it is desired to provide a relatively flexible connection between central office components instead of connecting them directly.

Distributing frames are usually double sided (i.e. horizontal side and vertical side) although single sided frames are provided in some systems. Distributing frames are named. The more common names are as follows:

Main Distributing Frame (MDF) - where the cables from outside the central office terminate.

Intermediate Distributing Frame (IDF) - for connections between equipment in a central office.

Combined Distributing Frame (CDF) - where a frame serves as MDF and IDF.

Trunk Distributing Frame (TDF) - for terminating trunks and their connecting signalling and transmission equipment.

The horizontal side of a distributing frame is named after the horizontal supports as shown in Figure 72. It is abbreviated "H" such as the HMDF shown below.

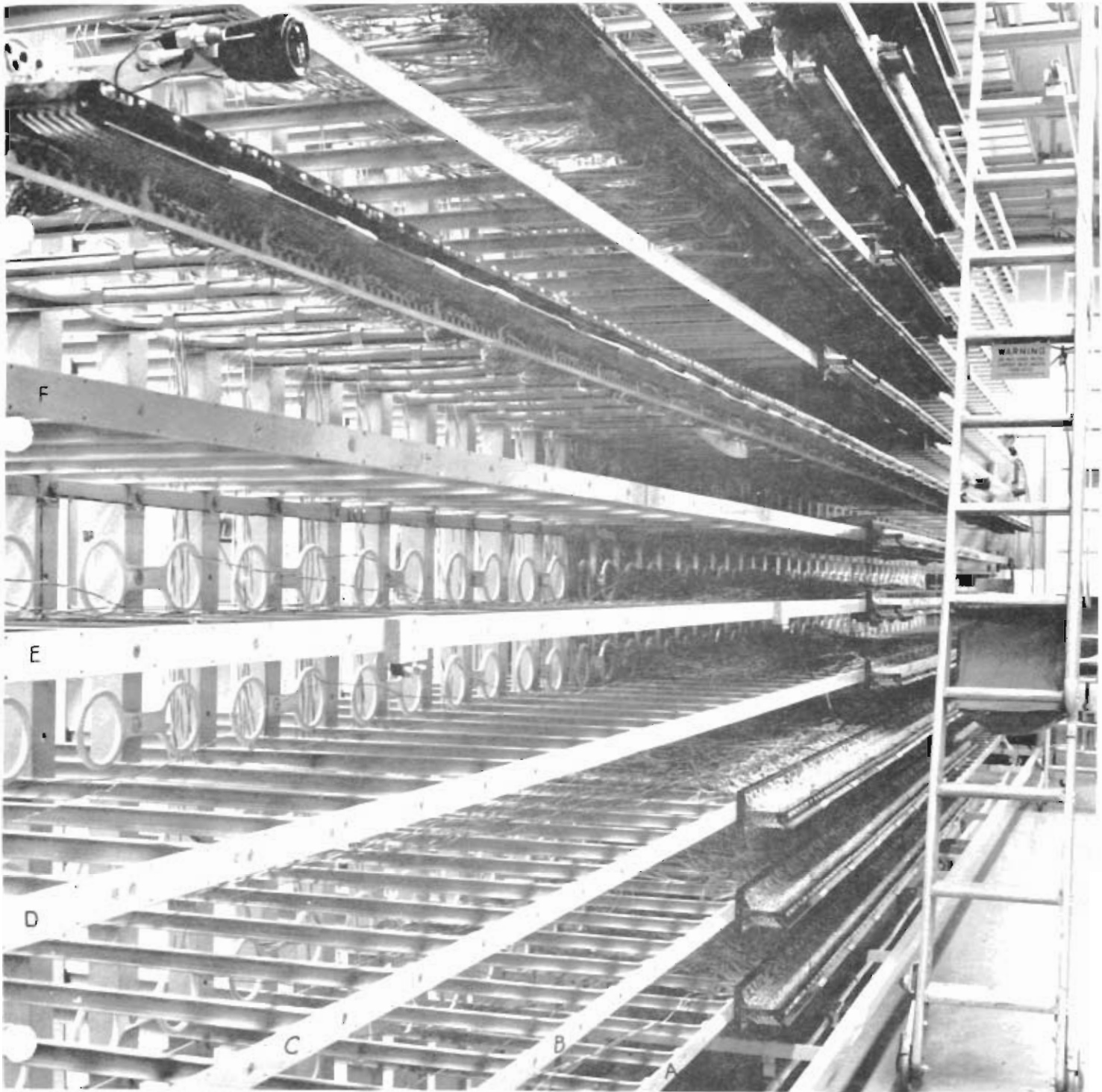


FIGURE 72 HORIZONTAL SIDE OF MDF

The vertical side of a distributing frame has vertical supports abbreviated "V" such as in the VMDF shown in Figure 73.

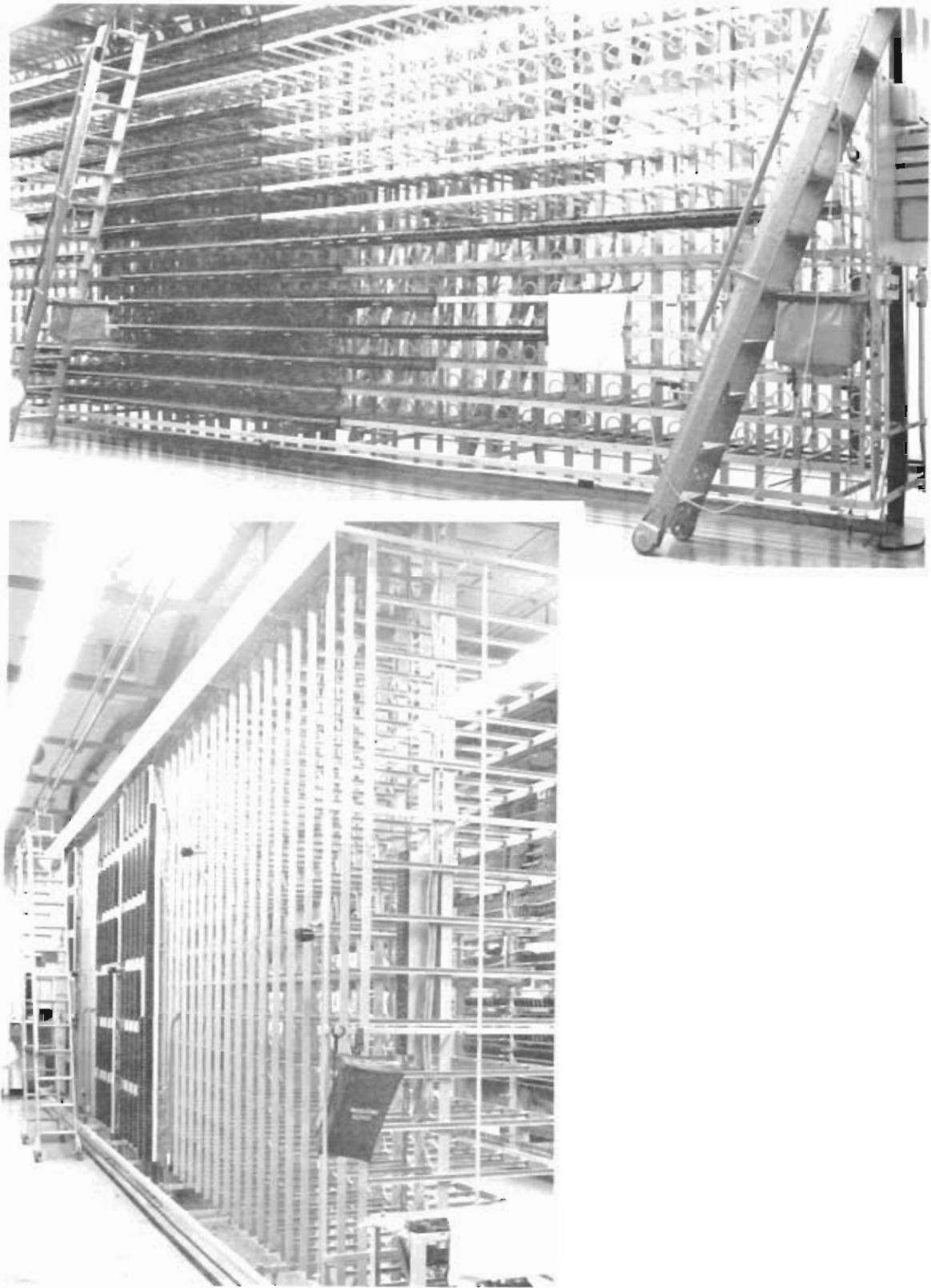


FIGURE 73 VERTICAL SIDE OF MDF

Terminal Strips

Distributing frames are predominately used to mount terminal strips as shown in Figures 74 and 75.

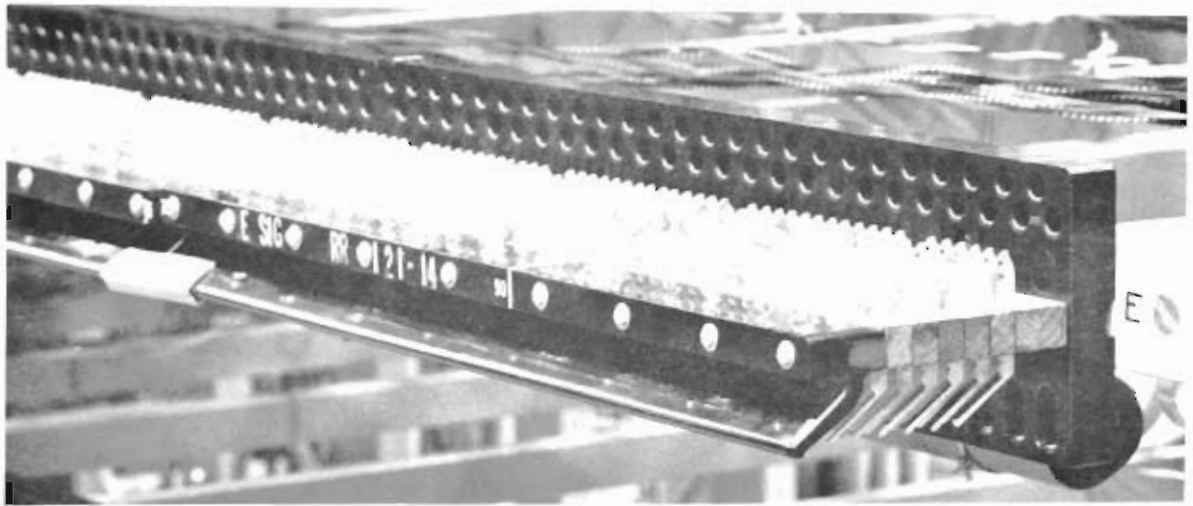


FIGURE 74 TERMINAL STRIP ON HMDF

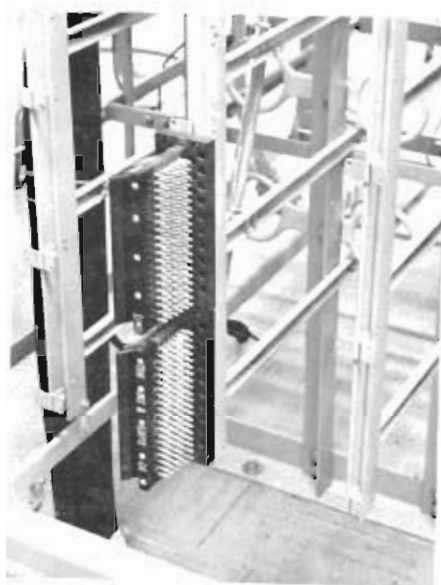


FIGURE 75 TERMINAL STRIP ON VMDF

Jumpers

The connections between terminal strips on a distributing frame are called jumpers. Jumpers are sometimes called cross connection wire and is furnished as single, two conductor, three conductor or four conductor. Jumpers are identified by abbreviations and are ordered as codes are indicated below:

| Conductors | Abbreviated | Ordering Code |
|---|-------------|-----------------|
| single conductor | 1W | U20S (20 gauge) |
| two conductor | 2W | U20P (20 gauge) |
| | | U22P (22 gauge) |
| three conductor | 3W | U22T (22 gauge) |
| four conductor (twisted spirally) | 4W | U22F (22 gauge) |
| four conductor (two pair twisted together) | 4W(P) | U22M (22 gauge) |

This cross connection wire is also used on some frames other than distributing frames in central offices but the same abbreviations and codes apply.

Three other common types of equipment that mount on the distributing frame are: - protectors

- jack boxes

- loudspeaker telephones

Protectors are lightning protectors for preventing surges of electrical current from lightning or other sources from entering the central office equipment and doing serious damage. Lines from subscribers and other offices enter the office through these protectors. (See Figure 76)

Jack Boxes are provided to allow installation and maintenance personnel jack access to portable test equipment and other test circuits. (See Figure 77)

Loudspeaker Telephones provide installation and maintenance personnel a "hands free" method of communicating with the test center in the office. (See Figure 77)

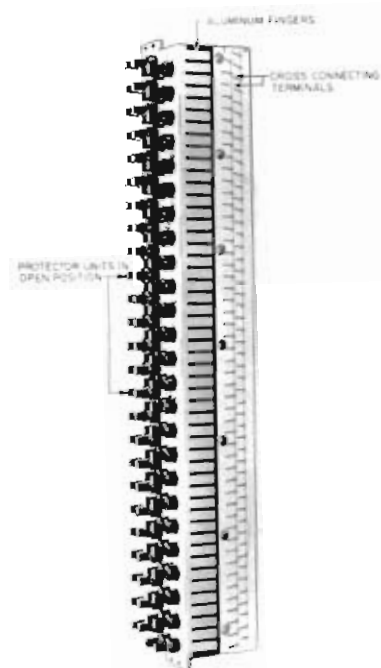


FIGURE 76 PROTECTORS



FIGURE 77 JACK BOX AND LOUDSPEAKER TELEPHONE

Power Cable

Switchboard cable and wire is limited in size to the gauges mentioned earlier. When larger sizes are required for the distribution of power to the equipment in the office, power cable is provided.

For the most part, power cable is solid copper or aluminum wire. Smaller cables are single conductors while larger ones have stranded cable to allow for bending. This is illustrated in the end views of power cable shown in Figure 78.

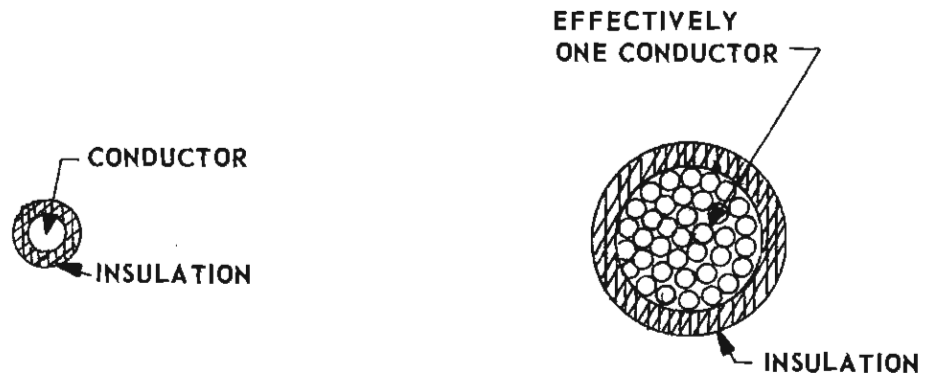


FIGURE 78 POWER CABLES

Power cables run from the power fusing point on the Power Board or Battery Distributing Fuse Board (BDFB) to the equipment bays. Figure 79 shows power cables terminating on the Power Board.

