1A "ESS*" SWITCH

GENERAL DESCRIPTION

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1. GENERAL

1.01 This practice describes the operation and major characteristics of the 1A ESS switch.

1.02 This practice is a general reissue. New subjects added to this document include:

- Attached Processor System (APS)

- Circuit Switched Digital Capability (CSDC)

- Memory Spectrum

- Carrier Interconnection (CI)

- AUTOPLEX* System 100 (System 100)

- Automatic Message Accounting (AMA).

Since this is a general revision, arrows ordinarily used to indicate changes have been omitted.

1.03 A glossary of terms is provided in Part 11. Abbreviations and acronyms are provided in Part 12.

1.04 The purpose of this practice is to provide a general overall understanding of the 1A ESS switch and its applications. Other practices are referenced along with the related subject for more information.

1A ESS SWITCH OVERVIEW

1.05 The 1A ESS switch uses a high-speed electronic processor operating with a stored generic program to control the actions of the central office (CO) on a time-sharing basis. The 1A ESS switch is compatible with all existing CO equipment. The 1A ESS switch may be used as a growth unit in existing buildings, or as a dial-for-dial replacement without any station modification and minimum trunking changes at the distant office. The field use for the 1A ESS switch is common control switching, local, and toll tandem switching. The majority of 1A ESS switch features are included in feature documents. For a listing and brief explanation of most 1A ESS switch features, refer to Practice 231-090-011.

1.06 The 1A ESS switch is an automatic common control type switching system directed by a generic program. See Fig. 54 for a functional block diagram of a 1A ESS switch. A 1A ESS switch differs greatly from electromechanical switching systems in the devices employed as well as in the call handling techniques used. The system makes extensive use of solid-state devices with rapid operating speeds which permit a relatively small quantity of equipment to perform the control functions. Variations and modifications are accomplished primarily by changing the stored generic program or data tables rather than by changing hardware and wired logic.

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2. BASIC SYSTEM TECHNIQUES

2.01 Several basic system techniques used in the 1A ESS switch are:

- Stored program control

- Functional concentration

- Time-shared control

- Optional feature loading

- Modular design

- Plug-in equipment units

- Duplication

- Automatic fault location and system reconfiguration.

2.02 *Stored Program Control:* The functions performed by the system are specified by software programs consisting of combinations of precisely defined instructions. Examples of such program instructions are: observe the state of a specified group of lines, add two specified quantities, observe the sign of a specified quantity, and decide which of the two alternatives to execute. The program instructions, suitably encoded, are stored in memory units from which they are transmitted to the central control (CC) of the 1A processor for interpretation and execution. It is possible for control of the system to be altered by changing a stored program without circuit modification.

2.03 *Functional Concentration:* The system equipment is concentrated into a small number of highly efficient units, each specialized in some broad system function, such as control, input, output, memory, etc. The result is a simple overall 1A ESS switch equipment organization.

2.04 *Time-Shared Control:* A single CC directs the operation of all other system units in accordance with program instructions. Using electronic devices, the CC can operate at speeds much faster than the rate at which events associated with a single call occur. Consequently, the CC is time-shared for all the calls handled by the system. Time-shared control is accomplished by subdividing the task required to process a call into small segments and by interweav-

ing the segments with those segments of other calls. In addition, certain operations can be performed concurrently on behalf of a number of calls.

2.05 *Modular Design:* System units are provided in modular blocks for economy and convenience in office growth.

2.06 *Plug-in Equipment Units:* A major portion of the system units are plug-in units. Faulty units can be replaced quickly and conveniently.

2.07 *Duplication:* To insure uninterrupted customer service, equipment whose failure would affect a large number of customers is duplicated. For example, the 1A ESS switch includes a duplicated CC. Both CCs operate side by side on the same input information, with one CC given an active status and the other as stand-by. If a fault occurs in the active CC, it is removed from service and the stand-by CC is switched to active status with no loss in customer service. Another example would be that the active program store (PS) is backed up by two spare PSs.

2.08 *Automatic Fault Location:* The 1A ESS switch automatically performs a large part of its own checking for system troubles. Within the 1A processor, this check is accomplished by comparing the outputs of duplicated units. In the peripheral community, this checking is performed by scanning of maintenance points. When trouble is detected, system diagnostic tests indicate which unit is in trouble and fault recovery programs remove it from service. Further trouble analysis aids maintenance personnel in determining exactly what caused the fault.

CUSTOM CALLING FEATURES AND SERVICES

2.09 *Custom Calling Features and Services:* A variety of features and services are offered by the 1A ESS switch to meet different customer needs. Several of the major custom calling features provided by the 1A ESS switch are shown below.

A. Speed Calling

2.10 The speed calling feature permits a customer to dial abbreviated codes for frequently called numbers. This feature is available for individual lines or on a group (centrex) basis. Speed calling allows the dialing of a number by using a code which has fewer digits than the called directory number

(DN). The customer changeable speed calling feature allows the customer to assign and make changes to the code list and speed calling list. For more information on the speed calling feature refer to Practice 231-090-401.

B. Three-Way Calling (Add-on)

2.11 The three-way calling feature allows a third party to be dialed of keyed into a two-party established connection and is available for use with individual noncoin and non-PBX lines. The feature includes both consultation hold and add-on capabilities. The three-way calling customer may hold one party with privacy exclusion while dialing and talking to another party in a three-way connection. For more information on the three-way calling feature, refer to Practice 231-090-080.

C. Call Waiting

2.12 The call waiting feature sends a two-tone burst to a talking customer when a third party is calling. The customer with the feature may answer the calling third party by flashing the switchhook, which puts the original call on hold. Switchhook flashes may be used by the customer to alternate between the two connections. To terminate the original call, the call waiting customer disconnects. Once the disconnection is made, ringing occurs to the calling waiting customer. When answered, a connection is established to the calling party. For more information on the call waiting feature, refer to Practice 231-090-081.

D. Call Forwarding

2.13 Call forwarding is a group of features that allows a customer to automatically route all incoming calls to another line. The customer selects which line all incoming calls will be routed to. For more information on all of the services provided by the call forwarding feature, refer to Practice 231-090-073.

SOFTWARE ORGANIZATION

2.14 The software that controls the 1A ESS switch is organized as a generic program plus a data structure which is made up of parameter data and translation data.

2.15 *Generic Program:* The generic program is a general purpose switching system control program that is to be installed in every 1A ESS switch as opposed to each office having an individually tailored control program. The primary reason that this approach is taken is that all of the support effort required to maintain the program, implement new features, etc, would become completely unmanageable if it were to be required on a per-office basis.

The 1A ESS switch generic program includes:

(a) Base

   (1) Core

   (2) Base Features

(b) Optional Feature Packages.

The base is always included in a generic program and is made up of a core and base features. The core includes routines to provide normal telephone service. It also includes essential maintenance and administrative functions. Base features are new features developed for a certain generic and are always located within the base as a relocatable feature package (FP). Optional FPs are individually selected by telephone companies for each particular switching office. Selected combinations of optional FPs are offered as optional feature groups. Most optional FPs are separately loadable; that is, if they are not requested by a telephone company, no program store space is allocated to them. Some of these features, however, are included within the base and their usage controlled by software switches located in parameters. For this type of optional FP, program store space is always required even though the office may not have access to that feature.

2.16 *Parameter Data:* The parameter data is the engineered part of the data which defines, for each office, the services which that office has available to its customers. It also contains the information about what equipment exists in the office and what call store (CS) memory allocations have been made.

2.17 The only time it is necessary to make changes to the parameter data is when a hardware or software modification of the office occurs. The hardware modifications are typically growth situations where equipment frames are being added. The software modifications are usually the result of a reissue of the generic program made to improve some segment of the code, incorporate new capabilities into the program, or correct any program errors which may have been detected. The type of office information contained in parameters is of five basic types:

- Equipment items

- Software (usually traffic dependent)

- Certain master scanner (MS) and central pulse distributor (CPD) assignments

- Office options

- Translation to parameter compatibility.

2.18 *Translation Data:* The translation data contains the specific details about each line, trunk, service circuit, and other equipment units in the office. For the customer line, the information includes the services to which the customer subscribes, the type of equipment on the customer's premises, and the relationship of his DN to the line equipment number. The trunk and service circuit translation data includes which trunks are associated in each trunk group, etc. The translation data also contains the data which is used to translate office codes, determine routing and charging information as to the disposition of irregular calls, such as partially dialed numbers or misdialed numbers.

2.19 The translation data is subject to continuing changes since new customers are being added daily and old customers are moving or changing the services to which they subscribe. The trunk translations are similarly being changed to keep efficient trunk group sizes, modify routing and alternate routing plans, and to change charging information when telephone rates change. In order to make these changes, the generic program provides the ability to input the required modifications to the translation data. Since this is a continuing process, it becomes the telephone company's responsibility to manage the translation data.

3. MAJOR SYSTEM FEATURES

AUTOPLEX SYSTEM 100

3.01 The Autoplex System 100 (System 100) feature is a mobile telephone service based on a

cellular design. This feature is available with the 1AE7 generic and later programs. It provides individual and business customers with telecommunication between mobile units and also between mobile units and the public switching network. The primary system in this feature includes the mobile telephone switching offices (MTSOs), cell sites, mobile units, cell site voice trunks, and cell site data links. Each subscriber's mobile unit has a mobile identification number (MIN) which is assigned to a particular home mobile service area (MSA). Subscribers may also travel outside their home MSA as a roamer and obtain mobile telephone service from foreign MSAs. The MSA is a geographical area that is made up of hexagonal shaped cells. The cells are grouped into patterns and each cell site is assigned radio frequency channel sets. The available radio frequencies are limited and are efficiently reused by reducing a cell site's transmission power and repeating the cell patterns throughout the MSA. In this manner, many subscribers may occupy the same radio frequency at the same time without interference.

3.02 The MTSO is a modified 1A ESS switch and does not have lines. The primary system is interfaced to the DDD network via voice trunk transmission facilities between the MTSO and local exchanges (zone offices). The MTSO connects to cell sites with cell site voice trunks and cell site data links. A cell site is a an installation containing the radio and control equipment that completes the talking path to and from mobile units. A mobile unit is the full complement of equipment interfacing a subscriber with a cellular system. For a system description, refer to Practice 231-200-005; and for maintenance considerations, refer to Practice 231-200-020. A complete listing of System 100 documents is provided by Practice 231-200-000 (when available).

CENTREX SERVICE

3.03 The centrex (CTX) feature is a large business service package that provides many individual stations on the customer premises with access to direct-inward-dialing and automatic identified outward dialing (AIOD) capabilities. The CTX feature is available in two different configurations. One is the CTX-CO and the other one is CTX - Customer Unit (CU). No switching equipment is located at the customer premises with the CTX-CO configuration. Some switching equipment is located at the customer premises with the CTX-CU configuration. For a gen-

eral description on CTX, refer to Practice 966-102-100.

3.04 Multiline residential and small business customers, with two to six telephone lines, may also utilize an existing CTX feature. This is possible with the multiline variety package service which operates without the use of special key telephone equipment. For more information on the multiline varity package, refer to Practice 231-090-110.

AUTOMATIC CALL DISTRIBUTION

3.05 Automatic call distribution (ACD) is system used to concentrate, queue, and equitably distribute incoming calls to several operators with maximum efficiency. This was made possible by the switching, call processing, and translation capabilities of ESS switch. Basic ACD requires very little equipment on the customer's premises. Standard telephone sets and/or key telephone sets are used for operator position equipment. For more information on basic ACD, refer to Practice 231-090-269.

3.06 The phase 1 ACD feature uses compact 20-button consoles (500A type) for call processing by operators and desk-type display units. This phase allows for system control and traffic data reports to supervisors. For more information on phase 1 ACD, refer to Practice 231-090-334.

3.07 Phase 2 ACD uses 600-type consoles for processing incoming calls plus a sophisticated ACD-ESS switch management information system (AEMIS). The AEMIS uses a minicomputer located on the customer premises. This feature can serve up to 1000 operators divided into a maximum of 30 functional groups (also called splits). The customer may reassign operators to different functional groups to handle calls or other work situations, without wiring changes or rearrangement of operators. For more information on phase 2 ACD, refer to Practice 231-090-399.

HILO 4-WIRE SWITCHING

3.08 The HILO 4-wire switching allows a 2-wire 1A ESS switch to function as a 4-wire, 600-ohm toll terminal machine. This feature provides two electrically independent transmission paths through the switching network of a 2-wire office. It is available for trunk-only toll offices (Fig. 1), and combined local/toll offices (Fig. 2). Incoming pulses can be mul-

tifrequency (MF) dial pulse (DP), and TOUCH-TONE calling. Outgoing pulses can be MF, DP, TOUCH-TONE calling, and no pulsing. Revertive and panel call indicators are not available. Equivalent 4-wire switching is achieved by providing two switched metallic conductors and an unswitched metallic common return path.

3.09 The HILO 4-wire feature is intended for small to moderate size toll offices. It is also applicable to those offices in which the local and toll function can be combined, thus using only one machine to serve both functions. Remreed trunk link networks (TLNs) must be used with HILO 4-wire switching. For more information on HILO 4-wire, refer to Practice 231-090-366.

911 EMERGENCY SERVICE

3.10 The 911 emergency service is available in the basic or enhanced versions. Basic 911 (B911)

emergency service provides the capability for a local office to complete 911 calls to a B911 public safety answering point (PSAP). It also provides for optional PSAP customer services for the completing and handling of 911 calls. Enhanced 911 (E911) emergency service provides geater B911 capabilities along with more optional PSAP customer services. With E911 service, a 1A ESS switch serves as a E911 tandem office for all 911 calls from other local offices in the 911 service area. It also serves as a local office for 911 calls originated by customers served by a E911 tandem office. The E911 tandem office may serve one or more PSAPs in a 911 service area. For more information on B911 service, refer to Practice 231-090-287; and for E911 service, refer to Practice 231-367-010.

COMMON CHANNEL INTEROFFICE SIGNALING

3.11 Common channel interoffice signaling (CCIS) is a system feature for exchanging information between processor equipped switching systems
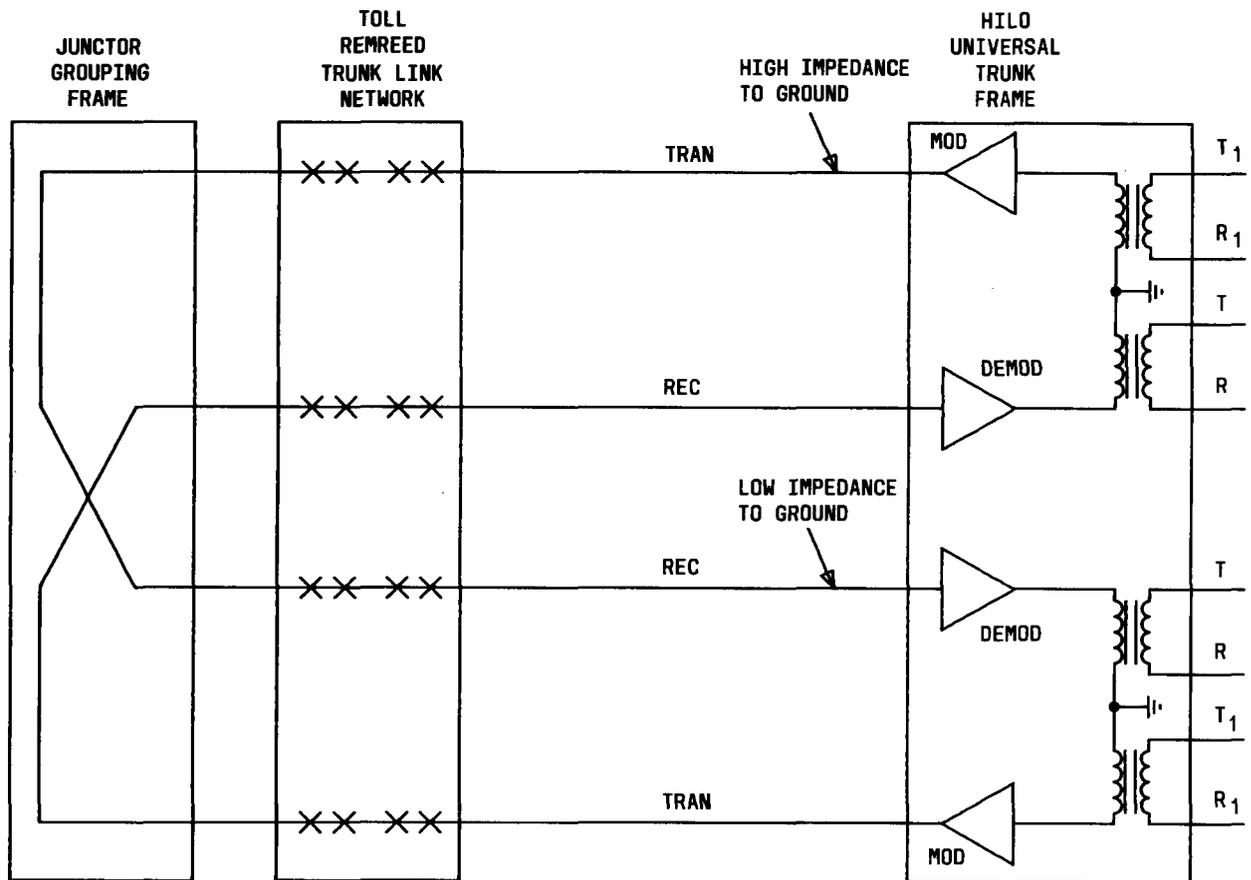
Fig. 1—HILO 4-Wire Trunk-Only Toll Office (Showing MODs and DEMODs)

LLNs   LOCAL TLNs

LINES

INTERLOCAL TRUNKS

LOCAL SERVICE
CIRCUITS

(2W)

INTRAPROCESSOR
TRUNKS*

TOLL TLNs

* THESE TRUNKS CONNECT THE
LOCAL TLN COMMUNITY WITH
THE TOLL TLN COMMUNITY. THE
TERM APPLIED TO THESE INTRAOFFICE
TRUNK ARRANGEMENTS, ALTHOUGH A
MISNOMER, IS AN INTRAPROCESSOR
TRUNK

(HILO
4W)

TOLL TRUNKS

TOLL SERVICE
CIRCUITS
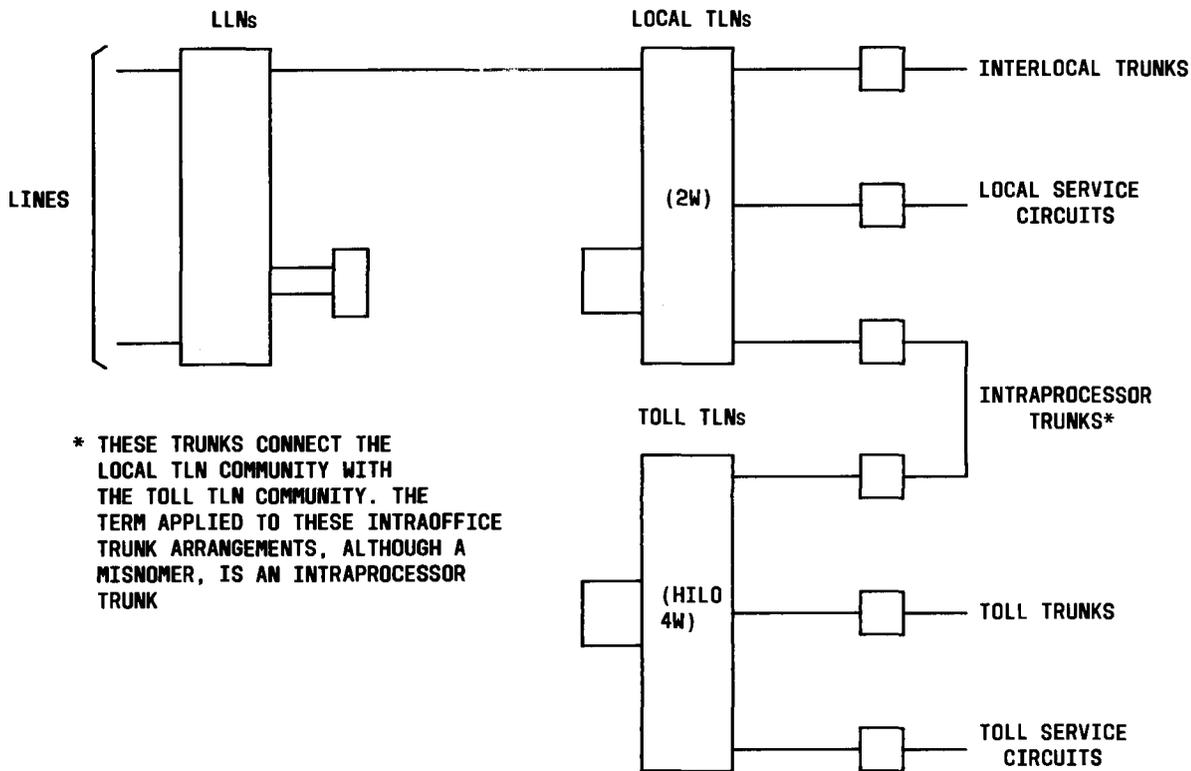
Fig. 2—HILO Combined Local and or Toll Office

over a network of signaling links. All signaling data, including the supervisory and processor address signals necessary to control call setup and takedown, as well as network management signals, will be exchanged by these systems over the signaling links instead of being sent over the voice path as done using present inband signaling techniques. The CCIS is available with the 1AE5 and later generic programs.

3.12 There are a number of advantages with CCIS over present inband signaling techniques. The major advantages are: signaling speed, information capacity, 2-way signaling, separate signaling channel, compatibility with international signaling, greater reliability, and flexibility in transmitting all types of signaling information for present and future designs. For more information on CCIS, refer to Practice 231-090-416.

REMOTE SWITCHING SYSTEM

3.13 The Remote Switching System (RSS) is an optionally loaded feature that is available

with the 1AE6 and later generics. This feature provides a 1A ESS switch with the capability to operate with a remote switching arrangement (Fig. 3). The microprocessor controlled RSS remote terminal operates under software control of the host ESS switch. A remote switching facility provides modern telephone service to small communities. Small communities that could not economically support an independent switching office are provided with features and services of an ESS switch. The 10A RSS under control of a 1A ESS switch can serve as few as 150 lines or up to a maximum of 2048 lines.

3.14 Communications between the 10A RSS and the host 1A ESS switch is by a high speed (2400 baud) data link. Voice carrier channels are used for communications over the data links. For an ESS switch to operate with the RSS arrangement, the addition of a peripheral unit controller data link (PUC/DL) frame is required. The PUC/DL is located at the host switching office and serves as the communications interfcae between the RSS and the host switching office.

LEGEND:
CC   CENTRAL CONTROL
DLI   DATA LINK INTERFACE
PUC/DL   PERIPHERAL UNIT CONTROLLER/DATA LINK
RT   REMOTE TERMINAL
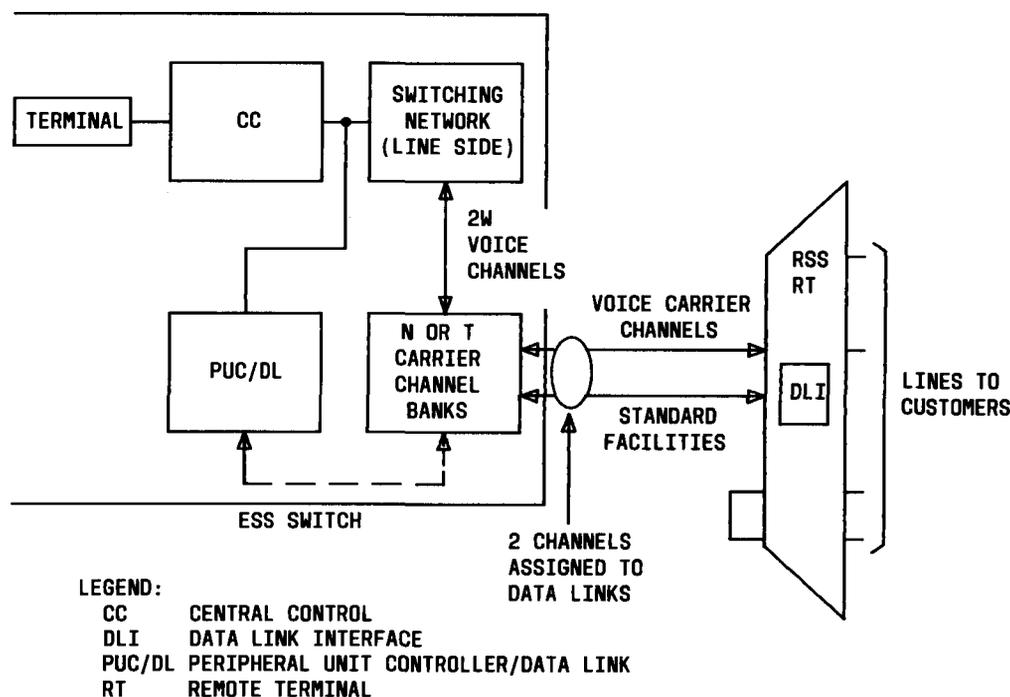
Fig. 3—RSS Block Diagram

3.15 The 10A RSS may be located more than 150 miles away from the host switching office. The maintenance and testing of the 10A RSS is done at the host ESS switch or at a switching contol center (SCC). For more information on RSS, refer to Practice 231-090-153.

ELECTRONIC TANDEM SWITCHING

3.16 The electronic tandem switching (ETS) is an optionally loaded feature that is available to customers with the 1ESS switch and 1A ESS switch CTX systems. It can be used in an electronic tandem network with DIMENSION* PBXs.

3.17 The ETS feature allows a business to have its own private communications network. Stations that are served by any company PBX or CTX tandem locations are referred to as on-network stations. Off-network stations are stations outside the private communications network.

3.18 A customer with the ETS feature is provided with a group of private network features

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which improve tandem tie trunk services. The ETS group of features include:

- Automatic route selection (ARS)

- Facility restriction levels (FRLs)

- Uniform numbering (UN)

- Automatic alternate routing (AAR)

- Queuing

- Authorization codes

- Traveling class marks (TCMs)

- Account codes

- Facility assurance reports

- Station message detail recording (SMDR)

- Traffic data to the customer

- Facilities administration and control.

For more information on the ETS feature, refer to Practice 231-090-154.

LOOP RANGE EXTENSION

3.19 The loop range extension (LRE) is an optionally loaded feature that provides 3- or 6-dB gain when used with fully loaded loops from 1500- to 2800-ohms conductor loop resistance. The amount of gain is inserted automatically (depending upon loop resistance) by the range extension circuit.

3.20 A repeater is placed in the B-Links between the line switch circuits (LSCs) or line switch frames (LSFs) and junctor switch frames (JSCs) or JSFs of the line link network (LLN). This repeater provides the gain of office signaling and supervisory range to 2800-ohms on long customer loops. Location of the repeater in the B-Links enables several customers to economically share the feature. The concentration in the LLN allows a savings in the use of repeaters per customer lines which require LRE. A line to trunk call with loop range extension circuit is shown in Fig. 4. For more information on LRE, refer to Practice 231-090-160.

DIGITAL CARRIER TRUNK

3.21 The digital carrier trunk (DCT) is an optionally loaded feature available with the 1AE6 generic and later programs. This feature interfaces T-carrier lines with a 1A ESS switch. The T-carrier lines terminate in a digital carrrier trunk frame. This trunk frame uses a peripheral unit controller (PUC) with duplicated microprocessor and DCT banks. The PUC serves as the interface with the 1A processor and provides for trunk state control, trunk supervisory scanning, and maintenance functions. This feature replaces existing 1A ESS switch trunk circuits and carrier channel units. For more information on DCT, refer to Practice 231-090-152.

CIRCUIT SWITCHED DIGITAL CAPABILITY

3.22 The circuit switched digital capability (CSDC) feature is available with the 1AE7 generic program. This feature provides end-to-end transmission of digital data at 56 kilobits per second (kb/s) and/or analog voice signals on a circuit switched basis. The CSDC feature is optionally loaded and requires the digital carrier trunk and peripheral unit controller feature groups. To provide CSDC service between a 1A ESS switch and a 4ESS switch, the 1A switching office must also have the local common channel interoffice signaling (Local CCIS) feature group.

3.23 Customers access the CSDC network using their 2-wire loop into the serving network office. During a CSDC call, a user at either end may alternate between the voice and data modes as many times as desired. The CSDC feature can support subvariable data rates from customer premises equipment, but a 56 kb/s data rate is used in the network. The schematic drawings for the alternate voice/data channel unit is SD-7C300 and the mainte-
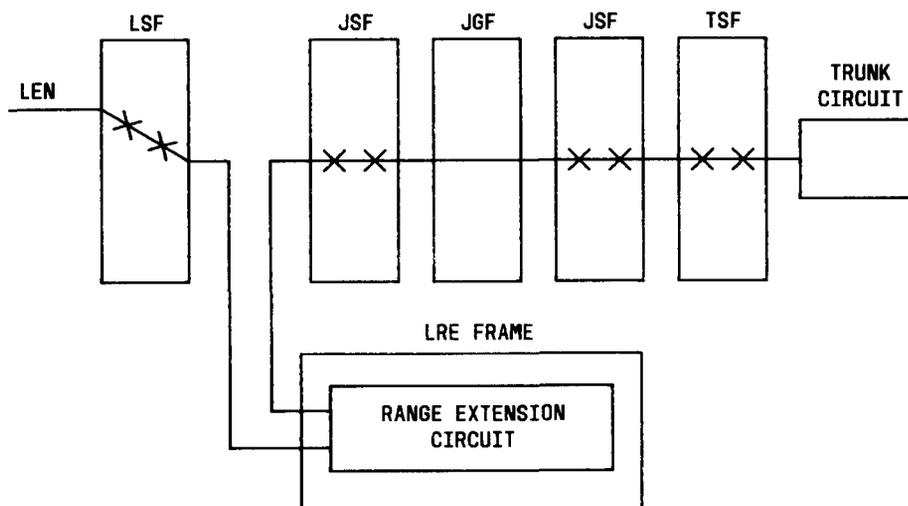
Fig. 4—1A ESS Switch Line to Trunk with LRE

nance circuit is SD-1A611. For more information on the CSDC feature, refer to Practice 231-390-380.

CARRIER INTERCONNECT

3.24 The carrier interconnect (CI) feature is available with the 1AE8A generic program. This feature provides the local exchange network interconnection for inter-LATA (local access and transport area) carriers and international carriers. The CI feature also provides the telephone customer access to either of the carriers using a uniform dialing plan. For more information on the CI feature, refer to Practice 231-090-120.

4. 1A ESS SWITCH DESCRIPTION

4.01 The 1A ESS switch (Fig. 54) consists of the 1A processor, attached processor system (APS), maintenance and administrative control, switching network, and monitor and control. All of the equipment is mounted on frames. The frames are either single, double, or triple bay frames. Each bay is 2 feet 2 inches wide except for some single bay frames where a bay is 3 feet 3 inches wide. Nearly all frames are 7 feet tall. Most of the 1A processor frames are 18 inches deep, while the rest of the system frames are 12 inches deep.

4.02 The 1A processor includes:

- Duplicated central control (CC)

- Call store (CS) and program store (PS)

- File store (FS) system or attached processor interface (API) frame

- Auxiliary Data System (ADS)

- Input/output (I/O) frame

- 1A processor memory address spectrum

- Processor peripheral interface (PPI) frame.

4.03 The APS hardware includes a 3B processor and part of the API frame in the 1A processor.

4.04 The maintenance and administrative control hardware includes:

- Master control center (MCC)

- I/O terminals (IOTs)

- Dynamic overload control (DOC)

- Remote office test line (ROTL).

4.05 The switching network hardware includes:

- Line link networks (LLNs)

- Junctor grouping frame (JGF)

- Trunk link networks (TLNs)

- Junctor circuits

- Trunk and service circuits

- Lines

- Trunks.

4.06 The monitor and control hardware includes:

- Central pulse distributor (CPD)

- Master scanners (MS)

- Scanners

- Signal distributors (SD).

1A PROCESSOR

A. Central Control

4.07 There are two CCs (CC0 and CC1) provided with each 1A processor. The CC (Fig. 5) processes the information that enables the 1A processor to operate and maintain the 1A ESS switch. The CC, reads, decodes, and executes, the control program with a basic machine cycle of 700 nanoseconds. Frequently there is data associated with an instruction. This data, which is kept in the CS or PS, is read and processed by the CC as directed by the instruction. An instruction which includes a memory access requires 1400 nanoseconds. Normally, the duplicated CCs operate in step; that is, both CCs do the same operation at the same time. However, one CC is designated active while the other is designated as standby. Matching circuits are provided in each CC to insure that they execute the same instructions, transmit and receive the same data, and make the same deci-

sions. If either CC should fail, the failing CC is removed from service, and the other CC continues operation in a nonmatching mode.

4.08 The CC communicates to other units over buses. The are four primary buses to and from the CC. These buses are:

- PS bus

- CS bus

- Auxiliary unit bus (AUB)

- Peripheral unit bus (PUB).

The PS and CS buses are the communications paths to the CC for all PSs and CSs, respectively. The AUB is the communications path to the CC for both the ADS and the FS system or APS. The PUB is the communications path to the CC for the I/O frame, PPI, monitor and control equipment, and the switching network.

4.09 When either data or instructions are transferred from the CC to units of the 1A processor, the units are enabled via the coded enable method. With coded enable a sync pulse followed by an address is sent to every unit on a bus. Only the unit whose internal address matches the one sent over the bus will process the information. When the processing is complete, an all-seems-well (ASW) signal is sent by addressed unit to indicate the successful completion of the operation.

4.10 Data or instruction transfers between the CC and the switching network are over the PUB. Units of the switching network are enabled by CPD enabling. The CPD unit does the enabling. Upon receiving an order from CC, the CPD pulses the enable line associated with the desired unit. The CC places data on the PUB and only the unit receiving the CPD enable pulse is able to accept and act on this data. When the unit receives an enable pulse from the CPD, it returns a verify signal to CC. The verify signal is used by CC to determine if the correct unit was enabled.

B.   Processor Peripheral Interface Frame

4.11 The primary functions of the PPI frame (Fig. 6) are to provide the interface between the CC and the peripheral community; and between the con-

trol and display panel (CD) of the master control center (MCC) and the rest of the system. The PPI frame provides these interfaces via the PUB. The PPI frame also has the logic required to control and monitor the lamps, keys, and displays of the CD.

4.12 The other functions of the PPI frame are to provide the logic required for testing the CC access to the PUB, and monitoring for the 1A processor power frame. Testing of the CC access to the PUB is provided by loop-around circuitry within the PPI frame. Maintenance programs run by the CC send test messages out over the PUB. The loop-around circuitry traps these messages and sends them back over the PUB to the CC. The maintenance programs then compare the original message with the one received from the loop-around circuits to determine if a fault exists on the PUB.

4.13 Power switches located at each frame of the 1A processor contain lamps and switches that permit maintenance personnel to observe power status, and to make frame requests for a change in power status. Circuitry within the PPI frame monitors these switches and reports any requests to CC. This circuitry also monitors the power switch to determine if any power failures have occurred. Monitored conditions within the power switch are:

- Request to place equipment out-of-service

- Request power off

- Request power on

- Power fault.

This circuitry also provides the CC with the ability to control the power switch. This control allows the CC to light the appropriate lamps on the power switch and to initiate a test of the power monitor circuit on the associated frame. For more information on the PPI frame, refer to Practice 231-301-000.

C.   Input/Output (I/O) Frame

4.14 The I/O frame (Fig. 7) contains the input/output units (IOUs) that interface the IOTs to the 1A processor. The input/output frame which resides on the PUB may contain a maximum of two IOUs. Since the IOTs operate at speeds much slower than the CC, the IOU does extensive logic and buffering. This buffering allows the CC to administer input
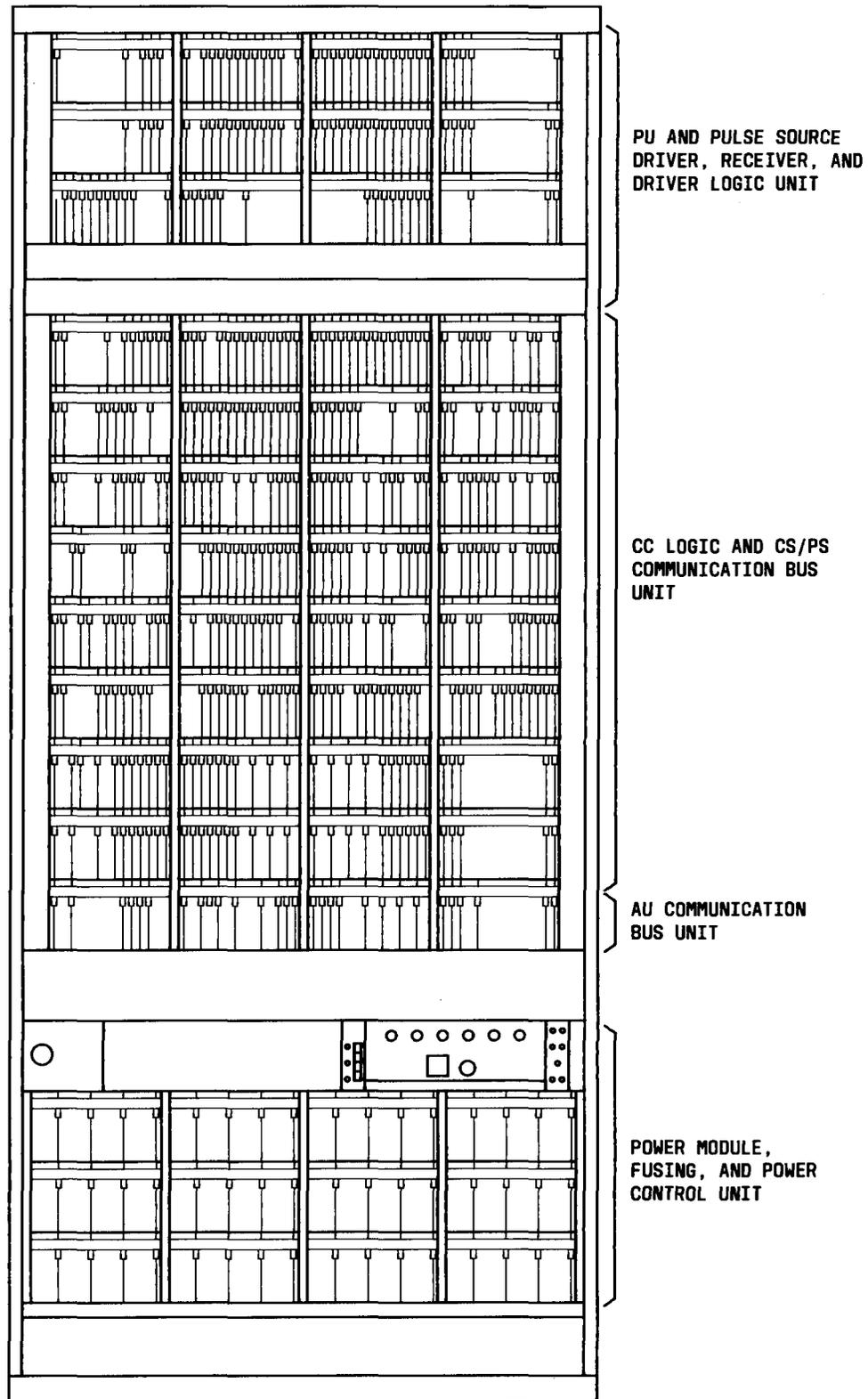
Fig. 5—Central Control Frame

PU AND PULSE SOURCE DRIVER, RECEIVER, AND DRIVER LOGIC UNIT

CC LOGIC AND CS/PS COMMUNICATION BUS UNIT

AU COMMUNICATION BUS UNIT

POWER MODULE, FUSING, AND POWER CONTROL UNIT

PERIPHERAL
INTERFACE
UNIT

SCANNER, SIGNAL
DISTRIBUTOR, AND
PRIVATE BUS UNIT

CONTROL AND
DISPLAY LOGIC
UNIT

REMOTE ACCESS
INTERFACE UNIT

REMOTE ACCESS
INTERFACE POWER
DISTRIBUTION UNIT

HEAT BAFFLE

NO. 1A ESS ALARM UNIT

NOT
EQUIPPED

NO. 1A ESS SYSTEM
STATUS LOGIC UNITS

NOT EQUIPPED

TELEPHONE, TIMER
AND MISCELLANEOUS
UNIT

SSC (E2A)
REMOTE UNIT

POWER UNIT

FILTER UNIT

BAY 0   BAY 1

Fig. 6—Processor Peripheral Interface Frame

or output transmissions at infrequent intervals, thus requiring less CC real time for I/O tasks. Each IOU includes one input/output unit selector (IOUS) and from one to eight input/output unit controllers (IOUCs).

