GENERAL DESCRIPTION

NO. 2B ELECTRONIC SWITCHING SYSTEM

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1. GENERAL

1.01 This section describes in general terms the operation and major characteristics of the No. 2B Electronic Switching System (ESS).

1.02 This section is reissued to provide coverage for Loop Range Extension (LRE) and remreed networks and to incorporate miscellaneous changes. Since this is a general revision, arrows ordinarily used to indicate changes have been omitted.

1.03 The No. 2B ESS is a No. 2 ESS which uses a new design processor incorporating 1A and other current technology. The new processor is designated the 2B processor and is based on the design of the 3A central control (3A CC). The 2B processor is engineered for 30,000 busy hour calls with the 2B-EF-1 generic program and 35,000 busy hour calls with the 2B-EF-2 generic program. It is compatible with all No. 2 ESS peripheral equipment including networks, scanners, automatic message accounting (AMA), and supplementary central pulse distributor (SCPD).

1.04 The 2B processor occupies less than one third the space of No. 2 ESS control complex. The No. 2 ESS control complex and AMA frames (if equipped) consists of a maximum of 28 equipment bays arranged in two equipment lineups. The 2B processor (maximum of five bays), trunk test frame, and AMA frame (if equipped) consist of a maximum of seven bays arranged in one equipment lineup. The No. 2B ESS also provides a substantial reduction in current drain and air-conditioning requirements from the No. 2 ESS control complex.

1.05 The No. 2B ESS is a switching system designed to serve offices intended for initial installations in the 1,000 to 10,000 line range, growing to a total of 10,000 to 20,000 lines. In any office, the maximum number of lines is determined by the traffic characteristics of the office and by an upper limit of 15 networks, or 31 trunk scanners.

1.06 The No. 2B ESS is a common control switching system which means that switching actions are separated from the equipment that controls them (Fig. 1). Call connections through a switching network can be directed for many lines by a centralized or "common" group of control equipment. In No. 2B ESS, the network may either be a ferreed network (Fig. 2) or a remreed network (Fig. 3). The control equipment routes a call through the network and is released to act on other calls.

1.07 Some of the attributes of the No. 2B ESS are high-speed electronic devices such as semiconductor devices, integrated circuits, ferreed switches, ferrod sensors, single store community, and microprogram control. This arrangement provides relatively flexible operation since additions and changes in basic service are made through stored program modification.

1.08 The No. 2B ESS provides custom calling services and various new features to facilitate maintenance and administration as well as the required flexibility to simplify office growth and modification of features. The 2B processor is available with either the 2B-EF-1 (rated additions and maintenance [A&M] only) or 2B-EF-2 generic

