

**GENERAL OUTLINE**  
**OPERATION AND EQUIPMENT FEATURES**  
**EQUIPMENT DESIGN REQUIREMENTS**  
**CROSSBAR TANDEM SYSTEM**

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(a) Remote Office Test Line (ROTL)	Translator Frame	8
(b) Traffic Control	3-Digit Incoming Register and Link Frame	13
(c) Computerized Maintenance and Administration Support (COMAS III)	Incoming Registers (3-Digit)	130
(d) Trunk Busy Distributing Frame	10-Digit Incoming Register Link Frame	10
(e) Point-to-Point Data Recording	10-Digit Incoming Register Supplementary Link Frame	10
(f) Auxiliary Coin Charge Computer (TSP)	Incoming Registers (3-Digit Registers and 10-Digit Registers)	300
(g) Computerized AMA Recording (CAMA-C)	Link and Connector Frame (TSP)	80
(h) Engineering and Administrative Data Acquisition System/Network Management (EADAS/NM)	Link and Connector Supplementary (TSP)	40
(i) Directory Assistance Charging	Link Controller Frame (TSP)	15
(j) One-Second Timing Accuracy for AMA	Light Hour Transfer Control Frames (Associated with TSP Operation)	21
(k) Reduced Call Processing Time.	Marker Frames	8
	Marker Connector Frames	13
	Control Pulsing Connector Frame (Remote Operation)	10
	Supplementary Pulsing Connector Frame	5
	Marker Connectors	39

**CAPACITY**

**1.03** The capacity of the crossbar tandem office is as follows:

Billing Indexer	3	TSP Operator Outgoing Trunk Frame	As Required*
Billing Indexer Supplementary Frame	3	Office Link Frames	20
Billing Indexer Auxiliary Frame	1	Outgoing Trunks (Tandem Completing)	6000
Call Identity Indexer Frames	5	Outgoing Trunks per Office Group	240†
Call Identity Indexers	20	Position Link Frames	5
Coin Charge Computer Frames	2	Position and Position Control Frame (Local Operation)	165
Auxiliary Coin Charge Computer Frames	2	Position Control and Control Signaling Frame (Remote Operation)	165
Cordboard Transfer Trunk	As Required	Position and Position Signaling Frame Remote Operation)	165
Finder Frames Two	By Dial	Position Display Frame (Remote Operation)	5‡
Units—Each Serving	Assist 0	Control Pulsing Frame Remote Operation)	6
99 Dial Assistance	Trunks		
0 Trunks and a Maximum of 8 Transfer Trunks			
Data Transfer—Data Channel Frames	4		
Data Transfer—Sender Connector Frame	4		
Data Transfer—Register Connector Frame	6		
Data Transfer—Position Connector Frame	14		
Data Transfer—Trunk Connector Frame	2		
Delay Call Trunk Frame and Units	5		
Delay Call Trunks	145		

\* One frame serves 44 traffic service positions with 30 outgoing trunks in 4 trunk groups.

† Limited to 58 Routes.

‡ If each link group is at a different remote location.

Recorders (including one emergency)	21
Rater, Coin Frame	2
Senders	195
Sender Link Frames	64
Sender Register Connector Frames	2
Sender Register Connectors	4
Transverter Frames	12
Transverter Connector Frames	20
Transverter Connector Supplementary Frames	10
Transverter Connector Transverter Auxiliary	3
Transverter Connector Position Auxiliary	4
Transverter Connectors	40
Timer Link and Control Frames	10
Trunk Link Frames	20
Incoming Trunks	6400 *
Pretranslator Frames	2

**2. SUPPLEMENTARY INFORMATION**

**GENERAL**

800-600-000—Checking List—General Equipment Requirements
817-000-000—Numerical Index—Crossbar Tandem System
817-013-180—Performance Requirements
760-600-151—General Fire Specification Guide for Bell System
760-210-150—Ceiling Heights for Equipment Building
E-8013—Crossbar Tandem Questionnaire
J20152—817-035-150—Switchboard Power Cabling—Miscellaneous Wiring of Major Frames
J22457—816-104-100—General—AMA—No. 1 Crossbar System

**TRANSMISSION PATH FRAMES**

J27052—817-210-150—Office Junctor and Line Junctor Grouping Frames
J27554—817-200-150—Trunk Link and Trunk Link Extension Frames
J27650—817-201-150—Office Link and Office Extension Frames

**COMMON CONTROL FRAMES**

J22151—817-107-150—Call Identity Indexer Frames and Units
J22154—817-112-151—Transverter Connector Frames
J22155—817-110-150—Sender Register Connector Frame
J22156—817-540-150—Data Transfer Frames
J22462—817-120-150—Recorder Frame
J22464—817-106-150—Billing Indexer Frame
J22465—817-112-150—Transverter Frame
J22474—817-316-150—Pretranslator Frame
J27755—817-111-150—Incoming Register and Link Frame (3-Digit) (A&M Only)
J27953—817-300-150—RP, MF, and DP Sender Frames
J27961—817-302-150—PCI Sender Frame
J27968—817-301-151—Functional DP and MF Sender Units
J27969—817-301-150—DP and MF Sender Frames
J28053—817-108-150—Position Link Frame
J28150—817-215-150—Marker Connector Frames
J28450—817-202-150—Sender Link Frame
J28761—817-310-150—Marker Frame
J28765—817-203-150—10-Digit Incoming Register and Link Frames
J28772—817-315-150—Translator Frame
J28773—817-521-150—Timer Link and Control Frame (TSP)
J99269—817-510-150—Link and Connector Frame—(TSP)
J99270—817-511-150—Link Controller Frame—(TSP)
J99273—817-516-151—Rater Frames and Associated Equipment—(TSP)
J99274—817-516-150—Coin Charge Computer
J99286—817-505-151—Position and Position Control Frames and Units and Associated Signaling Equipment for Remote Operation—(TSP)
J99293—817-506-150—Cordboard Transfer Trunk Finder Frame—(TSP)
J99304—817-610-150—TSP Operator Outgoing Trunk Frames
J99318—817-505-152—Light Hour Transfer Control Frames (TSP)

**TRUNKS AND RELAY RACK EQUIPMENT**

J23052—817-040-150—Relay-Rack Equipment
J23066—817-041-150—Auxiliary Relay-Rack Mounted Equipment
J27250—817-601-150—Incoming Trunk Frames
J27251—817-615-150—AMA Trunk Frames

J27252—817-602-150—Two-Way Trunk Frames  
 J27253—817-611-150—Traffic Service Position Trunk Frames  
 J61564—818-081-150—Relay Rack Units (Calendar & Clock Unit)  
 J98615—801-406-151—Four-Wire Terminating Units  
 J92608—817-062-150—Sender Attachment Delay Equipment  
 J93815—822-204-151—Equipment Units for No. 12 Service Observing Desk  
 J98304—819-751-150—Alarm Transfer Equipment Units  
 J99275—817-530-150—Relay-Rack Mounted Equipment Units—(TSP)

**OTHER FRAMES AND CABINETS**

J1P004—817-102-150—Computerized Recording AMA (CAMA-C)  
 J22451—817-105-150—Master Timing Frame—(AMA)  
 J22456—817-121-150—Perforator Cabinet—Perforator and Reader Cabinet—Call Count Process Control Register Equipment—(AMA)  
 J22466—817-732-150—Line Observing Frame—(AMA)  
 J22653—817-047-150—Traffic Supervisory Cabinet  
 J28778—817-505-153—Traffic Control Frame and Console  
 J22750—817-042-150—Office Interrupter Frame  
 J27054—817-064-151—Traffic Register Equipment—Using 400-Capacity Traffic Register Rack  
 J27059—817-064-150—Traffic Register Equipment—Using 300-Capacity Traffic Register Cabinet  
 J28352—817-740-150—Floor Alarm Unit  
 J28762—817-043-150—Group-Busy Frame  
 J92603—801-006-157—Traffic Register Cabinet  
 J92604—822-105-150—Traffic Usage Recorder Frame—Traffic Usage Recorder Control Panels  
 J92605—822-120-150—Traffic Register Camera Control Panel—Traffic Register Camera Control Unit  
 J25151—817-044-150—Multifrequency Pulsing Receiving Frame  
 J98609—801-620-151—Multifrequency Current Supply for AC Keysets and Multifrequency Pulsing Senders

**MAINTENANCE FRAMES**

J21850—817-731-150—Sender Make-Busy Frame  
 J23259—817-730-150—Trouble Recorder and Connector Frames  
 J23267—817-701-153—Computerized Maintenance and Administration Support  
 J23351—817-710-150—Sender Test Frames—Sender and Register Test Connector Frame  
 J24050—817-702-150—Trunk Test Frame—For Use With Remote Control Zone Registration Trunks  
 J24350—817-711-150—Trunk Automatic Test and Connector Frames (AMA—TSP)  
 J27061—817-065-150—Point-to-Point Data Recorder Frame  
 J27753—817-701-150—Incoming Trunk Test Frame and Incoming Trunk Test Connector Frame  
 J28555—817-701-154—Remote Office Test Line Frame  
 J67447—817-706-150—Automatic Transmission Test and Control Frames  
 J98501—817-705-150—Manual Outgoing Trunk Test Frame and Outgoing Trunk Test Jack Bay  
 J99277—817-716-150—Rater-Charge Computer Test Frame—(TSP)  
 J99299—817-715-150—Position Test Frames—Position and Position Control Test Units (TSP)

**OPERATING ROOM EQUIPMENT**

J21350—817-101-150—CAMA Switchboard—(AMA)  
 J99268—817-505-150—100A TSP Section and Associated Operating Room Equipment—(TSP)

**TOLL TESTBOARD EQUIPMENT**

J63516—801-225-153—17B Toll Testboard  
 J63524—801-225-163—Circuit Patching Bay

**TEST SETS**

J24752—817-720-150—Trunk Test Set (Wagon Type) and Associated Equipment  
 J24753—817-723-150—Test Set for Timing Tests  
 J93017—801-205-152—Relay-Rack Mounted Test Equipment (J93017A Only—Test Panel for 209FF, 209FK, 209FL, and 209FM Relay)  
 J94002—801-250-150—2-type Panels, Units, and Portable Test Sets for Transmission Measuring

J94714—801-205-158—35F Relay Test Set \*  
 J94722—817-721-150—Auxiliary Trunk Test Set  
 (Box Type)  
 J94723—801-205-161—Pulse Checking Test Set (Box  
 Type)  
 J94724—801-205-162—Contact Closure Test Set (Box  
 Type)  
 J94725—801-205-163—Mercury Relay Test Set  
 J94727—801-205-165—1A Signaling Test Set  
 J94730—801-205-168—1A Fault Locator Test Set  
 J94731—801-205-169—Cold Cathod Tube Test Set  
 J94736—801-206-152—1A Pulse Analyzer  
 KS-14510—Volt-ohm-milliammeter  
 KS-15750—Tube Tester

### AUXILIARY EQUIPMENT

#### Power Plants

J86434—802-726-150—302A Power Plant 24 and 48  
 Volts  
 J86465—802-754-151—410B Power Plant 130 Volts,  
 1-80 Amperes  
 J86617—802-802-161—504B Power Plant—AC Sup-  
 ply Units with Emergency Operation from  
 Battery  
 J86724—802-805-150—506A Power Plant—Low Vol-  
 tage AC Supply Units

#### MISCELLANEOUS

J20156—817-036-150—Limiting Conductor Lengths  
 Between Frames and Units  
 J25551—817-060-150—End Guards, Aisle Pilot Lamp  
 Supports—Distributing Power Terminal  
 Strip Supports, Record Books and Holders,  
 Spare Fuse Mountings, and Print Display  
 Boards  
 J25552—817-037-150—Frame Lighting and Appliance  
 Outlets  
 J28350—801-601-158—Emergency Alarm Systems  
 With or Without Code Signaling—Including  
 Automatic Fire Detection Feature  
 J29268—817-016-150—Provision of ANI Operation in  
 CAMA Offices—Modification Procedures  
 J29270—817-600-150—Trunk Tables—Listing Trunk  
 Unit Equipments, Features, and Options  
 J29271—817-500-150—Operation of CAMA Offices  
 with 100A TSP—Modification Procedures  
 (TSP)  
 J99324—817-048-151—Announcement Frame—No.  
 5A Announcement System  
 J85505—802-015-150—Central Office Lighting—  
 Fluorescent Type  
 J85507—802-015-152—Frame and Aisle Lighting—  
 Fluorescent Type

J90603—801-006-150—Cable Rack  
 J90604—801-007-150—Ladders, Benches, and  
 Stools—Application Practices  
 J90605—801-007-151—Rolling Ladders—Track Type  
 J90801—801-006-151—Cable Hole Sheathing  
 J90802—801-006-152—Engineering Requirements for  
 Low-Type Auxiliary Framing  
 J93814—822-204-150—No. 12 Service Observing  
 Desk  
 J95501—802-015-157—Central Office Lighting Equip-  
 ment, Appliance Outlets, and Miscellaneous  
 Conduits  
 J95502—802-015-158—Emergency Lighting Equip-  
 ment for Central Offices  
 J97025—801-006-155—Relay Racks—Angle Type  
 Framework and Cabling  
 J97033—801-010-150—Fuse Bay—Angle Relay-Rack  
 Type  
 J97037—801-010-151—Fuse Bay Angle Relay Rack  
 Type

### 3. DRAWINGS

#### Circuits

SD-25435-01—Crossbar Tandem Office Keysheet  
 SD-25435-02—Current Drain Data  
 SD-80909-01—Battery Distributing Circuit

#### Cabling

ED-25346-14—Method of Running Power  
 -15—Feeders  
 ED-27127-01—Wire Gauges and Types of Insulation

### 4. GENERAL DESCRIPTION AND OPERATION OF CROSSBAR TANDEM

**4.01** Crossbar tandem equipment is used primarily  
 in panel, step-by-step, and crossbar areas to  
 switch calls among offices by means of crossbar  
 switches in a marker common control system. Its  
 central location provides for the application of au-  
 tomatic message accounting (CAMA) or (CAMA-C)  
 to record billing data for local and toll calls. It per-  
 mits the use of AMA on calls from panel offices for  
 which local AMA has not been developed. It provides  
 for the application of 100A Traffic Service Positions  
 (TSP) to the tandem office to extend customer Direct  
 Distant Dialing (DDD) to include customer dialing of

special toll calls, Coin Distance Dialing (Coin DD), and local and toll dial assistance originated as Dial Zero Calls. With proper terminating equipment it also provides for switching intertoll trunks on a 2-wire basis.

**4.02** The crossbar tandem system functions in many respects like a No. 1 crossbar office. The basic arrangement is shown in the upper portion of Fig. 1. The lower portion of Fig. 1 shows equipment elements required when AMA operation is provided for a crossbar tandem system. An incoming trunk is connected through a trunk link frame, office junctor grouping frame, office link frame, and an outgoing trunk to another office. In operation, the incoming trunk is connected to a sender through a sender link frame. The sender registers the called number and other required information and connects to a marker through a marker connector frame. The marker receives information from the sender and supplies the sender with information it needs to complete the call. The marker selects an outgoing trunk to the desired destination and connects the incoming trunk through the trunk and office link frames to the outgoing trunk. Figure 2 shows the basic switching plan of a crossbar tandem system with traffic service positions. Basically, the fundamental switching plan remains the same. However, additional equipment elements are required for connection to the traffic service position and its associated common control equipment. These new equipment elements consist primarily of: the traffic service position, link and connector, link controller, traffic regulator, chief operators administration units, data transfer, position control, 10-digit incoming register and link, coin rater, charge computer, and coin timer link and controller.

**4.03** The best route to a particular office in a foreign area is selected by a translator when several routes are available. For this call, the sender transmits six digits to the marker. The first three digits, representing the area, are decoded by the marker and the second three, representing a particular office are decoded by the foreign area translator which is called in by the marker. This results in the selection of the most direct route available to the particular office in the foreign area. The translator is also used for PBX in-dialing to select the desired PBX from the several that may share the same first 3 digits.

**4.04** When a crossbar tandem office is arranged for AMA or AMA with TSP operation, additional functions and frames are required to record data for

billing purposes and to complete special calls with the aid of a traffic service position operation. Billing data is recorded as perforations on paper tape\* as with local offices arranged for AMA. The tapes are processed in accounting centers on the same machines used for processing local AMA tapes. When a crossbar tandem office is arranged for CAMA-C operation with or without TSP, the billing data is processed by an IBM computer and recorded on magnetic tape. This feature replaces the paper tape perforators and their associated cabinet equipment but retains all other AMA circuits.

**4.05** The elements of an AMA call recorded for billing purposes include the called and calling customer numbers, the time of answer, the time of disconnect, the called area, message billing index, and the trunk number. The calling customer number may be obtained by an operator at a CAMA switchboard or a 100A traffic service position or it may be determined by automatic number identification (ANI) equipment in the local and tandem office.

**4.06** On an operator identified call into the CAMA tandem not arranged for TSP operation, the CAMA operator is called in while the call is being set up. The operator asks the calling number, and keys it into the sender before the call is allowed to be completed. With ANI features provided, the tandem office sender requests the calling customer number from the local office after receipt of the called number. The calling customer number is pulsed from the local office into the sender on an MF basis. CAMA tandem arranged for traffic service position operation may handle operator identified noncoin calls at the traffic service positions rather than at CAMA positions. In many cases, present CAMA positions will be retained for handling the noncoin station calls with features to transfer CAMA night traffic to traffic service positions.

**4.07** When a CAMA tandem handles a special toll call, such as person-to-person, collect, credit card, and charge to third number, the assistance of the traffic service position operator is needed for recording the correct charge data in the CAMA equipment. This assistance on special toll calls and coin DD is furnished at cordless positions which are bridged on dialed connections at the crossbar tandem.

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\* Refer to J22457-816-104-100 for description of Tape Make-Up, Perforation Devices, etc.

The bridged connections are held only long enough to provide the necessary assistance, or can be locked in for the duration of the call if needed. AMA entries for calls handled at the TSP are similar to those made for customer dialed calls made without operator assistance. However, distinctive message billing indices are used to identify the calls handled by the TSP.

**4.08** The AMA equipment consists primarily of a switchboard and/or TSP console, perforators or CAMA-C equipment, position links and/or TSP links, transverters, master timer, transverter connector, billing indexer, recorder, call identity indexer, 3-digit incoming register and link, sender register connector, 10-digit incoming register and link, data transfer, rater, timer link, and charge computer frames. The 3-digit incoming register and link (3-digit register) and its associated sender register connector are used in step-by-step areas to avoid second dial tone. The 10-digit incoming register and link equipment is also used in step-by-step areas; however, all digits are registered in the register and upon completion of dialing, this information is transmitted to the MF sender by way of the data transfer circuit. The CAMA switchboard and/or the traffic service positions may be located in the same building as the switching equipment or in a distant building (remote operation).

**4.09** The operation on an operator identified call from a panel or crossbar office is as follows: After the sender is seized and has started to receive pulses from the sender in the local office, it is attached to an operator position through a position link. After pulsing is finished, the operator asks for the customer's number and keys it into the sender. The sender connects to a transverter through a transverter connector and transmits to it information required for the initial entry.

**4.10** The operation on a special toll call requiring the assistance of a TSP operator is as follows: The incoming trunk is connected to the sender by the sender link frame in the normal manner. The sender registers the number of the trunk link frame, the identifying trunk class and data group number as sent by the sender link frame and receives and registers the called number and calling number (ANI). Following the receipt of all information, the sender signals the trunk to initiate a bid for a TSP position by signaling a seizure to the link and connector circuit. When the position control circuit recognizes that it has been connected to a trunk, it in turn bids for a data transfer circuit.

**4.11** The data transfer circuit provides the means of interconnecting transmitting and receiving leads between the sender, trunk, position, 10-digit incoming register and link circuit (DP calls), and when coin traffic is involved, the rater and charge computer.

**4.12** When the call detail information has been passed to the position control circuit, the data transfer circuit checks the integrity of the information passed and also signals the sender to bid for a marker to set up terminating connections. The data transfer circuit then releases from the connection.

**4.13** The sender, having received the OK check from the data transfer, bids for a marker to set up the terminating connection. The sender completes its normal outpulsing functions and disconnects. The control circuit, having received the necessary call detail information, signals the operator that a call is present on a designated loop and transmits an alerting "ZIP" tone to the operator. At this time all of the pertinent call information lamps such as class of call and instructions for operator handling are illuminated at the position console by the control circuit.

**4.14** The operator will complete the necessary functions to fulfill the customer's request and will operate one of the billing class keys to register the type of charge treatment. After insuring that the desired connection has been obtained, the operator will operate the start timing (ST TMG) key to initiate the AMA tape initial entry. The position control circuit will bid for connection to a transverter and after obtaining a satisfactory AMA record, signal the operator accordingly.

**4.15** The operator, if services are not required for other functions, such as notify or time and charge, can disconnect from the call by operation of the position release (POS RLS) key. This causes the position control circuit to release all registers and the loop connection and present an idle appearance to the link circuits so that a new call can be connected to the position.

**4.16** The transverter seizes the billing indexer which derives the proper billing index number, office index, and type of billing entry. Distinctive message billing indexes are used to identify the calls handled at the TSP. The transverter passes the required items of information to the recorder for per-

formation on the tape as part of the initial entry. The transverter also causes the trunk to identify itself through the call identity indexer to the recorder and have its number perforated as part of the initial entry. The marker functions as on non-AMA. If the call is set up satisfactorily, the answer and disconnect times, which are initiated by signals received by the trunk, are perforated on the tape as subsequent entries by the recorder operating in conjunction with the master timer. In CAMA-C equipment the computer scans all recorders every 10 milliseconds so as to gather initial entry data. It also scans all AMA trunks every 100 milliseconds in order to detect a change in state indicating a possible answer or disconnect condition. The time of these entries is furnished by the computer. Initial entry and answer time are temporarily stored on a permanent file disk during the call-in progress stage. When a valid disconnect entry is detected the message details are assembled and transferred to a removable disk and stored as a sequential file. Periodically the computer gathers the assembled details and dumps it on magnetic tape in a single entry format. Tapes are subsequently forwarded to a data processing center for billing.

**4.17** On calls in step-by-step areas served by a tandem office, the step-by-step incoming trunk is connected to an incoming register through the incoming register link frame. Connection to the incoming register is completed during the interdigital interval between the last digit of the directing code and the first digit of the called code. Dependent upon the type of traffic required, the incoming trunks are assigned to either a 3-digit incoming register or a 10-digit incoming register.

**4.18** On calls utilizing the 3-digit register, the register records the first three digits and the sender the remaining digits. Subsequently the three digits recorded in the register are transmitted to the sender through the sender register connector. The call is then processed in the usual manner.

**4.19** On calls handled by the 10-digit register, the register records all the digits dialed. When seven or ten digits have been received or having determined by timing that no digits are expected (dial 0 call on a combined 0, 0+, and 1+ trunk), the register calls for the data transfer circuit for further processing of the call. When the register has been connected to a data transfer circuit, it transmits digital and other information and releases after receiving an OK check from the data transfer. The output of the 10-digit register is transmitted to an MF sender by way of the data transfer circuit.

**4.20** Coin distance dialing (DDD) on TSP permits the customer to dial the call from a coin telephone in the same manner that a call from a noncoin telephone is dialed. The call is brought into the tandem office on a coin incoming trunk and is connected to a sender through the sender link frame. The sender receives information identifying the trunk class and its data group number. The sender receives and registers the called number followed by a distinctive start pulse indicating station paid (1+ traffic) or special toll (0-, 0+ traffic). After receipt of ANI information, the sender signals the trunk to bid for a TSP position. The call is rated and computed and the initial period charge including tax is displayed to the operator automatically. Rating functions are furnished by the rater whose principal job is to determine the rate treatment number for customer dialed coin zone or coin toll calls. The charge computer calculates the time and charges for the initial and overtime periods of customer dialed coin zone and coin toll traffic. The purpose of the timer link and controller circuit is to furnish the incoming coin trunks, which are in the charge condition, pulses required by the trunk for timing purposes.

**4.21** The traffic regulator controls the distribution of calls to positions and provides an administrative lamp signal to indicate the current speed of answer being given.

**4.22** The traffic regulator controls the connection of trunks and CAMA senders to positions by noting the demand for the various classes and the availability of positions. It accomplishes this by controlling the gates on the link frames for each class of service and controlling the position availability signals to the links. A master gate in the regulator opens to admit all calls waiting outside the individual gates for each class on each frame. These gates then close. The regulator, by signaling position availability, permits all admitted calls to be served in accordance with the controllers preference programs. When all calls within the master gate are served, the gate opens and the sequence starts over. The regulator recognizes priority request from trunks which are served without regard to status of the gates by signaling all of the link frames that all positions are busy. This stops regular call distribution until the waiting priority requests are served.

**4.23** Light hour transfer control equipment options are provided for crossbar tandem offices equipped for 100A TSP operation.

**4.24** Functionally, the light hour transfer circuit provides the means of transferring the traffic load of one 100A TSP link group to another specified link group during light traffic hours.

**4.25** A link group designated "night" will be assigned to receive all transferred traffic from other link groups. Where a 100A TSP will also serve CAMA traffic, it must be assigned to this link group.

**4.26** A second link group designated "twilight" may be arranged to receive transferred traffic. The "twilight" group is arranged to transfer its traffic to the "night" link group.

**4.27** The remaining link groups are designated "day" link groups and may be arranged to transfer their traffic to either the "night" group or the "twilight" group.

**4.28** Three night transfer frames per link group designated TRFR-N (0-2) are provided for all link groups transferring to night. An additional three frames per link group designated TRFR-T (0-2) are required for "day" groups arranged to transfer traffic to either "night" or "twilight".

**4.29** Other facilities which are available at the TSP to improve service include the following:

- (a) Two-way communication with a centralized supervisor console by means of the supervisor selecting trunk circuit.
- (b) Monitoring facilities at one selected position in each link group, using the position selecting and monitoring circuit.
- (c) Operator recording of observed troubles by means of the operator identified trouble tracing circuit.
- (d) Transfer of certain types of calls such as overseas, etc, to cordboard positions properly equipped to handle them. This is done through the transfer trunk finder.
- (e) The ability to communicate over outgoing trunk circuits to information or other service operators if the operator so desires.
- (f) The ability to cancel a call record if necessary.

**4.30 Framework -General**—Crossbar tandem frames are bulb-angle structures 11 feet 6 inches high with sheet metal bases 10 inches wide and of varying lengths. The perforator cabinets are low sheet metal cabinets 4 feet 4 inches high, 1 foot 10-1/2 inches long, and 2 feet 8-1/8 inches deep. Most frames have their own fuse panels which are mounted at the top. Some of the frames of early design have sender casings front and rear. Frames of later design have sender casings on the front and enclosures with removable covers on the rear. Frames of recent design employ wire spring relays and do not require frame covering. The 17B toll testboard, circuit patching bay, and trunk assignment patching bay are channel relay rack structures 11 feet 6 inches high and 2 feet 0-3/8 inches long. The testboard with its keyshelf is 2 feet 3-1/2 inches wide while the trunk assignment patch bay and circuit patching bay are 10 inches wide. Sheet metal cabinets are provided to accommodate traffic control, traffic supervisory, CAMA-C and COMAS III equipment. In a CAMA-C installation cabinets of various sizes are furnished (see Fig. 3 for floor plan information).

## 5. DESCRIPTION OF EQUIPMENT FOR TANDEM OFFICES—GENERAL

### Trunk Frames—General

**5.01** The *trunk frames* accommodate the numerous trunks used to provide incoming calls access to crossbar tandem switching equipment elements. The trunk frames are single bay structures accommodating either 23-inch mounting plate units or 30-1/2 inch mounting plate units. The frames have capacities of 10, 20, 30, 40, or 60 trunks depending on the apparatus involved. Trunks are grouped in decades of one to ten trunks numbered 00 to 09, 10 to 19, etc, or 50 to 59 on the trunk frames. The trunks in a decade have certain common requirements and are handled on a decade basis at the various trunk appearances. At the trunk link frame, each trunk decade (00 to 09, 10 to 19) is connected at the trunk link frame so as to contribute one trunk to each of the ten primary switches on the frame. Each primary switch accommodates a maximum of sixteen trunks, two on each level from 2 to 9. Trunks 00 to 09 will normally appear as the first of the trunks on a level and trunks 10 to 19 as the second. The trunk numbering consequently indicates by the units digit, 0 to 9, the trunk link primary switch on which it appears and by the tens digit, even or odd, the position on the level.

**5.02** Where the trunk link frames are to accommodate 110, 130, or 150 trunks, it may become

necessary to assign trunks of a group of 20 on one trunk frame to two trunk link frames. The two groups of ten trunks should appear on corresponding levels on both frames and should assume the position on the level indicated by the tens digit of the group involved in each case. On each trunk link frame, these groups occupy the highest equipped level. This permits the remaining trunks to be assigned in the usual manner and to retain uniform significance from the numbering standpoint.

**5.03** The trunks within a decade are assigned to the trunk test connector switch levels and the call identity indexer relays within the tens group according to trunk number units digits.

**5.04** At the sender link frame, each decade of trunks is associated with a group of verticals of a sender link primary switch on a sender link frame associated with senders of the proper type. The trunks within a decade are assigned to levels of the sender link primary switch according to the trunk number units digit. For trunks requiring the data transfer a cross connection per pentad (half a decade) to indicate data group number is made in the sender link circuit to agree with the assignment of the pentad to a data group.

**5.05** Each pentad of trunks is associated and identified at the data transfer circuit with the data group number for data transfer purposes. This association is determined at the traffic service position link frame and is maintained at appearances of the pentad at the data channel frame, data transfer trunk connector frame, and the sender link frame. As a result of pentad association at the 100A TSP link frame, pentads for the data transfer circuit are distributed equally over data groups, with an even pentad being associated with an even data group and odd pentad with an odd data group.

**5.06** Pentads of trunks are distributed equally over 100A TSP link frame primary switch levels to which data group numbers correspond. Out of each decade, the lower (even) pentad is associated with an even switch level and the upper (odd) pentad with an odd switch level. It is recommended that both pentads of a trunk frame decade be connected to the same 100A TSP link primary switch. However, certain trunks employ locked link operation. These trunks are distributed by pentads evenly over 100A TSP link and connector frames. This requirement may make it necessary to connect the two pentads of a trunk decade to different TSP link primary switches. Under these conditions association of odd or even identity is retained.

**5.07** A trunk link frame cross connection that is common to the two trunks on a specific primary switch horizontal is employed to inform the marker of certain characteristics of the associated trunks. This requires that both trunks of the pair be susceptible to identical treatment in this respect. It is desirable to minimize restrictions as to future modifications by assigning only one type of trunk to any pair.

**5.08** Trunk frames fall into four general categories, Non-AMA, AMA, 100A TSP, and 2-way. Trunk tables are available in J29270 which list in a codified manner all trunks used in crossbar tandem. The code is useful in ordering and serves to convey pertinent information regarding the trunks features and application.

#### **Non-AMA Trunk Frames**

**5.09** The *non-AMA trunk frames* are remote-control zone registration (ZT), through supervision (TSTT), repeated supervision (RST), simplex or composite supervision (CXT), PCI pulsing (PCIT), and MF pulsing (ITMF), (RST BL) for Extended Area Service, Loop or E and M.

**5.10** The remote-control zone registration trunk frame accommodates 20 remote-control zone registration trunks together with synchronous motor-driven timers, one interrupter checking unit or two single-plate reserve trunk applique units, and miscellaneous common equipment. Remote-control zone registration trunks are used for calls from panel offices arranged for remote-control zone registration. Charge pulses are sent to the originating office according to the rate cross connections in the trunk and the duration of the call. In the case of 2-rate trunks, the marker determines whether the lower or higher rate is effective.

**5.11** Reserve trunks are provided to handle calls for remote-control zone registration trunks which are under routine test. This is to avoid making the trunk busy at the originating end. They consist of regular trunks working in conjunction with reserve trunk applique units. They are automatically substituted for any associated service trunk under test and are arranged to assume, automatically, the particular rate schedule of the trunk for which they may be substituted at the time.

**5.12** The through supervision trunk frame accommodates 60 trunks used in completing calls from

No. 1 crossbar or panel offices.

**5.13** The repeated supervision trunk frames accommodate 30, 40, or 60 trunks, depending on the apparatus involved, and are used on calls involving reverteive, dial, or multifrequency pulsing from crossbar, panel, step-by-step, and No. 4 type offices, and from operators.

**5.14** The simplex or composite supervision trunk frame accommodates 40 or 60 trunks, depending on the apparatus involved. These trunks are used on dial pulsing or multifrequency pulsing calls from local or toll offices and may be arranged to rering forward with a simplex ringing signal.

**5.15** The PCI pulsing trunk frame accommodates 40 PCI trunks for use with PCI senders in completing calls from panel, No. 1, and No. 5 crossbar offices on a non-AMA basis.

**5.16** The MF pulsing trunk frame accommodates 30 MF pulsing trunks for use on calls from a toll switchboard in the same or adjacent building.

**5.17** The Extended Area Service (EAS) trunk frame accommodates 40 loop or 40 E and M lead supervision trunks, arranged for dial pulsing and convertible to MF pulsing.

#### **AMA Trunk Frames**

**5.18** The *AMA trunk frames* are of three types PCI (AMAT), dial pulsing (AMAT DP), and multifrequency pulsing (AMAT MF) accommodating 30, 20, and 20 incoming trunks, respectively, and the common relay interrupter and miscellaneous equipment. These trunks are used on calls from customers in panel, step-by-step, and crossbar offices and control the recording of the call by the associated AMA equipment.

**5.19** An AMA trunk functions the same as a non-AMA trunk in establishing a connection through the trunk and office link frames to an outgoing trunk. On seizure, a sender arranged for AMA is attached through a sender link. In processing the call, the trunk identifies itself to the recorder through the call identity indexer causing the trunk number to be perforated as part of the initial entry. After the call is answered, the trunk again calls in the recorder

to perforate the trunk number with the answer time entry. By means of the trunk number the separated elements of the call are brought together in the accounting center for billing purposes. In CAMA-C the elements of the call are assembled on magnetic tape before going to the accounting center.

**5.20** When a call originates in a step-by-step office, a DP trunk is seized after a directing code is dialed by the customer. In the interdigital time between this directing code and the area or office code, the trunk causes a register link to seek an idle register and a sender link a sender. It is intended that a register be connected in the interdigital time and record the three digits of the area or office code. The sender must be connected before these three digits are recorded in the register. When the register has recorded three digits, it signals the sender to record the remaining digits. Subsequently the area or office digits are transmitted to the sender through a sender register connector and the register disconnects. As soon as these digits are recorded in the sender, a marker is called in and the call is processed as for other trunks.

**5.21** A maximum of 100 AMA trunks, serving a maximum of 10, 20, or 30 office names may be assigned to one call identity indexer, recorder, and trunk test connector. A reserve trunk must be included for PCI trunks and one for MF trunks, arranged for operator call identification, from panel and No. 1 crossbar offices. The proper reserve trunk is substituted for the service trunk under test by the automatic trunk test frame. The DP trunks, MF trunks from No. 5 crossbar offices, and ANI MF trunks from panel and No. 1 crossbar offices can be made busy at the originating end by the trunk test frame and, therefore, do not require reserve trunks.

#### **TSP Trunk Frames**

**5.22** The *100A traffic service position trunk frames* are provided in four categories; special toll, recording-completing, centralized dial coin, and delayed call trunks.

**5.23** The 100A traffic service position trunk frame (TSPT) accommodates 20 special toll incoming trunks, or 20 recording-completing trunks or 10 of each. Each frame has an interrupter relay unit arranged to serve the trunks, and mounting space is provided for the miscellaneous jacks and test posts which are required only on alternate frames.

- 5.24** The 100A traffic service position trunk frames (CDCT), Fig. 79, accommodate 10 centralized dial coin trunks. The CDCT trunk numbering is based on pairs of trunk frames in order to maintain an even number of decades. Trunks on even-numbered CDCT frames are numbered 00 to 09 and on odd frames 10 to 19. Each frame has an interrupter relay unit arranged to serve the trunks, and mounting space is provided for miscellaneous jacks and test posts which are required only on alternate frames.
- 5.25** The 100A traffic position trunk frames (DCT), Fig. 78, accommodate 29 delayed call trunks and one allotter and trouble indicator unit. The allotter and trouble indicator unit includes miscellaneous jacks and test posts for the frame.
- 5.26** The function of the tandem trunks associated with the traffic service position is to assist in setting up of calls through the tandem office when the nature of the calls requires the assistance of an operator.
- 5.27** *Special toll trunks* cover the handling of calls such as person-to-person, reverse-charge, charge to third party, or credit card charge. The customer dials a directing digit followed by the called number. The directing digit directs the call to the tandem office over trunks associated with the traffic service position. On seizure, the trunk is connected to a tandem sender by way of its associated sender link and controller circuit. After the calling and called numbers are received by the sender, it signals the trunk circuit to connect to an idle operators position through its associated switchboard link and connector circuit. The position requests the services of a data transfer circuit which connects to the trunk and sender circuits and transfers the call data to registers at the selected position. The operator is then connected to the transmission circuit for talking to the calling customer, while the sender calls a marker to set up a channel to the desired outgoing trunk. The trunk circuit assists in setting up this connection by identifying itself to the marker, closing the first crosspoints in the trunk link frame, and supplying means for maintaining the connection through the trunk and office links for the duration of the call.
- 5.28** *Recording-completing trunks* provided service for customers who desire operator assistance. The customer dials an operator code and is routed to the tandem office over a recording completing trunk associated with the 100A traffic service position.
- 5.29** When a customer dials the operator code, a recording completing trunk in the tandem office is seized which causes a tandem sender to be connected. After ANI information is recorded, the sender passes a position request signal to the trunk. After receiving the call details, the position enables conversation to take place between the calling customer and the operator.
- 5.30** The customer informs the operator of the called number and whether the call is person-to-person, station-to-station, station paid, collect, or special, and then keys this information into the position register. When the position is reattached, the position calls in the data transfer circuit and the called number is passed from the position register through the data transfer circuit.
- 5.31** There are a few types of calls which the 100A TSP operator will not complete. They are: overseas calls, marine operator calls, conference calls, mobile telephone calls, and sequence calls. In these cases, the operator initiates a transfer of the call. The trunk starts a trunk finder which causes a cord-type tollboard operator to take up the call. The 100A TSP operator will be bridged on the transfer connection and will pass the call details. After this the position is released leaving the transfer connection under joint control of the calling customer and the cord-type toll switchboard operator.
- 5.32** *Centralized dial coin trunks* are furnished in a tandem office to permit the handling of calls dialed by coin customers. When the incoming coin trunk is seized at the tandem office, it connects to a sender through the sender link frame. From the sender link, the sender receives information identifying the trunk class and its data group number. The sender receives and registers the called number followed by the station paid start pulse consisting of 1500 and 1700 hertz. After this the sender requests ANI from the originating office. Following receipt of the ANI information, the sender signals the trunk to bid for a position which in turn bids for a data transfer circuit. The data transfer circuit, when seized, closes through a number of transmitting and receiving leads between the sender, the trunk, the rater, and the position. The sender passes the called and calling number information as well as the station (1+) mark to the position. The sender passes to the rater the first six digits of the called number, a 7- or 10-digit mark, class of service, recorder number and the station mark. The rater also receives the office index from the trunk and combines this with the

recorder number to determine the originating rate center from which the call came. From the above data, the rater determines the rate treatment number which is used by the computer to indicate the charges for the duration of the initial and overtime periods. In addition, the rater determines the duration of the initial period to set the trunk timer for the initial period. Should the call be to a vacant code, the sender requests the marker to set up the call to a VACANT CODE announcement. Should the call be to a point which cannot be rated automatically, it must be manually rated by the operator.

**5.33** If the call can be automatically rated, the rater passes the rate treatment number to the trunk, where it is stored for the duration of the call. The rater sets the trunk timer for the duration of the initial period and passes the rate treatment number to the position.

**5.34** When all information has been transferred, the rater is released, and the data transfer circuit then signals the sender to call for a marker to complete the call. Following this a charge computer is brought in through the data transfer circuit to determine the initial period charge which is displayed to the operator.

**5.35** The operator requests the customer to deposit the amount indicated on the display and monitors the deposit of coins. After all functions are completed, the operator initiates perforation of the initial entry and disconnects.

**5.36** When the called party answers, the trunk calls for a recorder to perforate the AMA answer entry and connects to the timer link circuit for the pulses necessary for timing the initial period. At the end of the initial period the trunk sends a coin-collect signal and receives and stores information for the overtime period duration.

**5.37** When the calling party disconnects, the trunk releases the connection forward and calls for a recorder to perforate the AMA disconnect entry. The trunk sends a coin collect or return signal to the originating office and restores to normal.

**5.38** The operator while connected to a trunk may elect to operate on a locked-link basis, manually collect or return coins, or ring back the calling customer.

**5.39** *Delayed call trunks* are provided for a tandem office arranged for operation with a 100A

TSP to initiate a connection to one or both customers on a call previously delayed. The delayed call trunk has one appearance each at the delayed call trunk allotter, the sender link, and the traffic service position link, and two appearances at the trunk link. (It has no incoming trunk appearance as such, no AMA circuit appearance, and no data transfer circuit appearance).

**5.40** The delayed call trunk frame, which is provided one per link group, provides for 29 delayed-call trunks and the associated delayed-call trunk allotter and trouble indicator unit. The delayed call trunks have two trunk link appearances each, which means that five trunk units will provide a decade of appearances at the trunk link frame.

**5.41** The operator obtains a delayed-call trunk by signaling the delayed-call trunk allotter which in turn causes a trunk to seek a position through the TSP link frame. Delayed-call trunks are connected by the TSP link frame only to positions requesting them. Using the delayed-call trunk, the operator initiates calls to two customers in succession for purposes of establishing a connection between them. The operator selects one of two trunk link appearances of the delayed-call trunk. The trunk, responding to a signal from the operator, causes a sender to be attached through the sender link. Upon receipt of the number keyed by the operator, the sender calls in a marker which sets up the connection between the trunk and the called office. The trunk assists in setting up this connection by identifying itself to the marker and closing the first crosspoints in the trunk link frame. On calls requiring a connection to a second customer, the operator selects the other trunk link appearance of the trunk and proceeds to initiate a second call in the same manner as the first. The two customers may then be connected together through the delayed-call trunk under control of the operator who also performs timing and charging functions for the call.

#### **Two-Way Trunk Frames**

**5.42** The *2-way intertoll trunk frames* accommodate trunks used in setting-up calls to or from a distant office and releasing the connections upon completion of the calls. The frames also accommodate miscellaneous common equipment. There are 2-way intertoll MF frames (2WYT MF) and 2-way intertoll DP frames (2WYT DP). The 2-way intertoll MF frames accommodate either 20 trunks with access from a switchboard or 30 trunks without access from

a switchboard. The MF trunks are arranged for multifrequency pulsing both incoming and outgoing. The 2-way intertoll DP trunk frames accommodate either ten trunks with access from a switchboard or 20 trunks without access from a switchboard. The DP trunks are arranged for incoming dial or multifrequency pulsing and dial outpulsing.

**5.43** The 2-way extended area service trunk frames (2WYT LP) and (2WYT EM) accommodate 30 loop or 30 E and M lead supervision trunks. Both types are arranged for dial pulsing using incoming bylink to 10-digit register from step-by-step with or without common control, and can be converted to MF pulsing from step-by-step offices with common control.

#### Trunk Link Frames

**5.44** The *trunk link frame*, Fig. 4, consists of primary and secondary bays of switches and relay equipment comprising 200 links used for interconnection of incoming trunks and office junctors. The primary ends of the links are arranged to serve 160 incoming trunks (basic frame) or 320 trunks (with trunk link extension frame). The secondary ends of the links serve 200 office junctors. The trunk link frame is arranged to operate with a maximum of eight markers and 20 office link frames and will serve any combination of AMA and non-AMA trunks, limited only by the decade requirements and cabling considerations.

**5.45** The trunk link extension frame per Fig. 4 provides for a maximum of 160 trunks to which the trunk links are given access by a multiple between the primary and primary extension switches.

**5.46** The *association of trunk, trunk link, and sender link frames* is by direct switchboard cabling. The 160-trunk capacity of the basic trunk link frame is accommodated on ten primary switches. The added 160 trunk capacity of the trunk link extension frame is accommodated on ten primary extension switches. Each switch accommodates 16 trunks in pairs on eight levels. The other two levels are used for discriminating purposes to serve the proper one of a pair of trunks involved in a given call. A group of ten trunks is considered to be of one type from the standpoint of sender requirements and code grouping as well as circuit features. It is cabled to appear as a primary switch group of ten trunks on the sender link frame. It is served, therefore, by that one type of sender to which it can give but one indication as to

the associated trunk link frame number and code group. Because of this, trunks may have traffic characteristics differing in general between decades or groups of a maximum of ten trunks. These groups are cabled to the trunk link frames in such quantities that each frame serves trunks of varying characteristics in approximately the same proportion. To carry this plan of load distribution still further, the ten trunks of each group are terminated one in each of ten primary switches of the trunk link frame. Since the trunk link frame gives the marker indication by primary switch levels of certain characteristics of the associated trunks, it is necessary that both trunks on each level be of the same type in this regard.

**5.47** The number of trunk link frames per tandem office is limited to 20 by the junctor distribution plan which also controls the design of the office link and markers.

#### Sender Link Frame

**5.48** This frame, Fig. 5, is a 2-bay structure. Four 200-point, 5-wire primary switches and four 200-point, 5-wire secondary switches, together with the sender subgroup connector multicontact relays and terminal strips, are mounted in one bay. The other bay contains a fuse panel, trunk group connector multicontact relays, and two controller circuits enclosed in a front casing and a rear enclosure.

**5.49** The *sender link frame* is provided with ten groups of four primary-secondary links, each group having access on the primary switches to ten trunks and on the secondary switches to a total of 40 senders of either of two kinds. The frame serves a maximum of 100 trunks and has access to a maximum of 80 senders.

**5.50** Each of the two controller circuits, A and B, serves half of the 40 links interconnecting the primary switch verticals with the secondary switch verticals. Each group of four links serving ten trunks is made up of two A and two B links.

**5.51** The ten horizontals of each secondary switch are cabled to ten senders of one kind or to ten senders of each of two kinds. These two kinds of senders may be revertive and dial pulse, revertive and multifrequency, dial pulse and multifrequency, or PCI arranged for AMA and multifrequency, etc. When there are two kinds of senders, the horizontal multiple strapping is cut at the point corresponding to the division between the links serving trunks requir-

ing one kind of senders and those serving trunks requiring the other kind. Senders are treated in switch subgroups of five. Each switch subgroup of senders appears at secondary switch horizontals 0 to 4 or 5 to 9. Each group of four links has access to senders of one kind only. The multiples for the different kinds of senders are entirely independent of each other and each may appear on some frames to the exclusion of the other kind. The sender multiple for each kind of sender is arranged so that all sender subgroups have approximately the same number of appearances and are extended through the greatest possible number of frames. The multiplying arrangement of the sender subgroups can best be understood from an example. Table A shows the distribution of eleven sender subgroups (55 senders) over nine sender link frames.

TABLE A

LINK GROUP A OR B AND SWITCH SUBGROUP NO.	SENDER LINK FRAME NUMBER								
	0	1	2	3	4	5	6	7	8
	(SENDER SUBGROUP NUMBER)								
A3	0	1	2	3	4	5	6	7	8
A2	1	2	3	4	5	6	7	8	9
A1	2	3	4	5	6	7	8	9	10
A0	3	4	5	6	7	8	9	10	0
B3	4	5	6	7	8	9	10	0	1
B2	5	6	7	8	9	10	0	1	2
B1	6	7	8	9	10	0	1	2	3
B0	7	8	9	10	0	1	2	3	4

**Sender Frames**

**5.52** A *sender* is used to assist in the completion of a call through the tandem office. The sender receives and stores information required by other circuits and controls the selection in the tandem office of a trunk to the desired terminating office.

**5.53** The sender receives from the originating office the called number and the calling number (when the tandem office is arranged for ANI operation).

**5.54** The sender receives and registers from the sender link frame, the trunk link frame number which serves the trunk, the trunk class mark, trunk data group number, rate class, if any, and other information required to complete the call.

**5.55** After the sender registers the office or area and office codes, it connects through a marker connector to the marker. It transmits information to the marker and receives from the marker information that is required to complete the call.

**5.56** There are four types of senders and sender frames available, namely: revertive, PCI, dial, and multifrequency pulse. The pulsing used in transmitting the called number from the originating office to the tandem sender indicates the type of sender.

**5.57** The revertive pulse sender frame, Fig. 6, has a capacity of five revertive senders. This sender functions with trunks incoming from panel or crossbar offices that control the routing of the call partly or wholly on a revertive pulsing basis. It is used to complete calls to panel, crossbar, step-by-step, and manual offices.

**5.58** The revertive sender is arranged to register seven digits and to complete calls by revertive pulsing: dial pulsing (4, 5, or 6 digits), and on a straightforward basis. PCI calls are completed by closing a circuit for the direct transmission of PCI pulses from the originating office over the tandem completing trunk.

**5.59** The PCI, dial, and multifrequency pulse senders are arranged for AMA, but will also handle non-AMA calls. They are able to register and output a greater number of digits than the revertive sender and to complete calls by revertive, PCI, dial, and multifrequency pulsing and on a straightforward basis.

**5.60** The PCI sender frame, Fig. 7, has a capacity of three PCI senders. This sender is used in the completion through tandem of calls dialed by customers in panel and crossbar offices. PCI pulsing into the tandem office is used to obtain greater code capacity (640 as compared to 300 for revertive) and to permit outputting of party letters from the local office. It is arranged to register eight digits and to output four to eight digits on a dial or multifrequency basis. The digits may be four or five numerals or four numerals and a party letter preceded, if desired, by 1-, 2-, or 3-code digits. The code digits may be transmitted as registered or converted to any other values by translation from the marker.

**5.61** The dial pulse sender frame and the multifrequency pulse sender frame, shown in Fig. 8, have a capacity of four dial pulse senders and four multifrequency pulse senders, respectively. The dial pulse sender is used in the completion through tandem of calls from step-by-step customer, from manual, DSA and toll switchboards equipped with dials, from other senders arranged for dial pulsing. The multifrequency pulse sender is used in the completion through tandem of calls from senders arranged to transmit multifrequency pulses and from manual, DSA, and toll switchboards equipped for multifrequency keypulsing. These senders will accept three to eleven digits and will outpulse one to eleven digits. The outpulsed digits may be as registered, 1, 2, or 3 digits prefixed to the registered digits to be outpulsed, the first three digits changed and on area calls, the first three registered digits may be deleted and the next three digits code converted.

**5.62** The dial pulse sender is arranged for bylink operation to avoid second dial tone to step-by-step customers. With this feature, the first three digits following the directing code are registered in an incoming register which is connected to the tandem incoming trunk by the incoming register link. Subsequent digits are dialed directly into the sender. The digits in the register are transferred to the sender through a sender register connector.

**5.63** On AMA calls, the calling number may be registered by an operator or by multifrequency pulsing from an originating local office arranged for automatic number identification. For operator identified calls, the sender causes the position link to connect the customer to an operator at the CAMA switchboard. The operator obtains the calling number from the customer and multifrequency or dc key pulses it into the sender where it is recorded. The talking path between the calling customer and the operator is established after all called number digits have been received by the sender. When the senders are arranged for automatic number identification, the calling customer number (for individual and 2-party lines) is passed on to the sender through a multifrequency pulse receiver associated with the sender. Calls involving 4-party or multiparty customers or in case of automatic identification failure are handled by an operator.

**5.64** After the sender has received the necessary information including the called and calling numbers, class signals, etc, necessary for billing purposes, it transmits the information to a transverter

for eventual perforation on the tape. If the first attempt to establish billing fails, a second attempt is made. If this also fails, the call is set up to overflow except that calls identified as bulk-billed are completed without a billing record.

**5.65** The dial pulse and multifrequency pulse senders in conjunction with a marker and translator provide for analyzing the area and office code of a 10- or 11-digit number in order to direct the call over the best route when there are several routes into a foreign area.

**5.66** When a tandem office is arranged for traffic service position operation, MF sender SD-27024-01 must be provided to complete TSP traffic.

#### **Multifrequency Pulsing Receiving Frame**

**5.67** In order for a sender or test frame to register ac pulses, it requires the aid of a multifrequency pulse receiving unit which is located on a *multifrequency pulsing receiving frame*, Fig. 9, but permanently connected to the sender or test frame. There are 38 of these units arranged in pairs on 19 equipment units on each frame. The multifrequency receiving leads from the incoming trunk are connected through the sender to the receiving unit which separates the ac signaling frequencies (which range from 700 to 1700 cycles in six steps of 200 cycles each) into channels, and the channel equipment sets the sender registers on a dc pulsing basis.

#### **Multifrequency Current Supply Frame**

**5.68** When senders are arranged for multifrequency outpulsing, *multifrequency current supply* equipment is required. This frame, Fig. 10, consists of two 6-frequency oscillator units, an alarm and transfer unit, distributing resistance panels, and miscellaneous equipment. This equipment is also required for sender test and AMA trunk test frames arranged for MF operation for calls-waiting signal equipment used with a remote CAMA switchboard and 100A TSP use.

#### **Marker Connector Frames**

**5.69** The function of a *marker connector* is to connect a sender to an idle marker for the selection of a trunk to the proper destination and for information necessary for completing the call.

**5.70** Two subgroups of marker connector frames are required when dial pulse senders per SD-

25999-01 and/or multifrequency senders per SD-27024-01 are furnished in an office with revertive senders per SD-25359-01 and/or PCI senders per SD-25961-01. The dial pulse and multifrequency senders transmit to the marker on certain leads on a 2-out-of-5 basis and requires one subgroup of marker connector frames per J28150C. The revertive and PCI senders transmit to the marker on certain leads on a 2-out-of-7 basis and requires the other subgroup of marker connector frames per J28150B. These different systems of transmitting to the marker result in these leads in the marker multiple differing in designation and use at the marker. Multifrequency sender SD-25978-01, when not arranged for foreign area translation, transmits to the marker on certain leads on a 2-out-of-7 basis and on a 2-out-of-5 basis when arranged for foreign area translation. Consequently, senders per SD-25978-01 must be assigned to one subgroup of marker connector frames or to the other, depending on whether or not they are arranged for foreign area translation.

**5.71** A *marker connector frame*, Fig. 11, is a single-bay framework with multicontact relays and associated mounting plate equipment. It is arranged for a maximum of three connectors, each connector serving five senders and eight markers. The frame is equipped according to the number of senders and markers in the office. Four or more connectors are required depending on the number and types of senders provided. The senders are assigned so that not more than approximately 25 percent of the senders of a type are taken out of service by the removal of a connector from service and not more than approximately 50 percent by the removal of a connector frame from service.

#### **Marker Frame (Ring Type)**

**5.72** In completing a call through a crossbar tandem office the *marker* is used to decode the office or area code, to select and test the corresponding outgoing trunk group and channels thereto, to set up information in the sender for handling the call, and to operate the proper select and hold magnets on the trunk and office link frames to connect the incoming trunk to the selected outgoing trunk. Calls may originate in step-by-step, crossbar, and panel offices, private branch exchanges, and at dialing and keypulsing switchboards. They may be completed to panel, crossbar, step-by-step, and manual call indicator offices, to private branch exchanges, and to official codes; they may be extended to panel sender, crossbar, step-by-step, and manual call indicator tan-

dem offices, and to panel distant office equipment. Operator calls may be extended to manual straight-forward positions.