I/O PERIPHERAL
BUS UNIT

TERMINAL
STRIP UNIT

POWER–OFF KEY
UNIT 0

INPUT/OUTPUT
UNIT 0

POWER–OFF KEY
UNIT 1

INPUT/OUTPUT
UNIT 1

FILTER UNIT
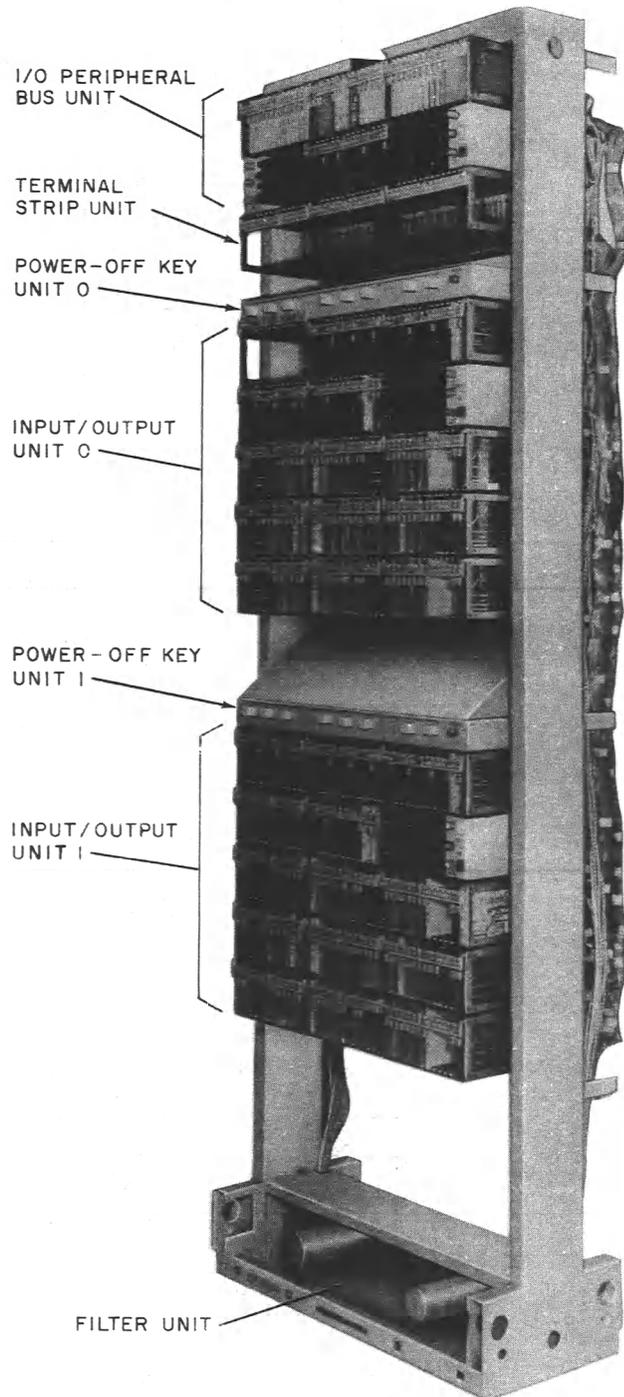
Fig. 7—Input Output Frame

Input/Output Unit Selector

4.15 The IOUS includes the logic required to service from one to eight IOUCs. Commands sent by the CC are received at the IOUS. The IOUS decodes the address and instruction. If the instruction is for a data transfer, the IOUS enables the IOUC specified by the address and the data plus decoded instruction are sent to the IOUC. During normal IO operations, the IOUS gathers service and maintenance requests from each IOUC and reports a request to the CC when polled. Throughout the data transfer operations, the IOUS provides clock pulses to synchronize the IOUC and IOUS. The IOUS also does internal checks on the information received from CC.

Input/Output Unit Controller

4.16 The IOUCs have all of the logic required to control the IOTs. Each IOUC has three port interfaces to one terminal. All ports can be individually enabled; however, each enabled port of a certain IOUC receives the same data. All signals (data and control) exchanged by the IOUC and IOTs are Electronic Industries Associated standard signals. The data that is transferred is encoded using the United States of America Standard Code for Information Interchange (USASCII) characters. The IOUC contains a character buffer that holds up to 24 characters before transferring them to either the CC or the IOT. This buffering allows the IOUC to compensate for the speed difference between the CC and the IOT.

D.   Input/Output Processor Frame

4.17 The input/output processor (IOP) frame (Fig. 8) replaces the I/O frame. The IOP frame provides the same function as the I/O frame which serves as an interface between the IOTs and the 1A processor. In addition to the interface function, the IOP frame provides new terminal and data link features. The generic program includes IOP software (common program releases) which provides the I/O capabilities. The IOP frame and I/O software provide for a varity of high and low speed transmission rates. The IOP frame is micrprocessor controlled and may be partially or fully equipped. A fully equipped IOP frame includes:

(a) Two IOP bus units

(b) Two IOPs

80	**J5A006DA** **BUS UNIT 0**
76	**J5A006DA** **BUS UNIT 1**
72	**4 INCH** **SPACE**
68	**J5A006DB**
64	**IO PROC** **LOGIC UNIT** **(UNIT A,**
60	**COMM. 0)**
56	**J5A006CE** **1A IOP**
52	**GROWTH UNIT** **(UNIT A, COMM. 1)**
48	
44	**10 INCH** **SPACE**
38	**J5A006DB**
34	**IO PROC** **LOGIC UNIT** **(UNIT B,**
30	**COMM. 0)**
26	**J5A006CE** **1A IOP**
22	**GROWTH UNIT** **(UNIT B, COMM. 1)**
18	
14	**14 INCH** **SPACE**
10	
	J5A006DC **POWER FILTER UNIT**

I/O PROC A

I/O PROC B
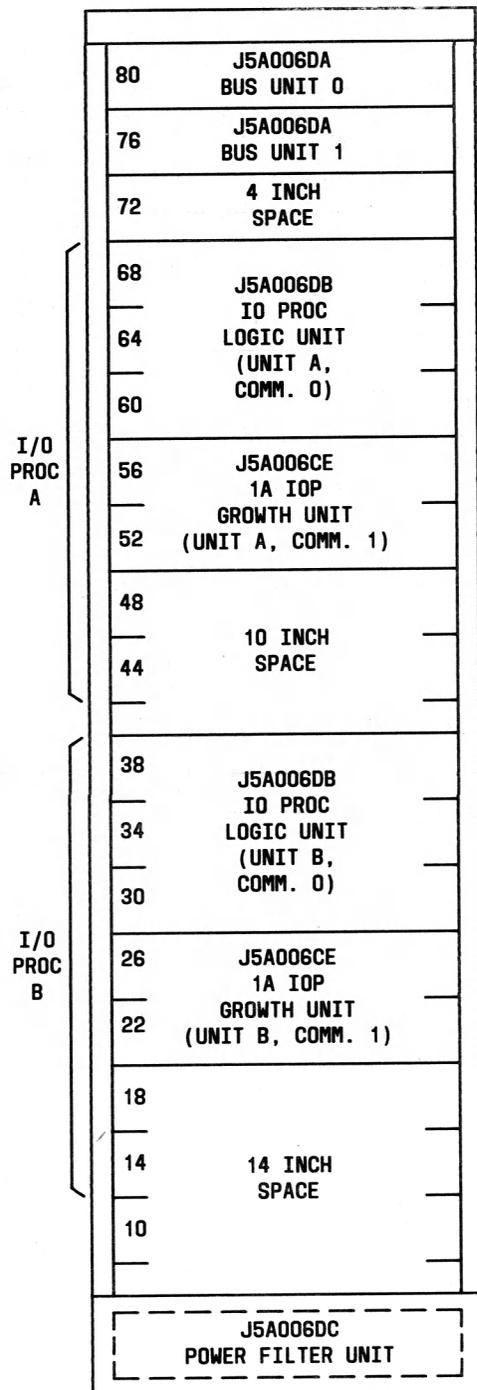
FRONT VIEW

NOTES:
1. J5A006DB (SD-5A052-02), and J5A006CE (SD-5A049-01) Units Are arranged for use with asynchronous or isochronous terminal devices.
2. The 1A IØP growth unit (J5A006CE) or 3B IØP growth Unit (J1C130AB) may be job engineered into any frame.

Fig. 8—Input Output Processor Frame

(1) Logic unit

(2) Growth unit

(c) One IOP filter unit.

For more information on the IOP frame, refer to Practice 254-201-045.

E. Memory Address Spectrum

4.18 The software that operates and maintains the 1A ESS switch is stored in memory units and backup systems. This software is located throughout the 1A processor memory address spectrum. The total range of the 1A processor memory address spectrum with the 1AE7 generic program is 0 through 17,777,777 (octal). Each processor address gives the location of a memory word in the CS, PS, or CC. The CS addresses are 0 through 7,777,777 (octal) and the PS addresses are 10,000,000 (octal) through 17,777,777 (octal). Program store processesor address 17,600,000 (octal) through 17,777,777 (octal) are internal to the CC. The type of information used within the memory spectrum includes:

- Transient information

- Generic program

- Parameter information

- Translation information

- Utility programs

- Call processing information within CC registers.

4.19 The memory address spectrum is divided into groups of 200,000 (octal) processor addresses per group. Each group is assigned a 2-digit octal number called a k-code. A processor address includes a k-code, an address within the k-code, and a digit indicating if the address is a CS address or PS address. The CS/PS digit occupies binary bit position 21 of the processor address. If it is 0, the address is within the CS; and if it is 1, the address is in PS. The k-code is in bit positions 16 - 20 and the address within that k-code is in bit positions 0 - 15. For more information on the memory address spectrum, refer to Practice 231-300-014.

K-Codes

4.20 A k-code is used by the CC to access (enable) a particular group of processor addresses. A physical 64K memory unit has one k-code assigned to it and a physical 256K memory unit has four individual k-codes assigned to it. Original assignment of k-codes for store units may change due to automatic or manual reconfiguration.

4.21 The maximum number of CS k-codes that may be assigned is 32 (decimal). They are numbered octally 00 (processor address 0) through 37 (processor address 7,777,777). Call store k-codes are classified as either duplicated call stores (DCSs) or unduplicated call stores (UCSs). The UCSs are divided into low UCSs (LUCSs) and high UCSs (HUCSs). The first four k-codes (0-3 octal) are always DCSs and contain the restricted area of the memory spectrum. Any one of the next eight k-codes (4-13 octal) may be assigned as a DCS or LUCS. Call store k-codes 14 through 17 are LUCS and CS k-codes 20 through 37 are HUCS. The sum total of DCS k-codes and LUCS k-codes is equal to or less than 16 (decimal).

4.22 A flexible k-code area exists between the DCSs and UCSs that includes CS k-codes 4 through 13. The flexible k-code boundary is between CS k-codes 7 and 10. The purpose of the flexible k-code area is to allow for efficient k-code assignments with the available CS memory in each individual 1A ESS switch. The maximum number of possible DCS k-codes is 12 (0-13 octal). The maximum number of possible LUCS k-codes is also 12 (4-17 octal) provided the DCS area requires no more than 4 (decimal) k-codes.

4.23 The maximum number of program store k-codes assigned is 32 (decimal). As with the CS, they are numbered octally 00 (processor address 10,000,000) through 37 (processor address 17,777,777). The first thirty PS k-codes (0-35 octal) store the generic program, and portions of the parameter information. Program store k-code 36 stores utility programs. The address spectrum in program store k-code 37 is internal to the CC and stores call processing information.

F. Call Store/Program Store

4.24 The physical CS and PS memory units are equipped in pure communities of 64K semicon-

ductor or 256K semiconductor stores. Both of these stores have metal oxide semiconductor (MOS) random access memory (RAM). Each store unit periodically does its own refresh operation.

4.25 *Call Store:* The CS is a read-write memory. The DCS and UCS are identical physically, but are used in the processor differently. Since the DCSs handle transient call processing information, they are fully duplicated. The UCSs are used to store PS fault recognition programs, translation information, and portions of the parameter information. A backup copy of the UCS information is kept on disk memory in the APS of FS.

4.26 If a DCS is faulty, it is removed from service and its duplicate operates in a simplex mode. If a UCS is faulty, it is removed from service and will be replaced by a CS from the DCSs. This would leave the replacement's duplicate CS operating in a simplex mode.

4.27 *Program Store:* The PS is a read-write memory. The PSs are used to store the generic program (also called the resident program), a portion of parameters, and utility programs. The utility programs are typically kept in the FS or APS and are loaded into a PS when needed.

4.28 All information stored in a physical PS is kept on disk memory in the FS or APS (also called backup). This eliminates the need for duplicate PS memory units as with the DCS. However, in order to maintain continuous reliable operation, two additional PS memory units, called rover stores, are provided to replace any faulty PS. If a faulty PS is detected, it is removed from service and replaced by a rover store. The same information stored in the faulty PS is read into the rover store replacement from backup.

4.29 During normal operation, the two rover stores keep duplicate copies of on line PSs that store base level and other critical program instructions. In the event one of these on line PS units is faulty, a replacement rover store does not need to be loaded from backup.

64K Call Store/Program Store Semiconductor Memory Unit

4.30 A 64K CS/PS memory unit is mounted in a single bay frame. The frame is used as a CS

frame or PS frame (Fig. 9). A maximum of six 64K CS/PS memory units can be mounted in one frame. One 64K CS/PS memory unit equals one CS or one PS. Each unit includes a power section and 12 circuit packs (CPs) on which memory, logic, power control, and bus interface functions are located. Each 64K CS/PS memory unit has a storage capacity of 65,536 (decimal) 26-bit words. For more information on the 64K CS/PS memory unit, refer to Practices 231-062-473, 254-201-012, and 254-201-013.

256K Call Store/Program Store Semiconductor Memory Unit

4.31 The 256K CS/PS memory units are mounted in two bay frames. The frame has a combination of CS and PS memory units (Fig. 10). One 256K CS/PS memory unit equals one CS or one PS. Each unit includes a power section and 12 CPs on which memory, logic, power control, and bus interface functions are located. Each 256K CS/PS memory unit has a storage capacity of 262,144 (decimal) 26-bit words (24 data bits and 2 parity bits). For more information on the 256K CS/PS memory unit, refer to Practices 231-062-473, 254-201-014, and 254-201-015.

G. Auxiliary Data System

4.32 The Auxiliary Data System (ADS) is a versatile, medium speed, data handling system. The ADS utilizes magnetic tape for data storage and retrieval functions. The ADS is used for:

- System reinitialization (SR)

- AMA or centralized AMA

- Program updates

- System memory dumps

- General data handling.

4.33 Two communities make up the ADS. Each community includes two data unit selectors (DUSs) and from 2 to 16 pairs of data unit controllers (DUCs) and data units (DUs) (each pair is made up of one DUC and one DU). The purpose of the DUS is to interface the DUC and DU pairs to the CC over the AUB.

4.34 For an office equipped with an FS system, the DUS is physically located above the disk mem-

BUS INTERFACE TERMINAL STRIP UNIT (UPPER) J5A008AB-1

SEMICONDUCTOR STORE UNIT J5A008AA-1 (STORE 0)

SEMICONDUCTOR STORE UNIT J5A008AA-1 (STORE 1)

SEMICONDUCTOR STORE UNIT J5A008AA-1 (STORE 2)

SEMICONDUCTOR STORE UNIT J5A008AA-1 (STORE 3)

SEMICONDUCTOR STORE UNIT J5A008AA-1 (STORE 4)

SEMICONDUCTOR STORE UNIT J5A008AA-1 (STORE 5)

BUS INTERFACE TERMINAL STRIP UNIT (LOWER) J5A008AC-1

Fig. 9—64K CS PS Semiconductor Frame

256K SEMICONDUCTOR STORE UNIT J5A010AA-1 (CALL STORE 03 OR 11)	256K SEMICONDUCTOR STORE UNIT J5A010AA-1 (CALL STORE 04 OR 12)
256K SEMICONDUCTOR STORE UNIT J5A010AA-1 (CALL STORE 02 OR 10)	256K SEMICONDUCTOR STORE UNIT J5A010AA-1 (CALL STORE 05 OR 13)
256K SEMICONDUCTOR STORE UNIT J5A010AA-1 (CALL STORE 01 OR 09)	256K SEMICONDUCTOR STORE UNIT J5A010AA-1 (CALL STORE 06 OR 14)
256K SEMICONDUCTOR STORE UNIT J5A010AA-1 (CALL STORE 00 OR 08)	256K SEMICONDUCTOR STORE UNIT J5A010AA-1 (CALL STORE 07 OR 15)
CALL STORE BUS INTERFACE TERMINAL STRIP UNIT J5A010AB-1	CALL STORE BUS INTERFACE TERMINAL STRIP UNIT J5A010AB-1
PROGRAM STORE BUS INTERFACE TERMINAL STRIP UNIT J5A010AC-1	PROGRAM STORE BUS INTERFACE TERMINAL STRIP UNIT J5A010AC-1
256K SEMICONDUCTOR STORE UNIT J5A010AA-1 (PROGRAM STORE 00 OR 06)	256K SEMICONDUCTOR STORE UNIT J5A010AA-1 (PROGRAM STORE 05 OR 11)
256K SEMICONDUCTOR STORE UNIT J5A010AA-1 (PROGRAM STORE 01 OR 07)	256K SEMICONDUCTOR STORE UNIT J5A010AA-1 (PROGRAM STORE 04 OR 10)
256K SEMICONDUCTOR STORE UNIT J5A010AA-1 (PROGRAM STORE 02 OR 08)	256K SEMICONDUCTOR STORE UNIT J5A010AA-1 (PROGRAM STORE 03 OR 09)

Vertical scale markings (left side): 84, 82, 74, 72, 64, 62, 54, 52, 44, 40, 39, 35, 27, 25, 17, 15, 07, 05, 00

Fig. 10—256K CS PS Semiconductor Frame

ory units in a FS frame. For an office equipped with an APS, the DUS is located in the API frame. The DU may be either a tape transport or data link. When the DU is a tape transport, the associated DUC is a tape unit controller (TUC). The TUC and tape transport are both physically located in a tape unit frame J5A002A (Fig. 11). When the DU is a data link, the associated DUC is a data link controller (DLC). For more information on the ADS, refer to Practices 254-201-000 and 254-201-001.

H. File Store System

4.35 The primary uses of the FS system is to store the nonresident generic program, and to store backup information for all of the PSs and unduplicated CSs. The memory storage capacity of a fully equipped FS system is 15 megabytes. The FS system is replaced with the APS for all new 1A ESS switches and all 1ESS switch to 1A ESS switch conversions.

4.36 The FS system is equipped with one or two communities (0,1). Each community includes a duplicated file store controller (FSC) with one to four disk memory units per FSC. Each FSC is mounted in a separate FS frame with its memory units (Fig. 12). When required, the left bay of the FS frame also includes a DUS (part of the ADS) mounted above the upper disk memory unit.

4.37 The FSC has a wired logic unit that receives and answers requests for data transfers between the FS communities and the PSs or CSs. Each disk memory unit contains a single disk plate that stores data on both faces. Each face has 100 tracks with a capacity of 3200 twenty-four bit words per track. One disk memory unit provides storage for 640,000 words. The disk plate rotates at a speed of 1745 RPM.

I. Attached Processor Interface Frame

4.38 The purpose of the API frame is to interface the 1A processor CC with the ADS and APS over the AUB. The API frame includes components from the ADS (data unit selector) and APS (API unit). The API frame is physically part of the 1A processor and is used in pairs. The ADS was previously discussed in paragraph 4.32. The APS is further described in paragraph 4.40.

4.39 Each API frame is a single-bay frame, 7 feet high, and 3 feet 3 inches wide. The equipage of

an API frame for a 1A ESS switch is one DUS J5A004AZ-1, and one API unit J5A012AA-1 (the API frame is designed to hold three API units). For more information on the API frame, refer to Practices 254-201-002 and 254-201-003.

ATTACHED PROCESSOR SYSTEM

4.40 The APS is an optional 1A ESS switch feature (starting with the 1AE7 generic). The initial purpose of the APS is to replace the FS. Other APS applications will be available with later versions of the 1A ESS switch generic. The maximum FS memory capacity is 15 megabytes while the maximum for the APS is 300 megabytes.

4.41 The APS hardware includes an AT&T 3B20D2 computer and a duplicated API unit (each API unit is located in separate API frames of the 1A processor). The AT&T 3B20D2 computer is a self-maintaining disk file system. It is mounted in a 7-foot high, 2-foot 2-inch wide, by 24- and 18-inch deep frame. The API units transfer data between the 1A processor and AT&T 3B20D2 computer over the AUB. For more information on the general system application of the APS, refer to Practice 231-301-005.

SWITCHING NETWORK

4.42 The switching network (Fig. 13) is used to establish metallic paths for transmission of voice and signaling through eight stages of switching. The network connects line to lines, lines to trunks, trunks to trunks, and lines or trunks to various service circuits. The service circuits consist of tones, signal transmitters, signal receivers, coin supervisory circuits, ringing circuits, and maintenance circuits. The network consists of a number of LLNs, TLNs, and junctor frames interconnected through the JGF. The number of LLNs and TLNs used is determined by the volume of traffic assigned to the office. Each path shown in Fig. 16 represents two wires (tip and ring). When a 1A ESS switch is ordered as a new office, it consists of a 1A processor and a remreed switching network. However, a 1A processor may be retrofitted into an existing 1ESS switch ferreed or remreed office to form a 1A ESS switch. The 1A ESS switch uses the remreed switch as the basic switching element of the network. Ferreed switches are used as the basic switching element only when the 1A processor is retrofitted into a ferreed type office.

TAPE
UNIT
CONTROLLER

TAPE
TRANSPORT

TRANSPORT LOCAL
CONTROL PANEL

TRANSPORT
DOOR LATCH

DC–TO–DC
CONVERTER

Fig. 11—Tape Unit Frame

DATA UNIT SELECTOR (PART OF AUXILARY DATA SYSTEM)

TWO DISK MEMORY UNITS

COMMUNICATIONS BUS UNIT

POWER UNIT

FILTER UNIT FUSE AND CONTROL UNIT

INVERTER LOGIC UNIT

LOGIC AND READ/WRITE UNIT

AIR PRESSURE SUPPLY UNIT

BAY 0

BAY 1

FILE STORE CONTROLLER

Fig. 12—File Store Frame

LINE LINK
NETWORKS

JUNCTOR GROUPING
FRAME

TRUNK LINK
NETWORKS

JUNCTOR
CIRCUIT

LINE-TO-LINE JUNCTORS

LLN-15 *

LINES

LINE-TO-TRUNK JUNCTORS

JUNCTOR
CIRCUIT

1024
JUNCTORS
PER NETWORK

1024
JUNCTORS
PER NETWORK

JUNCTOR
CIRCUIT

LINES

LLN-0

JUNCTOR
CIRCUIT

TRUNK-TO-
TRUNK
JUNCTORS

LINE-TO-TRUNK
JUNCTORS

TLN-15

TO TRUNK
OR SERVICE
CIRCUITS

1024
JUNCTORS
PER NETWORK

1024
JUNCTORS
PER NETWORK

TLN-0
(1024
INPUTS;
1024
OUTPUTS)

TO TRUNK
OR SERVICE
CIRCUITS

* 32 LLNs WITH EXTENDED LINE LINK NETWORKS.
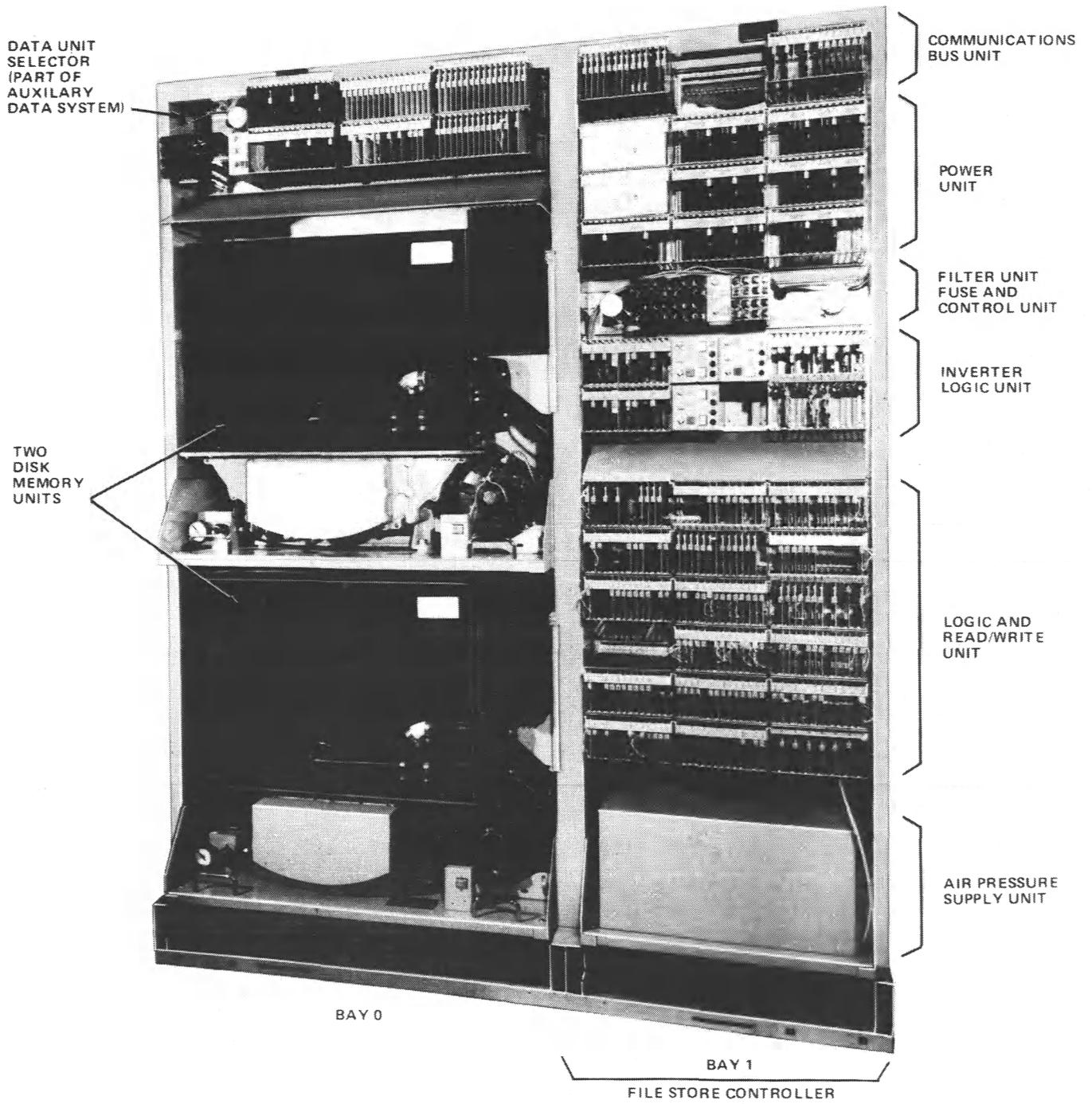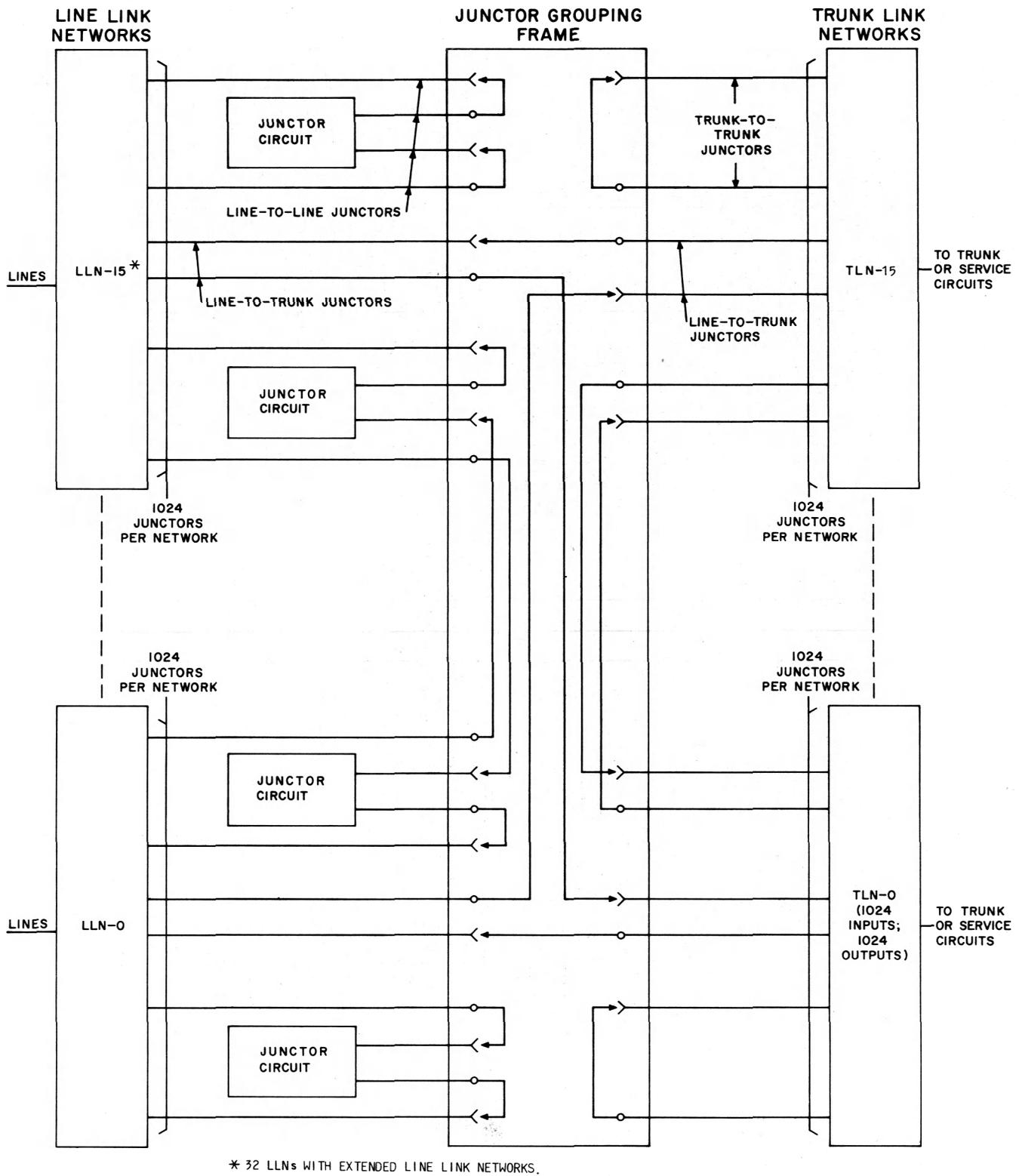
Fig. 13—Local Office Switching Network

A. Line Link Network

4.43 The LLN (Fig. 14) provides the first four stages of switching for the network. The LLN is divided into two circuits, the line switch circuit (LSC) and the junctor switch circuit (JSC). The LSC provides terminations for lines and consists of two stages of switching which does the concentration and distribution functions. The JSC provides two stages of switching for futher distribution and connection to the junctors. There are two designs of LSCs available: one is with 2:1 line concentration ratio (LCR) for heavy traffic and the other with a 4:1 LCR for regular or light traffic. The mixed concentration ratio change (MCRC) permits a mixture of the two LCR designs. This feature permits both 4:1 and 2:1 LLNs to be used in the same office. The feature is used where an office with a heavy LLN concentration ratio (2:1) cannot economically justify to expand using additional heavy LLNs. This feature allows an office of this type to expand more economically by using regular LLNs (4:1). The feature allows two B-link ratios to be used where one ratio is 4:4 and the other may be 5:4, 6:4, 7:4, or 8:4. The line B-links refers to the connection between the outputs of the LSCs and the inputs of JSCs in an LLN. Various ratios of lines to junctors may be used in an office (Table A). The choice of ratio to be used is traffic dependent and may be changed only during office growth to meet the needs of changing traffic conditions. Four JSCs per LLN are required for a 1A ESS switch.

4.44 The LLN of a retrofit ferreed office like a remreed LLN is divided into two circuits. In the ferreed office these circuits are called the LSF (Fig. 15) and the junctor switch frame (JSF) (Fig. 16).

4.45 A 2:1 LSF may consist of a 2-bay home or mate frame; network control is provided separately for each frame. Each bay consists of eight concentrators with each containing eight 4 by 4 switches and four 8 by 4 switches. Two controllers, each of which controls eight concentrators, are associated with each frame. Either of the controllers can control the complete frame if one of the controllers becomes faulty. A 4:1 LSF is arranged with a 2-bay basic frame and a single supplementary bay. Network controllers are located on both the basic frame and the supplementary bay. Either network controller can control the complete frame if one of the controllers becomes faulty. A scanner control unit which operates line scanner matrixes on both frames is located

on the home frame for 2:1 and on the basic frame for 4:1 line switching concentrators.

4.46 The same type of JSF is used in both 4:1 and 2:1 line concentration ratio LLNs. Each JSF contains four grids. Each grid has eight 8 by 8 switches in each of two stages. In addition, a 1 by 8 switch is associated with each switch in stage 1. The 1 by 8 switch provides access to a common test vertical that is connected to false cross and ground (FCG), no-test, and restore-verify circuits.

B. Extended Line Link Network

4.47 The extended line link network (ELLN) feature is designed to allow up to 32 LLNs in a 1A ESS switch office. This feature is provided with the 1AE4 and later generic programs.

4.48 The maximum number of LLNs in one office is dependent upon the type of concentrators on the LLNs and the office concentration ratio. Offices having only 2:1 type concentrators on the LLNs may normally have 28 LLNs regardless of the office concentration ratio. In offices equipped with 4:1 type concentrators, the number of LLNs is dependent on the office concentration ratio. If the office concentration ratio is 4:1, the number of LLNs allowed is normally 28. In offices with concentration of 5:1, the maximum number of LLNs allowed is 25. If the office concentration ratio is 6:1, the maximum number of LLNs allowed is 21.

C. Trunk Link Network

4.49 The LLNs are associated with customer lines or PBX trunks and TLNs are associated with interoffice trunks and service circuits. The remreed TLN (Fig. 17) provides the last four stages of switching through the switching network, and consists of trunk switch circuits (TSCs) which provide terminations for trunks and JSCs. A retrofit ferreed TLN consists of trunk switch frames (TSFs) (Fig. 18) and JSFs. The remreed TLN is completely compatible with the ferreed TLN; thus, networks of both types may operate in the same office.

4.50 Trunk-to-junctor ratios of 1:1 to 1.5:1 (Table B) may be arranged by providing a 1024 TLN. A 1:1 trunk-to-junctor ratio (2048 TLN) represents eight TSCs and eight JSCs. Only one trunk-to-junctor ratio can be used in a single 1A ESS switch. The se-

FRONT VIEW LINE LINK NETWORK, 2:1 LCR

Overall width: 9 FT. 9 IN. (three sections of 3 FT. 3 IN. each)

JUNCTION SW CKT FRAME J1A079A	LINE SW CKT FRAME J1A080A	LINE SW CKT FRAME J1A080A
BUS UNIT	BUS UNIT	BUS UNIT
JUNCTOR SW CKT 3	LINE SW CKT 1 (2:1 LCR)	LINE SW CKT 3 (2:1 LCR)
JUNCTOR SW CKT 2		
	SCANNER CKT 0	SCANNER CKT 1
JUNCTOR SW CKT 1	LINE SW CKT 0 (2:1 LCR)	LINE SW CKT 2 (2:1 LCR)
JUNCTOR SW CKT 0		
FUSE PANEL UNIT	FUSE PANEL UNIT	FUSE PANEL UNIT
FILTER UNIT	FILTER UNIT	FILTER UNIT

FRONT VIEW LINE LINK NETWORK, 3:1 LCR

Overall width: 13 FT. 0 IN. (four sections of 3 FT. 3 IN. each)

JUNCTION SW CKT FRAME J1A079A	LINE SW CKT FRAME J1A080A	LINE SW CKT FRAME J1A080A	LINE SW CKT FRAME J1A080A
BUS UNIT	BUS UNIT	BUS UNIT	BUS UNIT
JUNCTOR SW CKT 3	LINE SW CKT 1 (2:1 LCR)	LINE SW CKT 3 (2:1 LCR)	LINE SW CKT 5 (2:1 LCR)
JUNCTOR SW CKT 2			
JUNCTOR SW CKT 1	SCANNER CKT 0	SCANNER CKT 1	SCANNER CKT 2
	LINE SW CKT 0 (2:1 LCR)	LINE SW CKT 2 (2:1 LCR)	LINE SW CKT 4 (2:1 LCR)
JUNCTOR SW CKT 0			
FUSE PANEL UNIT	FUSE PANEL UNIT	FUSE PANEL UNIT	FUSE PANEL UNIT
FILTER UNIT	FILTER UNIT	FILTER UNIT	FILTER UNIT

Fig. 14—Remreed Line Link Network Frame Configurations

TABLE A

LINE LINK NETWORK SIZES

RATIO OF LINE TERMINALS TO JUNCTORS	MAX. NO. OF LINE SWITCH CKTS. PER LLN	MAX. NO. OF CUSTOMER LINES PER LLN	MAX. NO. OF LLNs PER OFFICE	MAX. NO. OF LINES PER OFFICE
FOR HEAVY CUSTOMER USAGE (2:1 CONCENTRATION RATIO)				
2:1	4	2048	16	32,768
3:1	6	3072	16	49,152
2:1	4	2048	28 *	57,344
2.5:1	5	2560	28 *,†	71,680
3:1	6	3072	38 *,	86,016
3.5:1	7	3584	28 *,†	100,352
FOR REGULAR CUSTOMR USAGE (4:1 CONCENTRATION RATIO)				
4:1	4	4096	16	65,536
6:1	6	6144	16	98,304
4:1	4	4096	28 *,	114,688
5:1	5	5120	25 *, †, ‡	128,000
6:1	6	6144	21 *, §	129,024

* The 1A ESS switch with extended line link networks. The maximum number of LLNs for these offices is determined by the junctoring requirements and the generic program. The maximum number of LLNs shown above with extended networks is with 25 percent of all calls being intraoffice.