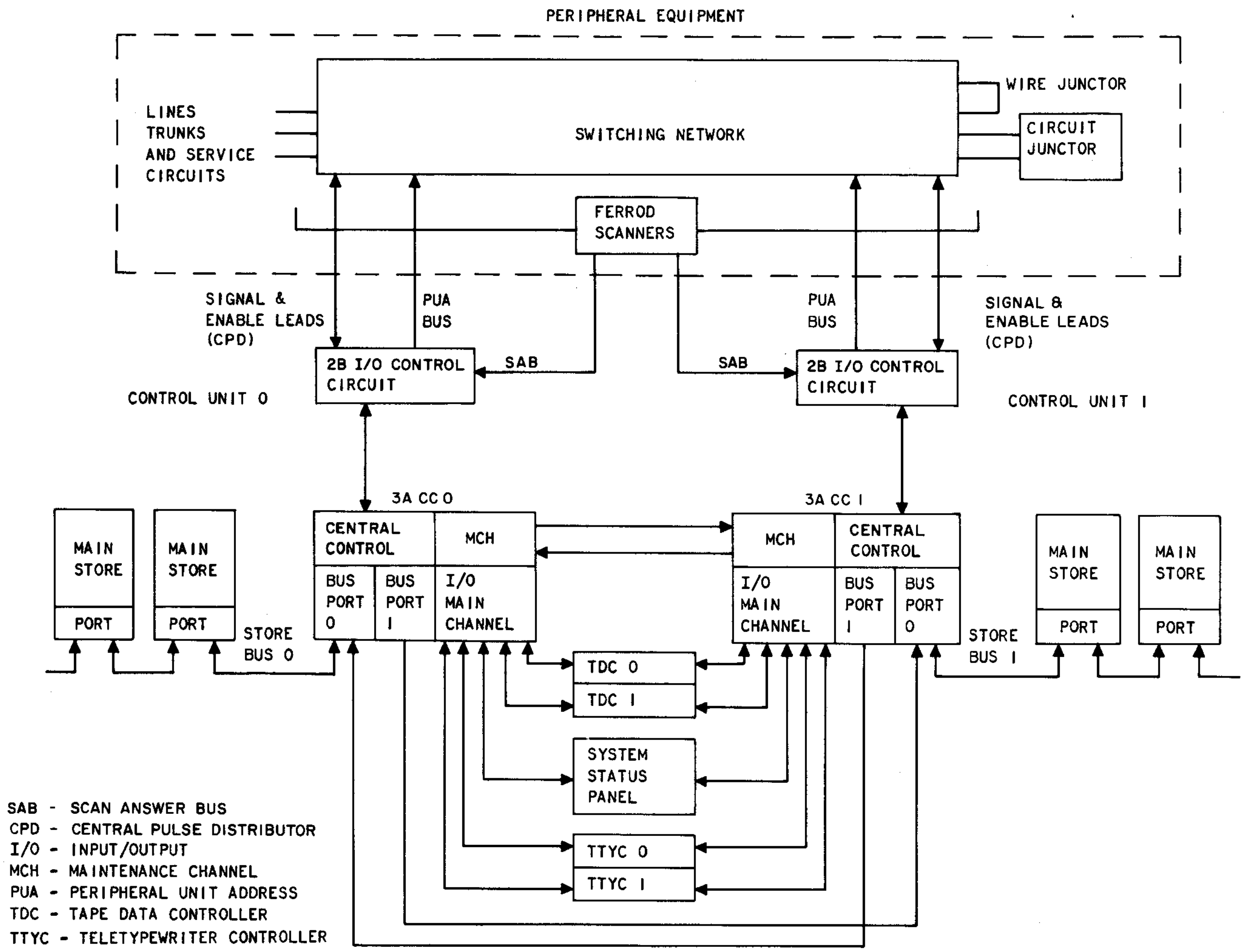


Fig. 1—No. 2B ESS Block Diagram

program. These generics provide for full basic telephone service features, standard custom calling features, and centrex-central office (CO) capability. Since the 2B processor uses a semiconductor memory for program and translation data, program and translation update procedures will be significantly simplified over the magnetic card writing procedures of the No. 2 ESS.

1.09 The No. 2B ESS provides centrex service with the 2B-EF-1 and 2B-EF-2 generic programs. Centrex service is a centralized telephone communications exchange service using the data handling capabilities of a nearby No. 2B ESS central office. The No. 2B ESS centrex system is shown in Fig. 4. The centrex system utilizes the switching equipment of the central office and regular connection of centrex subscriber lines to a No. 2B ESS central office. Each centrex customer can be equipped with an attendant console to provide attendant services. A centrex data loop interconnects the attendant consoles at the customer premises with the No. 2B ESS central office. Centrex service also requires a centrex data link frame at the central office and a centrex console control cabinet installed at the centrex customer group premises. These units are used to implement data transmission between the centrex customer location and the central office.