**5.73** In processing a call involving an area code or PBX indialing, the marker receives six digits. The first three digits are decoded and used to cause a translator to be connected to the marker. The translator registers and decodes the second three digits and causes an FAC code point in the marker to be grounded.

**5.74** Routing information is obtained from two wires threaded through rings in a ring field consisting of nine horizontal rows of rings, each row containing from three to seven rings. Part of the routing information is stored by threading a wire connected to a code point through one or two rings in each row, as required, to a first string firing circuit terminal. The remainder of the routing information is stored by threading a second wire from a related second string terminal through one of two rings in each row, as required, to a second string firing circuit terminal. When the code point is grounded, a surge is sent through the first wire; a voltage is induced in every coil through which the wire is treaded, firing associated tubes which operate associated relays. The output of these relays are registered and the tubes and associated relays released. The related second string terminal is then grounded and the second string firing circuit sends a surge through the second wire which induces a voltage in every coil through which the wire is threaded, firing associated tubes which operate associated relays. The output of these relays is registered and completes the route information for the particular code point.

**5.75** The marker frame consists of a single-bay marker control unit and a double-bay marker route unit per Fig. 12.

#### **Office Link Frame**

**5.76** This 2-bay frame and one-bay office extension frame, shown in Fig. 13, are the same as the corresponding frames used in No. 1 local crossbar offices. A second extension frame may also be furnished in tandem offices to provide increased trunk capacity.

**5.77** The *office link frame* has a capacity of 200 links, the primary switches of which serve 200 offices junctors. The secondary switches provide for 100 outgoing trunks if the switches are not split and a

maximum of 200 or 300 outgoing trunks if the horizontal multiples of all switches are split. The extension frame has a capacity of 100 outgoing trunks. Extension frames may be used with nonsplit or split office frames on jobs having ten or less office frames, either in anticipation of growth or to provide increased outgoing trunk capacity. On installations of 12 or more office link frames, extension frames are normally furnished since, where more than ten office link frames are involved, the levels on the secondaries cannot be split because of insufficient junctor access, and the extension frames are needed to provide the necessary out-trunk capacity.

**5.78** On the basis of 200 or 300 trunks per frame and a maximum of 20 office link frames (as limited by the marker), the physical maximum number of outgoing trunks per marker group is 4000 with one extension frame and 6000 with two extension frames. To insure uninterrupted service, a test group of trunks is divided between two office link or extension frames, and the frames are furnished and operated in pairs.

#### Office Junctor Grouping Frame

**5.79** This is a 2-bay frame on which are mounted terminal strips and jumper distributing rings used to interconnect the secondary of the trunk link frames with the primary of the office link frames in such a way as to obtain complete access of incoming trunks to outgoing trunks. In addition to this, the grouping frame is arranged so that as the size of the office increases, the effort required to change the junctor distribution is kept to a minimum.

**5.80** The junctor channel between the trunk link frames and the office link frames is referred to as a TJO channel. Junctor assignment charts listed in the office junctor grouping frame specification, show the connections between trunk link secondary and office link primary switch verticals.

#### Translator Frame

**5.81** The *translator frame*, Fig. 14, is a single-bay frame used in conjunction with the marker to provide for 6-digit translation for a maximum of five foreign areas with 60 routes for each area. Its use provides for selecting the best route to a particular office in a foreign area where there are several routes by which the tandem office can reach the foreign

area. It is also used for selecting a particular PBX when several share a 3-digit code.

**5.82** Two translator frames arranged for paired operation serve a maximum of five foreign areas. When a maximum of ten foreign areas are to be served, a second pair of translator frames is provided. Likewise, four additional frames serve an additional ten areas if required.

#### Traffic Usage Recorder Frame

**5.83** The *traffic usage recorder frame*, Fig. 15, is used to measure usage of various circuits by scanning on a 100-second cycle and recording busies on traffic registers. It is a 2-bay frame accommodating two to twelve 100-point, 6-wire crossbar switches, six to twelve detectors, relays, and cross-connecting facilities. The switches are divided into scan and register switches which provide for scanning a maximum of 3600 circuits and provide access to a maximum of 1200 traffic usage registers. Circuits having holding times over 10 seconds are given one scan switch appearance and the 100-second scanning rate provides accurate hourly measurements in terms of hundred call seconds (CCS). Circuits having holding times of 10 seconds or less are given ten equally spaced appearances on the switches in groups of 60 with a maximum of 180 per frame and are scanned at a 10-second rate to obtain the desired accuracy.

**5.84** Control equipment for use with the traffic usage recorder frames may be arranged for wall or column mounting in one or two metal cabinets or it may be mounted in a relay rack bay. With the wall or column arrangement, when not more than three frames are required, one cabinet will house the control equipment and when four to twelve frames are required, a supplementary cabinet is required to accommodate the register grouping switches. The relay rack mounted arrangement will serve a maximum of 12 frames.

**5.85** The traffic usage recorder equipment also controls the cameras used to photograph traffic usage registers or regular traffic registers.

#### Office Interrupter Frame

**5.86** The *office interrupter frame* is a single bay containing motor-driven interrupters used for miscellaneous purposes. For reliability of service, a

minimum of four frames are provided per tandem office and the load equally divided among them.

#### Relay Rack Equipment

**5.87** The *relay rack equipment* covered in J23052 is designed to mount on bays drilled for 1-3/4 by 23-inch mounting plates and the equipment covered in J23066 is designed to mount on bays drilled for 2- by 23-inch mounting plates.

**5.88** Fuses for most tandem equipment are located on fuse panels on the frames. However, fuses for relay rack equipment are located on fuse panels mounted on a relay rack framework and located near the associated equipment.

#### Group Busy Frame

**5.89** The *group busy frame*, Fig. 75 is a single-bay structure which is used to provide information to the marker that all outgoing trunks in a group are busy, prior to seizing the office link frame. This feature obviates the necessity of busy testing each trunk in the group before transferring the call to overflow or to an alternate route. The group busy method results in more efficient operation of the marker when calls to any particular terminal, such as PBX, are abnormally high.

**5.90** As an additional feature the group busy frame may be equipped with some of the trunk busy units arranged for directional reservation under the control of a directional reservation circuit located at the traffic supervisory cabinet. With directional reservation, 2-way intertoll trunks may be automatically reserved for 1-way operation when the traffic load so dictates.

#### Trunk Busy Distributing Frame

**5.91** The *trunk busy distributing frame*, Fig. 86, is provided on an optional basis when the group busy feature is specified. It is recommended as a means to reduce cross connection and cabling congestion at the main distributing frame and to ease the administrative problems that are encountered when group busy and trunk busy terminations are re-assigned. It is a single bay bulb angle framework arranged with an array of terminal strips for cross con-

necting the S1 leads from the office link multiple to the S1 leads of the trunk busy relays located on the group busy frame.

#### Traffic Supervisory Cabinet

**5.92** The *traffic supervisory cabinet*, Fig. 87, is a sheet metal, floor mounted console about 50 inches high, 21-1/16 inches wide and 22 inches deep. It contains control keys, switches, lamps, and some miscellaneous equipment, for a number of traffic supervisory functions as follows:

##### Announcement Control

Permits the switching of up to eight announcement trunk groups to any one of the six recorded announcement channels of the standard 5A machine. These may be varied as required by the setting of rotary switches in the console.

##### Alternate Routing

By the operation of one of the 50 locking keys provided for this function, a route transfer in the marker is operated to effect a change in the normal route advance pattern if desired.

##### Final Route Advance Keys

Three position keys associated with the routing functions of the marker are provided to permit final route advance on some trunks to "No Circuit" (NCA) or "Emergency" (EMG) announcements depending on the operated position of the key. If the key is normal, connection will be made to "No Circuit" tone trunks.

##### Sender Attachment Delay Recorder (SADR) Control

Keys are provided to control the operation of the SADR circuit, including the ability to set the time delay interval desired.

##### Directional Reservation Switches

The setting of these switches control the point at which the traffic load on a group of 2-way intertoll trunks is sufficient to warrant reserving these trunks for 1-way operation, i.e., incoming only, from the higher class office to the lower.

### Miscellaneous Lamps

Various supervisory lamps are provided for traffic department information such as all markers busy, all transverters busy, sender load register, short time out, etc.

### Engineering and Administrative Data Acquisition System/Network Management Control

Permits the control of certain functions of the traffic supervisory circuit from a centralized network management center. The EADAS/NM unit is mounted in the lower part of the cabinet area and furnished on an optional basis.

### Traffic Control Frame and Console

**5.93** The *traffic control frame* is a single bay framework, per Fig. 82, that provides means for automatically or manually controlling traffic overload conditions in a crossbar tandem office. As an option, Engineering and Administrative Data Acquisition System/Network Management (EADAS/NM) feature may be added for use with centralized network management facility to provide remote control of selected traffic control functions. Space is provided on the frame for the control panel if the console is not specified.

### Traffic Control Console

**5.94** The *traffic control console* (Fig. 83) is a sheet metal cabinet approximately 50 inches high and contains the traffic control panel on a sloped surface. The panel mounts the queue controls, keys, and lamps which indicate the status of the control equipment and subtending office traffic. An optional strip chart recorder is available for recording continuous office loads associated with a sender queue group. The preferred location is near the traffic supervisory cabinet.

### Floor Alarms

**5.95** The *floor alarm* unit accommodates the alarm relay equipment for a variable number of frames and aisles of equipment distributed over a maximum of two floors. It provides audible and visual signals under trouble conditions and supplements the alarms appearing on the individual frames. The audible signals by means of distinctive tones indicate the type of alarm. The visual signals in the form of floor and aisle pilots using differently colored lamps indicate the general nature and location of the trou-

ble. This unit is supplemented by a mounting plate accommodating additional relays for AMA operation. The alarms may be transmitted to an alarm receiving center by means of alarm sending and transfer equipment when unattended operation of the tandem office is required.

### Traffic Register

**5.96** The *traffic register* equipment provides for obtaining traffic data, such as overflow, group busy, peg count, load, and usage. When the register portion of the equipment is located in an operating room, it is enclosed in a traffic register cabinet and the relays on a traffic register relay-rack in the switchroom. When the registers are located in the switchroom, they are mounted on a combination traffic register and relay-rack with the relays in the upper portion of the frame. A single-sided distributing frame is furnished adjacent to the traffic register relay rack or traffic register and relay-rack for terminating the many leads from the connecting circuits and for flexibility between the traffic registers and the connecting circuits. Traffic usage recorder registers are cabled from the patching jack field directly to the traffic usage recorder frame where cross-connecting facilities are provided. The traffic register cabinet and the traffic register and relay rack can accommodate 300 traffic registers. This number of registers is reduced by 30 for each set of eight magnetic counters furnished. The registers may be photographed automatically by means of traffic usage camera KS-14776 (maximum two per bay, each covering 150 registers) and traffic register camera control equipment or traffic usage recorder equipment. The forward projection of the camera beyond the face of 14-type registers is approximately 18 inches and therefore, special consideration is required when applying the camera to traffic register racks located in the switchroom. The traffic register control equipment consists of a small relay rack unit and a control panel suitable for mounting on a wall or column. This equipment is arranged for a maximum of 14 cameras.

### Service Observing Equipment

**5.97** Multiline *service observing equipment* for incoming trunks provide for service observing at a No. 12 service observing desk in the same or another building. This equipment consists of small surface-wired units and patching facilities mounted in relay rack bays. Each multiline service observing circuit has a maximum of 50 loop connectors arranged for patching to the relay-rack appearance of the trunks to be observed.

### Sender Attachment Delay Recorder Equipment

**5.98** Crossbar tandem is arranged to operate with the *sender attachment delay recorder equipment* per J92608. This equipment provides means for placing test calls through the sender link frames and to record, on a sender group basis, the number of test calls placed and the number which encounter delays in sender attachment greater than 3 or 7 seconds as desired. This equipment is relay rack mounted with control keys located at the traffic supervisory cabinet.

### Pretranslator Frame

**5.99** The pretranslator minimizes the holding time of DP senders or 10-Digit DP registers necessary to establish whether a call is of a 10-digit or 7-digit variety in an office where area and office codes are interchangeable. It instructs the common control equipment that a code is an area, nonarea, or conflicting code and in TSP offices, whether it is a vacant code, and to time accordingly. When code is conflicting it instructs the sender or register to apply shortened timing after receipt of 7th digit.

**5.100** The *pretranslator frame* (Fig. 80) is a single bay framework arranged to mount three pretranslators and associated test equipment. Two pretranslators are required for operation with 10-digit DP registers. Four pretranslators are required for operation with 3 digit DP registers. If both types of registers are provided six pretranslators must be specified.

### Added Features of Crossbar Tandem

**5.101** In addition to the major adjuncts to basic crossbar tandem, toll, CAMA and the 100A traffic service position, there are other features or changes of significance, which have been added recently to the tandem switching system. They do not involve extensive new equipment as such, but rather changes or additions to already existing equipment.

Of note are the following, with some mention of the equipment area affected.

### Directory Assistance Charging

**5.102** Facilities are now available on an optional basis to provide complete AMA recording of 411, 555-1212 and NPA+555-1212 for billing of non-coin directory assistance calls. This feature depending on office options requires modifications in the sender, sender test, marker 10-digit registers, transverter, transverter connector miscellaneous circuit for trouble recorder, rater data transfer and position control equipment.

### One-Second Timing for AMA

**5.103** An optional feature is now available to provide one-second timing accuracy for crossbar tandem offices arranged for paper tape AMA. Under control of the master timing frame, the recorder circuit will keep time in 1-second instead of 6-second increments, which results in more precise timing of calls in the central office. The shorter timing increment along with reduced processing timing allowances will cause more calls to extend into an additional overtime period resulting in a net revenue gain. Modifications are required in the master timing frame and AMA recorders, and a one plate conversion unit must be added during the transition from 6- to 1-second timing.

### Reduced Call Processing Time

**5.104** This feature provided on an optional basis modifies the dial pulse sender and sender test frames to reduce call processing time and operator work time by reinstating A and B digit area code recognition in offices located in NPAs where NNX codes are not exhausted. Minor equipment modifications are required in both the sender and sender test frames.

## 6. DESCRIPTION OF EQUIPMENT FOR AMA ONLY

### CAMA Switchboard

**6.01** The *CAMA switchboard*, Fig. 16, consists of a number of 2-position sections and a cable turning section. The switchboard section is a low sheet metal structure of the cordless type with sloping keyshelves. The metal framework of the switchboard and cable turning sections have a light gray finish and the keyshelves a blue-green finish. Each position is equipped with a 10-button keyset, auxiliary lamps, and keys. A lamp standard containing calls-waiting lamps and a supervisor division lamp are provided per supervisor division of ten positions maximum. The green, white, and red calls-waiting signal lamps are lighted in accordance with three team sizes A, B, and C (usually one to four operators, five to ten operators, eleven operators to the full capacity of the switchboard) and the number of calls waiting per occupied position. The lighting of the lamps per team size and number of calls waiting per occupied position is adjustable.

**6.02** The CAMA switchboard is used on operator identified calls in obtaining the telephone number of the calling customer. It is also used on 4-party calls where ANI is not applicable and on calls where for some reason automatic identification is not made. Calls are connected to operators through position link frames on an automatic distribution basis. An operator obtains the calling number from customers and keys it into the sender for recording on the AMA tape or in CAMA-C as part of the initial entry. The switchboard may be located in the same building as the crossbar office or at a remote location. The switchboard in the same building may be arranged for DC or MF keypulsing. The MF keypulsing arrangement is provided in new offices arranged for ANI operation. The remote switchboard is arranged for MF pulsing. During light load periods, the calls may be transferred to a toll or DSA board.

**6.03** A combined regular and key monitoring section is provided at the head end of the line-up when monitoring at the CAMA switchboard is required. The monitoring operator, located in the first position, can observe on any regular position through a keyset

and position selecting circuit. If during an emergency all positions must be abandoned, CAMA calls can be completed on a non-CAMA basis.

**6.04** The associated relay equipment is arranged in units and mounted on position and telephone unit frames (DC keypulsing) or the miscellaneous relay rack. The position and telephone unit frame is a 23-inch relay rack type of frame accommodating a maximum of 30 position and telephone units. The additional relays required for the ANI feature are mounted on the miscellaneous relay rack. The MF CAMA position circuit is arranged on three 2- by 23-inch mounting plates so 20 of these units can be mounted on a miscellaneous relay rack bay.

### Position Link Frame

**6.05** The *position link frame* is a 2-bay frame, Fig. 17, which accommodates 16, 5-wire crossbar switches and relay equipment. It provides a maximum of 40 senders access to a maximum of 100 total CAMA switchboard positions, outgoing trunks to CAMA positions, position circuits to a toll or DSA switchboard, or TSP Position Control Circuits.

**6.06** The position link frame is used to connect a sender arranged for AMA to a local DC pulsing switchboard position via a position and telephone unit, to a remote multifrequency pulsing position via an outgoing trunk to the CAMA position, to a local multifrequency pulsing position through a multifrequency CAMA position unit or to a TSP Position Control Circuit. At the switchboard, the operator obtains the calling number from the customer and multifrequency or DC keypulses it into the sender where it forms part of the AMA initial entry of the call.

**6.07** Forty senders are connected to the horizontals of four sender switches in one bay and multipled to the corresponding sender switches in the other bay. The verticals of the sender switches are connected to the verticals of the position switches to form 40, 10-wire links in each bay. The horizontal multiple of the position switches are split to form ten position group appearances of ten positions each, five in each bay and are connected to the position group appearance terminal strips of a cross-connection field at the top of the frame. The CAMA switchboard positions, outgoing trunks to CAMA positions, position circuits to toll or DSA switchboard or TSP position control circuits are connected to the position terminal strips of the cross-connecting field and are multipled

to other position link frames. These various circuits are cross-connected to the position group appearances so as to provide a proper traffic distribution over the links.

- 6.08** A minimum of two position link frames is provided to insure service.

#### Transverter Frame

**6.09** The *transverter frame*, Fig. 18, is a single-bay structure, arranged to mount equipment consisting mainly of U-type relays and some multicontact relays which are used as the billing indexer connector. It is used to provide the initial tape entry.

**6.10** The transverter is connected to a sender or TSP position control circuit by means of a transverter connector. From the sender or position control it receives necessary items of information, such as the recorder number, called and calling office codes, rate class, and customer number or third party charge number. It obtains the billing index number, office index, and type of entry from the billing indexer through the billing indexer connector. After the necessary information is obtained, the transverter passes it to a recorder through a recorder connector and it is recorded on the AMA tape or in CAMA-C as part of the initial entry.

**6.11** The transverter is provided with options that permit it to handle traffic that originates and terminates in one area, traffic that originates in more than one area and terminates in only one area, and traffic that originates in one or more areas and terminates in more than one area. In the last case, the terminating area is determined in one of two ways and the area indication passed to the billing indexer for use in connection with the charge for the call. The area may be established by the use of directive codes in the local office to select separate trunk groups to the tandem office, wherein by the use of class-of-service indications, which are individual to each decade of trunks, different areas may be selected for the different trunk groups, or by the use of 3-digit terminating area codes which make the area selection directly without use of the class-of-service indications. Transverters arranged for area determination by class of service may also be arranged to accept some 3-digit area codes.

- 6.12** A minimum of 2 and a maximum of 12 transverters may be provided.

#### Transverter Connector Frame

**6.13** The function of the transverter connector is to connect a sender or position control circuit to an idle transverter when the initial recording of a call is required.

**6.14** The *transverter connector frame*, Fig. 19, is a single-bay framework with multicontact relays and associated mounting plate equipment. It is arranged for two connectors, each connector serving a maximum of 5 senders and 12 transverters.

**6.15** One subgroup of transverter connector frames is required for PCI senders and another subgroup for non-PCI senders, since some of the leads in the transverter multiple differ in designation and use at the transverter.

#### Supplementary Transverter Connector Frame and Auxiliary Frames

**6.16** The supplementary frame is a build-out of the basic transverter connector frame. There are four connectors per frame, each capable of increasing the connector capacity to serve nine TSP position control circuits maximum in addition to the basic 5 senders, connecting to 12 transverters.

**6.17** This frame is a single-bay structure per Fig. 20, with mostly multicontact relays and associated general purpose relays.

**6.18** The transverter connector transverter auxiliary frame, Fig. 21, and transverter connector position auxiliary, Fig. 22, are single-bay frameworks providing additional cut-in relays to transverters and positions for use in recording calls charged to third number. The transverter auxiliary frame accommodates 14 connectors while the position auxiliary frame has a capacity for 12 connectors.

#### Billing Indexer Frame

**6.19** The *billing indexer* consists of a 2-bay originating frame, Fig. 23, and where required for additional capacity, a single-bay supplementary frame, Fig. 24. The originating frame accommodates equipment for one terminating area, 33 originating rate treatments, and 58 terminating rate treatments. The supplementary frame accommodates two terminating areas, 17 originating rate treatments, and 17 terminating rate treatments. Ordinarily, both frames

are associated with a maximum of 10 office names. Where an option of 20 or 30 office names are required an additional bay of equipment, the billing indexer auxiliary frame, Fig. 25, is required on the basis of one auxiliary frame serving three billing indexers. Each type of billing indexer frame consists mainly of multicontact relays and cross-connecting type terminal strips but has some other relay equipment.

**6.20** The billing indexer is called into operation by the transverter to furnish three essential items of information which is perforated on tape or recorded by the CAMA-C equipment. These are:

- (a) the billing index number which is part of the initial entry and is used by the accounting center in establishing the charges for the call
- (b) the office index which denotes the office in the recorder group\* that originated the call which is also part of the initial entry
- (c) the type of entry, that is, message unit (MU), message unit detail (MUD), or toll statement (TL).

**6.21** For the determination of its products, a number of cross-connections are required in the billing indexer. One covers the comparison of the originating rate treatment† with the terminating rate treatment‡ for the determination of the *billing index*. This may require intermediate differentiation to resolve rate classes and code conflicts. Other cross-connections involve the assignment of offices to recorder groups which results in the selection of the *office index* and a choice of the *type of entry* to be recorded for the particular billing index previously selected.

**6.22** The billing indexer has a capacity of 800 originating office codes which may represent offices in three different numbering areas. Of these a maximum of ten may conflict with other codes in the three areas. A maximum of 80 originating offices may have two or three rate classes, the remainder only one.

**6.23** Three terminating area office code fields are furnished. Each has 800 points which represent terminating offices to which calls may be billed on a bulk basis. One of these terminating areas

is usually the same area as the main originating area but not necessarily so. For example, where an originating area has zone registration coverage for its local calls but it is desired to extend bulk-billing on an AMA basis to another numbering area, only one terminating field is required, corresponding to the latter area. These terminating areas may be reached by directive codes (separate trunk groups) or by 3-digit area codes. Terminating code fields are provided only for those areas with some bulk-billing, all others to which calls may be completed through this tandem being considered as toll.

**6.24** A minimum of two and a maximum of three billing indexers may be provided.

#### Call-Identity Indexer Frame

**6.25** The *call identity indexer* is a single-bay frame, Fig. 26, arranged for four indexer units. The fuse panel shown at the top of the frame serves a maximum of six even-numbered and six odd-numbered indexer units and is provided as required. When floor plan arrangements are such that the call identity indexer frames are located adjacent to the associated recorder frames, the fuse panels are omitted, battery and ground being supplied from the respective recorder frame fuse panels.

**6.26** The call identity indexer is directly associated with the recorder and trunks on the basis of a maximum of 100 trunks per recorder per call identity indexer unit. The call identity indexer identifies the trunk being used on the call and actuates the recorder to cause the trunk number to be perforated on the tape. With CAMA-C the call identity indexer along with the recorder causes the call information to be stored in a computer file at a location assigned to the particular trunk number. These entries occur at the

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† Originating rate treatment (ORT) is applied to a grouping (usually on a geographical basis) of customers who are charged alike on identical calls. The grouping may include all or subdivisions of the customers in one or more offices in which the calls originate. The subdivisions are denoted by rate class and require separate trunk groups.

‡ Terminating rate treatment (TRT) is applied to a grouping of customers in one or more terminating offices for the purpose of determining the charge to the originating customer. All calls having a particular originating rate treatment to such a terminating group are charged alike.

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\* A recorder group consists of those recorders which serve up to ten, 20 or 30 originating office indexers.

beginning of the call (initial entry) and at the time of answer, and at the time of disconnect.

**6.27** Since one call identity indexer unit serves 100 trunks and four units mounted on one frame, a full office of 20 recorders (2000 trunks) would require five call identity indexer frames.

#### **Recorder Frame**

**6.28** The *recorder frame*, Fig. 27, is a single-bay structure on which are mounted four recorder units spaced vertically the same as the four call identity indexer units on the call identity indexer frame.

**6.29** The recorder is closely associated with the call identity indexer in that each serves the same group of 100 trunks maximum. In operation the recorder serves to receive the necessary items of information for billing from the transverter and the trunk number from the call identity indexer. This information is then either perforated on AMA paper tape or recorded by the CAMA-C equipment as the initial entry. Subsequent answer and disconnect time entries are also recorded with the associated trunk number. Other entries such as the hour and 3AM end of tape entry are made under control of the master timing frame for paper tape AMA only. In CAMA-C the tape identity is recorded as an end of tape label under control of the processor.

**6.30** Each transverter (12 maximum) is multiplied through each recorder unit and is connected to the recorder by a recorder connector which is part of the recorder unit.

**6.31** One emergency recorder is provided per office which is substituted automatically for any regular recorder out of service.

#### **Perforator Cabinet (Paper Tape AMA)**

**6.32** The *perforator cabinet*, Fig. 28, is a low sheet metal cabinet accommodating two perforators. The perforators are mounted in the upper part of the cabinet under a hinged cover with a transparent plastic window. The paper supply bins and motor-driven take-up reels for storing the perforated tapes are located behind a hinged door in the space below. At 3 a.m. of each day an end-of-tape pattern is placed on each tape under control of the master timing frame. This marks the tape for cutting and provides information necessary for identification and processing at the accounting center.

#### **Master Timing Frame**

**6.33** The *master timing frame*, Fig. 29, is a single-bay frame accommodating one master timing circuit capable of serving the recorders associated with one group of transverters and the trouble recorder frame.

**6.34** The master timing circuit includes an odd and even timing circuit and a recorder test circuit. When the office is arranged for paper tape AMA one of the timing circuits supplies pulses every 1 or 6 seconds to all recorders of a transverter group. Transfer facilities permit this function to be assumed by either the odd or even timing circuit. The recorders and associated perforators record the time in minutes and tenths of a minute on the tapes. At the start of each hour the master timing frame supplies the recorders with hour information for entry on the tapes and at 3 a.m. an end-of-tape pattern is placed on each recorder tape. The end-of-tape pattern includes the month, day, hour, recorder number, recorder group number, and a special pattern defining where the tape shall be cut for removal to the accounting center for processing. When the office is arranged for CAMA-C the timing functions are performed by the processor and recorded on disk and eventually transferred to magnetic tape.

**6.35** With either arrangement, AMA paper tape or CAMA-C, the master timing frame tests certain features of the recorders. These include an operational check of the data verification leads, recorder, number leads, and the operation of recorder relays not checked in service. It also supplies day, hour, and minute timing to the trouble recorder frame for entry on the trouble recorder cards.

#### **Incoming Register and Link Frame (3-Digit)**

**6.36** The 3-digit *incoming register and link frame*, Fig. 30, is a 2-bay frame having a capacity of 199 dial pulse incoming trunks and ten incoming registers. It is used with incoming trunks from step-by-step offices to avoid second dial tone. Because of the no-second dial tone feature, the register link is arranged for bylink operation to avoid loss of digits. A temporary pulsing path is connected from the seized trunk to a register by the operation of fast trunk and register preference relays before the first digit is dialed into the tandem office. A parallel pulsing path through the switch is established and the temporary path opened. The first three digits dialed by customer, following the directing code, are re-

ceived and stored in an incoming register. After the register has received three digits, they are transferred through a sender register connector to a sender. Subsequent digits dialed by the customer are registered in the sender.

**6.37** This frame accommodates ten 200-point, 6-wire crossbar switches, ten incoming registers (three 2- by 30-1/2 inch mounting plates per register) and associated trunk preference and register busy and preference equipment. The dial pulse incoming trunks connect to the verticals of the crossbar switches and the incoming registers to the switch horizontals. Corresponding horizontal levels on all switches on a frame are multiplied together and the connecting registers on the frame constitute a register group. Twenty trunks appear on each switch except for switch 0. Vertical 19 of this switch is used for test purposes. One switch and the 20 associated trunk preference relays constitute a horizontal group. Trunks are assigned to a horizontal group on a decade basis and connect to consecutive verticals on a switch. The actual number of trunks served by an incoming register and link frame is determined by the ability of the register group to handle the trunk traffic.

#### Sender Register Connector Frame

**6.38** The *sender register connector frame*, Fig. 31, is a single-bay frame having a capacity of two sender register connectors. Each connector is arranged to connect any one of a maximum of 50 senders to any one of a maximum of 130 incoming 3-digit registers. A sender connector is used to transfer the three digits recorded in an incoming register to a dial pulse sender.

**6.39** This frame accommodates sender connector and register connector multicontact relays and associated resistors, electron tubes, networks, and relays. Two sender register connector frames equipped with four connectors are furnished in an office arranged for bylink operation. The senders are divided about equally among the connectors. Each incoming register appears in each of the four connectors.

#### Line Observing Frame

**6.40** The *line observing frame*, Fig. 32, is a single-bay structure, equipped with a maximum of 30 line number matching circuits.

**6.41** The line observing frame provides facilities for initiating the recording of detailed observing

entries on the AMA tape on all calls from a maximum of 30 customer telephone numbers. These may be any telephone numbers served by the tandem office and are set up on selector switches on the individual line number matching units on the frame. The frame functions with the transverters and if a calling number set up in the transverter matches one of the numbers set up on the line number matching units, the transverter sets up the tape entry on an observed basis. Where all initial entries are four or five lines, the line observing frame may be omitted when so desired by the telephone company.

#### CAMA-C Equipment

**6.42** CAMA-C is provided as a partial duplex computer system utilizing a primary and back-up equipment arrangement each monitoring the status of the other. Both the primary and back up employ an IBM System 7 computer and peripheral equipment which consists of scanner, tape drivers, teletypewriters, and optional data sets. The scanners interface with the AMA recorders and trunks. Up to three scan cabinets are required in the primary system (Fig. 85) and one in the back-up. A maximum size system serves 2000 trunks and 21 recorders and requires an area approximately 25 by 20 feet. It is recommended that it be located in an area remote from the switching equipment.

### 7. DESCRIPTION OF EQUIPMENT FOR 100A TRAFFIC SERVICE POSITION OPERATION

#### 100A Traffic Service Position and Associated Administration Equipment

**7.01** The primary function of the *100A traffic service position* (TSP) is to provide operator services as required in conjunction with the direct dialing by the customer of the following basic types of toll calls: Dial Zero, CAMA, DDD Noncoin, DDD Coin, and Delayed. Calls may be either station-to-station or person-to-person with a paid, collect, or special class for each. The special class of call could be of the credit card or charge-to-third-party variety.

**7.02** The TSP section, as shown in Fig. 47, consists of two identical operator positions. The sheet metal framework which contains the positions is approximately 60 inches wide, 28-1/2 inches deep, and 42 inches high. The lock rail mounts operator and supervisor or frame line telephone jacks in recessed compartments and contains a utility drawer for each operator. A writing shelf extends the full width of

the TSP section and contains reference bulletins under transparent plastic shelf covers. The interior of the framework contains telephone circuit equipment, terminal strips for switchboard cable connections, reed type relays, and racks for running cable. Removable covers, extending the full width of the TSP section for easy access to the cable area, are located in front of the cable racks.

**7.03** Each TSP section is equipped with two keyshelves each of which contains mounting holes for 116 key or lamp sockets. A textured vinyl finish aluminum mask with perforations in the desired locations covers the keyshelf, providing a renewable surface that covers spare mounting holes. Spare mounting holes not covered by the mask are equipped with apparatus blanks.

**7.04** The keyshelves are hinged at the top of the TSP framework and contain square capped keys and lamps, numerical indicating tubes, ticket boxes, and a 24-hour clock. The keys are locking or nonlocking pushbutton type or turn locking type; some of the pushbutton type are illuminable.

**7.05** The TSP provides the usual switchboard functions such as ringing coin control, releasing, originating and terminating customer and making the position busy. In addition the operator has facilities for timing initial period, connecting to a centralized supervisor console and to outgoing trunks to information and maintenance centers. Other functions include:

- (a) Transfer of an originating customer to a cordboard.
- (b) Transfer of headset talking path to adjacent position.
- (c) Control perforation of initial entry on AMA paper tape or its recording in CAMA-C.
- (d) Obtain a visual display of originating or terminating number, coin charge, and minute information or rate treatment.
- (e) Hold or reactivate a loop for any portion of call duration.
- (f) Complete delayed calls.

(g) Handle CAMA traffic on a normal basis or on an overlap basis while engaged in long work-time calls.

(h) Initiation of trouble records.

One position per link group may be used for monitoring the regular service positions.

**7.06** The 100A TSP may be located in the central office building or up to 30 miles away in telephone company buildings or commercial type quarters. Operation of the TSP in the central building is called **local operation**, while operation at a distance from the central office is called **remote operation**.

**7.07** Associated with the TSP installations are several wall mounted cabinets which house the necessary keys and lamps for use by the administration's personnel in controlling TSP operation. This refers to such functions as permitting only selected traffic to reach certain positions, CAMA suspension, and loading indications as to how promptly the traffic is being handled. Light hour transfer when provided is also controlled from the administration cabinets.

**7.08** The relay equipment associated with the TSP, with the exception of some dry reed packages, is entirely contained on frames located in the switch room. These are as follows for local and remote operation.

#### Local Operation

##### Position—Position Control Frame

**7.09** One **position—position control frame**, Fig. 48 is required for two positions but not necessarily in the same console. The equipment is arranged on the frame in two identical sets of surface wired units and multicontact relays, except for a single monitoring unit, located midframe, which serves two positions. A milliwatt supply jack and amplifier test jacks are provided on the frame miscellaneous jack panel.

##### Remote Operation—Remote End

##### Position — Position Signaling Frame

**7.10** The Position—Position Signaling Frame, Fig. 49 is required for position equipment and position signaling equipment for two positions not necessarily in the same console. The equipment is arranged on the frame in two identical sets of surface wired units and multicontact relays, except for a single monitoring unit, located midframe which serves two positions. The signaling equipment includes two

7-inch high, 2-foot 4-1/8 inch wide channel compensating resistor units, located at the rear of the frame and hinged to permit rear access to units mounted on the front of the frame.

#### Position Display Frame

7.11 The *position display frame*, Fig. 50, is equipped with a maximum of 16 position display units and two position display test connector units mounting a maximum of eight multicontact relays each.

#### Remote Operation—Switching Office End

#### Position Control—Control Signaling Frame

7.12 The *position control—control signaling frame*, Fig. 51, is equipped with position control equipment and control signaling equipment for two positions. The equipment is arranged on the frame in two identical sets of surface wired units and a single position display connector unit mounting multicontact relays. The signaling equipment includes two 7-inch high, 2-foot 4-1/8 inch wide channel compensating resistor units, located at the rear of frame and hinged to permit rear access to units mounted on the front of the frame. A milliwatt supply jack and amplifier test jacks are provided on the frame miscellaneous jack panel.

#### Control Pulsing Frame

7.13 The *control pulsing frame*, Fig. 52, is equipped with a maximum 12 control pulsing units.

#### Control Pulsing Connector Frame

7.14 The *control pulsing connector frame*, Fig. 53, is associated with either positions 00-32 or 33-65 in a link group. The frame is equipped with a maximum of five busy and preference units, each associated with a control pulsing connector unit and a maximum of four supplementary busy and preference units on the frame and with a control pulsing unit located on a control pulsing frame. The connector units and supplementary connector units, two maximum per connector unit, are each equipped with a maximum of 11-multicontact relays, each of which serves a control signaling circuit. A connector unit also includes a multicontact relay serving the control pulsing test circuit. A maximum of 33 supplementary local cables

is provided to multiple the multicontact relays associated with the same control signaling circuit.

#### Supplementary Control Pulsing Connector Frame

7.15 The *supplementary control pulsing connector frame*, Fig. 54, is associated with positions 00-65 in a link group. The frame is equipped similarly to the control pulsing connector frame except four busy and preference units and four connector units can be provided. Two of each of these are associated with positions 00-32 and two with positions 33-65. This increases the maximum number of supplementary local cables to 66.

#### Trunk Frames

7.16 Because of their close resemblance to other tandem trunk frames, the incoming TSP trunk frame descriptions have been included under the general trunk descriptions.

#### Link and Connector Frame

7.17 The function of the *link and connector frame* is to provide means for connecting a trunk to a 100A traffic service position. This is accomplished under control of an associated traffic regulator and one of a group of three controllers.

7.18 Before a trunk can be served by any position, the link and connector frame to which it is assigned checks for at least one available primary to secondary linkage. The traffic regulator then establishes whether there is an idle operator capable of handling the particular type of traffic and proceeds to connect a controller to the link frame. Upon being connected, the controller identifies and admits behind a gate any trunk groups indicating they have calls waiting at the time of connection. It then selects from a preferred group the preferred trunk, which is determined by a class indication provided by the link frame, and proceeds to select the particular available position. An idle linkage is chosen from the trunk to one of three operator loops at the position by closing the select and hold magnets through primary, secondary, and tertiary crossbar switches.

7.19 The position will hold the connection under its control until it completes its function, while the controller will serve other trunks in the selected group and advance to other groups which were included in the gate at the time of connection. If, after all trunks have been served, a trunk is selected by the

automatic trunk test circuit, the controller will set up the linkage to the test frame which assumes the role of a simulated position.

**7.20** The basic link and connector frame is a 2-bay structure, per Fig. 55, with capacity for 50 trunks and 33 positions. If traffic requirements demand more operators a supplementary frame, per Fig. 56, provides for 33 additional positions. All positions within a link group are multiplied to all associated link frames in that group. Sixteen basic frames accommodate 800 trunks, which is the maximum associated with one link group. The office capacity is five link groups, serving 2500 trunks and 330 positions, maximum.

**7.21** The link controllers are on separate frames as described later and the traffic regulator is a separate relay rack-mounted unit.

#### Link Controller Frame

**7.22** The primary function of the *link controller* is to establish and control connections between customers who are dialing special toll calls, such as person-to-person, and operators at traffic service positions assigned to handle such traffic.

**7.23** There is a maximum of 50 trunks, arranged in ten groups of five associated with each link and connector frame. When a link frame recognizes that one or more of its associated trunks has requested connection to an operator at a traffic service position, it seeks connection to one of three controllers serving it.

**7.24** The controller upon receiving a signal for its services, connects itself to the link and connector frame requesting service and makes itself busy to all other link frames which it also serves. The controller recognizes and records any or all of the ten trunk groups which have indicated that they have calls waiting. The controller then selects a group from among the groups and serves it.

**7.25** Any trunk may be connected to one of three operator loops of any one of 66 traffic service positions. The 66 positions are arranged in seven groups. There are a maximum of 10 positions in each of the first five groups, and a maximum of eight positions in each of the last two groups. The controller having selected the trunk it will serve, now selects a preferred position group which has at least one idle

position and is capable of handling the required traffic.

**7.26** When the connection is completed, it is held under the control of the position and the controller will then serve other trunks within the connected trunk group. The controller will then advance to another trunk group that had been initially recognized as having requested service.

**7.27** The link controller frame, per Fig. 57, is a single-bay structure containing the equipment for one controller circuit. It is always furnished on the basis of three per link group or a maximum of 15 per TSP office.

#### Light Hour Transfer Control Frames

**7.28** The function of the *light hour transfer control* equipment is to provide means to transfer traffic normally handled by one link group of 100A traffic service positions to another link group of similar positions. This enables the reduction of the size of the operator staff during light traffic hours. As the traffic load subsides, the operators will be instructed in turn to vacate their positions. At an agreed time the traffic of this particular group, under control of a key in the unit administration cabinet, will be transferred to another link group designated either "night" or "twilight".

**7.29** For the purposes of discussion, a link group that transfers its traffic to another link group is considered to be a *day* group. The group that can receive traffic from other groups part of the time and later transfer, is called a *twilight* group. Finally, the group that receives transferred traffic but never transfers its own is the *night* group. The night group always remains in operation, and if the office serves any CAMA traffic, it must be assigned to this link group.

**7.30** The light hour transfer control frames accommodate all the connections between the link and connector frames and position control units of one link group and the position control units of the link group to which traffic may be transferred. The light hour transfer control frame per Fig. 58 is a single bay structure, three of which are required to transfer the traffic of one link group to the positions of either the "twilight" or "night" groups. Six frames are required if transfer to both "twilight" and "night" is specified.

**Data Transfer Circuit Frames—General**

**7.31** The *data transfer circuit* provides for inter-communication among the positions, registers, senders, trunks and rate charging circuits involved in special service calls through an appropriately equipped tandem office. The data channels, each consisting of a multilead path and the connecting relays are provided to transfer the data intelligence among the associated circuits. The positions, registers, senders, and trunks are divided into ten connector groups, any of which can be connected to any of the data channels.

**7.32** Bids for connection to a data channel can originate only at position, register, and test circuits. Access to the data channels is provided by means of the connector groups; a data channel can serve only one connector at a time as determined by the data channel preference and selection circuit. Similarly, only one position or register at a time is given access to its connector.

**7.33** Once a data channel is seized by a position, register, or test connector, the originating circuit transmits primary instructions to the data channel indicating the circuits to be interconnected, the direction of data flow, and the exact data which must be checked for the particular usage of the data channel. Based on these preliminary data, the data channel interconnects the required connectors to include the appropriate trunk, sender, rater, computer, or operator trouble tracing circuit in the multiple and establishes the data check pattern.

**Data Transfer Data Channel Frame for TSP and Extended Area Service**

**7.34** The *data transfer data channel frames*, as shown in Fig. 59, are furnished in a single group per office. The size of the group depends on the office function as indicated below. In the case of offices providing more than one function the number of data transfer data channel frames is the greater number of those required for each of the functions provided. All equipment is assigned in common to the groups of frames.

FUNCTION	NO. OF DATA TRANSFER DATA CHANNEL FRAMES PER GROUP
Traffic Service Position Operation (TSP)	4
Extended Area Service (EAS)	3

The coin raters, coin charge computers, and operator trouble tracing circuit are assigned directly to the data channels. The sender and trunk test frames are assigned through a test connector, and the positions, registers, senders, and trunks are assigned in data transfer groups to their respective connectors. Each connector is associated with one of the data connector groups. The senders from the same sender subgroup cannot be assigned to the same data transfer sender group.

**Data Transfer Position Connector Frame**

**7.35** The *position connector frames*, as shown in Fig. 60, are furnished in pairs in all offices up to a maximum of 14 such frames. Each frame can serve five positions in each of five position connector groups. The positions in the office (maximum 330) are divided about equally among ten position connector groups and are assigned to position connector groups in accordance with the units digit of their equipment number. A test position is assigned to each position connector group.

**Data Transfer Sender Connector Frame**

**7.36** The *sender connector frames*, as shown in Fig. 61, are furnished in pairs in all offices up to a maximum of four such frames. Each frame can serve ten senders in each of five sender connector groups. The senders in the office (200 maximum) should be evenly distributed among ten sender connector groups, provided that no two senders from the same sender subgroup are assigned to the same data transfer sender group.

**Data Transfer Register Connector Frame**

**7.37** The *register connector frames*, as shown in Fig. 62, are furnished in pairs up to a maximum of six such frames. Each frame can serve fifty registers, ten registers, in each of five register connector groups. Registers are assigned to register connector groups in accordance with their units digit identification at the incoming register link frame.

### Data Transfer Trunk Connector Frame

**7.38** The *trunk connector frames*, as shown in Fig. 63, are furnished in a pair accommodating the full complement of 2000 trunks. Each frame can serve 200 trunks in each of five trunk connector groups. Trunks are assigned to connector groups in accordance with their appearance on the position link frame. The trunks in each connector group are divided into subgroups for maintenance purposes and equal distribution of trunks across subgroups is not required for traffic purposes.

### 10-Digit Incoming Register and Link Frame

**7.39** The *10-digit incoming register and link* serves incoming trunks from the local step-by-step offices. When the trunk is seized by the distant office, the link circuit looks for an idle register among the ten registers serving the switch on which the trunk is located. Upon finding an idle register, a fast bylink is established until the path is checked and the appropriate crosspoint is closed. The link control relays are then released. Other trunks served by this switch can then be connected to registers which are not busy.

**7.40** When registration of the dialed digits is complete, the register seeks an idle sender and, when successful, bids for connection to the data transfer circuit. Following receipt of a signal from the data transfer circuit that the digits have been passed successfully to the sender, the register is released to await its next call.

**7.41** The *10-digit incoming register and link frame*, as shown in Fig. 64, is always equipped with ten switches and ten registers. Each switch has access to 20 trunks and ten registers. Consequently, if the 10-digit incoming register supplementary frame is not equipped, each trunk has access to each register and, conversely, each register serves all trunks in the link.

### 10-Digit Incoming Register Supplementary Frame

**7.42** The *10-digit incoming register supplementary frame*, as shown in Fig. 65, can be equipped with from one to ten registers. When the supplementary frame is provided, each register in the 0-9 group on the basic frame for which the corresponding register in the 10-19 group is equipped relinquishes half of its switch appearances to the corresponding register from the 10-19 group. Consequently, any register in

the 10-19 group and any register in the 0-9 group for which the corresponding register in the 10-19 group is equipped appears on only five switches and serves 100 trunks maximum. Each trunk still has access to ten registers.

### Rater Frame

**7.43** The function of the *rater* is to derive the charge information applicable to the call being processed, and to deliver its output in the form of a 3-digit rate treatment to the trunk and position control circuits. An additional output required from the rater is the duration of the initial period of the call.

**7.44** The rater will detail rate a maximum of 15 terminating areas from a maximum of 20 originating rate centers, subject to the following:

- (a) Three terminating areas generate 260 or fewer charge combinations.
- (b) Twelve terminating areas generate 130 or fewer charge combinations.
- (c) The average number of charge combinations for all 15 terminating areas cannot exceed 126.

Combinations in excess of the above limits will require the use of two or more terminating area relays for a rated area, thus lowering the number of areas that can be detail rated or the manual rating of certain NNX codes within the area. Additional automatic rating is provided for all areas having a single charge from all originating rate centers to all terminating points within the area.

**7.45** The basic rater frame is a 2-bay structure per Fig. 66. It is always associated with at least one *supplementary frame* per Fig. 67. This arrangement provides equipment to automatically detail rate a maximum of 15 multirate terminating areas and 10 rate lines of single rate terminating areas from a maximum of 20 originating rate centers subject to certain limitations as described in detail in the rater frame specification. Provision is made to increase the capacity of the rater by adding additional supplementary frames with cross-connections to serve the varied traffic patterns. The capacity of the rater is as follows.

MULTIRATE TERM. AREAS *	ORIG RATE CENTERS	FRAME QUANTITY BASIC FR AND:
15	20	1 Supl FR (Minimum Quantity)
30	20	2 Supl FR
15	40	2 Supl FR
30	40	4 Supl FR

\*and 10 rate lines of single rate terminating areas.

**7.46** The output of the rater, in terms of a 3-digit rate treatment number and the minutes applying to initial period for each call is used by the coin charge computer to calculate time and charges displayed at the 100A traffic service position and by the trunk to time the initial period of the call.

#### Coin Charge Computer Frame

##### Supplementary Coin Charge Computer Frame

**7.47** The *coin charge computer* calculates the duration of, and the charges for, the initial and overtime periods of customer dialed station-to-station and person-to-person coin zone and coin toll calls handled at the 100A traffic service desk. The computer passes this information to the desk where it is displayed before the operator.

**7.48** The computer can determine the charge and time information for a maximum of 300 rate treatments representing interstate and intrastate rates applicable to calls originating in a maximum of three states (originating areas).

**7.49** It is a single bay structure per Fig. 68 composed of four units, the basic unit (always required), a ten percent tax unit (optional), a surcharge unit (optional), and a flexible tax unit mounted on a supplementary frame per Fig. 69. The basic unit contains the rate treatment translation, the charge and time relays, and the output to position control. This unit may be used alone, or with the tax *or* surcharge units, or with the tax *and* surcharge units. The ten percent unit is, as the name implies, capable of calculating tax to be added to the initial and/or overtime charges. The surcharge unit is required when the local rate structure imposes a surcharge (additional charges) on the first 1 to 7 overtime minutes of a person-to-person call. The flexible tax unit is capable of calculating tax at 1/2 percent intervals between 0 and 10 percent. Four separate tax rates can be calculated at one time.

#### Auxiliary Coin Charge Computer Frame

**7.50** To provide a feature to compute overtime charges from overtime rates having penny fractions, an *auxiliary coin charge computer frame* is required. Being a service sensitive frame, two frames must always be furnished. The auxiliary coin charge computer frame, Fig. 89, is a single bay framework accommodating five relay units and a frame fuse panel.

#### Timer Link and Control Frame

**7.51** The *timer link and control frame* provides time period pulses to the coin toll trunks. The pulses are used by the trunk for the following reasons.

- (a) To start the timing of a call and to mark 60 seconds of elapsed time.
- (b) To charge a call 6 seconds after start of timing.
- (c) To collect the charges due, according to the following options.
  - (1) 18 seconds prior to the end of time period.
  - (2) 30 seconds prior to the end of time period.

**7.52** The timer link and control frame is 2-bay structure per Fig. 70. Each frame can serve a maximum of 200 coin trunks. A 100A TSP office may be equipped with up to 10 frames to serve 2000 trunks maximum.

#### Operator Outgoing Trunk Frame

**7.53** The function of the *operator outgoing trunk frame* is to provide means for an operator at a traffic service position to establish connections for use to the operators providing special services such as information, route and rate, etc. The TSP operator depresses a key associated with the service operator desired and the key itself lights when the connection is established.

**7.54** The operators request for an outgoing trunk is extended at an operator outgoing trunk position unit through the OGT position circuit associated with a traffic service position. An OGT selector associated with an OGT in the desired OGT trunk group, being thereby activated, hunts for the requesting position and, upon location thereof, connects it to the

desired switchboard or desk. At this time, the associated OGT lamp at the traffic service position will be lighted. Additional requests by other operators for outgoing trunks in the same OGT group will be served by other selectors and associated outgoing trunks up to the limit of the trunk group. If all the outgoing trunks in a group are busy the operators OGT lamp will flash. When the operator has finished with the OGT connection the OGT key is released which releases the outgoing trunk without further stepping of the selector.

**7.55** The operator outgoing trunk frame as furnished for regular installations permitting the standard 11-foot 6-inch height frame, is a one bay structure, as shown in Fig. 71. It has the capacity to serve 44 TSP positions with 30 outgoing trunks in 4 outgoing trunk groups. If all 4 trunk groups are required 2 will have maximum 10 trunks each and two maximum 5 trunks each or 30 total.

#### **Cordboard Transfer Trunk Finder Frame**

**7.56** The function of the *cordboard transfer trunks* and the associated *trunk finder* is to provide means for an operator at a traffic service position to transfer certain types of incoming calls to a cordboard when such a connection is required to complete the call. Such calls include: overseas calls, marine operator calls, conference calls, mobile telephone calls, sequence calls, etc.

**7.57** When a calling customer, seeking operator assistance on a special type of call, reaches an operator at a traffic service position (TSP) that cannot complete a call, the TSP operator must pass the call on to a cordboard position. The TSP is equipped with a transfer key with which the operator signals the trunk finder. The trunk finder locates the appearance of the associated recording-completing trunk which is handling the call and connects it through its associated transfer trunk to a cordboard position. The TSP operator is free to release from the call when the cordboard operator takes up the call. Major alarms will be sounded if either a finder release failure condition or an all finder busy condition persists beyond a short time-out interval. An alarm release key is provided on the frame, permitting the major alarm to be retired, replaced by a minor alarm which continues until the trouble is cleared.

**7.58** The cordboard transfer trunk finder frame (TSP TF) accommodates two groups of equipment, each including eight trunk finders and the asso-

ciated eight transfer trunks. Each trunk finder group provides transfer facilities for 99 maximum recording completing trunks. Each frame has a trunk finder test unit which includes the frame miscellaneous equipment and the trunk finder alarm and make-busy equipment. The two groups of equipment and the test unit are contained in a single bay structure as shown in Fig. 72.

## **8. MAINTENANCE FACILITIES**

### **Maintenance Frames—General Use**

#### **Trouble Recorder and Connector Frames**

**8.01** The *trouble recorder frame*, Fig. 33, the associated trouble recorder connector frame, Fig. 34, and the supplementary trouble recorder connector frame, Fig. 35 are used to record automatically troubles encountered during the establishment of service and test calls. A record is made by punching holes in a card by means of a perforator. The record card is printed so that the information recorded can be read directly by a maintenance employee. The trouble recorder frame also accommodates various lamps, make-busy jacks, test jacks, alarm lamps, and keys. The trouble recorder is a 2-bay frame accommodating the perforator, two jack, key and lamp panels, relays, and registers required for a maximum of two marker groups, two transverter groups and five 100A TSP link groups. It is located in the maintenance center. The trouble recorder connector is a single-bay frame, accommodating general purpose relays and multicontact relays used for connecting and scanning purposes. This frame is always required with the trouble recorder and is located near the associated transverters, markers, and recorders for cabling reasons. The supplementary trouble recorder connector is a single-bay frame accommodating the multicontact connector relays for a second transverter group and is located near the associated transverters for cabling reasons.

### **Computerized Maintenance and Administration Support Equipment—COMAS III**

**8.02** The *computerized maintenance and administration support equipment* consists of a Digital Equipment Corporation (DEC) PDP 11/40 mini-computer system and is used to perform the analysis and sorting functions for both ineffective attempts and marker compare of all codes testing. This system includes a processor, core memory, programmable real time clock, regulated power supply, and peri-

pheral interface control boards which are all furnished by DEC and housed in a single cabinet (Fig. 84). Western Electric manufactured scanner/distributor units are used as the interface between the minicomputer and the crossbar tandem office and are mounted in the cabinet above the processor. The leads from the interface unit to the crossbar tandem office are connectorized at the trouble recorder frame. COMAS III is arranged to accommodate two data ports and up to four teletypewriters. One teletypewriter for use as the processor input-output terminal and one for maintenance, are always furnished. On an optional basis the two additional teletypewriters and associated data sets may be provided for remote operation. The two data ports reserved for dial-up line operation are always provided and function with 103-type data sets when specified.

#### **Incoming Trunk Test Frame**

**8.03** The *incoming trunk test frame*, Fig. 36 is a single bay of equipment used for testing the incoming trunks in the terminating office. It is associated with these trunks through the incoming trunk test connector frame and makes its tests automatically or repeatedly as desired. One frame has a basic capacity of 4000 trunks but may be arranged for an additional 4000 if required. For transmission testing of toll trunks, an additional bay, J67447AA, Fig. 77 is furnished in conjunction with the basic test frame. A supplementary teletypewriter frame J67447AF, Fig. 76 may also be provided for automatically printing records of transmission tests.

#### **Supplementary Incoming Trunk Test Frame**

**8.04** The *supplementary incoming trunk test frame* (Fig. 90), is a single bay framework arranged to accommodate trunk test circuit equipment required to permit PCI, MF, and DP outpulsing on a 7-digit basis and to provide nonstandard 4-, 5-, and 7-digit test line codes. This frame may also accommodate the remote office test line (ROTL) access unit which provides the control of the trunk test by the ROTL frame.