† Concentration ratios are A&M; however, they are valid concentration ratios for 1A processor retrofits.

‡ The generic program will allow an additional 3/5ths fractionally equipped LLN.

§ The generic program will allow an additional 1/3rd fractionally equipped LLN.

lection of a specific ratio is traffic dependent and may be changed to meet the needs of office growth.

4.51 The 1024 TLN (1.5:1 trunk-to-junctor ratio) represents six TSCs and four JSCs. The remreed 1024 TLN occupies two 2-bay frames with a total width of 6 feet 6 inches for each 2-bay frame. The remreed TLN is used for 1:1 and 1.5:1 trunk concentration ratios. The four separate TSCs and JSCs on the 1024 remreed TLN share the PUB receivers and the diagnostic bus connections for each bay.

4.52 The remreed TLNs are only available equipped with a full complement of JSCs. The TSCs may be provided on a fractional network basis, with either ferreed or remreed hardware. The possible combinations of network concentration ratios are listed in Table C.

MONITOR AND CONTROL

4.53 In order for the 1A processor to perform the call processing and maintenance testing functions required to operate a 1A ESS switch, the 1A processor must communicate with the switching network. It is the job of the peripheral monitor and control units (Fig. 54) to provide the two-way communications link required by the 1A processor. These units consist of:

- Scanners

- SDs

- CPDs.

BASIC FRAME   SUPPLEMENTARY FRAME

FERROD
SENSORS

FERROD
SENSORS

CONTROL PANEL

FERREED
SWITCHES

RELAYS

RELAYS

FERREED
SWITCHES

PULSER

BAY 0   BAY 1   BAY 2
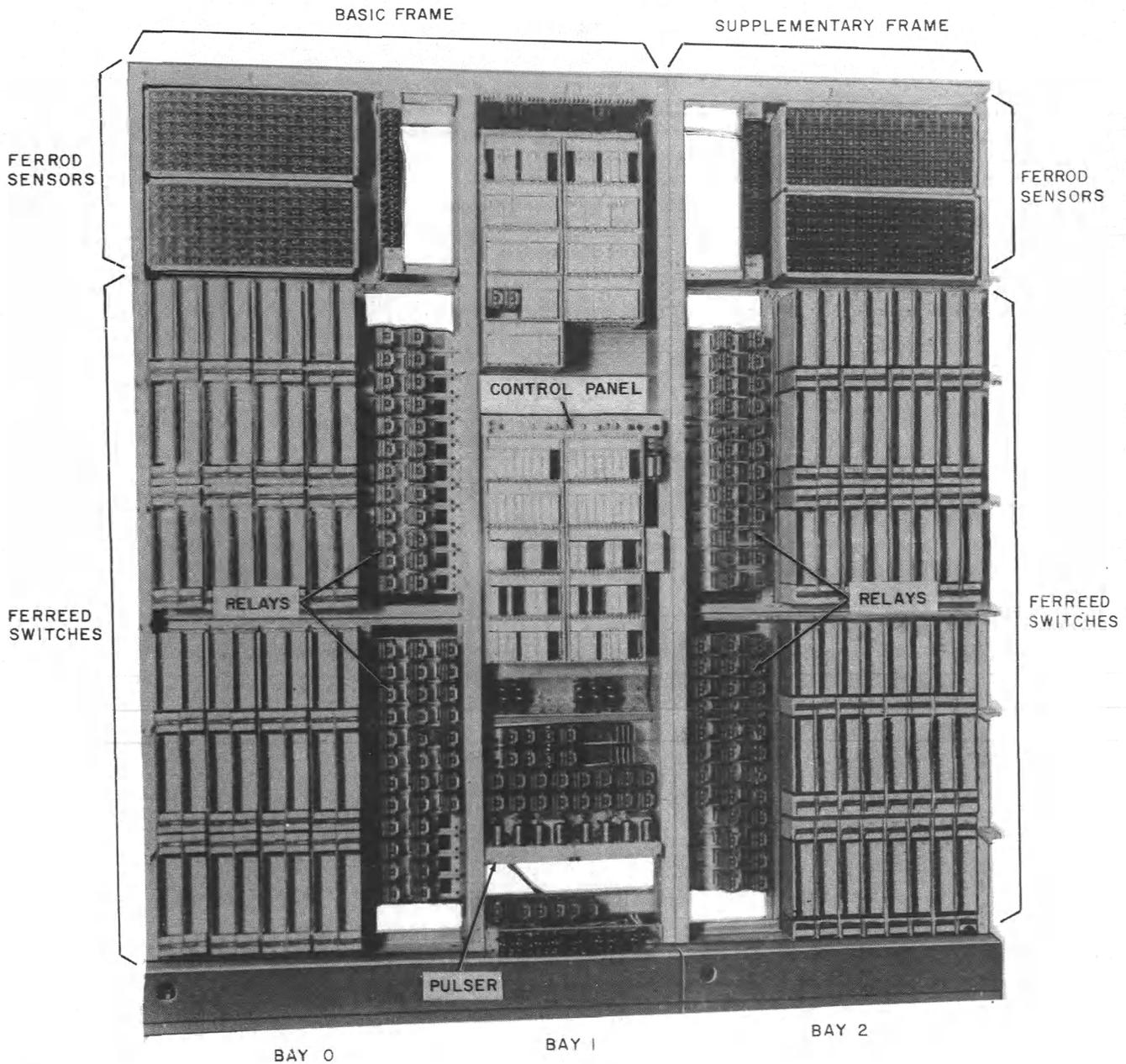
Fig. 15—4:1 Ferreed Line Switch Frame

A. Scanners

4.54 Scanners are current sensing devices which furnish input information to CC. Scanners are used to monitor customer lines for on-hook and off-hook conditions and to monitor dial pulses, etc. Scanners also monitor trunks and other circuits at discrete time intervals as directed by the system. The scanners are provided in 512- or 1024-point modules which are physically located on network, trunk, and junctor frames. Master scanners are provided for diagnostic and miscellaneous scanning functions.

4.55 Each point in the system to be scanned is connected to a current-sensing device called a ferrod sensor. The ferrod consists of a ferrite rod enclosed by a pair of control windings (Fig. 19). A single turn interrogate windings and a single turn readout winding are threaded through two holes in the center of the ferrod. The control windings are con-

FERREED
SWITCHES

CONTROL
PANEL

RELAYS

PULSER

RELAYS
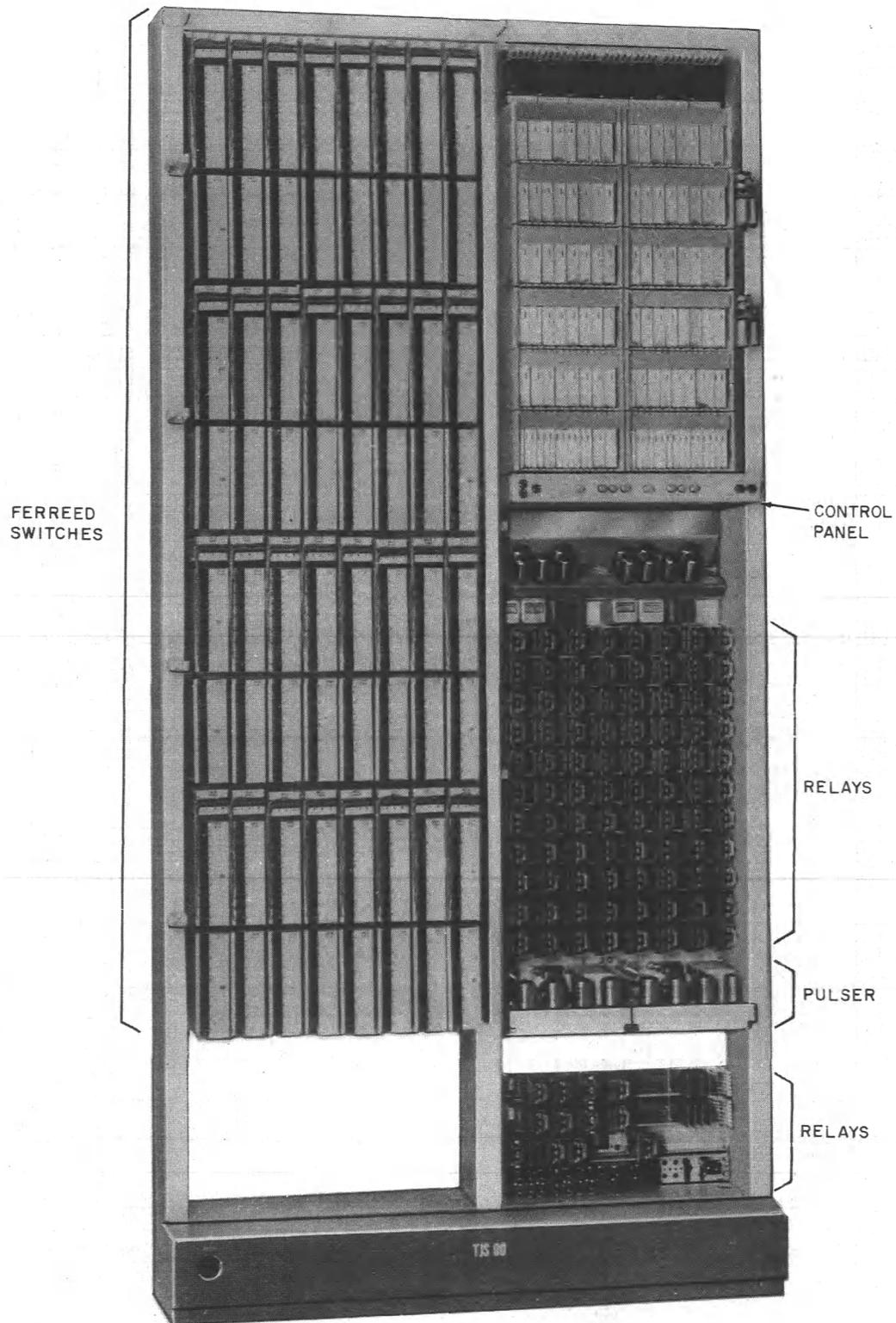
Fig. 16—Ferreed Junctor Switch Frame (Line or Trunk)

TRUNK SWITCHING CIRCUITS   JUNCTOR SWITCHING CIRCUITS
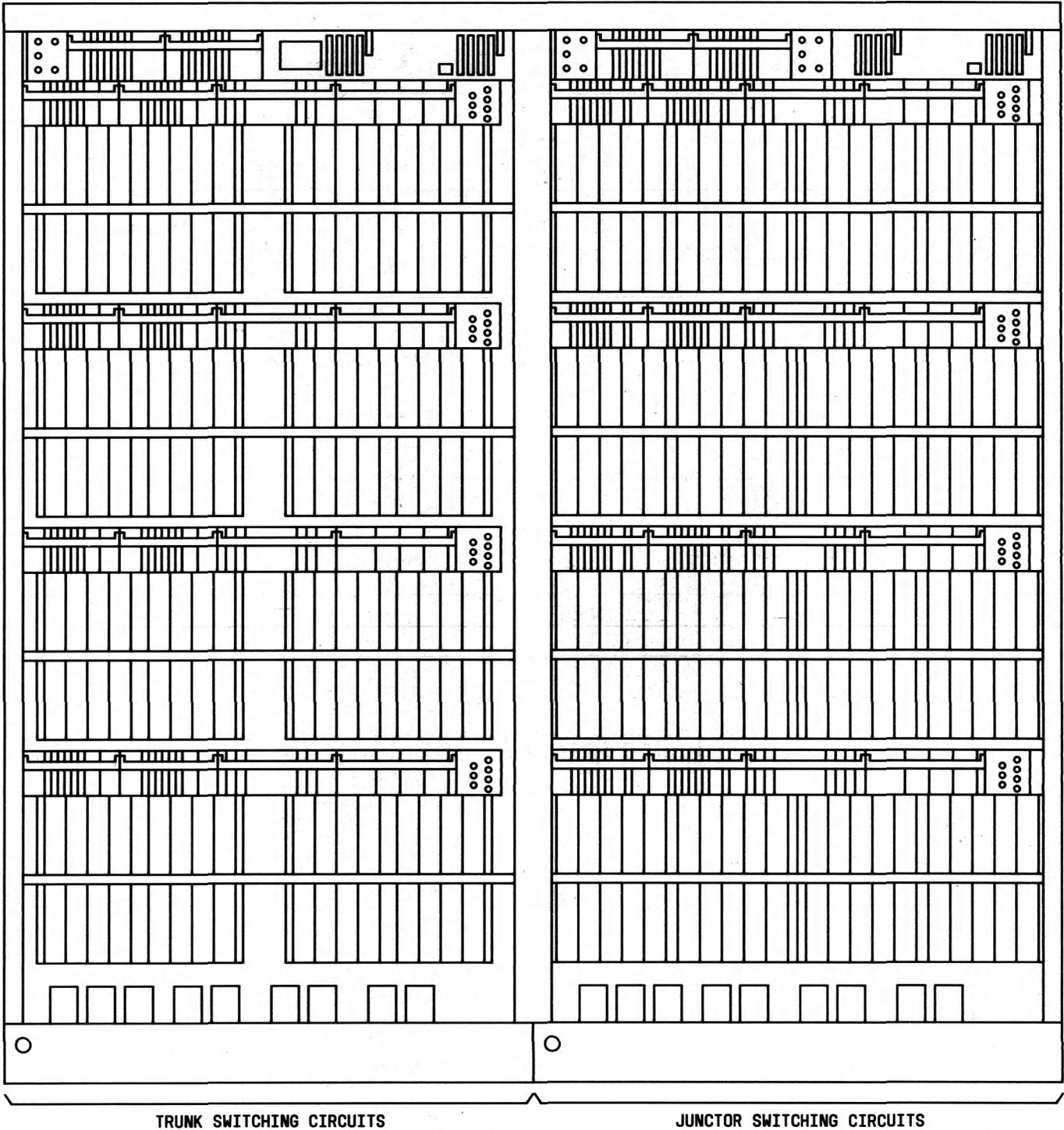
Fig. 17—Remreed TLN (1024 Junctor 1:1 Concentration Ratio)

FERREED
SWITCHES

CONTROL
PANEL

RELAYS

PULSER

RELAYS
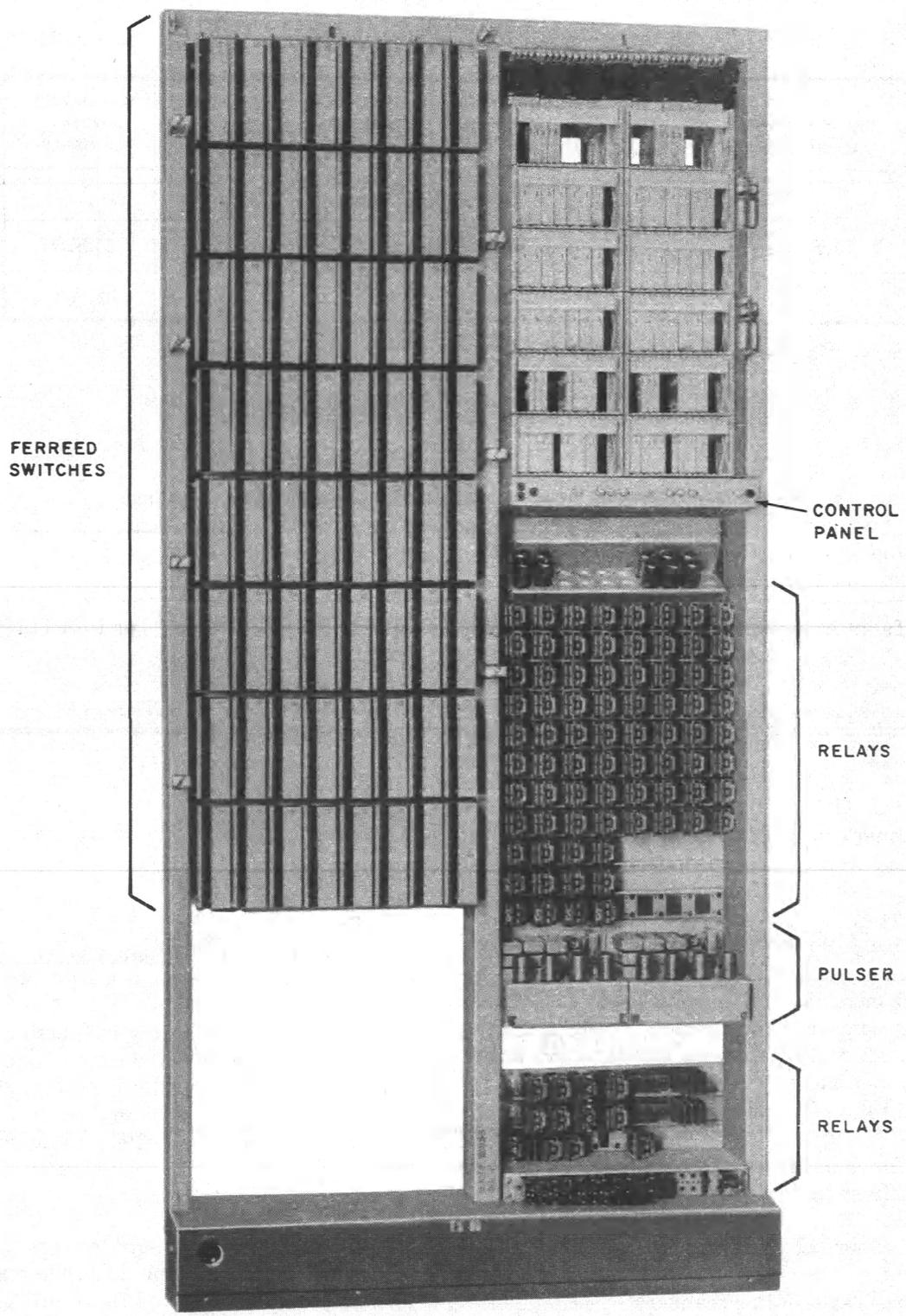
Fig. 18—Ferreed Trunk Switch Frame

TABLE B

TRUNK LINK NETWORK SIZES

RATIO OF TRUNK TERMINALS TO JUNCTORS	MAX. NO. OF TSCS PER TLN	MAX. NO. OF TERMINALS PER TLN	MAX. NO. F JUNCTORS PER TLN	MAX. NO. OF TLNs PER OFFICE	MAX. NO. OF TRUNKS PER OFFICE
1 to 1	4	1024	4	16	16,384
1.5 to 1	6	1024	4	16	24,576
1 to 1	8	2048*	8	16	32,768

*— May be 2-Wire or HILO 4-Wire

TABLE C

POSSIBLE COMBINATIONS OF NETWORK CONCENRATION RATIOS

LLN CONCENTRATION RATIO	\ TLN CONCENTRATION RATIO
Any in Table A	1024 TLN (1:1 or 1.5:1) or 1024 TLN (1:1) with 2048 TLN (1:1) or 1024 TLN (1:1) with 2048 TLN (1:1 HILO 4-Wire.)
No LLNs	2048 TLN (1:1) with 2048 TLN (1:1 HILO 4-Wire) or 2048 TLN (1:1)

nected in series with the circuit to be sensed or supervised. A scanner can select and interrogate any group of 16 ferrods specified by information received from the CC. Each of the 16 ferrods interrogated will cause a pulse or no pulse output referred to as a 1 or 0 readout, respectively. Whether the readout is a logic 1 or 0 will depend on the state of the scanned circuit. For example, if a customer line is being observed, the on-hook (open) condition results in a 1; the off-hook (closed) condition is a 0. In response to signals from CC, a scanner produces a 16-bit output word that is transmitted to the CC for interpretation.

4.56 The following types of scanners are used in a 1A ESS switch:

(a) Ferreed switch line scanners

(b) Remreed switch line scanners

(c) Universal trunk scanners

(d) MUT scanners

(e) Junctor scanners

(f) Master scanners

(g) Combined MT (master) scanners.

The scanners differ mainly in function and types of ferrods used; however, the control and operation of all scanners are essentially the same. The total number of scan points required in a 2-wire 1A ESS switch is about one and a half times the number of office lines.

4.57 The MS (Fig. 20) supplements the line, trunk, and junctor scanners to collect additional information at many points in an office. The master scanner also supplies the scan point for miscellaneous trunk (MT) frame circuits. This scanner consists of 1024-point ferrod sensor matrix and duplicated control units.

TO CUSTOMER, JUNCTOR, TRUNK
OR OTHER CIRCUIT TO BE SENSED OR SUPERVISED
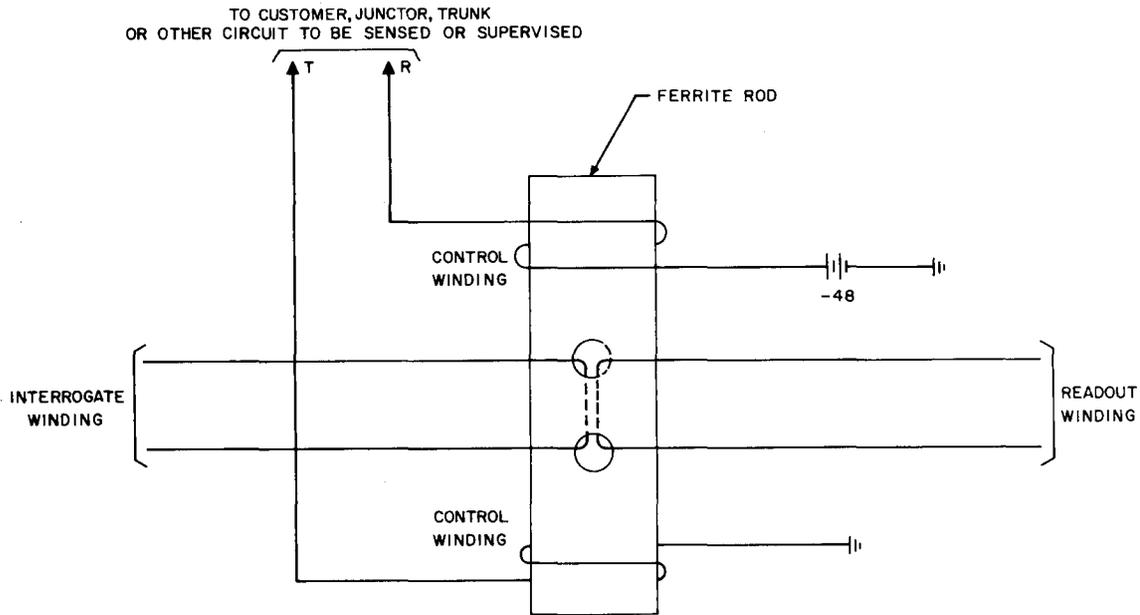
Fig. 19—Typical Ferrod Arrangement

B. Signal Distributors

4.58 The SDs are used to select and control equipment within the 1A ESS switch for which operation at electronic speeds is not required. The SDs provide the CC with a means for selecting and operating magnetic latching relays in trunk and service circuits, junctor circuits, and certain control circuits. Thus, SDs are the buffers between the microsecond CC requests and the millisecond relay response.

4.59 A supplementary SD (SSD) unit located on an MT frame is available for use when the SD point arrangement of junctor and universal trunk frames (UTFs) is insufficient. This supplementary unit provides a complete SD for circuits located on MT frames.

C. Central Pulse Distributor

4.60 The CPD (Fig. 21) is used to provide CC with access to many points within the system requiring action signals.

4.61 Upon receiving an order from CC, a CPD selects and pulses one of the outputs specified by the address from CC. Outputs from the CPD may be either unipolar (pulses of only one polarity) or bipo-lar (pulses of either polarity). Unipolar pulses are mainly used to enable peripheral units (scanners, SDs, network frame controllers). The verification pulse that results is returned to the CPD, decoded, and then sent to the CC. Bipolar pulses, sent to peripheral and other units, can be used to change the state of flip-flops or to operate a logic circuit. Circuits receiving a bipolar output pulse do not return a verify pulse to the CPD.

MAINTENANCE AND ADMINISTRATIVE CONTROL

4.62 The maintenance and administrative control consists of equipment used by maintenance personnel in maintaining an ESS switch. Maintenance and administrative control also contains the hardware that allows the 1A ESS switch to relieve incoming traffic congestion caused by outside switching offices. The following equipment comprises the maintenance and administrative control:

- MCC

- Trunk and line test frame

- Supplementary trunk test frame

- Manual trunk test frame
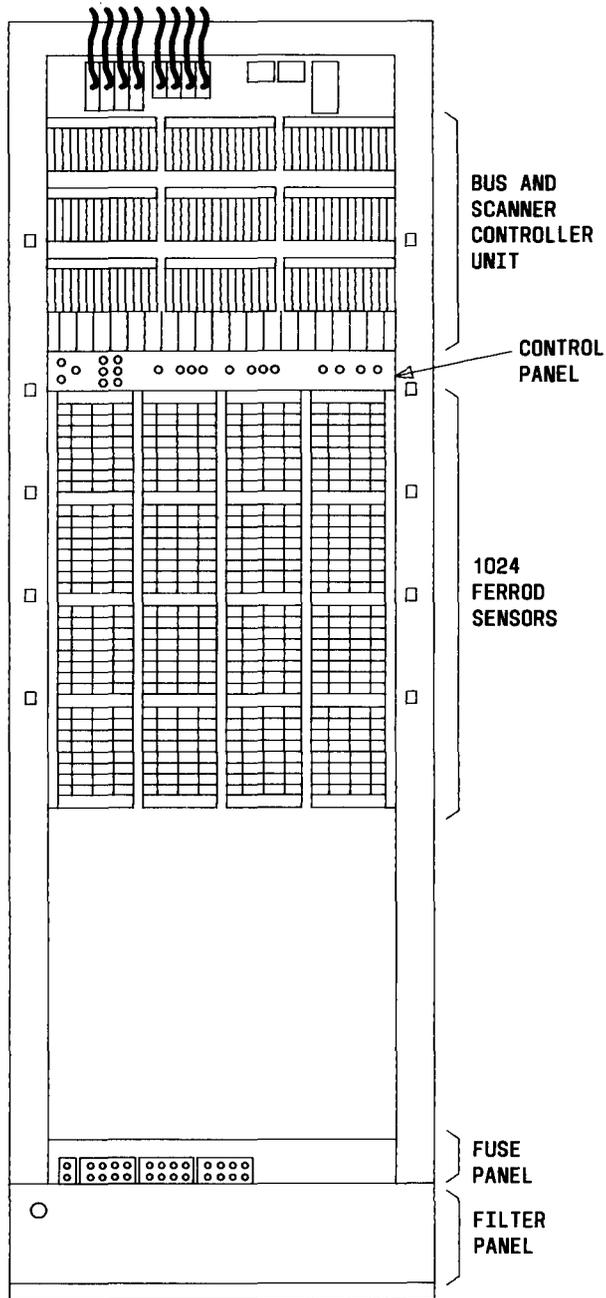
Fig. 20—Master Scanner

- IOTs

- ROTL

- DOC.

A. Master Control Center

4.63 The MCC serves as the primary interface between the 1A ESS switch and the maintenance personnel. The MCC consists of a 1A processor, control and display frame (C&D), a maintenance terminal including a cathode-ray tube display, and a newly designed trunk and line test panel (TLTP). The maintenance channel is described in paragraphs 4.73 and 4.74. The MCC equipment as described above is a functional equipment group and does not define a physical location. For example, an ADS tape unit may be located next to the C&D. The tape unit is not functionally part of the MCC but is located next to the C&D for the convenience of maintenance personnel. The C&D has control and display panels (CDs) that serve as a direct communications link between maintenance personnel and the system (Fig. 22). The controls are provided so manual recovery of the system can be brought about by direct control of system operation and configuration when automatic recovery fails. The indicators and displays provide information concerning system status and performance. As a functional unit the CDs are connected to the 1A ESS switch through the PPI frame. The PPI contains the control and display logic for the lamps, keys, and displays.

The CDs include the following:

- 1A processor display panel

- 1A processor request panel

- 1A ESS system status panel.

The processor display and request panels are common to all 1A ESS switch applications of the 1A processor; however, the system status panel is unique to the 1A ESS switch. For more information on the control and display frame, refer to Practice 231-301-000.

B. Automatic Message Accounting

4.64 The AMA feature is included with all 1A ESS switches. Its function is to automatically record billing data on calls. Software programs accumulate, format, and transfer the billing data from

(EVEN CPD)
BAY 0

(ODD CPD)
BAY 1

37

35

TRANSFORMER,
TERM. STRIPS,
AND CIRCUIT
PACKS

COMMUNICATION BUS
TERMINATION AND
DISTRIBUTION UNIT
J1A034BA

COMMUNICATION BUS
TERMINATION AND
DISTRIBUTION UNIT
J1A034BA

30

25

TERM. STRIPS

KEYS AND LAMPS

CONT PANEL UNIT, J1A034BB

CONT PANEL UNIT, J1A034BB

20

MATRIX
CONTROL UNIT
J1A034BC

MATRIX
CONTROL UNIT
J1A034BC

15

CIRCUIT
PACKS

10

MATRIX UNIT
2, J1A034BD

MATRIX UNIT
2, J1A034BD

05

FUSE PANEL J1A034BE

00

FUSE PANEL J1A034BE

FILTER PANEL J1A053K

FILTER PANEL J1A053K

2133MM
(7'0")

1320MM
(4'-4")

Fig. 21—Central Pulse Distributor

BULLETIN HOLDER

NO. 1A ESS SYSTEM STATUS PANEL

1A PROCESSOR DISPLAY AND OVERRIDE PANEL

TIME OF DAY CLOCK

TELEPHONE SET

1A PROCESSOR A-LEVEL PROGRAM REQUEST AND SYSTEM DISPLAY PANEL

TEL AND TEL SET JACKS

BAY 0   BAY 1

Fig. 22—Control and Display Frame Showing CDs

call store to the ADS. Optional features (starting with the 1AE8A generic) are the AMA Standard Entree (AMASE) and AMA Teleprocessing System (AMATPS). With the AMASE and AMATPS features, the billing data is transferred from CS to the APS.

4.65 The AMA feature stores billing data onto magnetic tape of the ADS. This tape is manually removed on a periodic basis and shipped to a revenue accounting office (RAO) for processing. For more information on the AMA feature, refer to Practice 231-390-063.

4.66 The AMASE and AMATPS features store billing data onto disk memory of the APS. These features operate on a store and automatic forward basis. The billing data is collected during the course of a call and is stored in an AMA register. All AMA registers are 18-words long with the AMASE feature, regardless of call type. Next, the contents of the register is copied into a CS buffer for later transfer to the APS. The APS formats this data into standard AMA entries and stores the formatted data on disk memory. The APS is periodically polled by a remote collector located in an RAO. When the APS is polled, it retrieves the AMA data from disk memory and teleprocesses it to the collector over dedicated or dial-up data links.

4.67 When a 1A ESS switch has AMASE/AMATPS, it may have another optional feature called the Multi-Entry Teleprocessing System (METS). This feature provides a means of recovering restricted DCS words in offices equipped with the APS. Instead of holding an AMA register on every billed call, for the full duration of the call, AMA register information is sent to the APS where it is retained until the call completes. At call completion, a call completion report is sent to the APS. After this, AMA handling is done in the same manner as AMASE/AMATPS features.

4.68 For more information on the AMASE and AMATPS features, refer to Practice 231-390-069 (when published 3Q84).

C. Trunk and Line Test Panel

4.69 The TLTP provides a means to manually remove from service and to test outgoing trunks, service circuits, or customer lines. The TLTP is also used to perform a number of miscellaneous transmission tests.

D. Supplementary Trunk Test Panel

4.70 The supplementary trunk test panel (STTP) is functionally identical to the TLTP when performing trunk tests. The major difference is that the STTP is not provided with line test features. With appropriate options, the STTPs may be located up to 1500 cable feet from the test level point or the reference TLN and may be powered from other systems in the building. Between each two STTPs is an auxiliary test frame housing a terminal and optional rack-mounted test equipment. Refer to SD-1A256-01 for the supplementary trunk test circuit.

E. Manual Trunk Test Position

4.71 The manual trunk test position (MTTP) (Fig. 23) is used to test HILO 4-wire trunks as well as 2-wire trunks. It is required for HILO 4-wire and toll CCIS and is optional for other trunk testing. It may be used in an office with STTPs. Between each two MTTPs is an auxiliary manual test (AMT) frame. The AMT mounts transmission test sets as well as an IOT. The IOT can be a send/receive channel. The MTTP and AMT can be located up to 1500 cable feet from the 1A ESS switch. Both the MTTP and AMT are standard 2 feet and 2 inch frames.

F. Input/Output Terminals (IOTs)

4.72 The IOTs provide telephone personnel with the capability to communicate with the 1A ESS switch. Communication between the telephone personnel and the CC is over transmission paths. These paths are called IO channels (IOCs). An IOC consists of an IOU, an IOUC, and from one to three ports. Several CS memory areas serve as storage for terminal messages. Some of the channels are specifically used for a medium speed (1200 baud) transmission rate which requires the use of a DATASPEED® 40 as an IOT. Other channels require a slow speed (110 baud) transmission rate which requires the use of a model 35 IOT. A few of the channels can be used for either slow or medium transmission rates. Table D shows the different IOCs and their rates. The following types of IOCs are used.

4.73 *Local Maintenance (LOC):* The local maintenance channel is used to report system status to maintenance personnel and allows maintenance personnel to perform a variety of system tests and interrogations. This channel and the remote maintenance channel are always included in a 1A ESS switch. Maintenance IOT messages indicate alarm conditions, trouble conditions, trouble diagnosis, traffic overload conditions, and replies to interrogations.

4.74 *Remote Maintenance (REM):* The REM channel is a multipurpose channel that is used as backup channel for several other channels.

4.75 *Recent Change Service (RCS) Order:* The RCS order channel is used to input service
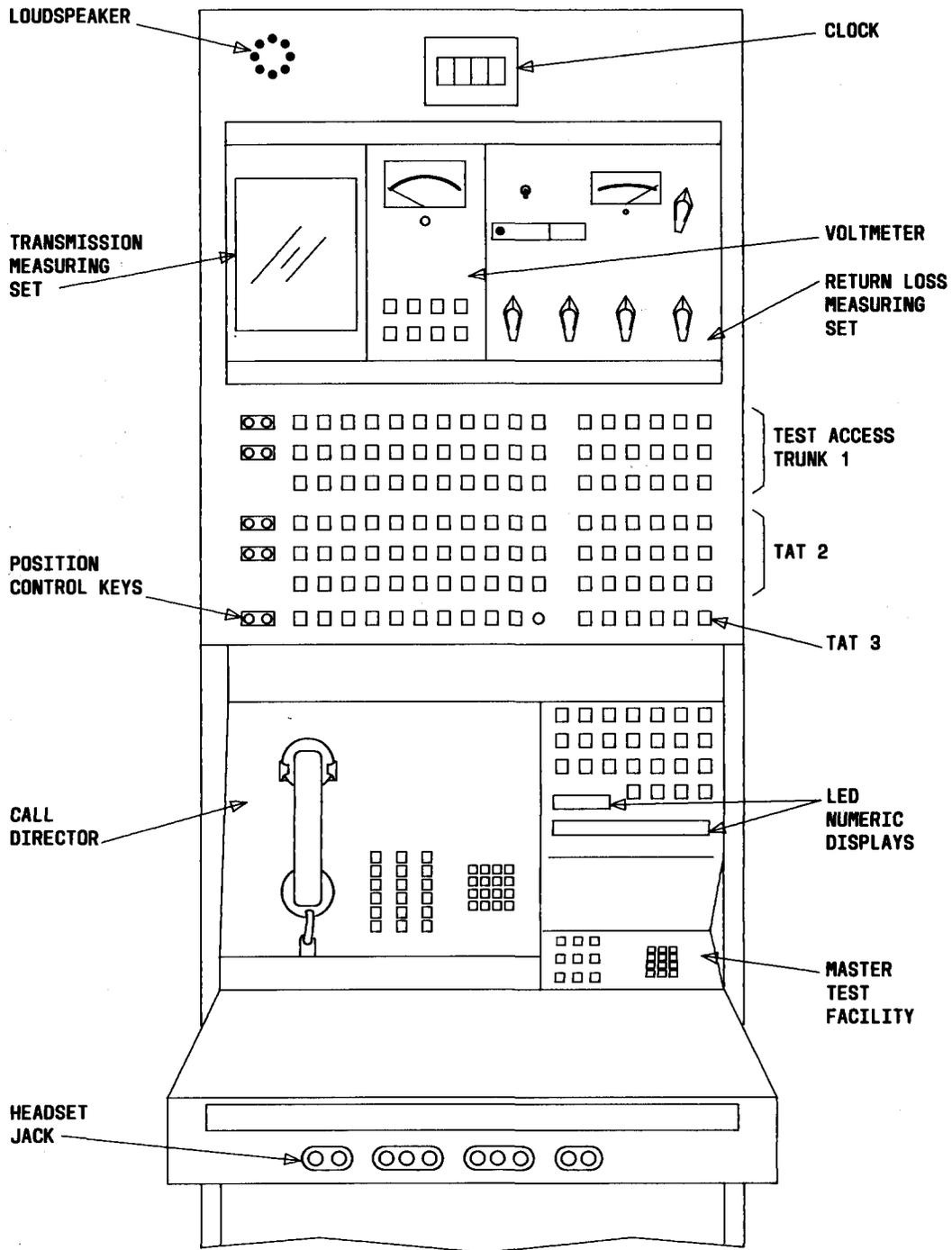
Fig. 23—Manual Trunk Test Frame

TABLE D

INPUT/OUTPUT CHANNELS (IOUs) FOR 1A ESS SWITCH

CHANNEL FUNCTION	MNEMONIC	CHANNEL SPEED	TERMINAL TYPE
Local maintenance	LOC	Medium	DATASPEED 40
Remote maintenance	REM	Medium	DATASPEED 40
Recent change service order	RCS	Slow or Medium	DATASPEED 40 or Model 35 KSR
Administrative dial service	TR1	Medium	DATASPEED 40
Supplementary dial service	TR2		
Supplementary remote maintenance	SRM	Medium	DATASPEED 40
SCC maintenance	SC1	Medium	DATASPEED 40
Supplementary SCC maintenance	SC2	Medium	DATASPEED 40
Beltline maintenance	BLT	Slow	Model 35 KSR
Plant service center	PSC	Slow or Medium	DATASPEED 40 or Model 35 KSR
Network management	NMG	Slow or Medium	DATASPEED 40 or Model 35 KSR
Calling line identification	CLT	Slow or Medium	DATASPEED 40 or Model 35 KSR
First trunk maintenance	ST1	Slow	Model 35 KSR
Second trunk maintenance	ST2	Slow	Model 35 KSR
Third trunk maintenance	ST3	Slow	Model 35 KSR
Fourth trunk maintenance	ST4	Slow	Model 35 KSR

order information. This information includes changes in type of service, installation of new service, and inclusion of new features as part of customer service. Translation information may be verified over this channel.