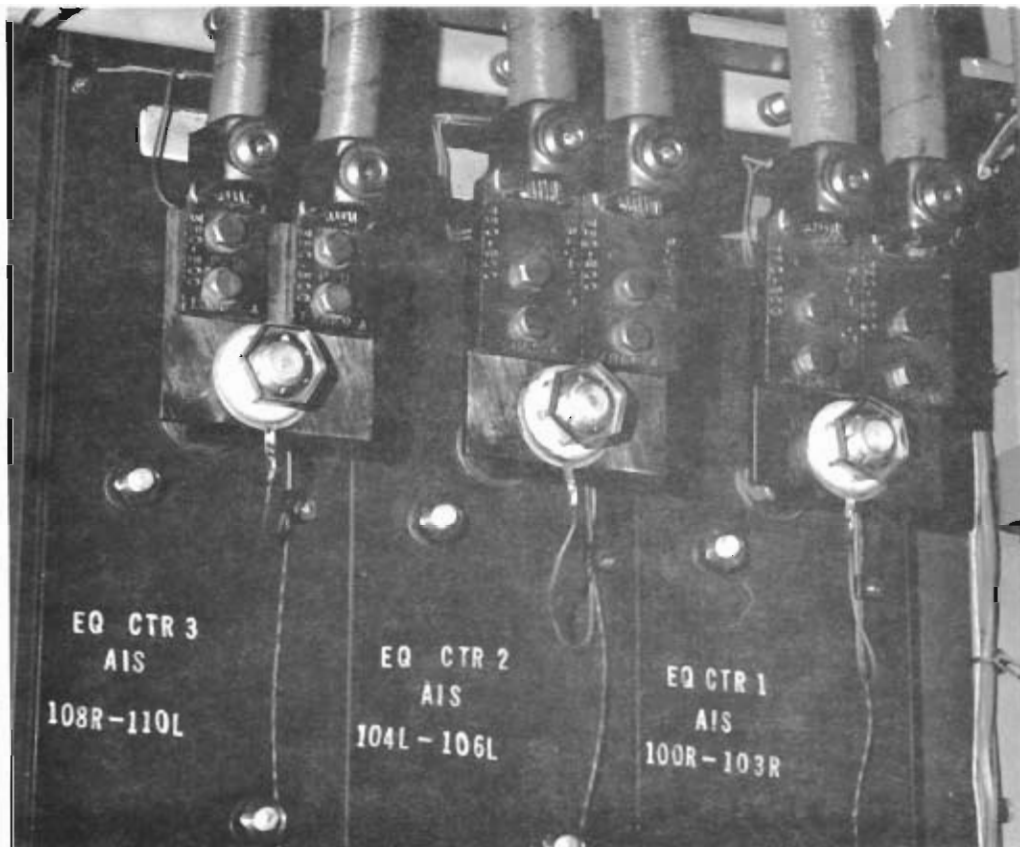
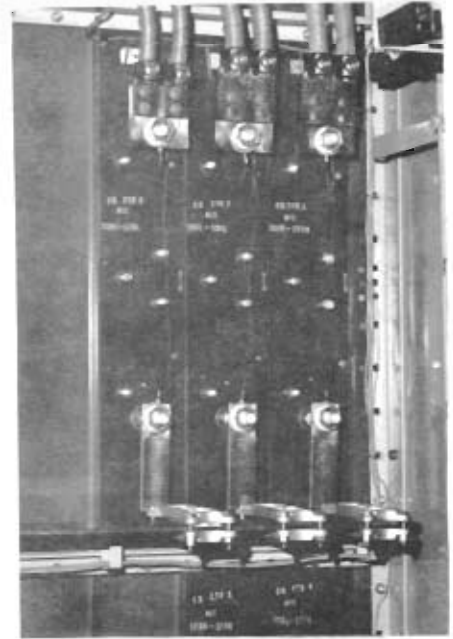


FIGURE 79 POWER CABLES AT POWER BOARD

Figure 80 shows a section of cable rack with power cables that run from the power room (on the other side of the wall) to the equipment room.

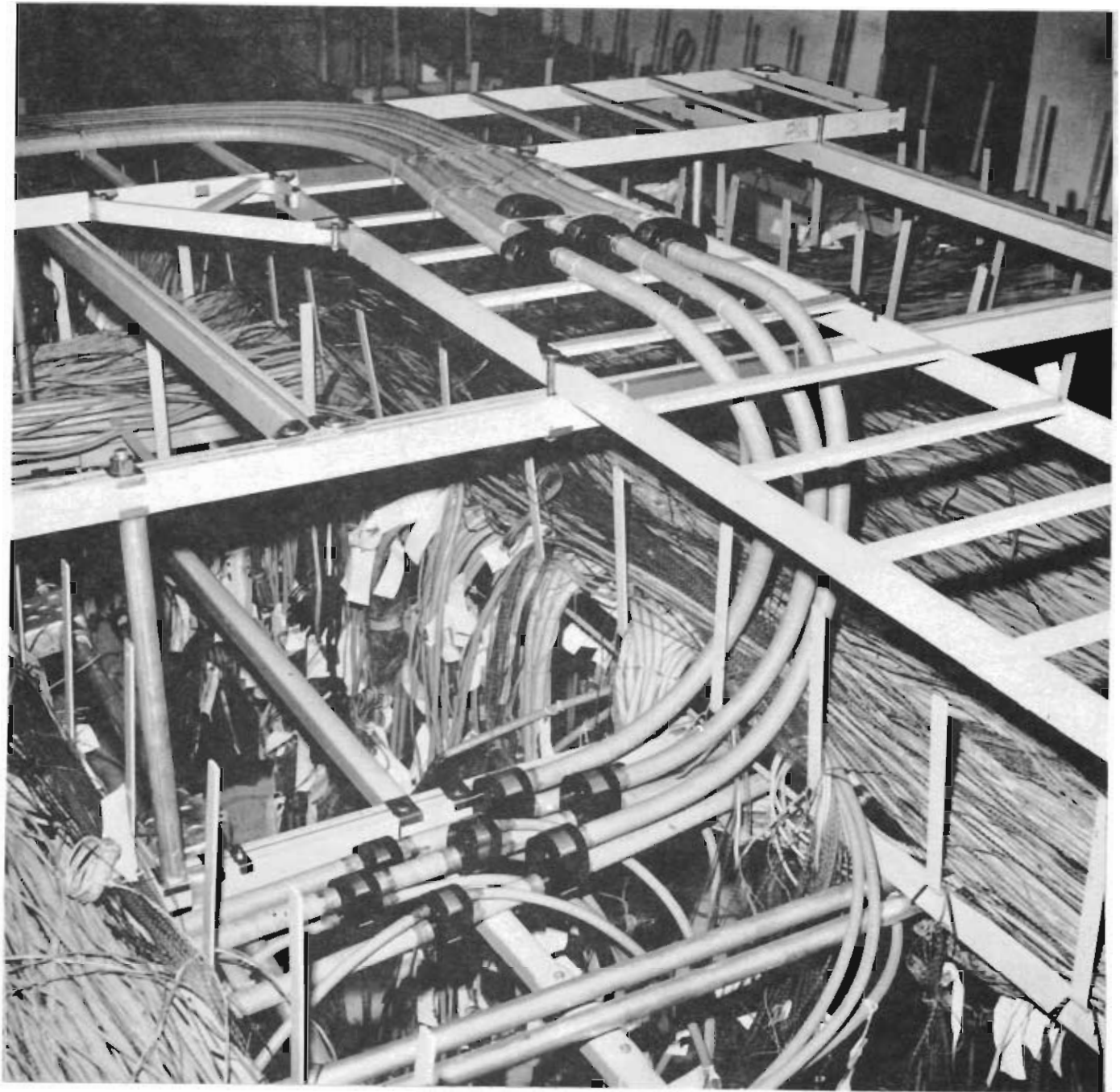


FIGURE 80 POWER CABLES ON CABLE RACK
(In the process of installation)

Bus Bar

When the capacity of power cables is exceeded, bus bar of copper or aluminum is used to carry and distribute the power as shown in Figure 81.

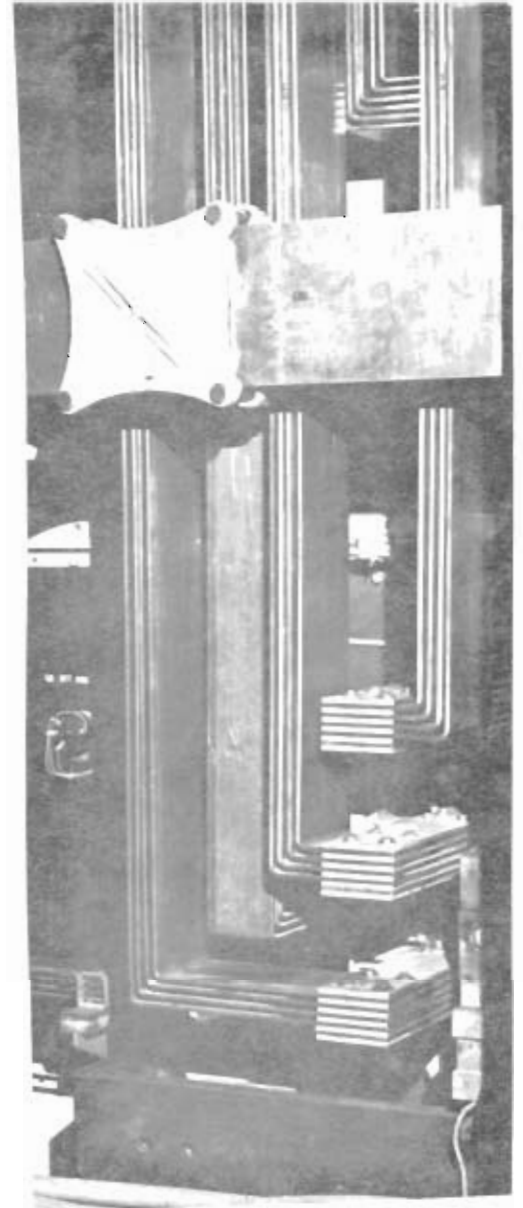
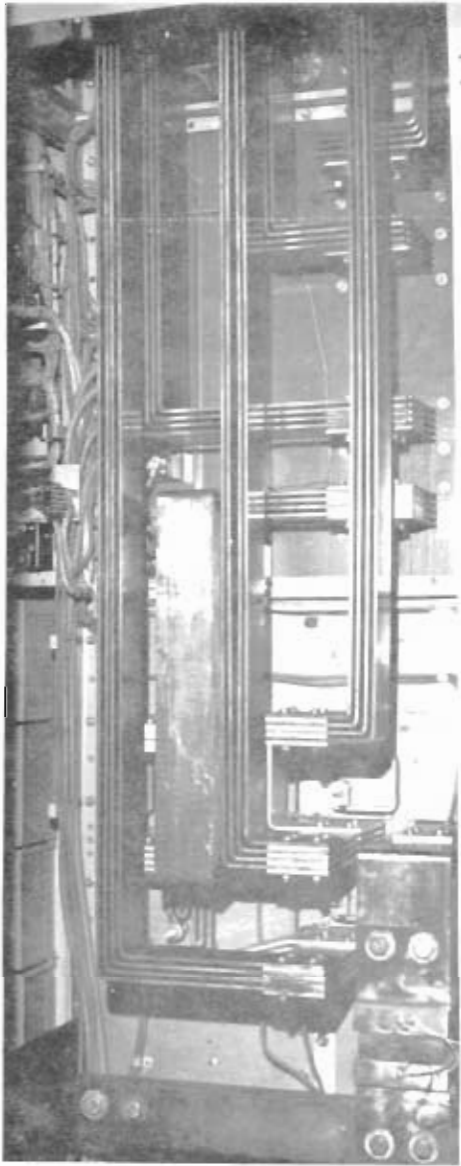


FIGURE 81 BUS BAR

Wiring Drawings

Regardless of whether the wiring is provided by Manufacturing or Installation, it is always shown on drawings which identify the type, gauge and apparatus termination for each conductor. These drawings are called wiring diagrams.

Wiring diagrams prepared from Bell Telephone Laboratories drawings are prefixed with a "T" with a five digit base and a numerical suffix. (Example: T-26030-19 Line Link Circuit)

Wiring diagrams which are not made from a corresponding Bell Telephone Laboratory drawing are also prefixed with a "T" but have a six digit number. (Example: T-532486 Selector Circuit Jack Wiring)

You will obtain all of the information you normally need to do the engineering from these wiring diagrams. Details of the format and content is provided in Course 021 CB.

Non-Standard Development

When equipment is designed for an Operating Company and has only limited or special application, Western Electric designs the appropriate drawings. "NJ" drawings, shown earlier in this course, are the equipment specifications.

"NT" drawings are wiring diagrams for this non-standard development and are similar in format to the standard "T" drawings.




Manufacturing Drawings

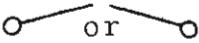


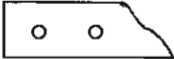

There are many other drawings designed especially for the manufacturing operations of providing wiring. As you will seldom use them, they are not described in detail in this series of courses but are listed for your reference.

| Drawing Prefix | Shows |
|----------------|---|
| SWJ or SWED | Surface Wiring Running List for equipment specifications |
| SR or TC | Connecting information drawings for local cable or pre-formed loose wire on frames or units. |
| LW | Loose wire running list for frames without sufficient leads to warrant local cable |
| LC | Local cable design specifications used as templates or detailed instructions for forming the local cable |
| RL | Local cable running list which shows the sequence of leads which are run to make up a local cable. |

Wiring Symbols

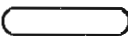
You will encounter numerous symbols on wiring diagrams or other drawings which identify the wiring to be provided. The most common symbols and their meanings are shown below:

| SYMBOL | MEANING |
|--|--|
| SW, SW1, D1, D2, D3 | Surface Wiring |
| 1W, 2W, 3W, 4W, 4W(P) | Jumpers |
|  | Switchboard Cable or Switchboard Wire (if four or less leads) |
| P  | Pair |
| LC  | Local Cable |
| Ø | Wiring normally run by the installer as switchboard wire, or loose wire. |

| SYMBOL | MEANING |
|--|------------------------------------|
| LW | Loose Wiring |
|  | Strap |
|  HDF VDF | Distributing Frame Terminal Strips |
|  DF As Req'd | |
|  VDF | |
|  | |

Work Assignment No. 3

Cross out the incorrect word for each question.

1. Surface wiring is normally provided by
Manufacturing - Installation
2. Local cable is the method of interconnecting components
on equipment - distributing frame.
3.  is the symbol for switchboard - local cable.
4. SWC indicates soldered - solderless connection.
5. The drawing that shows engineering how a circuit will be
wired is called a wiring list - diagram.
6. P20 indicates switchboard wire with two - three conductors.

Answers to Work Assignment No. 3

The correct answers are:

1. Manufacturing
2. equipment
3. switchboard
4. solderless (wrapped connection)
5. diagram
6. two

If you had difficulty answering any of these questions, consult with your administrator.

ENGINEERING AIDS

As you now have discovered, your job will involve preparing job specifications and updating central office records. In performing these functions, you will be assisted by prepared aids and you will obtain information from references. Our purpose here is to provide you with a brief description of these aids and references. You will learn how to select and use them in writing specifications in later courses.

Engineering Aids are defined as pre-engineered material for the preparation of job specifications and office records. This pre-engineered material, in the form of drawings, catalogs and other publications is designed solely for the purpose of assisting you and the Telephone Company engineer in the proper application, ordering and recording of central office equipment.

Specification Form Aids

A Specification Form Aid becomes the job specification in Regional Engineering. The general purpose of a Specification Form Aid is to reduce repetitive engineering and clerical effort, to increase and maintain a high level of quality in job specifications, and to influence the important objective of product standarization. There are three types of Specification Form Aids.

Specification Form Manual (SFM)

The SFM is designed to reduce the effort in writing basic headings, drawing lists, notes, Summary of Material information, Longhand Cable Running List, memos, and to provide a format guide by reducing the "looking-up effort" for editing and product oriented information. The use of these is covered in Courses 021 EA-ED.

Specification Form Preplanned (SFP)

The SFP is designed for the recording of a minimum number of job engineering decisions and the completion of the job specification through a controlled coding and exploding system. A higher degree of machanization is involved in processing an SFP job specification than with an SFM job specification. The use of these is covered in Course 021 ED.

Specification Form Computer (SFC)

The SFC is designed for the recording of a minimum amount of job engineering input data for the completion of the job specification by data processing techniques. A higher degree of mechanization is involved in processing an SFC job specification than with either an SFM or SFP job specification. The use of these is covered in Course 021 EA, EB.

A Specification Form Aid usually contains the information for ordering only one type of frame or equipment such as Connector, Sender, Local Test Desk or Service Observing. The conditions determining the choice in type Specification Form Aid to be used for a given product are covered in the Forms Catalog.

Specification Form Aids (spec forms) consist of pre-designed pages on which are shown the pre-engineered information. Since each order you process will involve custom application of component parts, all information in the spec forms will not be applicable and all needed information will not be shown.