#### **Incoming Trunk Test Connector Frame**

**8.05** The *incoming trunk test connector frame* is a single bay framework arranged to mount five connector units each of which serves to connect the incoming trunk test frame and/or the ROTL to 200 incoming trunks in the terminating office through out-

going trunks in the tandem office. One ROTL connector unit is provided per connector frame when office is arranged for ROTL.

#### **Sender Test Frames**

##### **Sender Test Supplementary Frame**

##### **Sender Test Connector Frame**

##### **Register Test Connector Frame**

**8.06** The *sender test frame*, Fig. 37, *associated connector frame*, Fig. 38, the *supplementary test frame*, Fig. 39, and the *register test connector frame*, Fig. 40 provide for testing PCI, revertive pulse, multifrequency pulse (SD-27024-01), and dial pulse (SD-25999-01) senders, local CAMA operator positions, trunks to toll or DSA switchboards equipped for CAMA operation, incoming registers, and transverters. Remote multifrequency pulsing positions are not tested by this test frame. The testing of outgoing trunks to remote positions and the operation of these positions is done at the manual outgoing trunk test frame. The supplementary test frame is required only when testing revertive or multifrequency senders or multifrequency pulsing CAMA positions. The sender test frame is a 2-bay frame and the supplementary frame, a single-bay frame with a capacity for testing 300 senders, 12 transverters, 100 CAMA positions including trunks to toll or DSA switchboards equipped for CAMA operation, and 400 incoming registers. The sender test connector is a single-bay frame arranged to connect a maximum of 200 senders to the sender test frame. The register test connector is a single bay frame required only when 10-digit DP registers associated with MF senders are furnished.

##### **Sender Make-busy Frame**

**8.07** The *sender make-busy frame*, Fig. 41, is a single-bay frame accommodating a jack field, registers, and relay equipment. The primary function of the sender make-busy frame is to provide sender make-busy jacks for use in removing any sender from service. Associated with these MB jacks are SS lamps which light to indicate as well as to identify stuck senders; SC lamps which light to indicate as well as to identify stuck senders involved in delayed assignments of PCI calls and CP keys affording means of canceling the automatic priming feature of any stuck sender when it is desired to trace the trouble. These are sender subgroup make-busy jacks.

jacks to reduce the timing intervals of the senders, and an alarm which operates when a predetermined number of sender subgroups become busy.

**8.08** When bylink or 100A TSP operation is required, incoming register make-busy jacks, cancel priming keys and alarm lamps and incoming register link alarm lamps are provided on the sender make-busy frame. Other functions of the sender make-busy frame include the provision of registers for recording the occurrence of various conditions in the associated sender groups, sender link frame controllers, position link frame controllers, and incoming registers.

#### Remote Office Test Line Frame

**8.09** The *ROTL frame* (Fig. 81), is a single bay framework equipped to serve as the called office access for testing trunks under the supervision of the centralized automatic reporting on trunks (CAROT). The frame is arranged for testing a maximum of 8000 incoming trunks to distant offices via access at the incoming trunk test connector frames.

#### Point-to-Point Data Recorder Frame

**8.10** The *point-to-point data recorder frame* (Fig. 88), is a single bay framework arranged to gather and record information pertinent to the switching of a call through a crossbar tandem office. Data samplings are accumulated pertaining to the originating and terminating point as well as the called number on calls through one or two selected markers and all trunk link frames. The data is fed into a recording device or to a data set for transmission to a remote location. Facilities are provided to enable control of the point-to-point data recorder from the remote location.

#### Manual Outgoing Trunk Test Frame

**8.11** The *manual outgoing trunk test frame*, Fig. 42, consists of a test frame and one, two, or three associated jack bays. The test frame accommodates the relay equipment. A jack bay accommodates a maximum of 2000 test and make-busy jack circuits for the trunks to be tested. Connection between the test equipment and the trunks is made with patching cords at the jack bays.

#### Toll Testboard Equipment—General

**8.12** When the office is used as a toll switching crossbar tandem office to switch intertoll trunks on a 2-wire basis, No. 17B toll testboard, trunk assignment patching bay, and circuit patching bay equipment is provided on 23-inch channel-type relay rack framework for use in the testing and maintenance of intertoll trunks.

#### No. 17B Toll Testboard

**8.13** The *No. 17B toll testboard* is used in testing intertoll trunks to facilitate the location of troubles and to expedite the restoration of service when it has been interrupted. This testboard consists of a lower unit and a jack field. The lower unit consists essentially of a keypan on which the keyshelf, plugshelf, and cordshelf rests, mounting bars which support the keypan and 23-inch mounting plate equipment, a cord protection panel in the rear for protecting the wiring to the relay equipment, a front panel for protecting the relay equipment, and a footrail. The jack field accommodates the test jacks which provide access to the intertoll trunks. Two jack field assemblies are available, one provides for a maximum of 240 intertoll trunk appearances and one for a maximum of 400 intertoll trunk appearances. The small jack field is for use when the frame also accommodates a signal test panel and a No. 19C oscillator or No. 2E singing point test panel.

**8.14** The capacity of the No. 17B lower test unit is as follows:

Cord circuits	4
Position and Telephone Circuit	1
Position Dial or Keypad Circuit	1
Telegraph Test Circuit	1
Dial Cord Circuit	1
Extension Cord Circuit	2
Loop Signal Trunk Test Circuit	1
E and M Lead Supervision Trunk Test Circuit	1
Signal Lead Connector Cord Circuit	1
Busy Test Key Circuit	1

**Trunk Assignment Patching Bay**

**8.15** The *trunk assignment patching bay* accommodates patching jacks (OL), connecting to the office link frame secondary multiple, and (TRK) jacks, connecting to intertoll trunks. These jacks provide for making reassignment patches between the office link frame secondary switch trunk terminals and intertoll trunks and for patching spare terminals to trunks. A trunk assignment patching bay accommodates a maximum of 420 assignment patching jack circuits.

**Circuit Patching Bay**

**8.16** The *circuit patching bay* accommodates patching jacks which provide for patching the toll line equipment to 4-wire terminating equipment and the CX or single-frequency signaling equipment to intertoll trunks. A circuit patching bay accommodates a maximum of 300, 6-jack patching jack circuits and 30, 3-jack interbay or intrabay patching jack circuits or telephone set and miscellaneous jack equipment.

**Portable Test Sets—General Use**

**8.17** *Portable test sets* available for crossbar dem offices are:

- Trunk test set (wagon type)
- No. 35F relay test set
- Mercury relay test set
- Cold-cathode tube test set
- Tube tester
- Contact closure test set (box type)
- Pulse checking test set
- Auxiliary trunk test set
- No. 12B transmission measuring set
- Test set for timing tests
- KS-14510 volt-ohm-milliammeter
- No. 1A fault locator test set
- No. 1A signaling test set.

**Maintenance Equipment—Non-AMA****Tandem Trunk Test Frame**

**8.18** The *tandem trunk test frame*, Fig. 43, consists of a single bay of connector and test equipment required in connection with remote-control zone registration trunks. It has a rated capacity of 300 trunks but is physically arranged to test a maximum of 400 remote-control zone registration trunks accessible through four connector switches on the frame. Each switch serves 100 trunks.

**Tandem Trunk Test Set**

**8.19** A *tandem trunk test set* (wagon type) is used for testing incoming trunks to the tandem office including the incoming features of 2-way intertoll trunks and excepting those trunks arranged for automatic testing.

**Maintenance Equipment—AMA and TSP****AMA Trunk Test Frame****AMA Trunk Test Supplementary Frame**

**8.20** The *AMA trunk test frame*, Fig. 44, for AMA tandem trunks is a single-bay structure, arranged to test each trunk in rotation, picking trunks in sequence from each recorder. It stops and brings in an alarm if trouble is encountered. Particular trunks may be selected and tested individually if required. The association of the trunk with the test frame is through the trunk test connector. One trunk test frame is required per office. A feature is available whereby CAMA-C can control the test frame to collect data for use in analyzing a class of network irregular signals. These signals are unauthorized single frequency (SF) and multifrequency (MF) tones used to bypass the AMA recording process in the CAMA office. For 100A TSP trunk testing, a supplementary bay per Fig. 45 is required.

**AMA Trunk Test Connector Frame**

**8.21** The *AMA trunk test connector frame*, Fig. 46, is a single-bay frame arranged to mount five trunk test connector units and four interrupter

checking units. A connector unit serves to connect the trunks associated with two recorders (200 trunks maximum) to the test frame. An interrupter checking unit is used to check the operation of the charge delay interrupter relays on six pairs of AMA trunk frames.

#### **TSP Position Test Equipment**

**8.22** The test equipment for testing the 100A TSP position and associated circuits comprises a test frame, a test wagon and several relay rack mounted units which are used singly or in combination as follows:

#### **Position Test Frame and Test Set**

**8.23** The *position test frame* is a single-bay structure per Fig. 73 which, together with its associated T-wagon, provides a means for testing the traffic service position No. 100A position circuit and position control circuit. The control unit is mounted in the T-wagon for association with the TSP under test either at the console location or at the frame location and provides a convenient way to prime and steer the test frame by means of multifrequency pulsed digits determined by the routing and type of test call desired. The test frame and wagon are capable of setting up any of the types of calls that the traffic service position is capable of handling. Test calls may be directed to any position (330 maximum) associated with a crossbar tandem office, regardless of the physical location of the position (local or remote). The position test frame is always located in the switching office and connects to the T-wagon through three pairs of leads. These pairs provide for test frame seizure control, priming and response signaling, and an emergency talking circuit. Connection between the T-wagon and the frame mounted equipment is established by means of a belt line running through all the traffic service positions and position circuit frame equipments. The belt lines are individual to a position link group (66 positions maximum).

**8.24** The T-wagon consists of a metal wagon-type housing with the relays, capacitors, and resistors mounted in the lower part of the wagon where they are readily accessible for maintenance purposes. The keys and lamps are located on the hinged top panel and the connector for patching the set to the frame or to the positions under test is mounted on the back.

#### **Control Pulsing Test Unit**

**8.25** The *control pulsing test unit* is a fully automatic test entity capable of testing on a routine or individual test basis all operational features of the control pulsing circuits associated with it. The circuit may be arranged to scan automatically from one to a maximum of seventy of the control pulsing circuits assigned to a tandem office and is provided on a one per office basis. It occupies a space of twenty-seven 2-inch by 23-inch mounting plates and is mounted on miscellaneous relay rack. Since a key and lamp panel is included as part of the unit, the latter is located at a height to permit convenient operation.

#### **Position Display Test Unit**

**8.26** The *position display test unit* is a fully automatic test device capable of testing on a routine or individual test basis all operational features of the position display circuits associated with it. The circuit is arranged to scan automatically from one to a maximum of 40 of the position display circuits assigned to a tandem office. Test circuits are provided on a one per remote office location. The unit occupies a space of twenty-four 2-inch by 23-inch mounting plates and is mounted on a miscellaneous relay rack. Since a key and lamp panel is included as part of the unit, the latter is located at a height to permit convenient operation.

#### **Rater-Charge Computer Test Frame**

**8.27** The *rater-charge computer test frame* provides facilities for making manual tests of two raters and two charge computers. It is a single bay structure per Fig. 74 and consists of a 2-section jack, key, and lamp panel, relay units for rater test, and a relay unit for computer test. The jack, key, and lamp panel contains the keys and switches for originating a test call of a rater or charge computer and the lamps to display the resultant output. Individual make-busy jacks per rater and per computer are provided in the jack, key, and lamp panel. Trouble registers per rater and per computer are located on a single mounting plate immediately above the jack, key, and lamp panel. A writing shelf with pigeon holes is provided.

### **9. FLOOR PLAN DATA**

**9.01** The floor plan layout is divided into five general groups as follows:

- (a) Switching equipment
- (b) Maintenance equipment, test frames, etc.
- (c) Perforator cabinets (AMA)
- (d) Switchboard positions (CAMA or 100A Traffic Service Positions)
- (e) Toll terminal equipment
- (f) Minicomputer equipment.

**9.02** In general, other things being equal, like frames are kept together. Also, in the case where different types exist, for example, trunks and senders, each type is segregated and separately numbered with room allowed for growth.

**9.03** Some over-all consideration should be given on all floor plan layouts to provide arrangements which minimize the amount of personnel passage past operating equipment in order to cut down the amount and circulation of dust fibers.

**9.04** A table of sizes for ready reference is given in the attached Fig. 3. In all cases, for specific recommendations as to location and sizes, the engineering requirements, specifications and listed floor plan data sheets should be consulted for the latest information.

**9.05** The *switching equipment*, comprising the incoming trunks, trunk links, office junctor grouping, office link, sender link, sender, marker connector, and marker frames, whether or not the office is arranged for AMA or TSP represents the basic switching facilities of the tandem office. The added AMA or TSP frames, such as the transverter, transverter connector, billing indexer, recorder, call identity indexer, data transfer, etc, are closely associated from a cabling and operating standpoint and the entire group is treated in a compact manner on the floor plan layout.

**9.06** The *maintenance equipment* consisting of the trouble recorder, sender test, sender test supplementary, trunk test frames, sender make-busy frame, and OGT test frames are grouped together at the maintenance center. Generally, this center will have the first choice of location as regards to personnel facilities and quick access to the equipment, and may be combined with the maintenance facilities for local crossbar in the same building.

**9.07** The *perforator cabinets* are preferably located in a separate room on the same floor as the recorders with convenient access for the personnel to handle the paper tape.

**9.08** The *CAMA switchboard positions*, when furnished in the same building as the switching equipment, are located in an operating room, usually a separate room on another floor from the switchroom. The positions are located in one or more lines each with a cable turning section. Growth may be either left to right or right to left. The positions may also be arranged back to back, separated by a transparent baffle.

**9.09** The *100A traffic service positions* are likewise located in an operating room area, preferably in small rooms or room subdivisions, accommodating about a dozen positions each. The sections are arranged as desks would be in a business office and no provision is made for lineups.

**9.10** The *toll terminal equipment*, consisting of four wire terminating sets, signaling units, repeaters, etc, is usually located in a separate toll terminal area that is laid out according to accepted toll practices. In this room would also be the 17B toll testboard, circuit patching and assignment patching bays.

**9.11** The CAMA-C minicomputer equipment is recommended to be located in an area separate from the switching room with the capability of a controlled environment. The COMAS III equipment is recommended to be located in the maintenance center.

## 10. POWER CLANTS

**10.01** The power requirements for crossbar tandem offices are similar to local No. 1 crossbar offices and the same power plans may be used if available. For a new office a 302A plant for 24 and 48 volts should be supplied. The battery distribution follows No. 1 crossbar practice per SD-80909-01. For zone registration trunk timers or master timers, a source of 22 volts ac is required. This is supplied from a relay rack mounted 506A power plant per J86724. A 504B plant per J86617 is required to furnish 115-volt, 60-cycle current from the office battery during commercial power failure or low voltage to the 506A power plant and to the perforator cabinet output reel motors. For zone registration charging pulses a 170-volt supply, tapped at 135 volts, is re-

quired per J86591. Various circuits require +130 volts. This voltage is supplied by 405A or 410B power plants per J86585 or J86465. Low tone and ringing are taken from an existing local office ringing plant. The 48-volt talking battery required for some trunks is obtained through filters. A talking battery supply frame filter, when required, is furnished for two adjacent trunk frames and mounted at the top of one of the frames.

**10.02** When 100A traffic service positions are on a remotely operated basis and located in non-telephone office type buildings, ie, having no telephone office power plant, the power supply may require specific recommendations. Such cases should be referred to the Bell Telephone Laboratories, Incorporated.

**10.03** If CAMA-C is to be installed in offices that experience annually more than three AC power failures of greater than 5 milliseconds duration, an inverter is recommended to provide uninterrupted AC power from the office -48 volt DC source. The inverter will furnish the AC only to the primary CAMA-C system. The back up obtains its power from the essential AC supply.

## **11. MISCELLANEOUS**

**11.01** A frame line circuit consisting of talking battery supply for telephone sets is multiplied through the telephone jacks of the various frames for intercommunication.

## **12. DRAWINGS**

**12.01** Figures 1 through 90 are attached herewith.



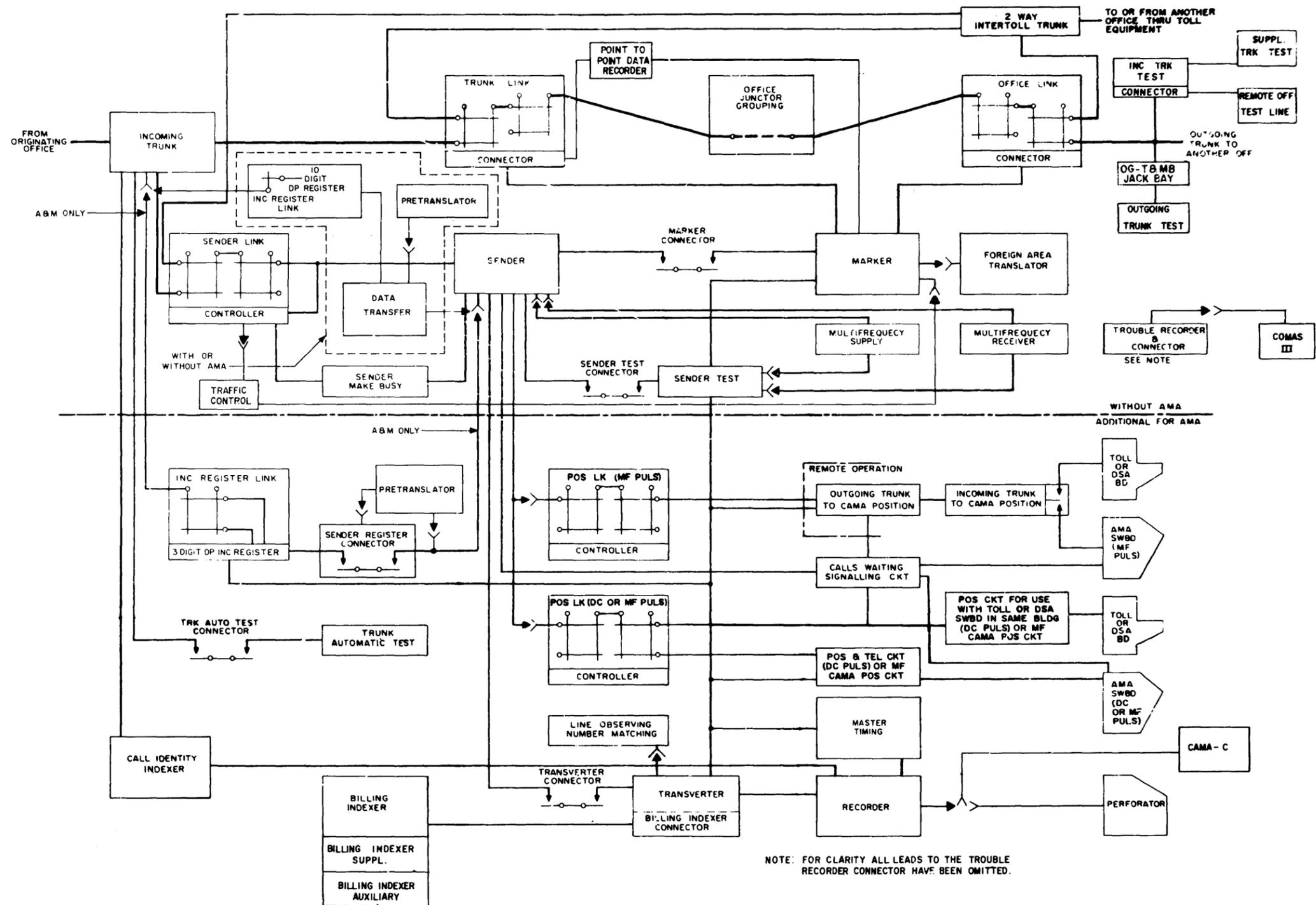


Fig. 1 — Block Diagram With and Without AMA

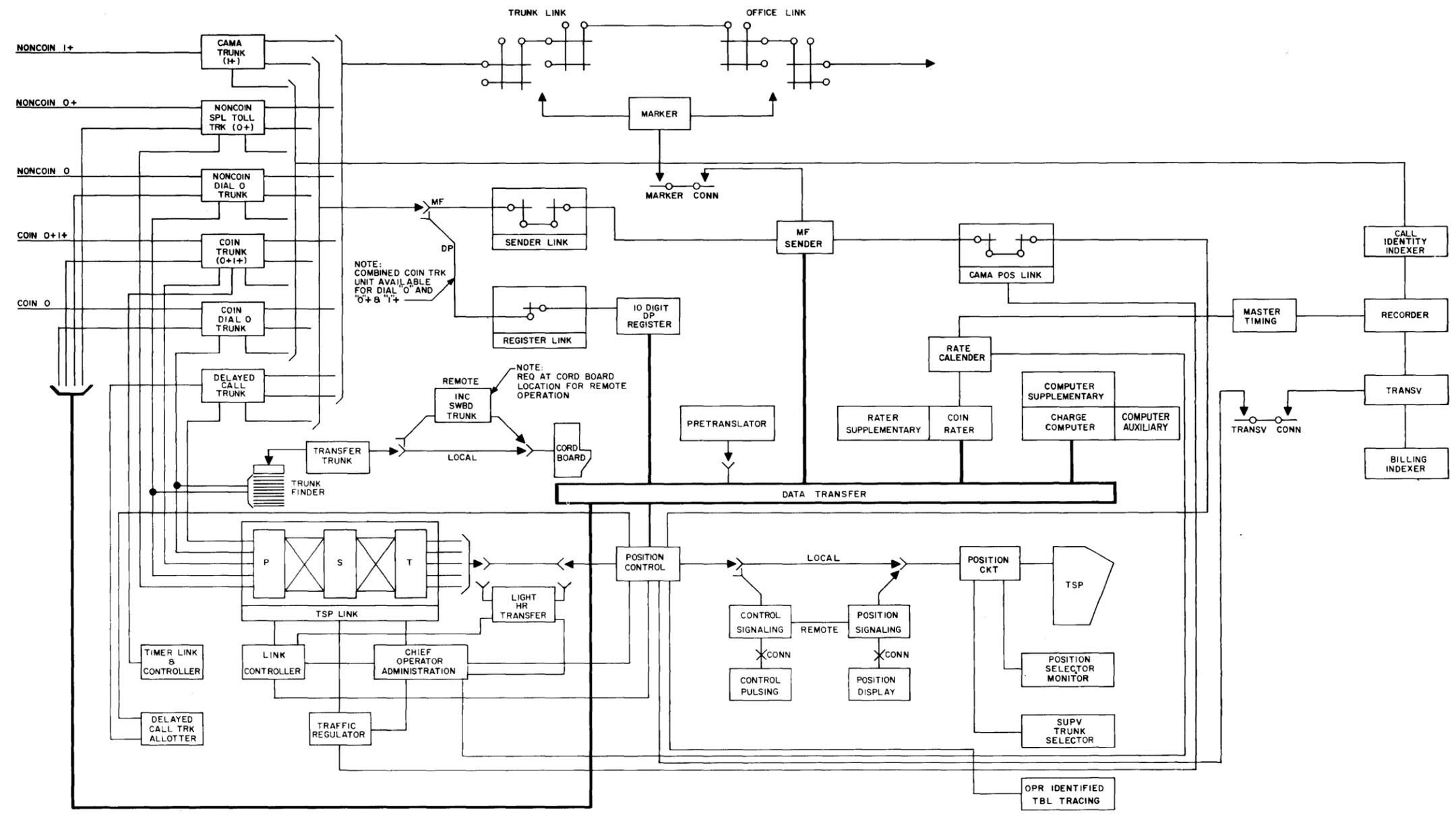


Fig. 2—Block Diagram With 100A Traffic Service Positions

FRAME	DESIG	FLOOR PLAN
AMA CENTRALIZED COMBINED DIAL COIN TRUNK	CCDCT	2-8 $\frac{1}{8}$
AMA CENTRALIZED DIAL COIN TRUNK	CDCT	2-0 $\frac{5}{8}$
COIN CHARGE COMPUTER	CNCC	2-8 $\frac{1}{8}$
COIN CHARGE COMPUTER SUPL	CNCCS	2-0 $\frac{5}{8}$
CONTROL PULSING	CP	2-0 $\frac{5}{8}$
CONTROL PULSING CONN	CPC	2-8 $\frac{1}{8}$
SUPPLEMENTRY CONTROL PULSING CONN	SCPC	2-8 $\frac{1}{8}$
CORDBOARD TRANSFER TRUNK FINDER	TSPTF	2-8 $\frac{1}{8}$
DATA TRANSFER DATA CHANNEL	DTDC	3-10
DATA TRANSFER POSITION CONN	DTPC	2-8 $\frac{1}{8}$
DATA TRANSFER REG CONN	DTRC	2-8 $\frac{1}{8}$
DATA TRANSFER SENDER CONN	DTSC	2-8 $\frac{1}{8}$
DATA TRANSFER TRK CONN	DTTC	1-10 $\frac{1}{8}$
DELAYED CALL TRK	DCT	2-8 $\frac{1}{8}$
LINK AND CONN	TSPL	6-0 $\frac{1}{2}$
LINK AND CONN SUPL	TSPLS	3-0 $\frac{1}{4}$
LINK CONTROLLER	LKC	1-10 $\frac{1}{8}$
NIGHT LIGHT HOUR TRANSFER CONTROL	TRFRN	2-2 $\frac{5}{8}$
OPERATOR OUTGOING TRK	OOGT	2-8 $\frac{1}{8}$
POSITION - POSITION CONTROL	PPC	2-8 $\frac{1}{8}$

FRAME	DESIG	FLOOR PLAN
POSITION - POSITION SIGNALING	PPS	2-8 $\frac{1}{8}$
POSITION CONTROL CONTROL SIGNALING	PCCS	2-8 $\frac{1}{8}$
POSITION DISPLAY	PD	2-0 $\frac{5}{8}$
POSITION TEST	PT	2-0 $\frac{5}{8}$
RATER	RTR	4-8 $\frac{3}{4}$
RATER SUPL	RTRS	6-0
RATER -CHARGE COMPUTER TEST	RCT	2-0 $\frac{5}{8}$
REG TEST CONN	RTC	2-0 $\frac{5}{8}$
SUPL TRANSVERTER CONN	TVCS	2-0 $\frac{5}{8}$
TIMER LINK AND CONTROL	TML	2-8 $\frac{1}{8}$
TRUNK TEST SUPL	AMATTS	2-0 $\frac{5}{8}$
TWILIGHT LIGHT HOUR TRANSFER CONTROL	TRFRT	2-2 $\frac{5}{8}$
10 DIGIT INCOMING REG AND LINK	TIRL	6-0 $\frac{1}{2}$
10 DIGIT REG SUPL	TRLS	3-0 $\frac{1}{4}$
TRANSVERTER CONN POSITION AUX	TVCPA	3-1 $\frac{5}{8}$
TRANSVERTER CONN TRANSVERTER AUX	TVCTA	2-4
100A TSP SECTION (2 POSITIONS)	-	5-0
100A TSP TRK	TSPT	2-8 $\frac{1}{8}$
AUXILIARY COIN CHARGE COMPUTER	ACNCC	2-0 $\frac{5}{8}$

FRAME
AUTOMATIC TRAFFIC TEST AND CONTROL
CIRCUIT PATCH
FLOOR ALARM
FOREIGN AREA
GROUP BUSY
INC TRK TEST
INC TRK TEST CONTROL
MANUAL OUTGOING TRUNK
MARKER
MARKER CONN
MULTIFREQUENCY CURRENT SUPPLY
MULTIFREQUENCY PULSING RECEIVER
NO. 17B TOLL TEST BOARD
OFF. INTERRUPT
OFF. JUNCTION
OFF. LINK
OFF. LINK WITH
PRE-TRANSLATOR
RELAY RACK
TRAF REG RE
MISC UNITS
FUSE BAY
POS EQPT
SENDER ATTACH

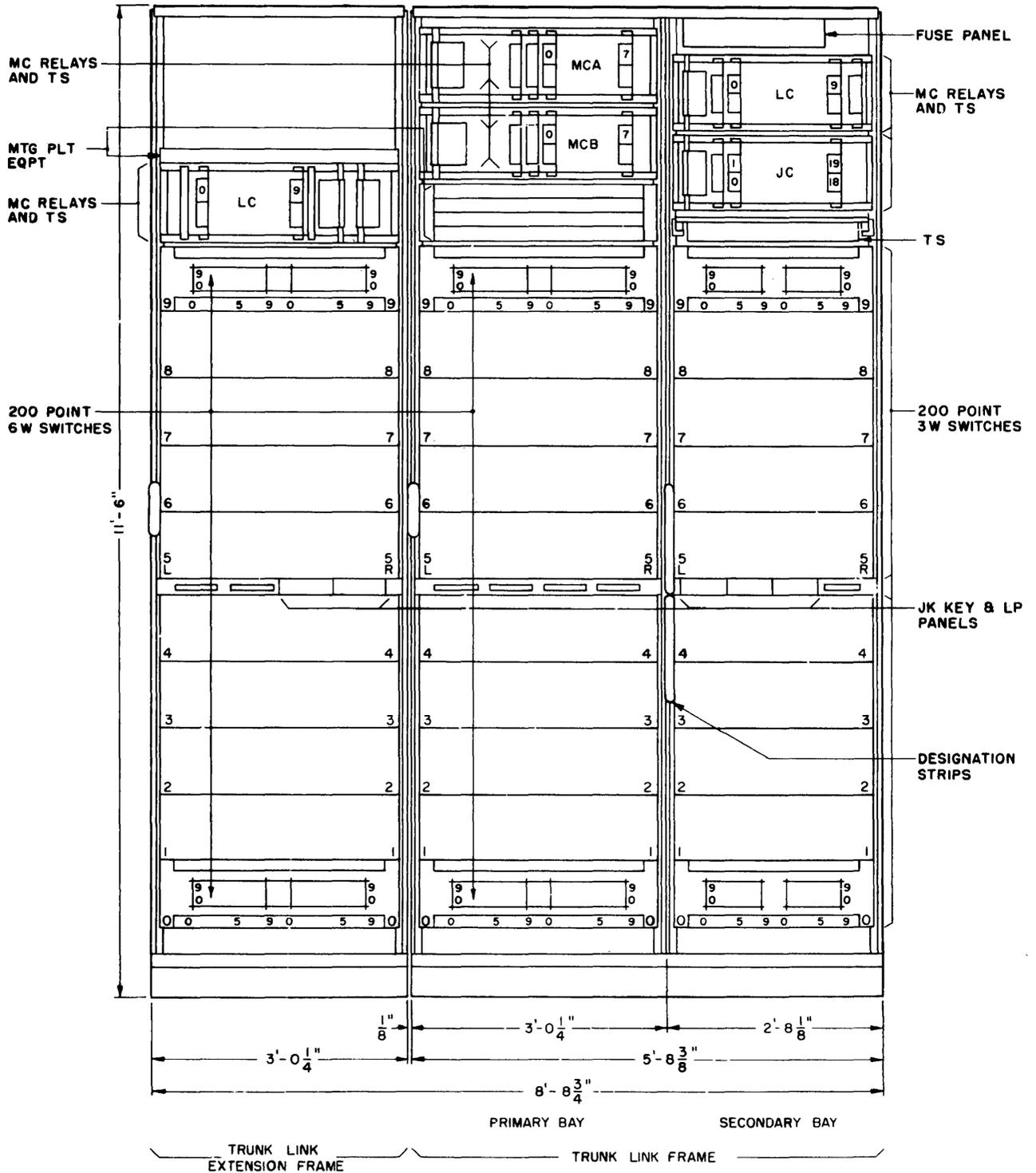


Fig. 4—Trunk Link and Trunk Link Extension Frames

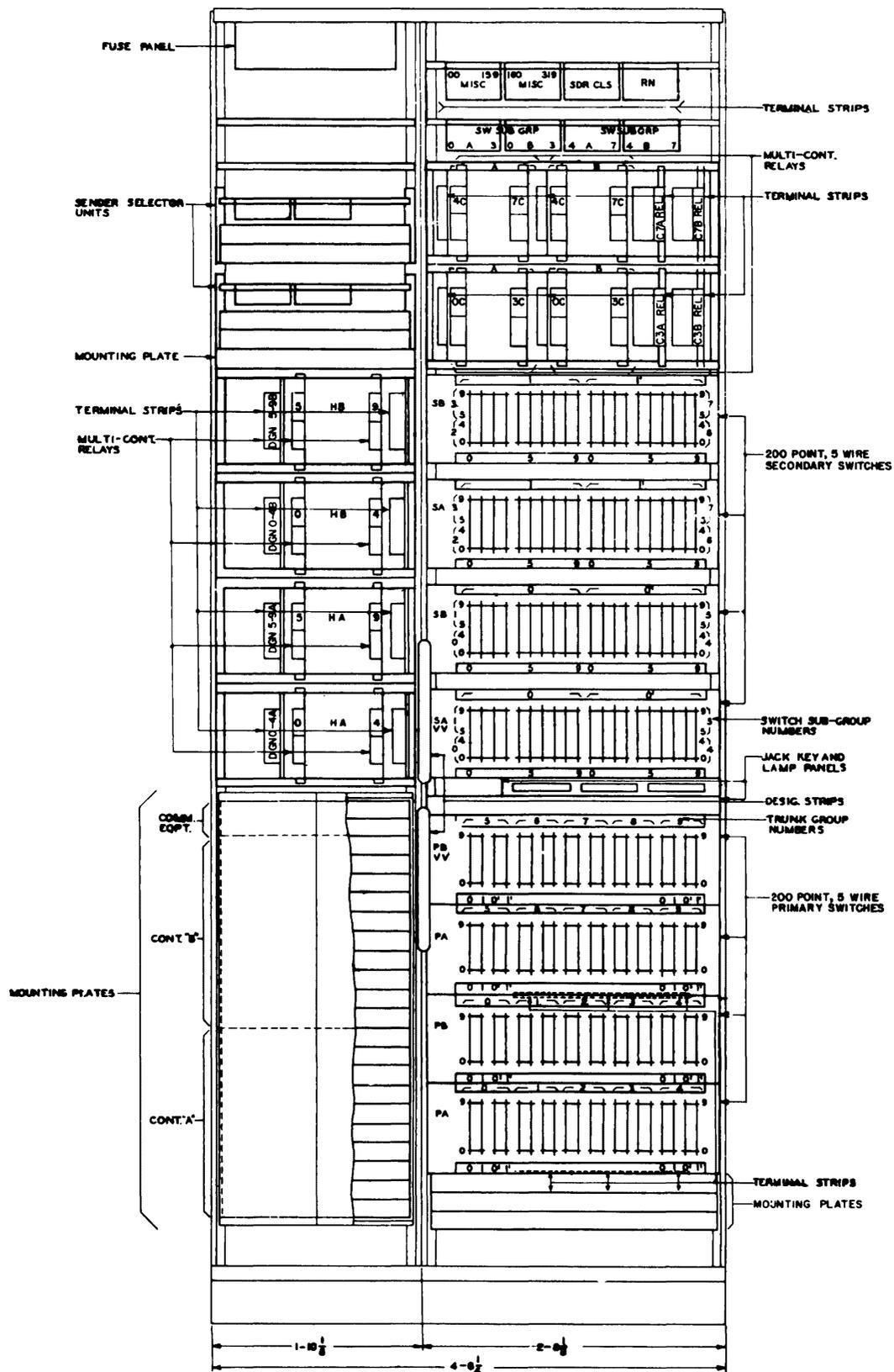


Fig. 5 - Sender Link Frame

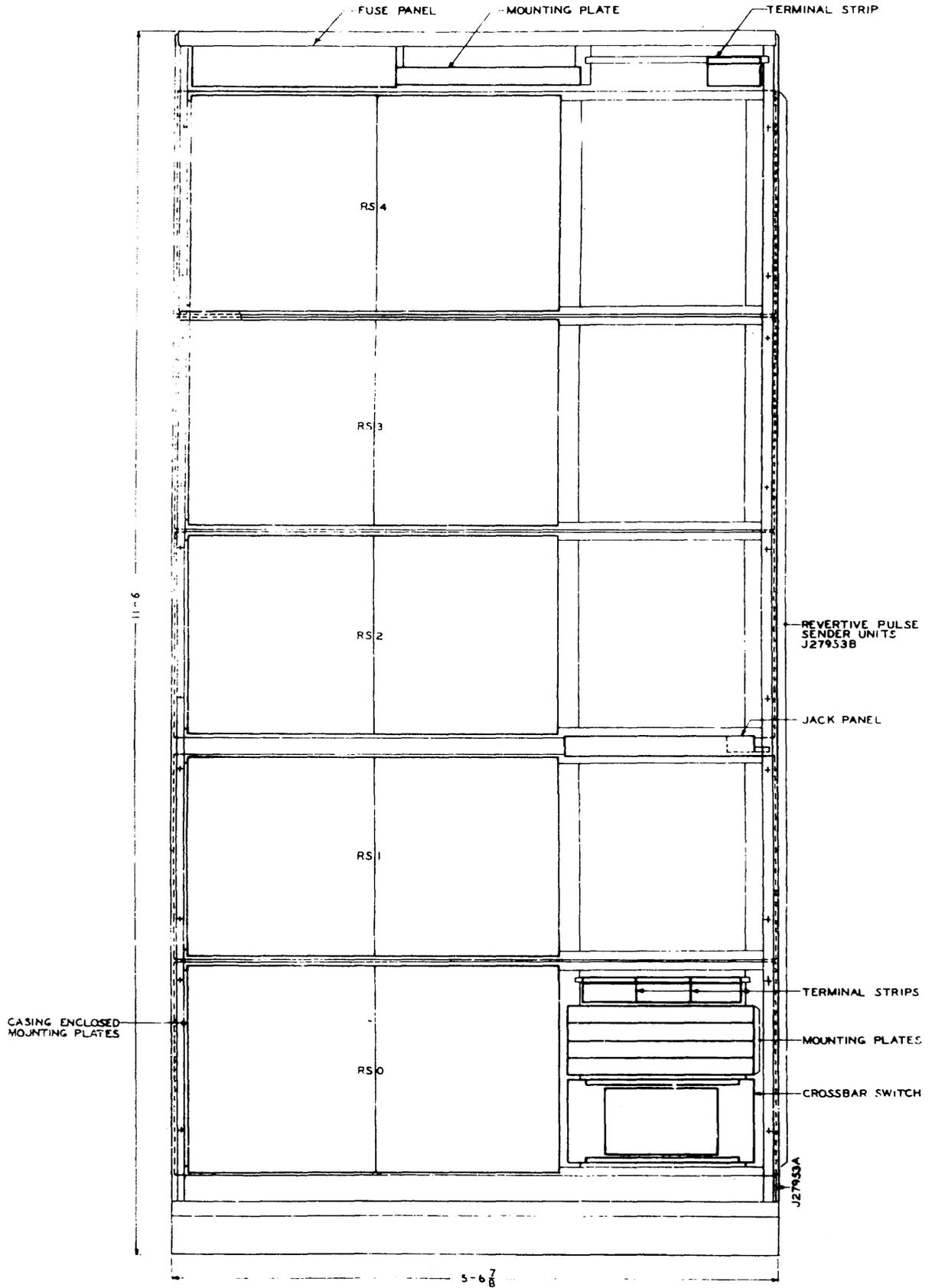


Fig. 6—Revertive Pulse Sender Frame

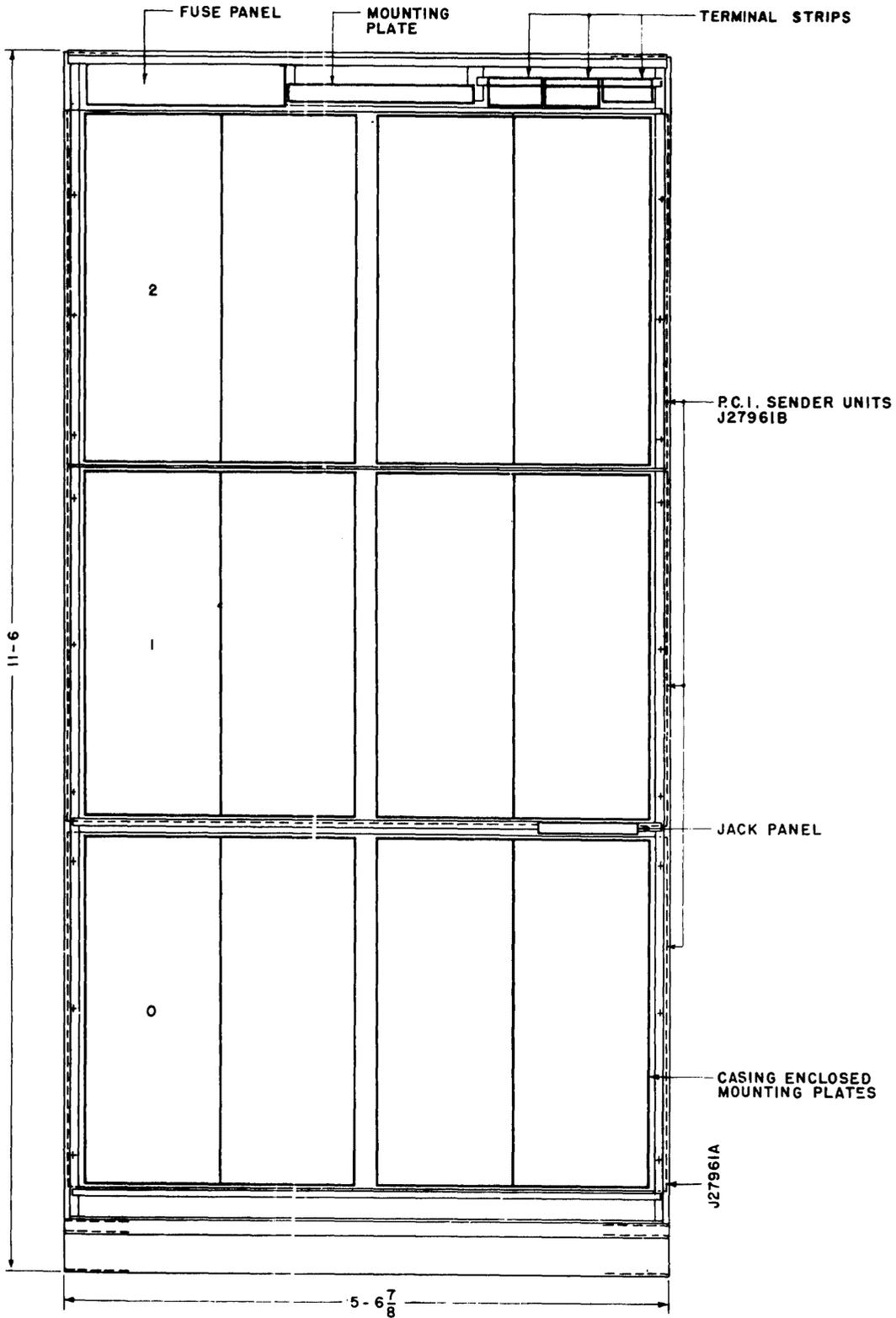


Fig. 7 - PCI Sender Frame - (AMA)