4.76 Administrative Dial Service (TR1): This channel, also called the traffic 1 channel, reports certain traffic load conditions, overload status, and the traffic data accumulated by the system. The dial service channel is used to implement line load control, toll network protection, and can be used to examine traffic registers in memory. This channel is used by network administration to maintain and administer traffic facilities.

4.77 Supplementary Dial Service (TR2): This channel, also called the traffic 2 channel, reports the C (continuous) schedule, H (busy hour) schedule, D (daily) schedule (segments A and B only), and W (weekly) schedule. The supplementary dial service channel is provided to produce outputs for machine-machine interfaces. Examples are magnetic tape cartridges recording data or external systems receiving data directly.

4.78 Supplementary Remote Maintenance (SRM): This maintenance channel is provided for use by the electronic systems assistance centers (ESAC) or similar centers. This channel has the same capabilities as the remote maintenance and local maintenance (LOC) channels.

4.79 SCC Maintenance (SC1): This maintenance channel is provided for use by the SCC. The SCC maintenance channel has the same capabilities as the remote maintenance and local maintenance channels.

4.80 Supplementary SCC Maintenance: This channel is used as a backup for the SC1 channel. The supplementary SCC maintenance channel has all of the capabilities of the SC1 channel. This channel is equipped with either a private line or dial access.

4.81 Beltline Maintenance (BLT): This channel gives switchroom personnel the capability to communicate with the CC from a mobile IOT. Switchroom personnel can move the mobile IOT to an equipment frame within the office and plug into the spare jack on the frame. This capability gives person-

nel better access to equipment and allows for more efficient testing of equipment.

4.82 Plant Service Center (PSC): The PSC channel, also referred to as the automatic line insulation test (ALIT) or local test desk (LTD) is a nonmaintenance send-receive channel. It is used by the system for recording information at a local or remote test bureau. This information consists of a list of permanent signals on lines, results of ALITs, and results of tests performed on pressurized cable connector pairs.

4.83 Network Management (NMG): This channel provides two features: Code blocking (CB) and trunk group control (TGC). These features are used in overload conditions to help alleviate traffic congestion. This is done by cancelling call attempts that have a low probability of completion and to inhibit the spread of machine congestion. In addition, this channel can be used to request status information and traffic data.

4.84 Calling Line Identification (CLID): This channel provides information that has been requested as a result of initiating calling line identification procedures. This information includes the calling DN, the called DN, and at what time the call was placed.

4.85 First, Second, Third, and Fourth Trunk Maintenance (ST1, ST2, ST3, and ST4): The terminals on these channels supplement the TLTP facilities in the MCC. Each trunk group is assigned to one of four test positions. Each position normally has two supplementary trunk test frames. Located between these two frames is an auxiliary test frame with an IOT which is used for communication over a trunk maintenance channel.

4.86 For more information on IOCs for the 1A ESS switch, refer to Practice 231-301-020.

G. Remote Office Test Line (ROTL)

4.87 The ROTL provides the capability of performing trunk transmission tests. Transmission tests are initiated by either an external testing location or an optional program controlled interrogator (PCI). The testing location is typically a centralized automatic reporting on trunks (CAROT), or another switching office. The optional PCI allows for locally initiated automatic trunk transmission tests using

ROTL. These tests are initiated via the maintenance channel, TLT, or the STT.

H. Dynamic Overload Control

4.88   The DOC frame provides a mounting space for the DOC transmitter circuit and the NMG indicator circuits. The transmitter circuit exits in an office only if the DOC frame is provided. The transmitter circuit provides the means by which the system can reduce calling traffic from outside offices when this traffic causes congestion. The DOC transmitter sends signals to these offices to either stop or decrease routing traffic to the DOC office on designated trunk groups. The NMG indicator circuit is mounted on the MT frame if no DOC frame is provided. The indicator circuit provides the means by which a remote NMG control center can monitor the switching system states. The indicator circuit provides 24 SD relays. A contact closure associated with each relay provides an on-off indication to the remote NMG control center.

CENTREX EQUIPMENT UNITS

4.89   The CTX service is a centralized telephone communication exchange service using the data handling and switching capabilities of a nearby 1A ESS switch. Reference should be made to Practice 966-102-100 for a complete list and explanation of CTX features. Centrex service requires the use of three additional specialized equipment units:

- CTX data link frame (at the 1A ESS switch)

- CTX console control cabinet (at the customer premises)

- Attendant telephone consoles (at the customer premises).

4.90   A data loop is connected between the data link frame and the console control cabinet to control the states of the lamps and to receive key signals from the remote centrex attendant telephone console.

4.91   The CTX office end of a CTX data loop terminates in a CTX data link circuit mounted on a CTX data link frame (Fig. 24) in the 1A ESS switch. The CTX data link frame is arranged to mount up to eight data link circuits and their associated equip-

ment. Each data link provides the interface between a data loop and the 1A ESS switch.
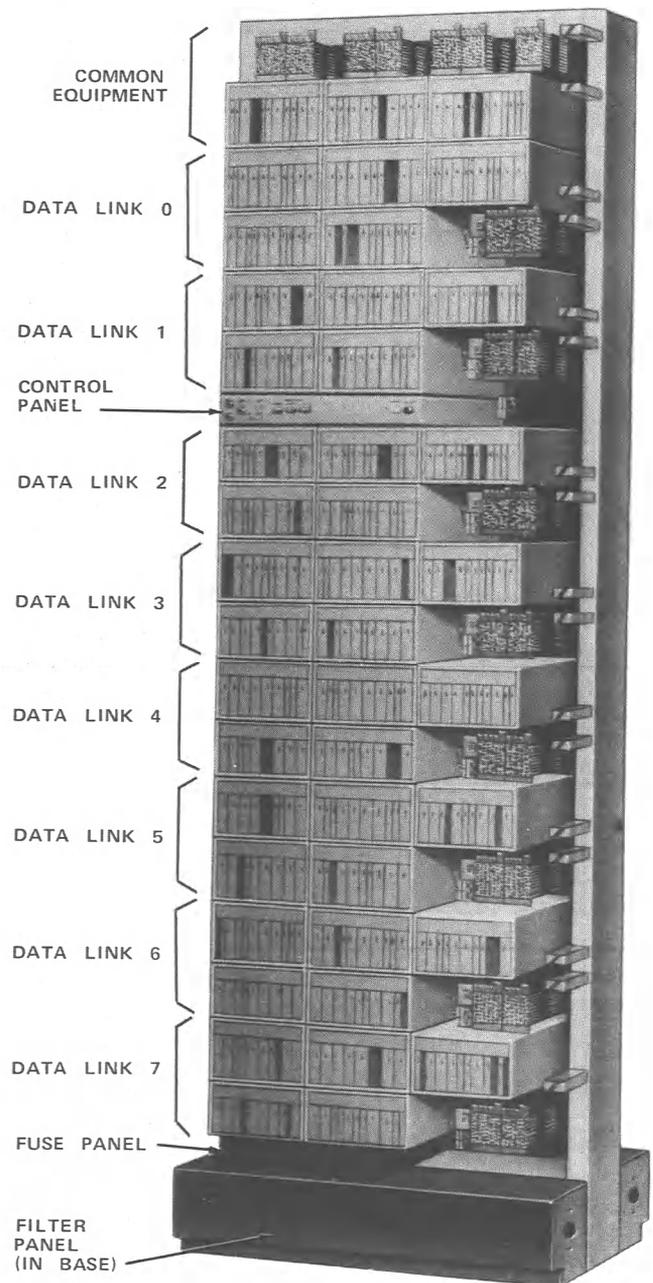
Fig. 24—Centrex Data Link Frame

4.92   The remote end of the data loop terminates in a console control circuit contained in the console control cabinet (Fig. 25) at the CTX location. The console control circuit provides the interface between

the data loop and the attendant telephone consoles. As many as four attendant telephone consoles can be controlled by a single data loop and a console control cabinet mounting four console control circuits.

4.93 Attendant telephone consoles (Fig. 26) are used by the CTX customer to provide attendant service. The 1A ESS switch can work with the 50A customer premises system (CPS) consoles arranged with attendant direct station selection (ADSS) and busy lamp field (BLF) for small CTX ser-

vice or PBX service (Practice 981-300-100). The 50B CPS provides all of the features available with the 50A CPS. A customer with the 50B CPS may have up to 4 attendant positions with BLF/direct station selection (DSS) features or up to 16 attendant positions without BLF/DSS features. The CPS may be engineered to meet traffic capacity and requirements of the CTX customer.
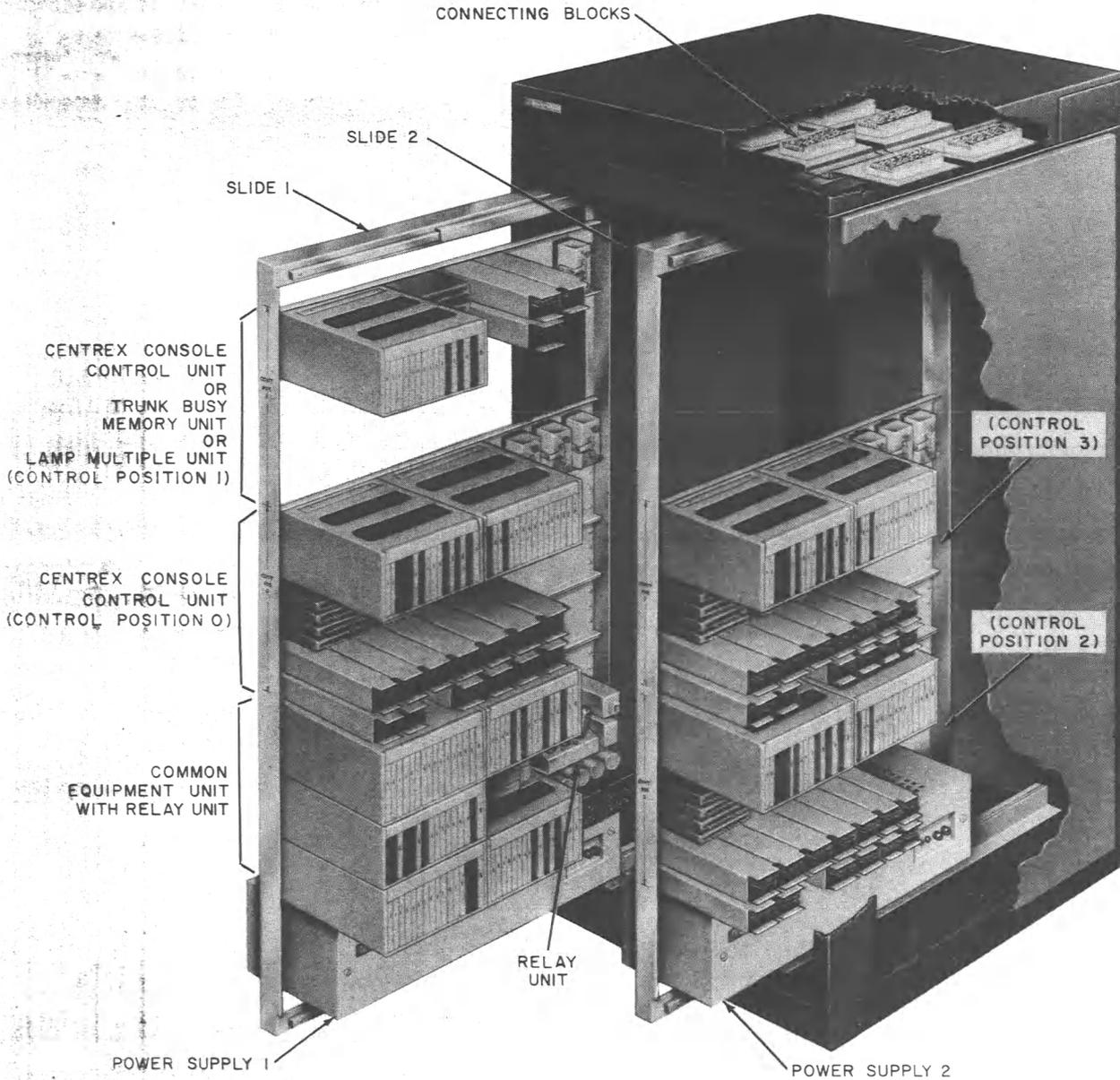
Fig. 25—1A ESS Switch Centrex Console Control Cabinet
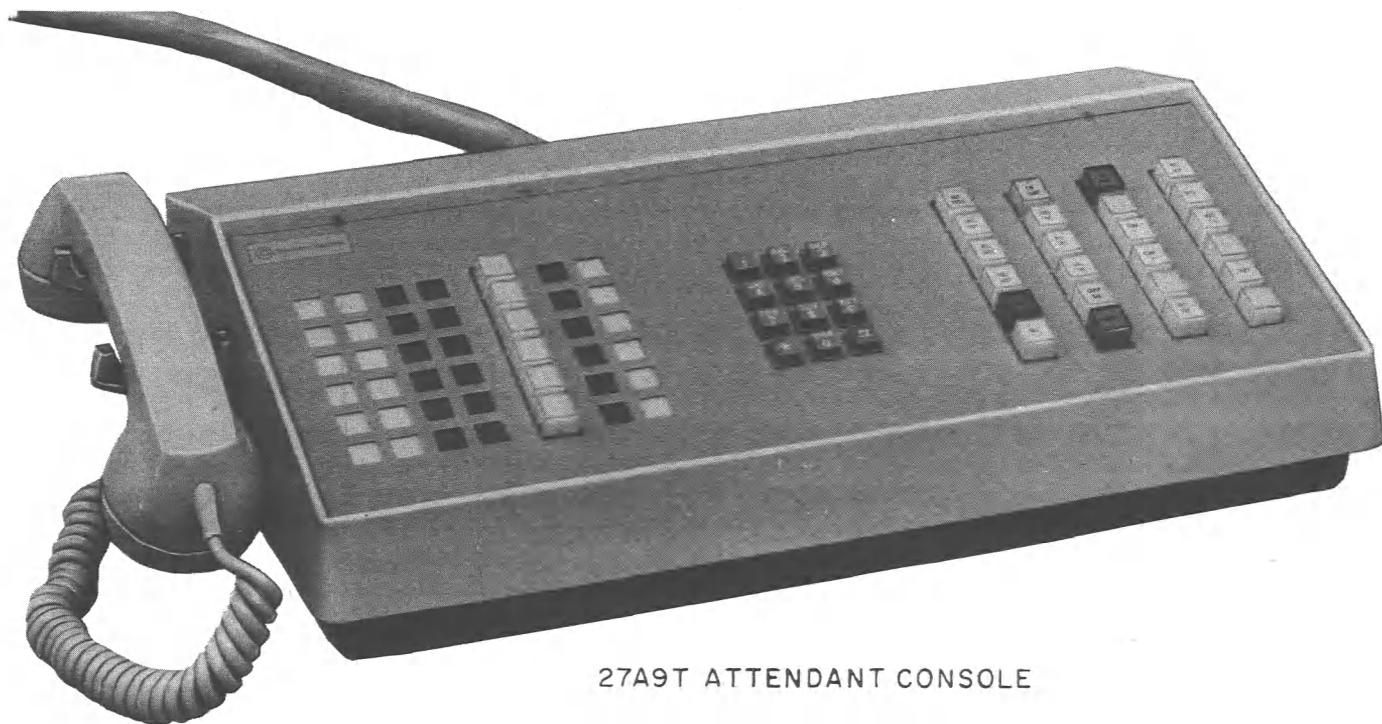
27A9T ATTENDANT CONSOLE
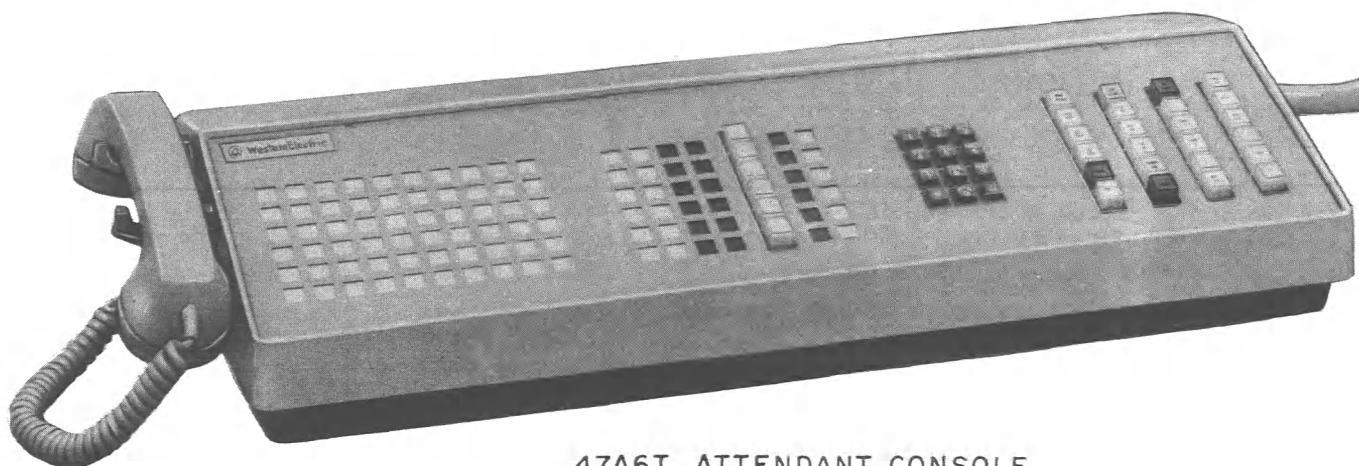
47A6T ATTENDANT CONSOLE

Fig. 26—Centrex Attendant Telephone Consoles

4.94 A summary of equipment capacities for units associated with the 1A ESS switch is shown in Table E.

DATA TERMINAL GROUP

4.95 The data terminal group is a 4-bay complex containing the terminals and modems for up to 32 signal links, as well as duplicated terminal access controllers. The controllers interface the terminals to the peripheral unit bus system of the processor. The terminal is a small, special-purpose stored-program processor which maintains data communication over the signaling link and provides buffering between itself and the 1A ESS switch processor for received and to-be-transmitted data filled information words. In the CCIS system these words are called signal units. The 1A ESS switch processor periodically polls the controller to determine which terminals, if any, contain waiting data-filled information words. Synchronization, error detection, retransmission of information words received in error, and acknowledgment of correctly received information words are also handled by the terminal independent of the processor.

**4.96** The data terminal basic frame (J1A094A-1) of the terminal group consists of two bays, each 3 feet 3 inches wide and 7 feet high (Fig. 27). Contained on this frame are up to eight terminals with modems, the duplicated terminal access controllers, and the associated voice frequency link access (VFLA) circuits. Two supplementary 3 foot 3-inch bays (Fig. 28) may be added, each containing four additional terminal-modem units and four associated VFLA circuits.

DISTRIBUTION FRAMES

4.97 In addition to the units and frames already mentioned, other frames are used which perform noncontrol functions. These frames are primarily distribution frames and are used to interconnect two groups of leads in a unique pattern according to the office assignment. The interconnecting pattern can be easily rearranged when assignments are changed. The additional noncontrol frames are:

- Main distributing frame and protector frame

- Trunk distributing frame

- Intermediate distributing frame.

A. Main Distributing Frame and Protector Frame

4.98 All outside cable from customers and other COs are terminated at the protector frame on protectors that prevent damage to office equipment from lightning and power crosses on selected special circuits. Cables from the protectors are connected to alternate columns of terminal blocks at the main distributing frame and are distributed vertically. Protector cables are interconnected with cables from LLNs and intermediate distributing frames which are connected to the remaining columns (distributed vertically across the column).

B. Trunk Distributing Frame

4.99 The trunk distributing frame interconnects trunk and service circuits and the TLN appearances. The distributing frame is also a preferred point for cross-connections not requiring direct access to an outside cable pair. The TLN appearances are connected to alternate columns of terminal blocks and the trunk circuits and service circuits are connected to the remaining columns.

C. Intermediate Distributing Frame

4.100 The intermediate distributing frame interconnects the main distributing frame and incoming and outgoing trunk circuits. In appearance, the intermediate distributing frame is the same as the trunk distributing frame. Cable pairs from the main distributing frame are connected to alternate columns of terminal blocks while cable pairs from the trunk circuits are connected to the remaining columns.

D. Power Distribution Frame and Power Plant Frame

4.101 Area bus centers and power distribution fuse boards are located near the CO equipment and serve as distribution points for the various voltages.

4.102 The power distribution system for a 1A ESS switch follows standard plant practices. The normal ac power source for the entire office is commercial ac. If commercial ac is lost, engine-driven alternators supply reserve ac power to replace commercial ac. Primary dc power is normally supplied by battery plant rectifiers that convert commercial/reserve ac to primary dc power. When commercial/reserve ac is disrupted, reserve batteries

TABLE E

SUMMARY OF EQUIPMENT UNIT CAPACITIES

NAME	DESIGNATION	CAPACITY OR REMARKS
Basic ferreed line switching circuit (4 to 1 conc.) bays 0 and 1	LSC (LSF)	512 lines — 128 B-links, network and scanner controllers for 1024 lines.
Supplementary lines switching bay (4 to 1 conc.) bay 2	—	512 lines — 128 B-lines (bay 2).
Line switching circuit (frame) (2 to 1 conc.)	LSC (LSF)	512 lines — 256 B-links, network and scanner controllers for 1024 lines.
(Line or trunk) junctor switching circuit (frame)	LJSC (LJSF) TJSC (TJSC)	256 B-links — 256 junctors.
Trunk switching circuit (frame)	TSC (TSF)	256 B-links — 256 trunks.
1024	1024 TLN	4 TJSC and 1 to 6 TSC (1.5:1 max.).
2048	2048 TLN	8 TJSC and 1 to 8 TSC.
Line Link Network	LLN	4 LJSC and 1 to 8 LSC.
Junctor Home Frame 2-bay basic: Bays 0 and 1 Supplementary: Bay 2	J	64 connectors for plug-in units (2 circuits per plug-in unit). Scanner controller for both home and mate frame. 1024 scan points and SD points (4 scan points and 6 SD points per connector).
Junctor Mate Frame 2-bay basic: Bays 0 and 1 Supplementary: Bay 2		64 connectors for plug-in units (2 circuits per plug-in unit). SD controllers but no scanner controllers.
Universal Trunk Home Frame 2-bay basic: Bays 0 and 1 Supplementary: Bay 2	UT	64 connectors for plug-in (trunk) units (1 or 2 circuits per plug-in unit). Scanner controllers for both home and mate frames. 1024 scan points and SD points (4 scan points and 6 SD points per connector).
Universal Trunk Mate Frame 2 bay basic: Bays 0 and 1 Supplementary: Bay 2		64 connectors for plug-in (trunk) units (1 or 2 circuits per plug-in unit). SD controllers but no scanner controllers.

TABLE E (Contd)

SUMMARY OF EQUIPMENT UNIT CAPACITIES

NAME	DESIGNATION	CAPACITY OR REMARKS
13A Announcement System	13A	1 to 8 channels, 1 message per channel, 3 types of messages: 3 to 12 sec. VML, 12 sec. FML, 3 to 24 sec. VML.
Peripheral Unit Controller Digital Carrier Trunk Frame	PUC/DCT	480 T1-channels per DCT frame.
Peripheral Unit Controller Data Link Frame	PUC/DL Frame	16 separate data links per PUC/DL frame. A PUC/DL frame can serve up to 8 RSS units.
Common Channel Interoffice Signaling	CCIS	2-way signaling, separate signaling channel, compatibility with international signaling, flexibility

take over the rectifiers and supply primary dc power to the office. DC voltages other than primary dc required by the office are provided by dc-to-dc converters that convert primary dc to the various dc voltages. Some critical office loads require uninterrupted (protected) ac power which is supplied by a dc-to-ac inverter when commercial ac is lost. Other ac loads that are essential to the office, but can tolerate short interruption of ac power without degrading service, are supplied commercial/reserve (essential) ac power. Those loads that are not essential to the office are supplied from only commercial ac power.

4.103 Normal and reserve power sources for a 1A ESS switch is depicted in Fig. 29. The normal primary sources for the entire system is 208V, 240V, or 480V, 60-Hz, 3-phase commercial ac. If commercial ac power is lost, the gas-turbine alternator reserve power system supplies reserve 480V, 60-Hz, 3-phase primary ac power. Emergency 208/120 Vac power can also be provided by the 504B power plant which supplies single or 3-phase ac voltage from the 48-volt office battery during a commercial power failure. Primary dc power for the system is +24V and −48V supplied by the 111A power plants or 326A and 326B power plants. Negative or positive 130 volts are supplied by the 610B or 660C converter plants and delivered to fuse panels on a miscellaneous frame in the switchroom for distribution to the loads.

E. Power Conversion and Distribution Frame (PCDF)

4.104 The PCDF is a 3-bay frame (Fig. 30) and provides dc power for the 1A processor frames in the 1A processor complex. The PCDF also provides a status and alarm interface between the plant power distribution facilities, power converters in the PCDF, and the 1A processor. The PCDF receives -48V power from the plant power distribution system. The outputs of the PCDF are -48V and +24V for distribution to the 1A processor.

JUNCTOR, TRUNK, AND SERVICE CIRCUITS

4.105 Trunk circuits in a 1A ESS switch are used mainly to provide transmission and supervision (telephone on- or off-hook). All other functions of conventional trunks, such as pulsing, charging, timing, etc, are delegated either directly to the program control or to the service circuits, which in turn are under program control. Service circuits include customer dial pulse and TOUCH-TONE receivers, tone circuits, ringing circuits, circuits for transmitting and receiving information, coin control circuits, and other similar circuits. Service circuits are connected through the switching network to lines or trunks as required. These circuits perform functions which can be handled more economically by providing a few special circuits than by adding equipment in each trunk to accommodate the same function.
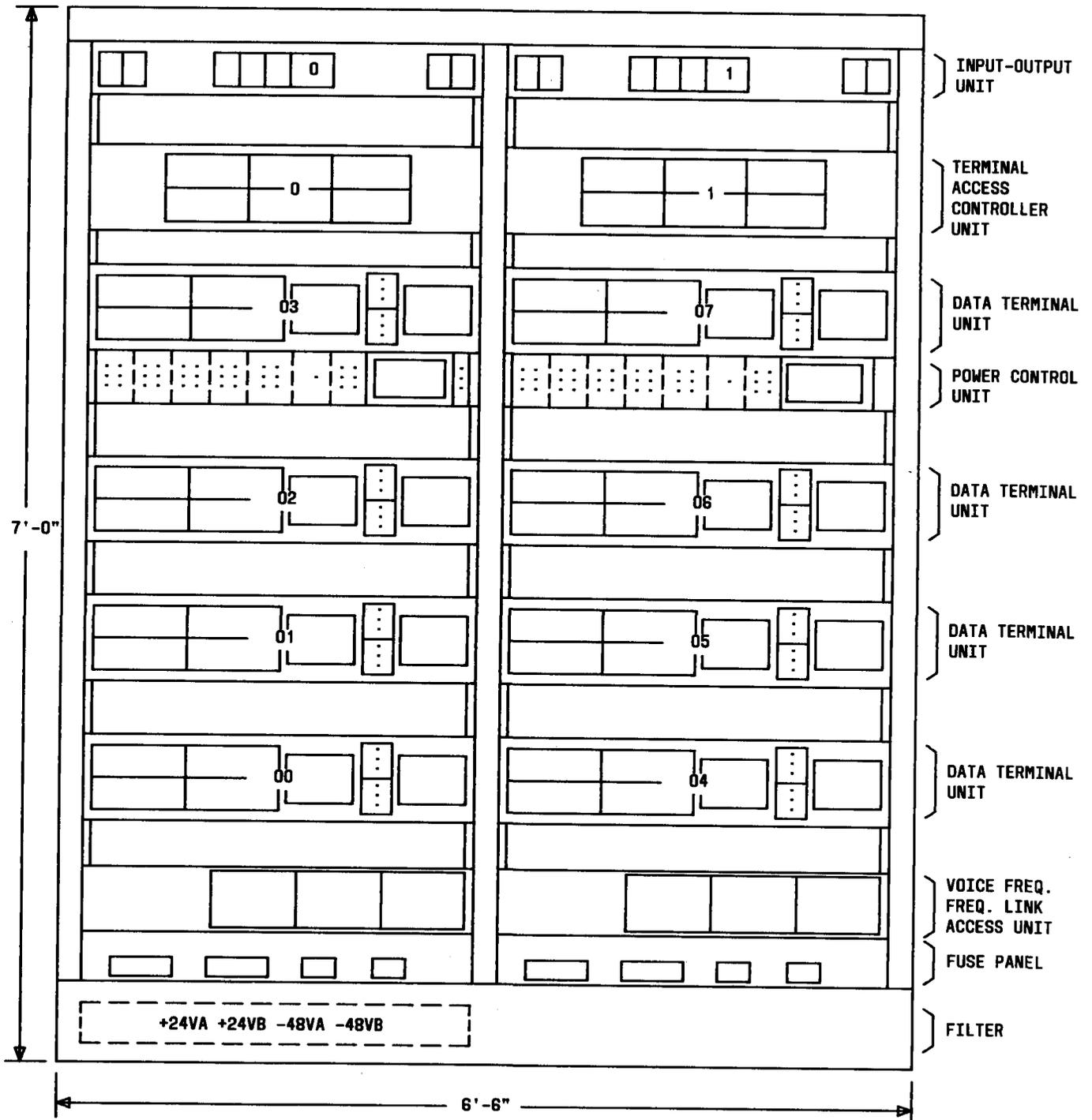
DATA TERMINAL BASIC FRAME

Fig. 27—Data Terminal Basic Frame

INPUT-OUTPUT UNIT

DATA TERMINAL UNIT

DATA TERMINAL UNIT

POWER CONTROL UNIT

DATA TERMINAL UNIT

DATA TERMINAL UNIT

VOICE FREQ. LINK ACCESS UNIT

FUSE PANEL

+24VA +24VB -48VA -48VB   FILTER

	1ST SUPL FR	2ND SUPL FR
A	08	12
B	09	13
C	10	14
D	11	15
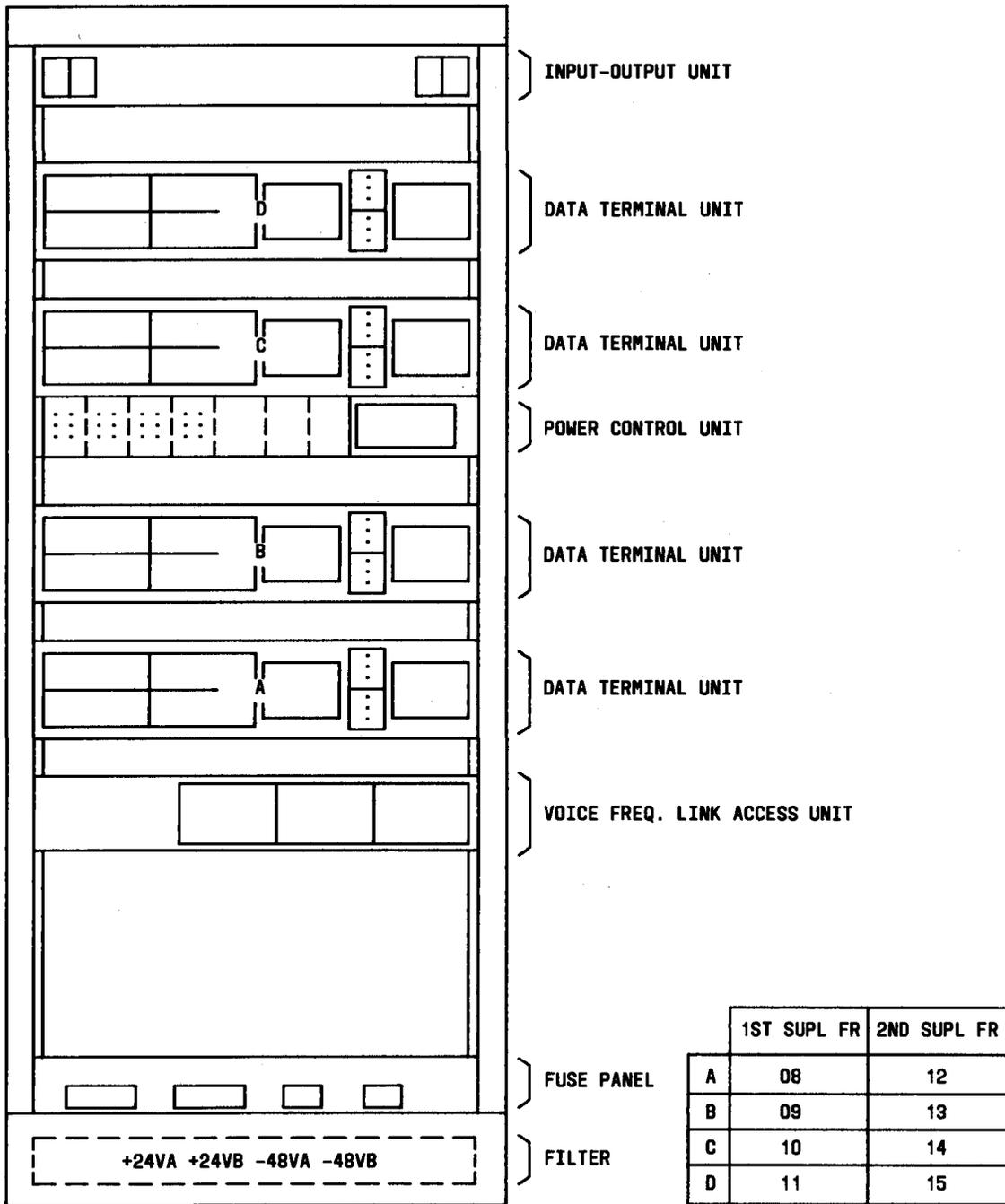
DATA TERMINAL SUPPLEMENTARY FRAME

Fig. 28—Data Terminal Supplementary Frame
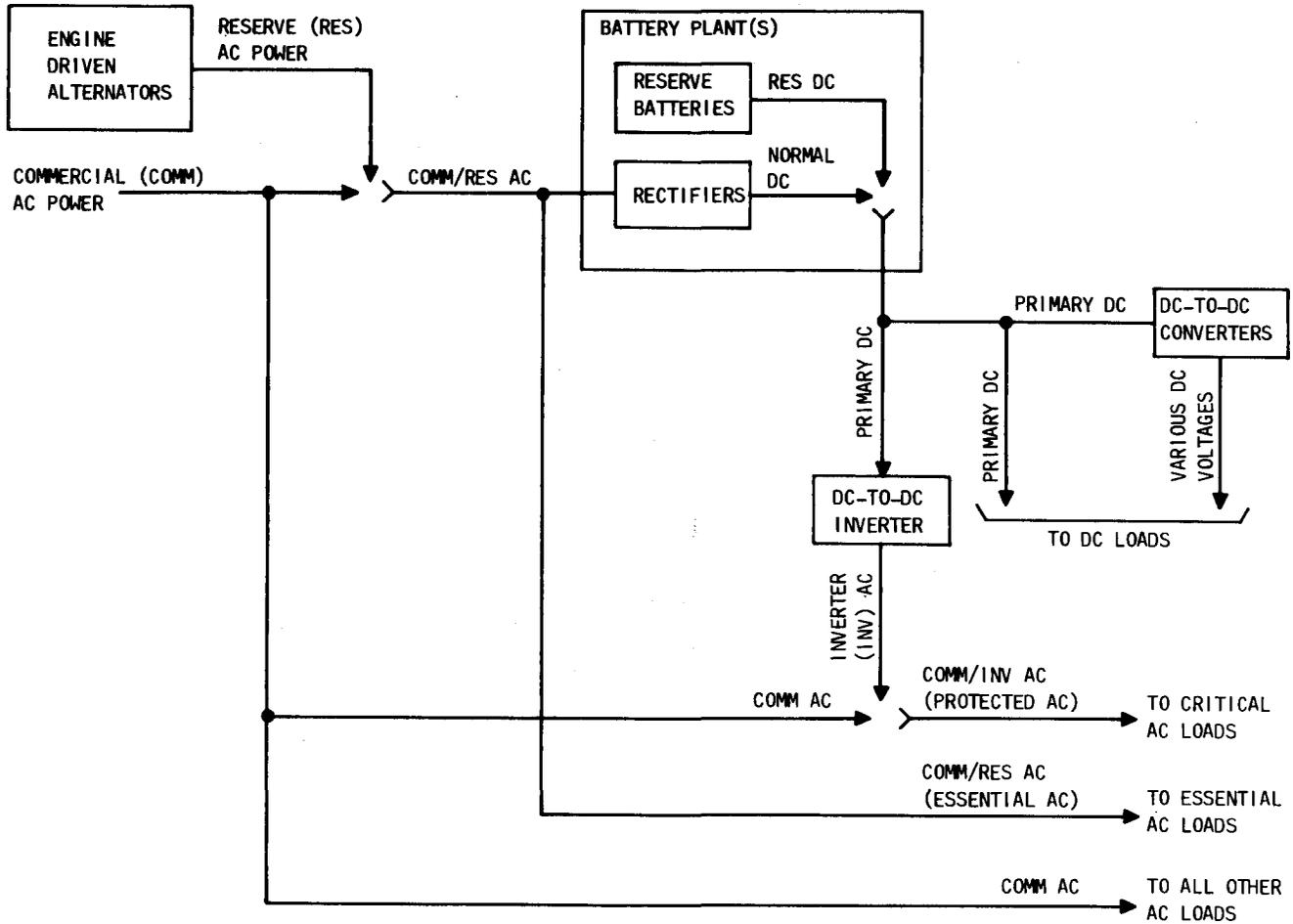
Fig. 29—Telephone Office Power Distribution System

4.106 Junctor circuits are switching circuits used to complete intraoffice calls. Junctor circuits also include a transmission circuit which provides ac coupling between the two lines and supplies talking battery to each end. Magnetic latching relays are used in junctor circuits for opening and closing the path between the circuit and each line. Junctor circuits are mounted on junctor frames. Junctor frames have the same configuration as universal trunk frames. An explanation of an interoffice call appears in Part 6 of this practice. Interconnection between LLNs, TLNs, and junctor circuits is provided by the JGF. Two types of JGFs are shown in Fig. 55 and Fig. 56. The junctor pattern for one office depends on its size and on the type of traffic.