To allow for these situations, spec forms are supplemented by

Engineering Forms General

There are numerous Engineering Forms - General (EFG) and a current listing is provided in Section 0 of the Forms Catalog. The more commonly used EFG's are additional pages for job specifications. A list is provided on the next page for your future use.

| <u>EFG</u> | <u>CODE</u> | <u>PAGE</u> | <u>HEADING</u> |
|------------|-------------|-------------|--|
| EFG-000 | - GL | | GENERAL |
| EFG-000 | - JS | | JOB SUMMARY (in installing specification only) |
| EFG-000 | - SS | | SUPPLEMENTARY SPECIFICATIONS (in installing specification only) |
| EFG-000 | - EP | | ENGINEERING REFERENCE PAPERS (in installing specification only) |
| EFG-000 | - WI | | WORK TO BE DONE BY THE INSTALLER |
| EFG-000 | - RE | | LIST OF REMOVED OR DISCONNECTED MATERIAL |
| EFG-000 | - WC | | WORK TO BE DONE BY THE CONTRACTOR (Turnkey Orders) |
| EFG-000 | - WH | | WORK TO BE DONE BY THE SERVICE CENTER |
| EFG-000 | - GI | | GENERAL NOTES FOR THE INSTALLER (in installing specifications, and in framework, cabling and power specifications if required) |
| EFG-000 | - GC | | GENERAL NOTES OF THE CONTRACTOR (Turnkey Orders) |
| EFG-000 | - IN | | INSTALLER'S NOTES |
| EFG-000 | - CN | | CONTRACTOR'S NOTES (Turnkey Orders) |
| EFG-000 | - DN | | SERVICE CENTER NOTES |
| EFG-000 | - DS | | SPECIFICATION DRAWINGS |
| EFG-000 | - CS | | COMBINED SPECIFICATION AND CIRCUIT DRAWINGS |
| EFG-000 | - FD | | FRAMEWORK, ASSEMBLY AND EQUIPMENT DRAWINGS |
| EFG-000 | - CD | | CIRCUIT AND OTHER MAINTENANCE DRAWINGS |
| EFG-000 | - ED | | INSTALLER'S EQUIPMENT DRAWINGS |
| EFG-000 | - IP | | INSTALLER'S REFERENCE PAPERS |
| EFG-000 | - PB | | PRINT BACK SYSTEM DRAWINGS |
| EFG-000 | - CP | | CONTRACTOR'S REFERENCE PAPERS (Turnkey Order) |

(Cont. on next page)

| <u>EFG</u> | <u>CODE</u> | <u>PAGE</u> | <u>HEADING</u> |
|------------|-------------|-------------|---|
| EFG-000 | - DP | | SERVICE CENTER REFERENCE PAPERS |
| EFG-000 | - TD | | TELEPHONE COMPANY DRAWINGS |
| EFG-000 | - FR | | FUSE RECORD SHEETS |
| EFG-000 | - FS | " " | " " |
| EFG-000 | - FI | | FLOOR ALARM AND INTERRUPTER RECORD SHEETS |
| EFG-000 | - TA | | TRUNK GROUP ASSIGNMENT CHARTS |
| EFG-000 | - TU | | TRAFFIC ASSIGNMENT CHARTS |
| EFG-000 | - MP | | PAPER MOUNTINGS AND PHOTOSTATS |
| EFG-000 | - SN | | SUMMARY OF MATERIAL NOTES |
| EFG-000 | - SM | | SUMMARY OF MATERIAL |

Drafting Aid (DA)

These consist of job wiring list forms and equipment drawing forms used by the Line Engineer to provide the drafting organization with information from which job drawings are prepared using a Tracing Form (TF). The Tracing Form (TF) is the counterpart of the DA, preprinted on mylar drafting film. A typical use of a DA is shown in Course 021 EA.

Forms Catalog

The Systems Equipment Engineering Aids Forms Catalog provides a listing of Specification Form Aids (SFM, SFP, SFC) with their titles and associated Drawing Aids. The catalog is divided into sections corresponding to the various PEC Centers. Each PEC Center is responsible for publishing and updating its portion of the catalog. Section 0 of the Forms Catalog covers EFG's. The use of the catalog is covered in Courses 021 EA-ED.

Reference Aid (RA)

These consist of catalog type material to provide the Line Engineer with reference information. Reference Aids are not marked for drafting, are not used for ordering purposes and are not part of any office record.

Reference Drawing (RD)

These consist of drawings to provide the Line Engineer with reference information of a type that is more suitably shown on a drawing than as an RA. Reference Drawings are not marked for drafting, are not used for ordering purposes and are not part of any office record.

Questionnaires (E-Forms)

Questionnaires are designed to assist the Telephone Companies in ordering central office equipment on Western Electric engineered jobs. Normally, the questionnaire becomes the Telephone Company Specification for an order as received by Regional Engineering. Accordingly, these forms are arranged in format to contain an outline of all circuits, equipment and other pertinent information required for a given type of equipment. Questionnaires will vary in size from several pages to over a hundred and fifty pages depending on the product or complexity of the equipment involved, ranging from a single type of frame to an entire dial central office.

Order Blanks (E-Forms)

Order Blanks are designed to assist the Telephone Companies in ordering equipment on Telephone Company engineered jobs. In this type of order the Telephone Company engineer performs the function that would normally be provided by the Line Engineer on a Western Electric engineered order. For this reason, differing from the questionnaire, the Order Blank format is arranged similar to an SFM Specification Form Aid and will become the job specification. Order Blanks are limited to certain types of equipment usually of the "package" type that lends itself to simplified engineering and ordering.

Common Language Translator (TR)

A Common Language Translator is a catalog-type engineering aid which enables the Line Engineer or Telephone Company engineer to translate an eight-character Common Language Equipment Code into specification drawing and wiring diagram information for ordering and recording purposes. On Western Electric engineered orders the Common Language Equipment Code is used by the Telephone Company as order input information in lieu of SD- and/or J- code information. Common Language Equipment Codes are assigned only to certain types of equipment having toll transmission application. Use of Common Language Codes will be covered in Course 022 AB which you will take at a later date.

REFERENCES

Company Instructions (CI)

The functional Headquarters Staff Methods organizations issue Company Instructions covering policy and general requirements within their designated subject responsibilities. These instructions may have broad application to all Company organizations or may apply to only one or more organizations. Instructions may be issued by other than Headquarters Staff Methods units to cover organizational or local procedures required to supplement instructions issued by Headquarters Staff.

Some Company Instructions prescribe operating procedures and forms to be used where Company wide standardization is required to:

- 1) Obtain consistent treatment and accurate consolidation of financial, personnel and other statistical data.
- 2) Assure compliance with laws and government regulations.

Manuals and handbooks are included in the Company Instruction Renumbering Plan. In these publications the existing formats may be continued where the handbook/manual will be assigned a CI number. Following is a list of some of the CIs most frequently used by the Standards Engineer.

Systems Equipment and Standards Engineering Handbook (CI97.100)

The Handbook contains instructions and information on the methods and practices approved for general use in performing equipment engineering work, arranged functionally by subject matter and frequently documented with supplements and exhibits rendering self-explanatory illustrations; i.e., flow charts, tables, and completed forms with or without associated notes. The use of CI97.100 is covered in Course 021 E.

Technical Design Manual (CI97.104)

This manual provides the standard symbols and format for central office records that are in the form of drawings.

Engineering Information Memorandum (EIM)

These memorandums are used to convey technical engineering information such as background or interpretation of existing, new or changed information on Standards drawings or other Standards output. EIM's are commonly used to provide descriptive information and drawing status for new products, projects or features being introduced.

DCS's, CRI's and Switch Conversion Sheets

DCS's and CRI's are used for the preparation of installer work items in terms of DCS or CRI "features" and to order miscellaneous wire required by the installer. They may also be used as a cross-check to verify the specific standard drawings, figures, options, apparatus, equipment and cabling involved in a modification but, except for wire, are not to be used for "B" and "C" Section editing purposes. The use of these is covered in Course 022 AA which you will take at a later date.

Switch and Shelf Conversion Sheets are used for the preparation of installer work items and for ordering apparatus and wire required by the installer. The conversion information is incorporated into the job specification in the form of an Installer's Note.

Up to this point you have seen numerous names of items that you will use. With the exception of Company Instructions and Engineering Forms - General, all of these items are prepared by the Standards Engineering Departments at the Product Engineering Control Centers (PECC). A synopsis of their outputs, and the ones you will use, is provided in Figure 82.

| TABLE A THE USE OF OUTPUT FROM THE STANDARDS ORGANIZATION | | | | | | | | | | | | | | | | | REMARKS | | | | | | | | |
|---|---------------|-----|-----------|------------|----------|------------|-------------|--------------|---------------|-------------|------------|-------------|--------------|--------|-------------|---------------|---------|-------|----------|----------|------------------|--------------|----------------|---------------|------------------|
| STANDARDS' OUTPUT | | NDD | Committee | Shop Order | Analysis | Production | Mfg Control | Eng Planning | Manufacturing | Engineering | Industrial | Engineering | Installation | Repair | Engineering | Manufacturing | | Shops | Customer | Planning | Line Engineering | Installation | Service Center | Telephone Co. | |
| Equipment Specification Drawings | (J,ED,H,NJ) | | | | | | | | | | | | | | | | | | | | | | | | CCS DEPARTMENT |
| Wiring Diagram Drawings | (T,NT) | | | | | | | | | | | | | | | | | | | | | | | | |
| Framework Assembly Drawings | (ED,H,NE) | | | | | | | | | | | | | | | | | | | | | | | | |
| Installation Test Equipment | (ITE,ITD) | | | | | | | | | | | | | | | | | | | | | | | | CABLE DEPARTMENT |
| Piece Part | (P,COMCODE#) | | | | | | | | | | | | | | | | | | | | | | | | |
| Switchboard Cable Connecting Drawing | (CC) | | | | | | | | | | | | | | | | | | | | | | | | |
| Switchboard Cable Plan Drawing | (ED) | | | | | | | | | | | | | | | | | | | | | | | | |
| Formed Swbd Cable Drawing | (H) | | | | | | | | | | | | | | | | | | | | | | | | |
| Surface Wire Running List | (SW,D1,D2,D3) | | | | | | | | | | | | | | | | | | | | | | | | |
| Buzz Test | (BT) | | | | | | | | | | | | | | | | | | | | | | | | |
| Connecting Information | (SR,TC) | | | | | | | | | | | | | | | | | | | | | | | | |
| Loose Wire Running List | (LW) | | | | | | | | | | | | | | | | | | | | | | | | |
| Local Cable Design | (LC) | | | | | | | | | | | | | | | | | | | | | | | | |
| Local Cable Running List | (RL,T) | | | | | | | | | | | | | | | | | | | | | | | | |
| Local Cable Check List | (CL) | | | | | | | | | | | | | | | | | | | | | | | | |
| Drill Code | (H) | | | | | | | | | | | | | | | | | | | | | | | | |
| Lavout of Holes | (A) | | | | | | | | | | | | | | | | | | | | | | | | |
| Job Wiring List Forms | (DA) | | | | | | | | | | | | | | | | | | | | | | | | |
| Reference Drawings | (RD) | | | | | | | | | | | | | | | | | | | | | | | | |
| Schematic Drawings | (NS,ST) | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | |
| New Development Description | (NDD) | | | | | | | | | | | | | | | | | | | | | | | | CN DEPARTMENT |
| Change Notice | (CN) | | | | | | | | | | | | | | | | | | | | | | | | |
| Customer Premise Change Notice | (CPCN) | | | | | | | | | | | | | | | | | | | | | | | | |
| Change Order | (CO) | | | | | | | | | | | | | | | | | | | | | | | | STEP BY STEP |
| B & D Change Notice | (EFG-157) | | | | | | | | | | | | | | | | | | | | | | | | |
| Detail Change Information | (DCS,CRI) | | | | | | | | | | | | | | | | | | | | | | | | |
| Switch & Shelf Conversions | | | | | | | | | | | | | | | | | | | | | | | | | |
| Temporary Information Memorandum | (TIM) | | | | | | | | | | | | | | | | | | | | | | | | |
| Drawing Issue Record | (DIR) | | | | | | | | | | | | | | | | | | | | | | | | |
| Specification Form Aids | (SFM,SFP,SFC) | | | | | | | | | | | | | | | | | | | | | | | | |
| Reference Aids | (RA) | | | | | | | | | | | | | | | | | | | | | | | | |
| Questionnaires | (E Forms) | | | | | | | | | | | | | | | | | | | | | | | | |
| Order Blanks | (E Forms) | | | | | | | | | | | | | | | | | | | | | | | | |
| Engineering Information Memo | (EIM) | | | | | | | | | | | | | | | | | | | | | | | | |
| Common Language Translators | (TR) | | | | | | | | | | | | | | | | | | | | | | | | |

FIGURE 8
THE USE OF OUT
THE STANDARDS O

FIGURE 82
THE USE OF OUTPUT FROM
THE STANDARDS ORGANIZATION

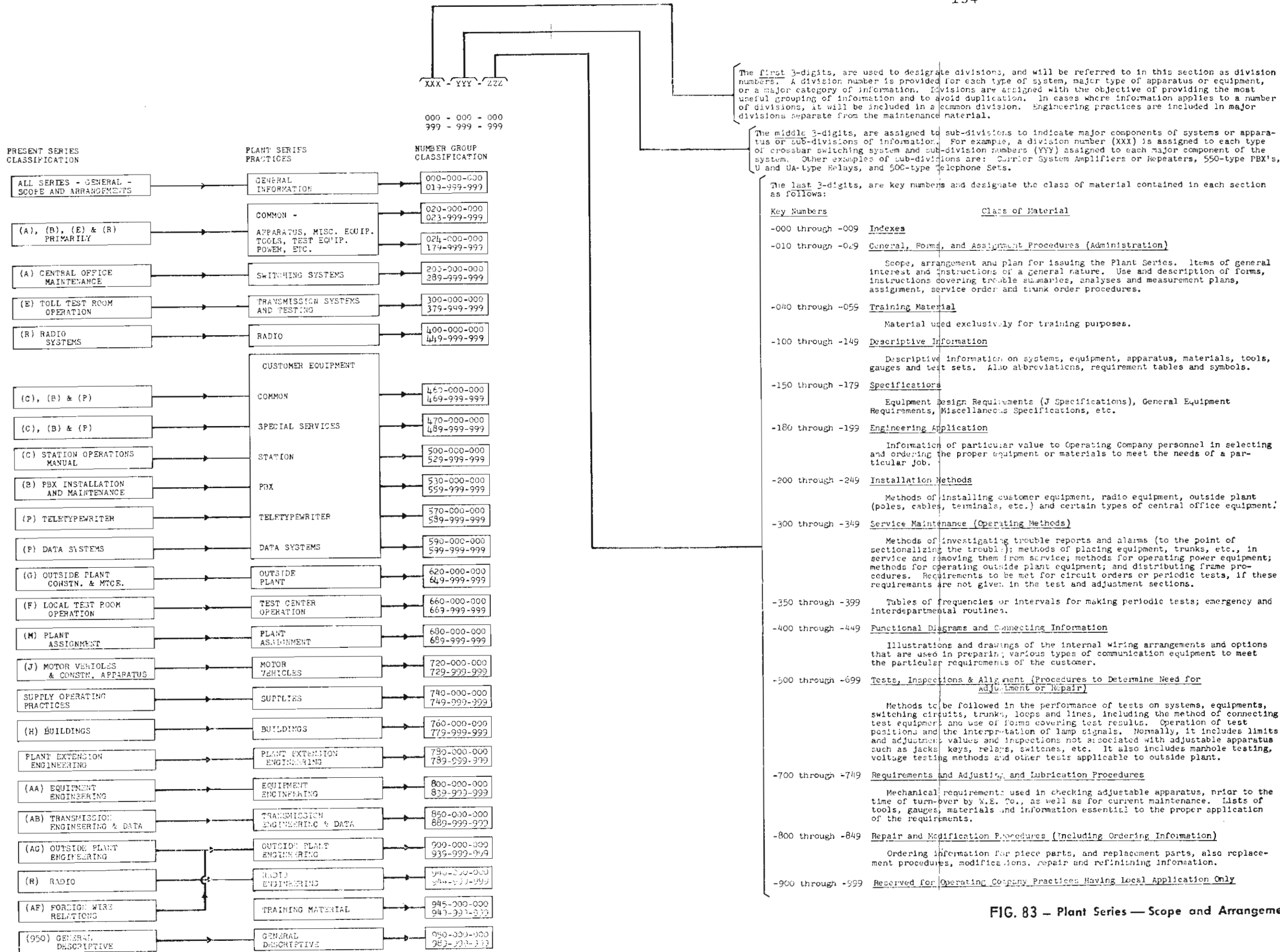


FIG. 83 - Plant Series - Scope and Arrangement

You will also make reference to Bell System Practices (BSP) which are designed by Bell Telephone Laboratories.

Bell System Practices (BSP)

The Bell System Practices are issued by Bell Telephone Laboratories to provide working information for the engineering, manufacturing, installation, inspection and maintenance forces of the Bell System.

The new "Plant Series" combines and consolidates information presently contained in all lettered and unlettered series of Bell System Practices. This series employs a uniform numbering Plan which will ultimately include all lettered series and the 950 Series of practices (See Figure 83).

Of special interest to you are:

Equipment Design Requirements (J Specifications)

J specifications are Equipment Design Requirements specifications covering equipment developed for Bell System use and are issued to:

- (a) Coordinate the information required for manufacturing and installing an equipment unit or a system as a whole and furnish the telephone companies with the associated engineering information.

- (b) Provide a brief description and explanation of the nature of a unit or system, and its application in the telephone plant.
- (c) Provide reference to circuit and equipment drawings and program documents.
- (d) Provide reference to supplementary drawings, specifications, BSPs, etc.