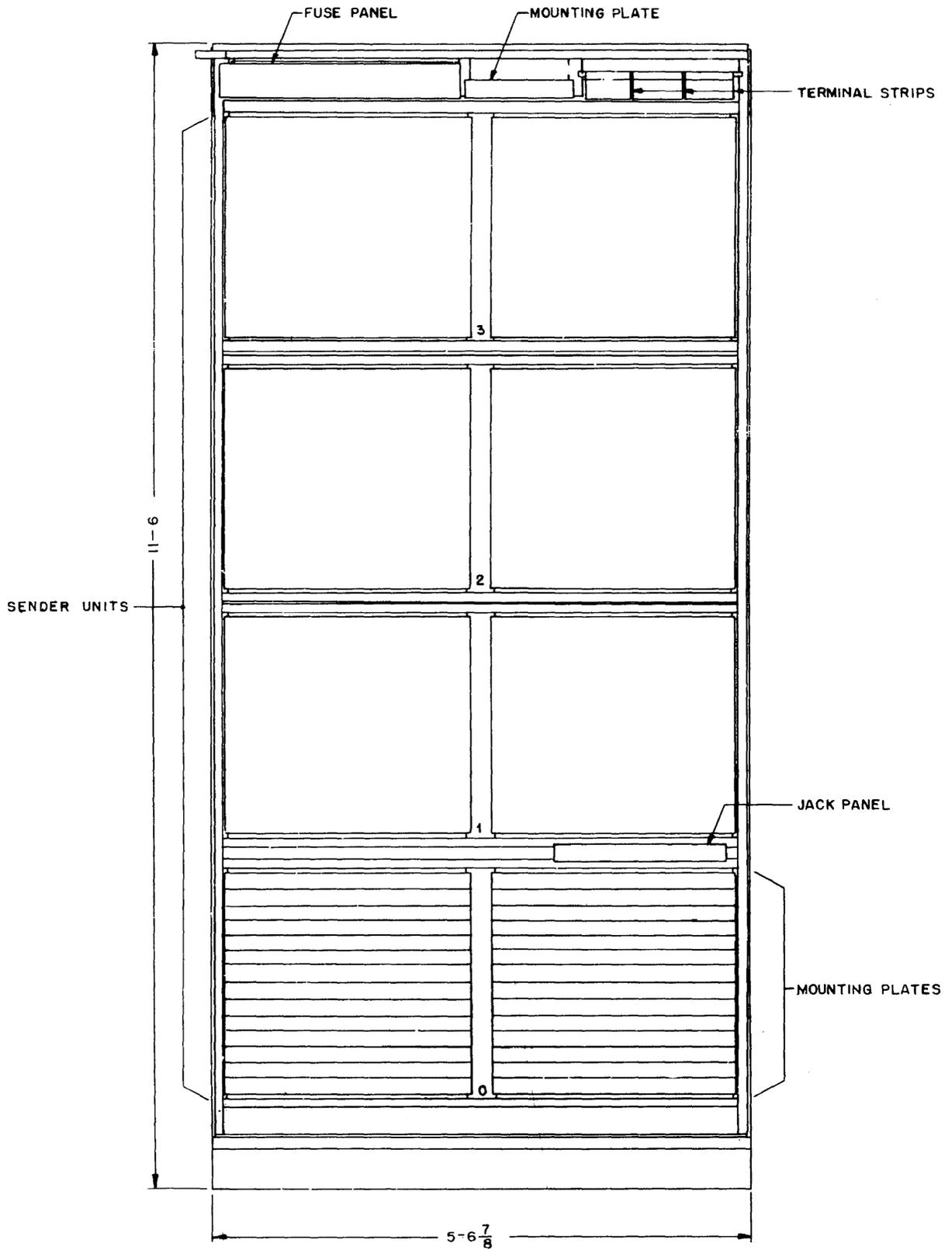


Fig. 8—Dial Pulse Sender Frame—Multifrequency Pulse Sender Frame

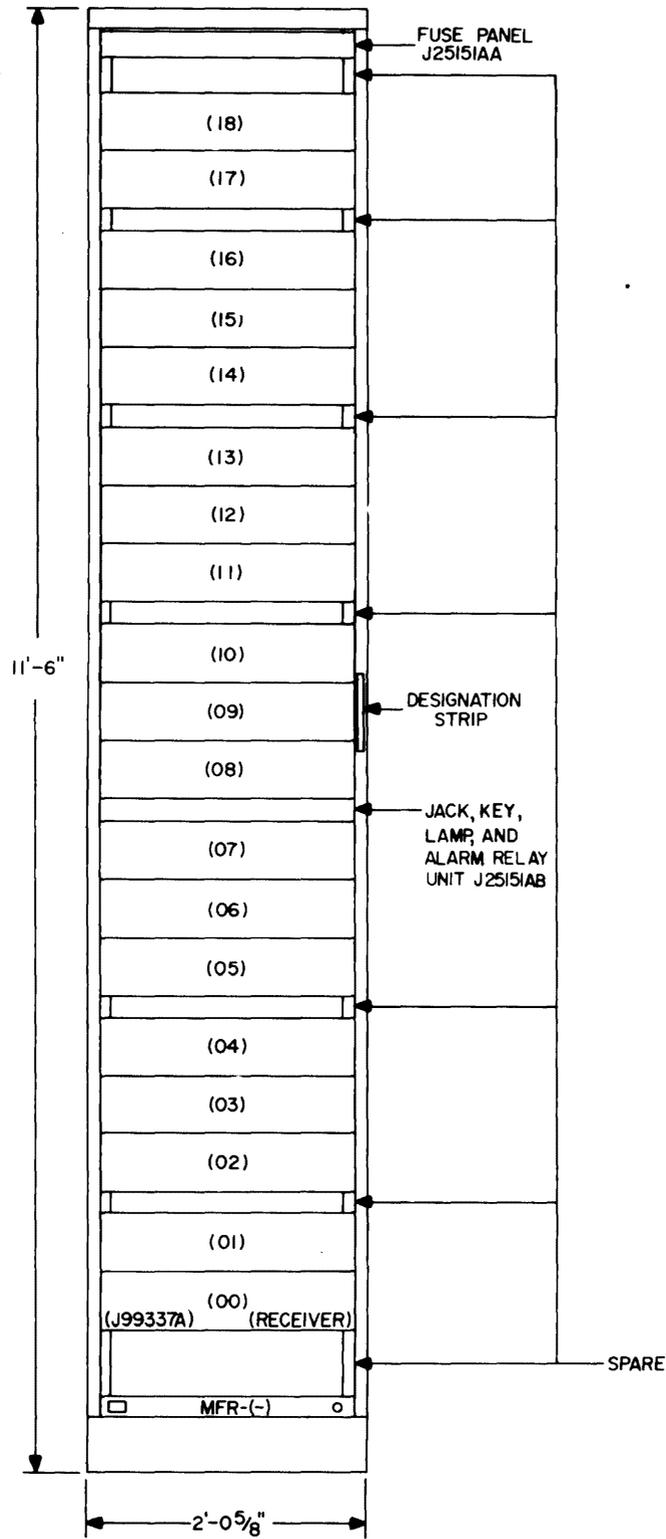


Fig. 9—Multifrequency Pulsing Receiving Frame

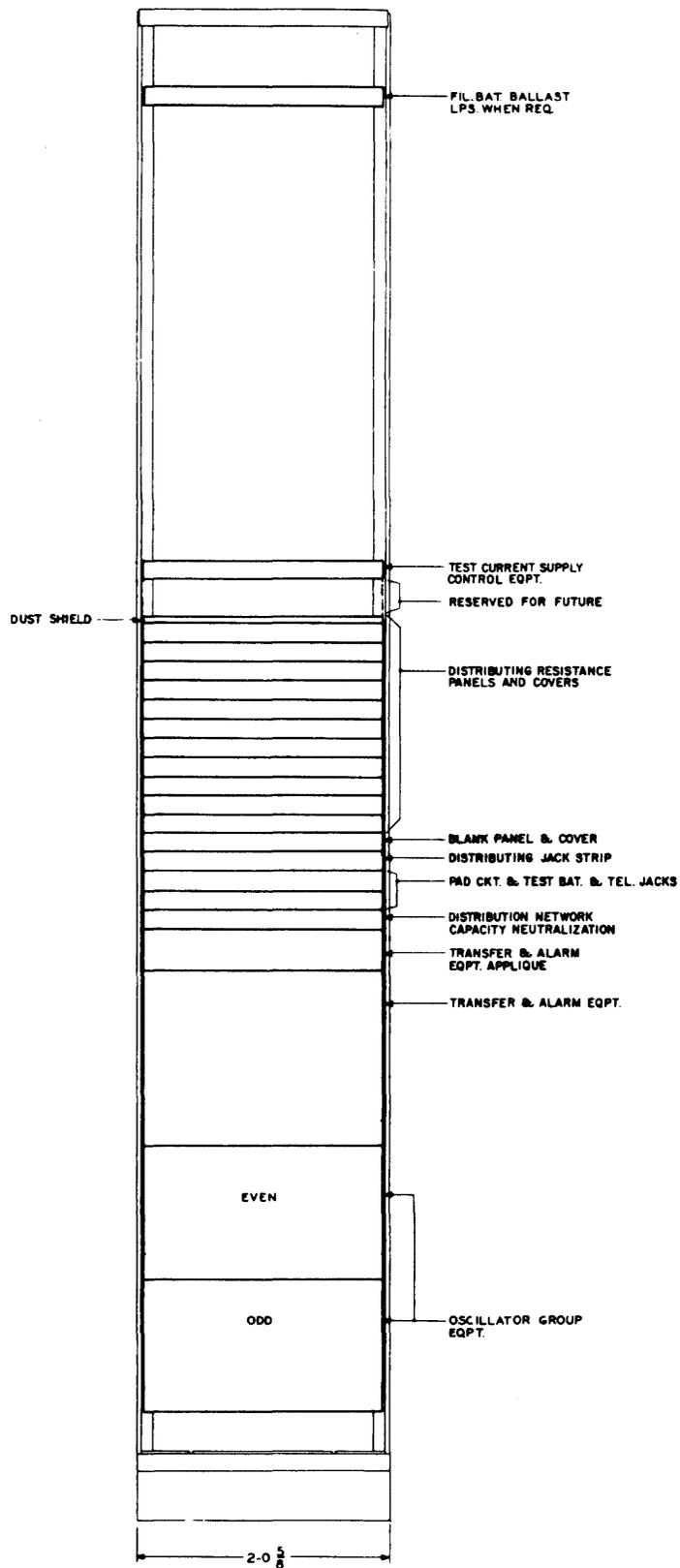


Fig. 10 – Multifrequency Current Supply Bay

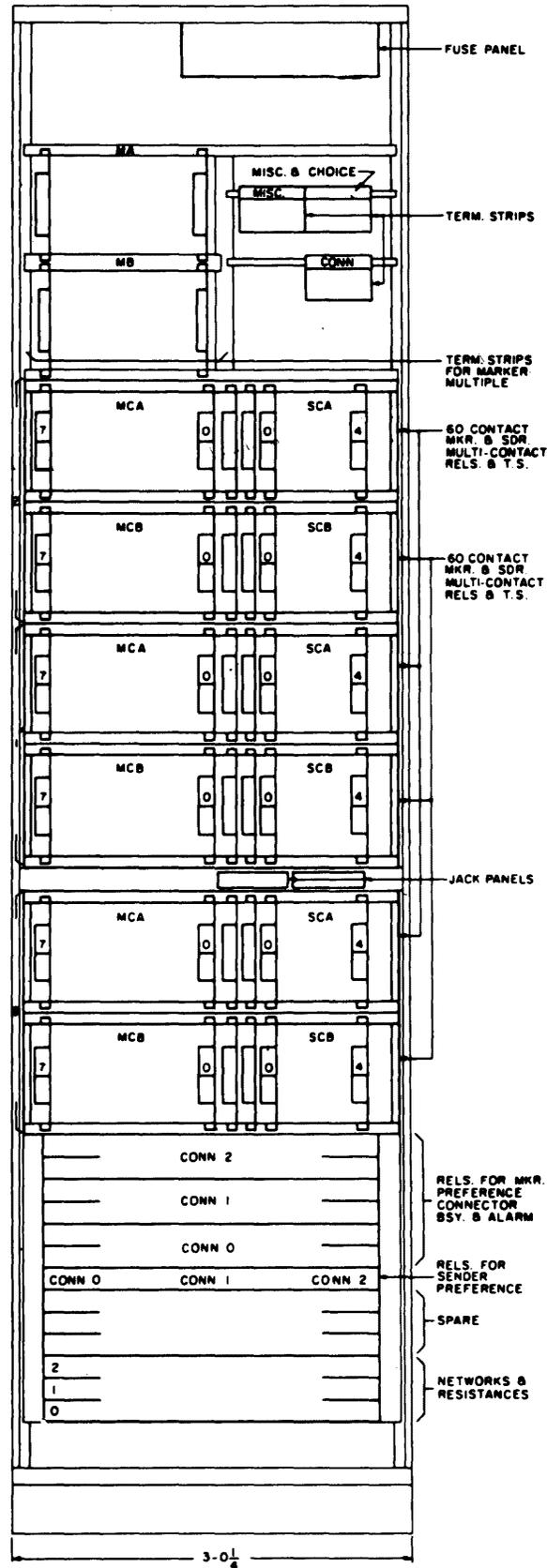


Fig. 11 - Marker Conn Frame

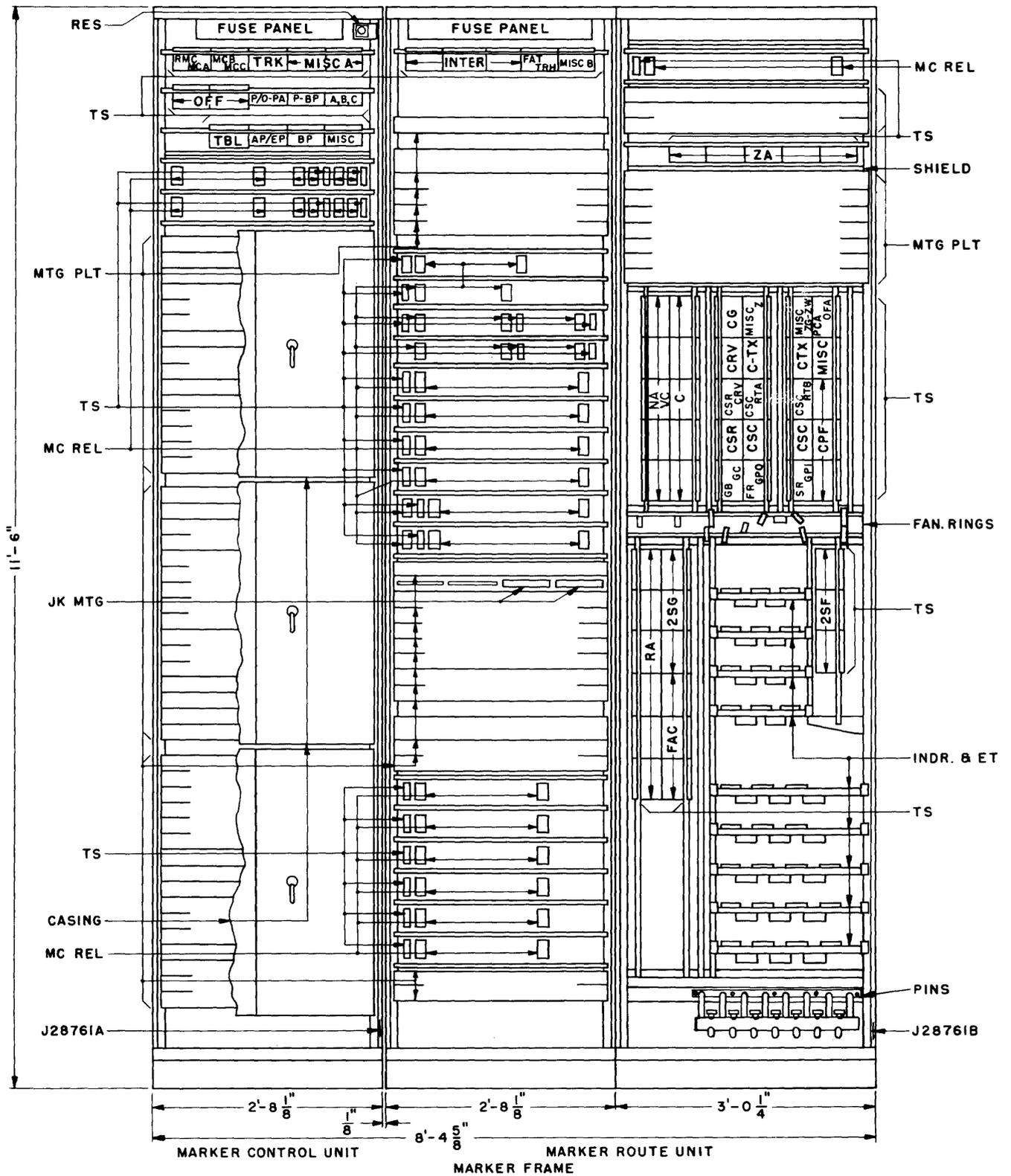


Fig. 12 — Marker Frame

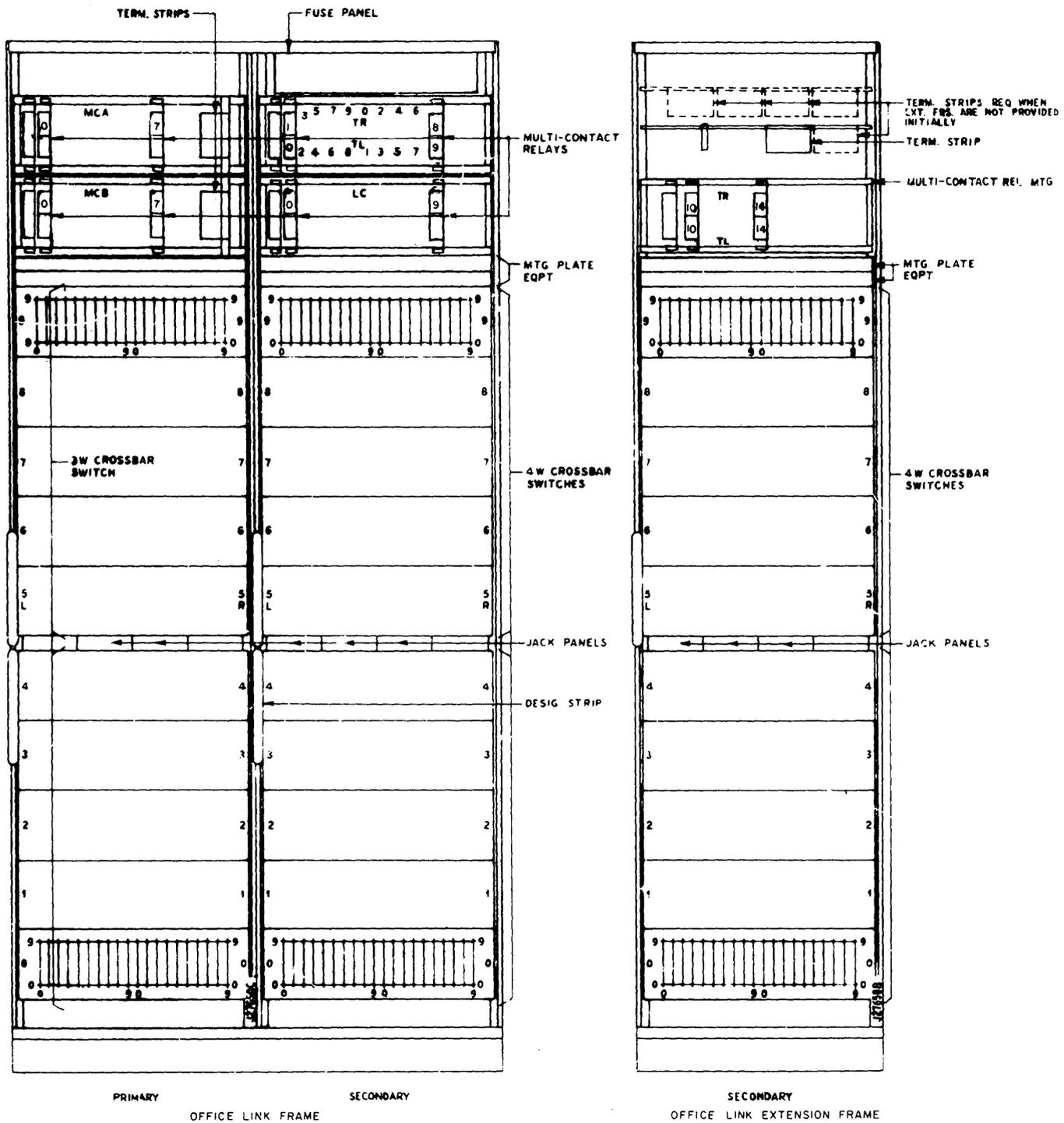


Fig. 13—Office Link Frames

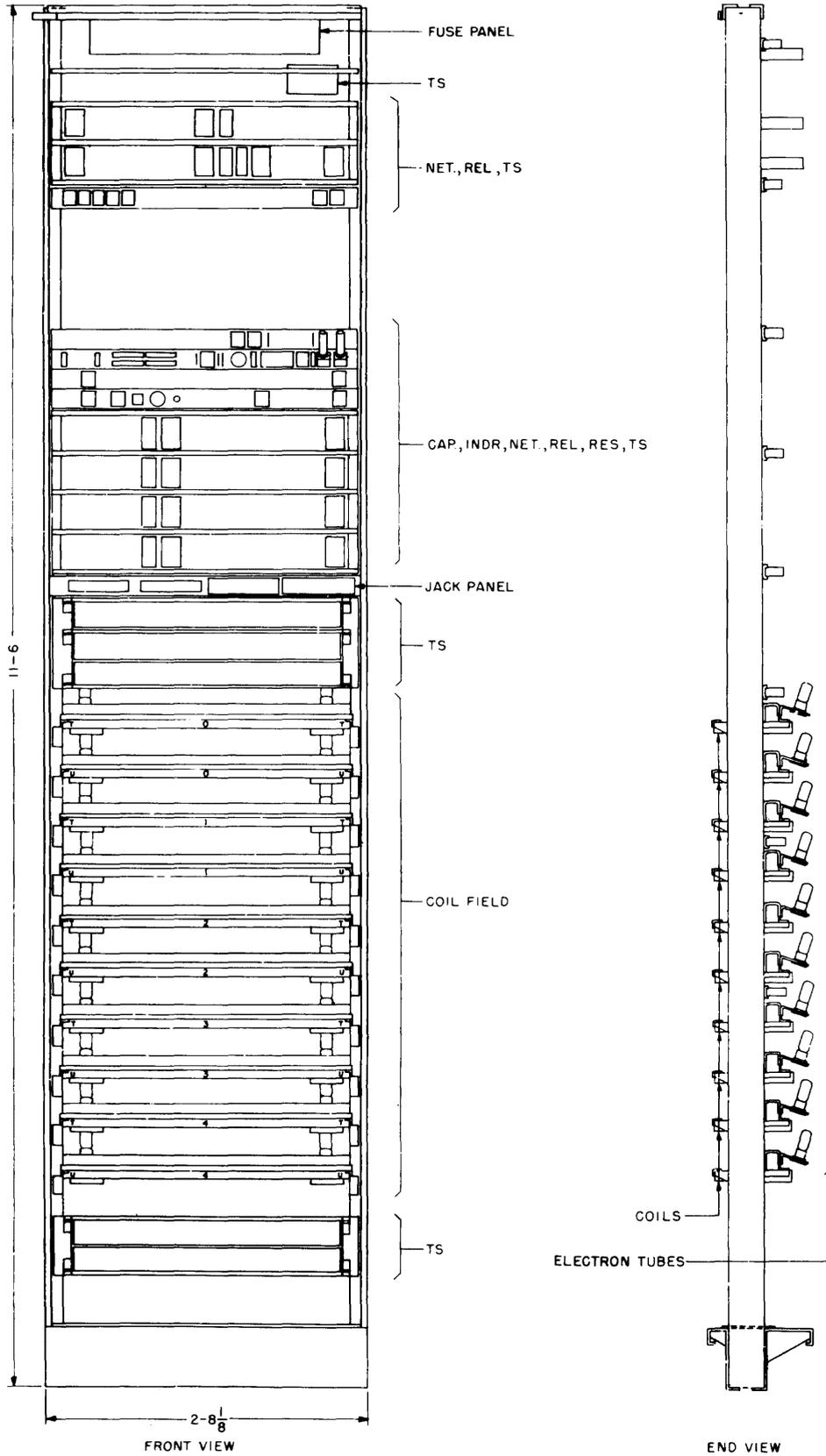


Fig. 14—Translator Frame

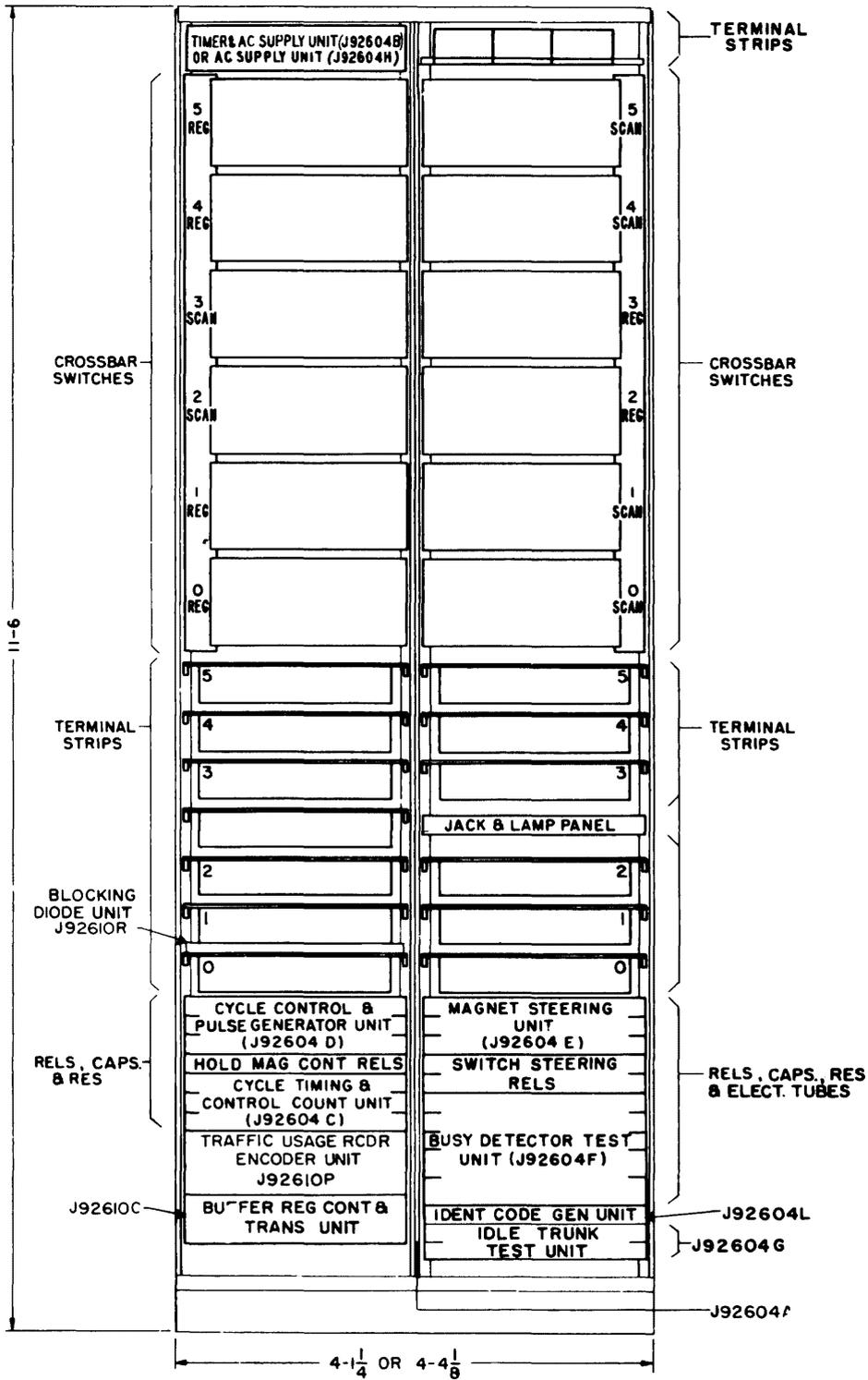


Fig. 15—Traffic Usage Recorder Frame

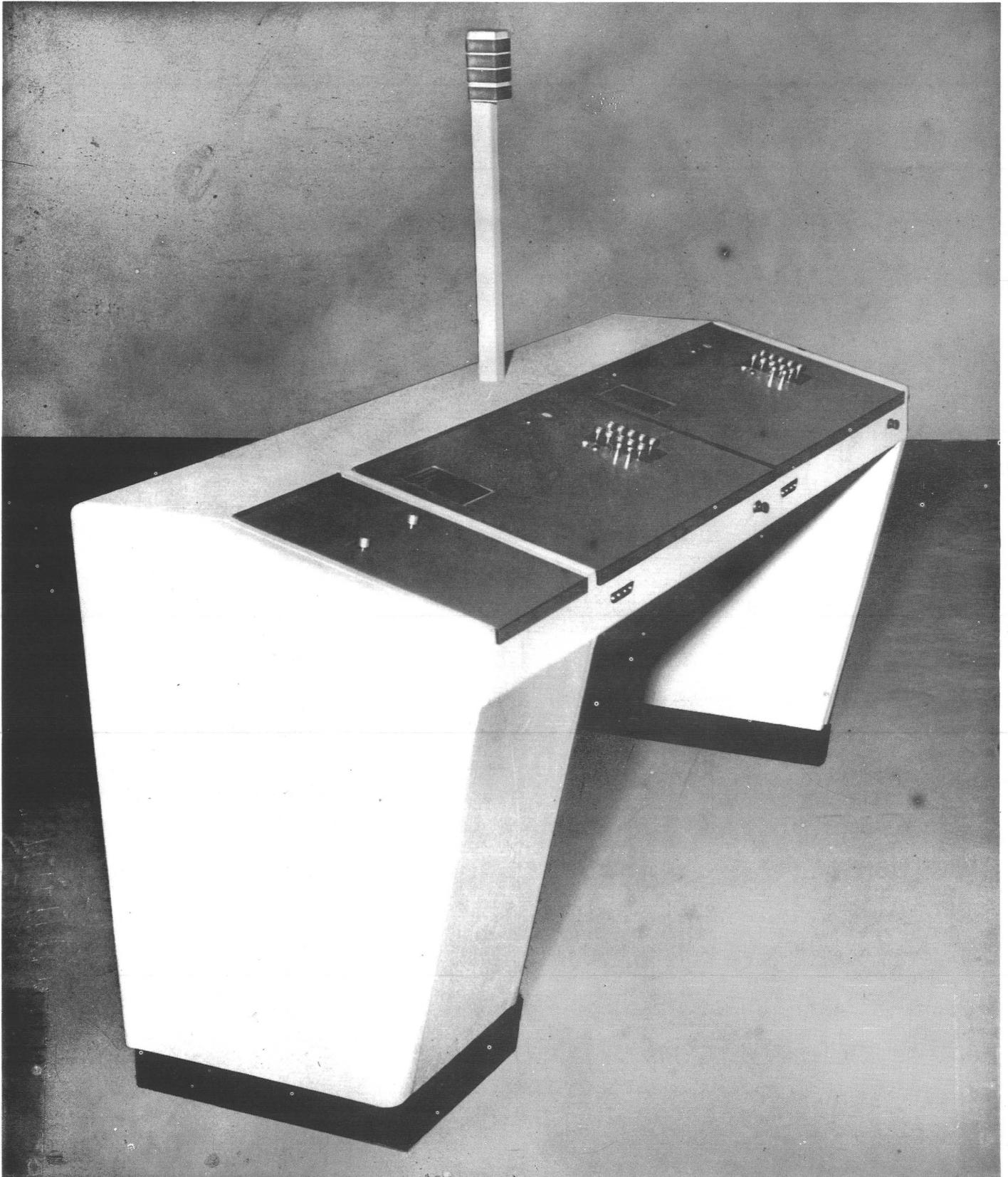


Fig. 16—CAMA Switchboard

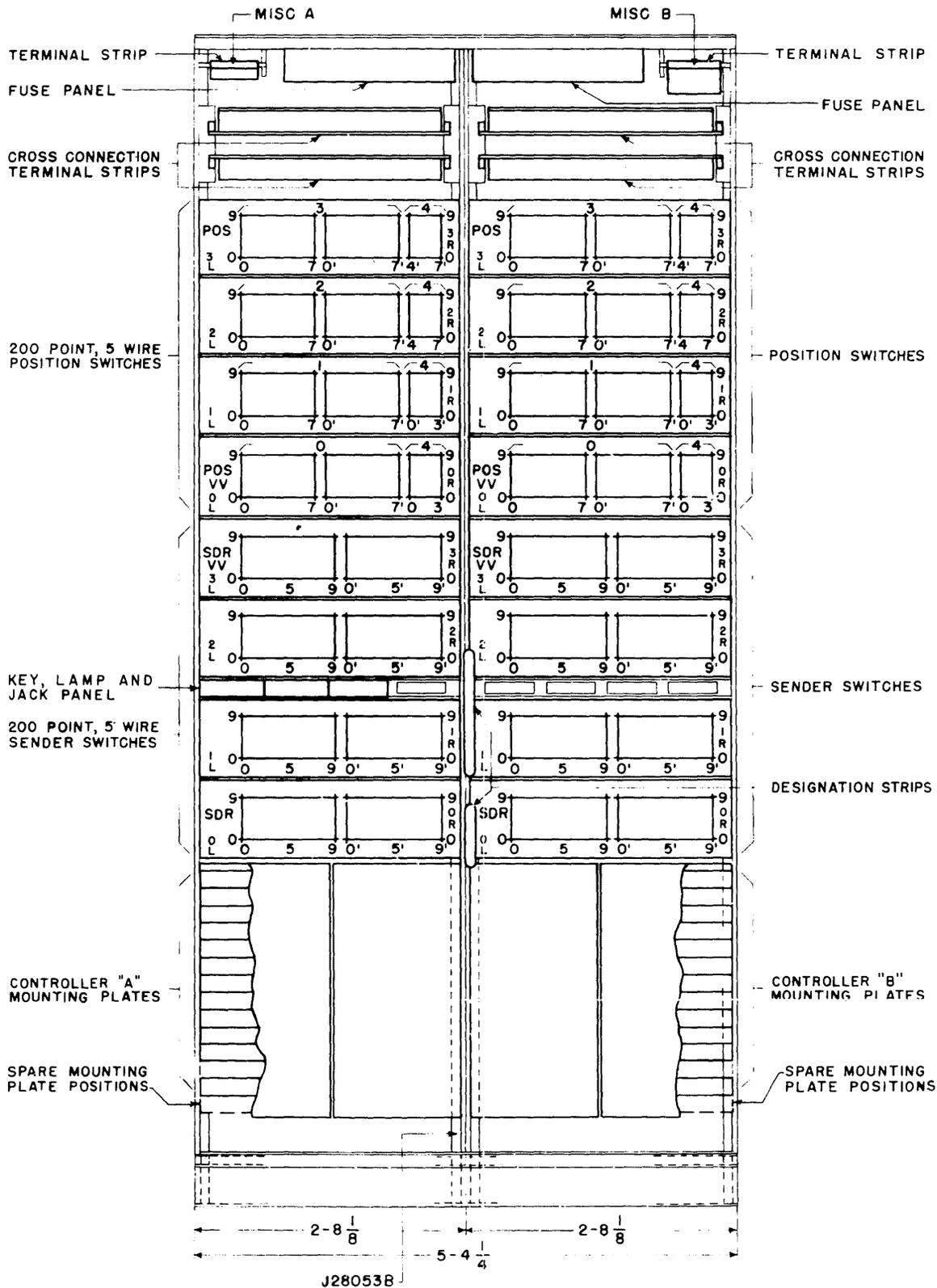


Fig. 17—Position Link Frame

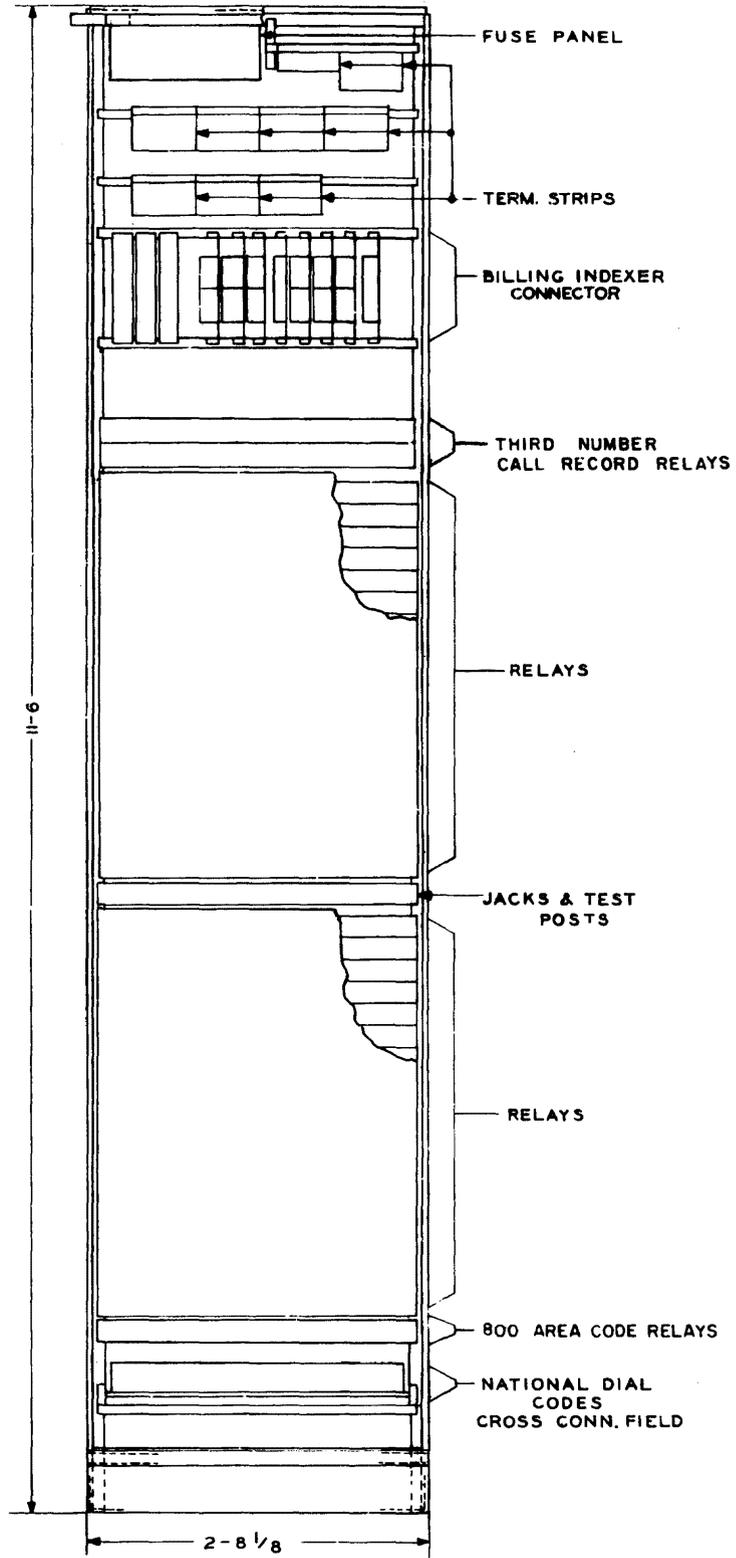


Fig. 18—Transverter Frame—(AMA)

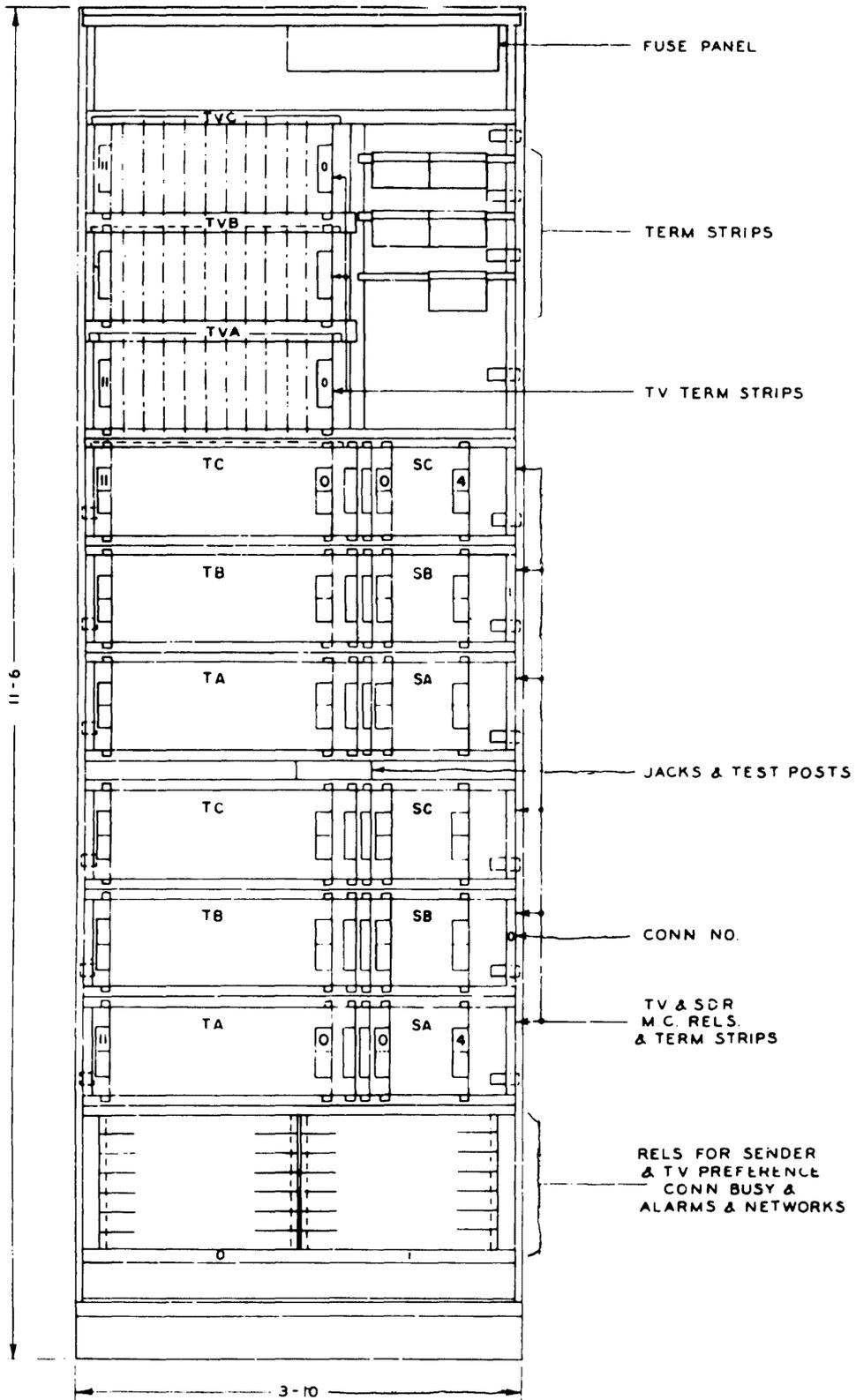


Fig. 19—Transverter Connector Frame—(AMA)

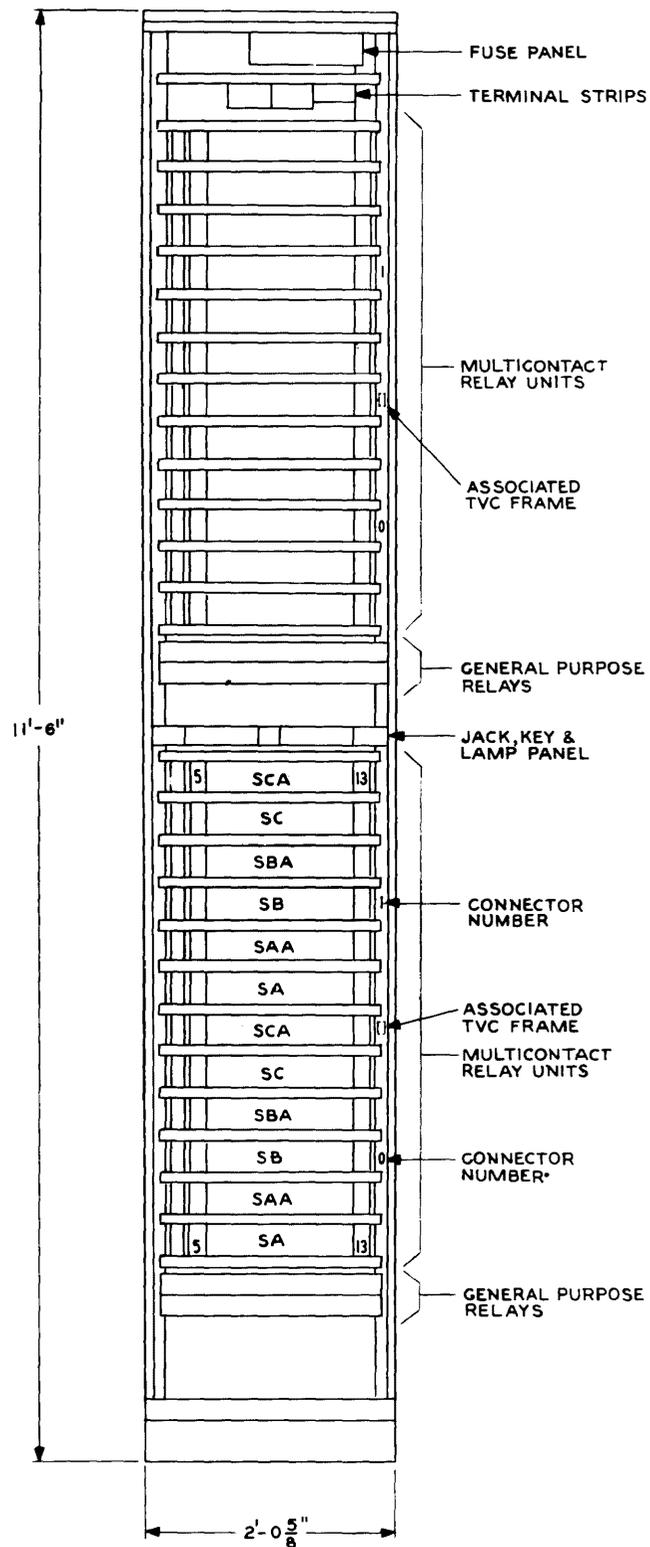


Fig. 20—Transverter Connector Supplementary Frame

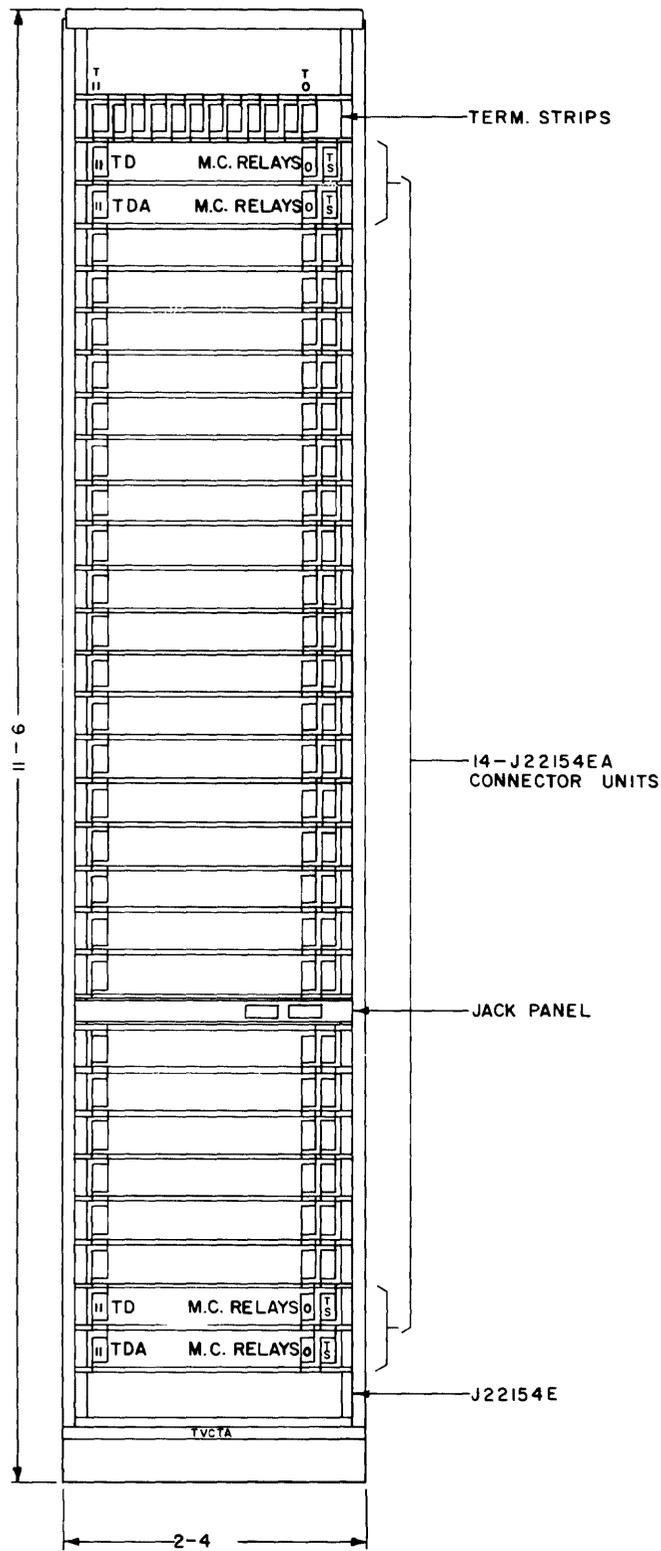


Fig. 21—Transverter Connector Transverter  
Auxiliary Frame

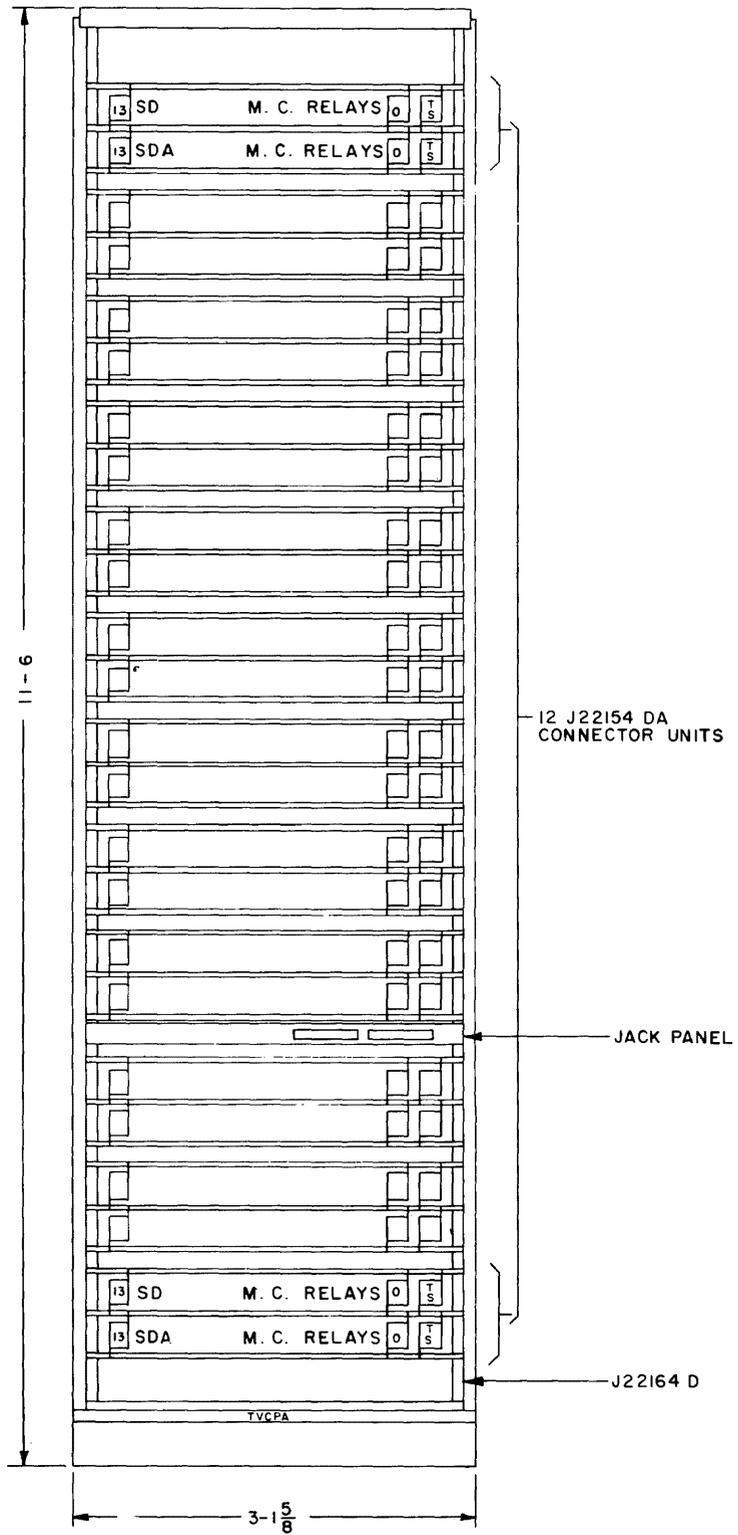


Fig. 22—Transverter Connector Position Auxiliary Frame

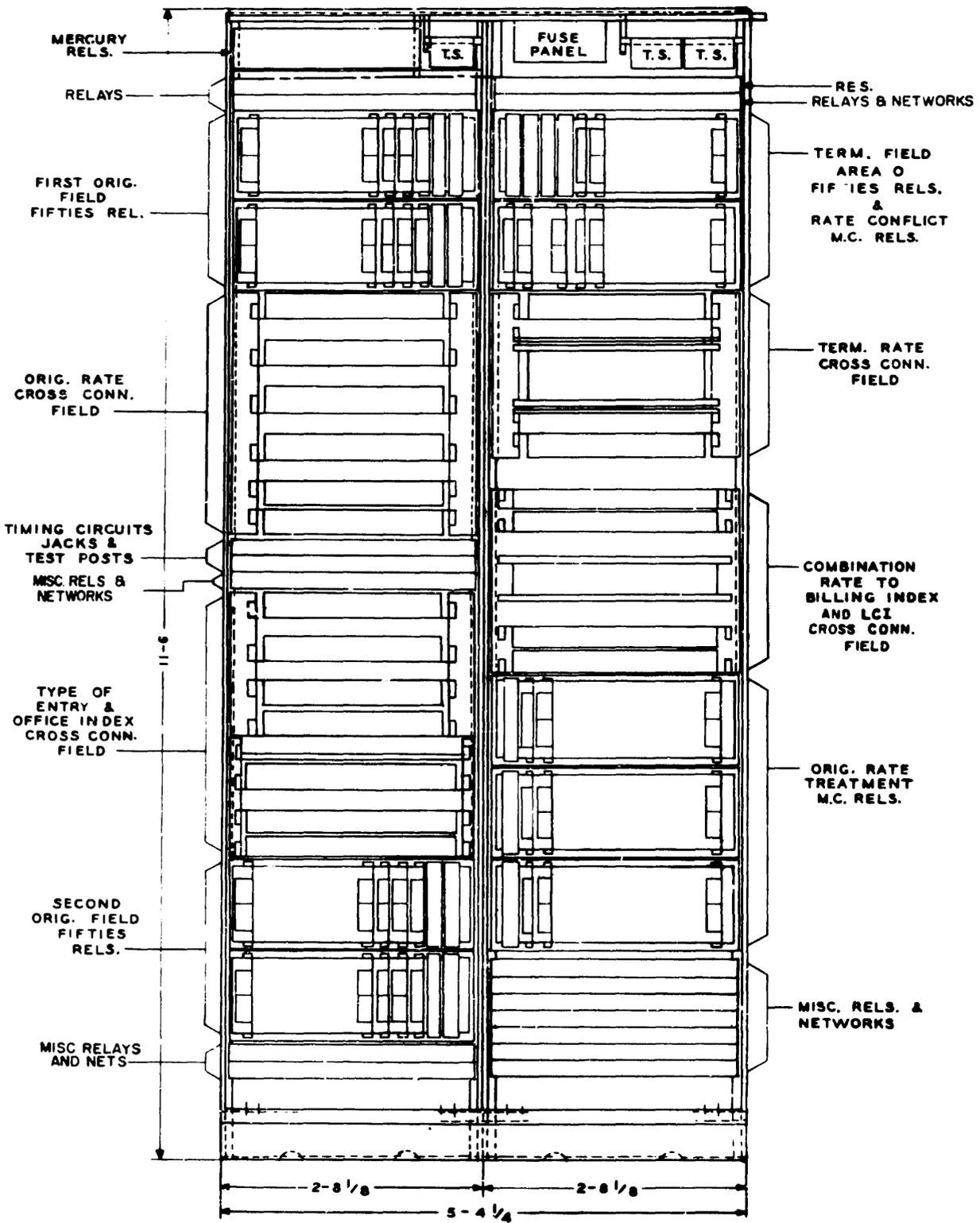


Fig. 23—Billing Indexer Frame—(AMA)