A. Universal Trunk Frame (UTF)

4.107 There are two types of UTFs: home and mate (Fig. 31). Each home and mate frame con-

sists of three bays each numbered 0, 1, and 2. The 0 and 2 bays are arranged to mount 64 individual plug-in trunk units, each for a total of 128 units for the frame. The number of circuits per plug-in unit may be either one or two. The frame accommodates 256 circuits if all the units are of the 2-circuit type. The frames are 6 feet 6 inches wide.

4.108 Bay 1 of the home frame contains 512 ferrod sensors and the control equipment necessary for interrogating 1024 ferrods and converting their outputs to signals that can be used by other parts of the system. Bay 1 of the mate frame contains only 512 ferrods; the control equipment for them being located on bay 1 of the home frame. Bay 1 of each home and mate frame contains a complete 1024-point SD.

4.109 Bay 1 mounts (in addition to the scanner and the SD) the power control panel, the fuse panels, and the power filters for the scanner and SD

Fig. 30—Power Conversion and Distribution Frame
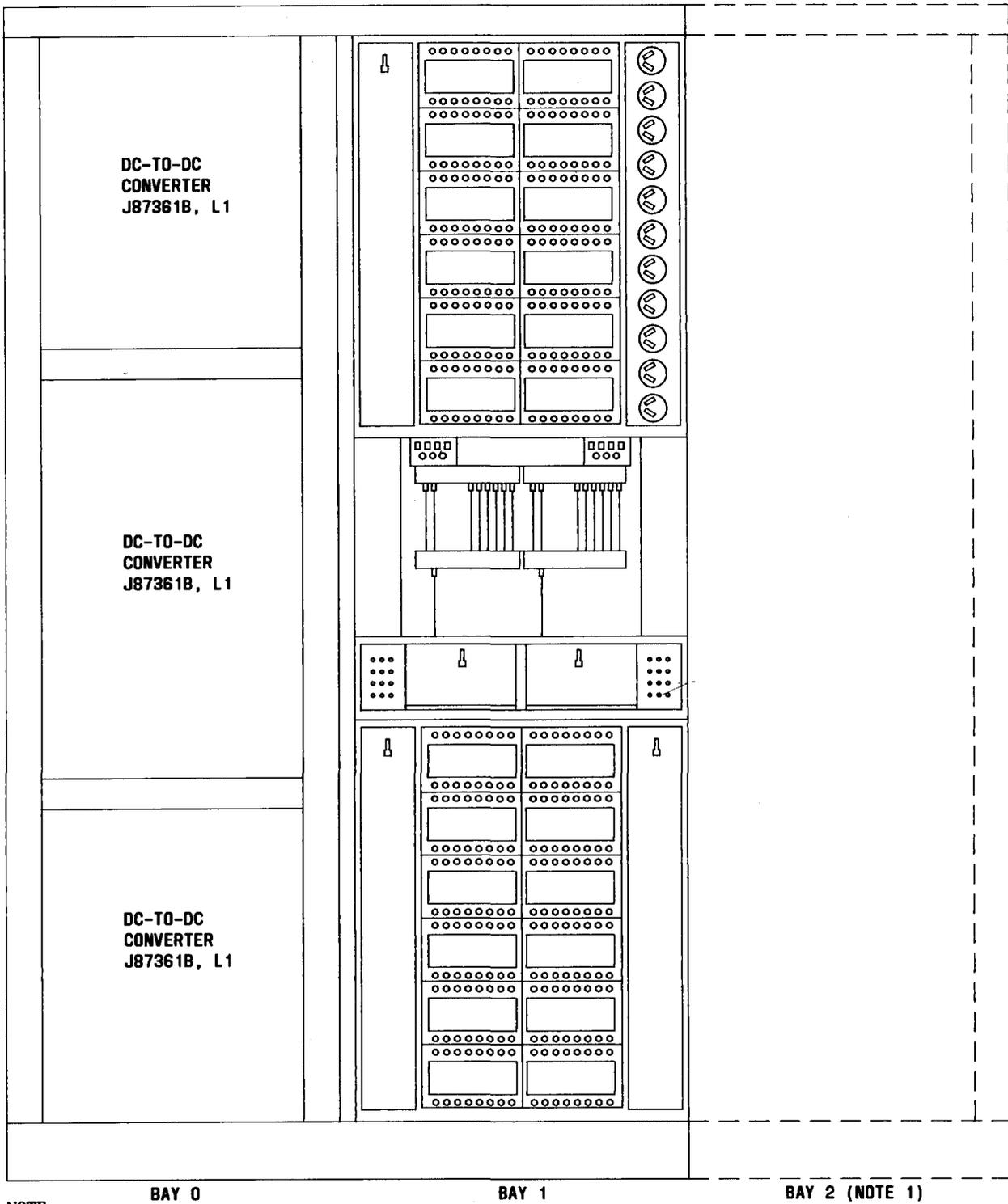
NOTE:
1. Bay 2 identical to bay 0
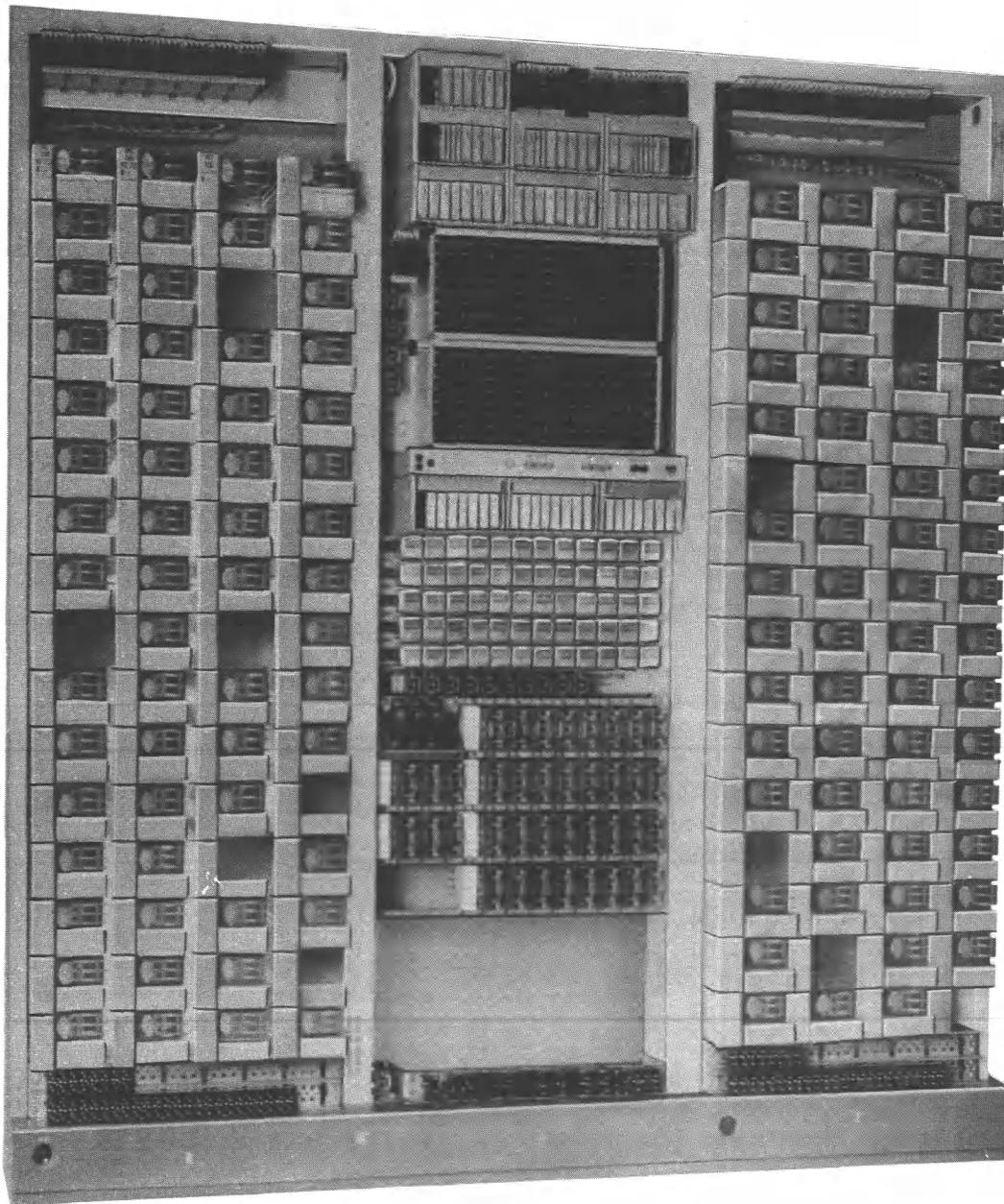
Fig. 31—Universal Trunk Frame

units. The 512 scanner matrix points and 768 of the 1024 signal distributor matrix points are hard-wired in a fixed pattern to the connectors on the trunk chassis mountings. The remaining 256 points are used for remote circuits. Four scan and six signal distributor points are reserved for each trunk chassis mounting connector.

B. Miscellaneous Trunk (MT) Frame

4.110 The MT frame is a single bay frame 2 feet 2 inches wide. The frame has thirty-six 2-inch mounting plate spaces used for mounting trunk and service circuits. The MT frame mounts those trunk and service circuits which do not fit the universal pattern required for mounting on the UTF. Those circuits on the MT frame are cabled via unit terminal

strips to their associated MS, SD, and distributing frame terminations.

4.111 The MT frame does not contain a scanner or SD. The MT frame is also used to mount other equipment, such as, an SSD, IOT, and AIOD.

C. Combined Miscellaneous Trunk (CMT) Frame

4.112 The CMT frame is a double bay (3 feet 3 inches per bay) frame that provides housing for the control circuits and up to 256 circuit board mounted miscellaneous trunk circuits.

4.113 The CMT frame can be provided with up to two SSDs and an MS. Each SSD supplies 960 points capable of operating either full-size or miniature magnetic latching relays. The MS supplies 1024 scan points. The layout of the CMT with two SSDs is shown in Fig. 32.

4.114 The plug-in MTs are plugged into the trunk interconnection circuit (TIC). The TIC is designed for a specific group or type of MT and is mounted in the CMT frame. Each TIC houses circuit boards containing miniaturized ferrods for scanner functions and circuit boards containing TRIACs (solid state switches) for SD functions. A CMT frame can provide housing for 16 TICs. Each TIC can provide housing for 16 MT circuits, plug-in TRIAC matrix circuit boards, and plug-in scanner matrix circuit boards.

4.115 The MTs are organized into nine groups of trunk circuits. Each group requires a TIC that accepts only trunk circuits from that particular group. A TIC can accept any trunk circuit in the group it is designed for, but cannot accept trunk circuits from any other group.

D. Miniaturized Universal Trunk (MUT) Frame

4.116 The MUT frame consists of a pair of 2-foot 2-inch bays arranged in a home-mate configuration that provides plug-in housing for 256 circuit board mounted universal trunk units (Fig. 33). Each trunk unit may contain one or two trunk circuits. The MUT frame also provides power, filters, and fusing for the trunk units. Contained in the MUT frame are two 1024-point TRIAC SDs, a 1024-point scanner, and PUBs.

4.117 The scanner in the MUT supervises only trunk and service circuits mounted in the MUT frame. The home frame has the 0 controller for the 1024-point scanner and the mate frame has the 1 controller for the 1024-point scanner. The associated matrix is split in half with 512 points on the home frame and 512 points on the mate frame.

4.118 There is a pair of SD controllers in the home frame and another pair in the mate frame. Therefore, both the home and mate frames have a 1024-point SD.

E. HILO Universal Trunk Frame

4.119 The HILO universal trunk (HUT) (Fig. 34) frame is a standard double bay framework 7 feet high, by 6 feet 6 inches wide, by 1 foot deep. The HUT frame supports 256 plug-in trunks (512 trunk circuits) and the associated power filtering, fusing alarm, bus, scanner, and SD control units.

4.120 The HILO 4-wire switching feature makes it possible to use an existing 1A ESS switch 2-wire remreed switching network to provide an equivalent 4-wire switching function. This function is accomplished by converting the 2-wire bidirectional conductor pair into two independent unidirectional unbalanced paths and using the ground path as the common return.

4.121 The HUT frame is used to complete and supervise paths established through the switching network. Relays within the trunk circuits operate under the direction of CC via the CPD and SD. The HUT SDs give CC access to relays in the trunk circuits. Scanners in the HUT supervise interoffice calls and MTs and service circuits. Bay 0 has the control unit for a 1024-point scanner. The associated scanner matrix is split in half with 512 points on controller 0 and 512 points on controller 1. The scanner detects and sends to the CC any change in trunk or loop conditions that results from relay operation or actions by a customer or distant office.

F. HILO Miscellaneous Trunk Frame

4.122 The HILO miscellaneous trunk (HMT) frame (Fig. 35) is a standard double bay framework, 7 feet high, by 6 feet 6 inches wide, by 1 foot deep, and is provided to accommodate most of the trunks that cannot be mounted on the HUT frame. The HMT frame, arranged for HILO incoming step-by-step

UNIT
CONTROL

BUS
CONTROL

UNIT
CONTROL

SSD AND
MASTER
SCANNER
UNITS

SSD
UNIT

MISC
CONTROL

FERROD
BOARDS
SCAN
MATRIX

TRIAC
BOARDS
SD MATRIX

TRUNK
INTERCONNECTION
CIRCUIT (TIC)

FUSES
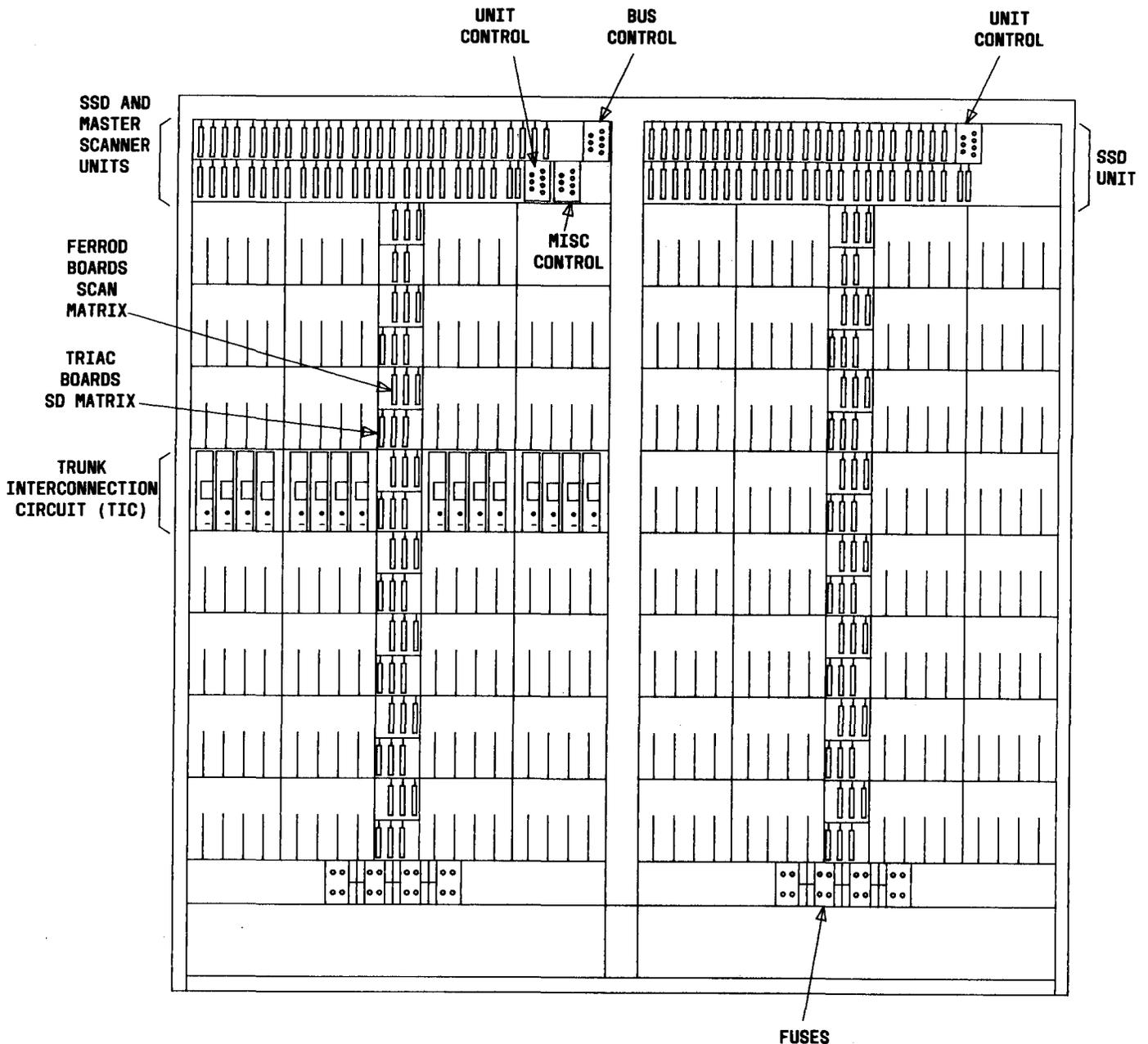
Fig. 32—Layout of CMT Frame With Two SSDs

trunks may be equipped with up to 256 trunk circuit plug-in units (512 circuits) of which there are two MT pack codes.

4.123 The HMT is used to complete and supervise paths established through the switching network. Relays within the trunk circuits operate under the direction of the CC via the CPD. The HMT frame does not contain its own SD circuit but uses the re-

quired number of SD points located on other frames (HUT frame or MUT frame) within the office.

4.124 The scanner in the HMT supervises only trunks and service circuits mounted in the HMT frame. Bay 0 of the HMT frame has the controllers for the 768-point scanner. The associated matrix is split in half with 512 points in bay 0 and 512 points in bay 1. The scanner detects and sends to the CC any
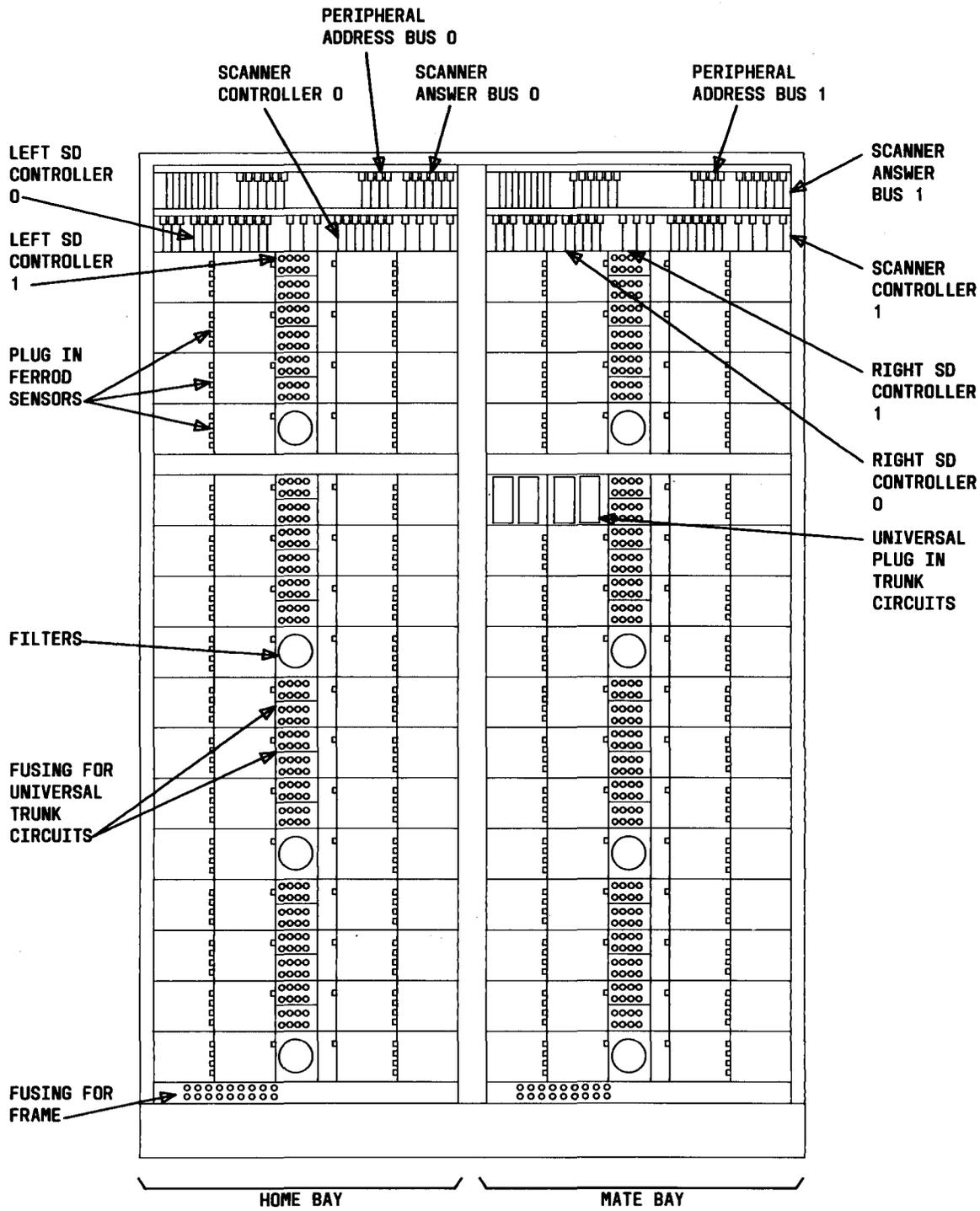
Fig. 33—Miniaturized Universal Trunk Frame

Fig. 34—HILO Universal Trunk Frame

POWER CONTROL UNIT
FOR SCANNER CKT

POWER CONTROL UNIT
FOR BUS CKT

J1A091A

BUS AND
SCANNER
CONTROL UNIT
J1A091AA, L1

BUS CIRCUIT
BUS 0 | BUS 1

SCANNER | CIRCUIT
CONT 0 | CONT 1

OPTIONAL
SIGNAL DISTRIBUTORS

EIGHT J1A091AC UNITS
EA E/W SIXTEEN POSITIONS FOR
HILO PLUG-IN TRUNK UNITS
AND ASSOCIATED
SUPPORTING CIRCUITRY

SAME AS
BAY 0

7'-0"

FUSE PANEL UNIT   J1A091AD, L1

SPARE

0
FILTER UNIT   J1A053AG, L1

HMT(000)
MS (07)

1

3'-3"

6'-6"

NOTE: FRAME EQUIPPED FOR OPTION Z

Fig. 35—HILO Miscellaneous Trunk Frame

changes in trunk or loop conditions that results from relay operations or from actions by a distant office.

RINGING AND TONE FRAME

4.125 The ringing and tone frame is available with three different capacities (Fig. 36, 37, and 38) 0.5 amp, 1.5 amp, and 6 amp. These frames are the 806H, 812A, and 808A ringing and tone frames, respectively. There are two versions of each frame: the ac-dc ringing and tone power plant and the superimposed ringing and tone power plant. These ac-dc ringing and tone power plant versions provide the following tones:

- Audible ringing tone

- TOUCH-TONE calling

- High tone

- Call waiting tone

- Busy verification tone

- Simulated audible ringing tone

- Preempt tone

- Precedence audible ringing tone.

Similar frames of 0.5-amp capacity on two bays, 1.5-amp capacity ac-dc on four bays, and 6-amp capacity superimposed on five bays are available.

RECORDED ANNOUNCEMENT FRAME

4.126 The recorded announcement frame (Fig. 39) is a single bay frame 2 feet 2 inches wide. Six announcement channels are provided on the magnetic drum. Each basic announcement channel unit uses distributing resistors to serve up to 20 announcement trunks. If more than 20 announcement trunks for each channel are required, a supplementary unit may be used. Up to 16 frames to provide 96 separate announcements may be installed in a 1A ESS switch.

13A ANNOUNCEMENT SYSTEM

4.127 The 13A announcement system is a completely electronic announcement system that utilizes the 29A magnetic bubble memory to store digital speech. The 13A announcement system is a multichannel system capable of having from one to eight channels. Each channel can supply one prepared announcement. Circuitry for an announcement message is located on CPs called message modules (Fig. 40). There are three types of message modules: a 12-second fixed message length (FML), a 3- to 12-second varible message length (VML) and a 3- to 24-second VML. Each message module can provide an announcement of up to 500 trunk circuits simultaneously. The message module utilizes the 29A bubble memory packages to store the prepared announcements. During the recording of an announcement, the analog speech is c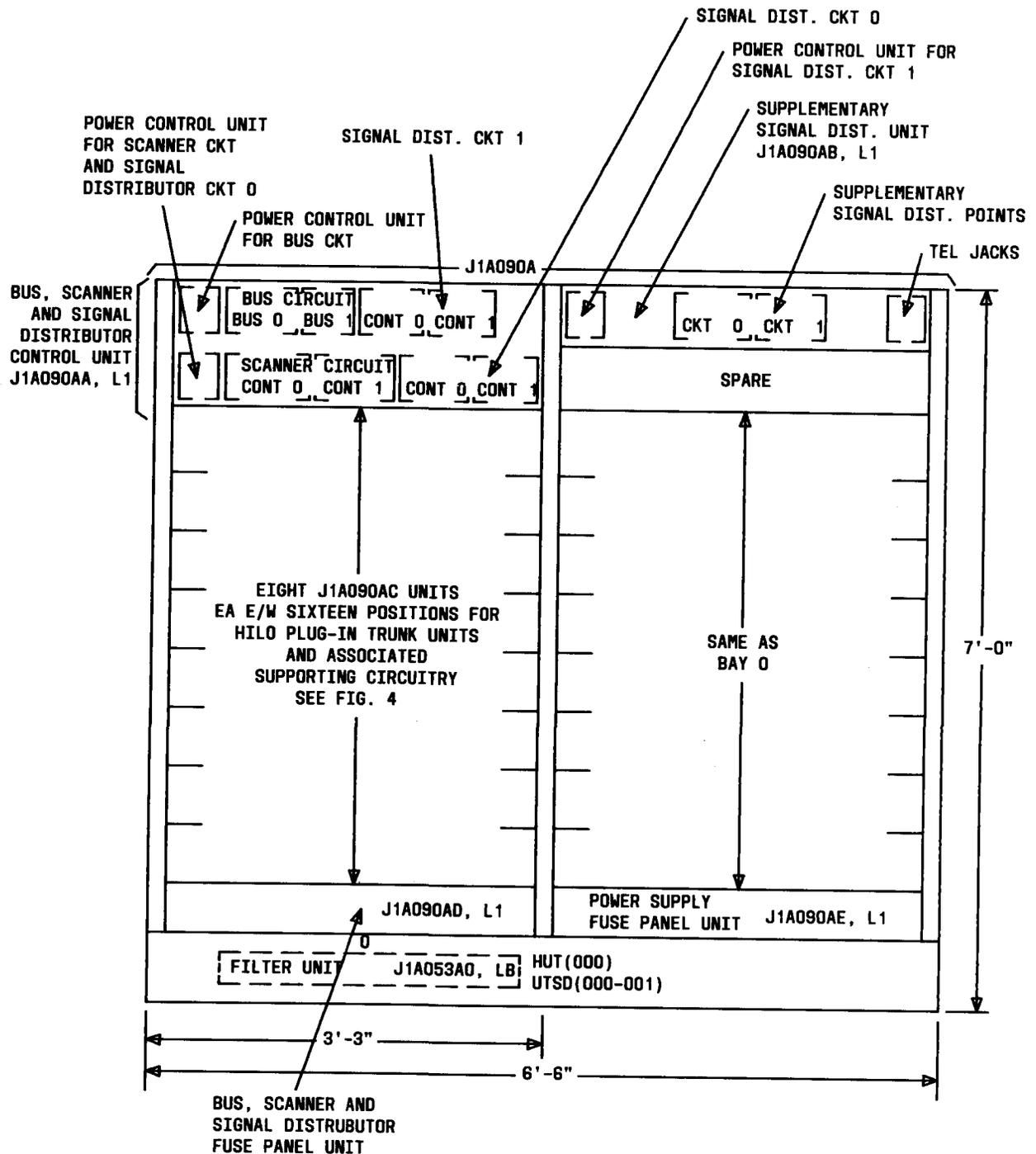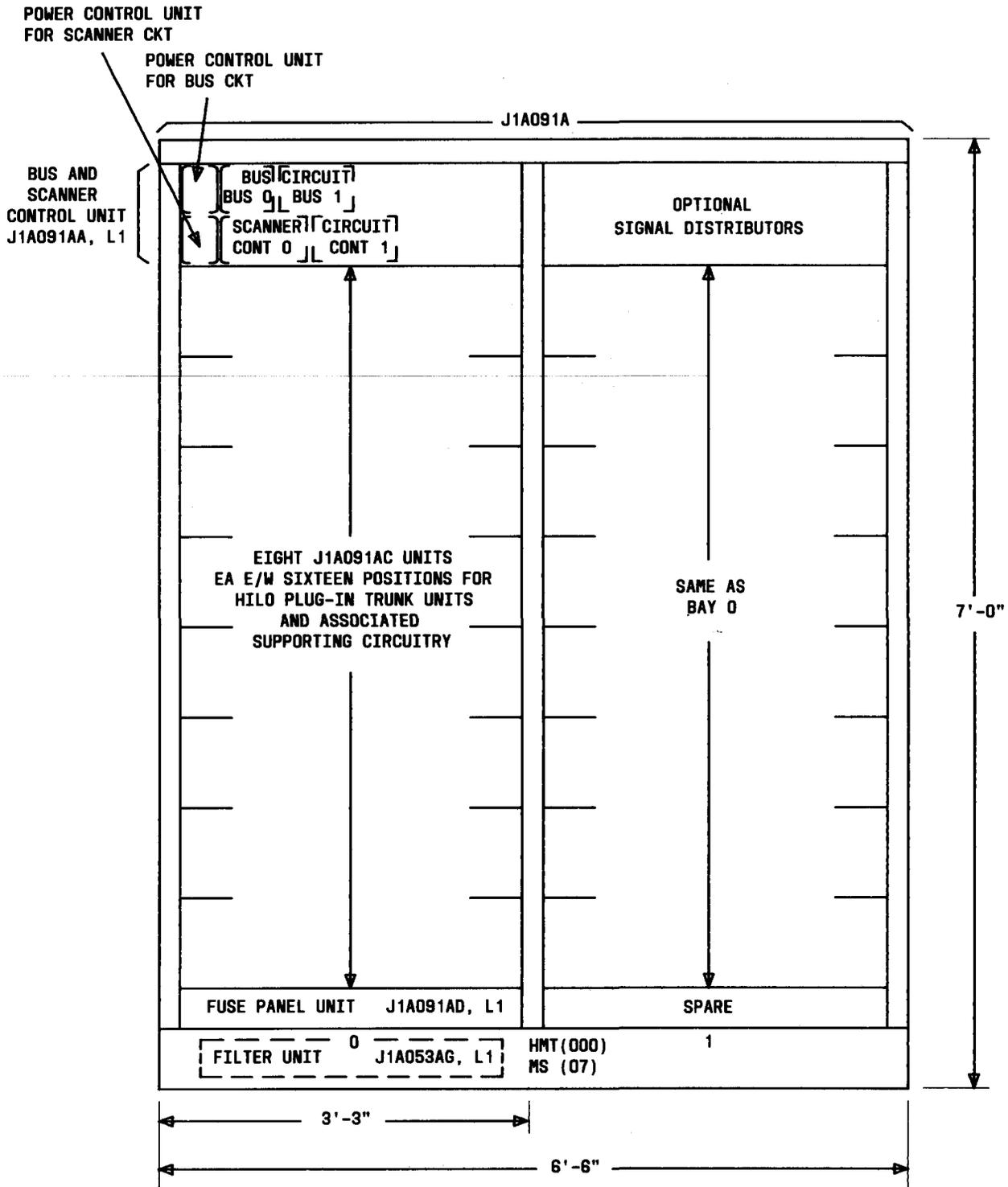onverted to an equivalent digital signal. Adaptive delta modulation is used to make the conversion by using encoding and decoding circuitry. Once the conversion is made the digital speech is stored.

4.128 Recording an announcement into the 13A announcement system is by a handset or tape recorder (Fig. 41). Once a message is recorded the stored information will remain even if power is removed from a module.

COMMON SYSTEMS RECORDED ANNOUNCEMENT FRAME

4.129 The common systems recorded announcement frame (CSRAF) has two different types of channels:

(a) Modular Message (MM) length and

(b) Variable Message Length (VML).

The MM channel provides a 4-second announcement for city-of-origin applications. The VML channel can provide a 16-, 32-, or 48-second announcement. One CSRAF can control up to 48 VML channels, depending on the announcement length of the VML channels and the mixture of VML and MM channels on the frame.

4.130 The CSRAF recording may be made either remotely on a dial-up basis from the customer premises or from within the CO. As with the recorded announcement frame, CO recordings on CSRAF are made at the frame and through a call director dedicated telephone. The CSRAF feature provides remote access to CSRAF as part of the ACD Phase II feature. It may also be used in other applications, since CSRAF is a multipurpose frame.