Numbering Plan

J specifications bear a J number and one or more BSP section numbers. The J specification number is used as the basic number of all J-coded units coded under the specification. The BSP numbers are assigned in the AA200., AA300., or 800 to 840 division of the Plant Series.

There are two plans for assigning J specification numbers, both of which are in good standing. The older plan applied to the established systems, and as new systems developed, the older numbering plan became saturated, necessitating a newer plan to accomodate newer systems. In the older plan, the number consists of five digits with a J prefix. The first digit represents the system involved, such as Local Manual, Panel, and Crossbar. The second and third digits of the number designate the class of equipment, such as, Line Finders, Test Frames, and Desks. In general, the fourth and fifth digits of the number, ranging

from 01 to 99, are assigned in numerical order to the individual specifications within the system and classes of equipment indicated by the first three digits. In the newer plan, the number consists of a digit, a letter and three digits, with a J prefix. There is no significance attached to the last three digits. For both plans, the J number blocks reserved for the various systems appear in Figure 84.

There are two plans for assigning BSP numbers, the AA Series plan and the Plant Series plan. The AA Series plan is in the process of conversion to the Plant Series plan. New assignments will be made in the Plant Series except in those blocks which have not yet been converted, in which case the assignments will continue to be made in the AA Series. In the AA Series plan, the first three digits (subdivision number) represent the system, and the second three digits represent detailed section numbers. In the 9-digit Plant Series plan, the first three digits (division number) represent the system, the second three digits represent the layer number, and the three digits represent the BSP classification. For both plans, the BSP number blocks are shown in Figure 84.

FIGURE 84

J and BSP Number Blocks Reserved for Various Systems

| <u>Systems</u> | <u>J Specification Number Block</u> | <u>Plant Series BSP Number Block</u> | <u>AA Series Number Block*</u> |
|---|---|--|--|
| Local Manual | J10000 to J19999 | 813 | 210. to 219. |
| Panel | J2XX01 to J2XX49 | 815 † | 220. to 229. |
| No. 1 Crossbar Tandem Crossbar No. 5 Crossbar | J2XX50 to J2XX99 | 816 † 817 † 819 † | 240. to 249. |
| Step-by-Step | J30000 to J39999 | 814 † | 230. to 239. |
| Trans- mission | Radio TV Mbl Tel, Prog Trmsn, TASI, Carr, Sotellite, Trans Meas Eqpt, Echo Supr, Line and Bal Eqpt, Rptr, 4-Wire Term Eqpt | J41601 to J42599 J44101 to J44699 J6XXXX series J6XXXX series | 805 804 |
| Common | AMA Special Projects All other | J49801 to J49899 J1C000 to J1C299 J90000 to J99999 | 800 § 801 § |
| PBX | J50000 to J59999 | 809 †, 810 ¶ | 350. to 359. |
| No. 4-Type Toll Switching | J67401 to J67499 | 818 † | 260. to 269. |
| Station | J53000 to J53099 | 812 | 320. to 329. |
| Data | Central Office and Telegraph Station | J70001 to J79999 J1D000 to J2D999 | 807, 808 ¶ 280. to 289. 348. to 349. |
| Power | J87300 to J87899 | 802, 803 ¶ | 360. to 369. |
| Toll (Swbd, Trunks, Test Bds) | J68800 to J68999 | 806 | 260. to 269. |
| No. 1 ESS (2-Wire) No. 1 ESS (4-Wire) No. 1 ESS (Data Features) | J1A000 to J1A499 J2A000 to J2A299 J3A000 to J3A999 | 820 | 251.000 to 251.399 251.400 to 251.599 251.600 to 251.799 |
| No. 2 ESS | J2H000 to J2H999 | 824 | 251.800 to 251.999 |
| No. 101 ESS (PBX) | J1H000 to J1H999 | 823 | 255.000 to 256.999 |
| Traffic Service | J1B000 to J2B999 | 821 | 257.000 to 257.499 |
| Private Service | J1G000 to J9G999 | 811 | 330. to 339 |
| Traffic Management | J3B000 to J4B999 | 822 | 257.500 to 257.999 |

* BSP number assignments will be made in the AA series only until converted to Plant Series.

† Conversion completed.

‡ Common Systems includes specifications applying to 6 or more systems.

§ Allocation of 800 and 801 will be determined later.

¶ Reserved.

Descriptive Information

BSP sections in the 950 to 999 division of the Plant Series are issued for equipment to provide general descriptive information and operating principles. These sections cover the information on large equipment units or systems as a whole.

Equipment Engineering Information

BSP sections in the AA400. series or the replacing 9-digit Plant Series are also issued in the switching systems area to provide engineering information and data for determining under what conditions and in what manner various features and arrangements of equipment should be used.

General Information

BSP sections in the 000 to 020 divisions of the Plant Series are issued to provide general information such as definitions, abbreviations, methods, descriptions, symbols, common language, etc. used in the Bell System.

ORDERING APPARATUS

As explained earlier in this course, the Apparatus Card Catalog is a listing of all Western Electric manufactured, coded apparatus, for use in assemblies or as replacements, which is used in sufficient quantity to warrant being stocked.

Apparatus Card Catalog

The Apparatus Card Catalog is a series of cards, arranged alphabetically by type of apparatus, that provides ordering and manufacturing information for the apparatus.

When you are required to order apparatus that is not provided as part of an Equipment Specification, you will use the Apparatus Card Catalog. From it, you will be able to determine the Rating and the necessary mounting and ordering information.

Rating

The rating will tell you whether or not you can order the apparatus for a specific application. The ratings possible are shown below.

Apparatus listed in the catalog is rated as follows:

(a) AT&T Co. Standard

Signifies approved by the AT&T Co. for general use and may be specified as required.

(b) AT&T Co. Special

Signifies approved by the AT&T Co. for use under special conditions.

(c) Distributor Standard

Signifies approved for Nonassociate (Non-Bell) use. Other ratings shown on white cards also apply to nonassociate trade, except where the Distributor rating is shown on a yellow card. Apparatus in good standing on white cards are also in good standing for nonassociate trade subject to conditions covered by notations "Bell System" and "Special Sales Conditions Apply."

(d) A and M Only (Obsolete)

Signifies approved only for use in additions to, or maintenance of existing equipment arranged for this type of apparatus. Generally this apparatus has been replaced by a standard apparatus, with which it is not interchangeable. Apparatus with this rating is usually designated with the symbol "+" throughout this section.

(e) Manufacture Limited (ML)

This designation is not a rating classification by itself, but is used to signify that demand is insufficient to justify continuing usual production levels, and the apparatus is not stocked. This apparatus will appear on the card with the designation "(ML)" appended to one of the four classifications covered in the previous paragraphs, and should be ordered only in cases where no suitable replacement will meet the requirements. Substitutions, if available, will be shown in the card catalog.

This substitute may not be suitable for all circuit conditions. Standard drawings which show apparatus that is rated (ML) should be referred to the PECC to determine the application of the apparatus. Apparatus with this rating is usually not listed in this section.

(f) Manufacture Discontinued (Abandoned)

Signifies apparatus has ceased to be manufactured. Tools for construction and assembly of the apparatus are usually destroyed, therefore manufacturing costs for new orders are considerably higher than for standard apparatus. Apparatus with this rating is usually not listed in this section.

(1) Wherever possible, substitutions should be made by

apparatus as indicated in the card catalog. Where no substitution is suitable, order the apparatus with the notation "Do Not Substitute."

(2) If a card is marked "MFR DISC., Replaced by ---- on Jobs Shipping After -----," and either the old or replacing apparatus meets the job requirements, the following will apply. If the job is scheduled to ship after the date shown on the card, specify the replacing apparatus; if the job ships prior to the date shown on the card, specify the old apparatus.

(g) Component Part

Signifies that the apparatus is primarily intended to be furnished as part of an assembly and in general is not likely to be ordered separately.

Notations

In certain cases, the apparatus is also shown with the following notations:

(a) Bell System

Signifies ownership by the Bell System. The notation appears in the title of the card, or on the view of the apparatus. This apparatus should not be ordered for anyone outside the Bell System.

(b) Special Sales Conditions Apply

Signifies apparatus manufactured by Western Electric under patent license, and restricts its use to "communication" equipment only. Since all Western Electric engineered orders cover communication equipment, the notation may be disregarded.

(c) Replaced By

Signifies the replacement is a direct substitute, mechanically and electrically for the replaced apparatus. However, in some cases, the replaced apparatus cannot be substituted for the replacing apparatus.

(d) Recommended

Signifies the apparatus is not a direct substitute for the apparatus rated MFR DISC. or A and M ONLY, but can be used as a substitute provided mechanical or circuit modifications are made.

(e) OK To Use

Signifies apparatus is proposed AT&T Co. Standard which has been made available for use before being rated STANDARD.

This notation is stamped on yellow cards only.

(1) If the yellow card is not stamped "OK To Use," and the apparatus is not a component of a standard drawing stocklist, consult the PECC Standards before ordering the apparatus.

(2) If the yellow card is stamped "OK To Use on Jobs Shipping After----," and the job specification is written prior to the date stamped on the card, consult the PECC Standards before ordering the apparatus.

Terminology (Reflecting Status)

The following terms appear on yellow cards and reflect the status of the apparatus prior to be given one of rating classifications.

(a) Proposed AT&T Co. Standard

Signifies that the apparatus is, or will be, approved for use in equipments or circuits rated AT&T Co. Standard or AT&T Co. Provisional.

(b) Not Yet Standardized by AT&T Co.

Signifies apparatus design released prior to approval by AT&T Co.

Usually, the cards in the catalog will be one of two types: general or detail. First, examine a typical general information card.

DATE THE CARD
WAS ISSUED

MAY 29, 1970

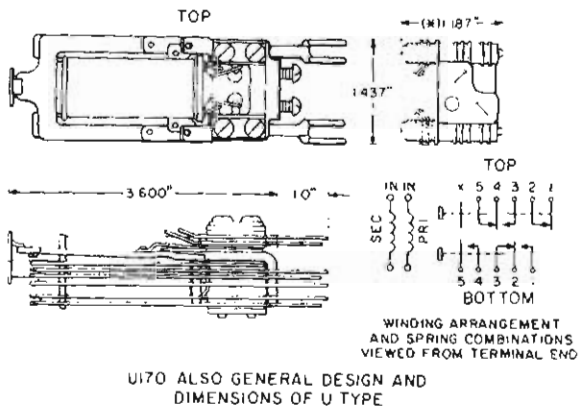
KIND OF INFORMATION THAT IS ON THE CARD,
IF THERE IS MORE THAN ONE CARD.

CARD TITLE (IN BOLD TYPE)

"U" TYPE RELAYS

(Card No. 1)

General Information



(*) This dimension varies according to the number of contact springs and winding terminals on the individual relays.

Flat type, round core, twin contact, general purpose relays capable of operating large spring combinations.

Armature stop pins are 0.005 inch high unless otherwise indicated by footnote.

Can be mounted on either drilled or punched type mounting plates.

Individual "U" type relay covers are required when the mounting plate is not equipped with a common cover or mounted in a cabinet. The proper individual cover is listed under the detail information for each relay and must be ordered separately.

Insulated from the mounting plate.

Contact springs are equipped with bar contacts, as designated under the detail information for each relay, as follows:

| | |
|-----|---|
| HB2 | Heavy, bimetallic. No. 2 metal (palladium) cap over nickel. |
| HS | Heavy, solid. Silver. |
| SS | Standard, solid. Silver. |
| H2 | Heavy, solid. No. 2 metal. |
| S2 | Standard, solid. No. 2 metal. |

Terminals are arranged for mechanically wrapped connections.

On new or repaired relays, inductive windings do not vary more than $\pm 10\%$ and noninductive windings more than $\pm 5\%$ from their rated resistances unless otherwise indicated by footnote.

Will mount on 1-3/4 inch vertical centers either with or without individual or common cover. When not equipped with individual covers, will mount on horizontal centers listed under the detail information for each relay. When individual U3, U4, or U5 relay covers are used, the horizontal mounting centers are 1-1/2, 1-3/4, or 2-1/8 in., respectively.

Codes U50 to U5999 are reserved for magnetic iron relays and codes in the U6000 series for permalloy relays.

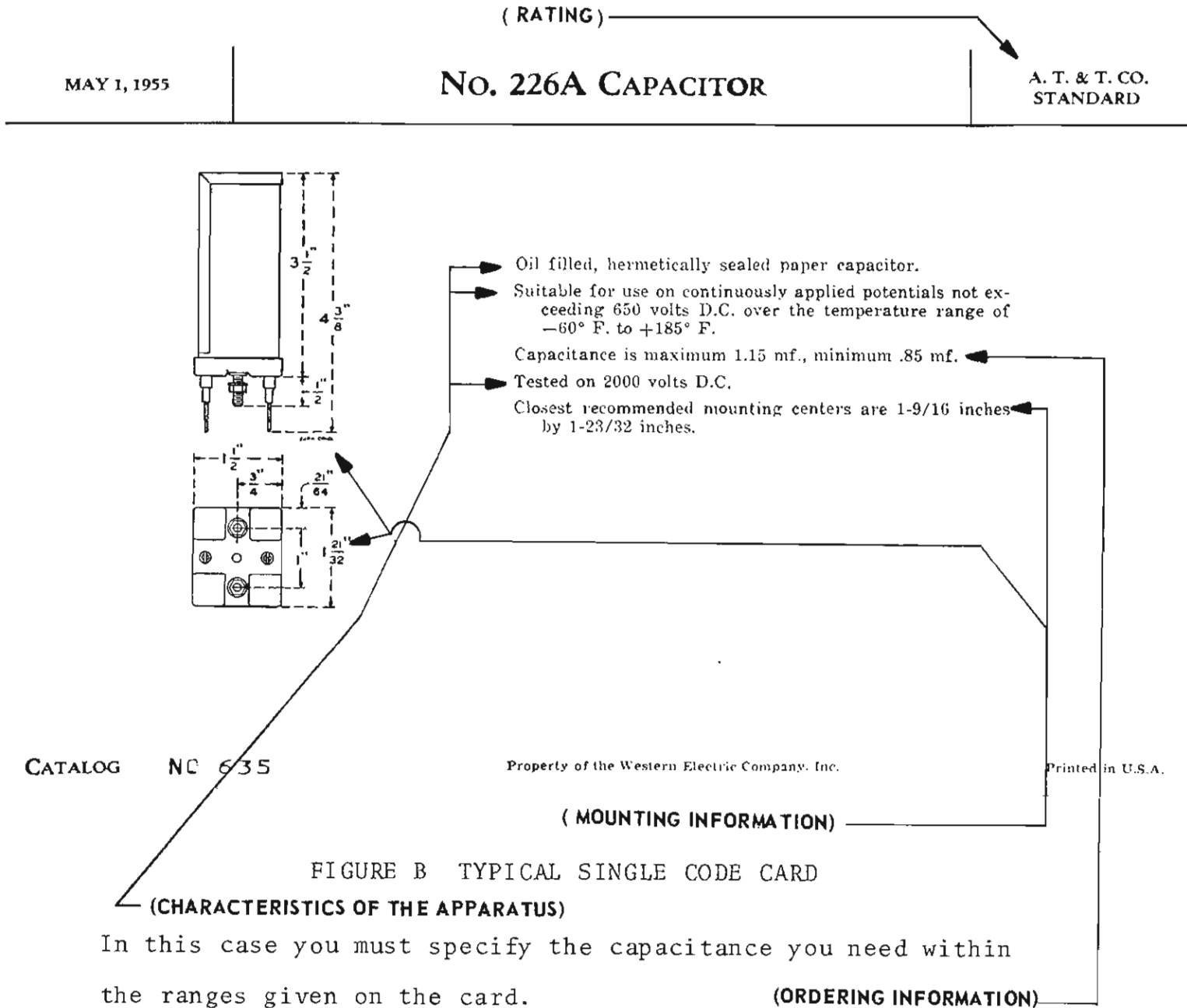
Property of the Western Electric Company, Inc.

Printed in U.S.A.

GENERAL INFORMATION ABOUT THE APPARATUS COVERED
ON THE CARD.