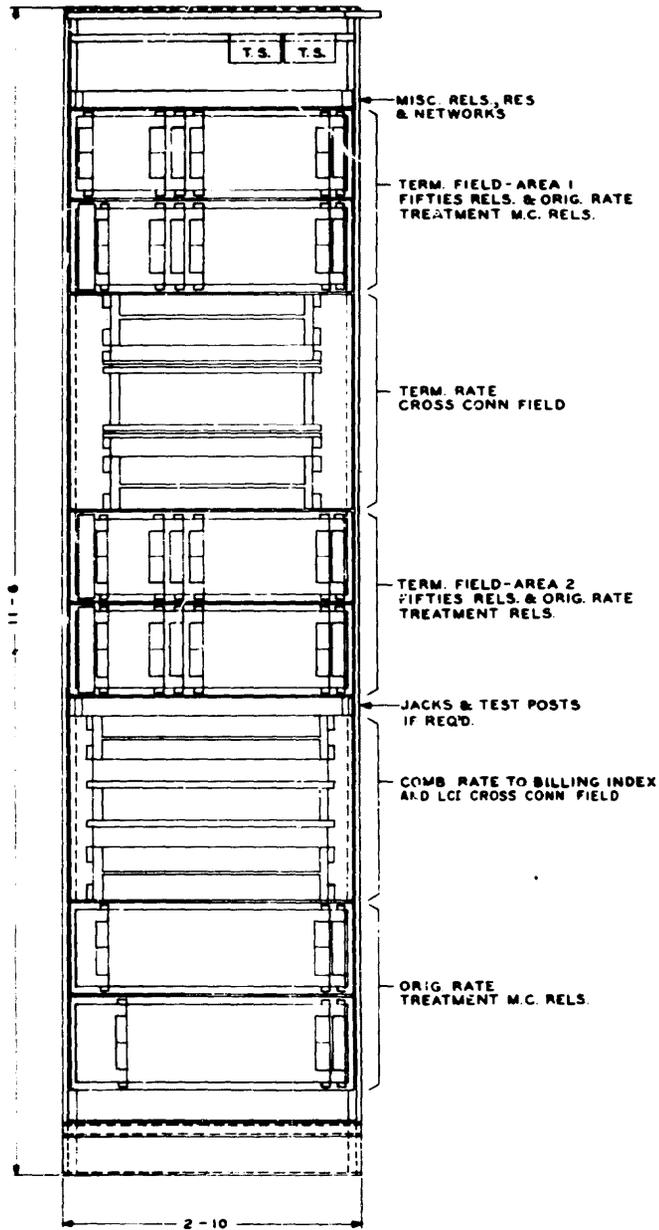


Fig. 24 — CAMA Billing Indexer Supplementary Frame

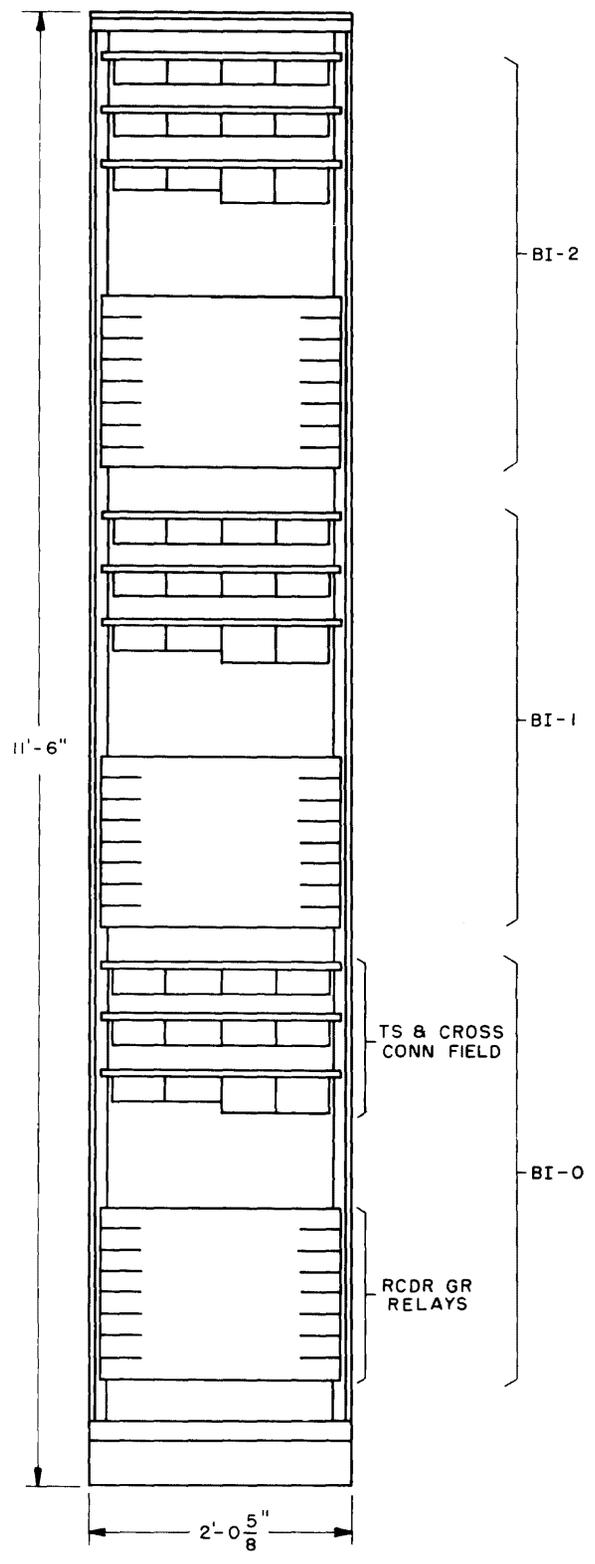


Fig. 25 — Billing Indexer Auxiliary Frame

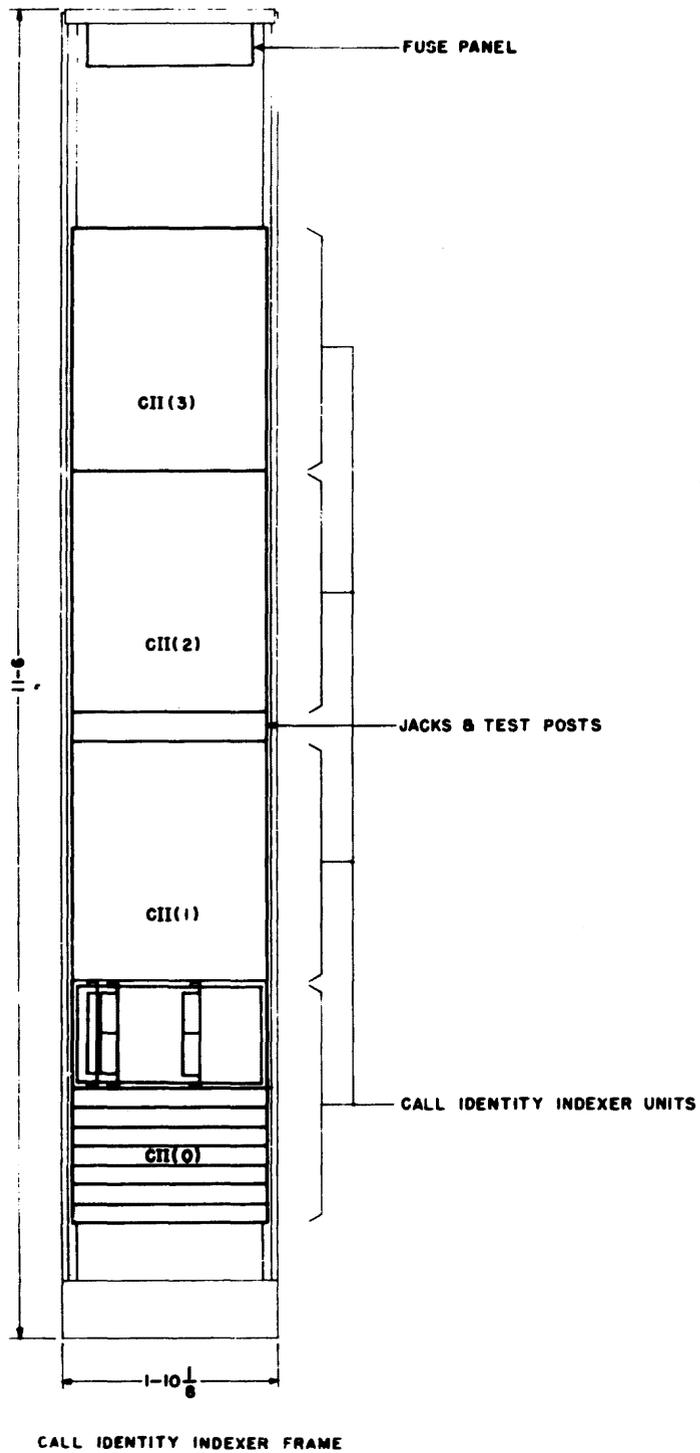


Fig. 26— Call Identity Indexer Frame

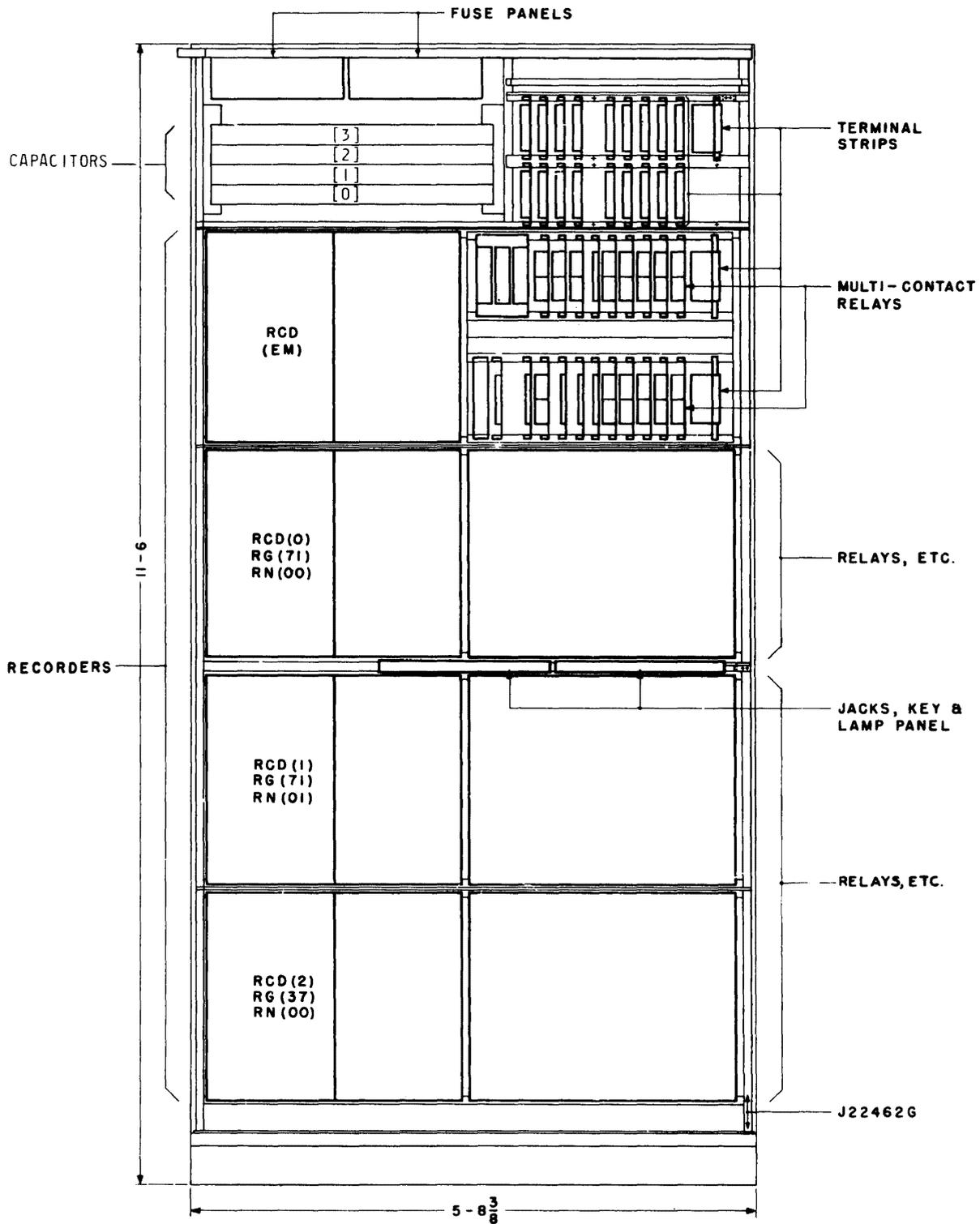


Fig. 27 — Recorder Frame

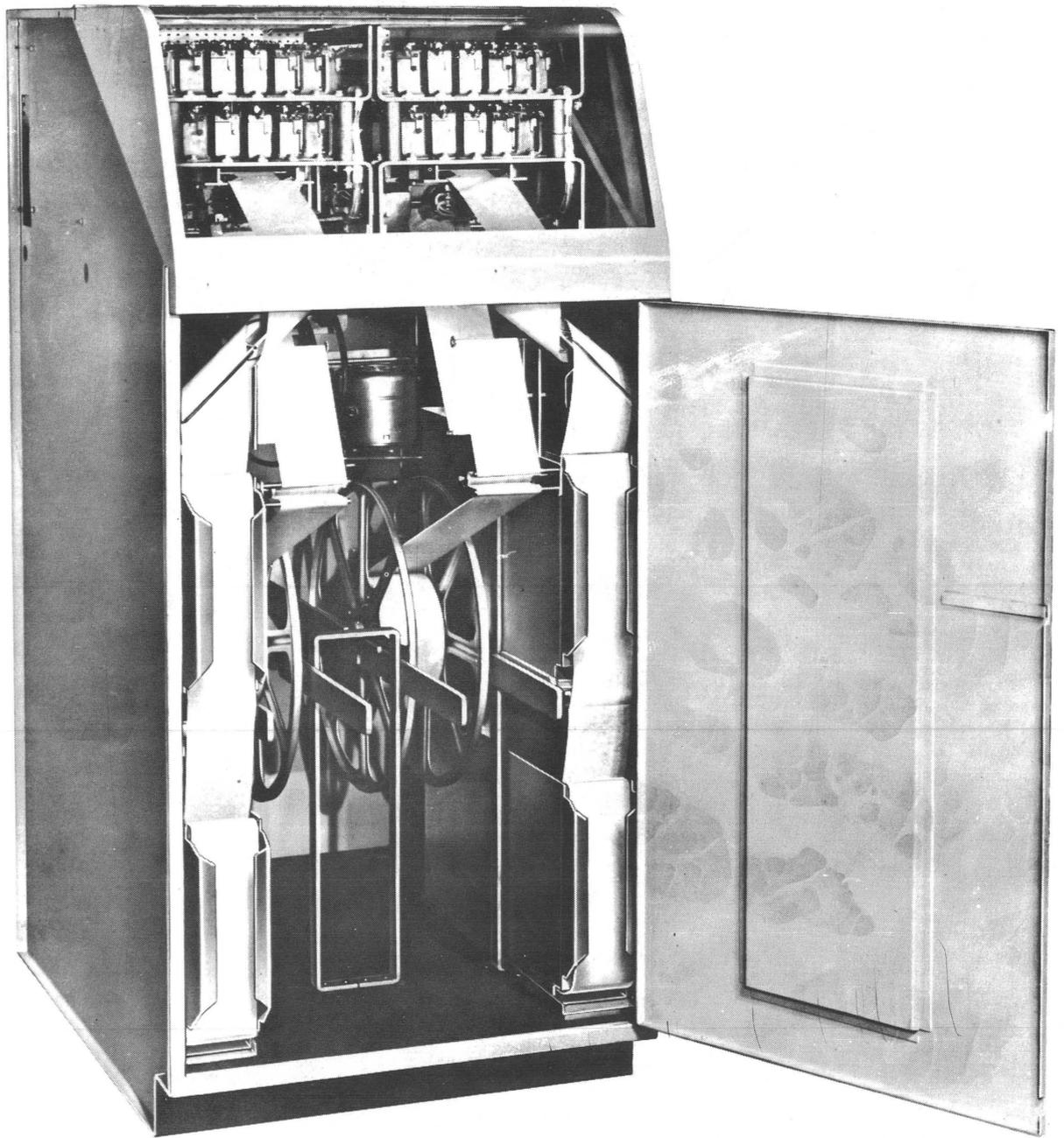


Fig. 28—Central Office Perforator Cabinet

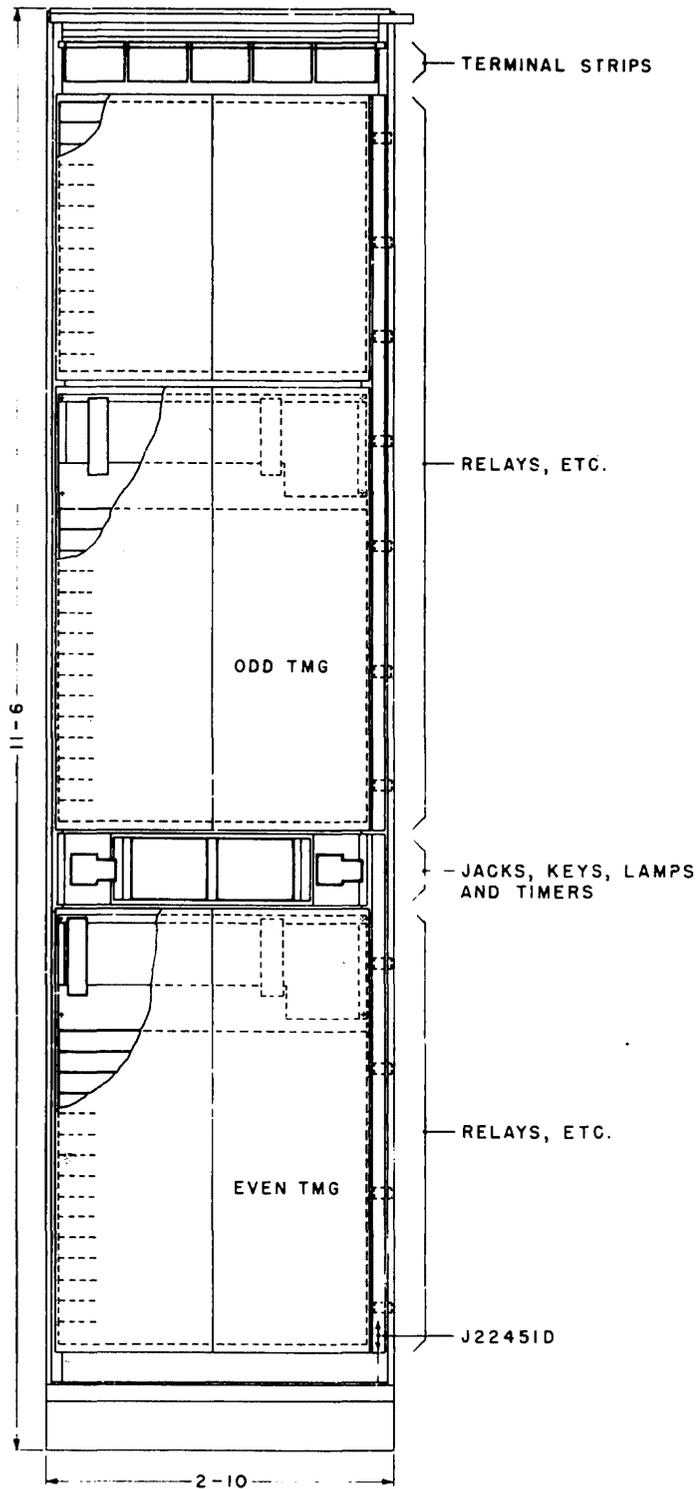


Fig. 29—Master Timing Frame

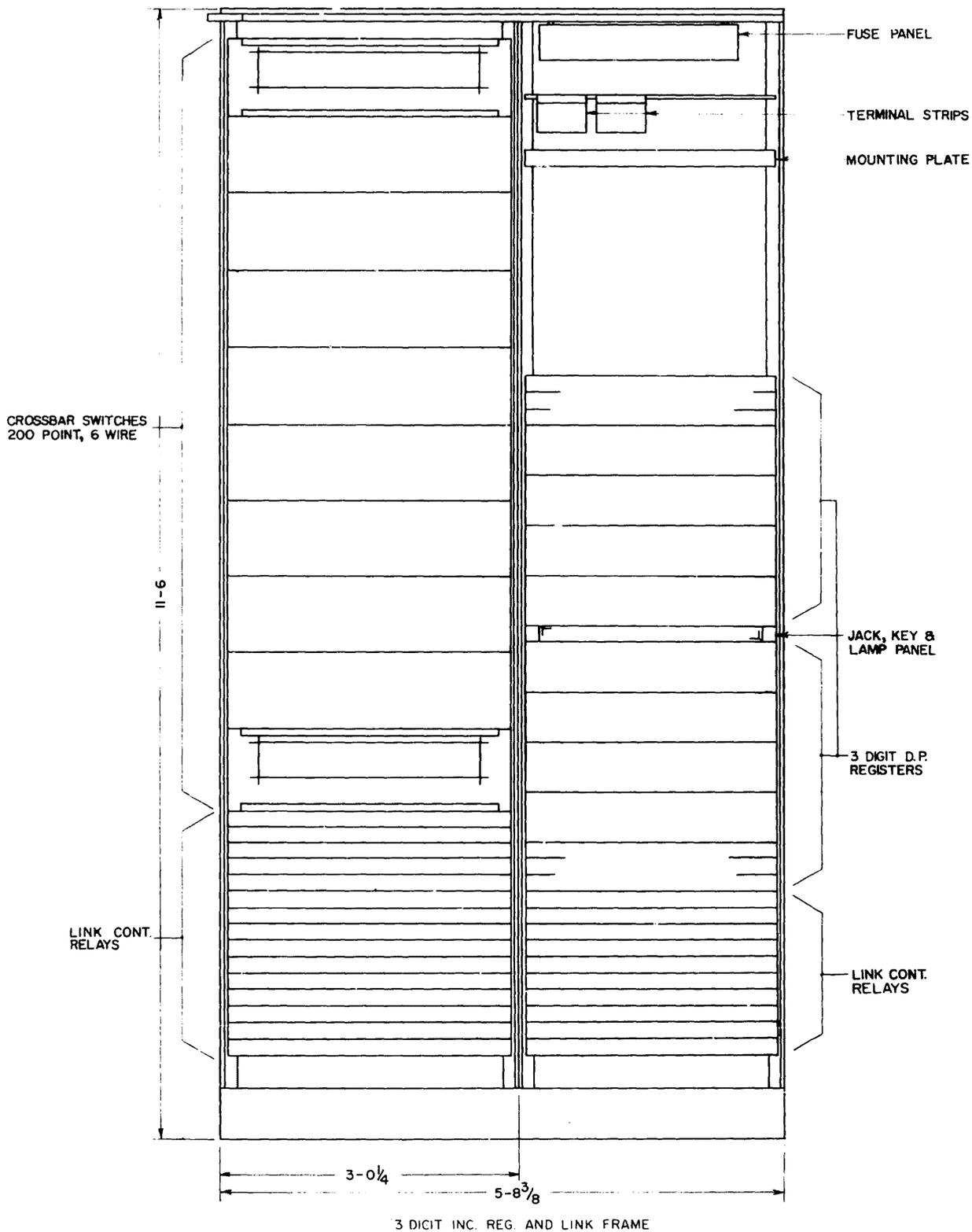


Fig. 30—3-Digit Incoming Register and Link Frame

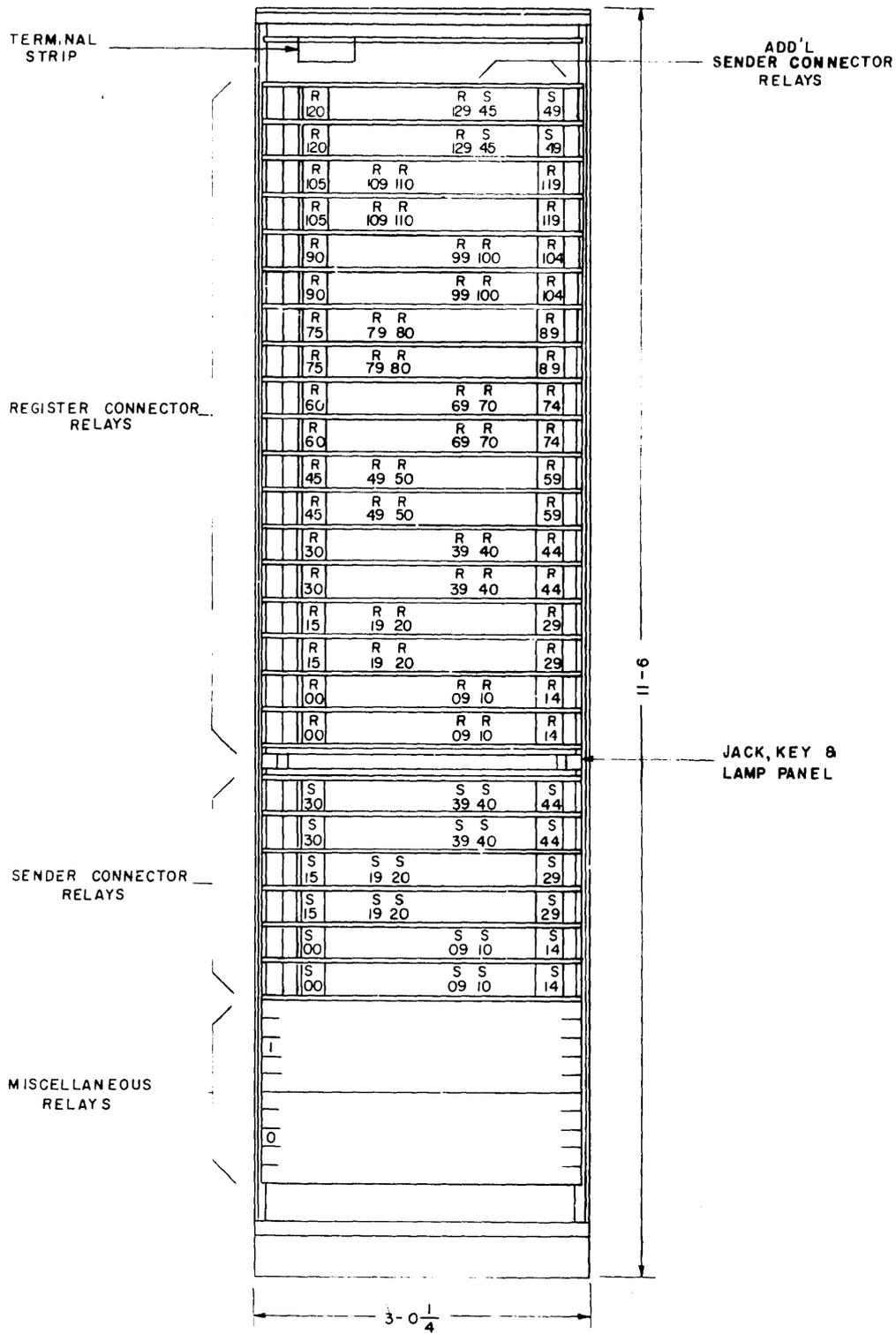


Fig. 31 — Sender Register Connector Frame

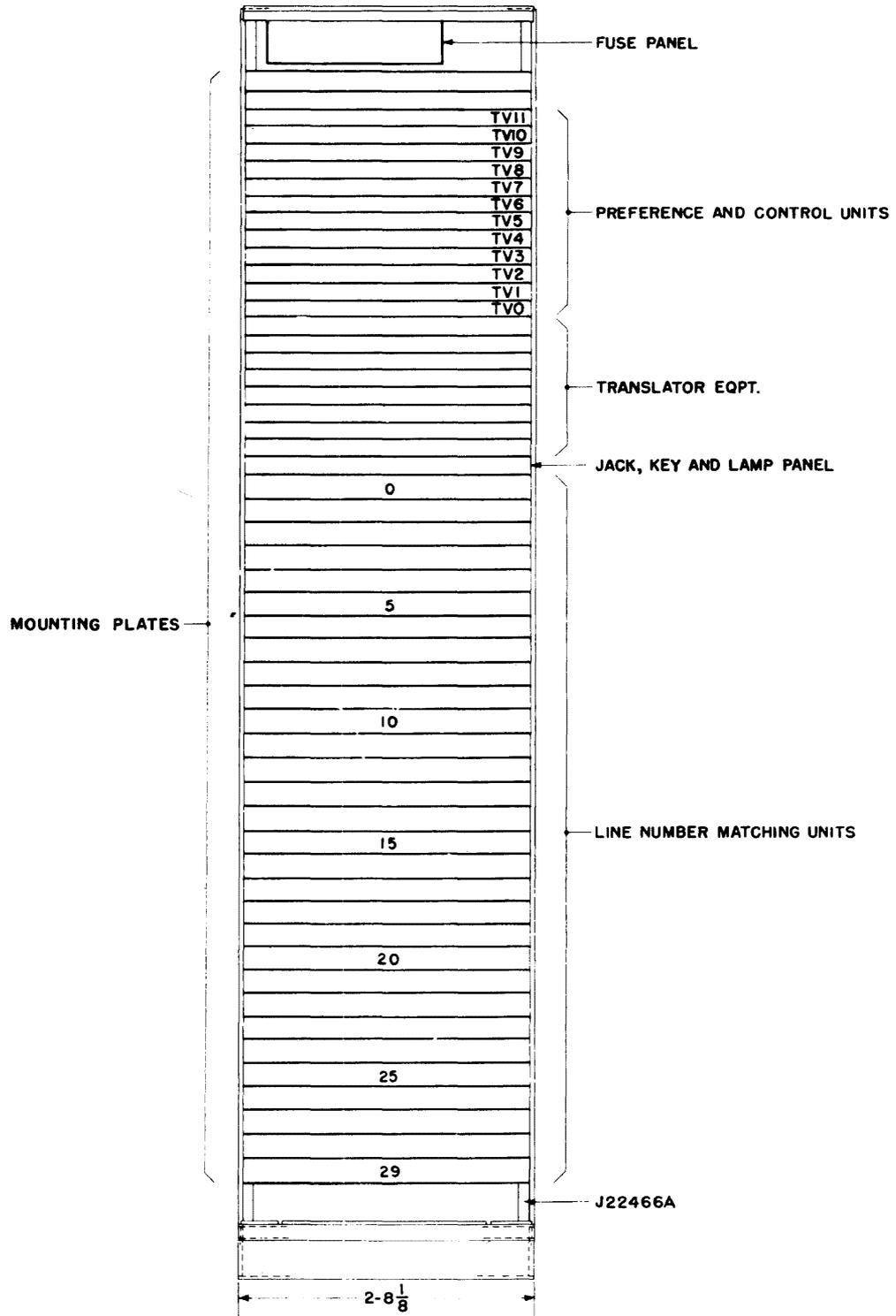


Fig. 32—Line Observing Frame—(AMA)

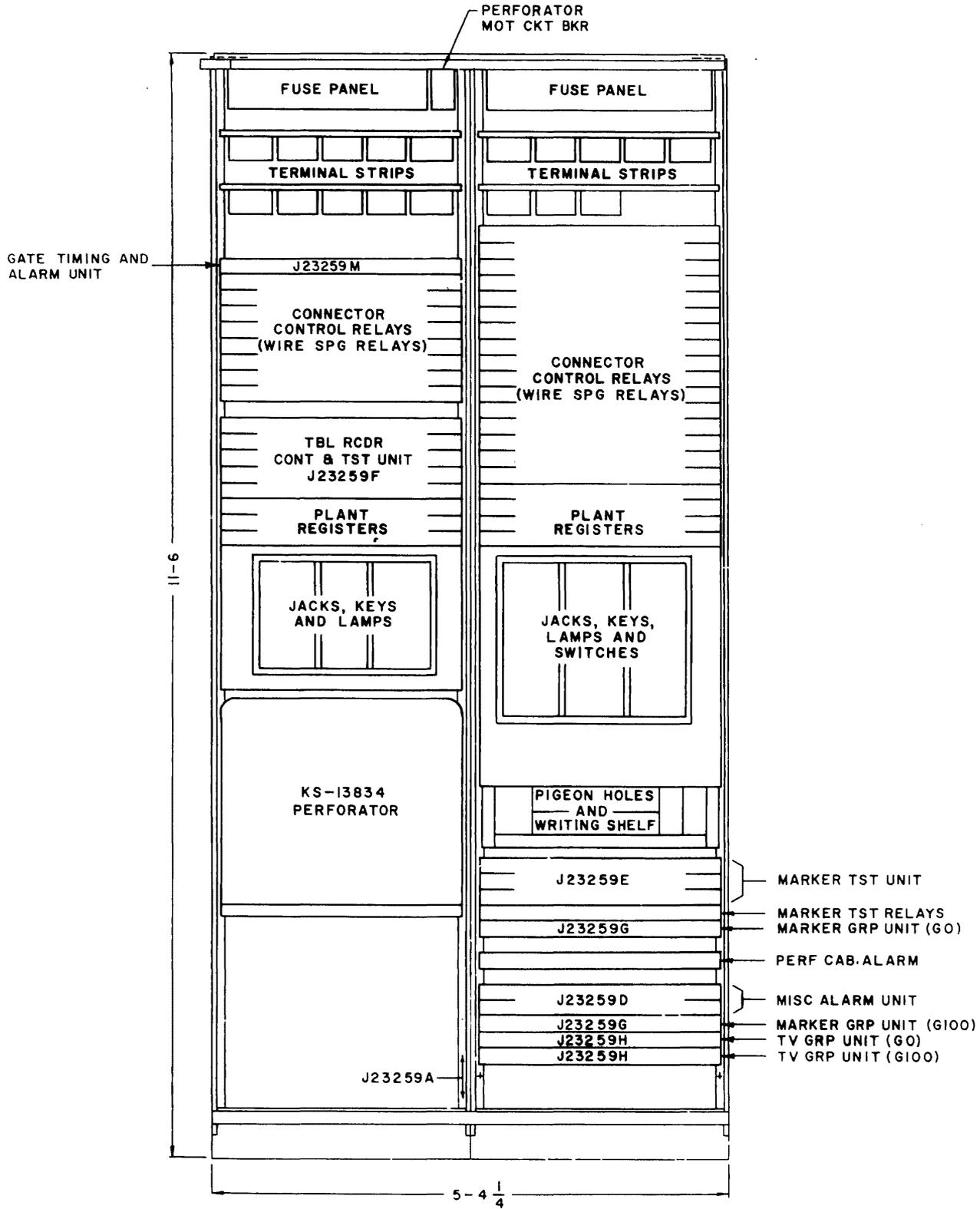


Fig. 33—Trouble Recorder Frame

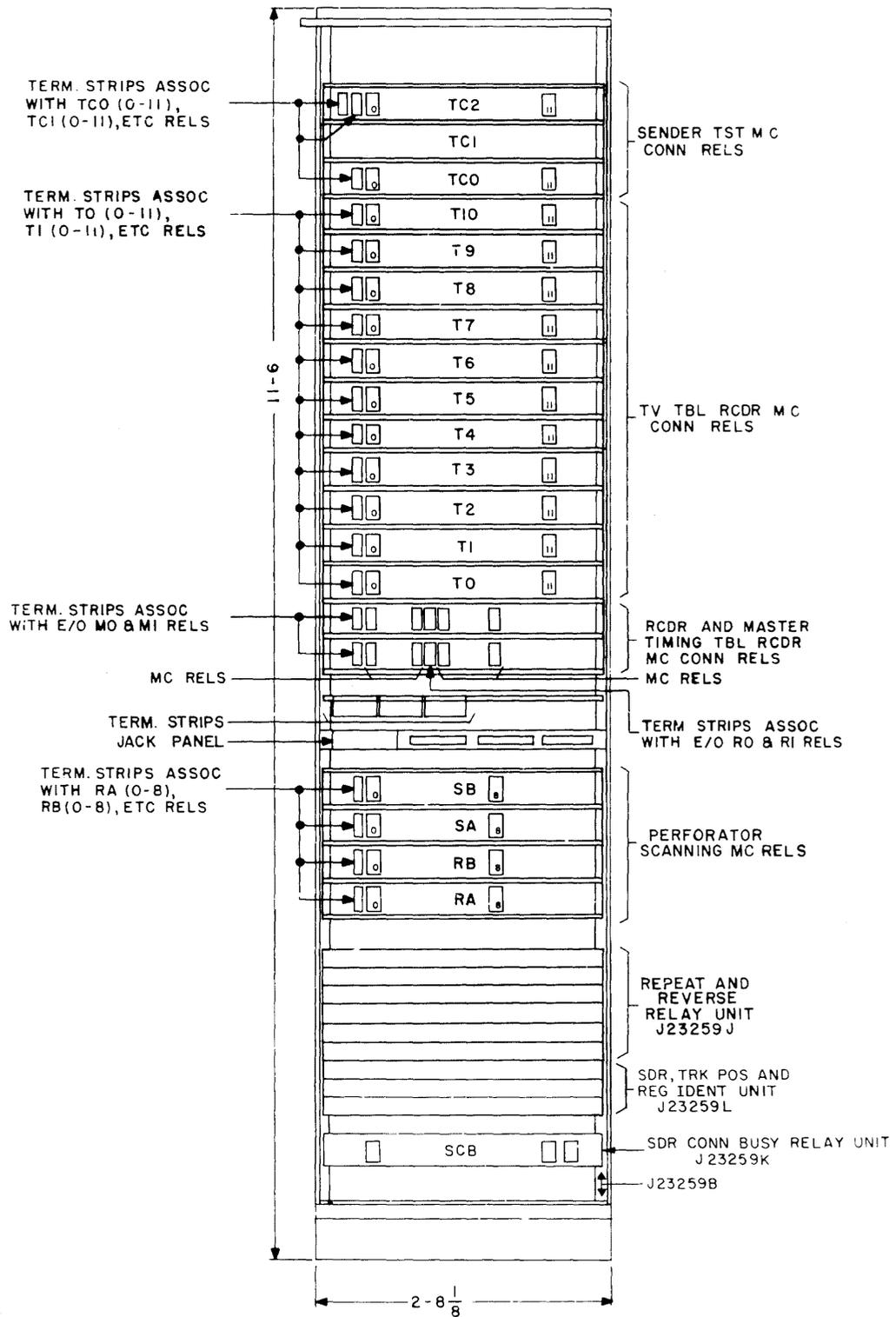


Fig. 34—Trouble Recorder Connector Frame

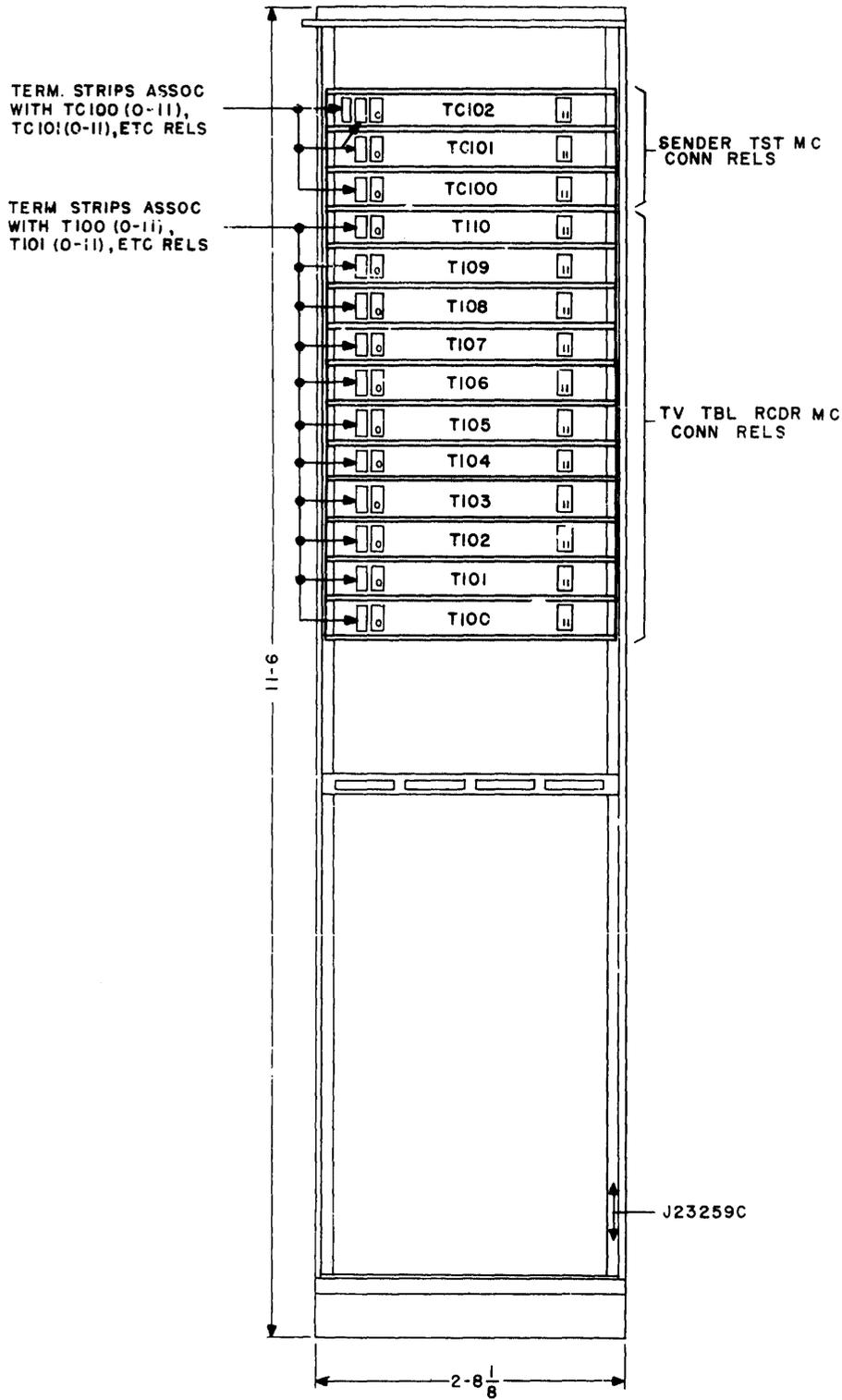


Fig. 35—Supplementary Trouble Recorder Connector Frame

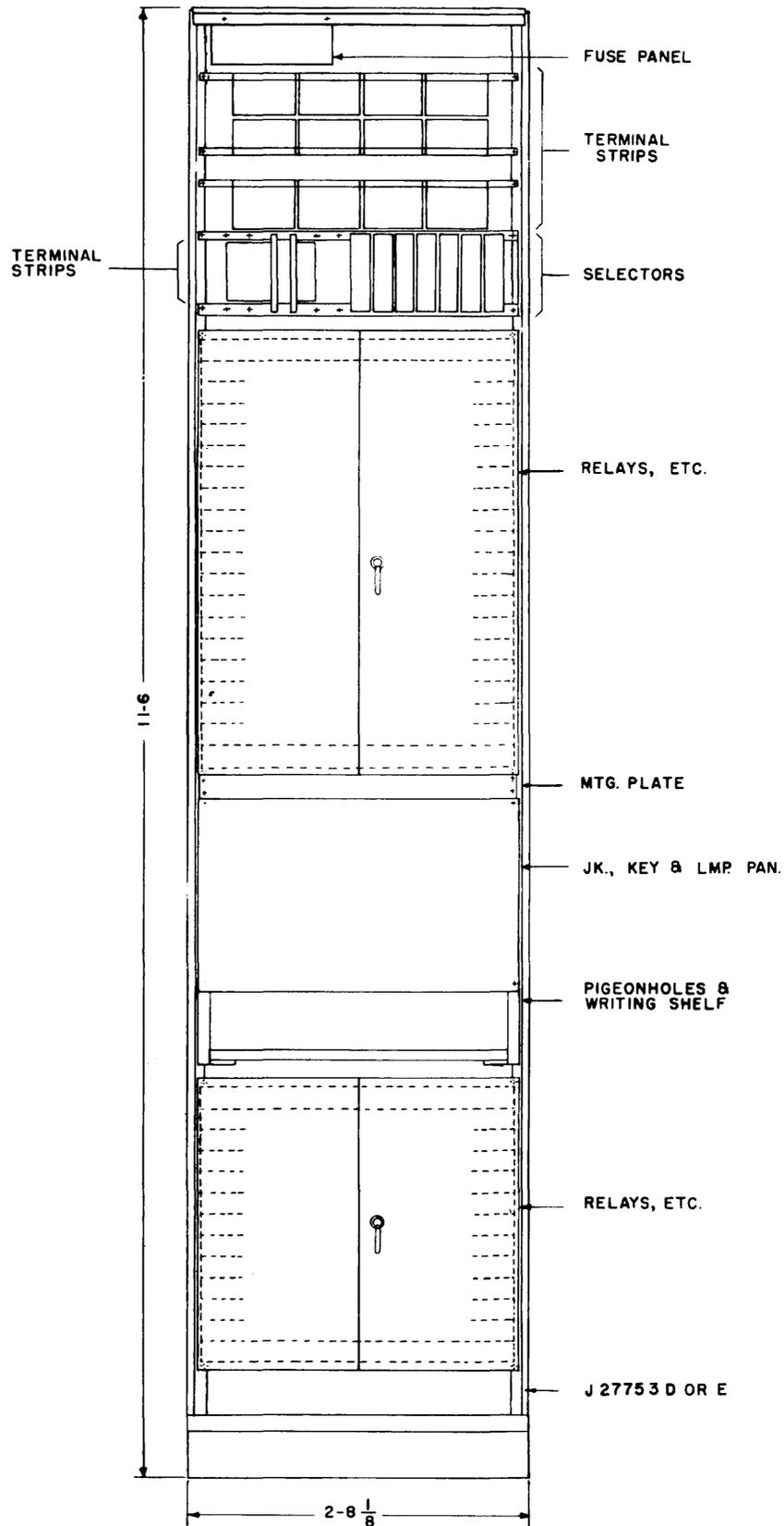


Fig. 36—Incoming Trunk Test Frame

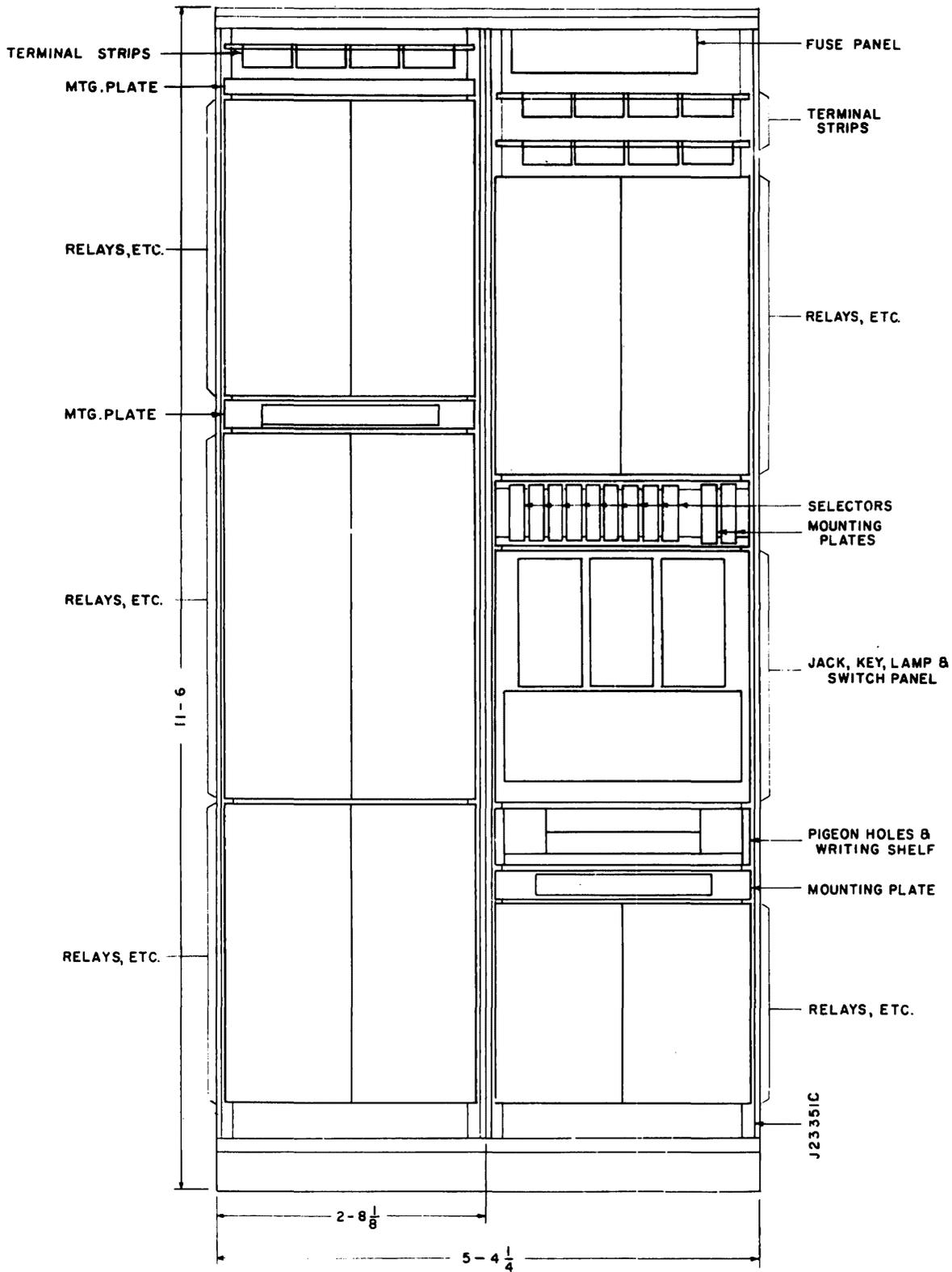


Fig. 37 — Sender Test Frame — (AMA)