RECEIVER
OFF HOOK
TONE
DISTRIBUTION

440A TONE
GENERATOR

TERMINAL STRIP PANEL
TO CONNECT TO
CIRCUITS IN ESS SWITCH

TONE
DISTRIBUTION

TONE OUTPUT
TRANSFORMERS

CONTROL
PANEL

INTERRUPTER

RELAYS

TONE
MONITORS

TONE
AMPLIFIERS

TONE
OSCILLATORS

RINGING
DISTRIBUTION
FUSES

RING MONITOR
AND TRANSFER
RELAY

110A RINGING
GENERATORS

FUSE PANEL
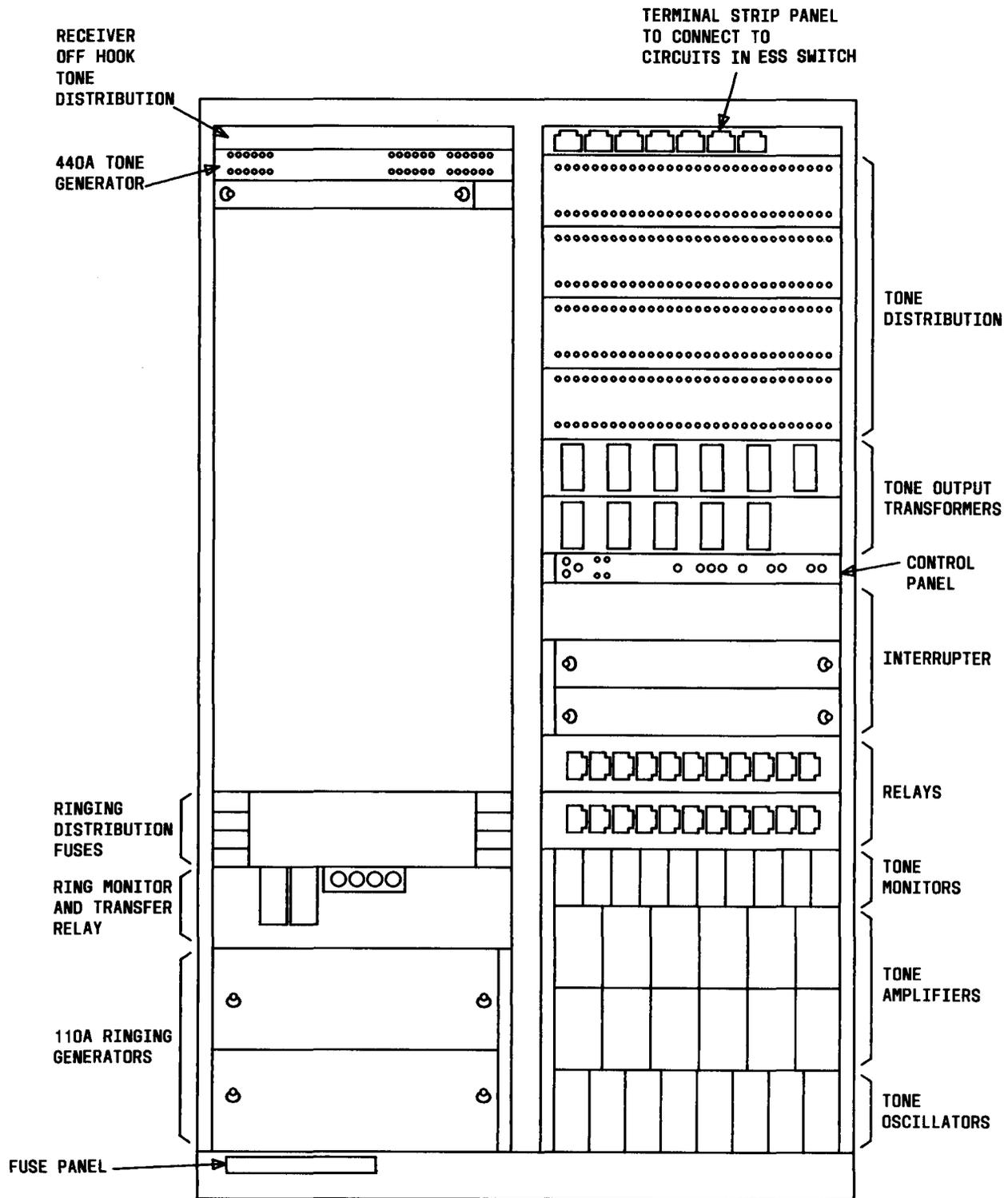
Fig. 36—Ringing and Tone Frame (806A)
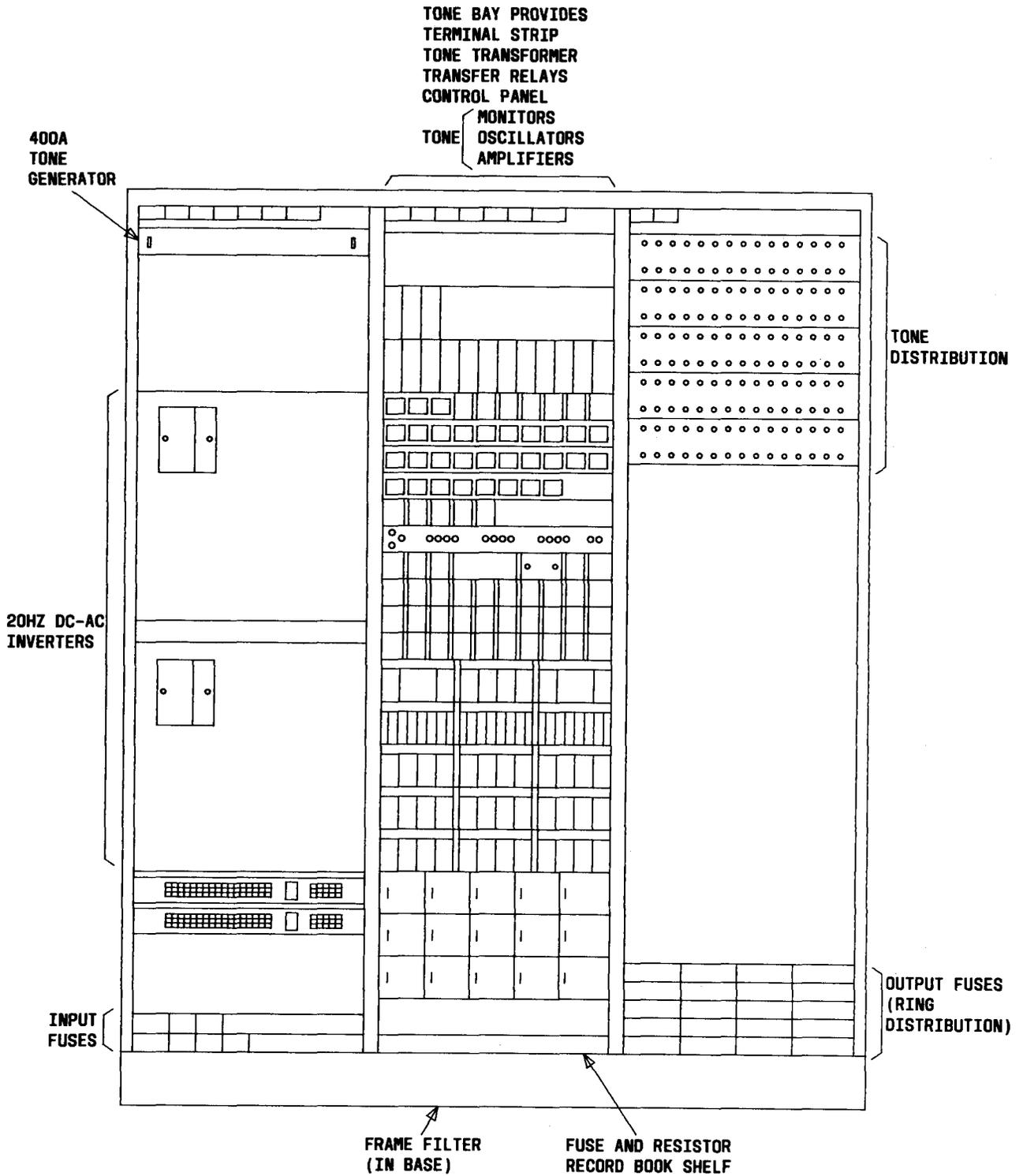
Fig. 37—Ringing and Tone Frame (812A)
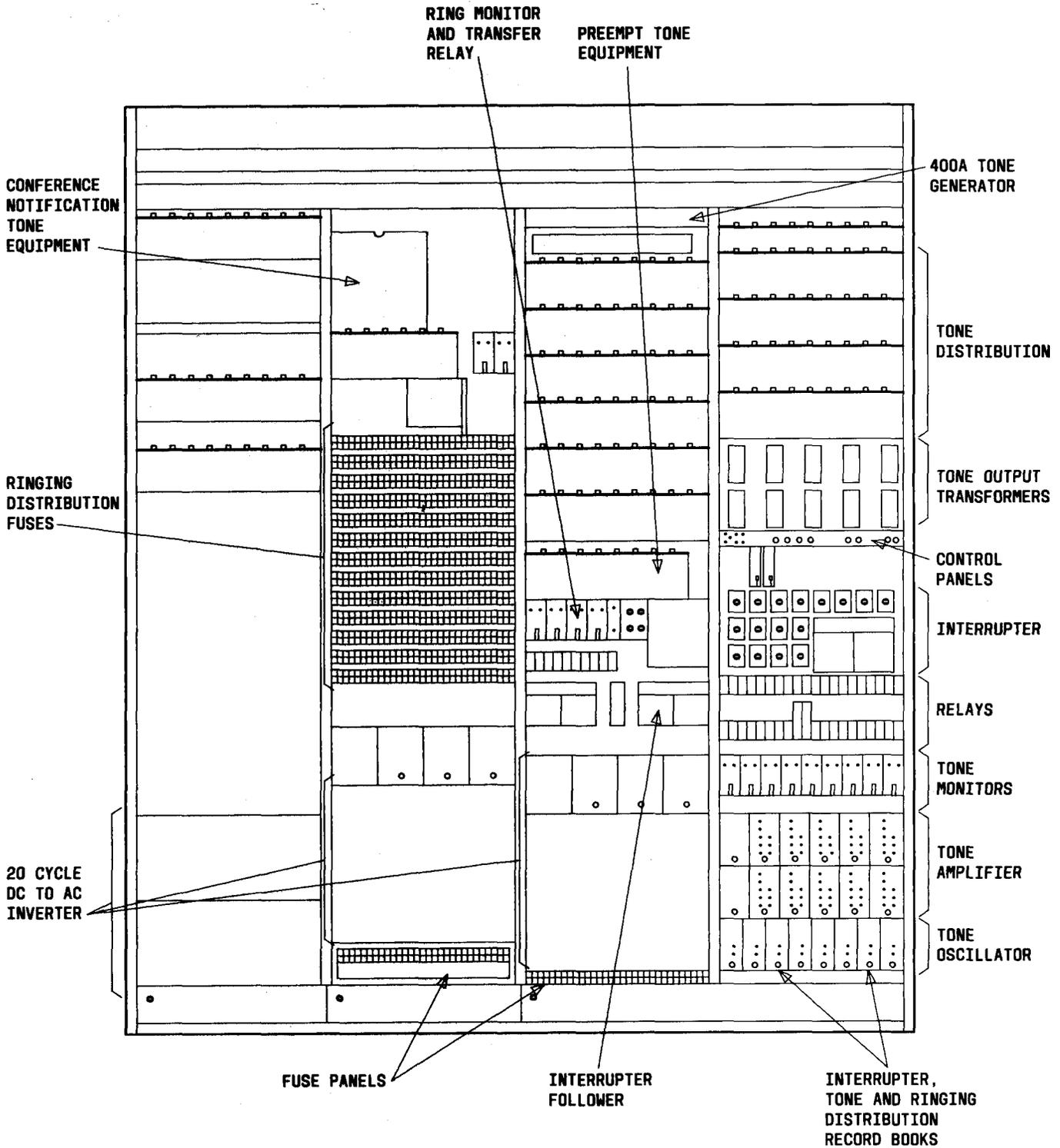
Fig. 38—Ringing and Tone Frame (808A)

KS-12068, L6
RECORDER
REPRODUCER

KS-19219, LI
AMPLIFIERS
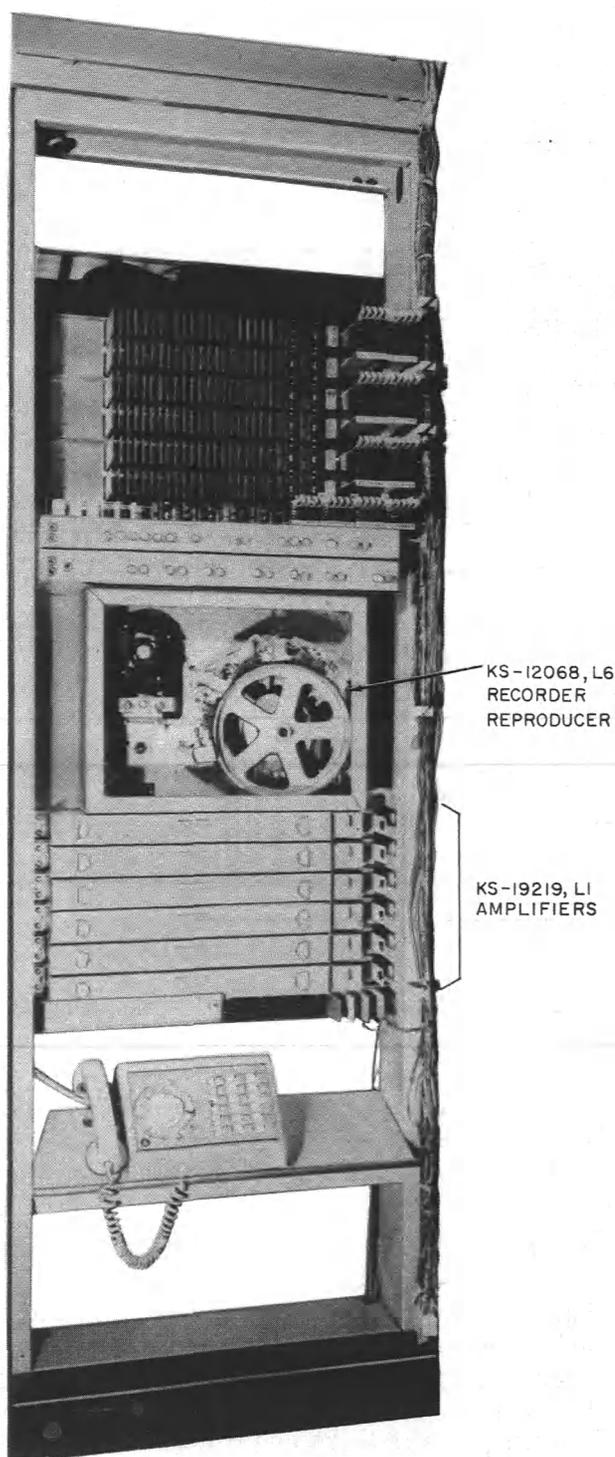
Fig. 39—Recorded Announcement Frame (Typical)

4.131 Each announcement channel can drive a trunk group of up to 80 trunks. A CO can have up to 15 CSRAFs. Associated with each CSRAF is one to three C&D frames.

LOOP RANGE EXTENSION FRAME

4.132 The LRE frame is a single bay framework which measures 2 feet 2 inches wide, 2 feet deep, and 7 feet high (Fig. 42). A LRE frame consists of range extension units, a common control panel and a fuse and distribution unit. Each LRE frame can have up to four range extension units. The number of LRE frames may vary from 1 to 100 (00 to 99) in a 1A ESS switch.

4.133 A range extension unit contains forty 7A range extender plug-in boards or eighty range extension circuits. Each 7A range extender board contains two range extension circuits. A range extension unit is divided into five groups and two shelves as shown in Fig. 42. A complete LRE frame with four range extension units contains one hundred sixty 7A range extender boards.

4.134 The range extension test circuit is used to perform a list of tests on the range extension circuits under the direction of maintenance personnel or CC. Some of the tests include: forward and reverse gain battery boost, short loop bypass, ring tripping, pretrip, and dial pulsing. The range extension test circuit is located on the MT frame.

4.135 The network access circuit is used to provide a test loop from the test line equipment numbers (LENs) through the TLN. The network access circuit is located on the universal trunk frame (UTF or MUT). One circuit is required for each LLN equipped with LRE.

PERIPHERAL UNIT CONTROLLER DATA LINK (PUC/DL) FRAME

4.136 The PUC/DL frame is a single bay frame which utilizes the PUC to serve as an interface between the ESS switching system and the DLC (Fig. 43). The PUC in the PUC/DL frame consists of duplicated microprocessor controllers. Each controller consists of a ESS-PUC interface, a central processing unit (CPU), memory, a PUC-peripheral interface, and line interface units (Fig. 44).

29A MAGNETIC
BUBBLE MEMORY
PACKAGES

THUMBWHEEL
ADJUSTMENT
SWITCH
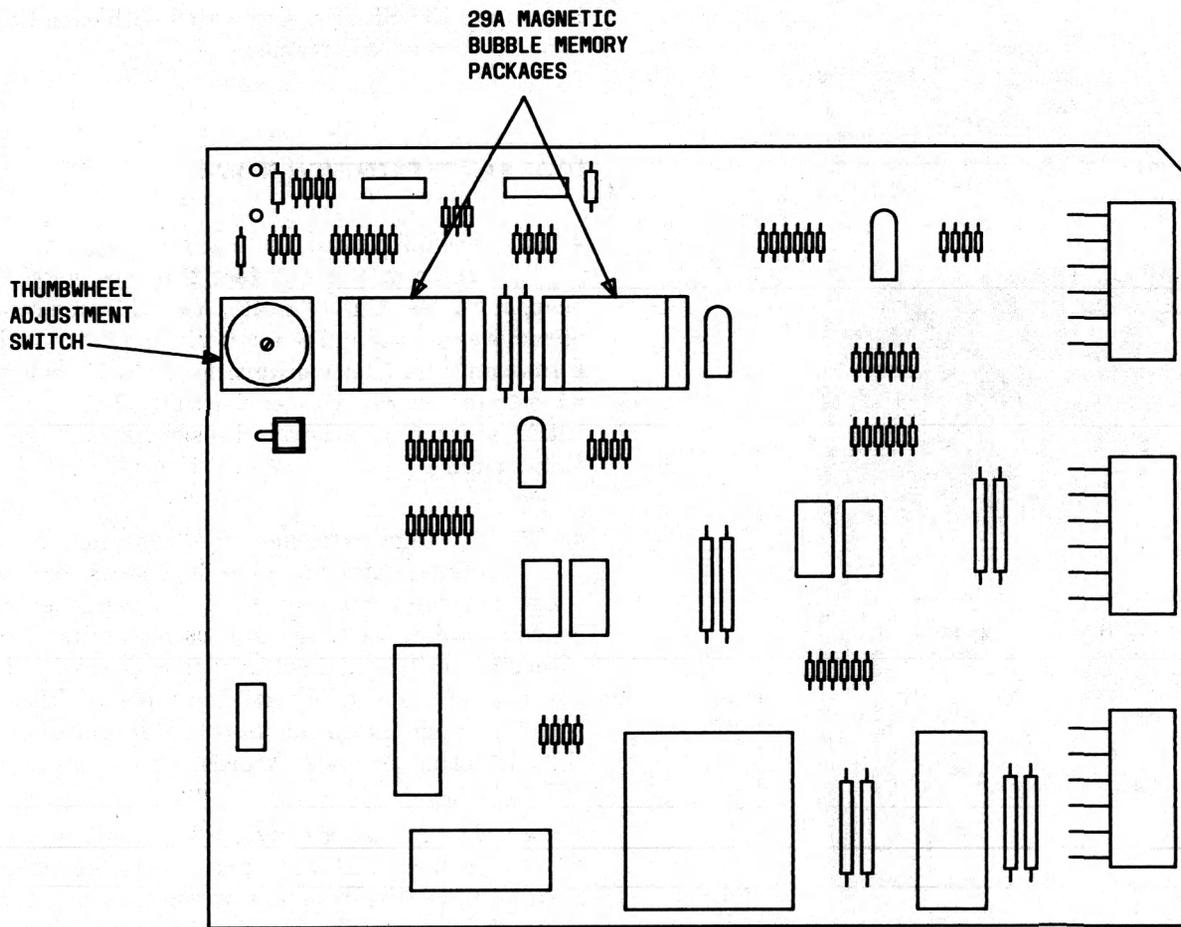
Fig. 40—VML (UD4) Message Module Circuit Pack

4.137 Data link messages from the ESS switch CC are received by the PUC/DL frame. The data is formatted and made ready for data link transmission. The PUC/DL provides error checking protocol and generates timing and signaling for the transmission of the data. Incoming messages over the data links are received and checked by the PUC/DL. This information is then sent to the ESS switch CC. The PUC/DL can handle up to 16 separate data links. The PUC/DL is used with the RSS feature and the ETS feature.

PERIPHERAL UNIT CONTROLLER DIGITAL CARRIER TRUNK (PUC/DCT) FRAME

4.138 The DCT feature is implemented in the PUC/DL 3-bay frame. The PUC/DCT frame consists of a PUC and digital carrier trunk banks

(DCTBs) which are contained in the DCT bay assemblies (Fig. 43).

4.139 The PUC consists of duplicated microprocessor controllers, memory, I/O circuits and hardware which provide capabilities for direct memory access (DMA). Some functions which are performed by the PUC are: trunk supervisory scanning, trunk signaling, maintenance, certain digit reception and transmission tasks, and trunk state control. The PUC serves as an interface between the CC and the DCTBs.

4.140 A DCTB is a 48 channel pulse code modulated terminal which provides a transmission interface between T-carrier lines and the trunk distrib-
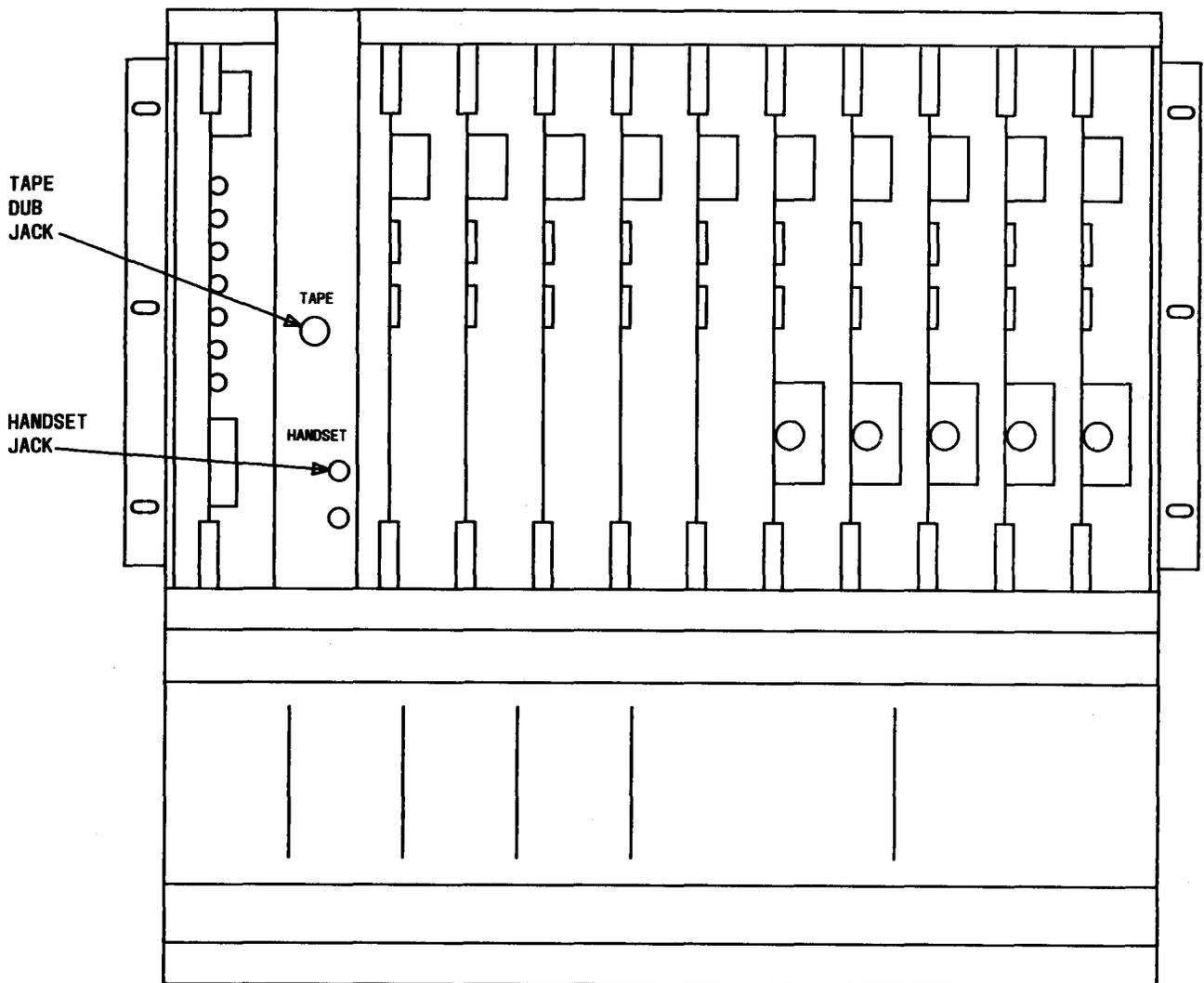
Fig. 41—13A Announcement System (Front Door Open)

uting frame. There are ten DCTBs for each PUC/DCT frame. A DCTB provides the following:

- Converts multiplex voice frequency and signaling information into a digital line format.

- Interfaces T-carrier lines or compatible multiplexes to the ESS switch.

- Detects and reports bank and line performance indications to the PUC.

5. EQUIPMENT CHARACTERISTICS

DUPLICATION

5.01 All common system units required to provide continuous service are fully duplicated. Fully duplicated units of the 1A ESS switch (Fig. 57) include:

- CC

- CPDs

- Intercommunication bus system

- DUS of ADS

RANGE EXTENSION UNIT

SHELF 1					
SHELF 0					

RANGE EXTENSION UNIT 3

RANGE EXTENSION UNIT 2

CONTROL PANEL

RANGE EXTENSION UNIT 1

RANGE EXTENSION UNIT 0

POWER

7'0"

26"

0   1   2   3   4

GROUP

7A RANGE EXTENDER (PLUG-IN)
 2 RANGE EXTENSION CIRCUITS/PLUG-IN
 8 PLUG-INS/GROUP
16 B-LINKS/GROUP
 2 SHELVES/RANGE EXTENSION UNIT
 5 GROUPS/RANGE EXTENSION UNIT
80 RANGE EXTENSION CIRCUITS (B-LINKS) / UNIT
 4 RANGE EXTENSION UNITS/FRAME
320 RANGE EXTENSION CIRCUITS (B-LINKS) / FRAME

Fig. 42—LRE Frame

• File store controllers (FSC) of FS system.

5.02 With the exception of the DUS and FSC, du-
plicated units operate side by side under nor-
mal conditions. Both units respond to the same
information, but only one unit operates in active sta-
tus. By continuously comparing the outputs of dupli-
cated units (and by other means), detection of a
system malfunction is possible. The unit at fault is
automatically identified by appropriate programs
and is taken out of service. In the case of the DUS and
FSC, both duplicated units are in the active state and
have access to duplicated information. Should CC
require information while one unit is busy with a re-
quest, the duplicated unit fetches the information
and returns it to CC.

EQUIPMENT ELEMENTS

5.03 Most 1A ESS switch functions are performed
by the following types of apparatus:

• Remreed switches for network switching

• Ferreed switches for network switching

• Ferrod sensors for scanning

• Magnetic latching relays

• Semiconductor devices

• Semiconductor memory.

The semiconductor memories used in the PS and CS
were described in Part 4 of this practice.

A. Remreed Switches

5.04 The remreed crosspoint switch (Fig. 45) is the
basic switching device used in remreed LLNs
and TLNs and is similar to the ferreed switch in
many respects. Only one type of the basic switch is
used to accommodate both the network tip and ring
conductor paths and the no test vertical path func-
tions. Grid apparatus units are packaged in two con-
nectorized configurations: the 10A junctor grid unit
and the 11A trunk grid unit. The 11A trunk grid unit
contains two stages of 8 by 8 switches connected in
a 64 by 64 configuration. The 10A junctor grid unit
contains the same 64 by 64 configuration, and, in ad-

DIGITAL CARRIER TRUNK BAY ASSEMBLY

FILTER UNIT

J1A098B-1 BUS, CONTROL, AND INTERFACE UNIT

J1A099AC-1 POWER AND ALARM CONTROL UNIT

MAINTENANCE BANK

FILTER UNIT

DIGITAL CARRIER TRUNK FRAME

J1A099AA-1 BUS, CONTROL, AND INTERFACE UNIT

840052594 HEAT BAFFLE

J1A099A6-1 POWER AND FUSE UNIT

J1A099AC-1 POWER AND ALARM CONTROL UNIT

FILTER UNIT

DATA LINK FRAME
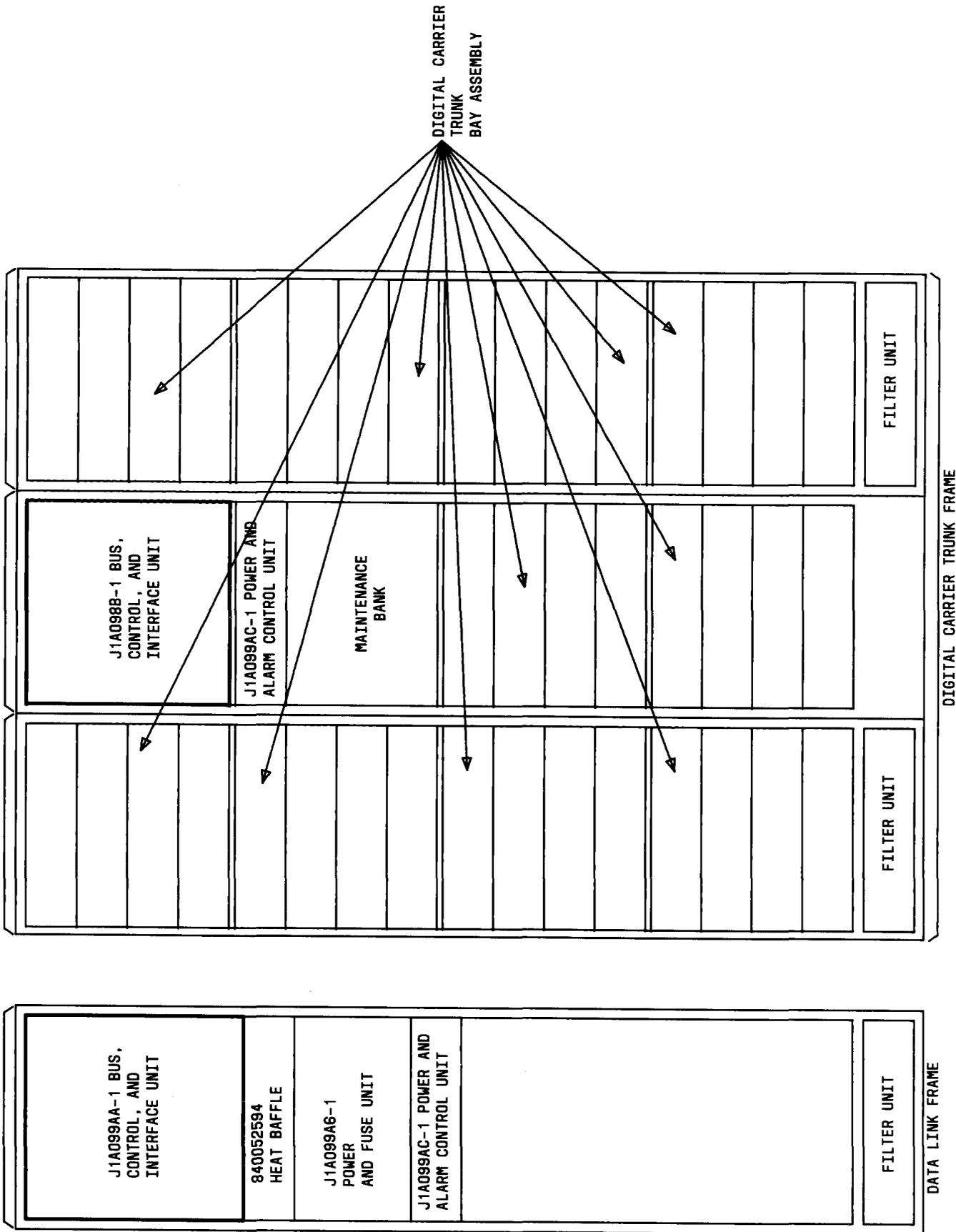
Fig. 43—PUC DL and PUC DCT Frames

PUAB(0+1)

SCAB(0+1)

CPD(0+1)   CPD(0+1)

TYPICAL 1/1A ESS SWITCH DUPLICATED PERIPHERAL BUS ACCESS

CONTROLLER 0   CONTROLLER 1

PUC

| ESS SWITCH-PUC INTERFACE | ESS SWITCH-PUC INTERFACE |

CENTRAL PROCESSING UNIT 0   CENTRAL PROCESSING UNIT 1

PUC

MEMORY 0   MEMORY 1

INTERFACE PUC-PERIPHERAL   INTERFACE PUC-PERIPHERAL

DATA LINK INTERFACE

LINE INTERFACE UNITS   LINE INTERFACE UNITS

0   7   0   7
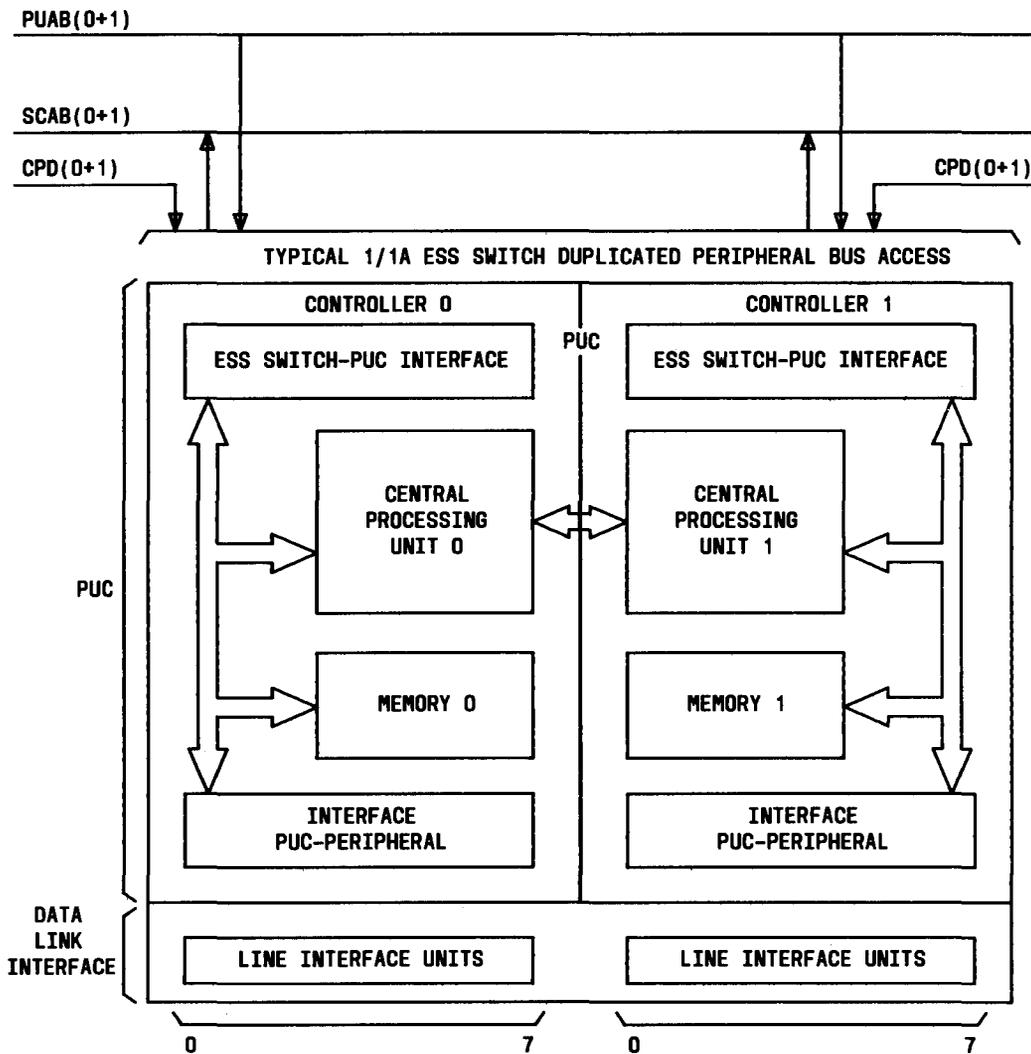
Fig. 44—PUC DL Block Diagram

dition, is arranged with test access switches to each output terminal.

5.05 The remreed switch is arranged with two windings so that part of each winding is both above and below the shunt plate. Sealed contact operation (close) occurs only by current pulses in both windings simultaneously (coincidence). A single current pulse through either winding causes switch contact release. The remreed sealed contact differs from the ferreed sealed contact in that the remanent magnet material is located in the reeds inside the sealed contact. The remreed switch also does not require continuous current to maintain an operated or re-leased state. Remreed switches are not operated or released while current is applied to the contacts.

B. Ferreed Switches

5.06 The ferreed switch is the basic switching device in the ferreed LLNs and TLNs. Two types of ferreeds are used in the system: crosspoint and bipolar. The crosspoint ferreed (Fig. 46) consists of two miniature glass-enclosed reed switches which determine network paths for tip and ring conductors. The switch contacts are opened and closed while no current flows in the switch.
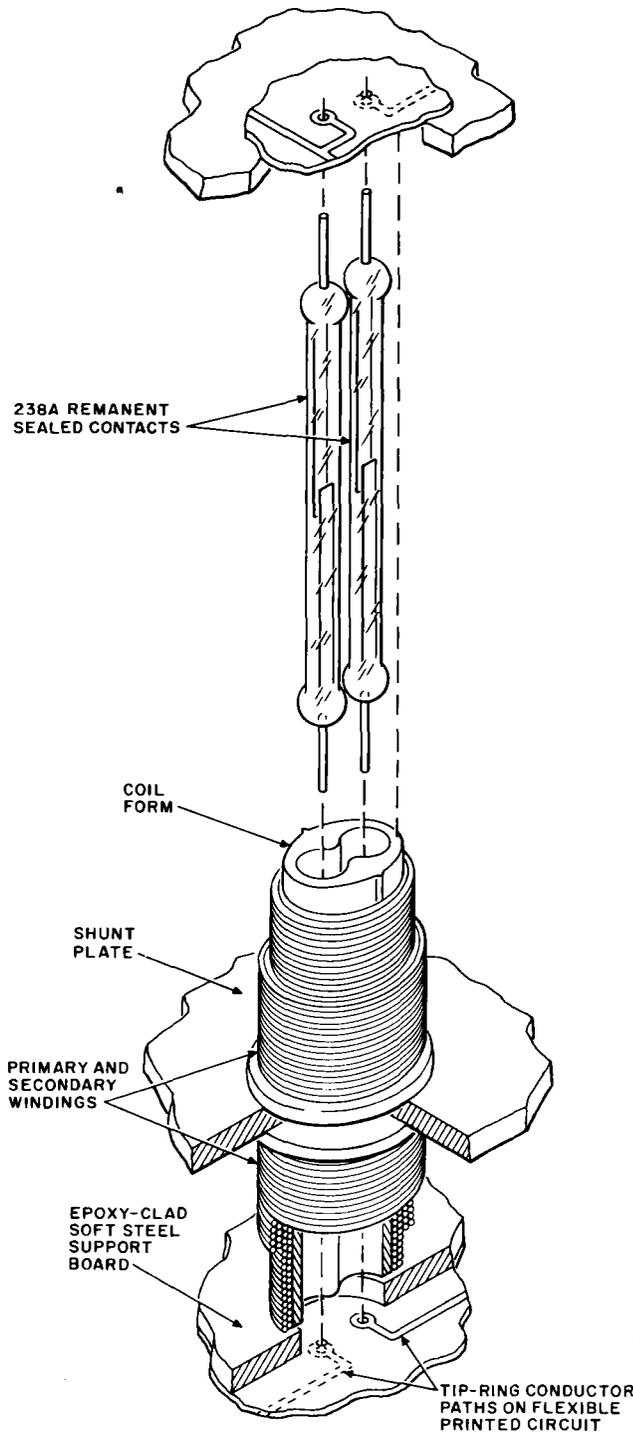
Fig. 45—Remreed Crosspoint Switch (Exploded View)

5.07 The bipolar ferreed switches (Fig. 47) are used to open and close the current paths for the line ferrod and the no-test verticles.
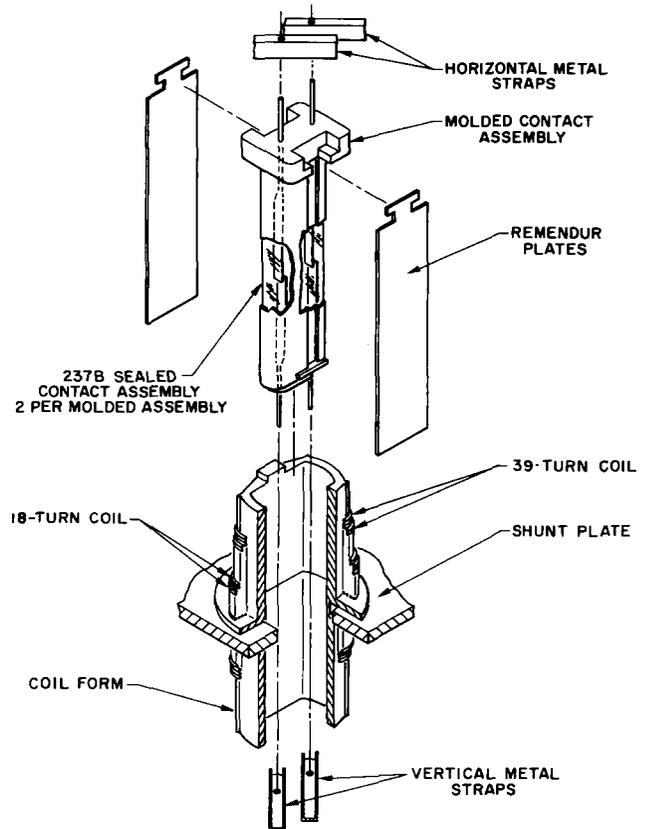
Fig. 46—Ferreed Crosspoint Switch (Exploded View)

5.08 The operation of the two types of ferreeds is different. The crosspoint ferreed is arranged with dual winding and operates only when pulses are applied to both windings simultaneously. A single pulse through either winding causes the ferreed to release. The bipolar ferreed requires a negative pulse for operate and a positive pulse for release. Neither type ferreed requires a continuous current to maintain an operate or a release state.