FIGURE A TYPICAL GENERAL INFORMATION CARD

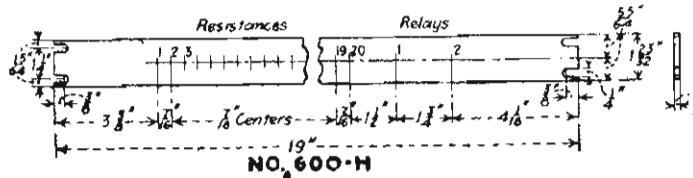
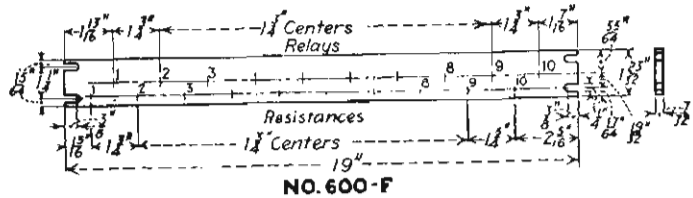
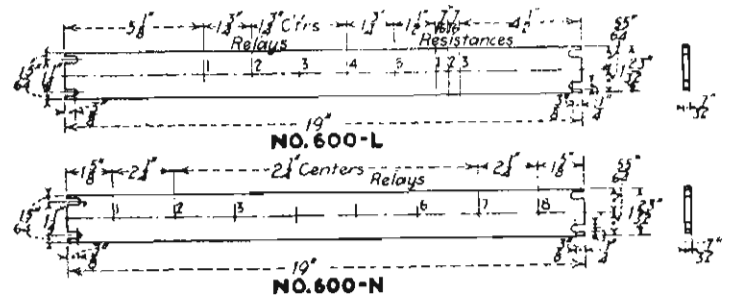
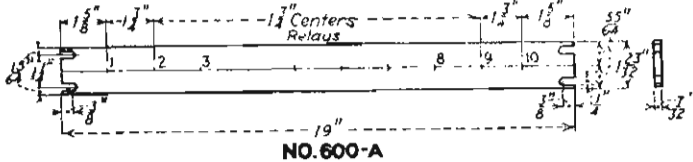
Detail information cards show information about a single code or several codes. On a single code card (see Figure B), the rating is shown in the upper right corner. You should immediately check to insure that you can use the item by checking its rating.



Detail information cards with several codes will have a notation in the upper right corner (see Figure C) which directs you to a rating for each code. Your procedure on this type of apparatus card is to - first, determine the code that meets your requirements, and

- second, check the rating.

JUNE 25, 1953

NOS. 600A, F, H, L & N MOUNTING PLATES**SEE RATINGS
BELOW****Metal plates.**

Orders must contain information for all positions, stating what apparatus or drilling is required for each and which, if any, shall be undrilled.

| Code No. | (*)Relays per Plate | (*)Resistances per Plate | Replaces No. | Rating |
|----------|---------------------|--------------------------|--------------------------|-------------------------------|
| 600A | 10 | — | 600B | A.T.&T.Co.Std. |
| 600F | 10 | 10 | — | A.T.&T.Co.Spl. |
| 600H | 2 | 20 | {600C 600AJ 600AK} | A.T.&T.Co.Std. |
| 600L | 5 | 3 | — | Mfr. Disc.; No. 600ED rec. |
| 600N | 8 | — | — | A.T.&T.Co.Std. |

(*) See first paragraph of Instruction Card (Card No. 1) on mounting plates.

CATALOG NC 535**(MOUNTING INFORMATION)**

Property of the Western Electric Company, Inc.

Printed in U.S.A.

(SELECTION CRITERIA)**(ORDERING INFORMATION)****(RATING)**

FIGURE C CARD WITH SEVERAL CODES

For the most part, you won't have much difficulty retrieving information from the card catalog for most apparatus items by following these simple procedures:

1. Look up the card(s) for the type of apparatus required.
2. Select the proper code by matching apparatus characteristics to your requirements.
3. Check the rating of the code.
4. If the code is usable, follow the ordering and mounting instructions given.

There is one area that you will require some additional information about, ordering mount plates.

The two basic types of plates most used are the Flat type and the Channel type. (See Figure D)

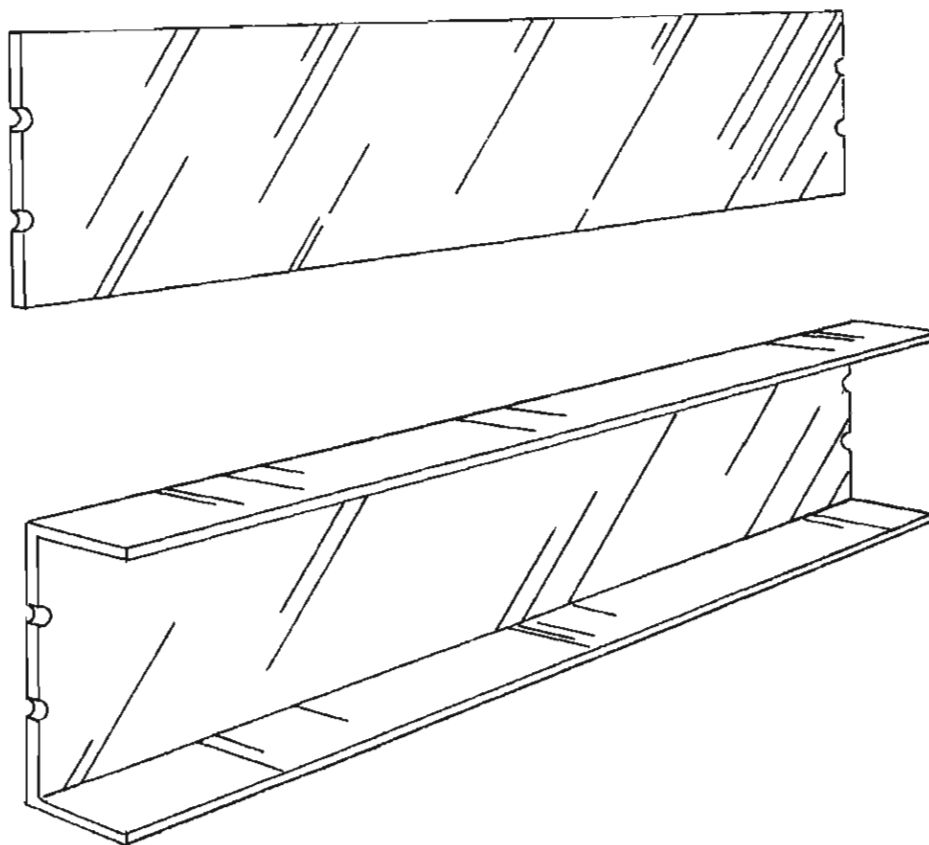


FIGURE D FLAT & CHANNEL PLATES

Dimensions

A mounting plate is considered a certain size. Size is a description of the length and the width as shown in Figure E.



FIGURE E SIZE = LENGTH & WIDTH

Most central office framework is also described by its size in terms of the mounting plates that it is arranged to mount.

For example, a mounting plate may be 2 inches wide and 23 inches long. We would say that its size is 2 x 23. It will mount on framework arranged for 2 x 23 plates.

Conventional Relay Rack framework is constructed to mount 19, 23, or 25 inch mounting plates which are either $1\frac{3}{4}$ or 2 inches wide. This is illustrated on the next page in Figures F & G.

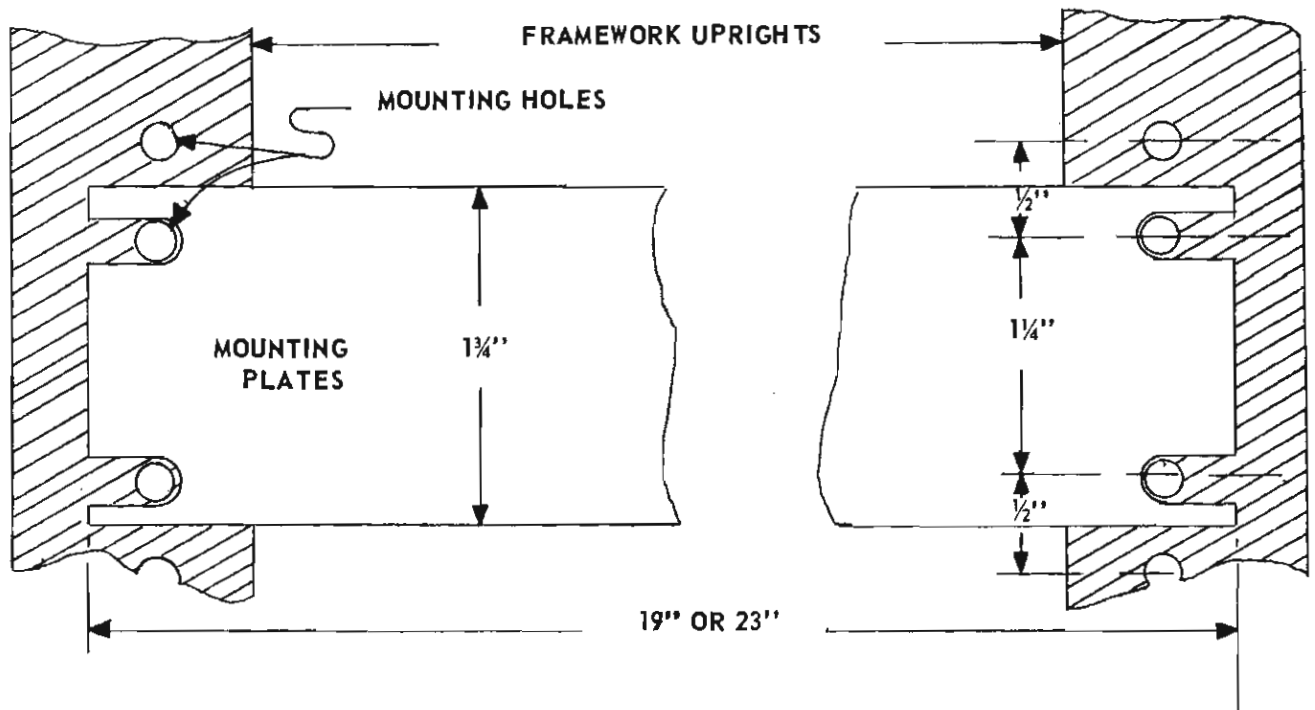


FIGURE F 1 3/4" PLATE & FRAMEWORK

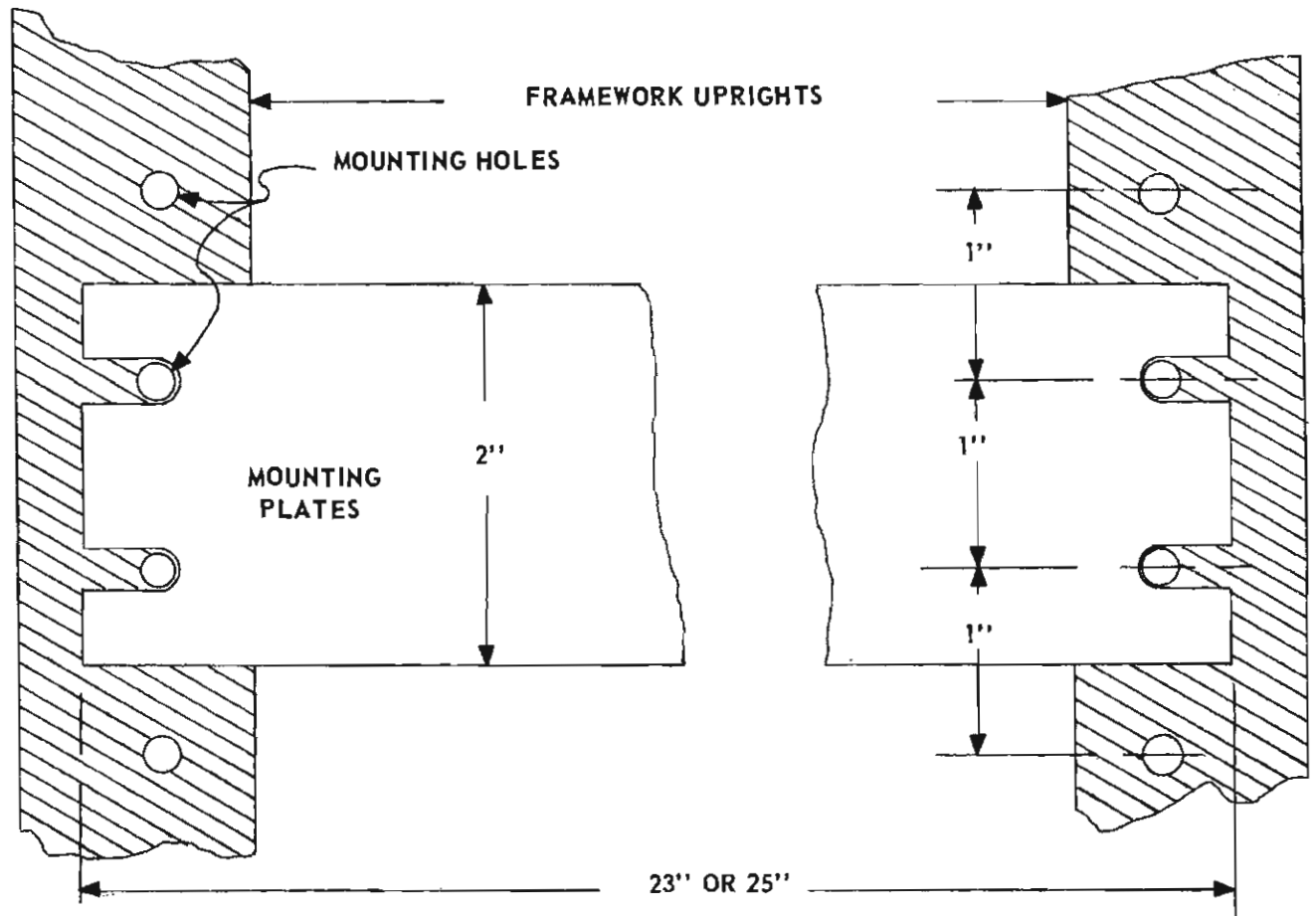


FIGURE G 2" PLATE AND FRAMEWORK

The next item is plate thickness as illustrated in Figure H, the thickness of the metal from which the plate is formed.

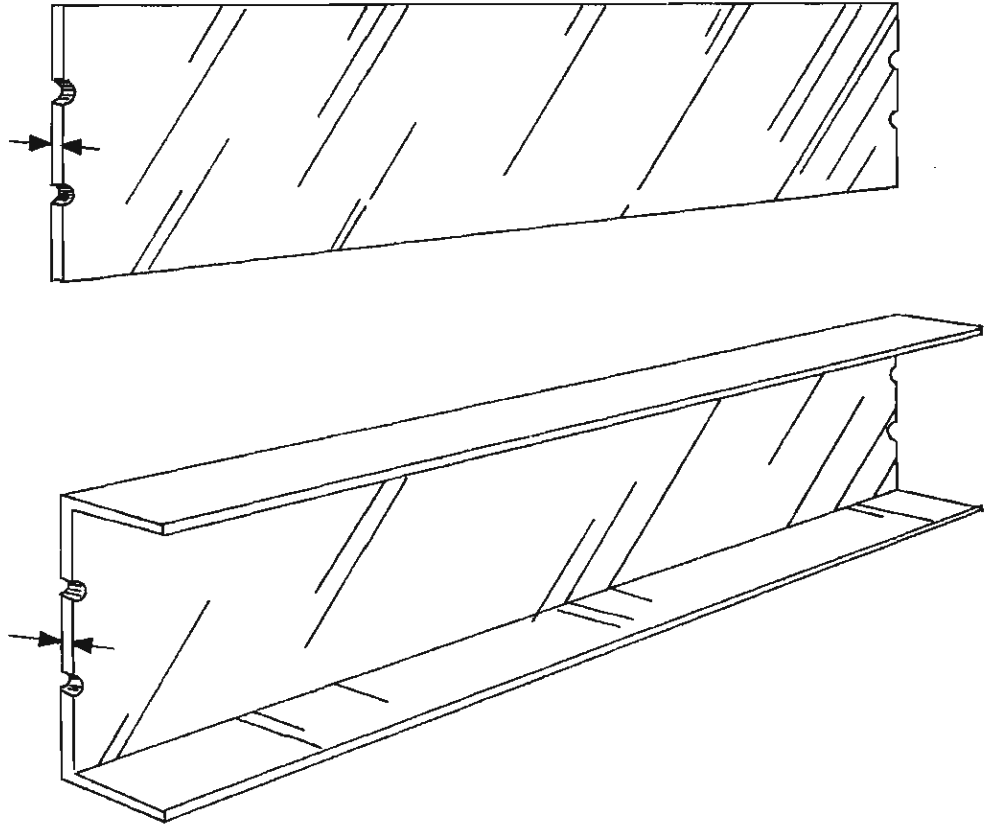


FIGURE H PLATE THICKNESS

This dimension (thickness), identified by a thickness code, "I", will be used for selecting the proper screws to attach the plate to the framework, coded plates, panels and certain apparatus which mount on uprights of frames, racks, mounting units, etc., do not include the mounting screws. When these coded mounting plates, panels, etc., are ordered separately, the fastening screws of a length and type to suit the particular mounting

condition must be ordered separately in the job specification. These screws for the various plate or panel thickness are listed in the following table. In the first column, the thickness code is a crossreference from the coded plates listed in the Mounting Plate Listing in Section 3 of the Handbook under "T".