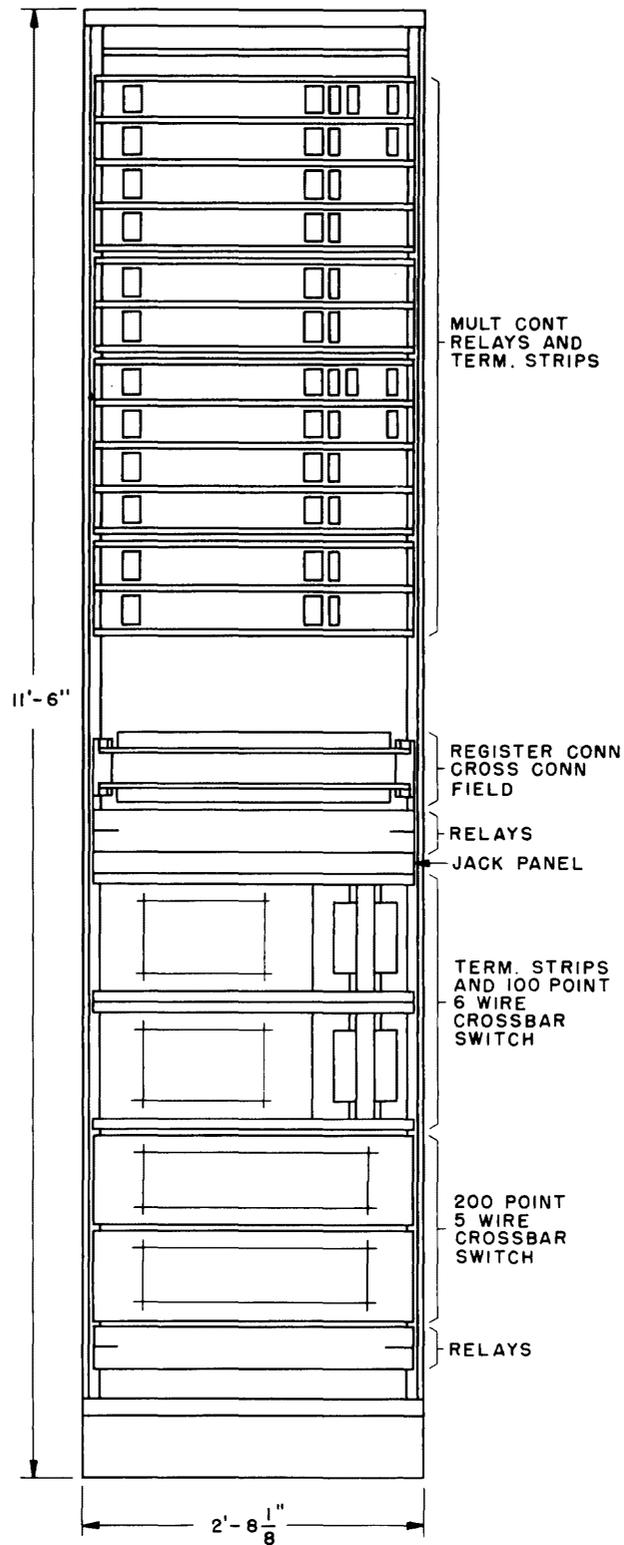


fig. 38 — Sender Test Connector Frame

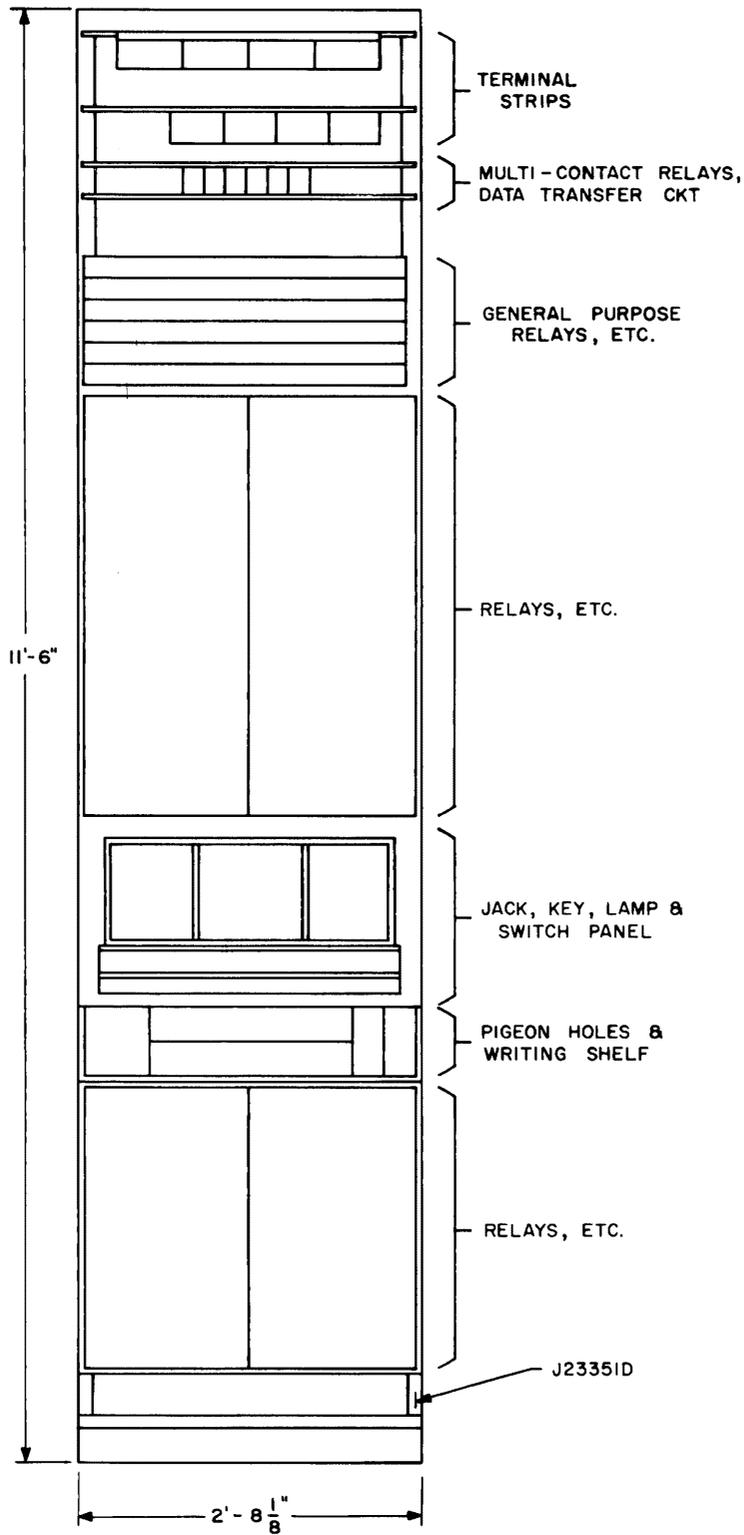


Fig. 39— Sender Test Supplementary Frame

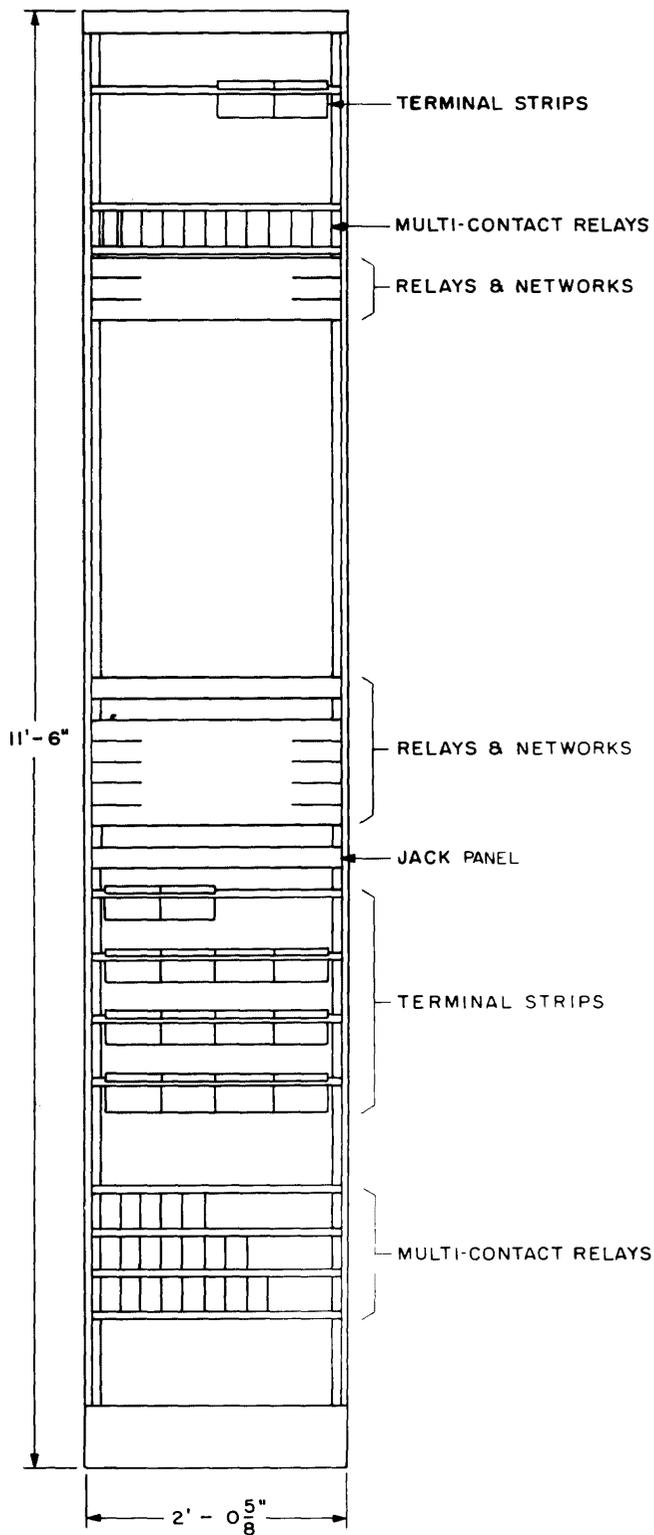


Fig. 40—Register Test Connector Frame

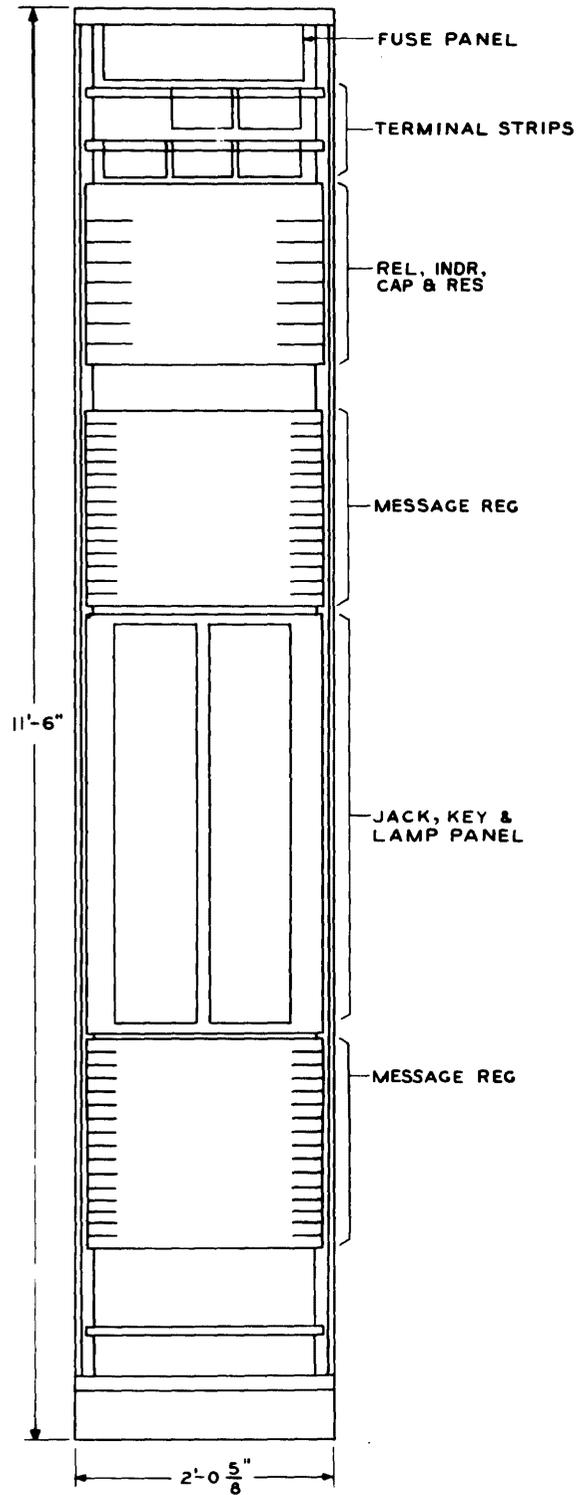


Fig. 41 — Sender Make-Busy Frame

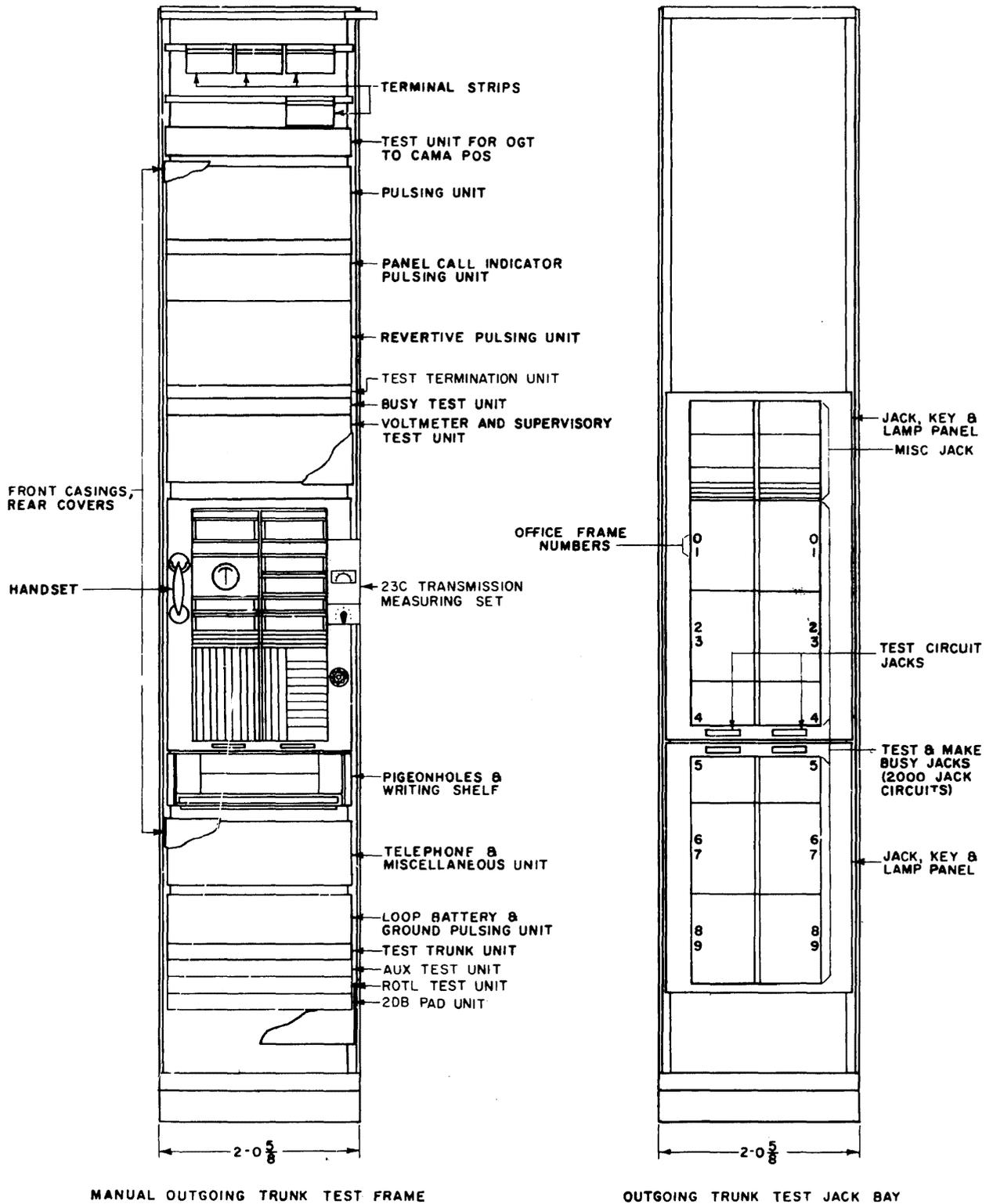


Fig. 42—Manual Outgoing Trunk Test Frame—  
Outgoing Trunk Test Jack Bay

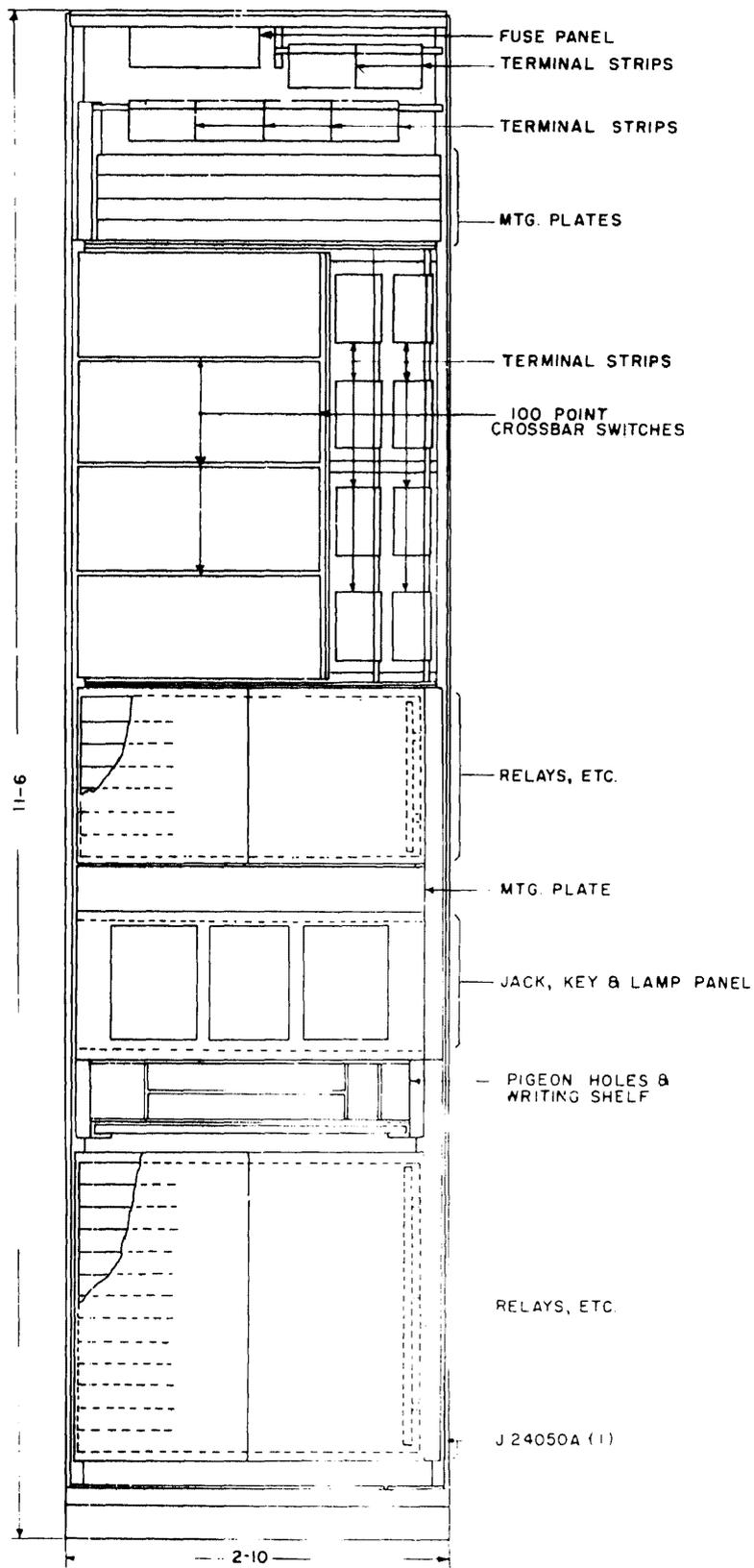


Fig. 43—Trunk Test Frame

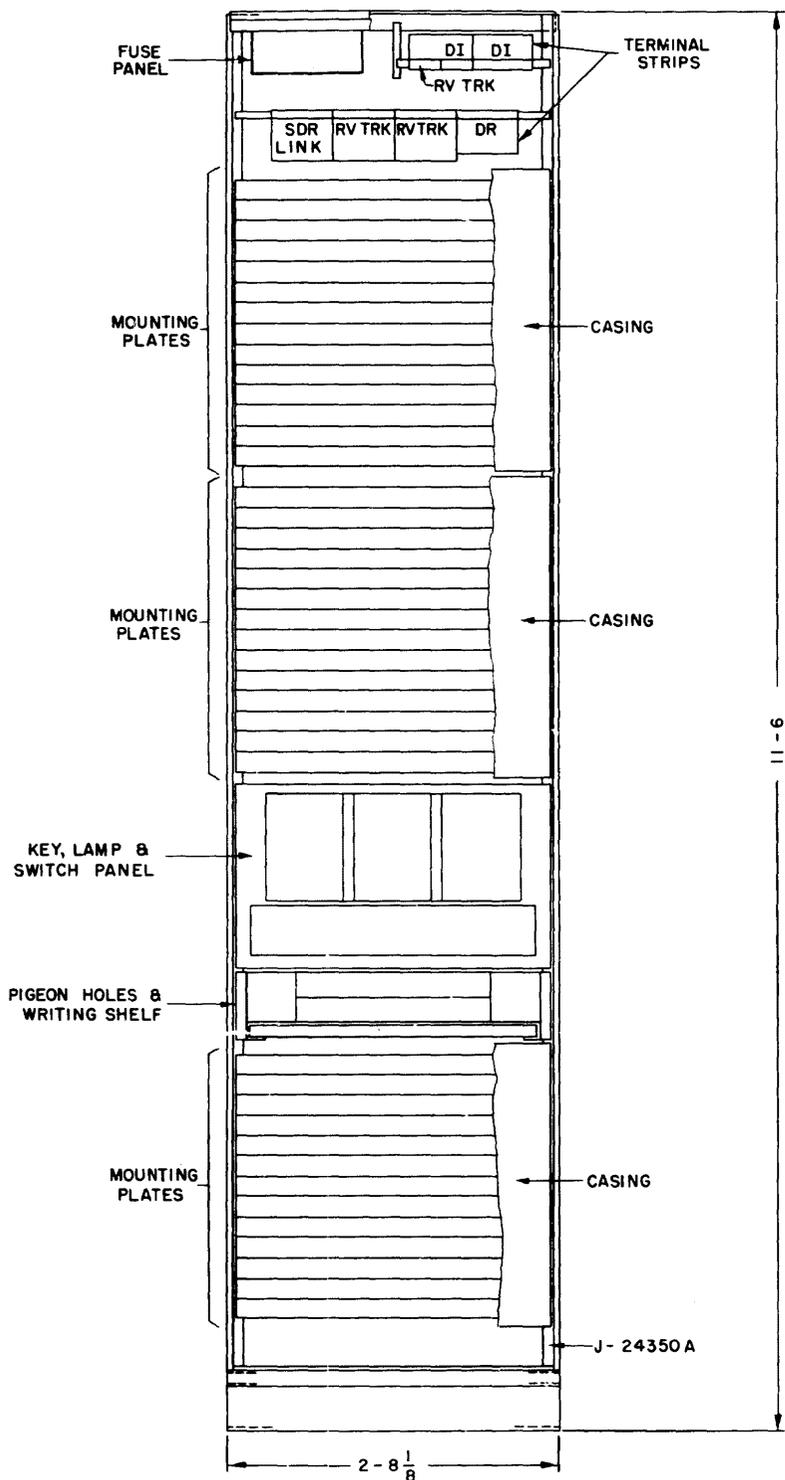


Fig. 44 — Trunk Automatic Test and Connector Frames — (AMA)