SYSTEM CHARACTERISTICS

1.10 This section, while touching briefly on the system and software features of the No. 2B

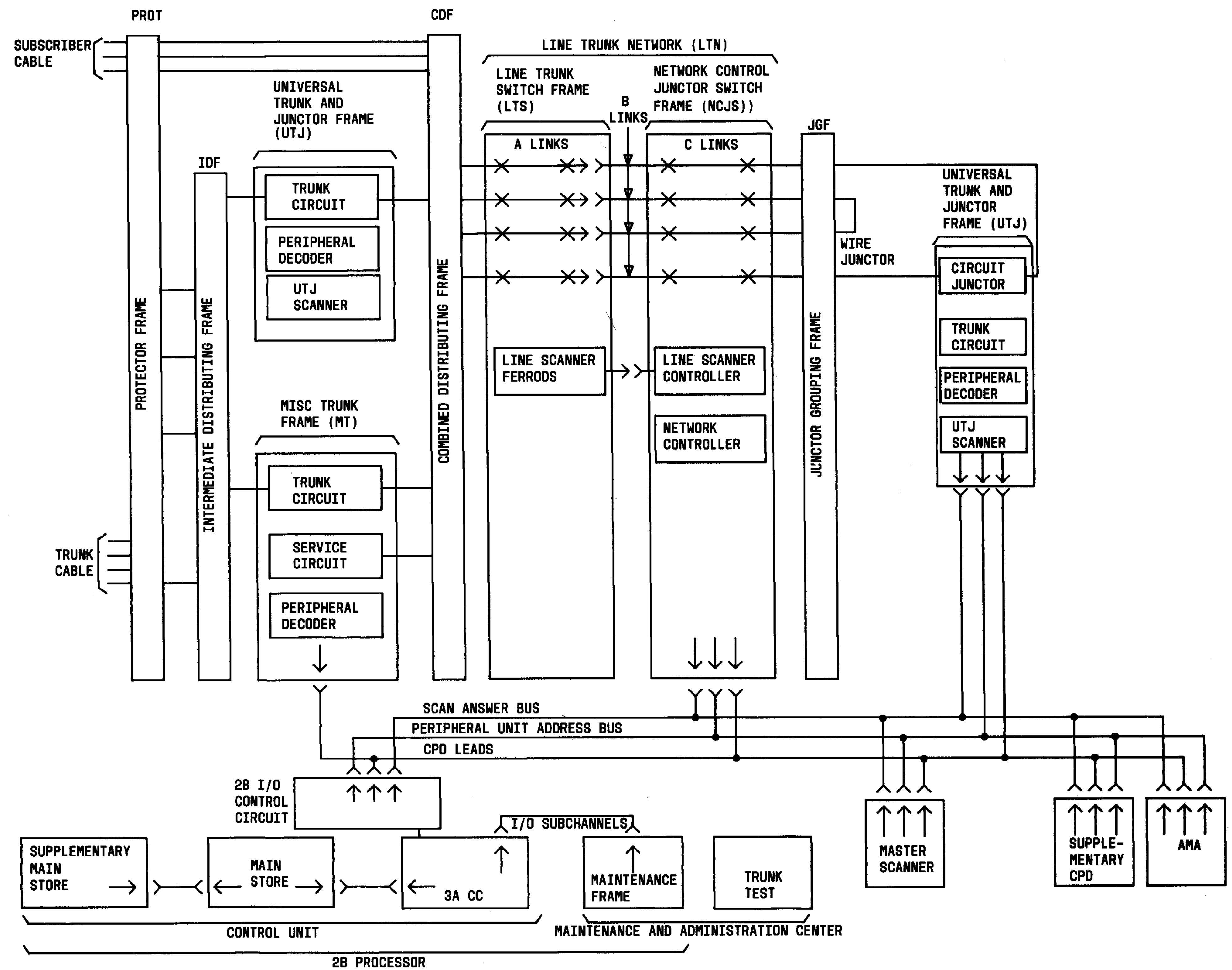


Fig. 2—System Schematic Block Diagram of No. 2B ESS with a Ferreed Network

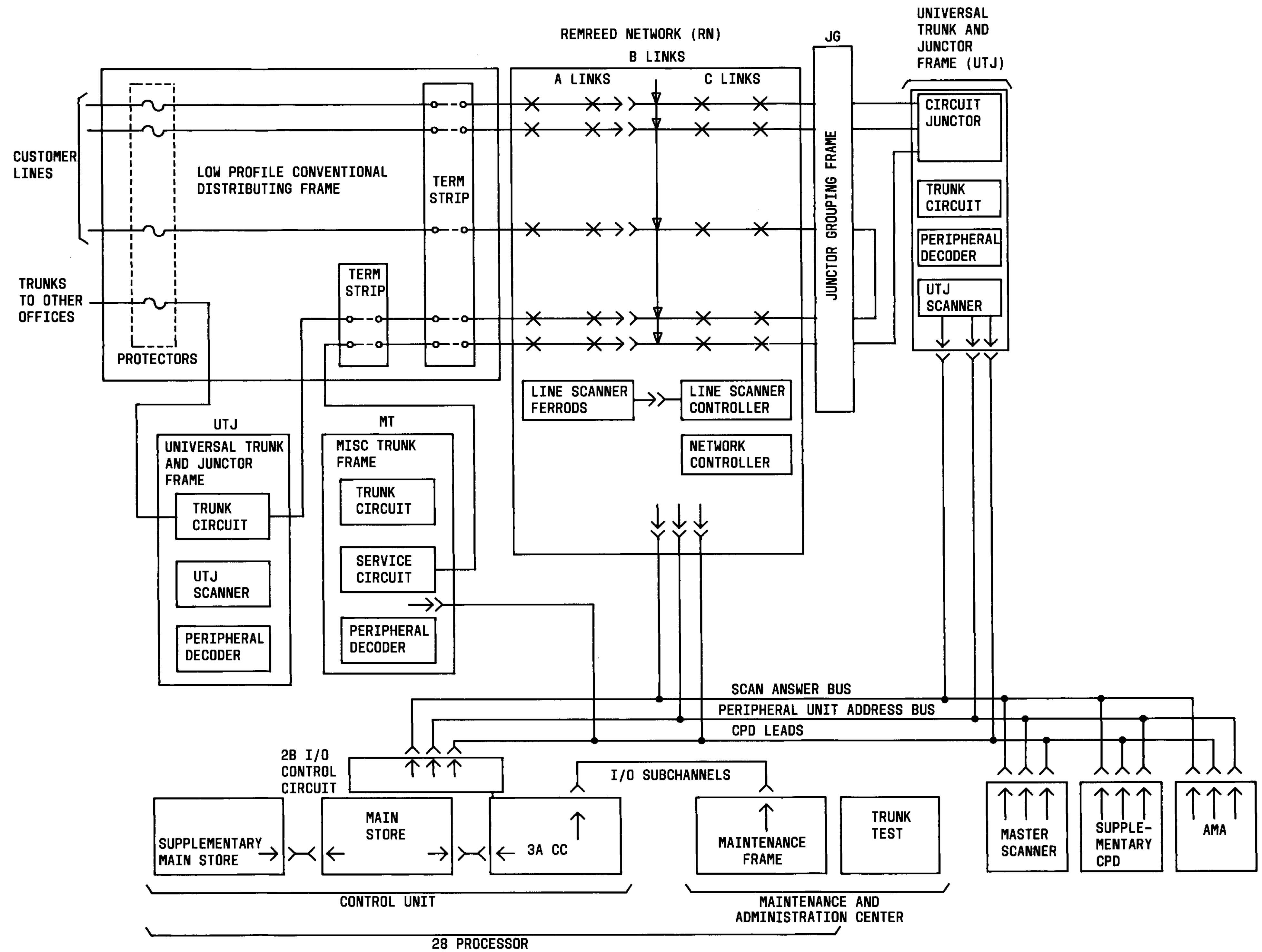


Fig. 3—System Schematic Block Diagram of No. 2B ESS with a Remreed Network

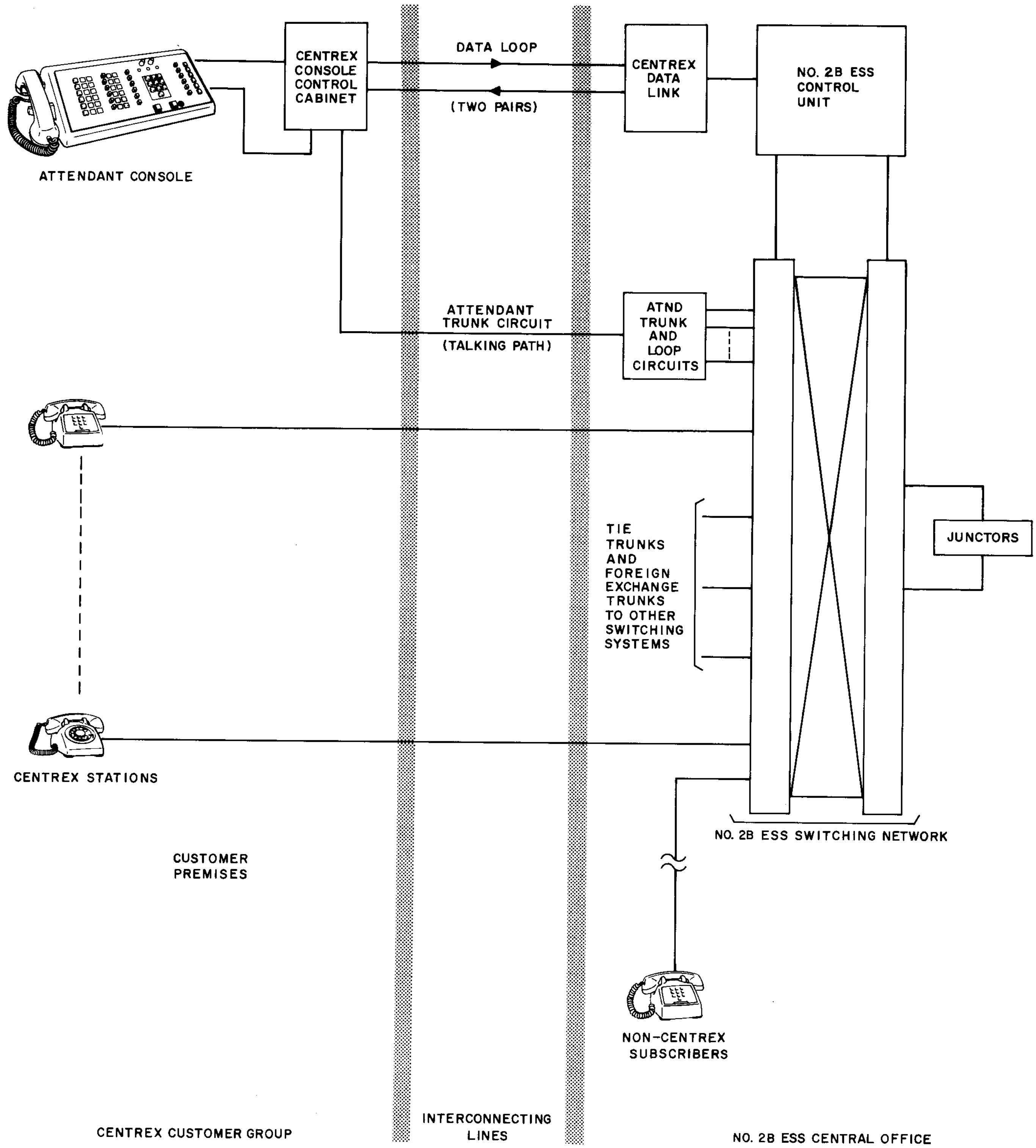


Fig. 4—No. 2B ESS Centrex System

ESS, is mainly concerned with the hardware aspects. System and software features are covered in Section 232-190-015.

1.11 Various design techniques used in the No. 2B ESS are:

- 1A and other current technology
- Semiconductor single store memory
- Microprogram control
- Functional concentration
- Time-shared control
- Modular design
- Plug-in equipment units
- Duplication of major units