| Mounting Plate & Panel Fastening Screws | | | | |
|---|--------------------------|-----------------------------------|---------------------|---------------------------------|
| PLT THK CODE | MTG PLT OR PANEL THK | TYPE OF FRAMEWORK | | |
| | | BULB ANGLE CHANNEL "1" BEAM | DUCT | BOX TYPE WITHOUT ADAPTERS |
| | | SPL RHMS | SPL RHMS | PHSTS |
| A | 1/16 | P353501 (5/16 LG) | P148634 (1/4 LG) | P174396 (3/8 LG) |
| B | 5/64, 3/32, 7/64, 1/8 | P353446 (3/8 LG) | P148634 (1/4 LG) | P174397 (1/2 LG) |
| C | 3/16, 7/32 | P353447 (1/2 LG) | P353446 (3/8 LG) | 840047534 (5/8 LG) |
| D | 5/16, 3/8 | P353448 (5/8 LG) | P353447 (1/2 LG) | 840047542 (3/4 LG) |
| E | 7/16 | P353449 (3/4 LG) | P353448 (5/8 LG) | P174398 (7/8 LG) |

Special round head .216-24 machine screws

Pan head self-tapping screws

(You should verify this table with the latest issue of Section 3 of the Handbook)

Drilling Information

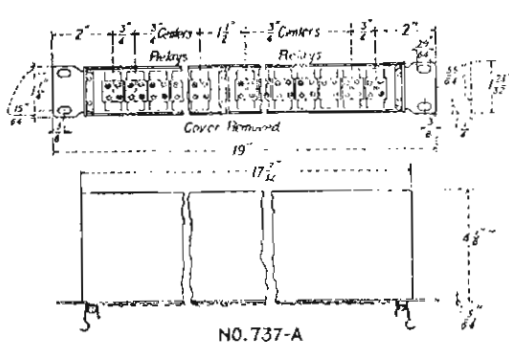
When you require mounting plates to meet job conditions, you must select one of the three methods of furnishing these plates:

- 1) Pre-drilled
- 2) Partially pre-drilled
- 3) Undrilled

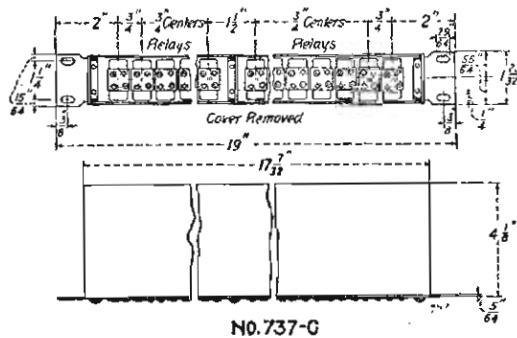
Pre-drilled plates are those which are manufactured and stocked with all mounting positions drilled (or punched) for specific apparatus types. Figure I illustrates such mounting plates.

AUGUST 26, 1948

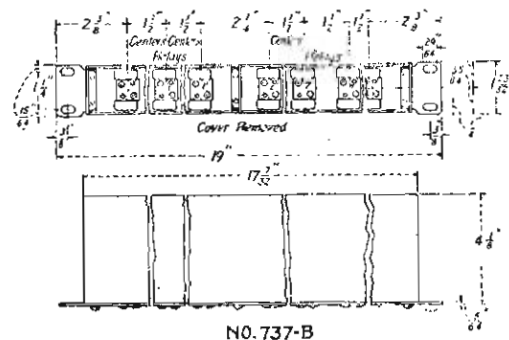
NOS. 737A, B & C MOUNTING PLATES

SEE RATINGS
BELOW

NO. 737-A



NO. 737-C



NO. 737-B

Metal plates.

Will mount interchangeably
with No. 600 type mounting
plates.

| Code No. | Relays per Strip | Rating |
|----------|------------------|-------------------------|
| (*) 737A | 20 | A. T. & T. Co. Standard |
| (†) 737B | 10 | " " |
| (a) 737C | 20 | " " |

(*) Provided with battery and ground clips. Arranged for ten "AB1" and ten "AB2" relays mounted alternately. Also arranged for twenty "A," "E" or "F" type relays which will mount on 3/4 in. center.

(†) Arranged for ten "A," "E," "F" or "R" type relays.

(a) Arranged for twenty "A," "E" or "F" type relays which will mount on 3/4 in. center. Same as the No. 737A except not provided with battery and ground clips.

CATALOG NO 635

Property of the Western Electric Company, Inc.

Printed in U.S.A.

FIGURE I PRE-DRILLED PLATES

On pre-drilled plates, the quantity of apparatus tells you the mounting positions. Note that the 737A plate is arranged for 20 relays; therefore, you can mount relays in positions 1 to 20. On the 737B, you can mount relays in positions 1 to 10 since it is arranged for 10 relays.

When you order a pre-drilled plate, all that is necessary for ordering information is that you account for the positions equipped.

Example:

Assume that you need to mount seven (7) R888 relays on a framework arranged for 1 3/4 x 19 mounting plates. You determine from Section 3 of the Handbook that a 737B mounting plate will fit your requirements. Here is how you would order:

| <u>Qty.</u> | <u>Description</u> |
|-------------|---------------------|
| 1 | 737B Mounting Plate |
| | E/W |
| 7 | R888 Relay |
| | POS 1 to 7 |

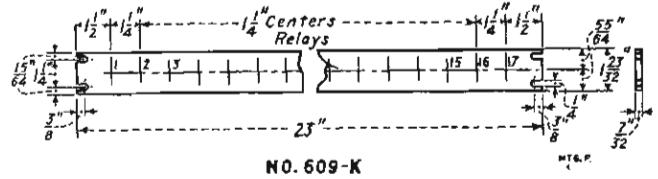
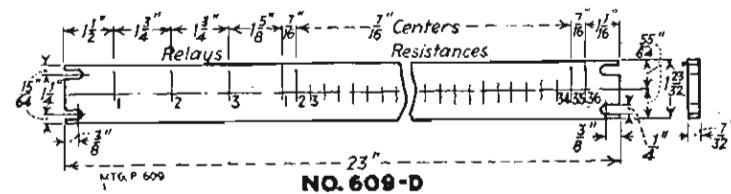
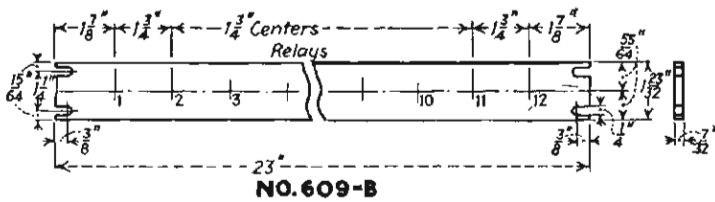
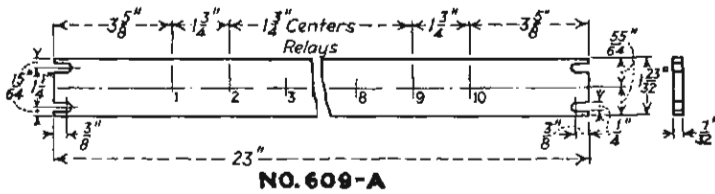
The "E/W" symbol means "equipped with". Notice that the plate has 10 positions but you only account for the positions which you are equipping with apparatus.

Now, consider undrilled plates. They are of two types, plates arranged with predetermined apparatus positions and plates with undrilled apparatus positions on 1/16" or 1/8" centers. Figure J shows an example of plates with predetermined positions.

Date of Issue
November 14, 1929

NOS. 609-A, B, D AND K MOUNTING PLATES

SEE RATINGS
BELOW



Metal plates.

Orders must contain information for all positions, stating what apparatus or drilling is required for each and which, if any, shall be undrilled.

| Code No. | (*) Relays per Plate | (*) Resistances per Plate | Rating |
|----------|----------------------|---------------------------|----------------------------|
| 609-A | 10 | — | A.&M. Only; No. 609-B rec. |
| 609-B | 12 | — | A.T.&T.Co. Std. |
| 609-D | 8 | 36 | " " |
| 609-K | 17 | — | " " |

(*) See first paragraph of Instruction Card (Card No. 1) on mounting plates.

STANDARD METHOD OF WORDING ORDERS:

See second paragraph of Instruction Card (Card No. 1) on mounting plates.

This card is the property of the Western Electric Company, Inc., and is a part of the TELEPHONE APPARATUS CATALOG (of the number indicated at the left). It is held subject to the Company's order at all times and must not be removed from the catalog of which it forms a part except on the Company's instructions. Printed in U. S. A.

Catalog No. 635

FIGURE J MOUNTING PLATE, UNDRILLED WITH PREDETERMINED POSITIONS

As stated on the apparatus card, you must account for all positions whether equipped, drilled or undrilled. Look at the following example.

Example:

Assume that you require one (1) B147 relay with four (4) 18R resistors, four (4) 18T resistors and four 18U resistors.

You are also advised that this apparatus makes up one Compensating Resistor Circuit and additional circuits may be required in the future.

Further assume that the apparatus is to be mounted on $1 \frac{3}{4} \times 23$ framework so that you come up with 609D mounting plate (Figure J). There are several procedures that you must follow for ordering undrilled plates. Those applicable to this example are shown next to the ordering information on the following page.

| <u>Qty.</u> | <u>Description</u> | | ① Account for all |
|-------------|----------------------------------|---------|---|
| 1 | 609D MTG PLT | | positions whether |
| | E/W | | |
| 1 | B147 REL | | EQUIPPED (The shop will obviously drill these positions in order to mount the apparatus) |
| → POS | 1 | | |
| 4 | 18R RES | | |
| → POS | 1 To 4 | | |
| 4 | 18T RES | | |
| | POS | 5 To 8 | - or - DRILLED - or - *UNDRILLED |
| 4 | 18U RES | | |
| | POS | 9 To 12 | |
| | DR For B REL, POS 2, 3 | | |
| | DR For 18 Type RES, POS 13 To 36 | | |

*Since in this case, we have accounted for all positions, none are "undrilled".

②

If mixed apparatus codes are to be mounted, order the unequipped positions drilled for the apparatus ultimately required. (Note: We assumed additional circuits may ultimately be required.)

③

On plates arranged for more than one apparatus type, with positions numbered 1 and up for each, do not specify REL POS, RES POS, etc. after each position number. (The shop has the same apparatus card you do so they can see which are the proper positions.)

Undrilled plates, with apparatus positions on 1/16" or 1/8" centers can have one of three arrangements:

1. A single row of positions on 1/16" or 1/8" centers.
2. Two or more rows of positions on 1/16" or 1/8" centers with each row designated (from the top down) by alpha's "A", "B", "C", etc.
3. Multiple rows on 1/16" or 1/8" vertical centers. In this case, the center horizontal row is designated (on the apparatus card) as row "O". The rows above center are designated "1T", "2T", etc. and the rows below center are designated "1B", "2B", etc.

Refer to example of these three arrangements in Figure K. In ordering apparatus to be mounted on a mounting plate, or in specifying drilling, the position specified shall be the horizontal and vertical center of the apparatus to be mounted.

After carefully reviewing Figure L to see examples of apparatus positions specified for apparatus.

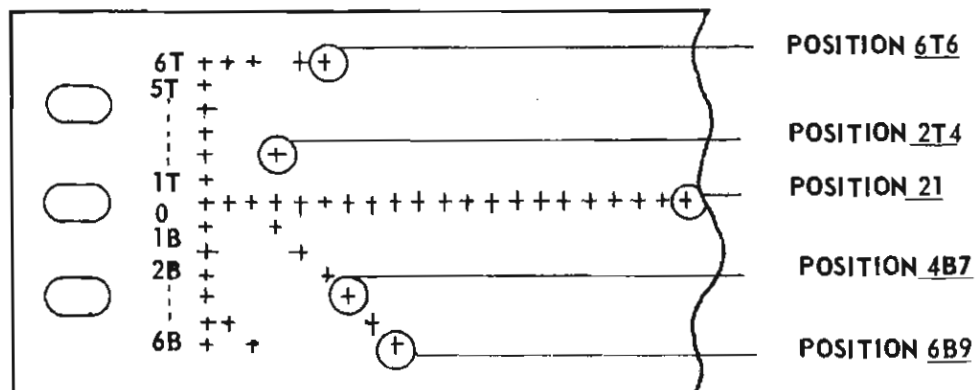
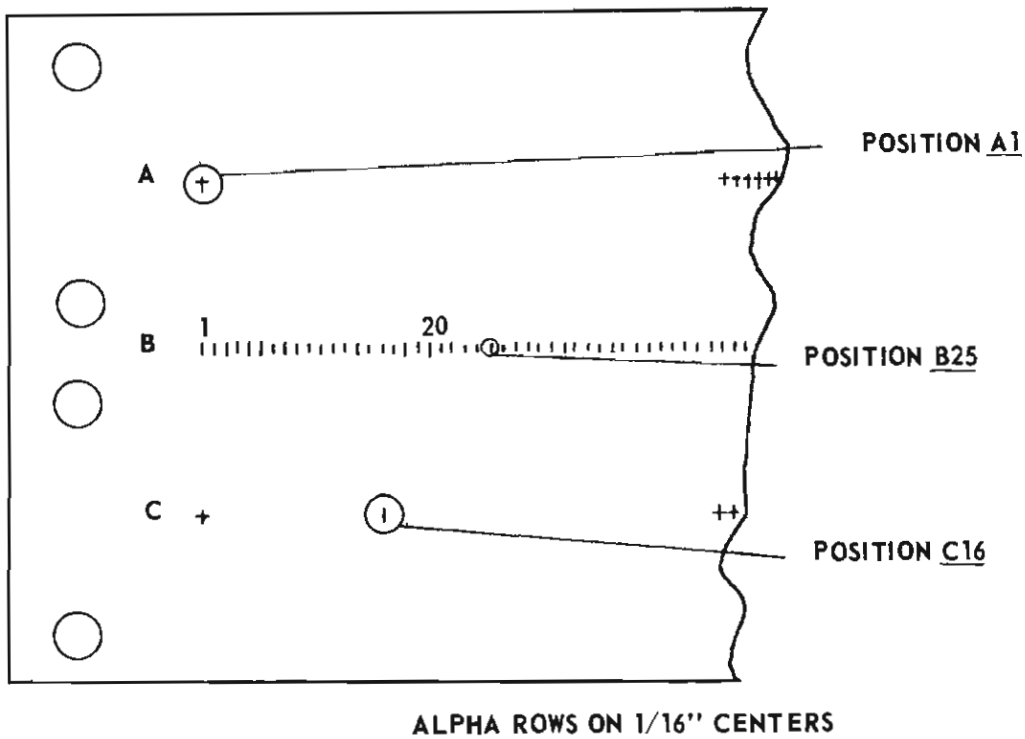
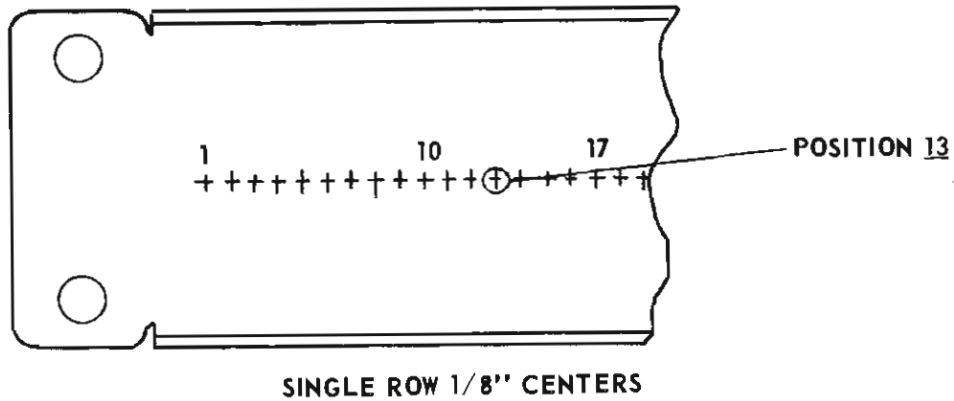