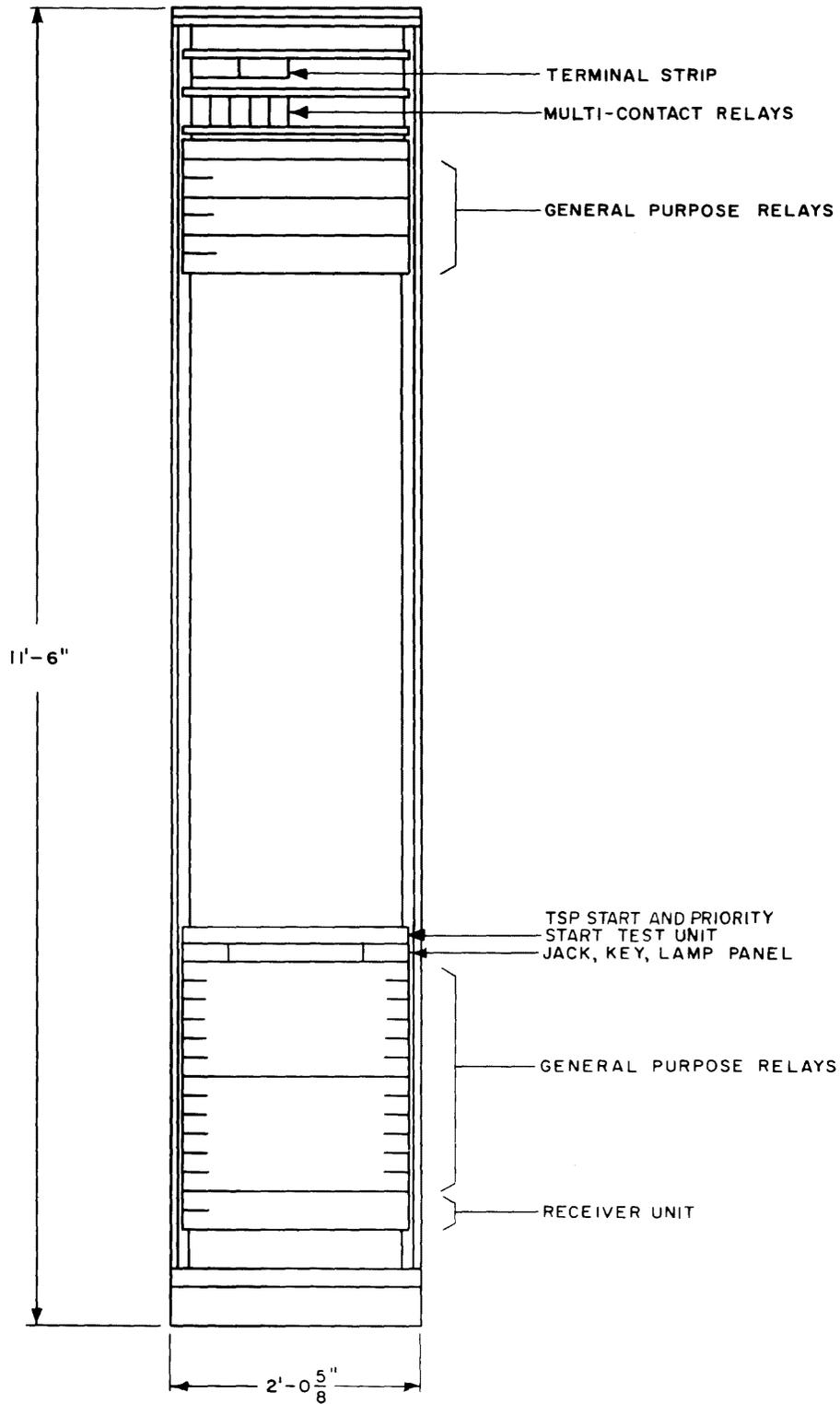


Fig. 45 — AMA Trunk Test Supplemental Frame

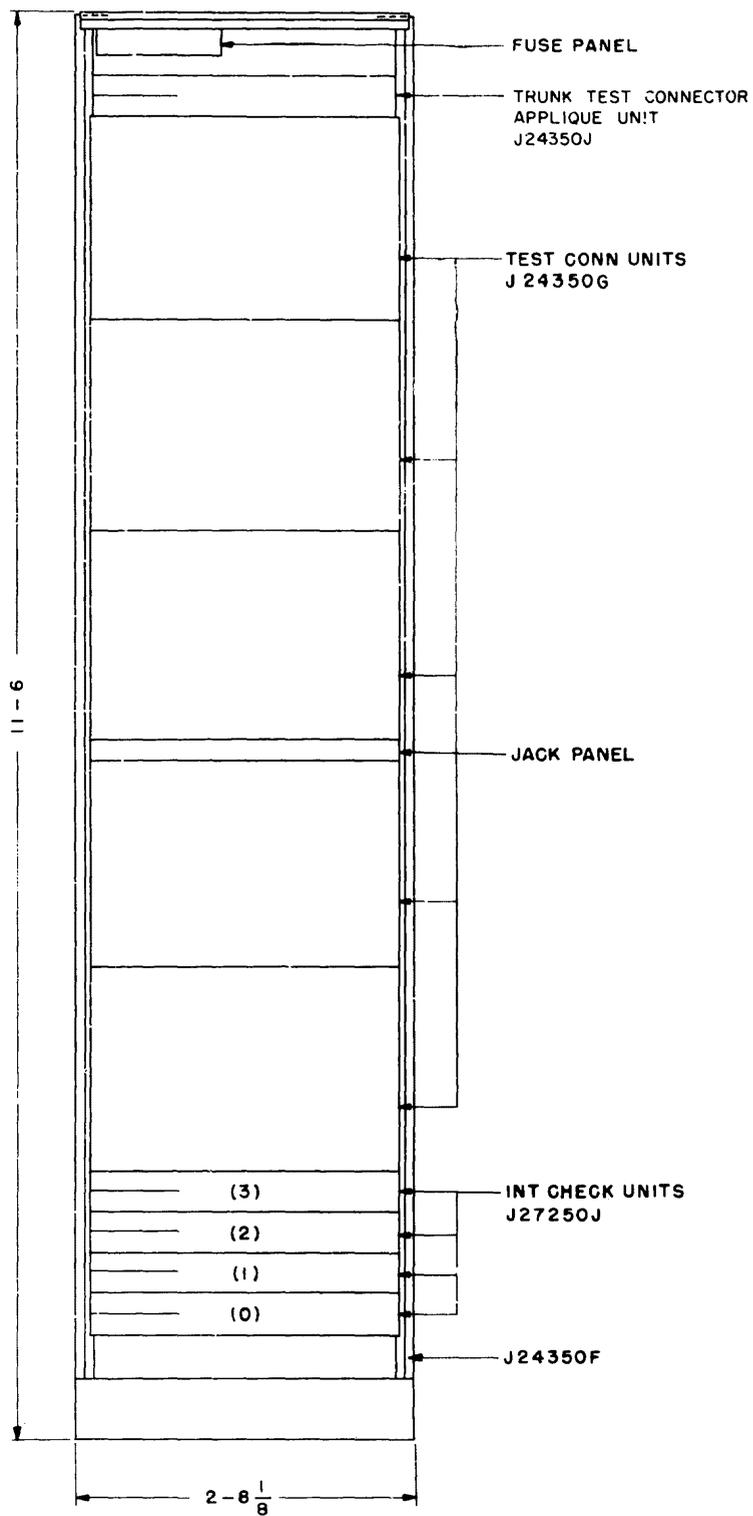


Fig. 46—Trunk Automatic Test Connector Frame

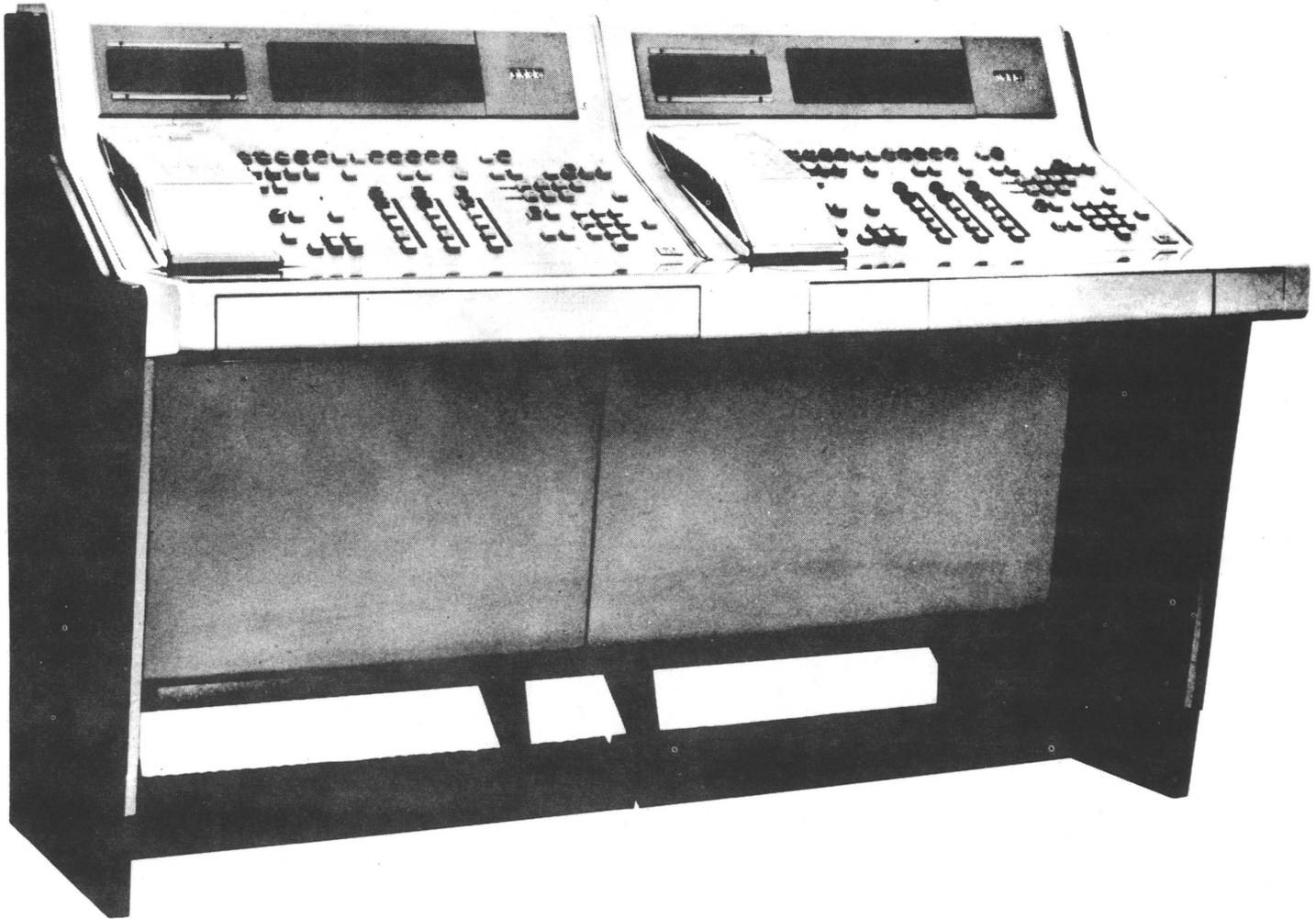


Fig. 47— 100A Traffic Service Position Section With Bulletin Holders

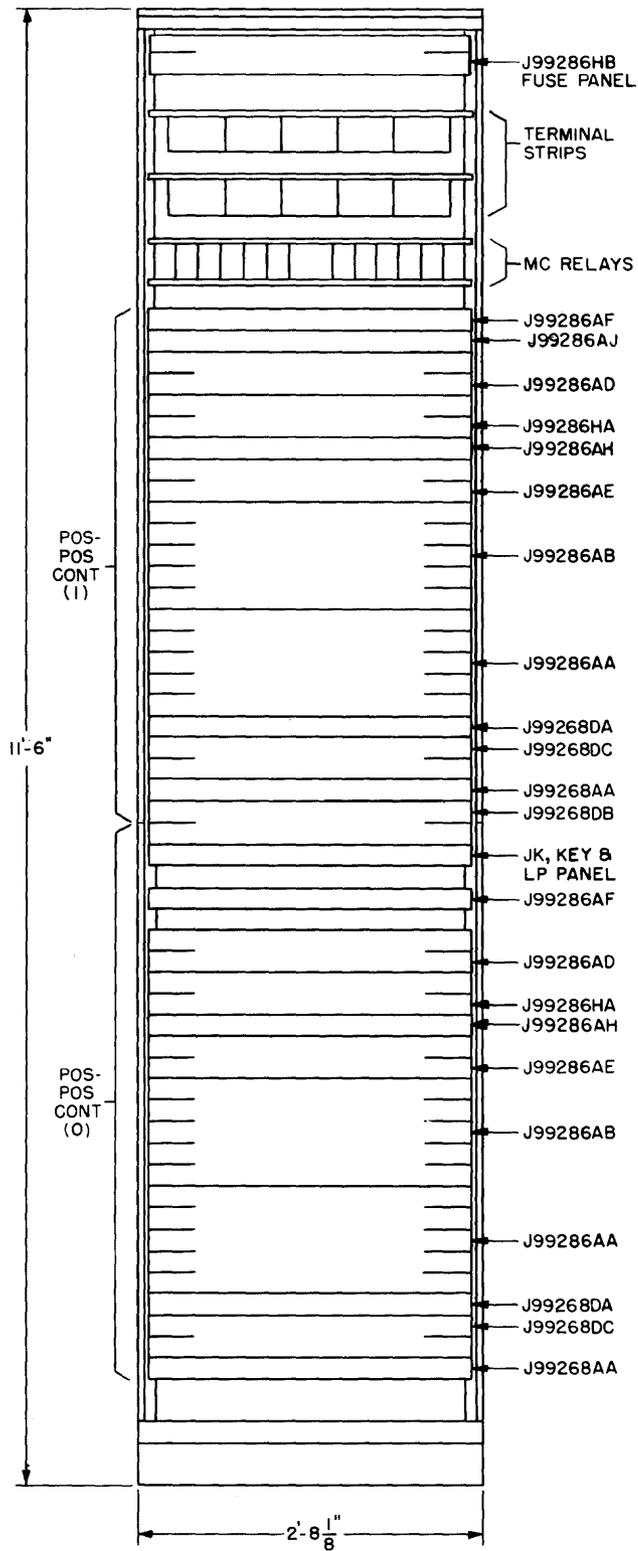


Fig. 48 — Position — Position Control Frame

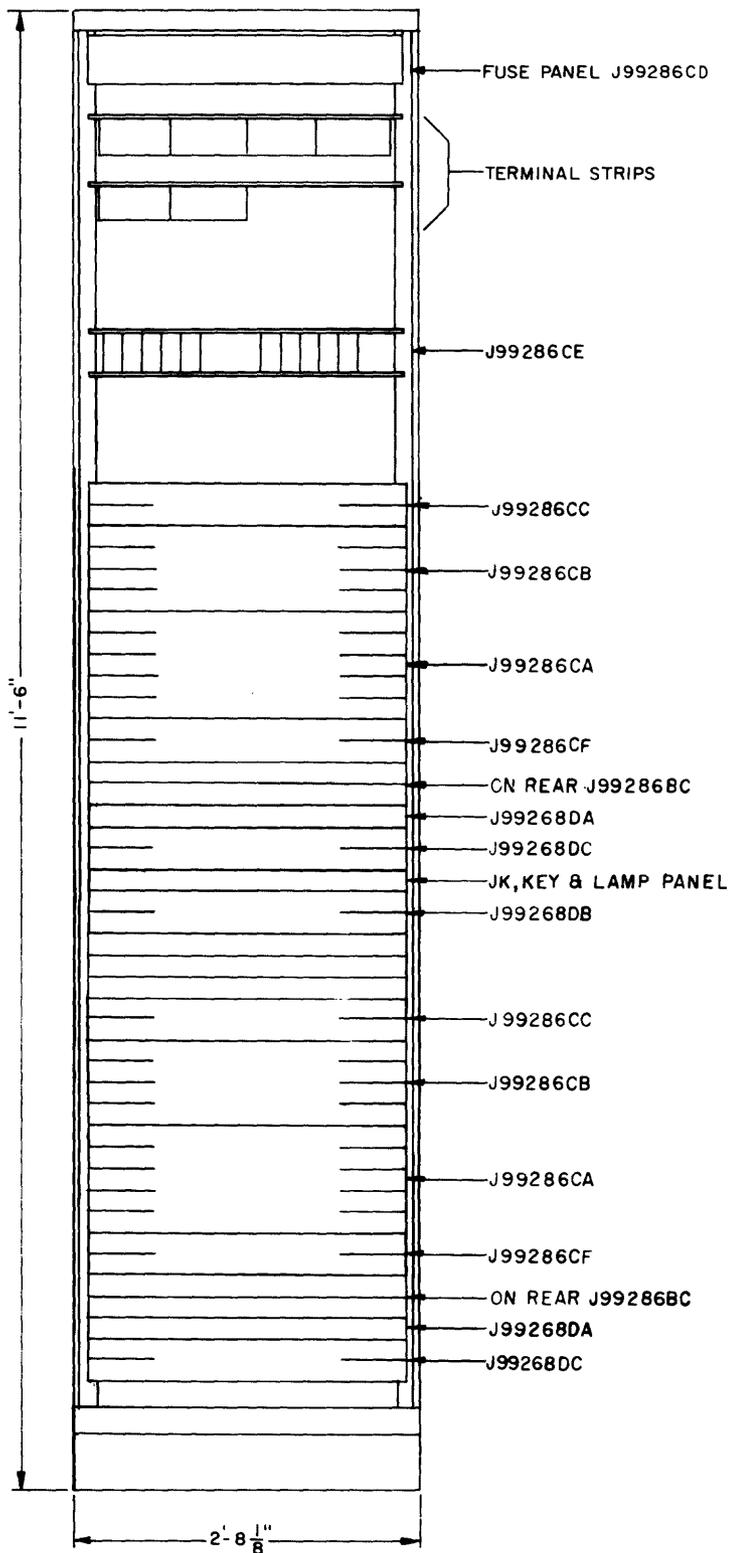


Fig. 49—Position-Position Signaling Frame

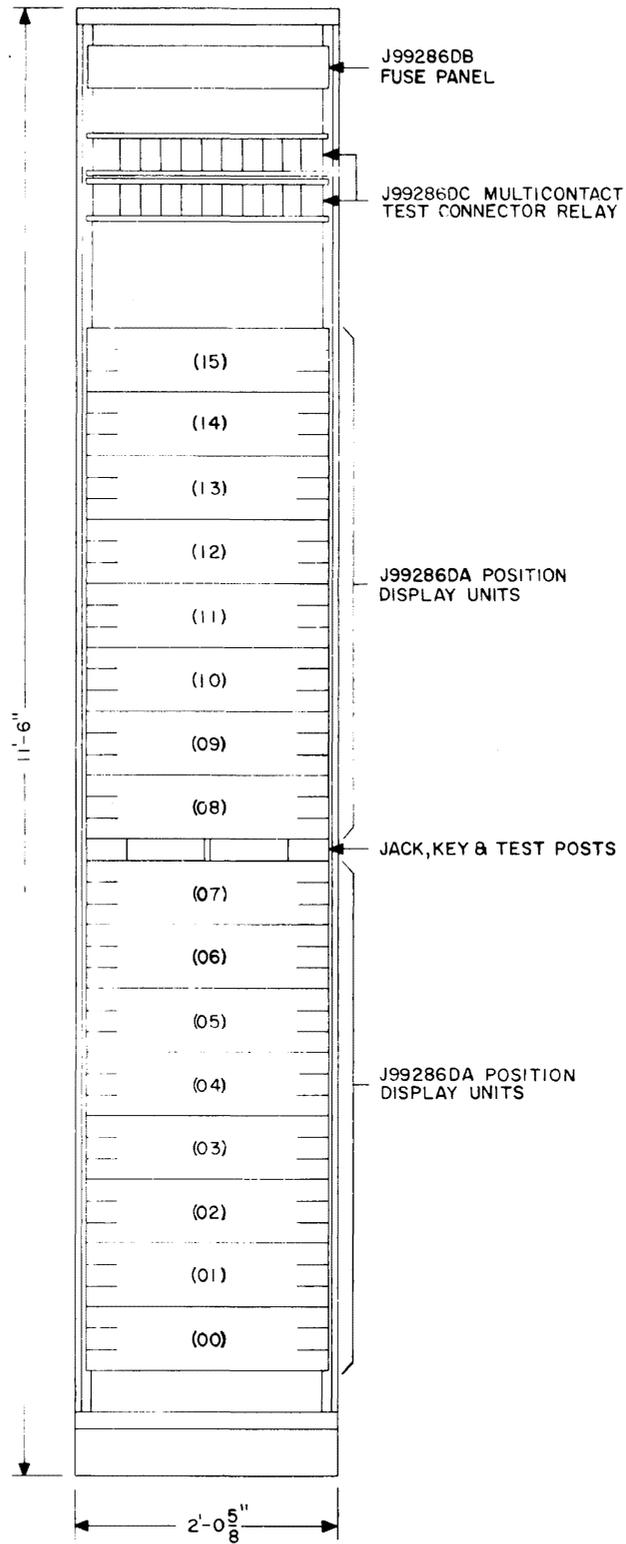


Fig. 50—Position Display Frame

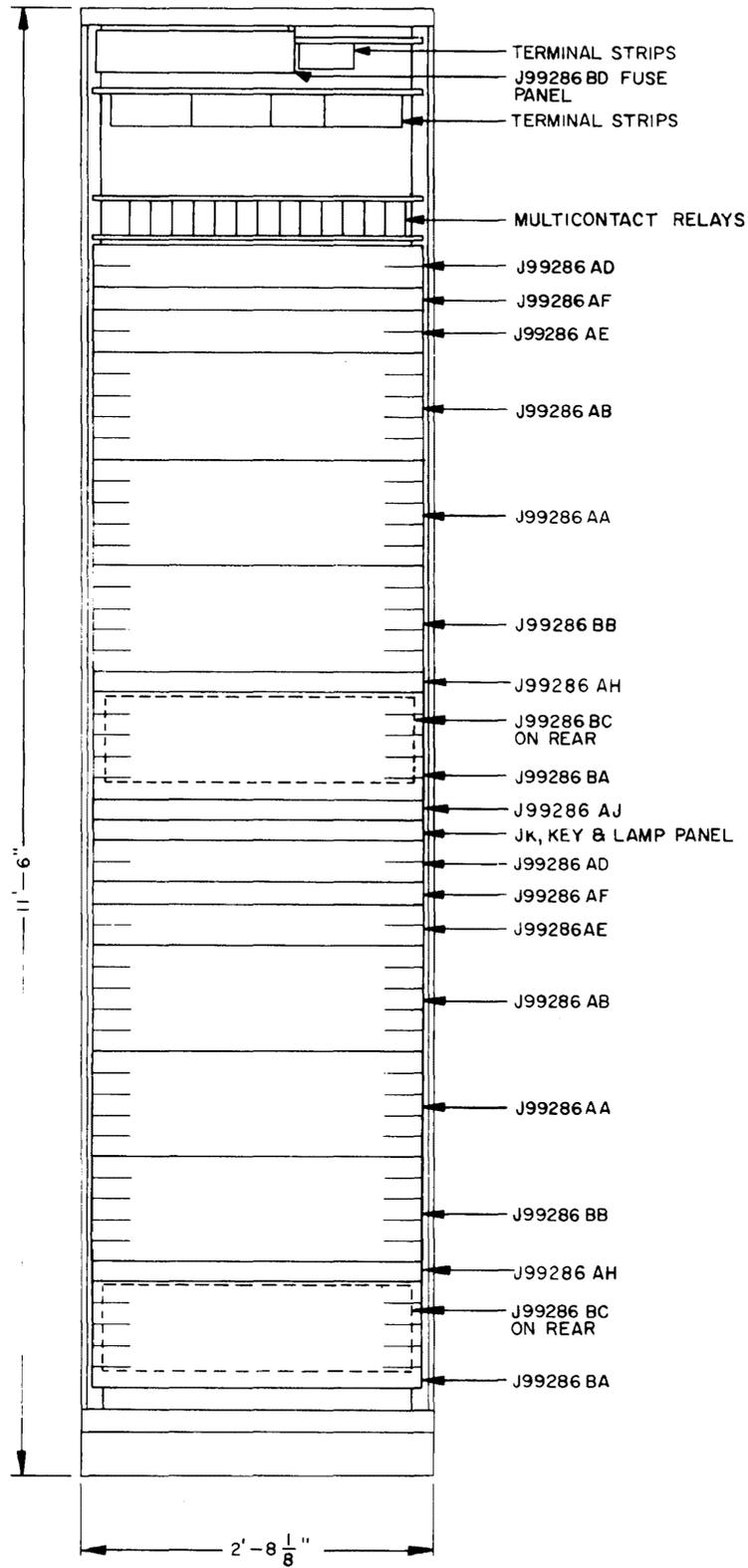


Fig. 51 — Position Control—Control Signaling Frame

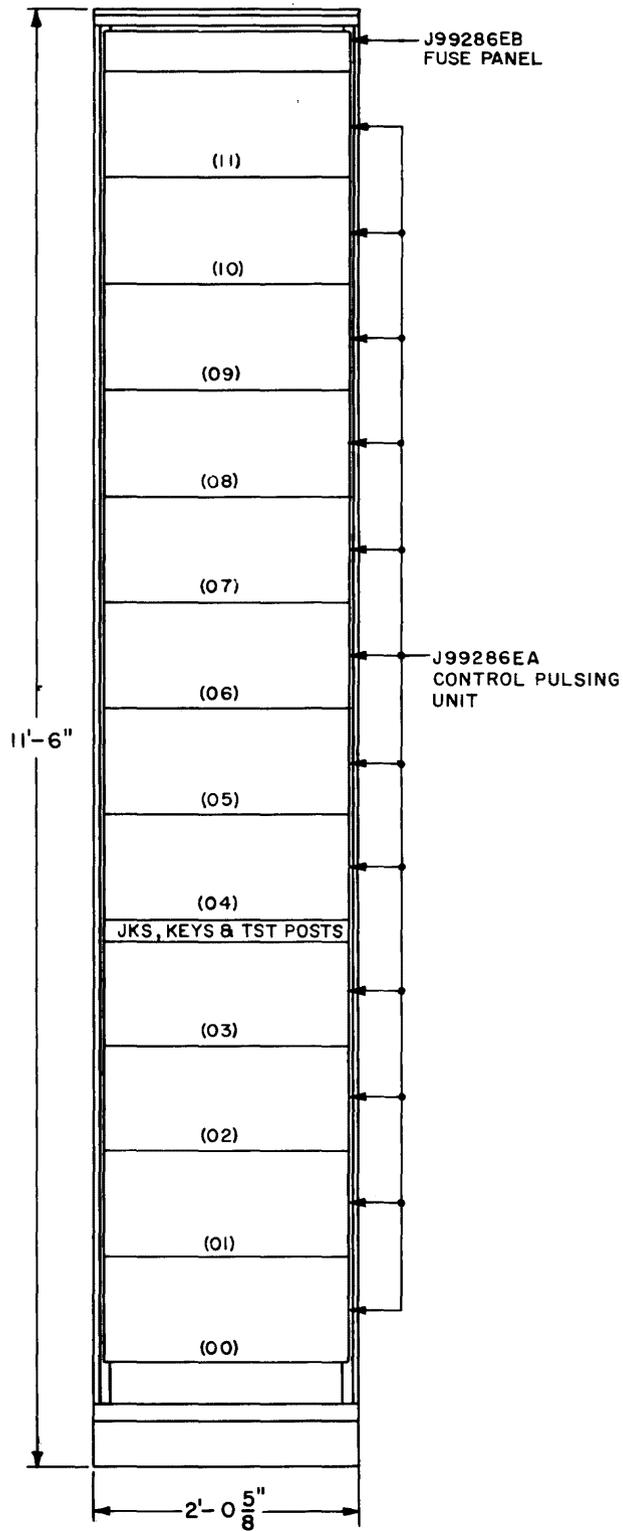


Fig. 52—Control Pulsing Frame

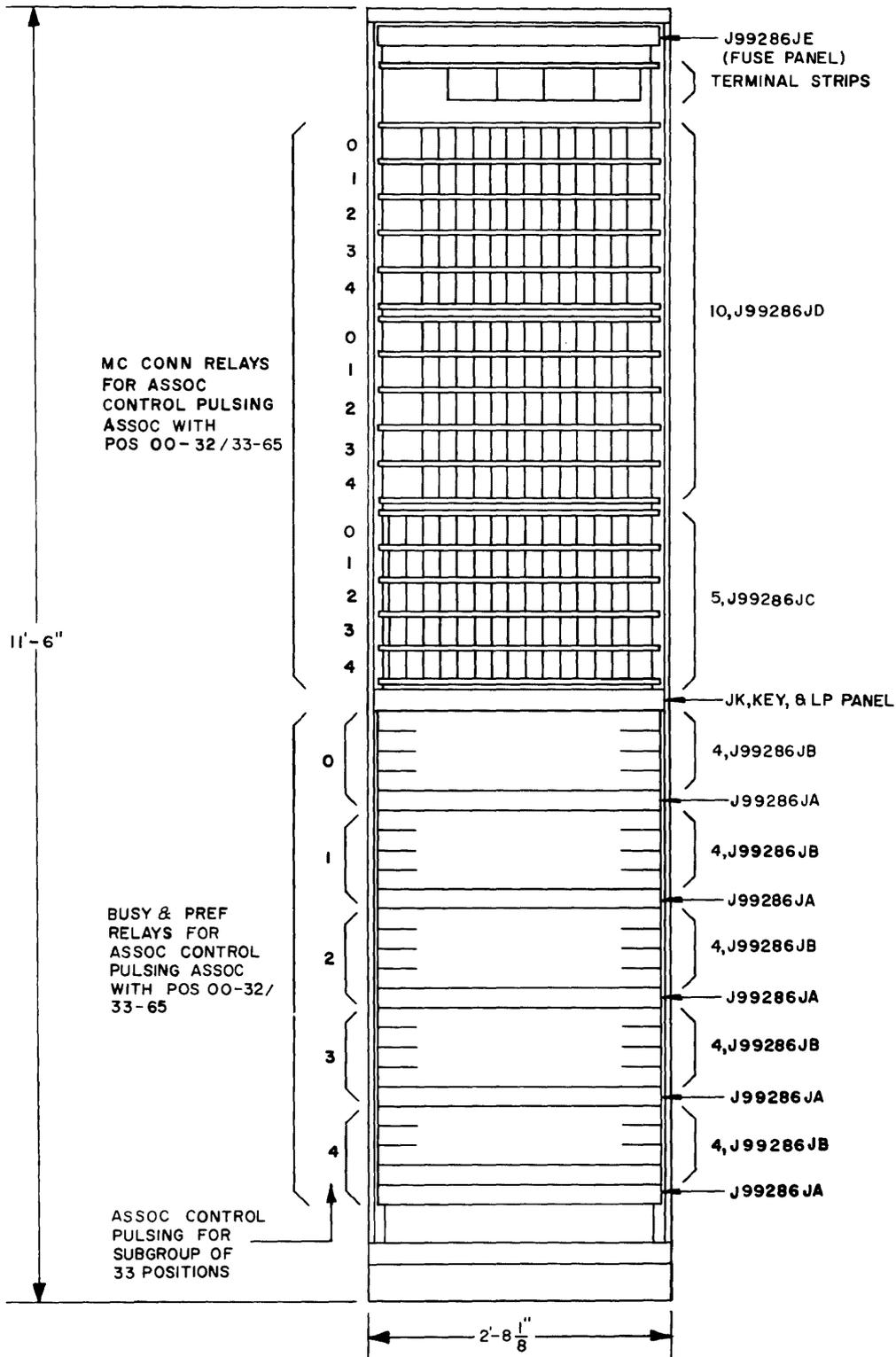


Fig. 53—Control Pulsing Connector Frame

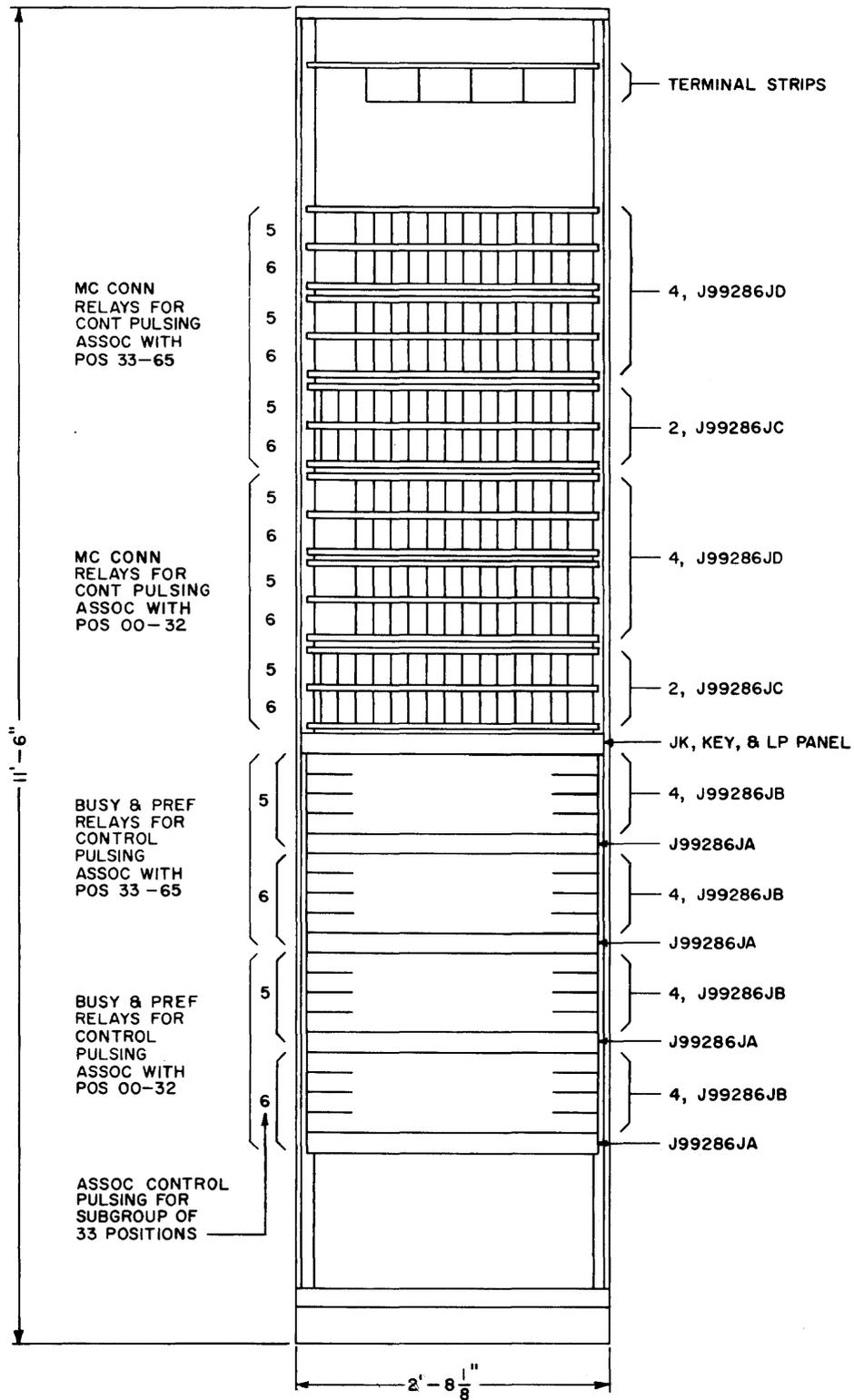


Fig. 54—Supplementary Control Pulsing Connector Frame

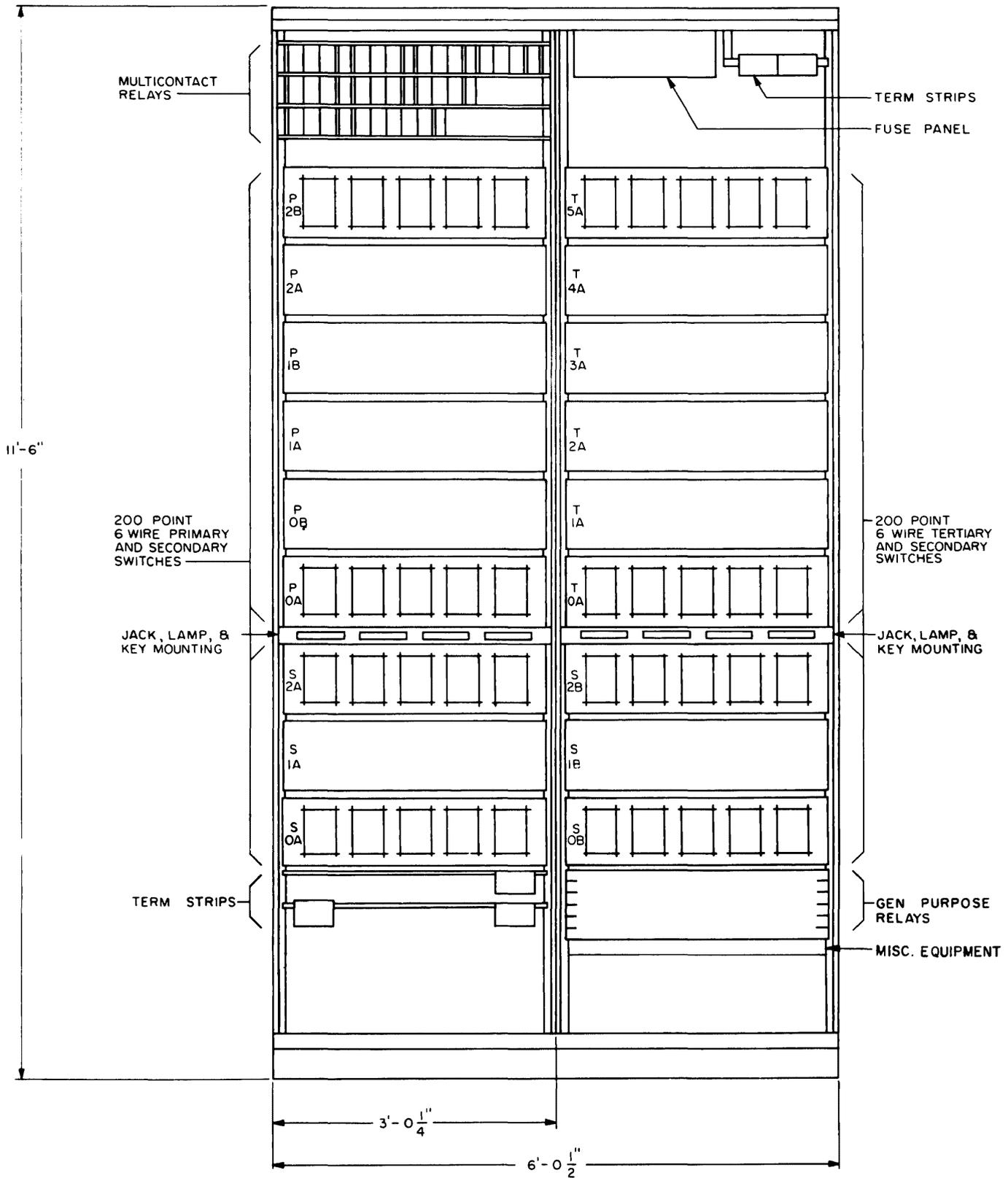


Fig. 55 — Link and Connector Frame

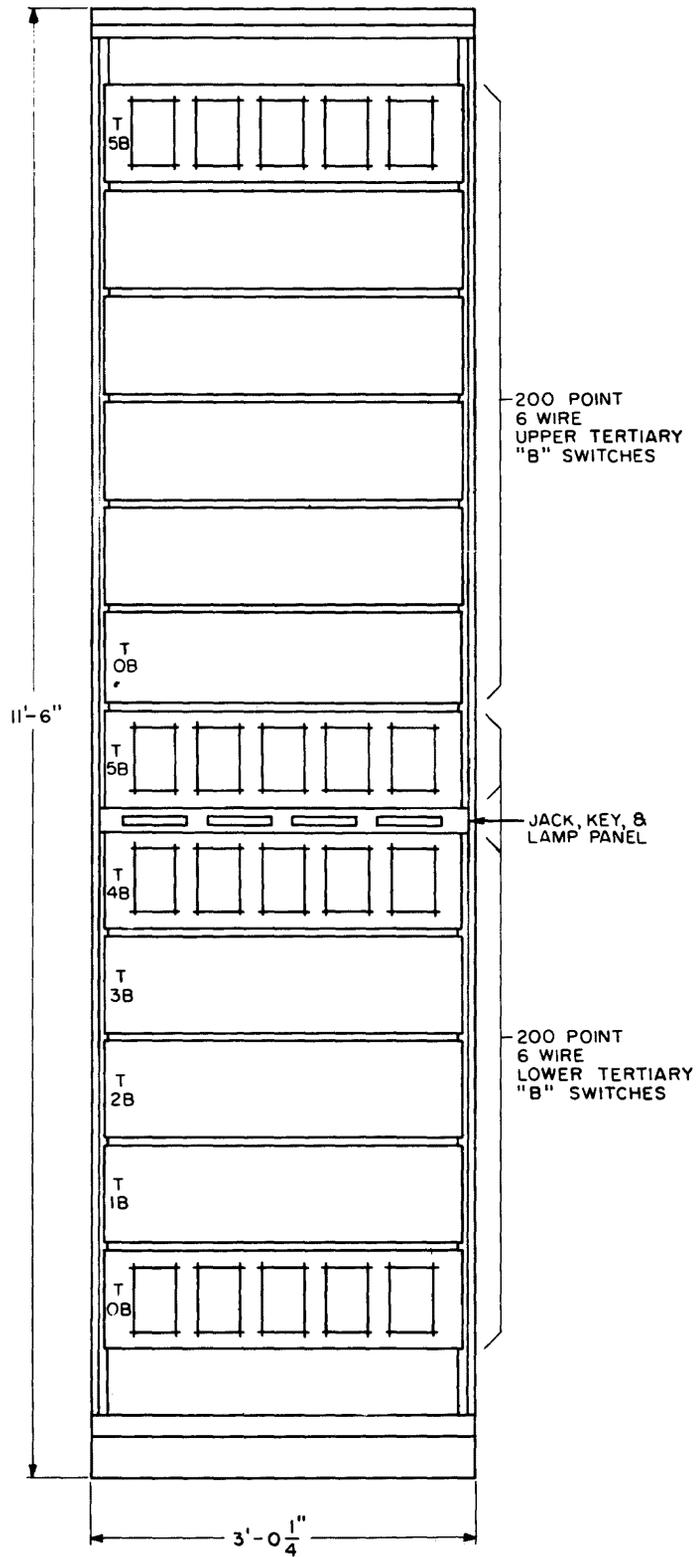


Fig. 56 — Link and Connector Supplementary Frame

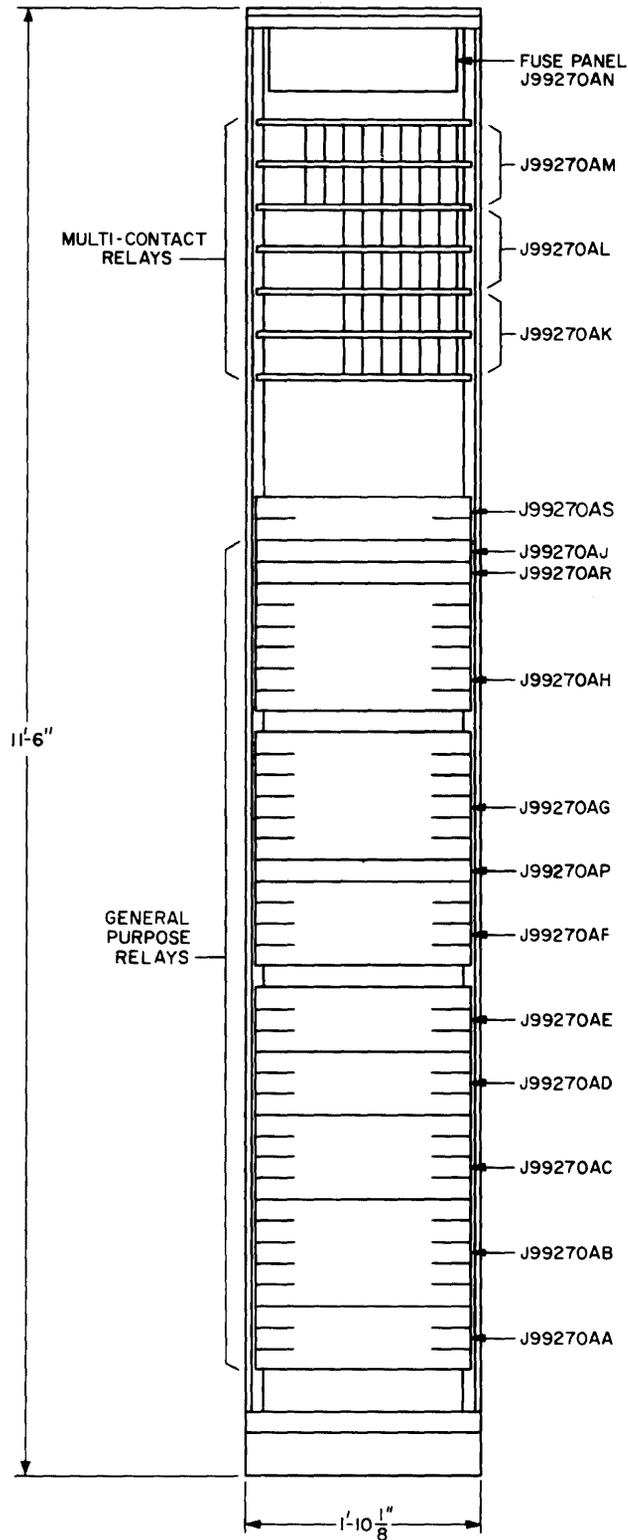


Fig. 57—Link Controller Frame

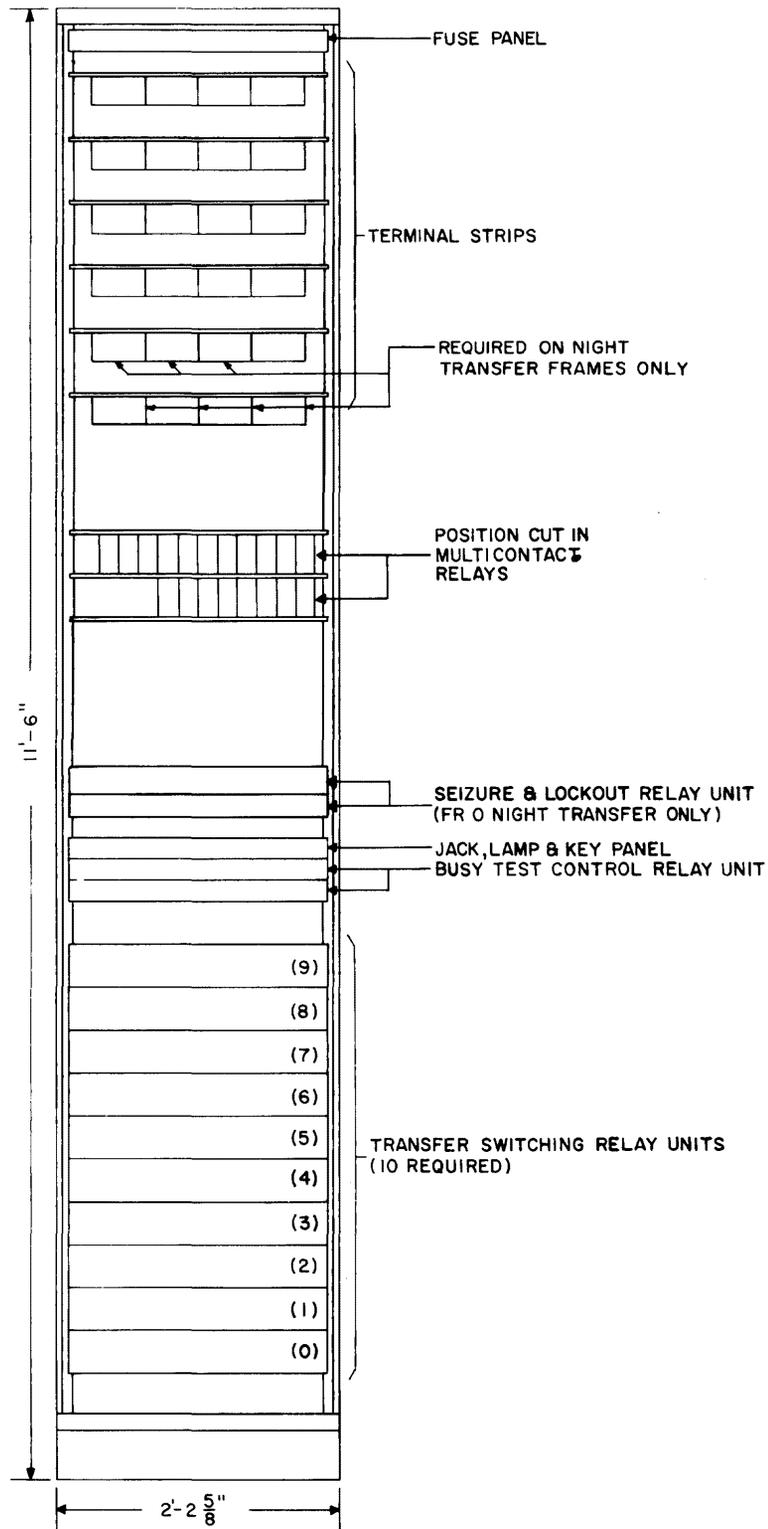


Fig. 58-100A Traffic Service Position Light Hour Transfer Control Frames



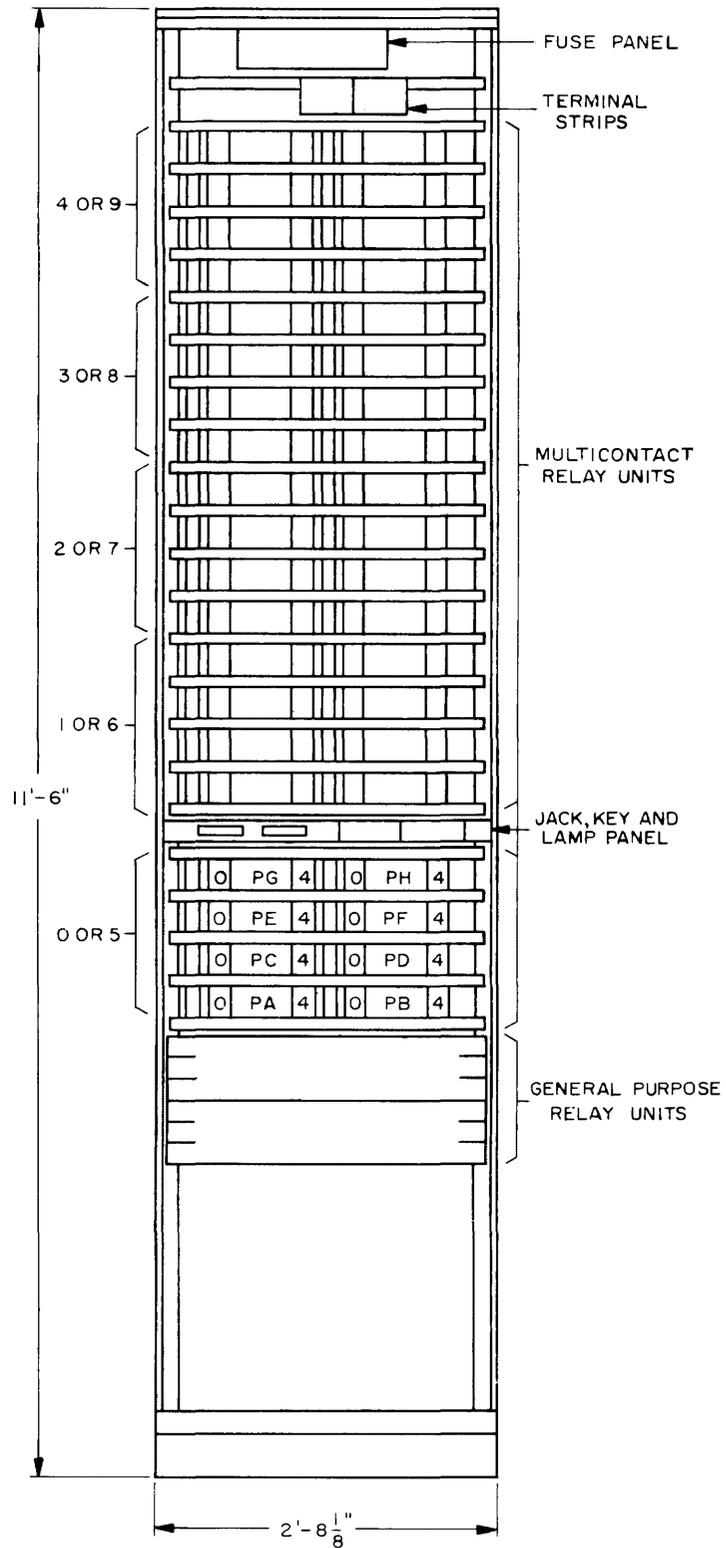


Fig. 60—Data Transfer Position Connector Frame

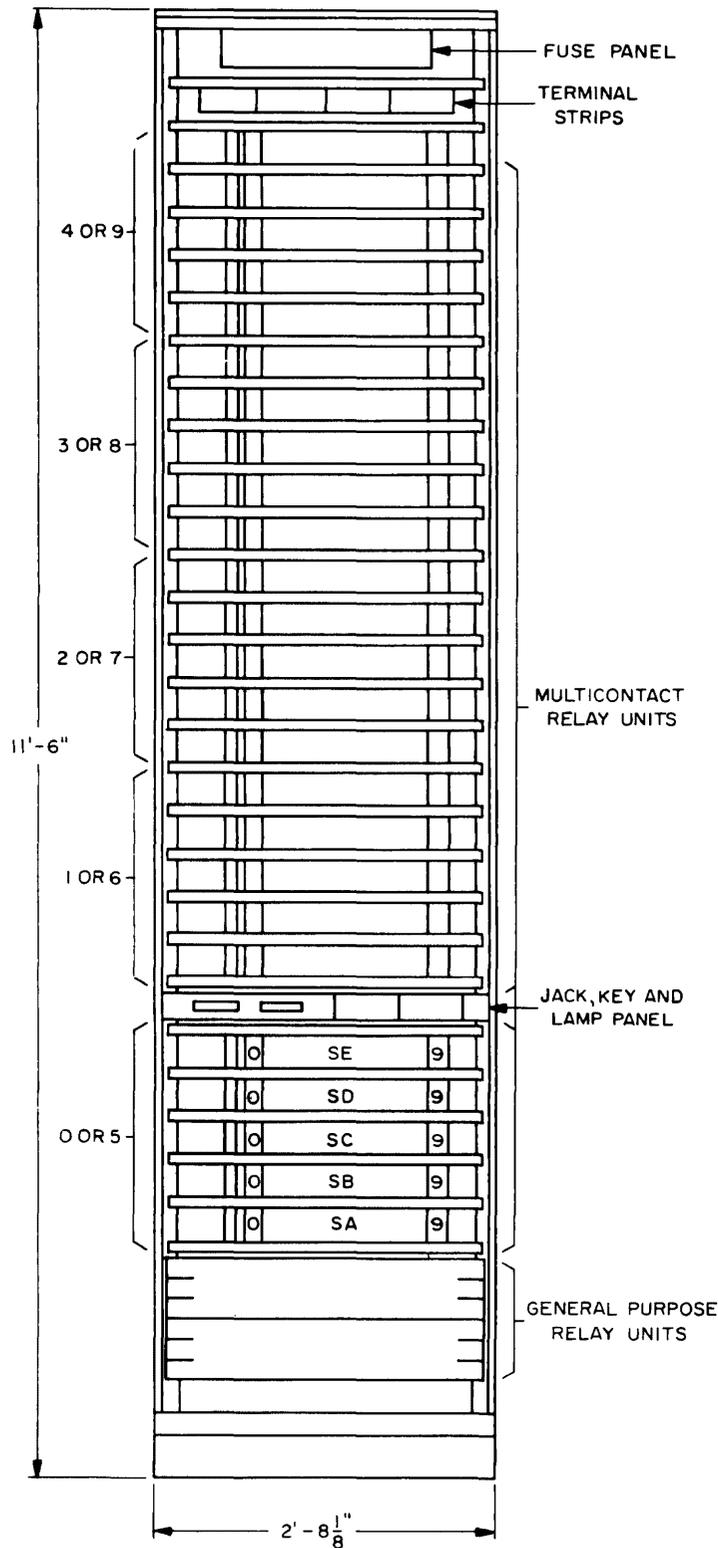


Fig. 61 — Data Transfer Sender Connector Frame

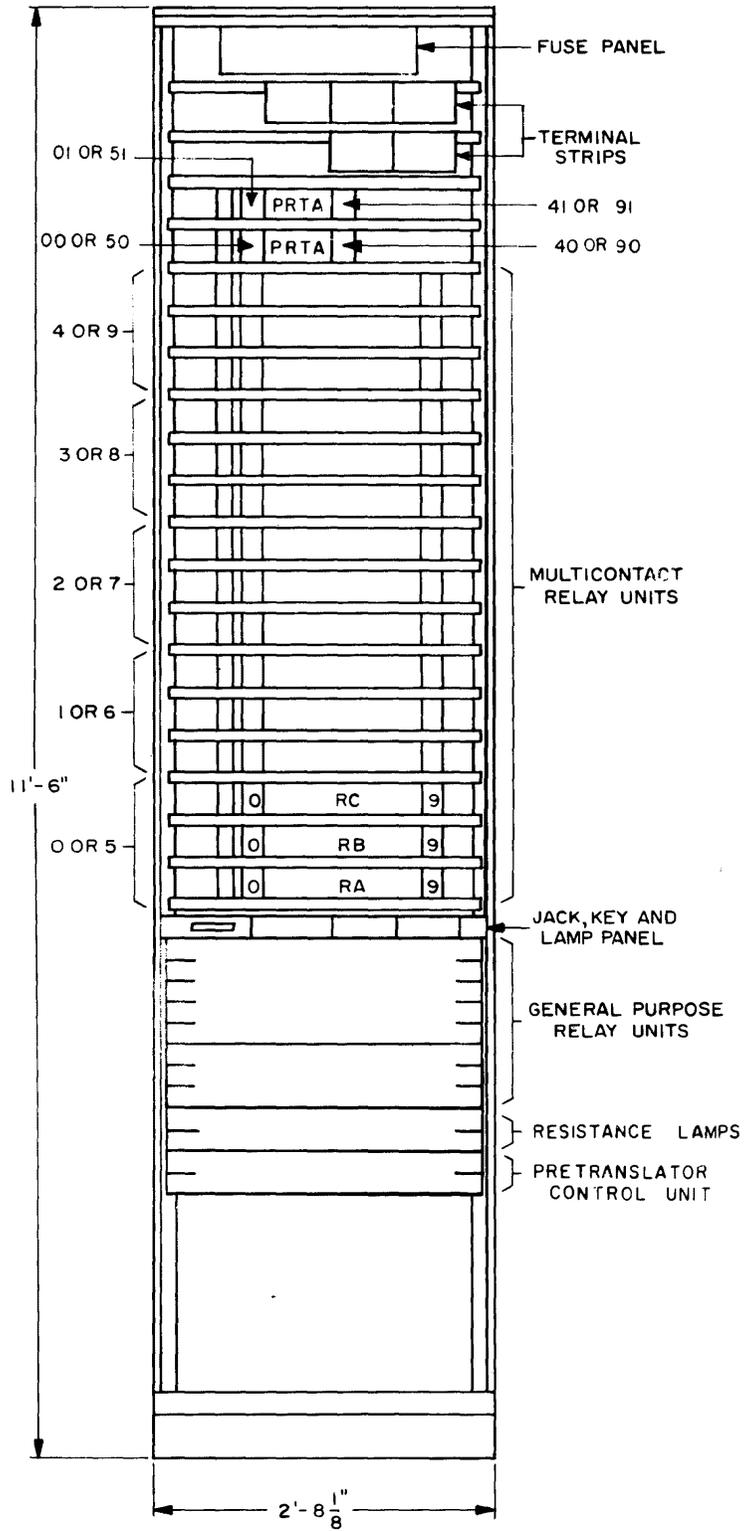


Fig. 62—Data Transfer Register Connector Frame

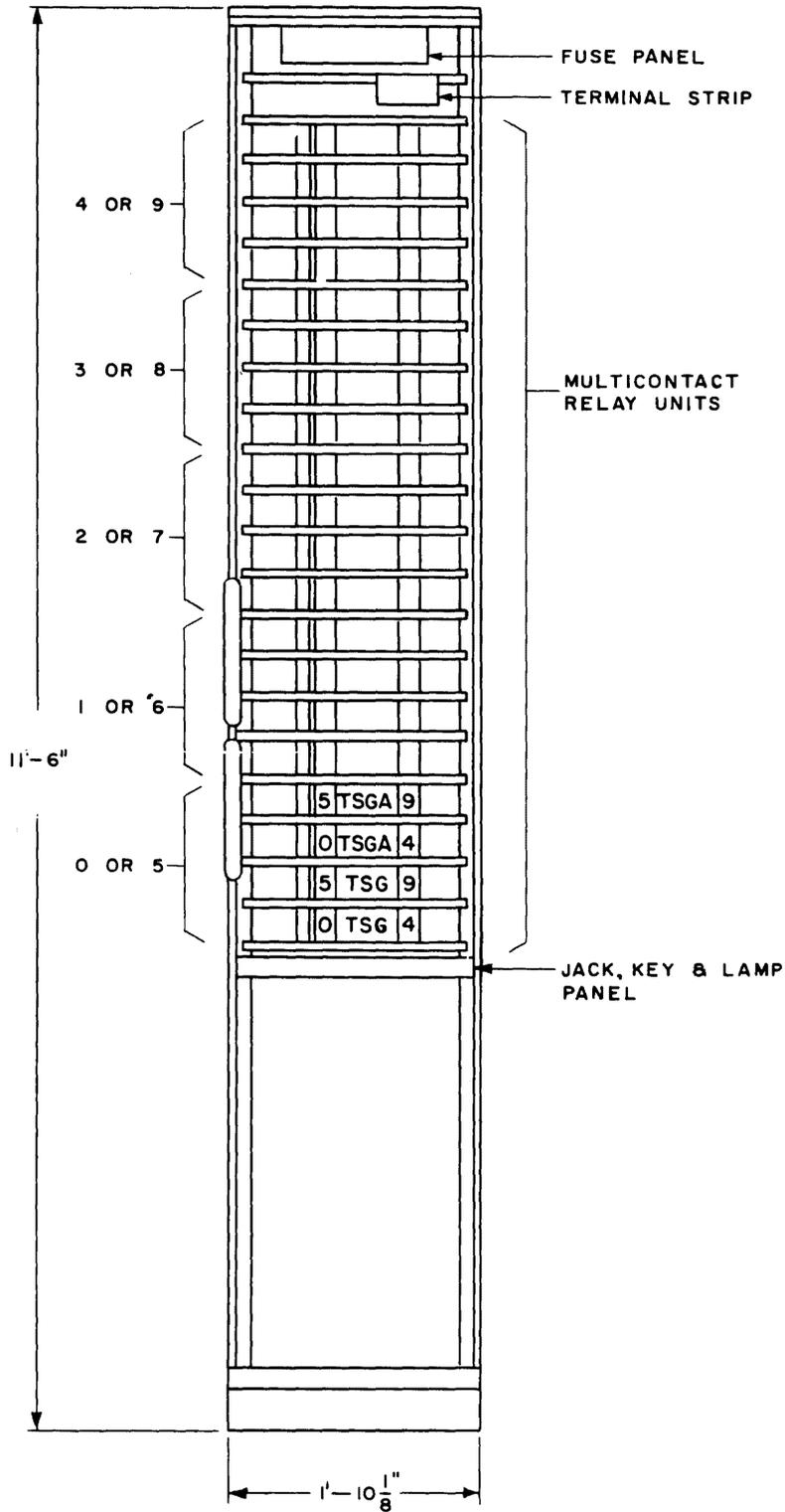


Fig. 63—Data Transfer Trunk Connector Frame

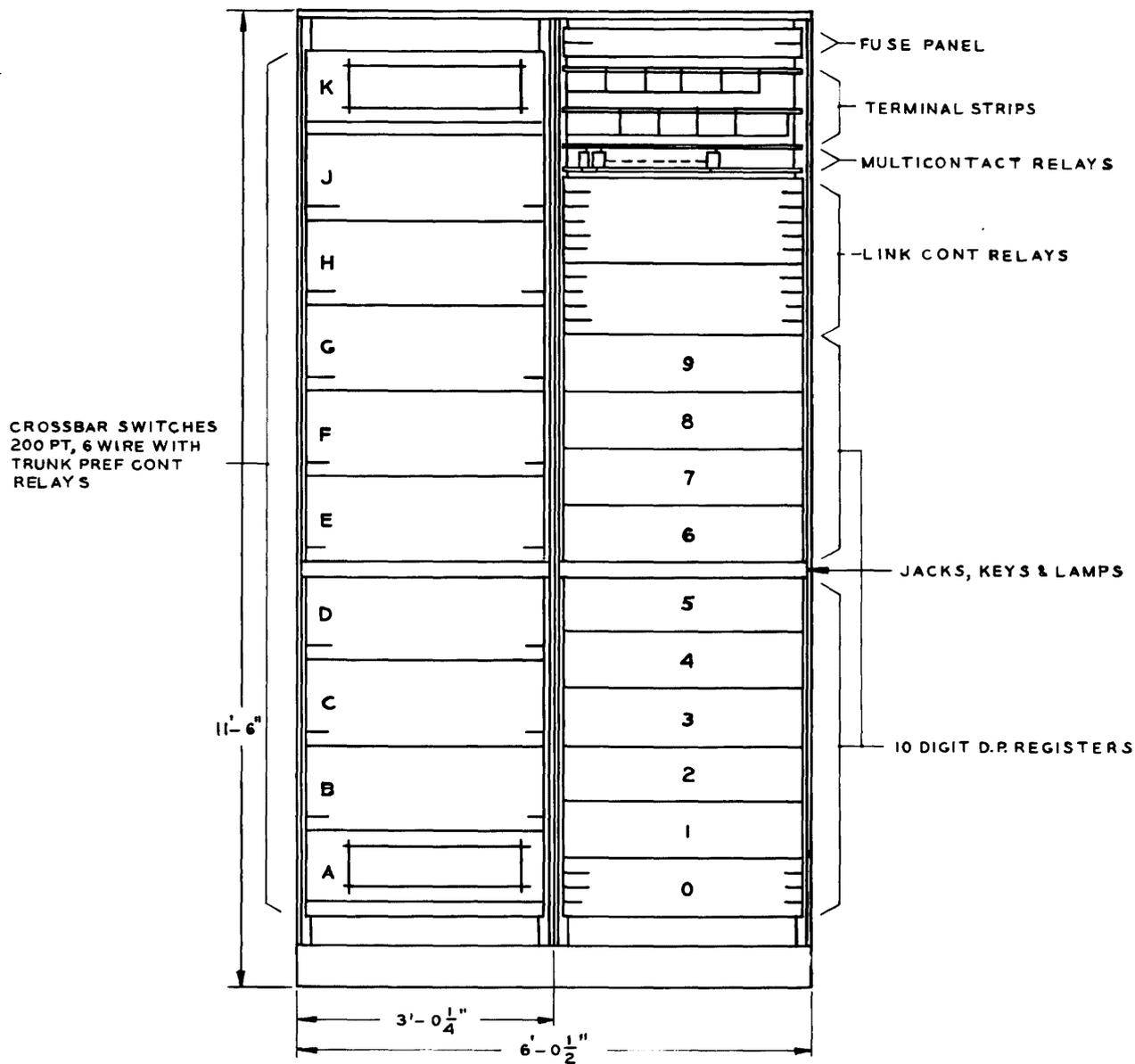


Fig. 64— 10-Digit Incoming Register and Link Frame

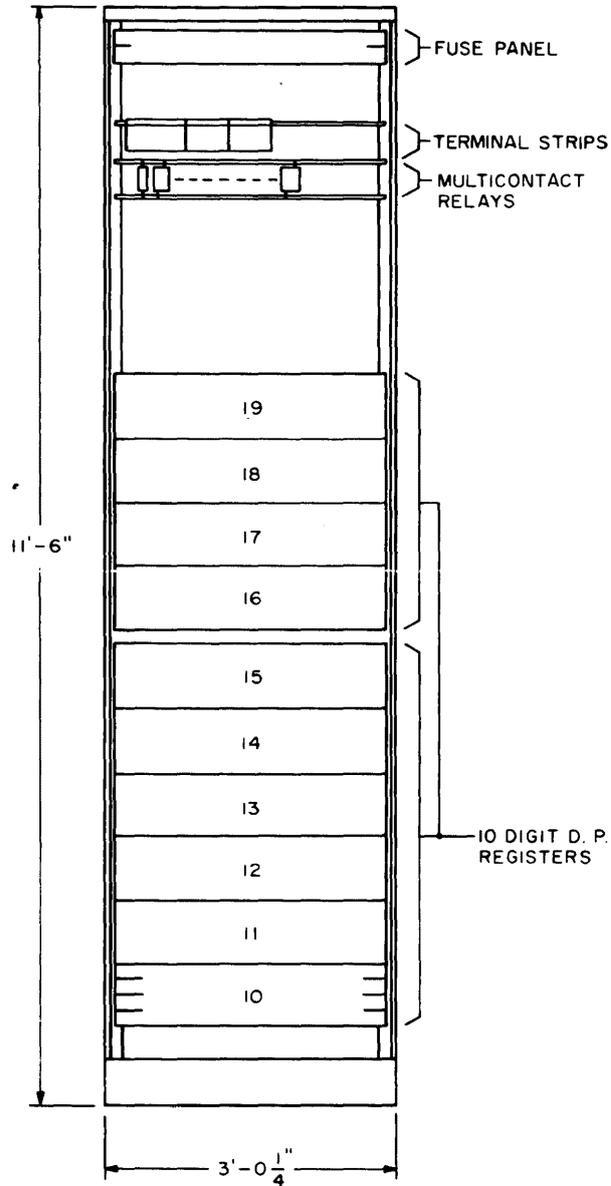


Fig. 65—10-Digit Incoming Register Supplementary Frame

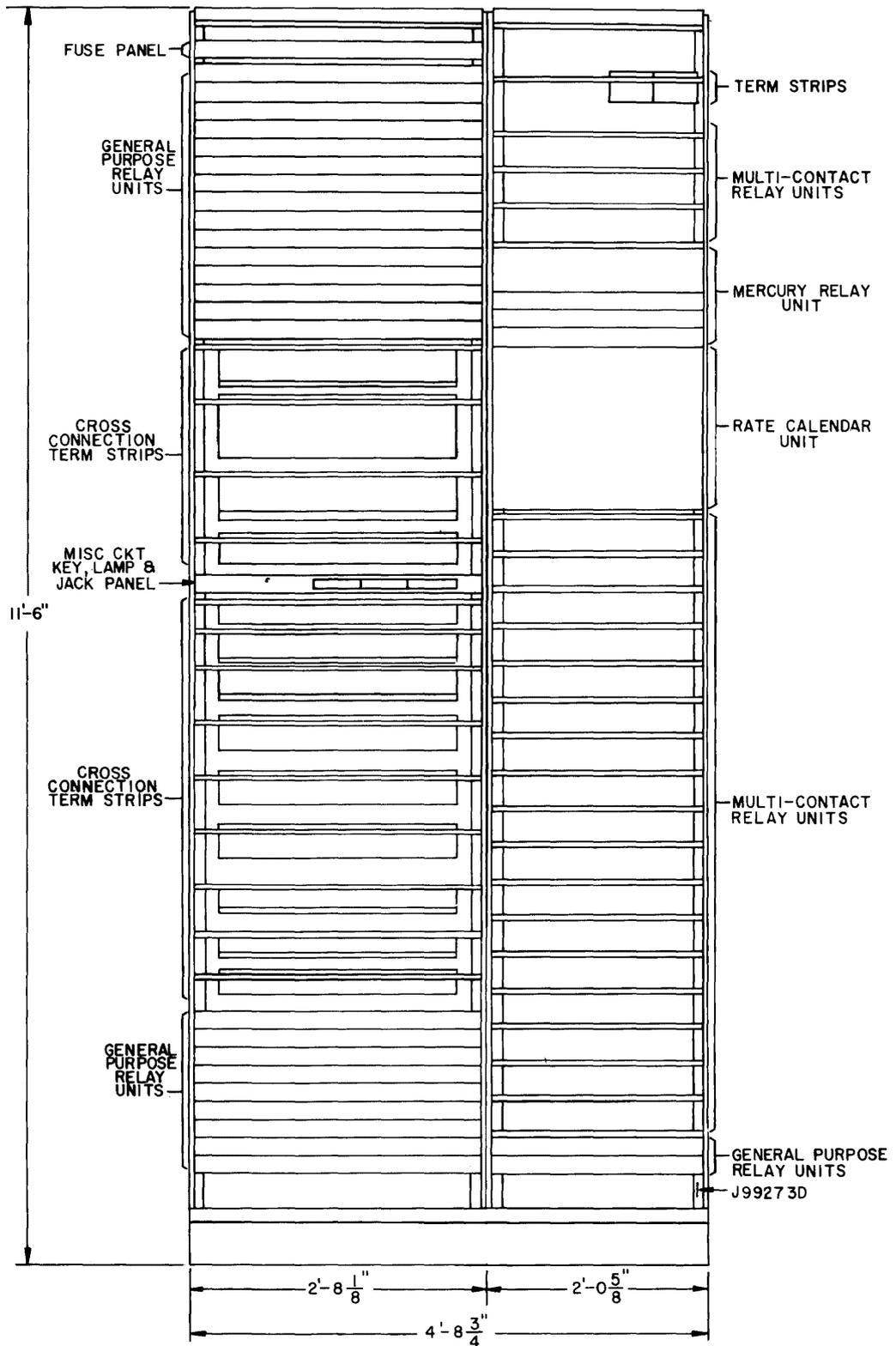


Fig. 66—Rater Frame

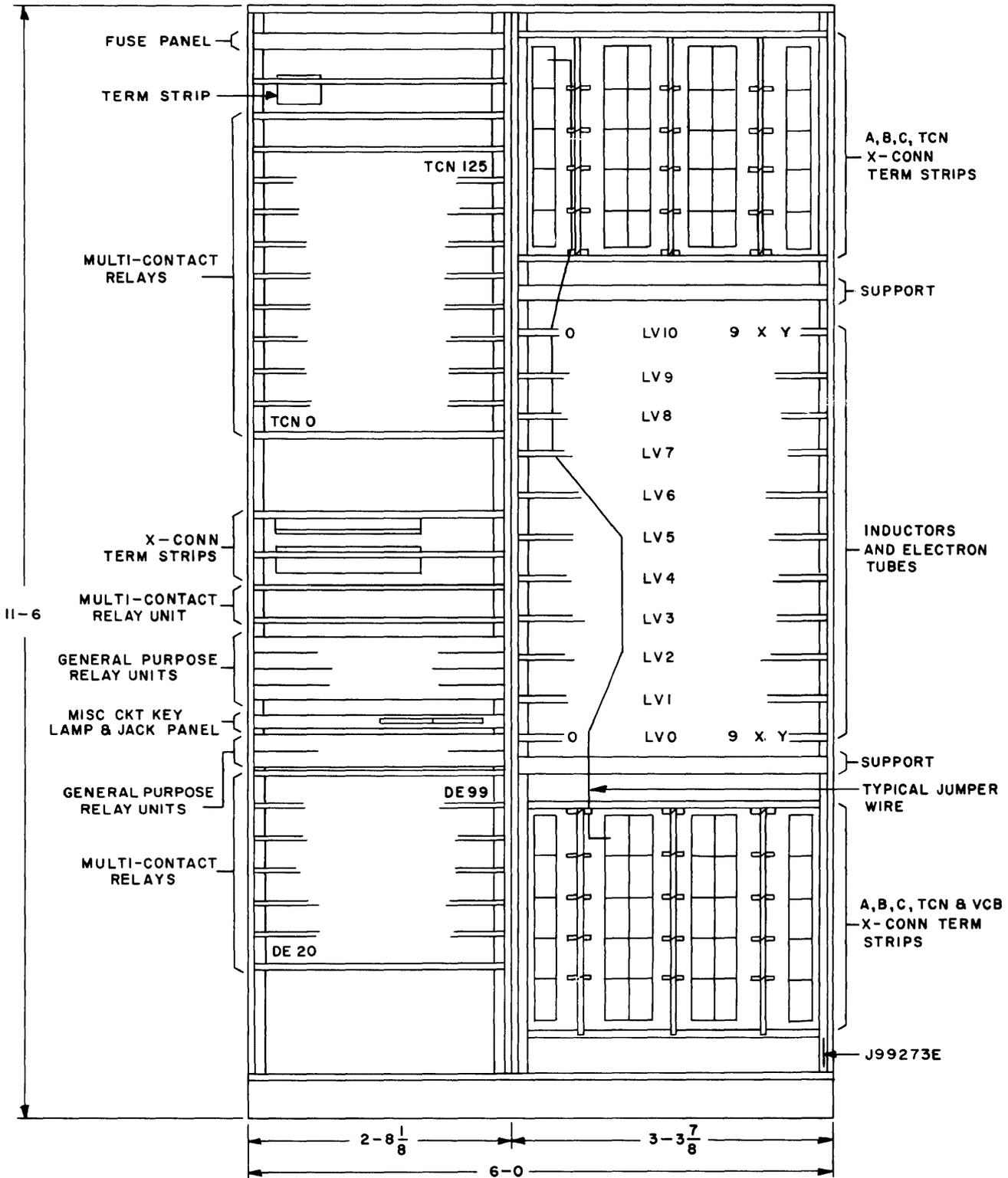


Fig. 67 — Rater Supplementary Frame

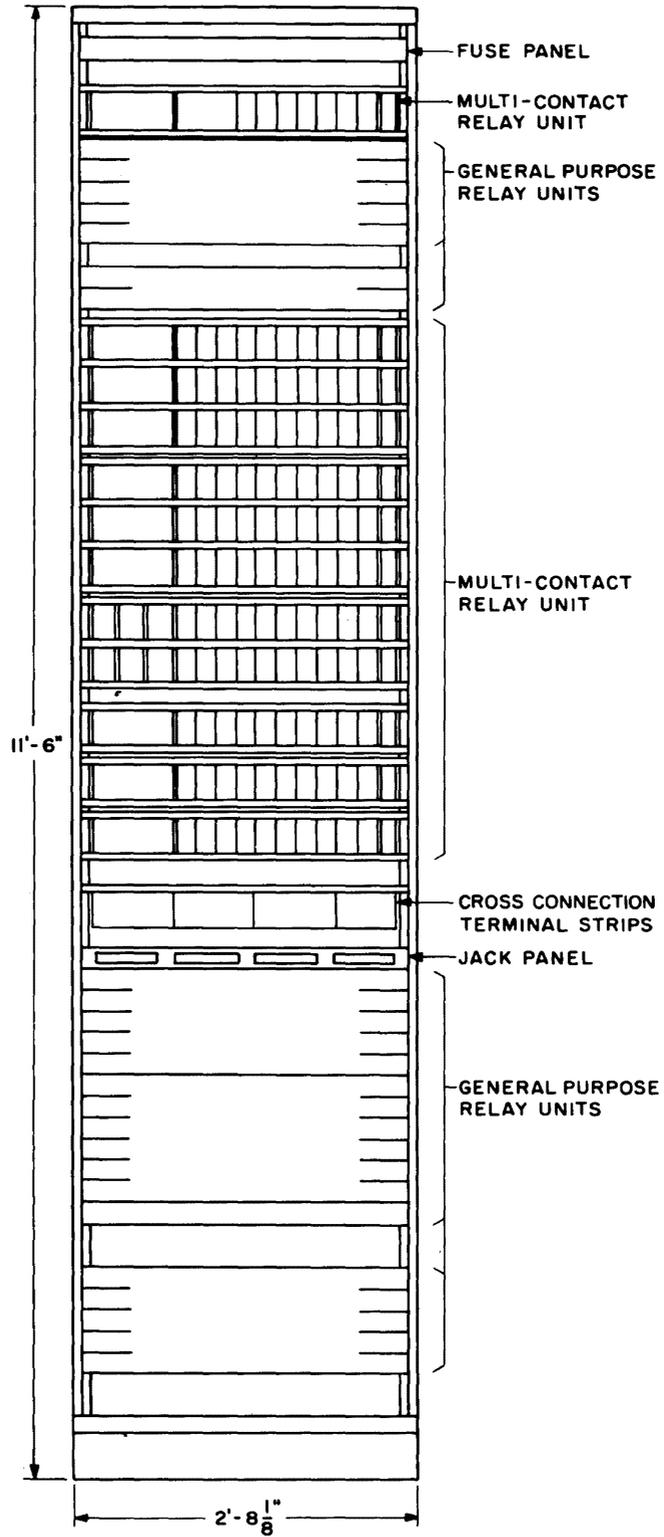