C. Ferrod Sensor

5.09 The ferrod sensor (Fig. 48) used in scanners provides magnetic coupling between the interrogate and readout windings by current applied to the control windings (See scanners in Part 4 of this practice). This current or the absence of current is established by the state of the circuit to be sensed. An
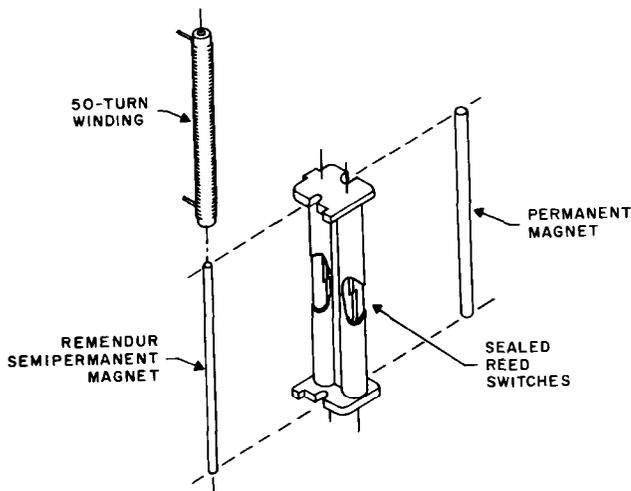
Fig. 47—Bipolar Ferreed Switch (Exploded View)

example is sensing of an on-hook or off-hook condition of a line. The on-hook condition causes a binary 1 output and the off-hook condition causes a binary 0 output.

5.10 Four types of ferrods are used in the 1A ESS switch and vary only in sensitivity. The more sensitive types are used to sense distantly located conditions.

D. Magnetic Latching Relays

5.11 Magnetic latching wire-spring relays appear similar to conventional wire-spring relays. The main characteristic of magnetic latching relays is the remanent core material which retains enough residual magnetism to hold these relays operated after the operating current is disconnected. Actual operation and release are similar to the bipolar ferreed, in that operation is accomplished by a negative pulse and release by a positive pulse. No current is required to maintain an operate or a release state.

5.12 The magnetic latching relays are operated and released by the SDs and provide the final closing of a metallic path in the associated circuit. When the path is closed, a pulse is generated by the relay and when detected is verification of the closure. The same type verification occurs when the metallic path is interrupted.

E. Semiconductor Devices

5.13 Semiconductor devices mounted on plug-in CPs are used for most of the logic and controls. Semiconductor devices make possible the operating speed and reliability required by the system. The CP provides for rapid replacement of defective circuitry and restoration of the unit to service.

6. METHOD OF OPERATION

TYPICAL INTRAOFFICE CALL

A. Call Origination

6.01 When a customer originates a call by lifting the receiver, a current begins to flow through a sensing element (ferrod sensor) associated with the line but located in the line scanner matrix. On the next line scan (intervals of 200 milliseconds), the CC receives no sensor output which indicates that the line is off-hook. Line state (busy-idle) memory in the CS indicates that the line was previously on-hook. The CC now marks busy the busy-idle memory of the line. Next, the originating line, identified by the associated scanned location, has a translation sequence performed which provides class-of-service information necessary for processing the call.

B. Dialing Connection

6.02 The CC selects an idle customer dial pulse receiver (Fig. 49) which is a service circuit capable of returning dial tone and detecting, but not counting, dial pulses. If the customer has a TOUCH-TONE telephone (class-of-service information), an idle customer dial pulse receiver equipped with a TOUCH-TONE calling detector is selected. The CC must then cause the establishment of a path through the LLNs and TLNs to connect the receiver to the originating line. The line scanner is disconnected from the calling line by disconnecting the line cutoff ferreed and the supervision of the line is transferred to a ferrod in the scanner associated with the customer dial pulse receiver. The CC, by using the SD, operates a relay in the customer dial pulse receiver that causes dial tone to be sent to the calling line. The dial tone is removed, again by SD action, as soon as the first pulse of the first digit is received. The calling line is scanned at the receiver every 10 milliseconds to detect changes on the line resulting from the dial pulses.

FERROD SENSORS
MOUNTED
IN CELL

MOUNTING
CATCH TO
HOLD FERRODS

6"

128 CELLS IN AN 8 X 16 ARRAY
EACH CELL WILL HOLD 2 FERRODS

(REAR VIEW)

2 FERROD SENSORS
MOUNTED BACK-TO-BACK
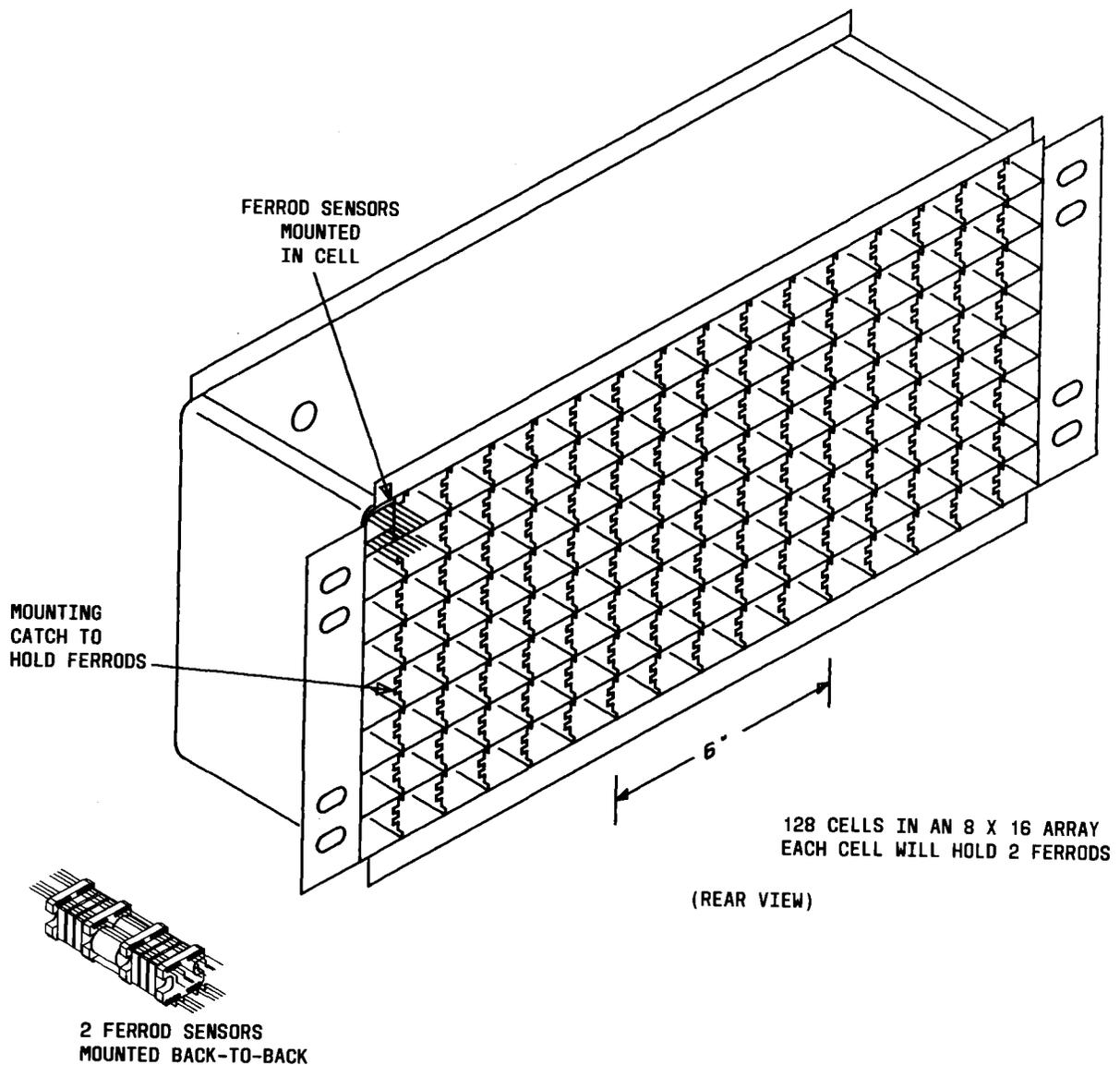
Fig. 48—Ferrod Sensors and Mounting Apparatus

C. Digit Analysis

6.03 Dial pulses are counted and recorded in the CS register memory by CC. A digit is considered to be completed when the line is off-hook with no changes detected for a period of at least 100 milliseconds. When the first digit is completed, a check is made to see if a digit 0 or 1 has been dialed, either of which may require different translation procedures. Next, the second and third digits are detected and recorded. A translation of the first three dialed digits (assuming a 0 or 1 has not been dialed) provides CC the call type (intraoffice, interoffice, etc) and the number of digits to expect.

D. Ringing Connection

6.04 Upon completion of the last dialed digit, CC causes the dialed DN of the called number to be translated into a format which provides the line equipment number (or location) and terminating class-of-service information. The busy-idle memory of the called line in the CS is also checked and, if idle, the memory is marked busy. An idle ringing circuit
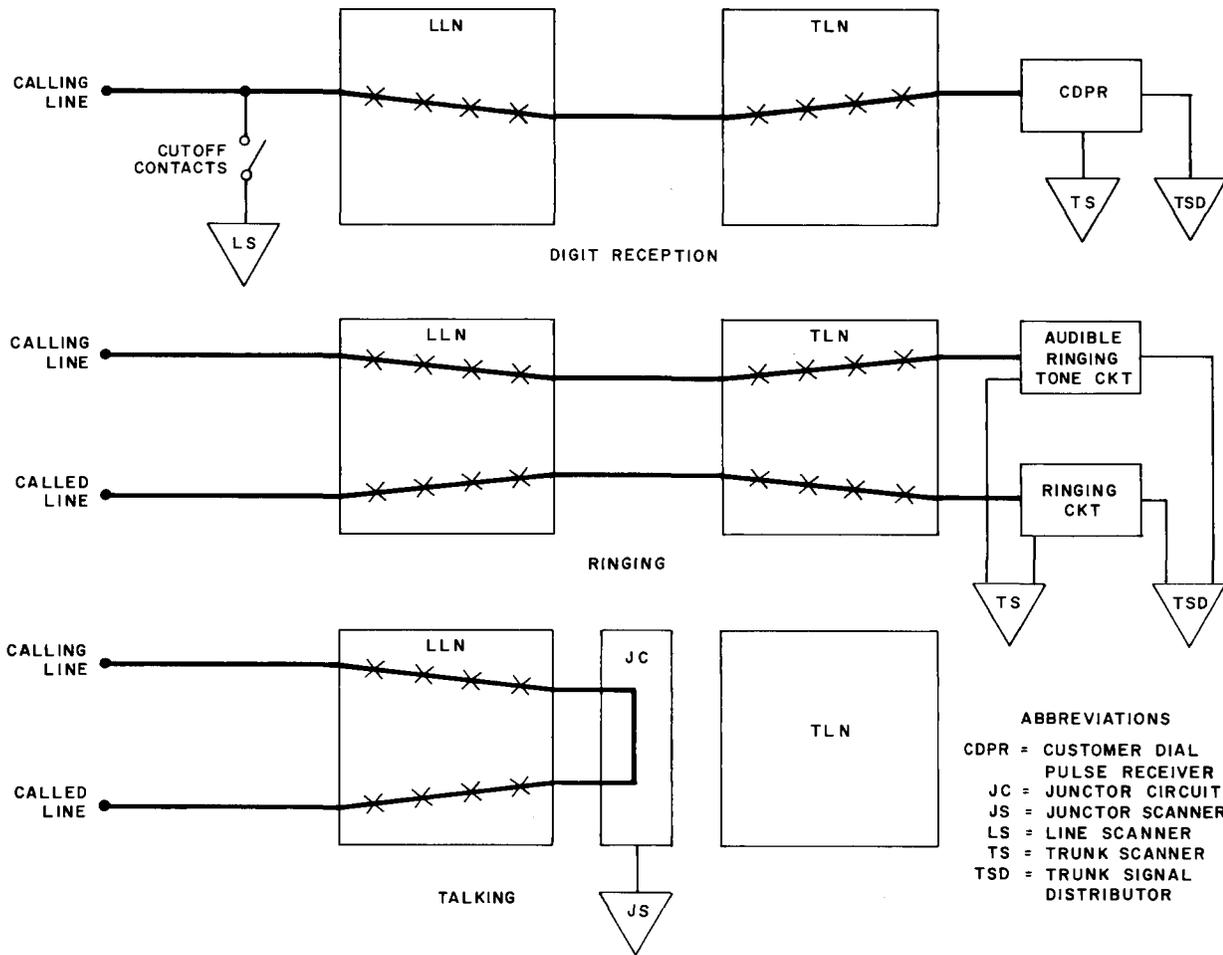
Fig. 49—Typical Connections for an Intraoffice Call

and audible ringing tone circuit are selected. Paths are selected to connect the ringing circuit to the called line and to connect audible ringing to the calling line. Also, a path from the calling and called line, including a junctor circuit, is selected and reserved in the CS memory. The customer dial pulse receiver and associated network paths are released and CS busy-idle indications updated. The appropriate network paths are established for ringing and audible ring-tone signals. Every 100 milliseconds the ringing circuit is scanned for off-hook or answer, and the audible ringing tone circuit is scanned for on-hook or abandonment.

E. Talking Connection

6.05 When the called line answers, ringing and audible ringing tone circuits are released and

the previously reserved talking path is then established. During talking, the junctor circuits are scanned every 100 milliseconds for supervision. When a change to on-hook by either calling or called line is detected, an interval of 200 to 300 milliseconds is timed. This is a safeguard against momentary on-hook conditions or hits which would cause disconnect actions to be performed prematurely. The call is under calling party control but a timed-release feature is provided which prevents the calling customer from holding the called line out of service indefinitely by failing to hang up the receiver. After the 200- to 300-milliseconds time-out following on-hook, the system times an interval of 10 to 11 seconds if the calling party remains off-hook. During this interval, if the called line returns to off-hook, the network path remains established. If an on-hook is detected from the calling line or the time-out occurs, the connection is

released. If the calling party hangs up first, the called line is given 10 to 11 seconds to go on-hook before interrupting the connection for a new origination and returning dial tone.

TYPICAL INTEROFFICE CALL

A. Outgoing Call

6.06 When translation (Fig. 58, sheets 1 and 2, and Fig. 50 for a general sequence of translations) of the first three dialed digits (assuming a 0 or 1 has not been dialed) indicates an interoffice call type, the number of digits to expect (7 or 10) and a route index are furnished. The route index information provides the outgoing trunk group number, any digit prefixing and deletion actions which may be required, the type of transmitter to be used, the alternate route index to be used if all trunks are busy, and any special options if required. With this information, the calling line continues to be supervised from the dial pulse receiver which is held and CC proceeds as follows:

(a) Selects an idle outgoing trunk

(b) Selects an idle transmitter

(c) Establishes a network path between the transmitter and trunk circuit

(d) Reserves a network path between the calling line and trunk circuit.

6.07 The trunk circuit is placed into a bypass state (clear metallic path) and a seizure signal is sent to the distant office from the connected transmitter. The CC proceeds to make a continuity check and, if successful, applies supervisory signals as required before commencing to outpulse. At the completion of outpulsing, the transmitter is released by CC and the supervision of the trunk is transferred from the transmitter to the trunk circuit. The previously reserved path between the calling line and the trunk circuit is established and the dial pulse receiver is released. Every 100 milliseconds the trunk ferrod is scanned, by scanners associated with the trunk, for answer (off-hook) and the calling line for possible abandonment (on-hook). When the called line answers, CC recognizes the change in supervision from the distant office, by the trunk ferrod, and the trunk busy-idle memory in the CS is changed to the talking state. A similar disconnect program and timing is used for interoffice calls as described for
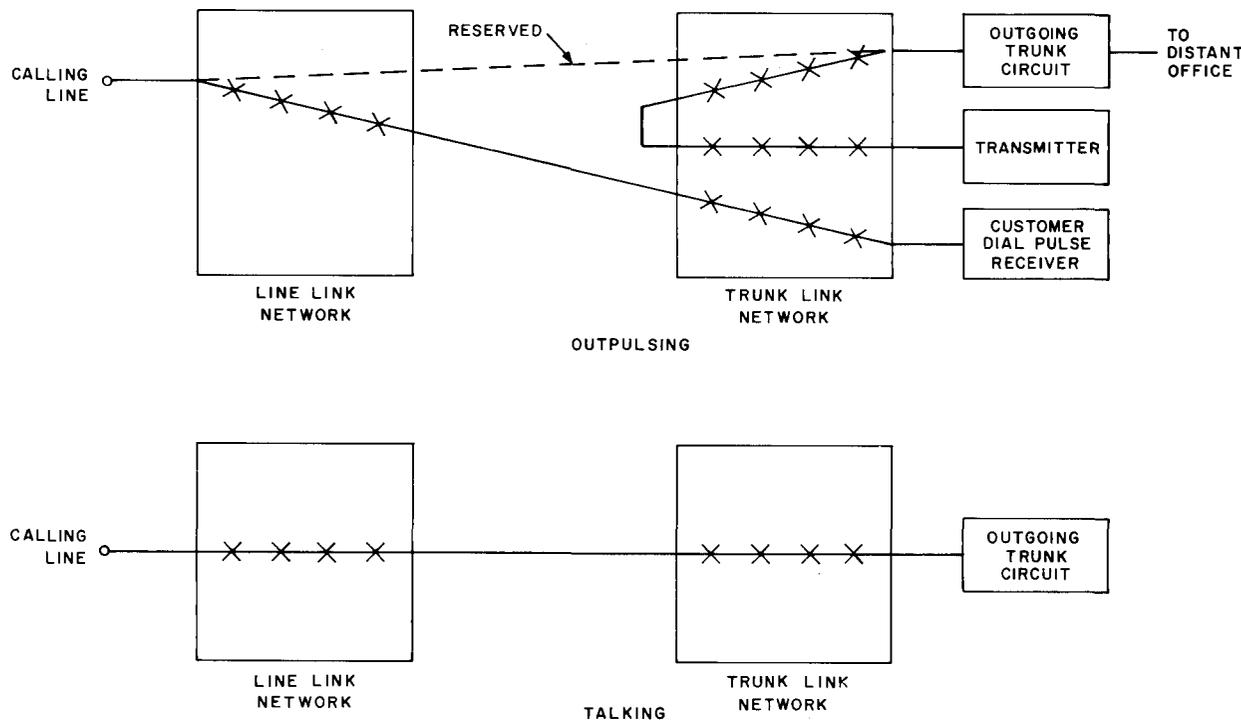
Fig. 50—Switching Sequence From Left to Right (Outgoing Call)

intraoffice calls except a guard interval of 750 milliseconds is imposed during which the outgoing trunk circuit cannot be reseized. The guard interval allows time for all associated relays in the distant office to release.

B. Incoming Call

6.08 For this description, it is assumed that the 1A ESS switch is processing an incoming call to an individual line. During the 100-millisecond supervisory scan of trunks, when CC reads the row containing the scan point of the incoming trunk circuit, CC detects a mismatch between the scanner reading and the associated trunk busy-idle word. The busy-idle word records the previous scanner reading for that row. Among other things, the trunk scan supervises for incoming trunk seizures as well as outgoing trunk answers. Therefore, the CC cannot conclude from the mismatch whether a seizure or an answer has been detected. The trunk scanner number of the trunk causing the mismatch is recorded in the trunk service request hopper because the trunk change is from on-hook to off-hook. Then the trunk scanner number is taken from the hopper and converted to a program store address. The translation information, stored in the PS address, indicates that the trunk is incoming (which means that a seizure has been detected). Also, the translation information specifies the trunk network number (TNN) which identifies the network location of the trunk (Fig. 51).

6.09 An incoming register is hunted and seized; the TNN is recorded in the incoming register; and this number is converted into the PS address of the translation information for the trunk. This translation information is used to determine the type of digit receiver (MF, DP, etc) to be connected to the trunk, the number of digits to be received, and the type of supervision required. The translation information is recorded in the incoming register. (An exception to this procedure exists for the step-by-step immediate dial incoming trunk. In this case, a special directed scan detects dial pulses via a ferrod in the incoming trunk circuit. This same ferrod also indicates the origination of the call.)

6.10 When the type of digit receiver is determined, an idle digit receiver is seized and the network map is searched for a path between the incoming trunk and the digit receiver. A peripheral order bus (POB) is loaded with the orders for the network controllers, SD, and scanner to make and check the connection. The path information is recorded in the junior incoming register.

6.11 The junior incoming register associated with the digit receiver is prepared to store the pulse count. The incoming trunk circuit is put in the bypass state, and the start dialing signal is transmitted to the distant office which, in turn, transmits the last four digits of the called line DN.

6.12 Upon completion of each digit, the pulse count is taken from the junior incoming register and, via a digit hopper, is recorded in the incoming register that is administering the call. When the last digit is completed, the digits received are converted to the PS address of the DN translation for the called line. A part of the DN translation is the LEN for the called line. This LEN is converted to the location of the line busy-idle bit in the CS. This bit indicates that the called line is idle.

6.13 The ringing phase of the call starts as a ringing register and a POB are seized; then, the incoming register is released. A search of the network map results in the selection of a reserved talking path from the incoming trunk to an audible ringing tone circuit and from a ringing circuit to the called line. Also a talking path between the incoming trunk and the called line is reserved. The information for all these paths is stored in the ringing register. The orders for the ringing connections are loaded into a POB with the SD and scanner orders for a power cross test and a party test.

6.14 Every 100 milliseconds, the ringing circuit is scanned for an answer. The incoming trunk is scanned for a possible abandonment.

6.15 When the called customer answers, ringing is automatically tripped by the ringing circuit. The ringing connections and the ringing register are released. Answer supervision is returned to the originating office. The previously reserved talking path is established and the temporary memory is brought up to date. The connection is now supervised via the trunk scanner for disconnect.

6.16 When the 200-millisecond trunk supervisory scan detects a change to on-hook on either the line or trunk side of the incoming trunk, hit timing (200 to 300 milliseconds) is started.

DIGIT RECEPTION

RINGING

TALKING
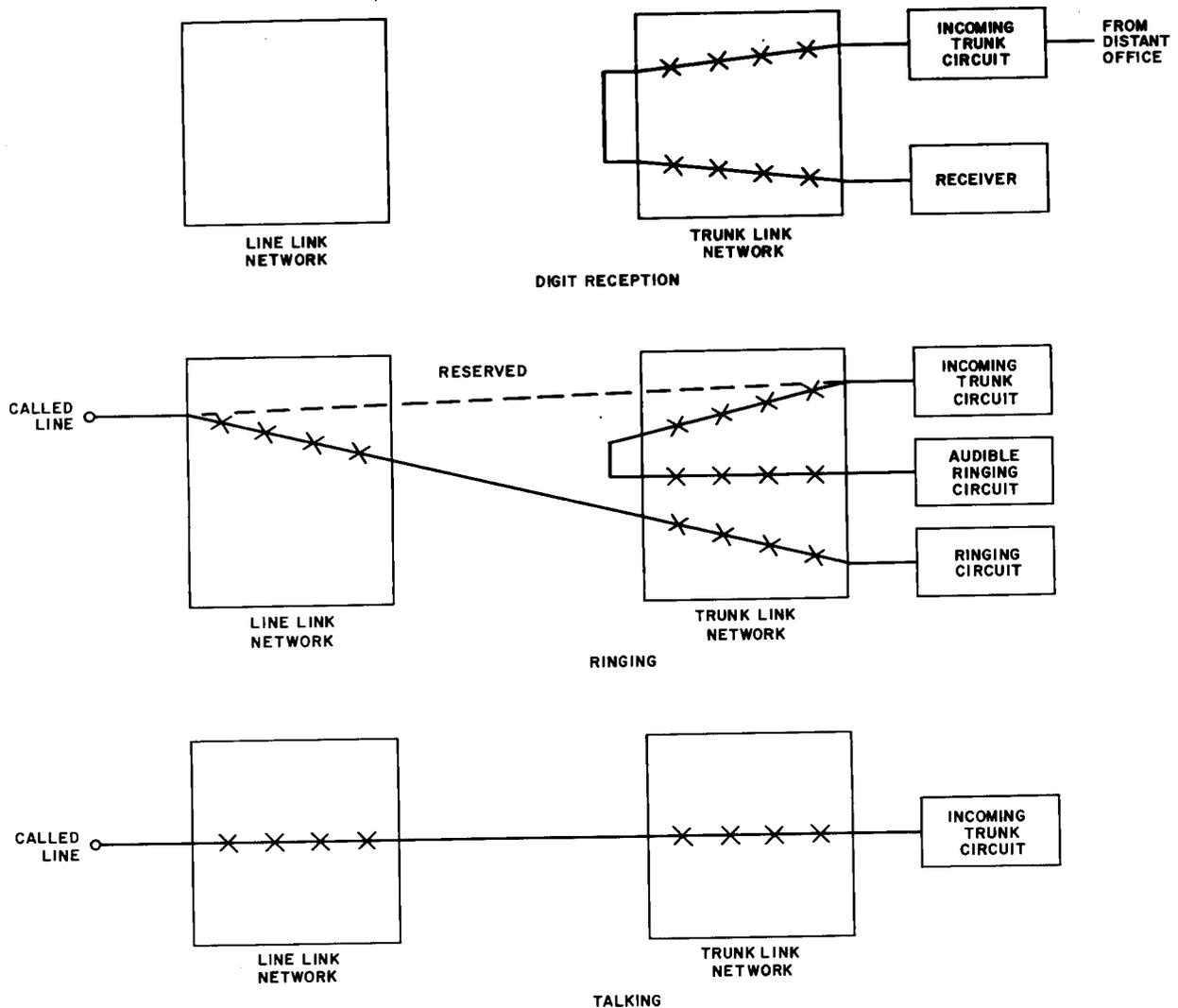
Fig. 51—Switching Sequence From Left to Right (Incoming Call)

6.17 After the hit timing period, a disconnect register is seized. If the distant end is disconnected first, the incoming trunk is made available for reseizure and a timed release period of 10 to 11 seconds is started. During this time, the customer is being scanned at the trunk every 100 milliseconds for disconnect. The connection is released when the customer disconnects or the timed release period ends. If the trunk is reseized in the meantime, the connection is released immediately and the line is supervised via the line scanner. If the customer remains off-hook, beyond the timed release period, the call is treated as a new origination.

6.18 If the customer is disconnected first, when hit timing is completed, the distant office is notified of the disconnect. The 1A ESS switch starts a timing period of 35 to 45 seconds when waiting for the disconnect signal from the distant office. When the 1A ESS switch receives the disconnect signal or when the timing period ends, the connection is released.

C. Common Channel Interoffice Signaling

6.19 The CCIS system is described in paragraphs 3.11 and 3.12 of this practice. For more information on CCIS operation and call processing, refer to Practice 231-090-416.

TYPICAL TRUNK-TO-TRUNK CALL

6.20   The positions of equipment for a typical call in a 1A ESS switch trunk-to-trunk connection are indicated in Fig. 52. An intermediate distribution frame serves as the boundary between switching and transmission equipment while the TLNs constitute the switching matrix. Four stages of switching are encountered in each pass through a TLN; therefore, a trunk-to-trunk connection encounters eight switching stages. From a transmission point of view, the only difference between the ferreed TLN and the remreed TLN is that the remreed TLN is one-fourth the size of the ferreed TLN. This factor affects parameters which are dependent upon the switched path length, with the remreed TLNs offering an improvement.

7.   PROGRAM ORGANIZATION

7.01   The organization of the 1A ESS switch generic program has been influenced by the following factors:

- To accommodate a large number of calls

- To provide sufficient flexibility for office growth and addition of recently developed service features

- To provide automatic detection and diagnosis of trouble conditions.

7.02   The 1A ESS switch generic consists of instructions that are comprised of one or two 24-bit words.

7.03   The 1A ESS switch generic program can be divided into a number of major functions. These functions are associated with programs designed to perform a particular system operation. The following are some of the general categories of nonmaintenance programs:

(a) Input-output programs which specialize in collecting a particular type of input information to be processed (for example, dial pulses) or in transmitting to peripheral equipment such information that has resulted from processing.

(b) Call processing programs which specialize in the processing of information associated with a particular type of call or a phase of a call.

(c) Service routine programs which specialize in processing functions not exclusively related to one type of call or to one phase of a call. These routines are called upon, when needed, by the various call processing programs and are referred to as clients of the service routine program. As an example: Any program can request a translation service routine to determine the equipment number corresponding to a given DN.

(d) An executive control program which schedules the task of the I/O and call processing programs.
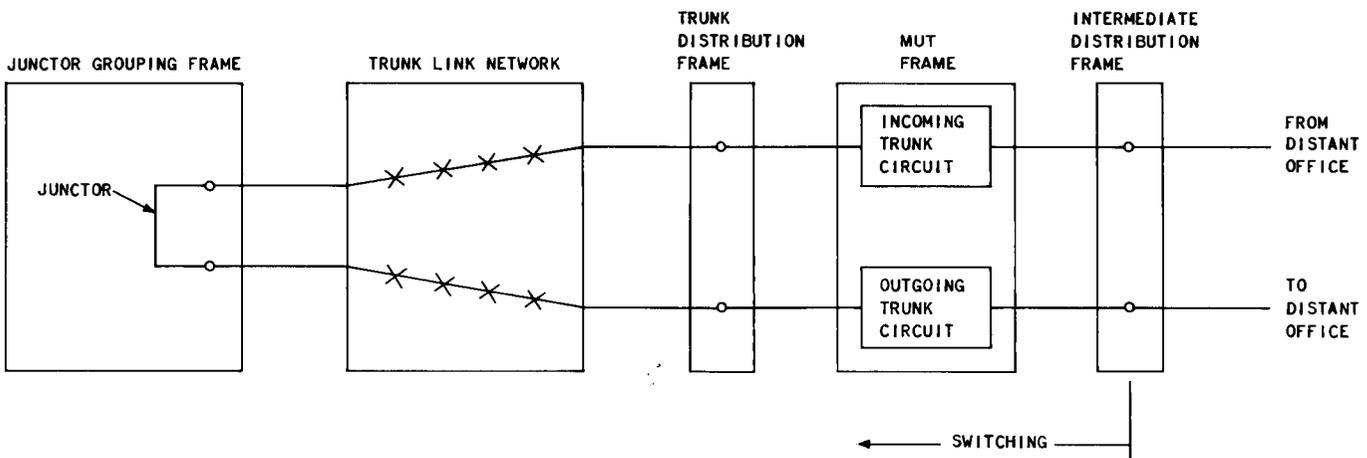
Fig. 52—Trunk-To-Trunk Connections

7.04 The organization of the program is also related with the organization of the information stored in the temporary memory of the duplicated CS. In general, each program functions with one or more duplicated CS areas. The contents of these areas are modified to reflect the occurrence of events or the results of processing. Information recorded by one program may later be used by the same program and/or by others.

7.05 Each duplicated CS area consists of one or more words. The size and layout of the area vary from case to case. A duplicated CS word may be used completely to store some item of information or may be divided into parts of one or more bits. Each word or part of a word has a precisely defined assignment. A whole word may be used, for example, to store the identity of the TLN terminal connected to the customer dial pulse receiver used for a particular call. Groups of four bits may be used to store the various digits dialed by an originating customer. A single bit may be used to indicate whether dialing has been completed or not.

7.06 The organization of the 1A ESS switch program is strongly influenced by the fact that the system must operate in real time; that is, the 1A ESS switch must respond promptly to actions that occur at times not under the control of the system. A single time-shared high-speed CC must keep up with the flow of information from subscribers and from distant COs. Consequently, the establishment of a hierarchy of priorities is necessary. Some system functions are of a nondeferrable nature and must be performed under tightly controlled schedules. Other functions are of a deferrable nature and occasionally can be delayed without significantly adverse effects. For example, monitoring originations is a deferrable type function and when postponed for a number of milliseconds, there is no noticeable effect on service. Detecting dial pulses is a nondeferrable type function and if postponed for even 5 milliseconds pulses may be missed, thus mutilating digits.

7.07 The CC scans each line scanner every 200 milliseconds. Trunk and junctor scanners are checked at a rate of 100 milliseconds. Should the office traffic become heavy, scans related to deferrable type functions are moved out. Line scans are then performed once every 300 milliseconds while trunk and junctor scans are made once every 200 milliseconds. Should office traffic become even heavier, the line scan rate may be moved out even further;

however, the trunk and junctor scan rate will not be moved beyond the 200 millisecond limit.

7.08 Nondeferrable type operation is carried out on schedule by a clock interrupt or a maintenance interrupt. Program execution is immediately interrupted and a transfer made to another program associated with the source of the interrupt signal. When the interrupt program has completed its functions, the program that was interrupted resumes operation as though no interrupt had occurred.

8. MAINTENANCE

MAINTENANCE PLAN

8.01 Maintenance provisions for the 1A ESS switch consist of the following:

- Maintenance circuits and programs provide for detection and diagnosis of failures automatically or by manual requests.

- An MCC provides a centralized control point for communicating, controlling, testing, and recording requirements of the system.

- An office alarm system provides for both system-detected and locally-detected failures.

8.02 The maintenance plan is supported by the following:

- Circuits are made reliable by using long-life components and by providing liberal margins between component ratings and actual operating conditions.

- Circuits are made rapidly reparable by the use of plug-in units.

- Duplication of equipment is provided throughout the system except where a failure would affect only a small number of subscribers.

- High-speed facilities are used to switch duplicated equipment in or out of service and to combine system units in various configurations.

- Various types of redundancy (parity bits, one out-of-N codes, etc) are used in the informa-

tion transmitted between units in order to detect errors.

FAULT RECOGNITION PROGRAM

8.03 When a malfunction is detected, call processing is momentarily interrupted by the CC interrupt sequencer which transfers the program control to an appropriate fault recognition program. The occurrence of a malfunction is detected mainly by means of circuits which perform matching, parity checking, or by scan points which monitor circuit conditions. The fault recognition program performs three functions:

- Determines which system unit failed and removes the unit from service.

- Reestablishes an operational configuration of the office.

- Fault recognition program requests an appropriate diagnostic program initiation at some later time and returns control to the call processing programs. Normally, the interruption of call processing does not last long enough to result in the loss of any dial pulses.

DIAGNOSTIC PROGRAM

8.04 A dignostic program provides a systematic sequence of tests for localizing a fault to a small number of plug-in CPS. The diagnostic program operation does not interrupt normal telephone service because the diagnostic actions are segmented and interweaved with the processing of calls. In turn, the diagnostic results are printed out on the maintenance channel. With the aid of a trouble locating manual, these printed results are translated by maintenance personnel into the location and type of CP(s) that requires replacement.

Exercise Program

8.05 The exercise program is a low priority scheduled routine which includes line-to-line test calls, trunk transmission and noise tests, and network map verifications.

Audit Program

8.06 The audit program is a form of exercise program which provides continuous checks for errors in stored data, reconstructing data found in error, and retrieving lost information.

9. EQUIPMENT INTERFACE

Interface With a No. 2 Switching Control Center System

9.01 A switching control center system (SCCS) is a centrally located facility capable of handling administrative, operational, and maintenance functions for 16 COs (Fig. 53). The SCCS provides sufficient display, control, and alerting capabilities to enable the COs to be remotely operated. Operationally, the primary responsibility for the associated CO resides at the SCC. Work scheduling, dispatching, trouble analysis, and administrative functions are performed at the SCC. The centralization concept of the SCC has four primary objectives:

- To improve service quality over an unattended operation by economically providing around the clock surveillance and control.

- To gain personnel proficiency by pooling existing expertise and allowing the pooled force to work on the problems of several offices.

- To improve proficiency and training by exposing the SCC force to more systems and the associated problems, making it easier for the SCC force to develop and retain their skills.

- To improve work conditions by providing a pleasant, attractive, and spacious place to work.

By utilizing these concepts, many types of switching machines can be served from the same center. The SCC also has the capability of shifting the primary CO responsibilities between the SCC and the associated CO.

Master Control Center Interface

9.02 Most MCC interface control and display functions have been remotely located at the SCC. An interface circuit at the MCC and telemetry are used to transfer these functions to the SCC. There are some additional indicators available at the SCC that
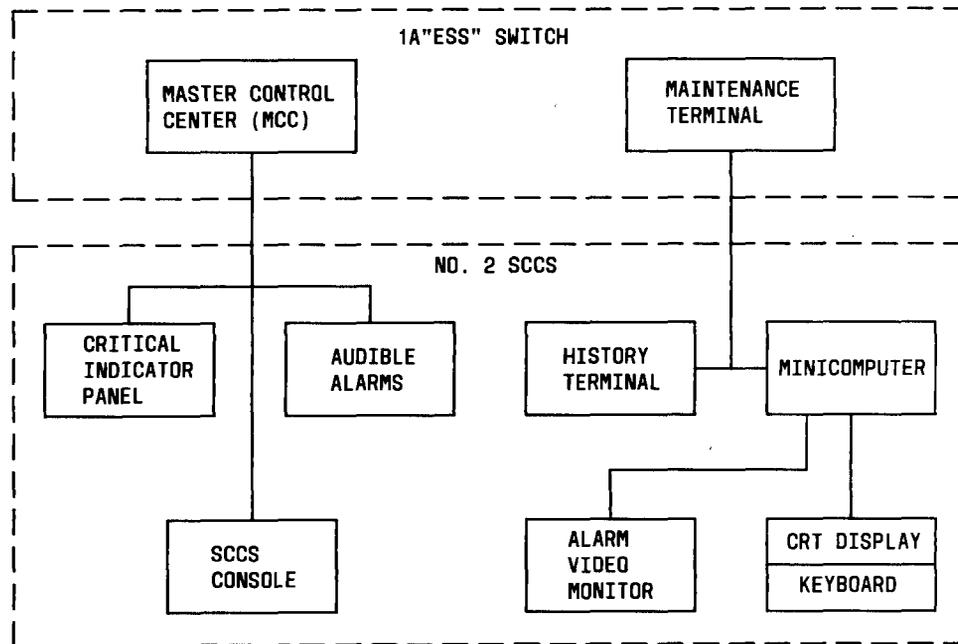
```
 ┌─────────────────────────────────────────────────────────────┐
 │                        1A"ESS" SWITCH                        │
 │   ┌───────────────────┐          ┌───────────────────┐       │
 │   │ MASTER CONTROL    │          │ MAINTENANCE       │       │
 │   │ CENTER (MCC)      │          │ TERMINAL          │       │
 │   └───────────────────┘          └───────────────────┘       │
 └─────────────────────────────────────────────────────────────┘

 ┌─────────────────────────────────────────────────────────────┐
 │                         NO. 2 SCCS                           │
 │  ┌──────────┐   ┌──────────┐   ┌──────────┐  ┌────────────┐  │
 │  │ CRITICAL │   │ AUDIBLE  │   │ HISTORY  │  │            │  │
 │  │ INDICATOR│   │ ALARMS   │   │ TERMINAL │  │MINICOMPUTER│  │
 │  │ PANEL    │   │          │   │          │  │            │  │
 │  └──────────┘   └──────────┘   └──────────┘  └────────────┘  │
 │                                                              │
 │         ┌──────────┐      ┌──────────┐  ┌────────────┐       │
 │         │ SCCS     │      │ ALARM    │  │ CRT DISPLAY│       │
 │         │ CONSOLE  │      │ VIDEO    │  ├────────────┤       │
 │         │          │      │ MONITOR  │  │ KEYBOARD   │       │
 │         └──────────┘      └──────────┘  └────────────┘       │
 └─────────────────────────────────────────────────────────────┘
```

Fig. 53—1A ESS Switch Interface With a No. 2 SCCS

are not found at the MCC. These are system state-of-health indicators intended to provide additional information to help analyze system problems.