- Automatic fault location and system reconfiguration
- Self checking of control units (CUs)
- Separate CU manual control and display
- Connectorization.

1.12 ***1A-Technology:*** This technology provides standardized logic gates using silicon integrated circuits (SIC), ceramic substrate mountings, packaging, and interconnections. These techniques enable the 3A CC to be small in size, economical in price, and execute at a cycle time of 150 nanoseconds.

1.13 ***Semiconductor Single Store Memory:*** The main memory of the CU is electrically alterable and duplicated and serves as a storage medium for generic program information, translations, and temporary call handling information. The main memory is an insulated gate field effect transistor (IGFET) design. A single store is capable of containing 256K words (where K = 1024). Up to four stores can be associated with each CU.

1.14 ***Microprogram Control:*** The internal sequencing of actions of the CU is controlled by a microprogram structure. Each instruction is performed by a sequence of microinstructions within the microprogram control. The microcycle time (time to perform one microinstruction) is 150 nanoseconds and main store (MAS) access time is 1.2 microseconds.

1.15 ***Functional Concentration:*** The system equipment is concentrated in a small number of highly efficient units, each specialized in some broad system function, such as control, input/output, and switching equipment, which provides the telephone and administrative functions of a local telephone office. Maintenance procedures are carried out by the stored program on a routine basis or when requested.