Fig. 68 — Coin Charge Computer Frame

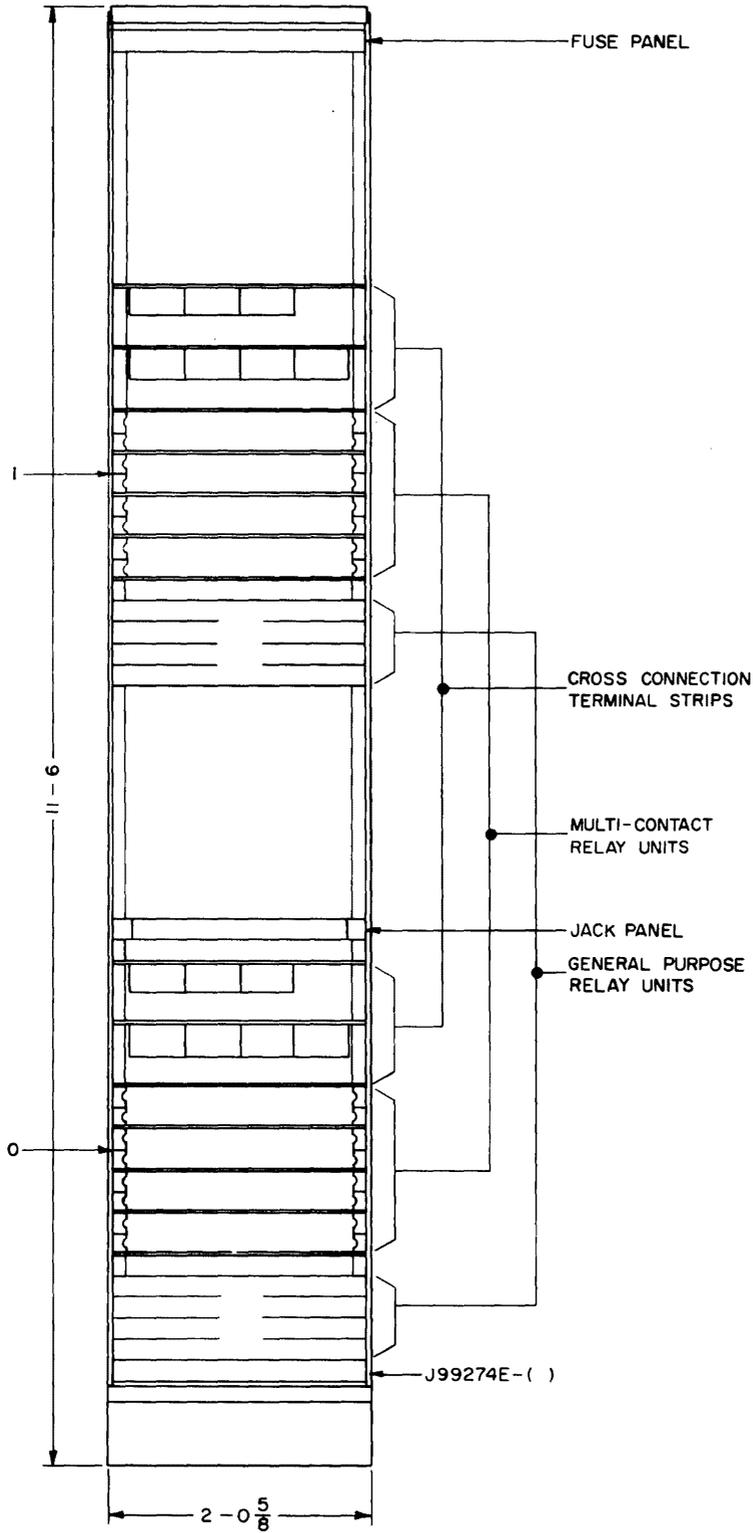


Fig. 69—Coin Charge Computer Supplementary Frame

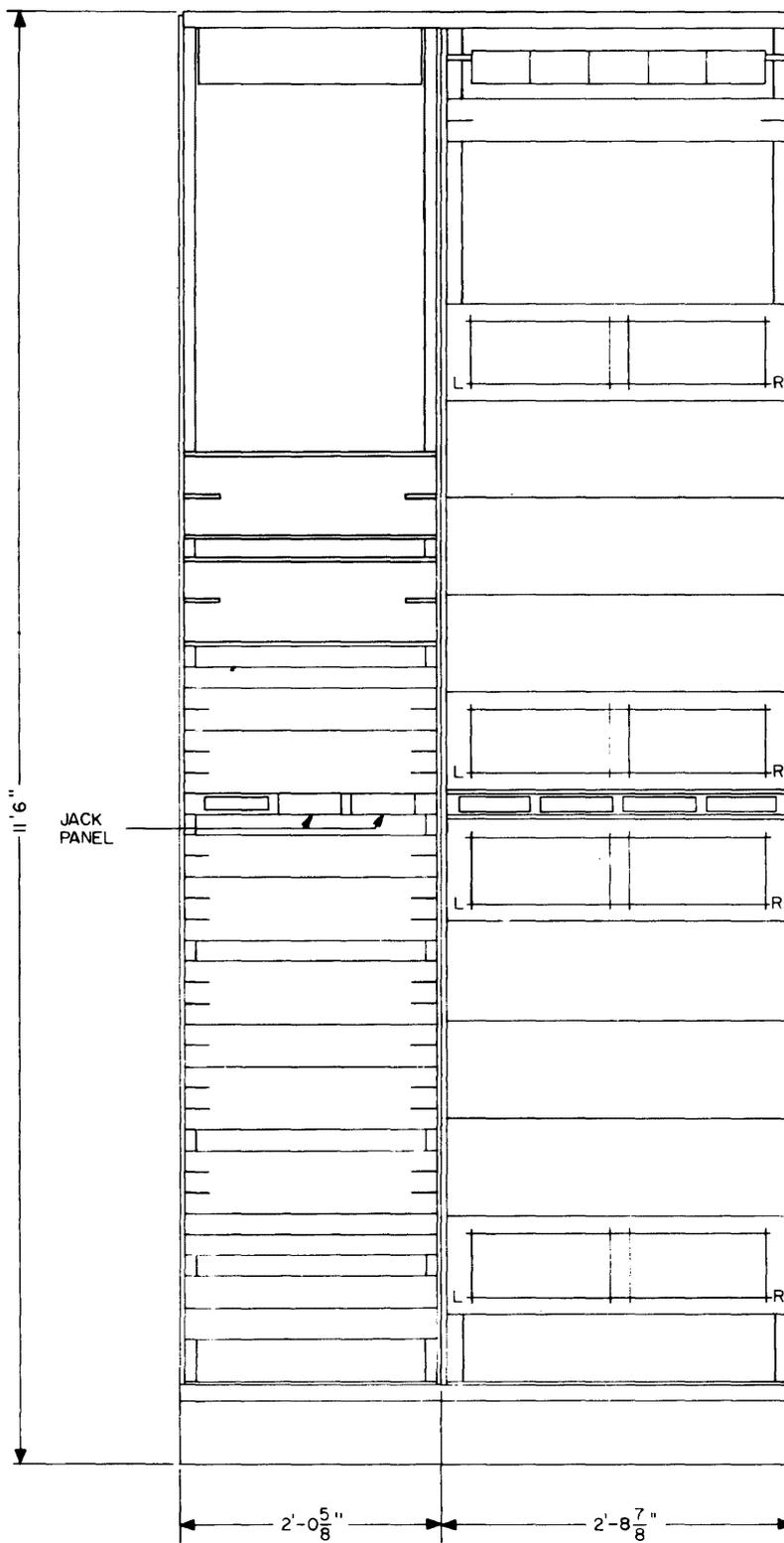


Fig. 70—Timer Link and Control Frame

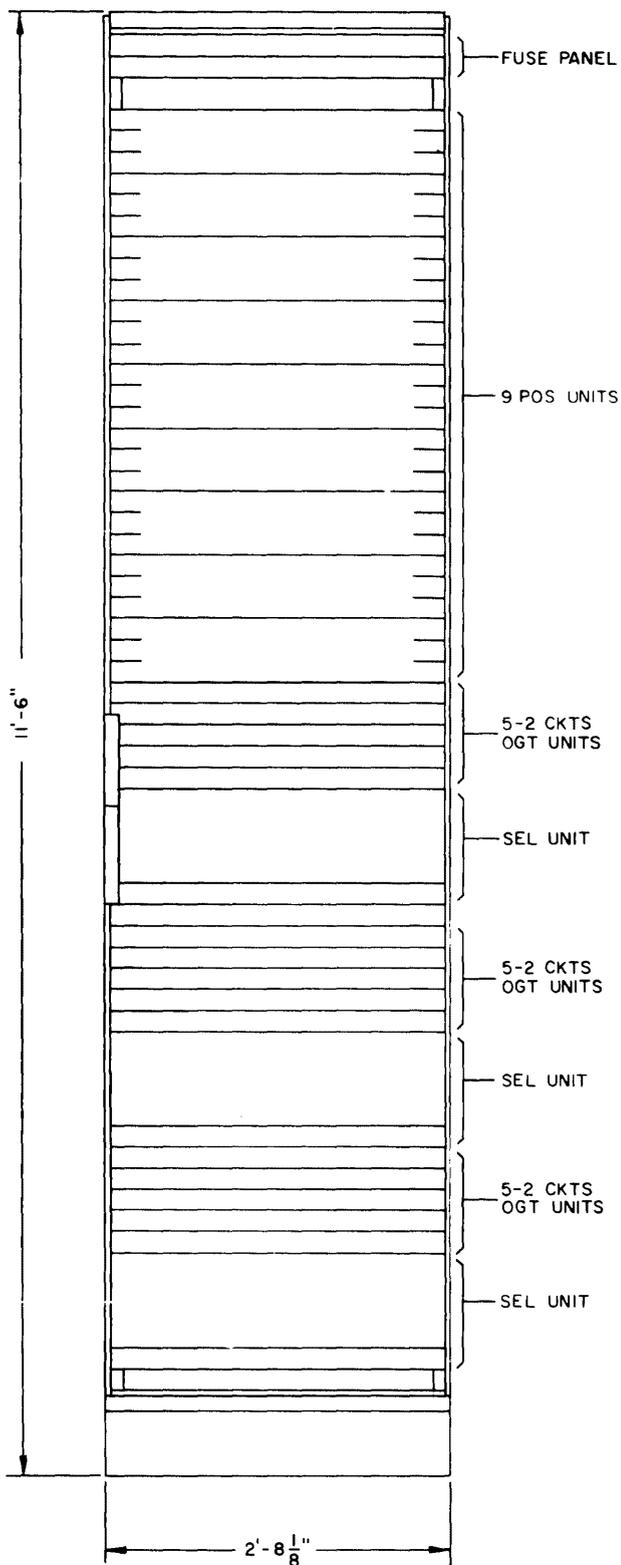


Fig. 71 — Operator Outgoing Trunk Frame

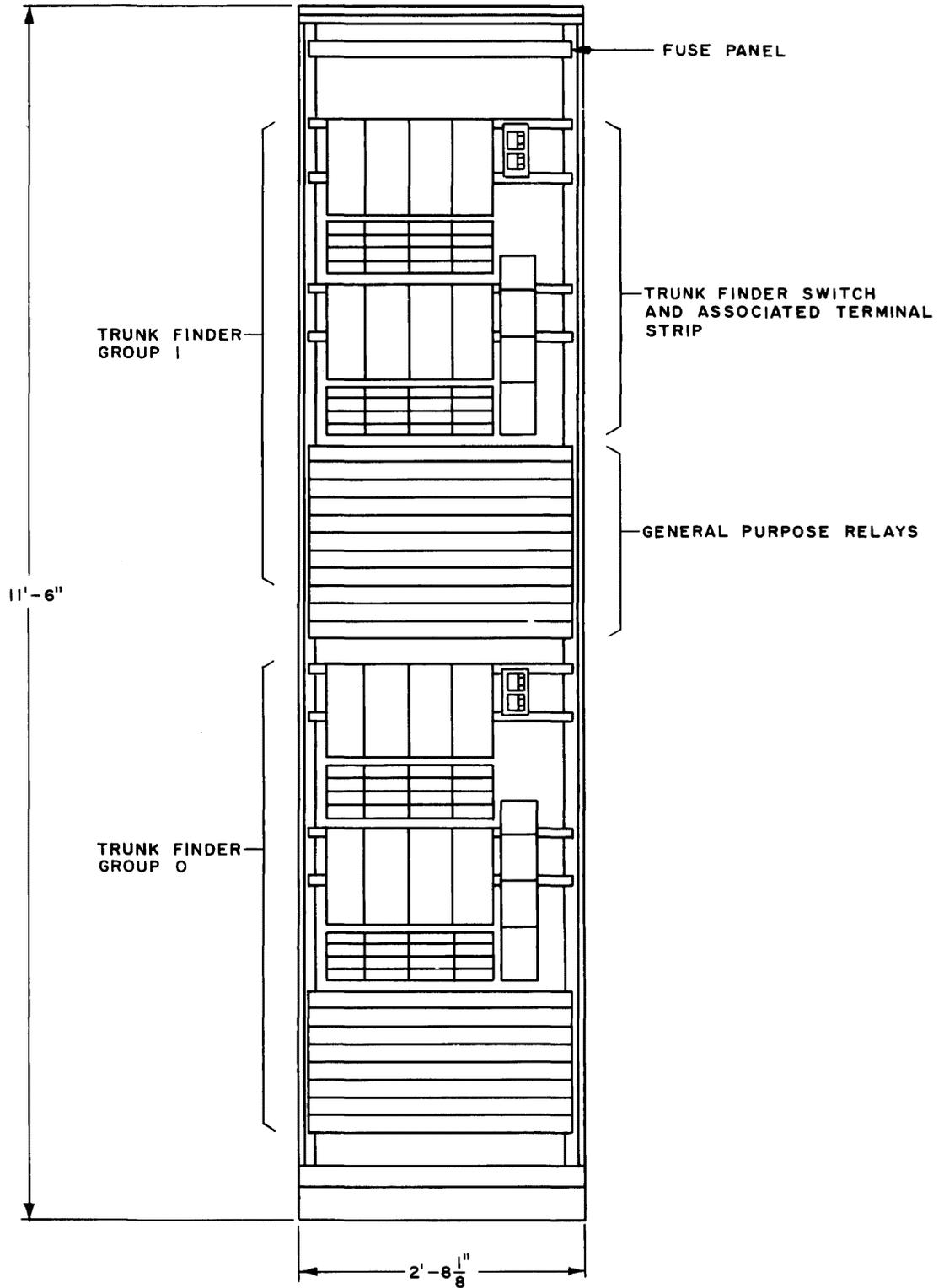


Fig. 72—Trunk Finder Frame

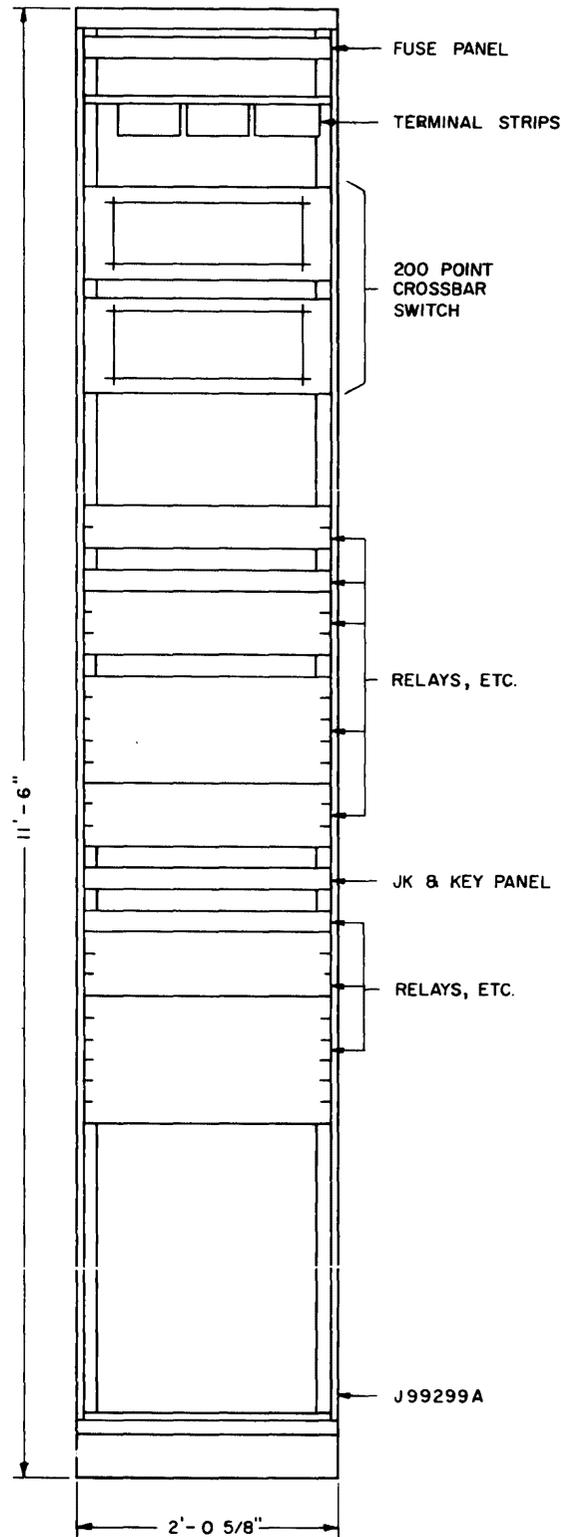


Fig. 73—Position Test Frame

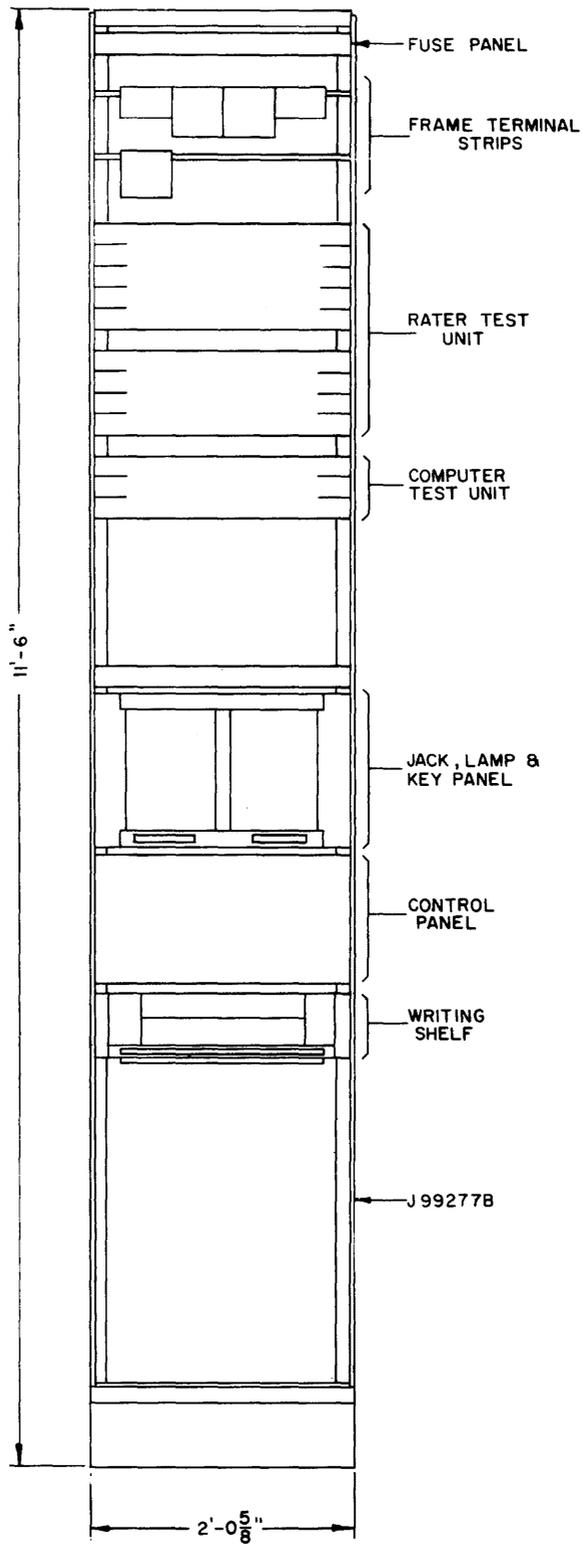


Fig. 74 — Rater Charge Computer Test Frame

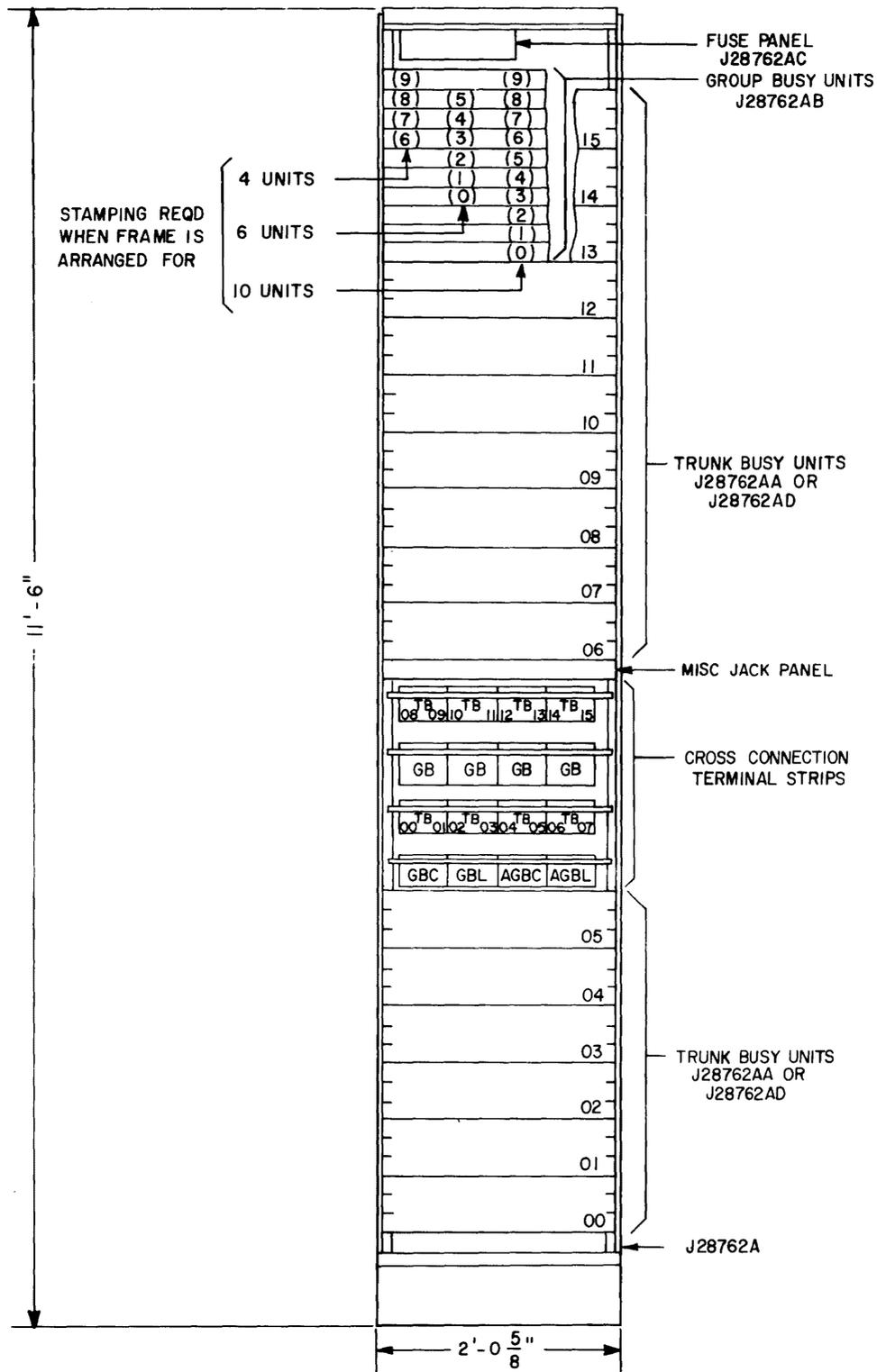


Fig. 75—Group Busy Frame

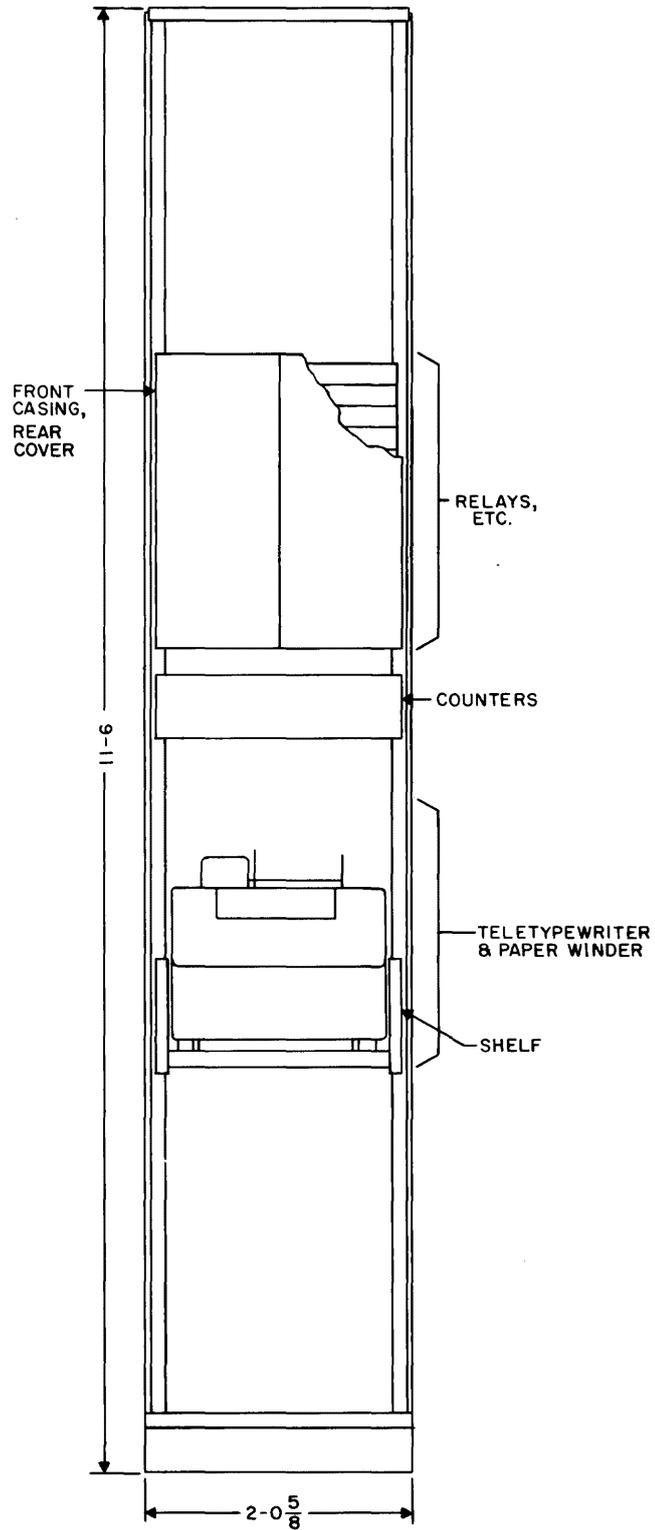


Fig. 76—Teletypewriter Frame

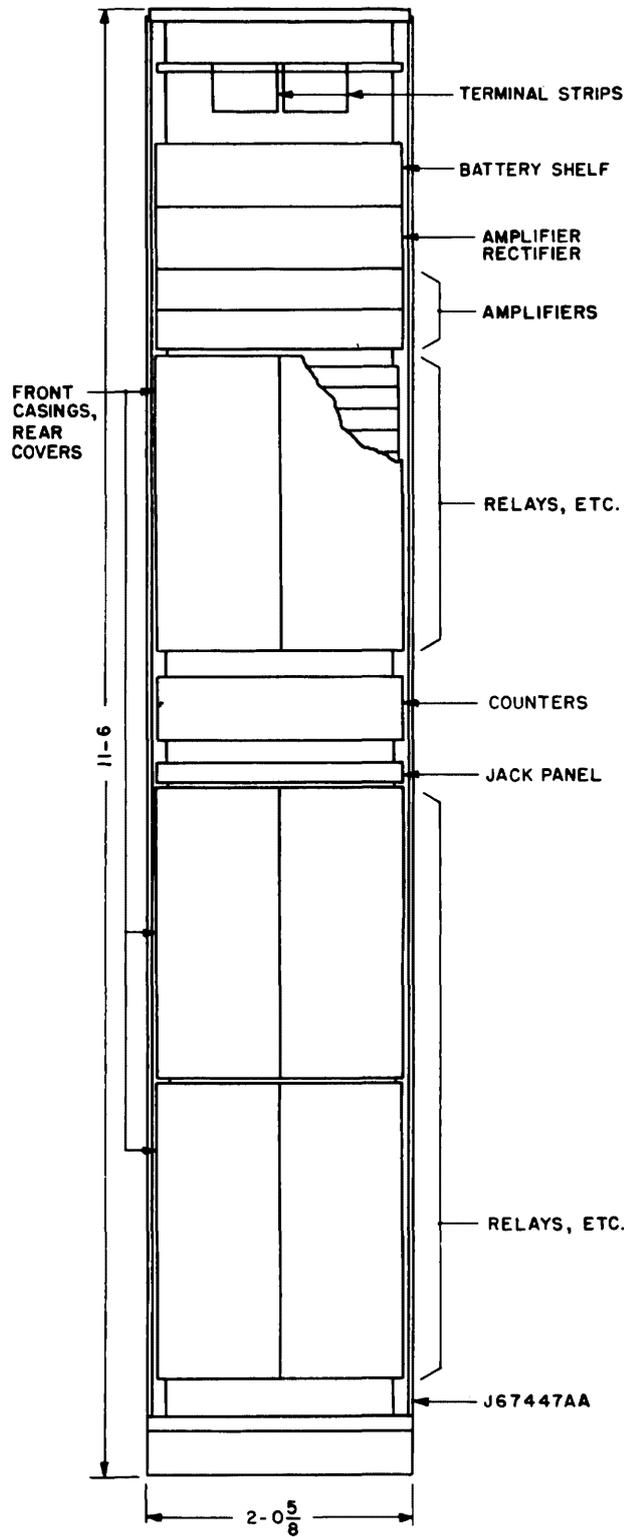


Fig. 77—Automatic Transmission Test and Control Frame

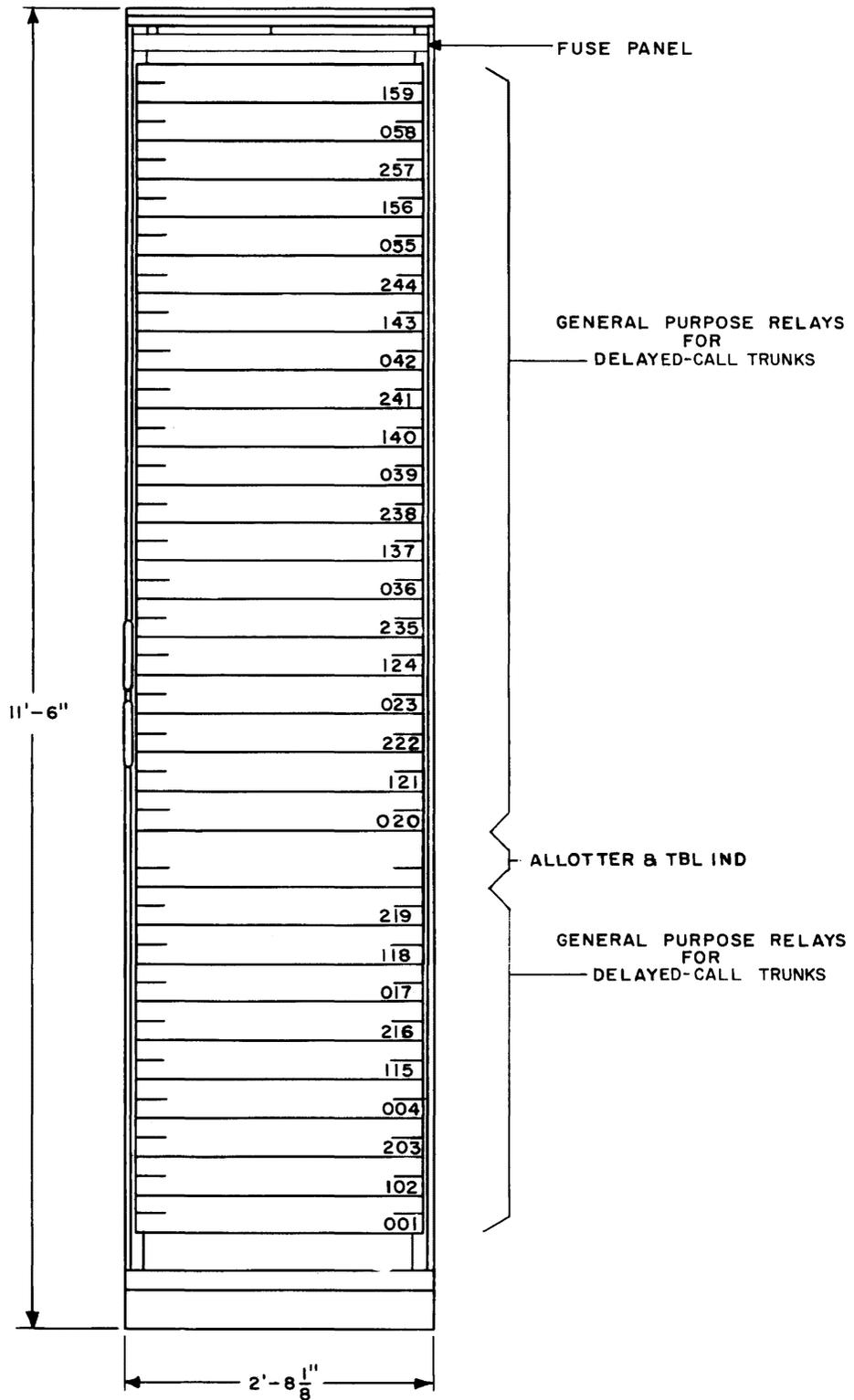


Fig. 78 — Delay — Call Trunk Frame

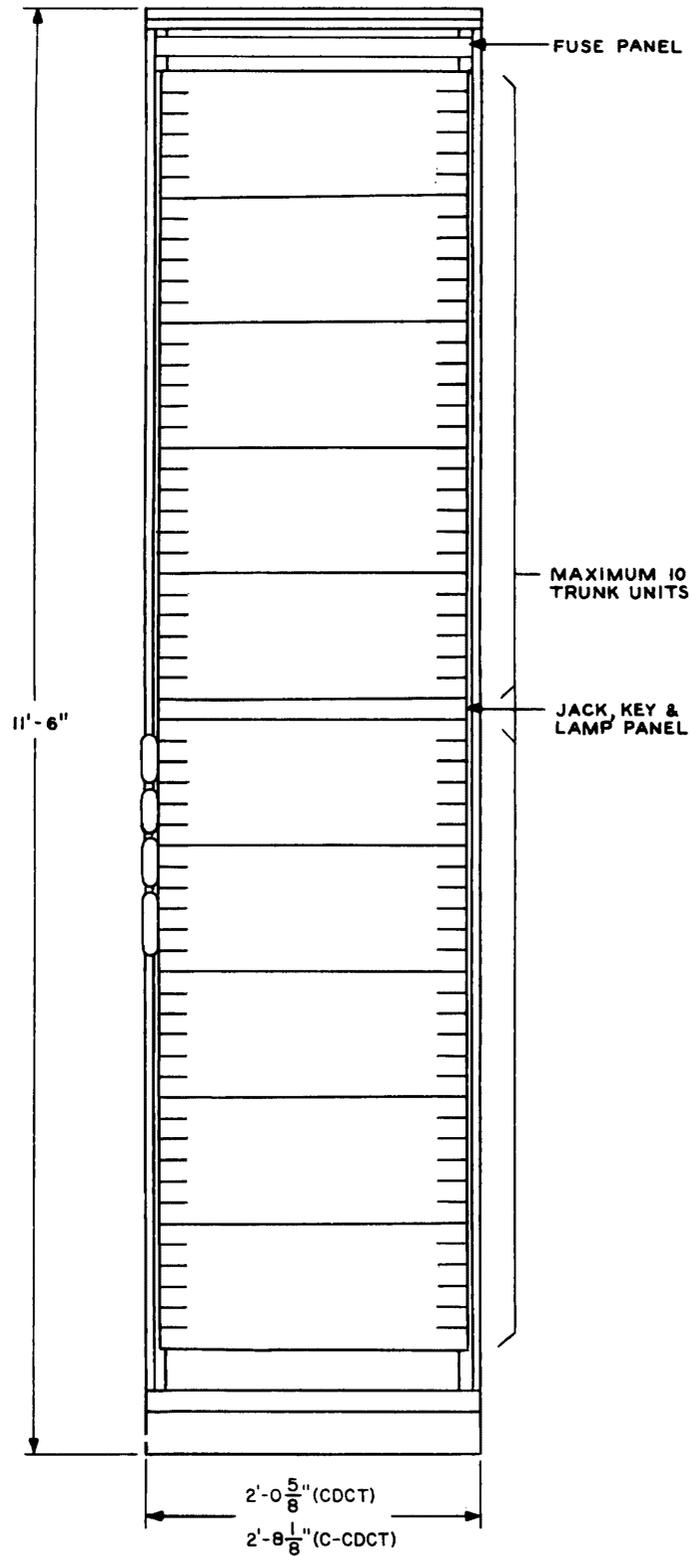


Fig. 79—AMA Centralized Dial Coin Trunk Frame

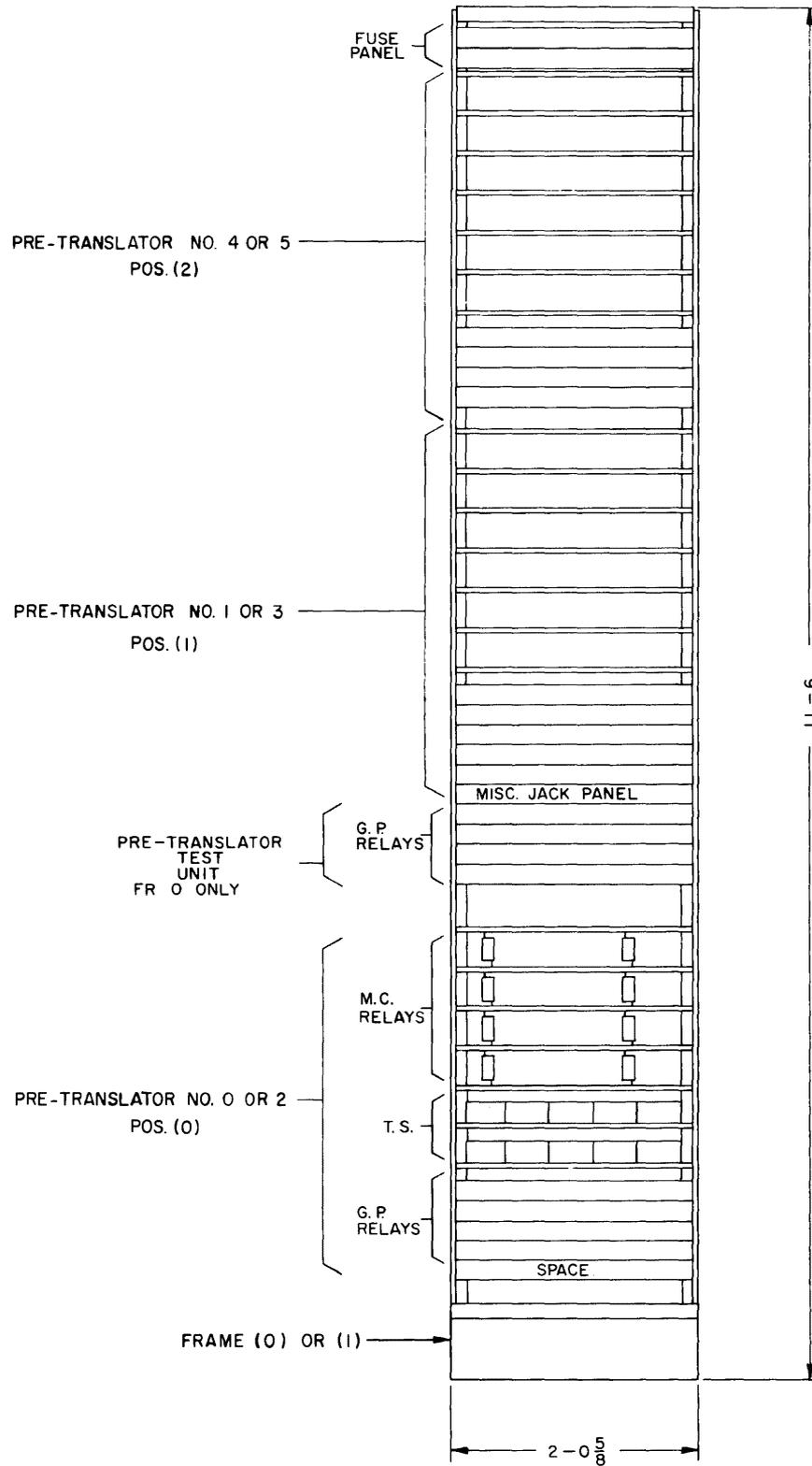


Fig. 80—Pretranslator Frame

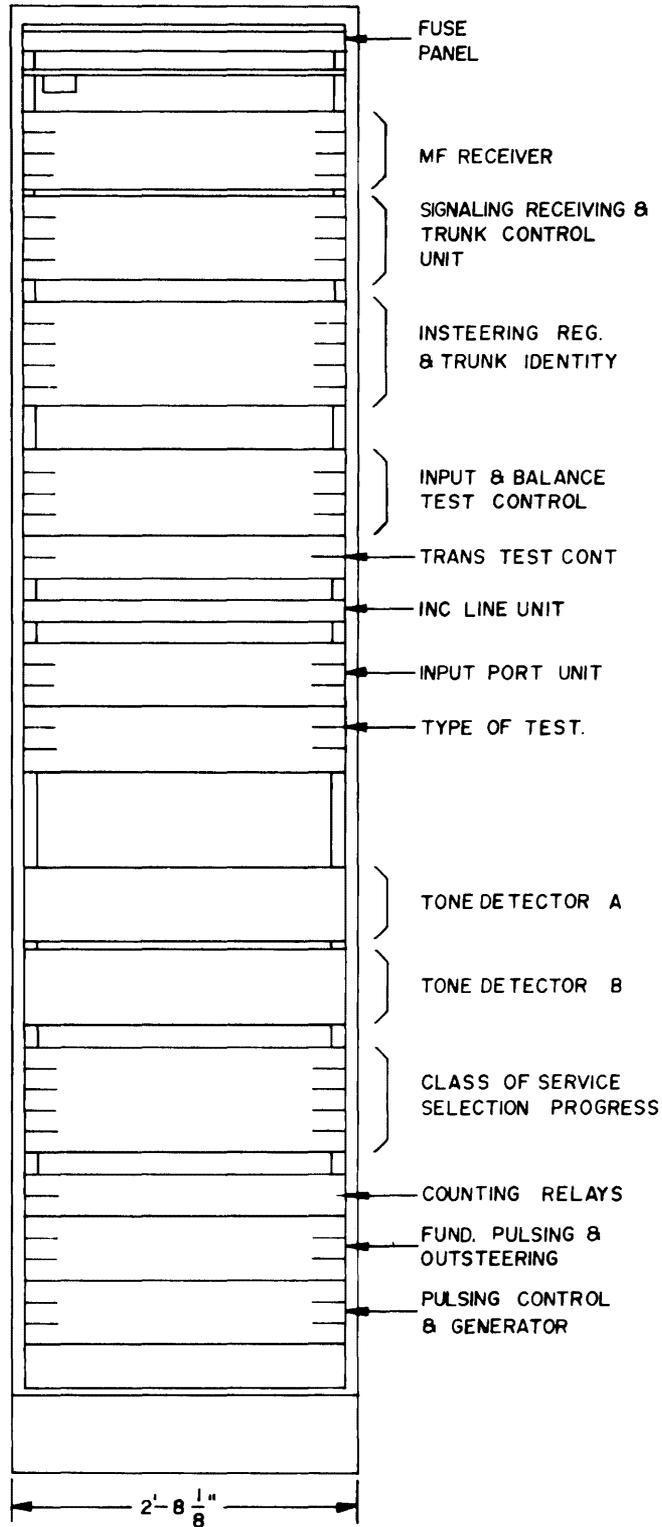


Fig. 81 — Remote Office Test Line Frame

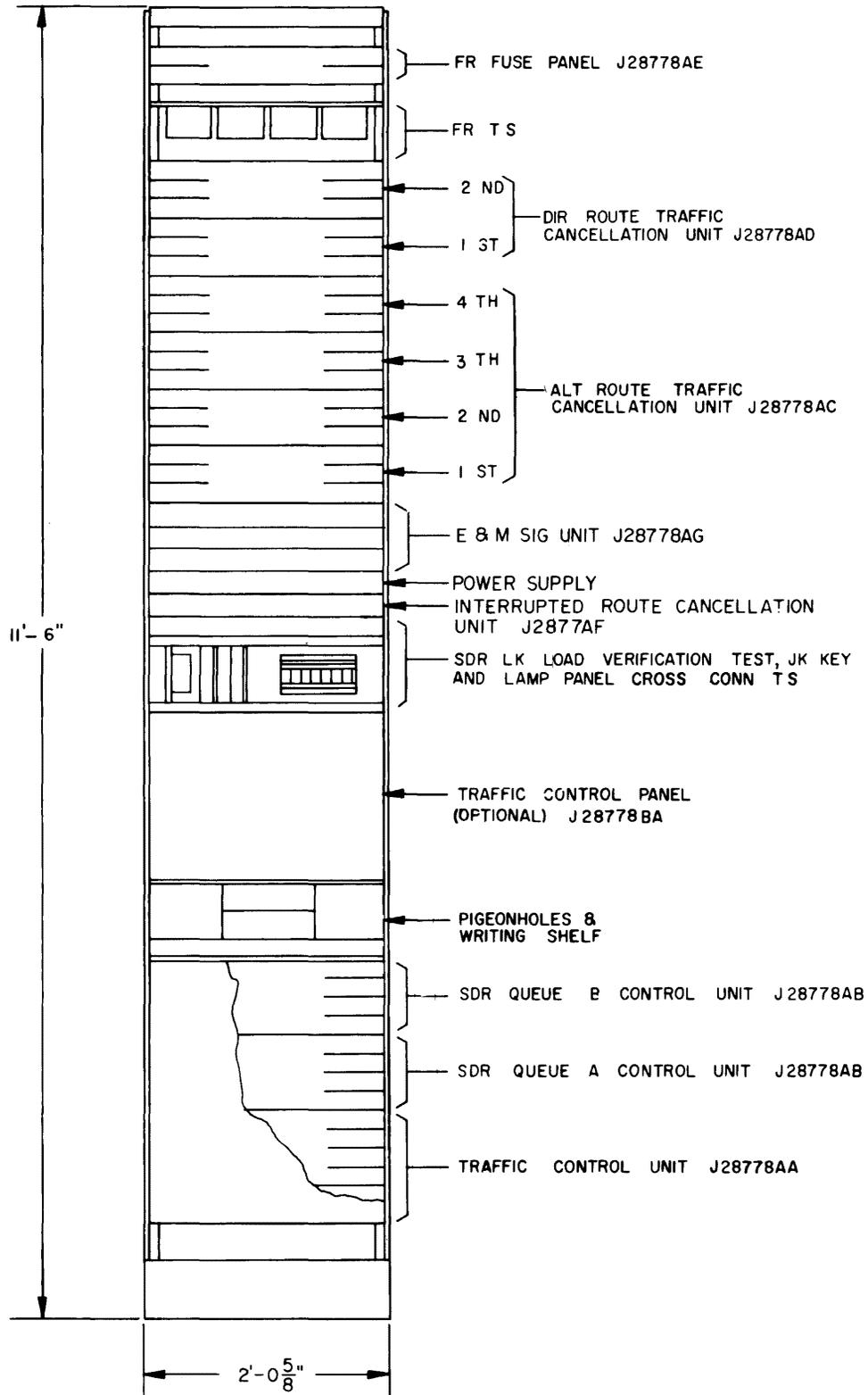


Fig. 82—Traffic Control Frame

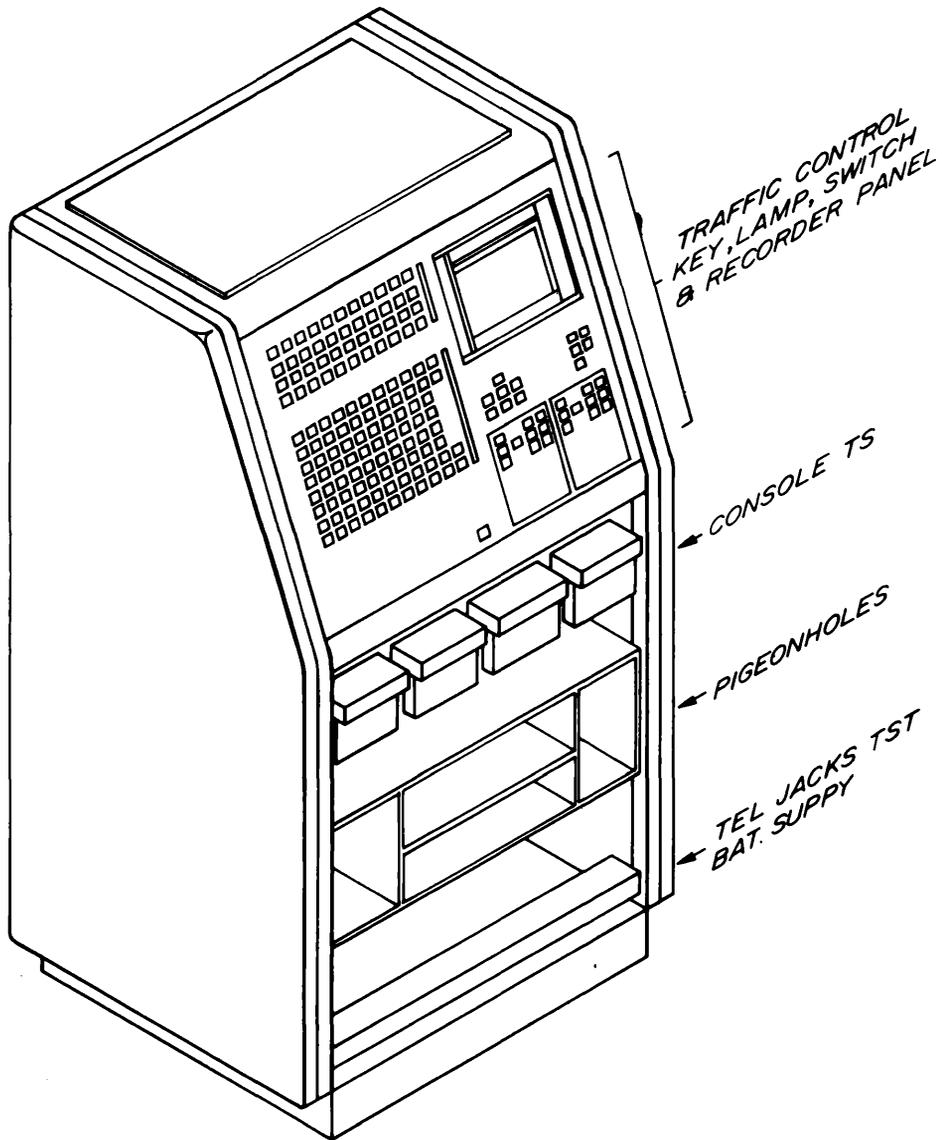


Fig. 83—Traffic Control Console

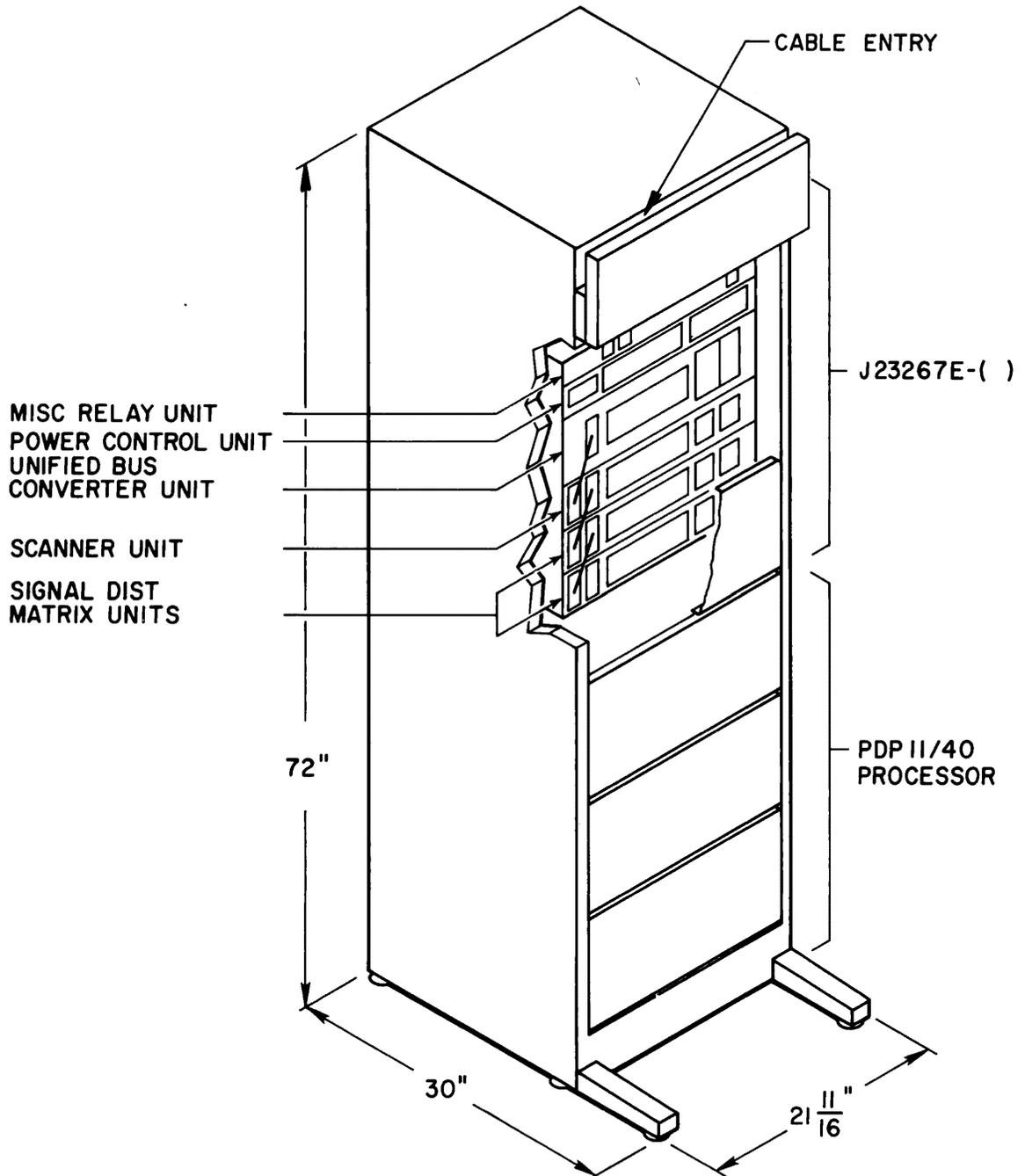
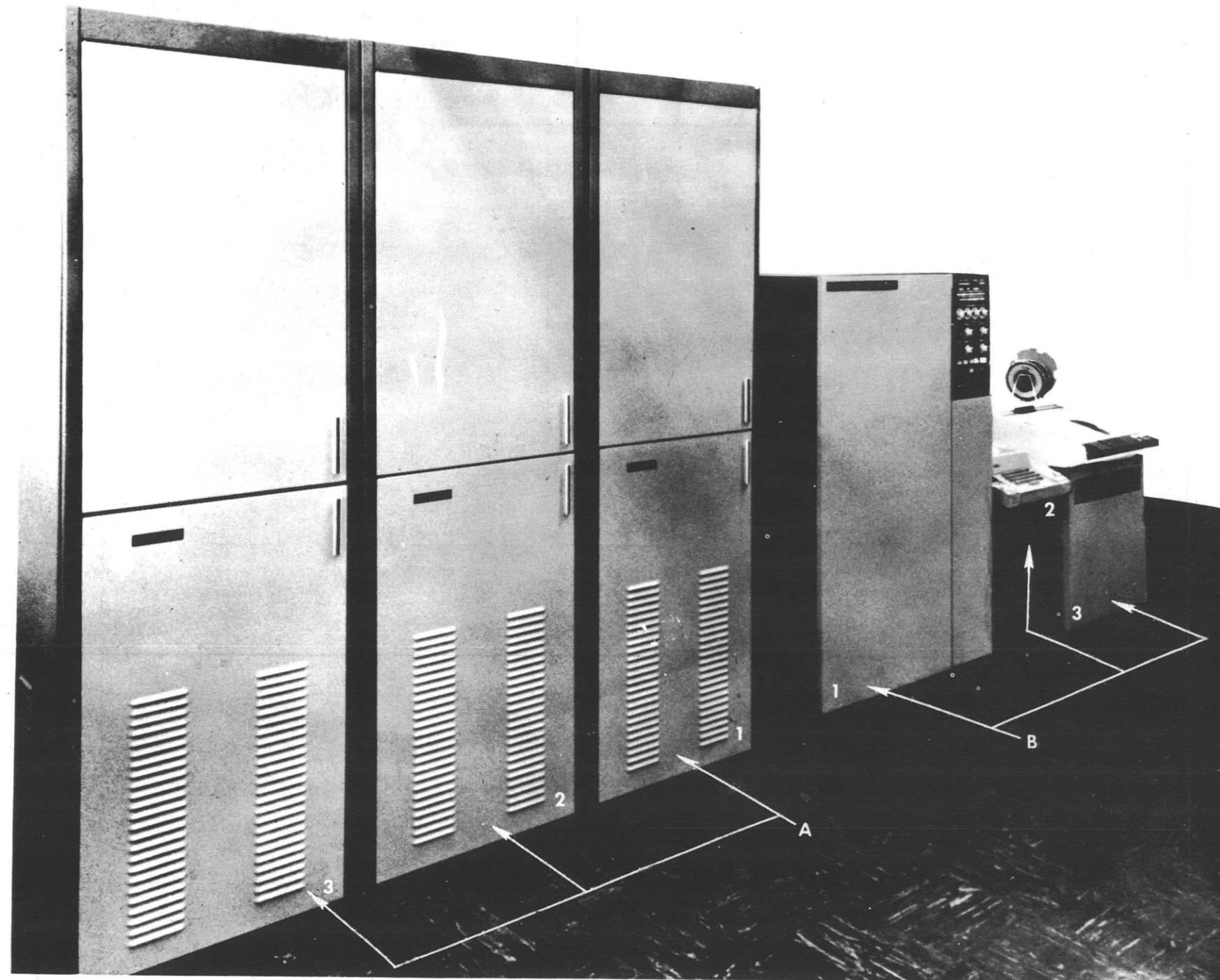


Fig. 84—Computerized Maintenance and Administration Support Cabinet



**A. SCAN CABINETS**

- 1. PS 0
- 2. PS 1
- 3. PS 2

**B. IBM SYSTEM/7**

- 1. PROCESSOR 5026-C3
- 2. OPERATOR STATION 5028
- 3. TAPE DRIVE CONSOLE 3140

Fig. 85—CAMA-C Primary System Lineup

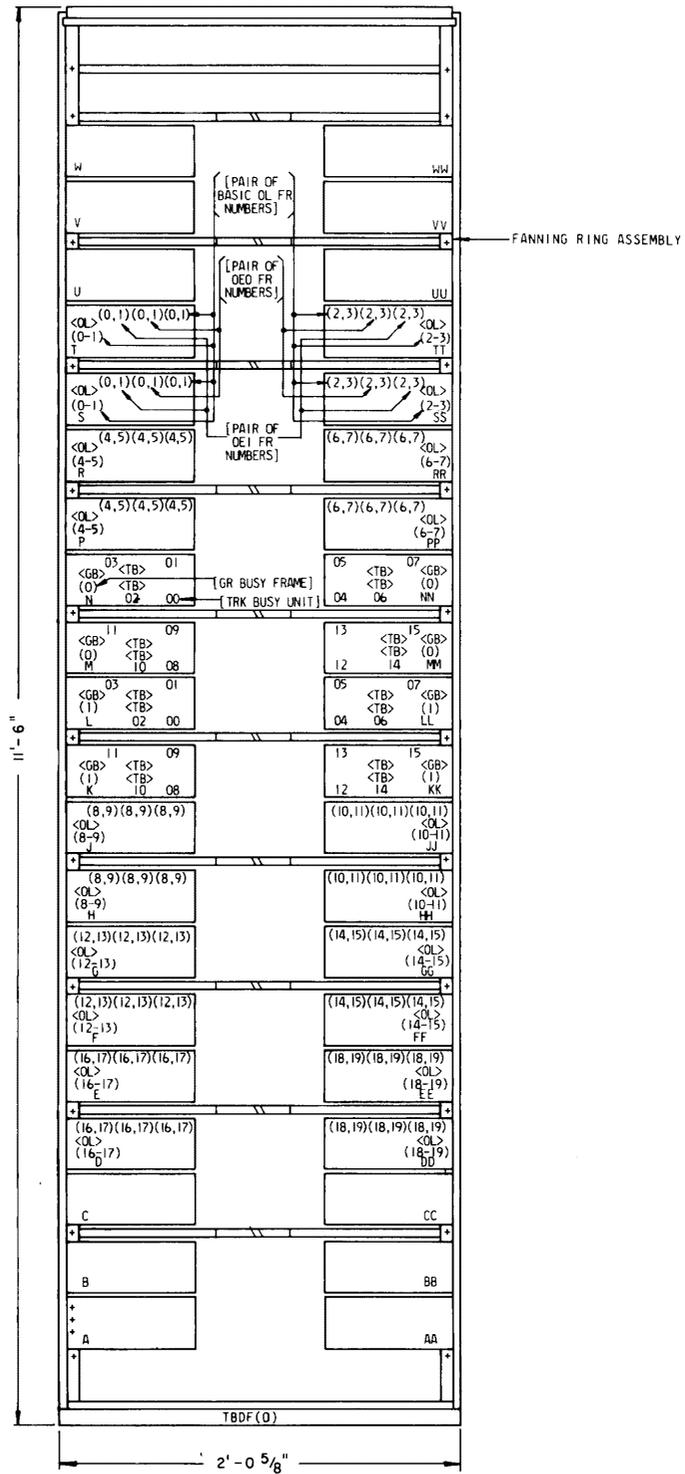


Fig. 86—Trunk Busy Distributing Frame

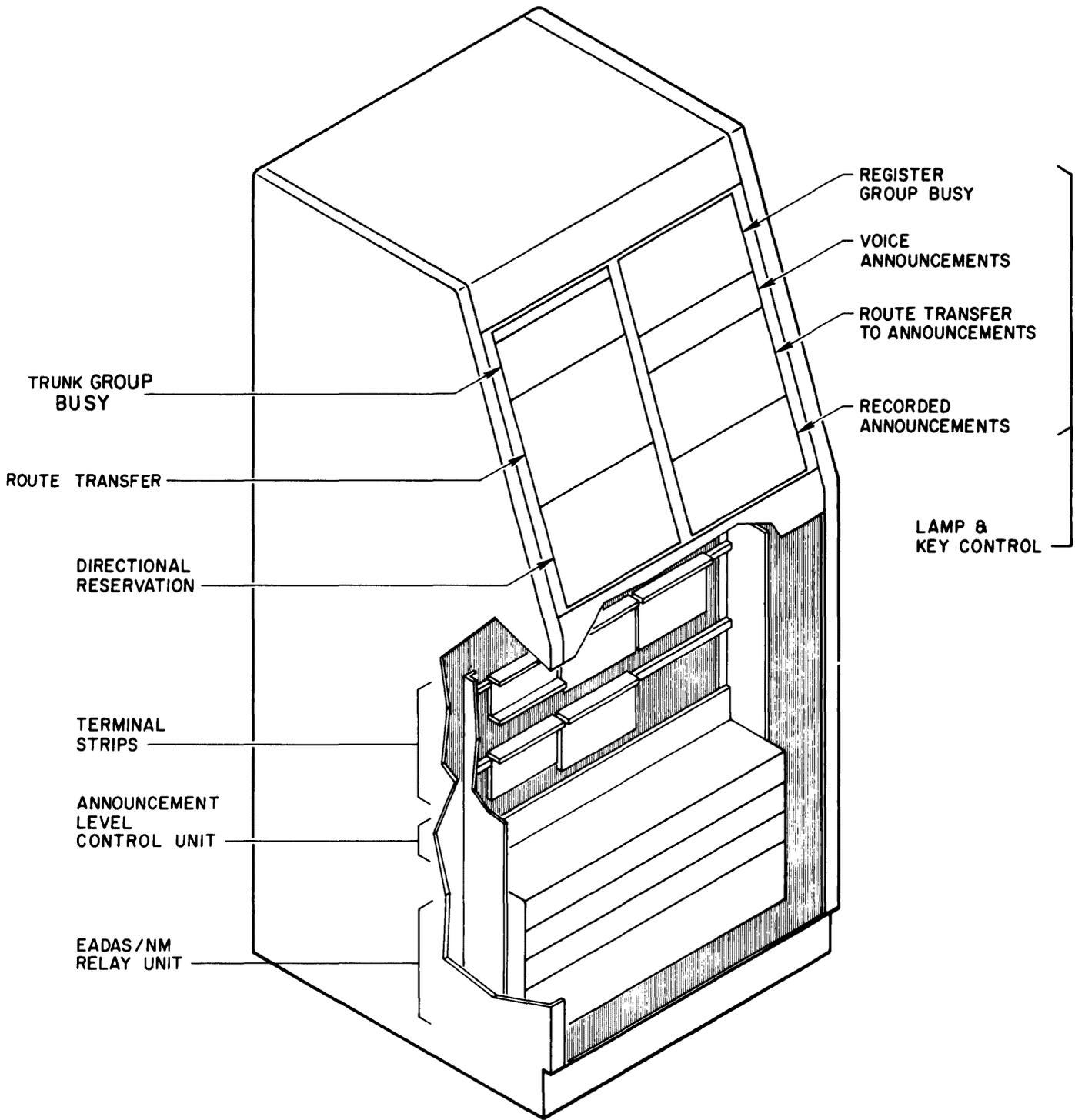


Fig. 87 — Traffic Supervisory Cabinet

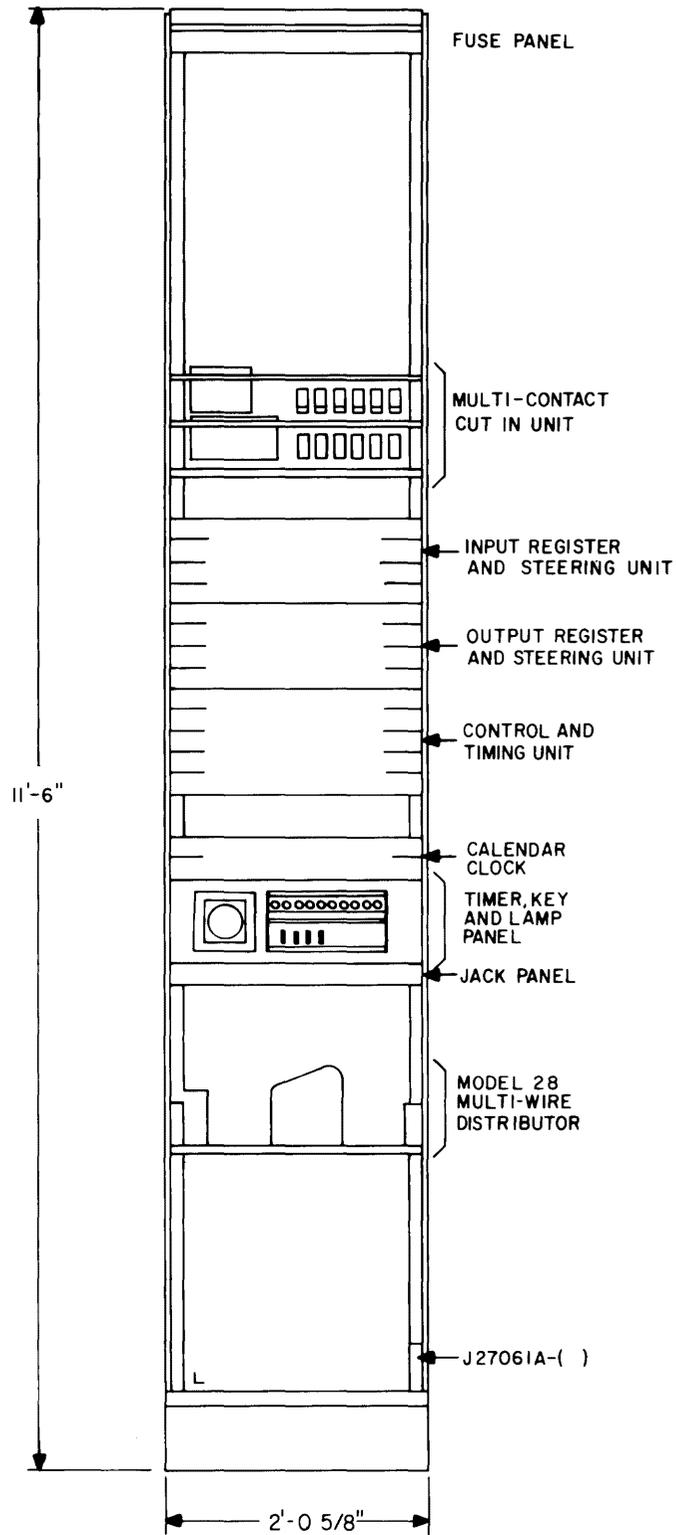


Fig. 88 — Point-to-Point Data Recorder Frame

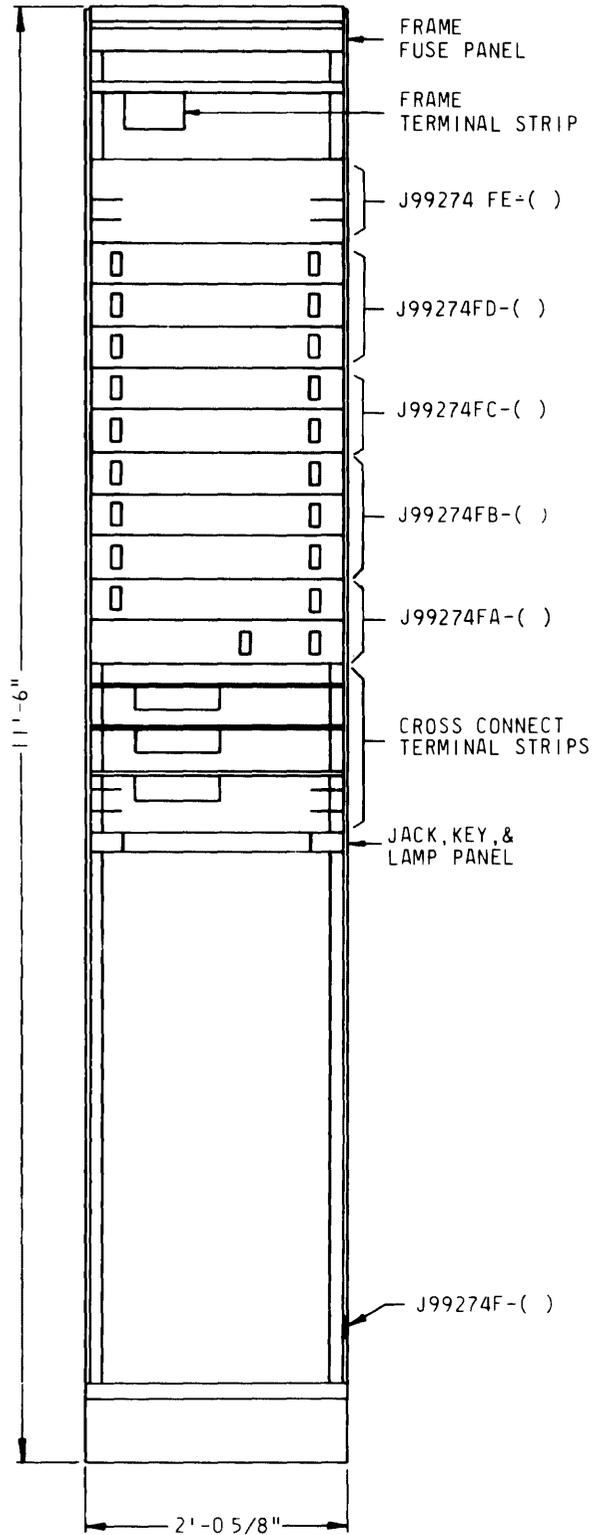


Fig. 89—Auxiliary Coin Charge Computer Frame

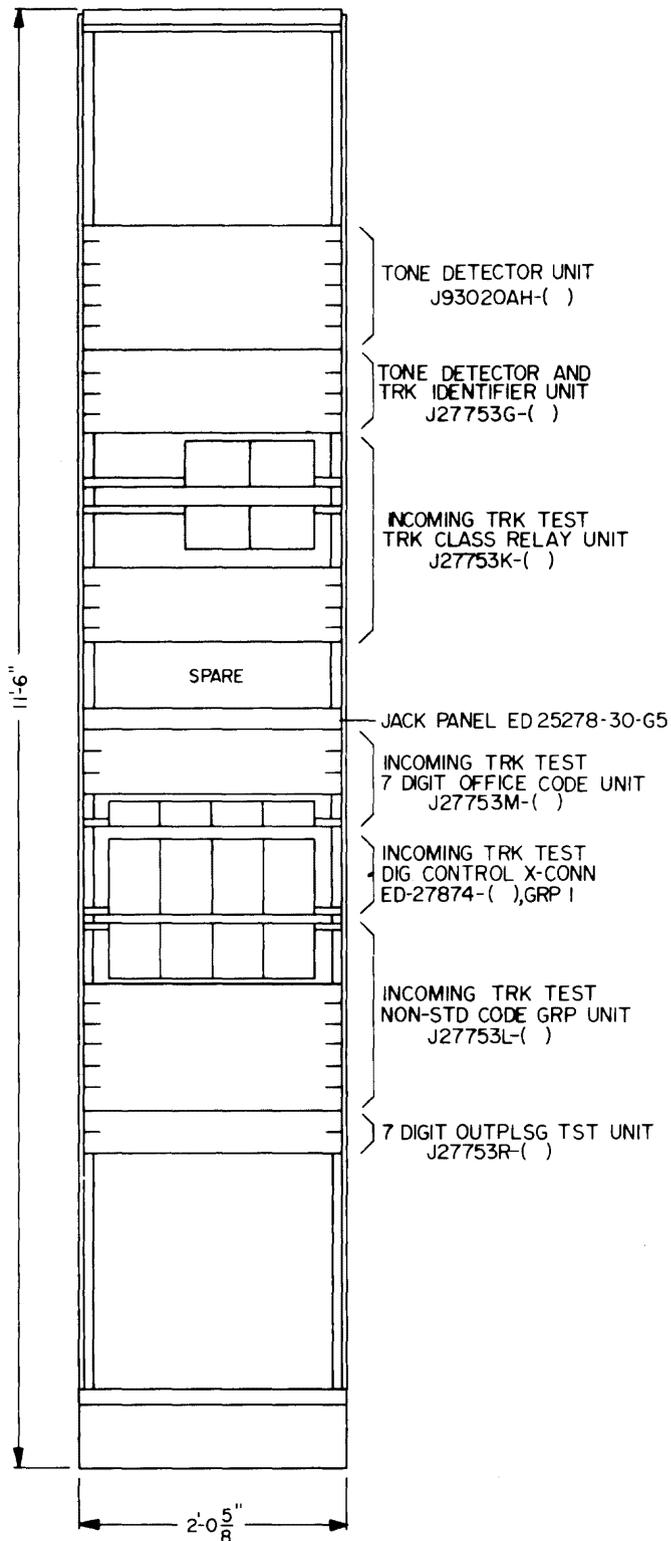


Fig. 90—Supplementary Incoming Trunk Test Frame