FIGURE K PLATES WITH POSITIONS ON 1/8" OR 1/16" CENTERS

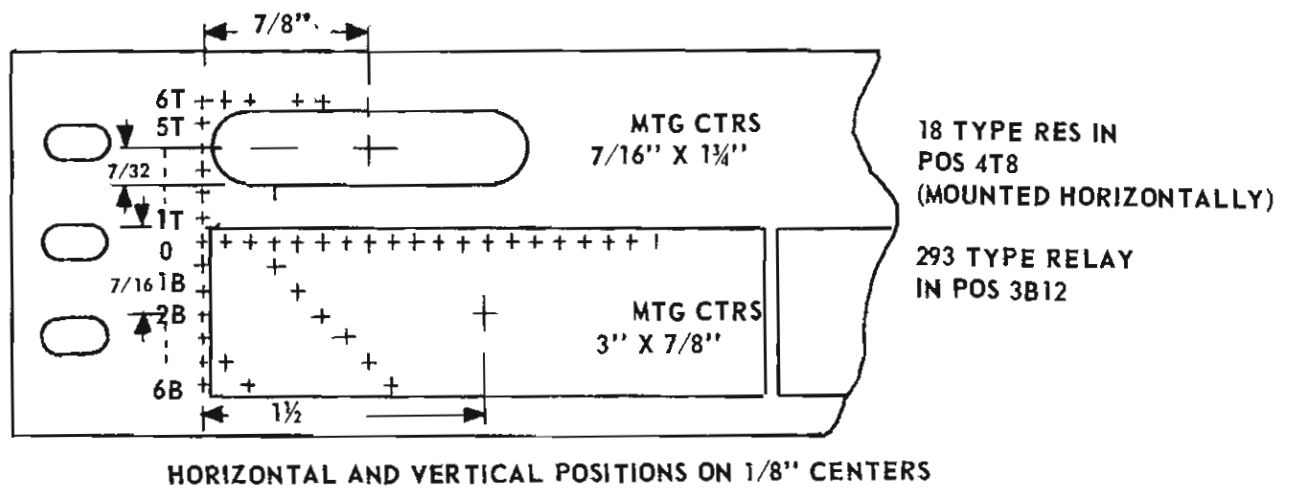
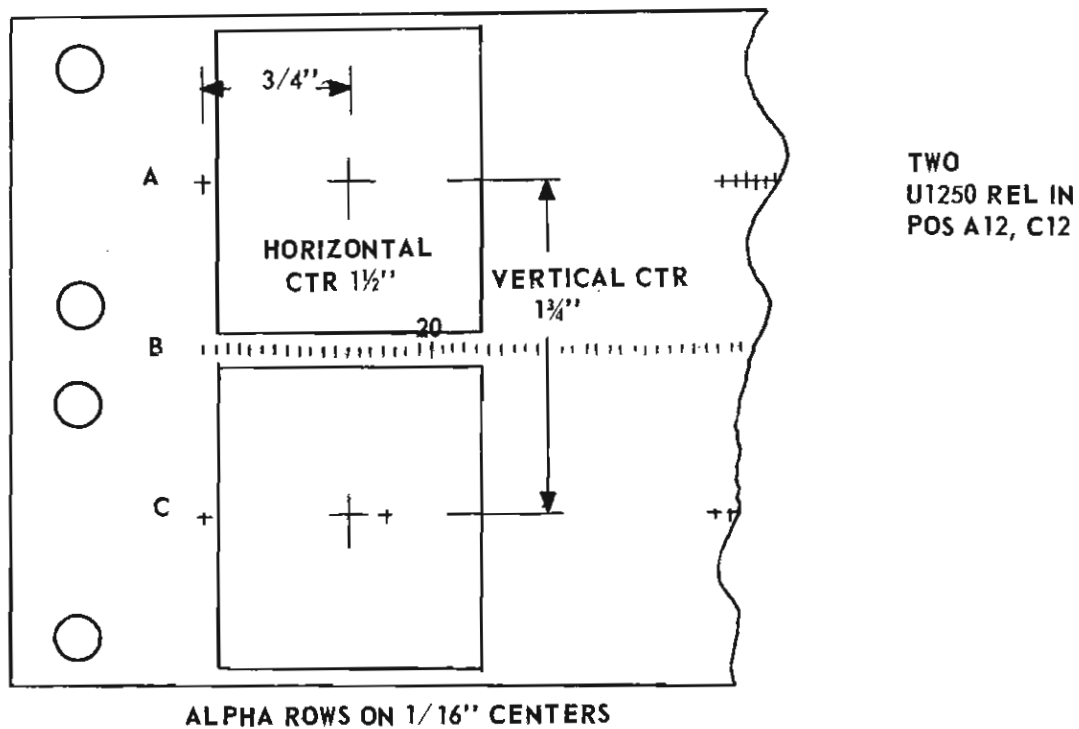
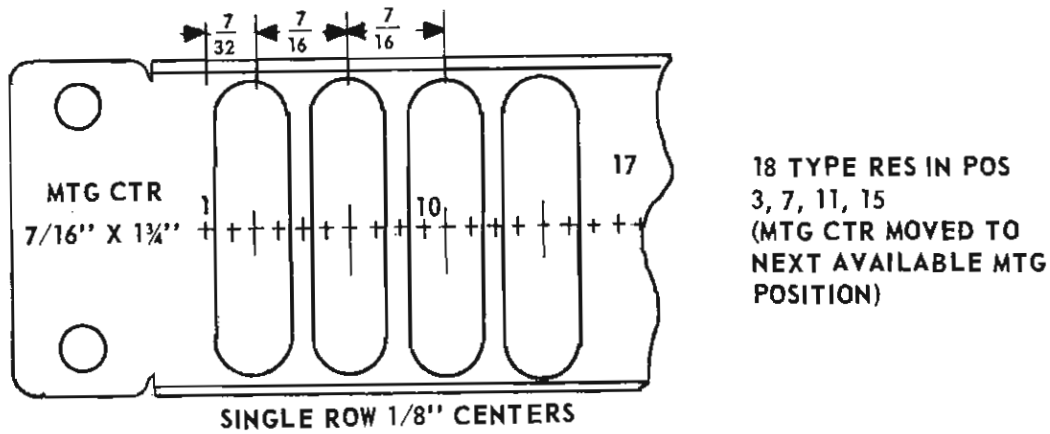


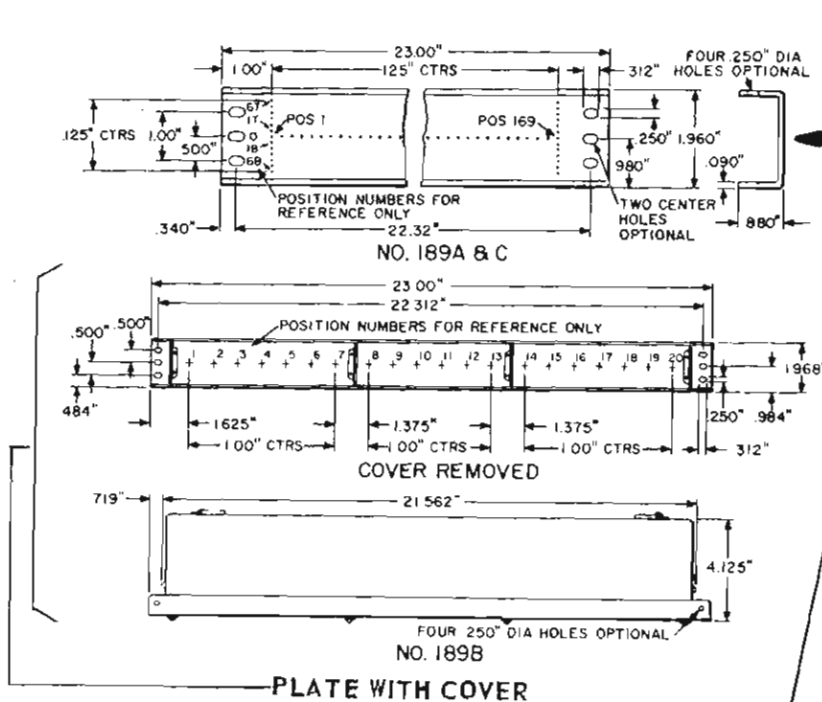
FIGURE L APPARATUS CENTERS & POSITIONS

Common Covers

Before you go into the details of how to order apparatus on a mounting plate and the procedures to follow, consider another item of importance, common covers. A common cover is one that covers all or part of the apparatus on a mounting plate, but is not an apparatus cover. It is either furnished with the mounting plate or ordered in the desired length. Both are shown in Figure M. On plates with covers, you must make certain that the apparatus is not too long to fit under the cover.

NOVEMBER 30, 1966

NO. 189A, B & C MOUNTING PLATES

SEE RATINGS
BELOW

Channel type metal plates.

No. 189A: Has 2197 positions on 0.125 inch centers, arranged in thirteen rows of 169 positions each.

Orders must contain information regarding which positions shall be drilled and stating what apparatus or drilling is required for these positions. Positions not mentioned in the order will not be drilled.

No. 50 type mounting plate covers may be used on this mounting plate.

Has zinc finish.

Initial use: In mounting apparatus in the No. 5 crossbar dial telephone system.

No. 189B: Drilled to mount twenty "E" or "R" type relays.

Has zinc finish.

Initial use: On miscellaneous relay rack units in step-by-step dial telephone systems.

No. 189C: Same as No. 189A except has a gray enamel finish.

Initial use: All systems.

| Code No. | Rating |
|----------|----------------|
| 189A | A.T.&T.Co.Std. |
| 189B | " " |
| 189C | " " |

PLATE WITHOUT COVER

Property of the Western Electric Company, Inc.

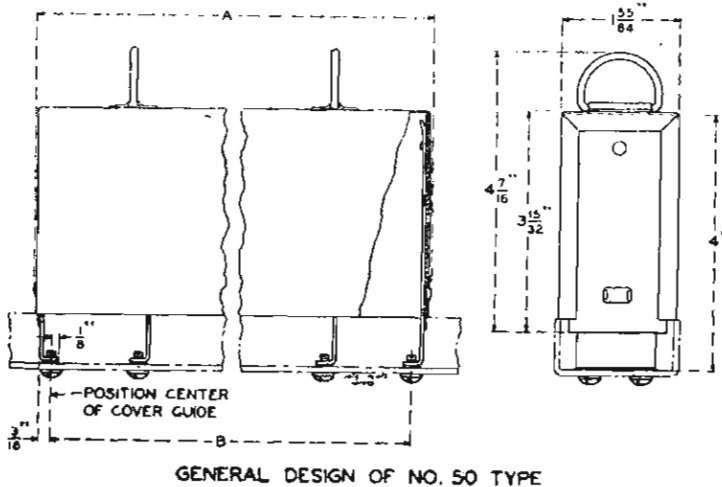
Printed in U.S.A.

FIGURE M PLATE WITH AND WITHOUT COVER

Covers may be coded (See Figure N) or piece parts as contained in the listing of "common covers" in Section 3 of the Handbook.

JUNE 28, 1963

NO. 50 TYPE MOUNTING PLATE COVERS

SEE RATINGS
BELOW

Metal covers, each provided with two end cover guides, and intermediate cover guides as indicated in table, together with the necessary insulators, bushings, washers and screws for mounting.

Orders for mounting plates to be equipped with these covers must specify the mounting positions for the cover guides. Unless otherwise specified in the order, the intermediate cover guides will be mounted in the same manner as the right hand end cover guide.

Intended for use on mounting plates such as the No. 178A, 189A and similar types.

| Code No. | Number of Intermediate Cover Guides | Dimensions (Inches) | | Rating |
|----------|-------------------------------------|---------------------|--------|----------------|
| | | A | B | |
| 50A | — | 8-1/16 | 7-1/2 | A.T.&T.Co.Std. |
| 50B | — | 11-9/16 | 11 | " " |
| 50C | 1 | 15-9/16 | 15 | " " |
| 50D | 2 | 21-9/16 | 21 | " " |
| 50E | 1 | 17-9/16 | 17 | " " |
| 50F | 2 | 21-5/16 | 20-3/4 | " " |
| 50G | — | 6-1/16 | 5-1/2 | " " |
| 50H | 1 | 18-15/16 | 18-3/8 | " " |
| 50J | 1 | 13-13/16 | 13-1/4 | " " |
| 50K | — | 9-9/16 | 9 | " " |
| 50L | — | 13-1/16 | 12-1/2 | " " |
| 50M | 2 | 22-1/16 | 21-1/2 | " " |
| 50N | 1 | 16-11/16 | 16-1/8 | " " |
| 50P | — | 4-3/16 | 3-5/8 | " " |
| 50R | — | 5-3/16 | 4-5/8 | " " |
| 50S | 3 | 32-1/16 | 31-1/2 | " " |
| 50T | 3 | 33-3/16 | 32-5/8 | " " |
| 50U | — | 8-5/8 | 8-1/16 | " " |

CATALOG NO 635

Property of the Western Electric Company, Inc.

Printed in U.S.A.

FIGURE N CODED COVER

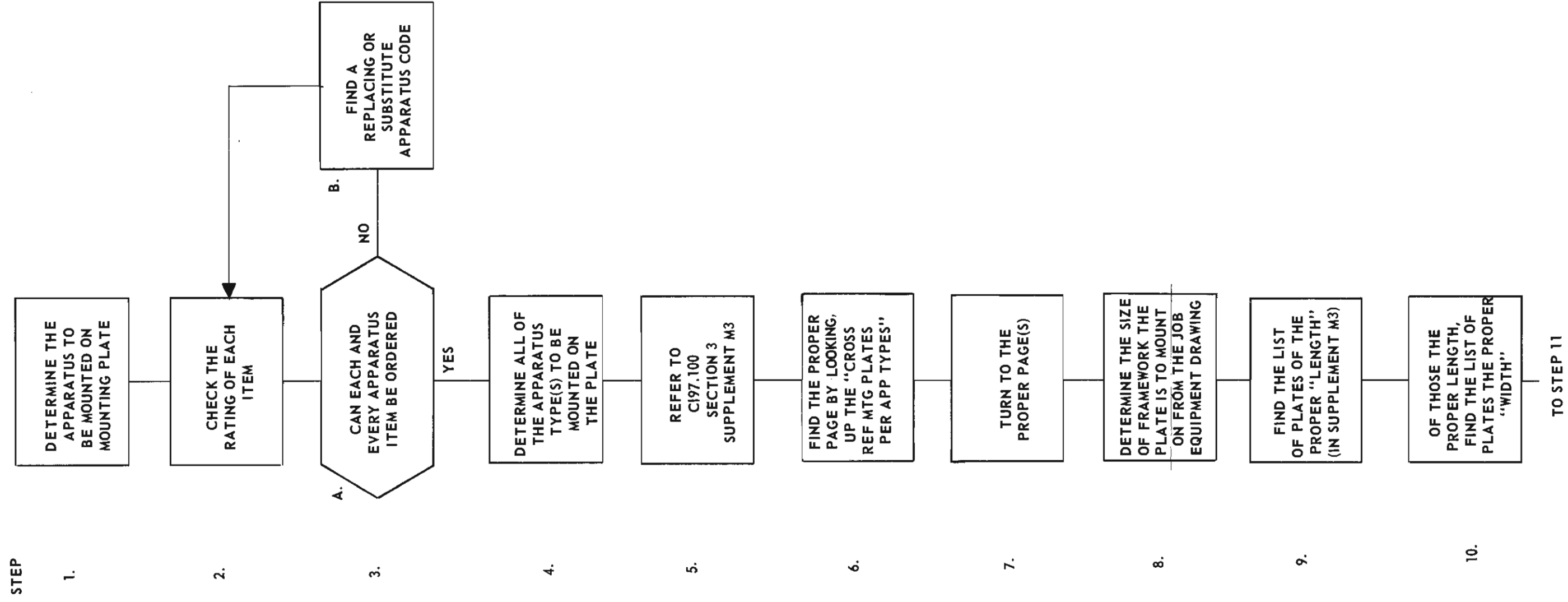
One of the important considerations in ordering mounting plates is whether you will equip them with common covers or not. In general, you will provide covers over apparatus that does not include its own covers. There are four basic guidelines to follow:

1. Order common cover when apparatus does not include its own cover.
2. Order common cover when individual apparatus covers (such as relay covers) would require excess space.
3. Do not cover items which must be accessed by installation or maintenance personnel. (Fuses, lamps, keys, jacks, meters, etc.)
4. Do not cover apparatus which would not fit under the cover without interference.

Arranging and Ordering (Mounting Plates)

Now, you are in a position to examine the procedures for arranging and ordering mounting plates.

MOUNTING PLATE JOB AID #1 -- PROCEDURE



FROM STEP 10

STEP

OF THOSE OF THE PROPER LENGTH AND WIDTH, SELECT ALL PLATES THAT ARE PRE-DRILLED FOR THE APP. YOU WILL MOUNT BY CHECKING UNDER THE "DR FOR" COLUMN FOR THE REQUIRED APPARATUS.

11.

A.

ARE THERE ANY PLATES PRE-DRILLED FOR THE APPARATUS THAT YOU REQUIRE

12.

B.

WILL YOU MOUNT RELAYS THAT REQUIRE INDIVIDUAL OR COMMON COVERS ON THE PLATE

NO
GO TO STEP 25C

GO TO STEP 24A

13.

NO

WILL YOU MOUNT RELAYS THAT REQUIRE INDIVIDUAL OR COMMON COVERS ON THE PLATE

YES

WILL ALL OF THE APP. FIT UNDER A COMMON COVER (SEE CI97.100, SECT 3, SUPL M5)

YES

14.

A.