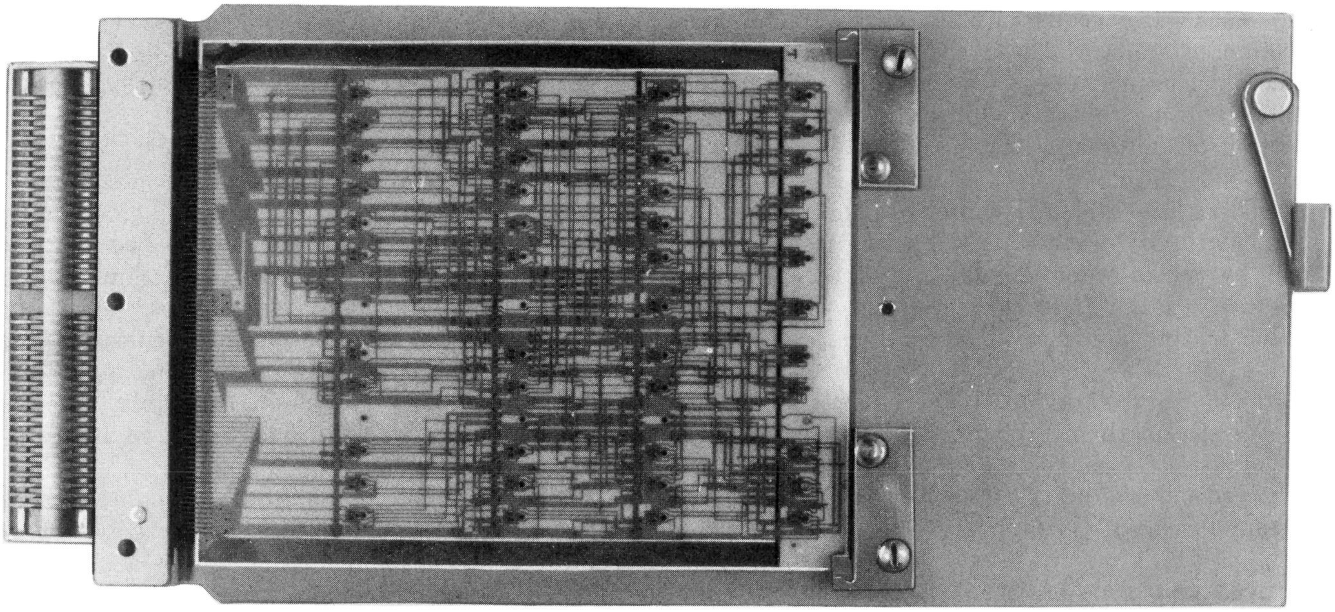
1.16 ***Time Shared Control:*** The on-line and off-line CUs operate asynchronously. The on-line CU controls the processing of all calls while the off-line CU is on standby. The on-line CU time shares processing of calls handled by the system. The CU has this capability since it operates at speeds much faster than the rate at which events associated with a single call occur. Call handling is accomplished by subdividing the work required to process a call into small segments interleaved with similar segments of work associated with other calls. Certain operations can be performed concurrently on behalf of a number of calls.

1.17 ***Modular Design:*** Traffic-dependent units are provided in modular blocks so that growth can be accommodated economically and conveniently.

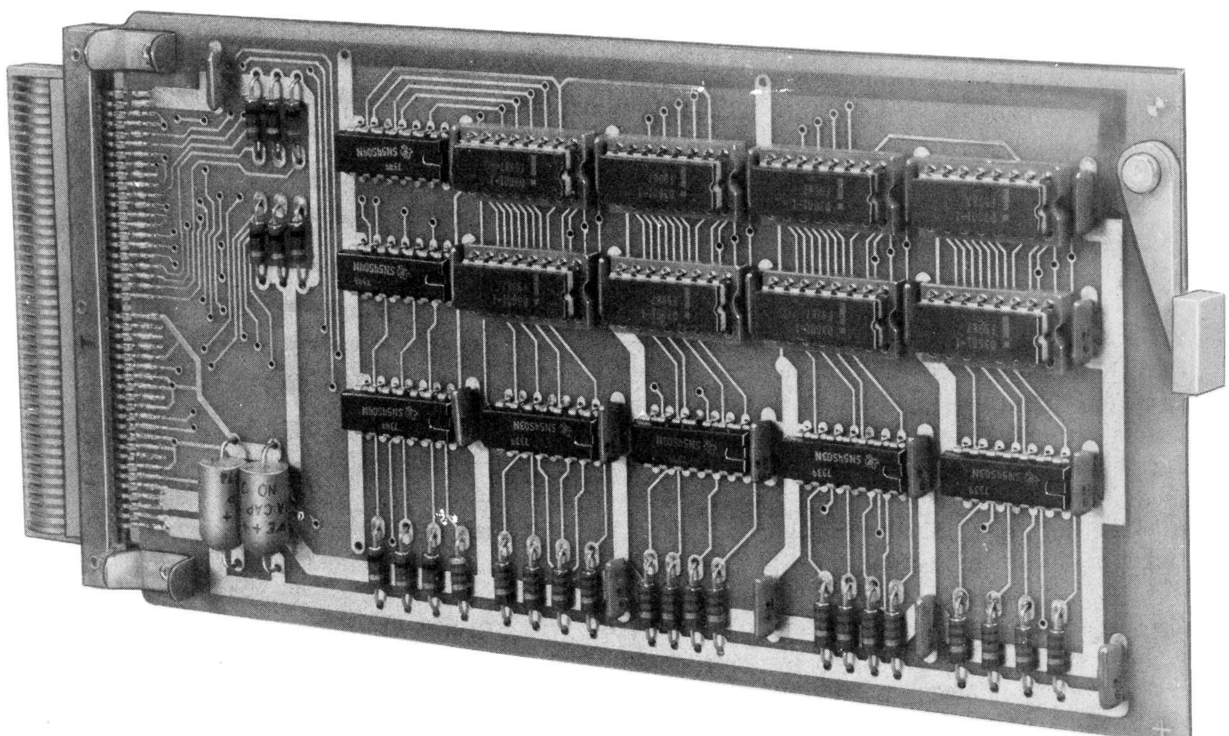
1.18 ***Plug-in Equipment:*** Many portions of the equipment and circuitry are mounted on circuit packs (Fig. 5) which are plug-in units with printed wiring. Faulty circuit packs can be quickly replaced.