IOT Interface

9.03 Each 1A ESS switch is connected to the SCC location by at least one dedicated IOT channel, an extension of the first maintenance channel. Other IOT channels may also be provided to the SCC or a dedicated or dial-up basis. The first maintenance channel is connected to the SCCS minicomputer where the IOT messages are logged and analyzed by the minicomputer.

10. EQUIPMENT ADDITIONS (OFFICE GROWTH)

10.01 Office growth is necessary whenever an operating office must add equipment or equipment frames to increase call handling capacity. For a more detailed description on office growth, refer to Practice 231-319-001.

10.02 In a 1A ESS switch, frames can be added to an operating system using relatively few wired connections. Parameter and translation changes instead of wired logic modifications provide most of the information required by the 1A ESS switch for added frames.

10.03 When new equipment or equipment frames are added to an ESS switch, they must be added without an interruption in telephone service. Continuous service is possible primarily due to the duplicate design of the 1A ESS switch which permits numerous operating configurations among the duplicated system units. Another aspect of the 1A ESS switch that allows growth to be accomplished in a smooth and orderly sequence is the way parameter and translation data defines the equipment. After the added equipment is wired into the system, selected parameter and translation updates can be performed to allow the system diagnostic and fault recognition programs to test the equipment. Testing occurs without interference to call processing, and call processing programs are unaware of the added equipment due to the parameter and translation updates that have not yet been accomplished.

10.04 Major objectives during office growth are to minimize the possibility of interruption of or impairment to customer service, to minimize changes required in normal operating procedures of the telephone company, and to permit allowable margins and overlap of installation effort to provide efficient job

schedules and utilization of manpower. These objectives can best be implemented by providing a safe and well defined environment in which growth frames can be tested without interference to the operating system. The intervals are minimized where simplex operation (no duplication) of equipment is required. Installation procedures are sequenced to allow growth frames to be integrated into the system in small steps that can be easily verified. Several safe stopping points are provided in the growth procedures to allow for unforeseen difficulties that may arise. The procedures are kept simple and explicit and use computer generated data where applicable.

10.05 System evaluation tests must be performed prior to and after office growth to ensure that the office is in excellent operating condition. These tests consist of testing the emergency action portion of the MCC to ensure that the system can operate without trouble in all possible configurations of the CCs, CSs, and PSs. Also, the system tests verify that power can be removed and restored to either one of the duplicate buses or equipment units without equipment troubles or adverse system action. An optional test is to execute a manual phase of reinitialization to make sure this function is operational.

10.06 Restrictions which must be considered in any office growth are imposed by dc power requirements, frame interdependencies (point assignments), frame line-up pattern, special wire length limitations, and other similar items. The dc power problem is easily solved, but other restrictions create tasks which are different and unique. Each task raises problems which must be solved individually.

10.07 Besides the addition of growth frames, there are other changes which must be accomplished. Translation changes may be performed before the system testing interval, just prior to diagnostic testing or after testing to complete growth and merge added equipment into service. Parameter changes may be performed just prior to or after testing. Junctor redistribution is required when networks are added or when junctor occupancy changes.

10.08 If there are a number of frames to be installed, they must be added to the existing machine in a certain sequence. There are also certain procedures which are followed for all frames and other procedures which are executed for only a given class of frames.

11. GLOSSARY

11.01 The following is a glossary defining some terms used in a 1A ESS switch.

Address

A combination of bits that identifies a location in a storage device or equipment unit.

Bipolar Pulse

A pulse that may have either a positive or negative polarity.

BIT (Binary Digit)

A binary unit of information. It is represented by one of two possible conditions, such as, the character 0 or 1, on or off, high or low potential, conducting or not conducting, magnetized or demagnetized.

Buffer

(a) An isolating circuit used between two other circuits. The isolation may be between high-speed and low-speed circuits or between high-impedance and low-impedance circuits.

(b) A CS register used to store information until it can be used by the system.

Bus

A group of leads providing time-shared communication paths over which information is transmitted from any one of several sources to any of several destinations as governed by gates.

Cut-Through Relay

A relay that is used to complete a talking path only after all ferreed switches have been closed.

Decode

To translate input information into a form recognizable by the unit receiving the information.

Duplicated Call Store

Memory units containing transient information pertaining to call processing.

Enable Pulse

A pulse that permits a unit or circuit to become operative.

Encode

To code information into a form suitable for transmission from one unit to another.

Error

A malfunction, the symptoms of which cannot be reproduced under program control.

Fault

A malfunction, the symptoms of which can be reproduced under program control.

Indexing

The process of adding the contents of a specified index register to that part of an instruction which specifies an address or some data to be operated on.

Instruction

A binary word which directs central control to perform a particular function.

Memory

A unit into which information can be placed to be extracted at a later time. The ability to retain information for later use.

Memory Circuit

A circuit which, having been put in some state by an input signal, will remain in that state after the removal of the input.

Nonresident Program

Portion of the generic program that is kept in the FS or APS and brought to the PS only when needed.

Parameter Information

Information contained in the PS pertaining to office equipment and certain hardware and software options.

Parity Bit

A bit attached to a word to make the total number of ones, including the parity bit, odd or even.

Parity Check

A check on the validity of a binary word by determining whether the number of ones in the word is odd or even.

Program

An organized set of instructions used to control system functions.

Program Store

A memory unit that stores the resident generic program.

Read

To retrieve information from a memory device.

Real Time

Actual time of occurrence of an event. A real time control system is one in which information related to a physical process is converted by the control equipment quickly enough so that the outputs obtained are useful in controlling that process.

Redundancy (Also Called Duplication)

The use of additional equipment and facilities to make possible continuity of service in the presence of troubles.

Resident Program

That portion of the generic program that is
maintained continuously in PS.

Subroutine

A sequence of programmed instructions to
perform a particular function which is com-
mon to several programs.

Temporary Memory

A read and write memory which contains in-
formation that can be changed by the internal
circuitry of the system.

Time-Shared Circuit

A common circuit whose services are used by
a number of circuits during separate time in-
tervals.

Translation Information

Information contained in the PS or CS per-
taining to the individual lines or trunks. It
may be used, for instance, to convert a DN into
an equipment location, to derive the class of
service, etc.

Translator

A circuit or program table used to change in-
formation from one form of representation to
another.

Trouble

A fault that causes a deviation from normal
system operation.

Unduplicated Call Store

Memory units used to contain office data, both
parameter data and translation data.

Unipolar Pulses

A pulse of one polarity only.

Word

A set of characters associated to express sys-
tem information. (The term "word" may be
prefixed by an adjective describing the nature
of the characters, such as binary word.)

Write

To insert information into a memory device.

12. ABBREVIATIONS AND ACRONYMS

12.01 The following are abbreviations and acro-
nyms used in this practice.

AAR	Automatic Alternate Routing
AC	Advance Calling
ACD	Automatic Call Distribution
ADS	Auxiliary Data System
ADSS	Attendant Direct Station Selection
AEMIS	ACD-ESS Switch Management Information System
AIOD	Automatic Identified Outward Dialing
ALIT	Automatic Line Insulation Test
AMA	Automatic Message Accounting
AMASE	Automatic Message Accounting Standard Entree
AMATPS	Automatic Message Accounting Teleprocessing System
AMT	Auxiliary Manual Test
API	Attached Processor Interface
APS	Attached Processor System
ARS	Automatic Route Selection
ASW	All-Seems-Well

AU	Auxiliary Unit
AUB	Auxiliary Unit Bus
BLF	Busy Lamp Field
BLT	Beltline Maintenance
CA	Call Answering
CACS	Customer Administration Center System
CAROT	Centralized Automatic Reporting on Trunks
CAS	Custom Announcement Service
CB	Code Blocking
CC	Central Control
CCIS	Common Channel Interoffice Signaling
CD	Control and Display Panel
C&D	Control and Display Frame
CDL	Centrex Data Link
CI	Carrier Interconnect
CLID	Calling Line Identification
CLT	Calling Line Identification
CMT	Combined Miscellaneous Trunk
CO	Central Office
CP	Circuit Pack
CPD	Central Pulse Distributor
CPS	Customer Premises System
CS	Call Store
CSDC	Circuit Switched Digital Capability

CSRAF	Common Systems Recorded Announcement Frame
CTX	Centrex
CU	Customer Unit
DCS	Duplicated Call Store
DCT	Digital Carrier Trunk
DCTB	Digital Carrier Trunk Bank
DLC	Data Link Controller
DN	Directory Number
DOC	Dynamic Overload Control
DP	Dial Pulse
DSS	Direct Station Selection
DU	Data Unit
DUC	Data Unit Controller
DUS	Data Unit Selector
ELLN	Extended Line Link Network
ESAC	Electronic Systems Assistance Centers
ESB	Emergency Service Bureau
ETS	Electronic Tandem Switching
FAR	Facility Assurance Reports
FCG	False Cross and Ground
FML	Fixed Message Length
FP	Feature Package
FRL	Facility Restriction Level
FS	File Store
FSC	File Store Controller
HMT	HILO Miscellaneous Trunk

HUC	High Unduplicated Call Stone	MM	Message Module
HUT	HILO Universal Trunk	MOS	Metal Oxide Semiconductor
I/O	Input/Output	MS	Master Scanner
IOC	Input/Output Channel	MSA	Mobile Service Area
IOP	Input/Output Processor	MT	Miscellaneous Trunk
IOT	Input/Output Terminal	MTSO	Mobile Telephone Switching Office
IOU	Input/Output Unit	MTTP	Manual Trunk Test Position
IOUC	Input/Output Unit Controller	MUT	Miniaturized Universal Trunk
IOUS	Input/Output Unit Selector	NMG	Network Management
JGF	Junctor Grouping Frame	PBX	Private Branch Exchange
JSC	Junctor Switch Circuit	PC	Privacy Code
JSF	Junctor Switch Frame	PCDF	Power Conversion and Distribution Frame
LCR	Line Concentration Ratio	PCI	Program Controlled Interrogator
LLN	Line Link Network	POB	Peripheral Order Bus
LOC	Local Maintenance	PPI	Processor Peripheral Interface
LRE	Loop Range Extension	PS	Program Store
LSC	Line Switch Circuit	PSAP	Public Safety Answering Point
LSF	Line Switch Frame	PSC	Plant Service Center
LTD	Local Test Desk	PUB	Peripheral Unit Bus
LUC	Low Unduplicated Call Store	PUC	Peripheral Unit Controller
MCC	Master Control Center	PUC/DCT	Peripheral Unit Controller/Digital Carrier Trunk
MOS	Metal Oxide Semiconductor	PUC/DL	Peripheral Unit Controller/Data Link
MCRC	Mixed Concentration Ratio Change	RA	Remote Access
METS	Multi-Entry Teleprocessing System	RAM	Random Access Memory
MF	Multifrequency	RAO	Revenue Accounting Office
MIN	Mobile Identification Number		

|			
RCS	Recent Change Service Order	TLN	Trunk Link Network
REM	Remote Maintenance	TLTP	Trunk and Line Test Panel
ROTL	Remote Office Test Line	TNN	Trunk Network Number
RSS	Remote Switching System	TSC	Trunk Switch Circuit
SCCS	Switching Control Center System	TSF	Trunk Switch Frame
SD	Signal Distributor	TUC	Tape Unit Controller
SMDR	Station Message Detail Recording		
SR	System Reinitialization	UCS	Unduplicated Call Store
SRM	Supplementary Remote Maintenance	UN	Uniform Numbering
SSD	Supplementary Signal Distributor	USACII	United States of American Standard Code for Information Interchange
STTP	Supplementary Trunk Test Panel		
System	Autoplex System 100	UTF	Universal Trunk Frame
TCM	Traveling Class Mark	VFLA	Voice Frequency Link Access
TGC	Trunk Group Control	VML	Variable Message Length
TIC	Trunk Interconnection Circuit	VSS	Voice Storage System.
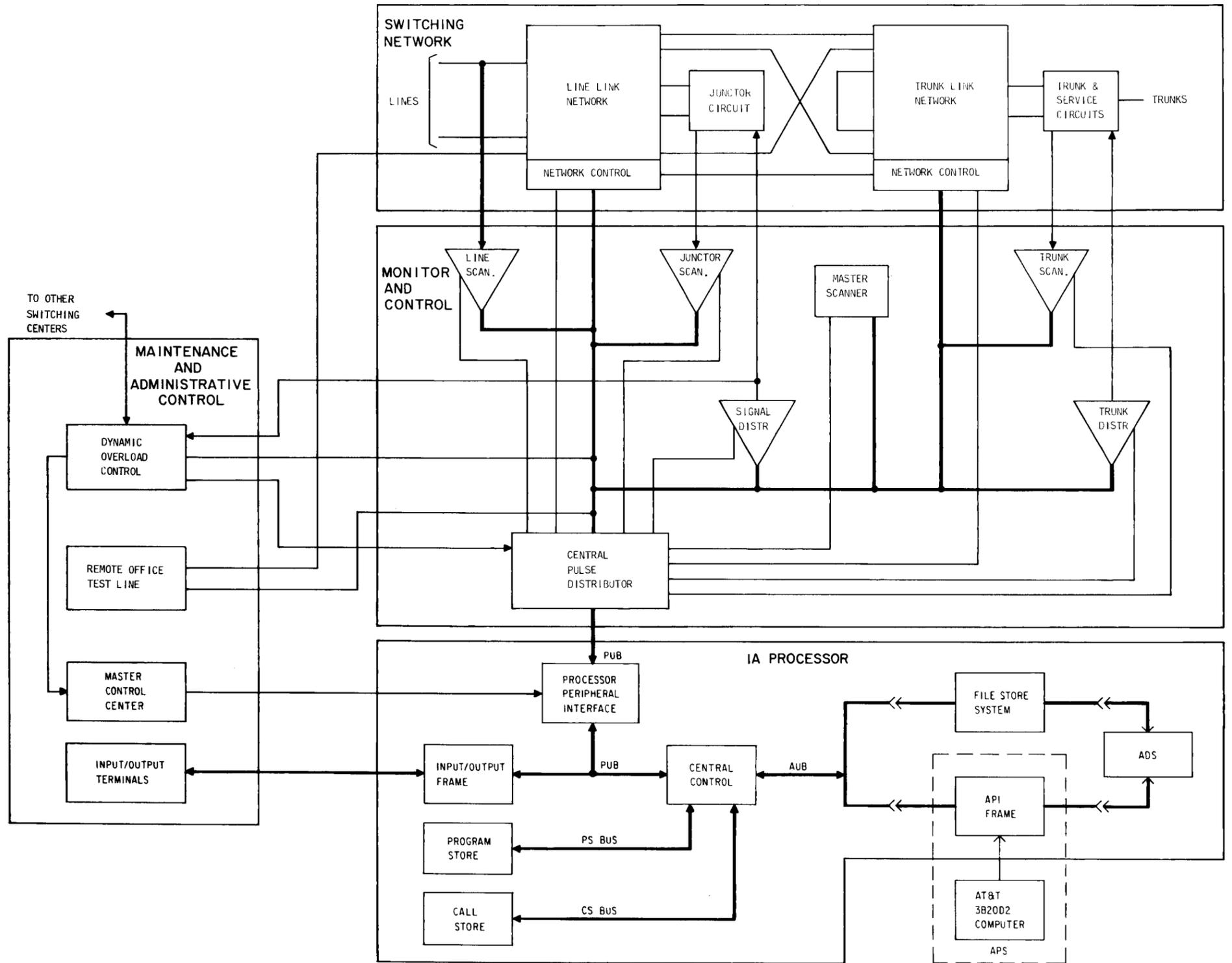
Fig. 54—1A ESS Switch Functional Block Diagram
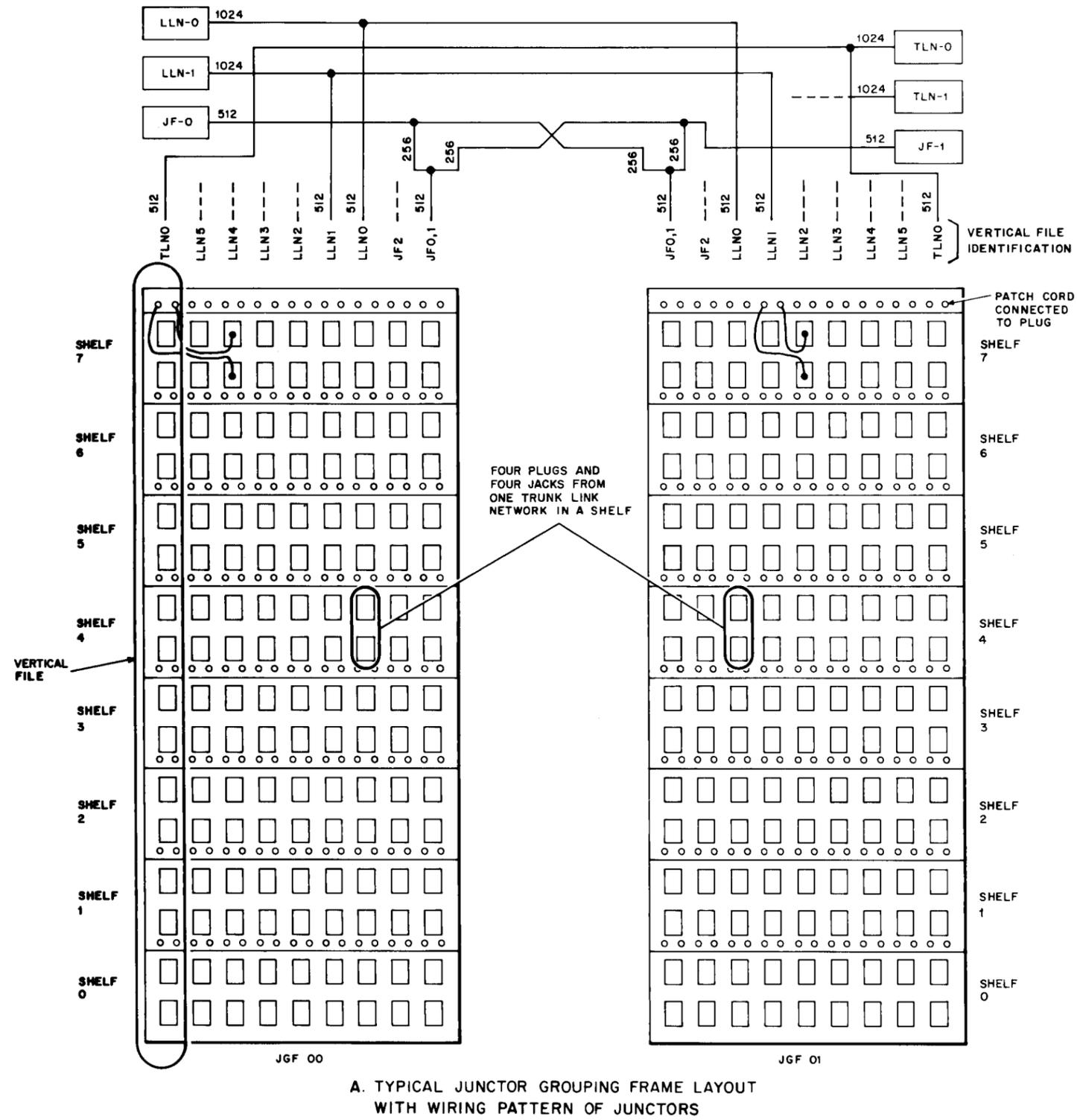
A. TYPICAL JUNCTOR GROUPING FRAME LAYOUT
WITH WIRING PATTERN OF JUNCTORS
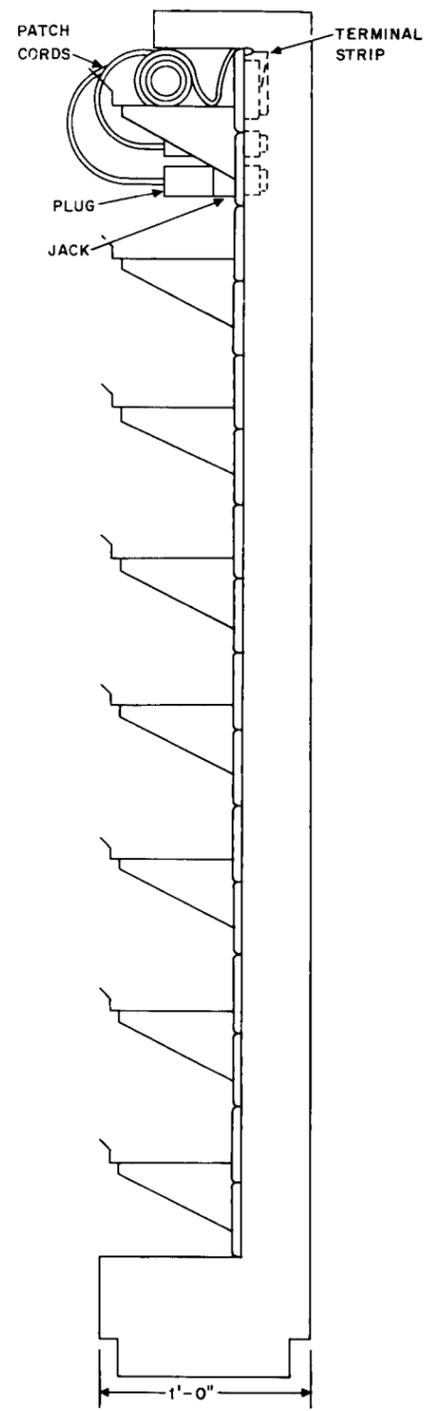
B. JUNCTOR GROUPING FRAME
(SIDE VIEW)

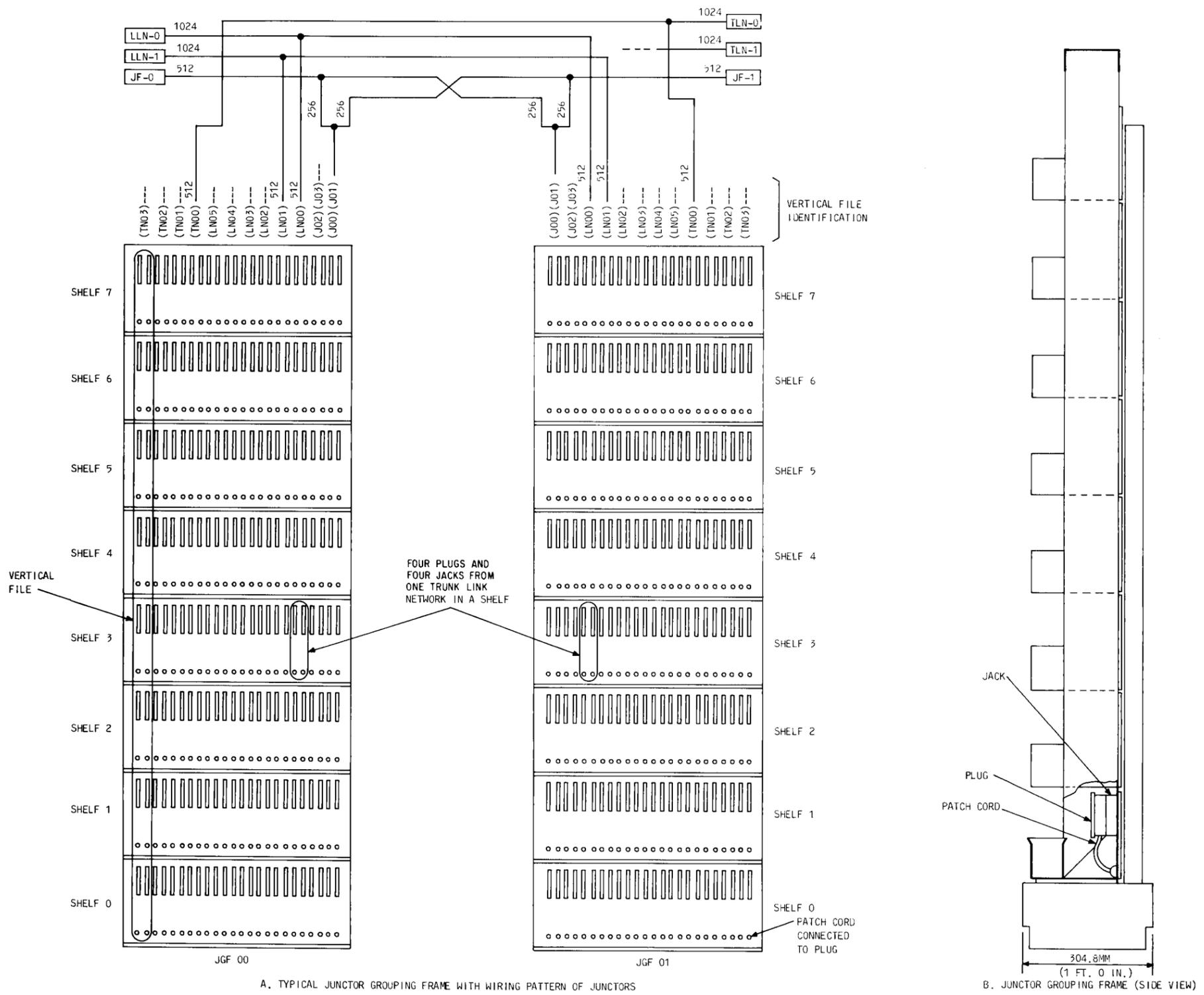**Fig. 55—Junctor Grouping Frame Layout 9, Vertical File**

A. TYPICAL JUNCTOR GROUPING FRAME WITH WIRING PATTERN OF JUNCTORS

B. JUNCTOR GROUPING FRAME (SIDE VIEW)

Fig. 56—Junctor Grouping Frame Layout 12, Vertical File
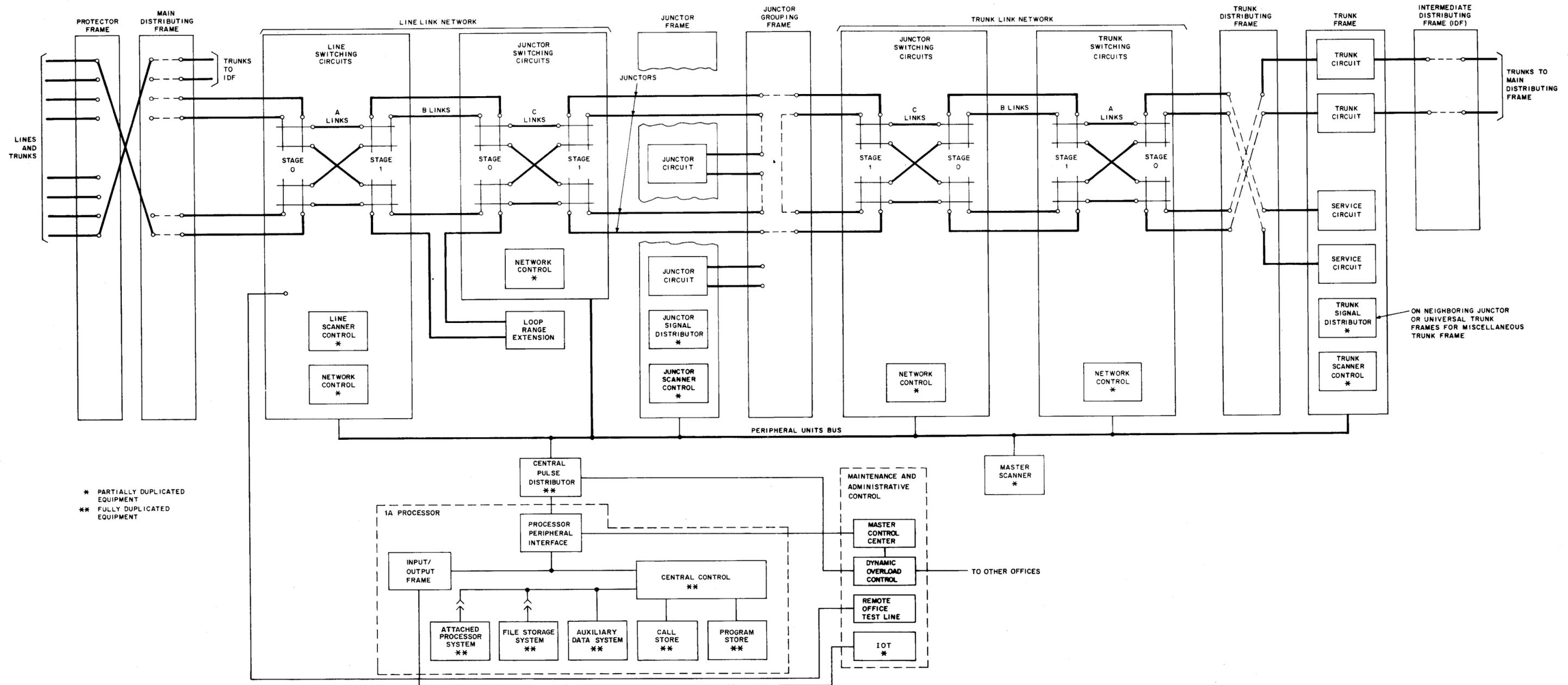
Fig. 57—1A ESS Switch Block Diagram

Fig. 58—General Translation Sequence During Outgoing Call (Sheet 1 of 2)
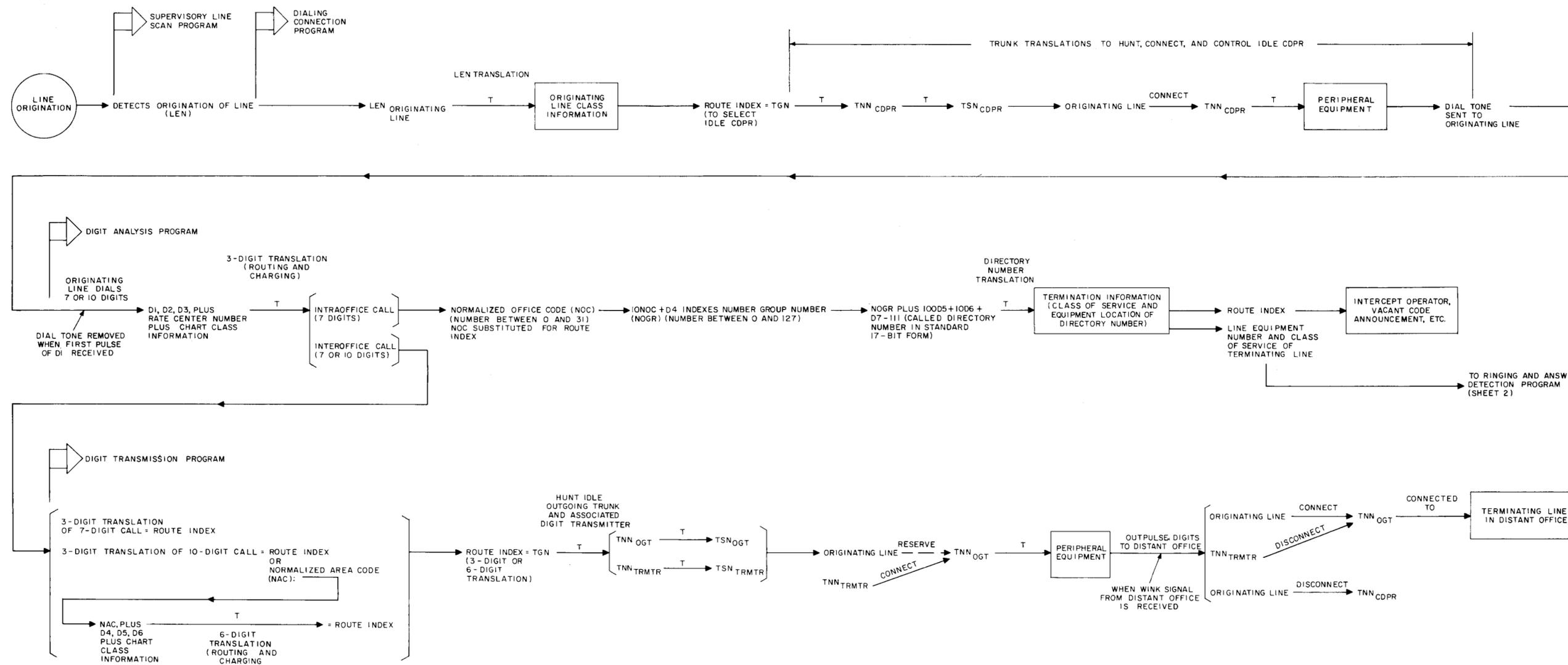
LEGEND:

ARTC — AUDIBLE RINGING TONE CIRCUIT
BTC — BUSY TONE CIRCUIT
CDPR — CUSTOMER DIAL PULSE RECEIVER
LEN — LINE EQUIPMENT NUMBER
NAC — NORMALIZED AREA CODE
NOC — NORMALIZED OFFICE CODE
NOGR — NUMBER GROUP NUMBER
OGT — OUTGOING TRUNK
RC — RINGING CIRCUIT
T — TRANSLATION
TGN — TRUNK GROUP NUMBER
TNN — TRUNK NETWORK NUMBER
TRMTR — DIGIT TRANSMITTER
TSN — TRUNK SCANNER NUMBER

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RINGING AND ANSWER
DETECTION PROGRAM

FROM
SHEET 1

IF TERMINATING
LINE IS BUSY → ROUTE INDEX = TGN (TO SELECT IDLE BUSY TONE CIRCUIT (BTC)) —T→ TNN$_{BTC}$ —T→ TSN$_{BTC}$ → ORIGINATING LINE —CONNECT→ TNN$_{BTC}$ → APPLY BUSY TONE TO ORIGINATING LINE → ORIGINATING LINE

WHEN ORIGINATING LINE DISCONNECTS → DISCONNECT → TNN$_{BTC}$

DISCONNECT → TNN$_{CDPR}$

IF TERMINATING LINE IS NOT BUSY → ROUTE INDEX = TGN (TO SELECT IDLE AUDIBLE RINGING TONE CIRCUIT (ARTC)) —T→ TNN$_{ARTC}$ —T→ TSN$_{ARTC}$ → ORIGINATING LINE —CONNECT→ TNN$_{ARTC}$ → ORIGINATING LINE —DISCONNECT→ TNN$_{ARTC}$

WHEN TERMINATING LINE ANSWERS

ORIGINATING LINE —CONNECT→ TERMINATING LINE

ROUTE INDEX = TGN (TO SELECT IDLE RINGING CIRCUIT (RC)) —T→ TNN$_{RC}$ —T→ TSN$_{RC}$ → TERMINATING LINE —CONNECT→ TNN$_{RC}$ → TERMINATING LINE —DISCONNECT→ TNN$_{RC}$

ORIGINATING LINE —DISCONNECT→ TNN$_{CDPR}$
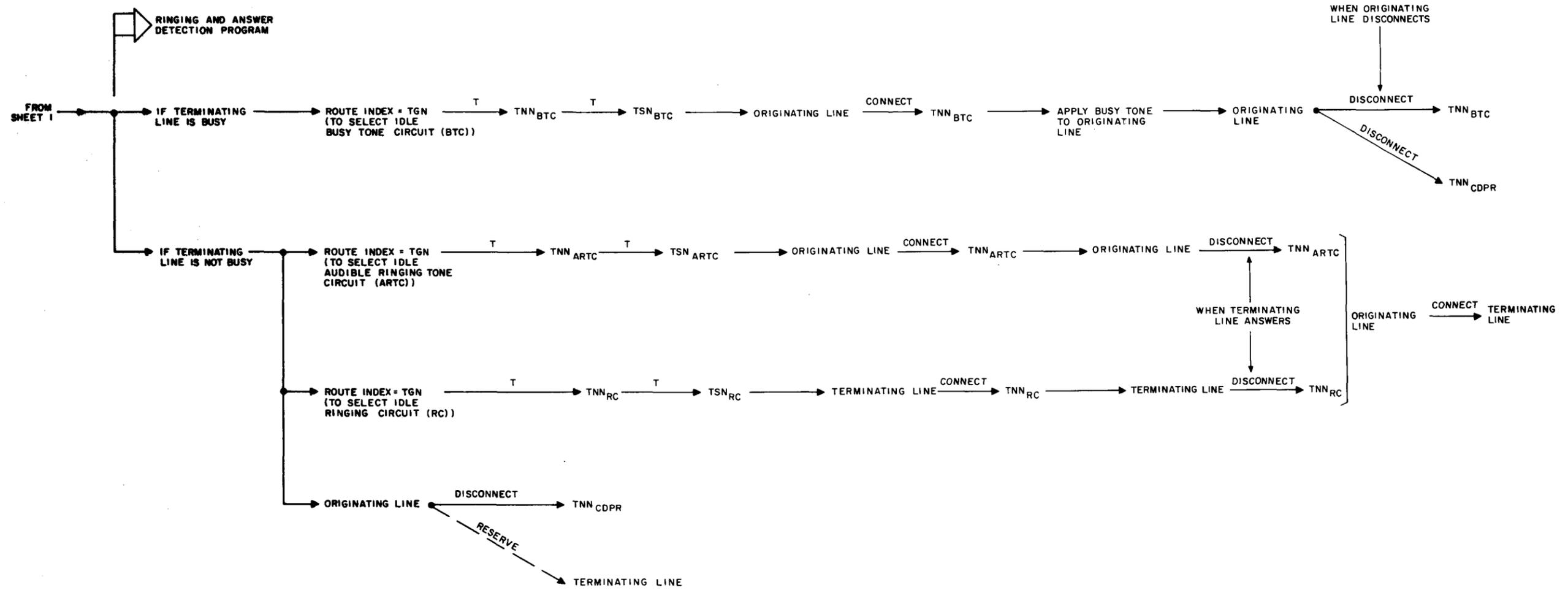
—RESERVE→ TERMINATING LINE

Fig. 58—General Translation Sequence During Outgoing Call (Sheet 2 of 2)