OF THE PLATES SELECTED IN STEP 11, SELECT THOSE WITH COMMON COVERS

15.

B.

OF THE PLATES SELECTED IN STEP 11, SELECT THOSE WITHOUT COMMON COVERS

C.

OF THE PLATES SELECTED IN STEP 11, SELECT THOSE WITHOUT COMMON COVERS

A.

ARE THERE ANY PRE-DRILLED, WITH COMMON COVERS

16.

B.

ARE THERE ANY PRE-DRILLED, WITHOUT COMMON COVERS

NO
GO TO STEP 25B

GO TO STEP 25C

DETERMINE THE APP. MOUNTING CENTER REQUIREMENTS OF EACH ITEM OF APPARATUS WITHOUT INDIVIDUAL COVERS (HANDBOOK OR CARD CATALOG)

17.

DETERMINE THE APP. MOUNTING CENTER REQUIREMENTS OF EACH ITEM OF APPARATUS INCLUDING INDIVIDUAL COVERS WHERE NECESSARY (HANDBOOK OR CARD CATALOG).

DETERMINE THE APP. MOUNTING CENTER REQUIREMENTS OF EACH ITEM OF APPARATUS (HANDBOOK OR CODE CATALOG)

A.

OF THOSE SELECTED IN STEP 16A, DO ANY MEET WITH THE MOUNTING CENTER REQUIREMENTS (MTG CTR)

18.

B. OF THOSE SELECTED IN STEP 16B, DO ANY MEET WITH THE MOUNTING CENTER REQUIREMENTS (MTG CTR)

NO
GO TO STEP 25A

GO TO STEP 25B

C. OF THOSE SELECTED IN STEP 16C, DO ANY MEET WITH THE MOUNTING CENTER REQUIREMENTS (MTG CTR)

NO
GO TO STEP 25C

YES

FROM STEP 18A SELECT THE PLATE WITH THE MINIMUM NECESSARY MTG CENTERS

19.

B.

FROM STEP 18B SELECT THE PLATE WITH THE MINIMUM NECESSARY MTG CENTERS

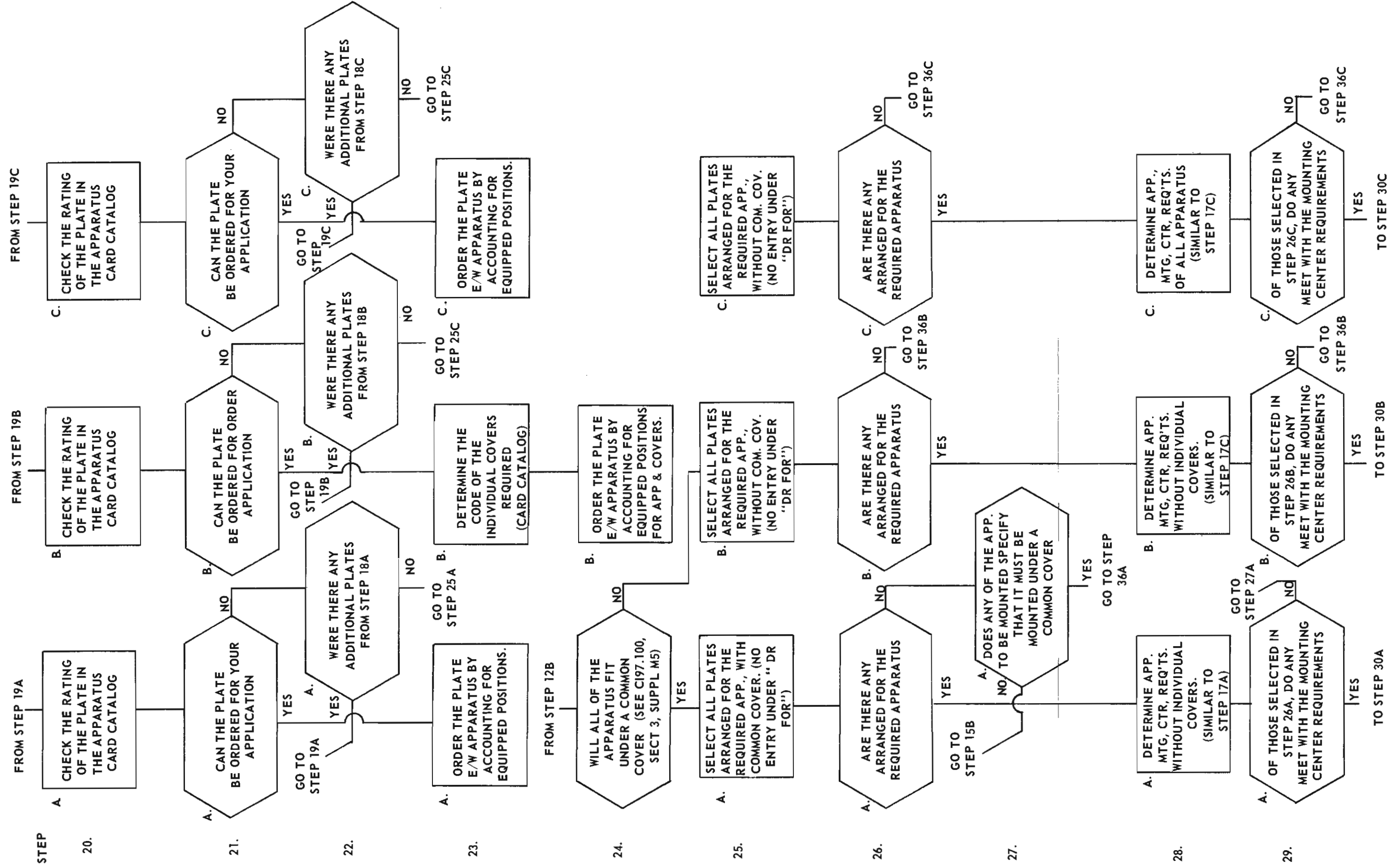
TO STEP 20A

YES

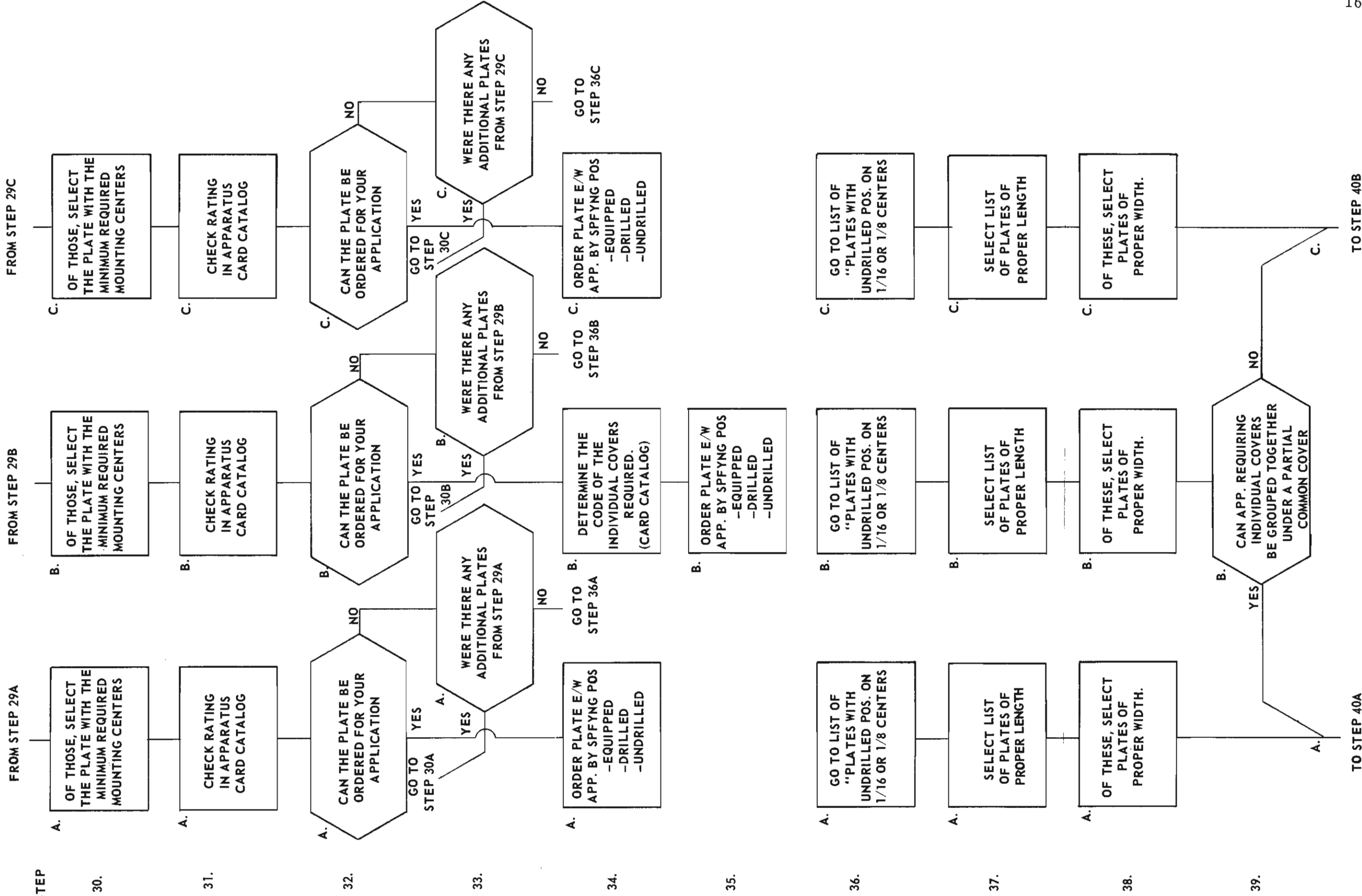
C.

FROM STEP 18C SELECT THE PLATE WITH THE MINIMUM NECESSARY MTG CENTERS

TO STEP 20C



STEP



FROM STEP 39A

STEP
40.

A.
SELECT PLATES
THAT CAN BE
EQUIPPED
WITH COMMON
COVER.

41.

A.
IS A SPECIAL
TYPE OR FINISH
OF PLATE REQUIRED?

NO

42.

A.
SELECT PLATE
OTHER THAN
SPECIAL TYPE
OR FINISH.

43.

A.
SELECT PLATE
OF THE SPECIAL
TYPE OR FINISH
REQUIRED.

44.

A.
LAYOUT AND ORDER
APPARATUS AND MOUNTING
PLATE PER
"MOUNTING PLATE JOB AID #2".

FROM STEP 39C

B.

IS A SPECIAL
TYPE OR FINISH OF
PLATE REQUIRED?

NO

B.

SELECT PLATE
OTHER THAN
SPECIAL TYPE
OR FINISH.

B.

SELECT PLATE
OF THE SPECIAL
TYPE OR FINISH
REQUIRED.

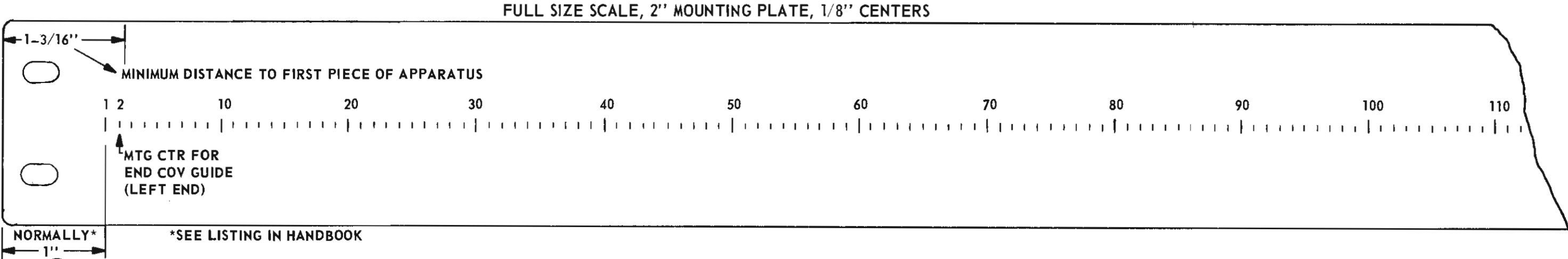
B.

LAYOUT AND ORDER
APPARATUS AND MOUNTING
PLATE PER
"MOUNTING PLATE JOB AID #3".

STEP

- (A) LOCATE DRILLING POSITION FOR ONE END COVER GUIDE AS THE SECOND POSITION IN ALL CASES, WHETHER ON 1/16" OR 1/8" CENTERS, AS FOLLOWS:
- 1). IF APPARATUS UNDER COMMON COVER STARTS AT THE LEFT SIDE, COVER GUIDE IN "POS 2".
 - 2). IF APPARATUS UNDER COMMON COVER STARTS AT RIGHT SIDE, COVER GUIDE IN POS SHOWN IN TABLE A.
- (B) ADD TOGETHER THE HORIZONTAL MOUNTING CENTER DIMENSIONS OF ALL APPARATUS TO BE MOUNTED UNDER COMMON COVER.
- 1). IF THE TOTAL DIMENSION IS 11" OR LESS, ADD 3/4" AND SELECT THE NEXT LARGER COVER.
 - 2). IF THE TOTAL DIMENSION IS 11-1/16" TO 16-1/4", ADD 1-1/8" AND SELECT THE NEXT LARGER COVER.
 - 3). IF THE TOTAL DIMENSION IS 16-5/8" TO 20-7/16", ADD 1-1/2" AND SELECT THE NEXT LARGER COVER.
- (C) AFTER YOU HAVE DETERMINED THE COVER LENGTH, LOCATE THE OTHER END COVER GUIDE BY PLACING IT IN A POSITION (THE LENGTH OF THE COVER MINUS 7/16") FROM THE ONE END ESTABLISHED IN STEP (A)

| TABLE A | | | | |
|---------|-----|----------|-----------|------------|
| 19" | 23" | 1/8" CTR | 1/16" CTR | POS |
| X | | X | | 136 |
| X | | | X | 262 or 272 |
| | X | X | | 168 |
| | X | | X | 336 |



- (D) LOCATE THE DRILLING POSITION FOR THE FIRST PIECE OF APPARATUS BY ADDING ONE HALF OF ITS HORIZONTAL MTG CTR DIMENSION TO 1-3/16". THEN MEASURE THIS TOTAL DISTANCE FROM THAT END OF THE PLATE WHERE YOU LOCATED THE FIRST COVER GUIDE. SPECIFY THE NEXT CLOSEST MTG POSITION.
- (E) DRILLING POSITIONS FOR SUBSEQUENT APPARATUS ARE DETERMINED AS FOLLOWS:
- 1). FOR SIMILAR APPARATUS, THE NEXT POSITION AT A DISTANCE EQUAL TO OR GREATER THAN THE STATED HORIZONTAL MTG CTR DIMENSION.
 - 2). FOR DISSIMILAR APPARATUS, THE NEXT POSITION AT A DISTANCE EQUAL TO OR GREATER THAN THE SUM OF (ONE HALF THE HORIZONTAL MTG CTR DIMENSION OF EACH OF THE TWO ADJACENT PIECES OF APPARATUS).
- (F) FOR COVERS THAT ARE 12" IN LENGTH OR GREATER, ALLOW 3/8" HORIZONTAL MOUNTING DISTANCE SPACE FOR INTERMEDIATE COVER GUIDES AS SPECIFIED IN CI97.00, SECT. 3, SUPPL M5.
- (G) ACCOUNT FOR POSITIONS EQUIPPED, DRILLED, AND UNDRILLED ALL OTHERS.

MOUNTING PLATE JOB AID #3 – WITHOUT COMMON COVER

STEP

- (A) LOCATE THE DRILLING POSITION FOR THE FIRST PIECE OF APPARATUS BY ADDING ONE HALF OF ITS HORIZONTAL MTG CTR DIMENSION TO $\frac{3}{4}$ ". THEN MEASURE THE TOTAL DISTANCE FROM THE END OF THE PLATE. SPECIFY THE NEXT CLOSEST MTG POSITION.
- (B) DRILLING POSITIONS FOR SUBSEQUENT APPARATUS ARE DETERMINED AS FOLLOWS:
- 1) FOR SIMILAR APPARATUS, THE NEXT POSITION AT A DISTANCE EQUAL TO OR GREATER THAN THE STATED HORIZONTAL MTG CTR DIMENSION.
 - 2) FOR DISSIMILAR APPARATUS, THE NEXT POSITION AT A DISTANCE EQUAL TO OR GREATER THAN THE SUM OF (ONE HALF THE HORIZONTAL MTG CTR DIMENSION OF EACH OF THE TWO ADJACENT PIECES OF APPARATUS).
- (C) ACCOUNT FOR POSITIONS EQUIPPED, DRILLED AND UNDRILLED ALL OTHERS.

FULL SIZE SCALE, $1\frac{3}{4}$ " MOUNTING PLATE, $1/16$ " CENTERS