1.19 ***Duplication:*** Major units are duplicated to ensure continuous operation and prevent service loss in the event of error or equipment failure. When a trouble condition is detected, the faulty unit is removed from service and the standby unit is placed in service.

1.20 ***Automatic Fault Location and System Reconfiguration:*** The No. 2B ESS provides extensive program and hardware facilities to detect system malfunctions. The faulty unit is automatically identified and taken out of service. A working system with the duplicate unit is reconfigured, and maintenance personnel are notified that a malfunction has occurred and are given the results of the diagnostic test.



A. FA-TYPE CERAMIC CIRCUIT PACK (PROTECTIVE COVER AND ENCAPSULATING MATERIAL REMOVED)



B. FC-TYPE CIRCUIT PACK

Fig. 5—Circuit Packs—Typical

1.21 ***Self-Checking Circuits:*** The 3A CC uses self-checking circuits to give immediate detection of faults. These circuits eliminate the need for synchronous operation and match comparison between two control units while still providing rapid detection of failures.

1.22 ***3A CC Manual Control and Display Panels:*** Each 3A CC has its own control panel by which maintenance personnel can gain access to the units under program control for off-line testing and manual operations.

1.23 ***Connectorization:*** To reduce the initial and growth installation intervals in No. 2B ESS, many of the connections between the processor and the peripheral units of the system are provided via connectorized cables.

FEATURES AND CAPABILITIES

A. Call Processing

1.24 The No. 2B ESS may be equipped with either the 2B-EF-1 or 2B-EF-2 generic program. Both programs provide many noncentrex custom calling features in addition to standard call processing. These programs provide single party service, multiparty service, private branch exchange (PBX) service, hotel-motel service, and message register service. Such custom calling features as call waiting, speed calling, call forwarding, and threeway calling are also included.

1.25 ***2B-EF-1 Generic Program:*** The No. 2B ESS equipped with the extended feature (EF-1) generic program provides all of the standard services and features as well as centrex service and a few additional features such as automatic identifier dialing (AIOD) and remote office test line (ROTL). The 2B-EF-1 generic feature is listed and defined in detail in Section 232-190-015.

1.26 ***2B-EF-2 Generic Program:*** The latest generic program which may be used in a No. 2B ESS is the extended feature (2B-EF-2) generic program. This program provides all of the services and features of the 2B-EF-1 generic program plus many additional features in addition to improved centrex service and international direct distance dialing (IDDD). Four additional features provided to centrex customers are simplified console attendant (50A CPS), call forwarding outside of the centrex group, do not disturb, and single digit dialing. In addition, the need for an operator on local overtime calls from a coin phone is eliminated. All of the features provided in the 2B-EF-2 generic program are listed in Section 232-190-015 along with a definition for each.

B. Maintenance

1.27 ***Common to All Generics:*** The programs have automatic fault detection, system recovery, and diagnostic capabilities. The fault detection system is based on both dedicated check circuits which constantly monitor the operational integrity of the system and trouble detecting programs which are run once every 24 hours.

1.28 Once a fault is detected, a trouble recovery program is called to control the system. If the fault is in an active CU, the CUs are switched and the faulty CU is inhibited. If the now active CU operates successfully, CU diagnostics are called up for the standby CU. If the standby CU passes all diagnostics, the trouble is assumed to be a transient error and an error counter is incremented. An excessive number of errors in a given time period results in programs being called which place the faulty CU in the standby mode. If a CU fault is detected in the standby CU, the standby CU is inhibited and CU diagnostics are run on it. If the trouble is a peripheral unit (PU) fault, the system will be directed to perform the same instruction again. If the system functions correctly on the second try, the fault is considered a transient error. If the system fails on the second try, the controllers are switched and the same instruction is attempted using the mate controller. If the system functions correctly using the mate controller, the original controller is removed from service. If the instruction cannot be performed correctly using the mate controller, the CUs are switched and the same instruction is attempted with the other CU. At the same time, the standby CU is made busy and diagnostic programs are run in the active CU. The results of the diagnostic program is a TTY printout which isolates the fault to as small an area as possible.

1.29 Major units of the 2B processor are duplicated to ensure continuous operation and prevent service loss in the event of error or equipment failure. When a trouble is detected, the faulty unit is removed from service and the standby unit is placed in service. The No. 2B ESS provides extensive program and hardware facilities to detect processor malfunctions. Self-checking circuits of the 3A CC give immediate detection of faults. These circuits eliminate the need for synchronous operation and match comparison between control units, while still providing rapid detection of failures. Since the 2B processor uses self-checking circuits, fault detection is adequate only as long as the check circuits work properly. A combination of hardware and software is used to ensure that the check circuits provide an indication when a fault occurs. Hardware provides a means of simulating test conditions or circuit faults. By appropriately setting up the test conditions and applying a well-designed test sequence, the detection circuitry is checked on a periodic basis to ensure its proper operation.

1.30 Although the 3A CC is designed to be as self-checking as possible, an overall system sanity check for both hardware and software is provided by the program timer. The use of the hardware timer is closely related to the system program. A reset is generated for the timer only if the program proceeds through the normal program loop correctly within the prescribed period. If the program deviates from the normal course, no reset is given. The timer automatically times out, stops processing, and starts the recovery process.

1.31 The long-term periodic exercises, which are run once every 24 hours, diagnose circuitry which is not normally checked by other detection methods. The 2B processor diagnostics use the "start small" philosophy. This means that a small portion of the machine is first diagnosed and if that portion of the machine operates properly, it can then be used for further diagnosis. As the diagnosis continues, the portion of the processor which has been checked increases until correct operation of the total processor is verified. In addition to the complete diagnostic test sequence, a test of CU switching is also performed. Peripheral unit exercises are also run every 24 hours in addition to the long-term periodic exercises. The following peripheral units are diagnosed in the sequence given under control of the Peripheral Unit Maintenance Monitor (PUMON) Program:

- Master and universal scanners
- Supplementary central pulse distributor
- Ringing and tone plants
- Recorded announcement machines
- Automatic message accounting frames
- Automatic identified outward dialing frames
- Attendant data link frames
- Networks
- Line scanners.

1.32 The automatic testing of trunk, junctor, service, and range extension circuits is administered by the Trunk and Service Circuit Test Monitor Program. This automatic testing will be performed every 24 hours as scheduled in the traffic work table (TWT). The automatic line insulation tests are also performed as scheduled in the TWT.

1.33 The ROTL feature allows interoffice trunk testing automatically from a centralized automatic reporting on trunks (CAROT) system. A No. 2B ESS office may operate as a near-end ROTL office or as a far-end ROTL office. A near-end office is necessary to perform trunk testing, but the incoming and 2-way trunks of the far-end office may be tested by CAROT via a near-end office. Refer to Section 232-132-101 for a detailed description of ROTL.

1.34 A trouble recovery program in conjunction with automatic circuits is used to obtain a working system whenever a fault is detected. If a fault is found in the on-line CU, the CUs are switched and the new off-line CU is inhibited from running programs.

1.35 Diagnostic programs are automatically called in after trouble detection and recovery has been completed or can be manually requested by a TTY input message. The 2B-EF-2 generic program has the same maintenance features as the 2B-EF-1 along with a few additional features.

1.36 ***2B-EF-2 Generic Program:*** The 2B-EF-2 generic program provides two additional maintenance features: one for testing E&M trunks to a No. 5 crossbar automatic call distribution (ACD) and one to aid the outside plant craft when they attempt to clear leakage and/or direct current foreign electromotive force (EMF) on subscriber loops. A detailed description of these features is provided in Section 232-190-015.

C. Administration

1.37 ***Common to All Generics:*** The administrative features provided in all No. 2B ESS offices consist of recent change (RC) programs, the capability of changing program store, plant measurements, and traffic measurements. The plant measurements and traffic measurements are made continually and printed out at prescribed intervals. The RC programs permit service orders describing service changes or new service requirements to be incorporated with the translations. In addition, some configuration changes can be incorporated by other RC messages. Thus, the system can provide immediate response to ever changing customer requirements.

1.38 The change in program store (CHIPS) program provides the capability to respond almost immediately to program changes by allowing changes to be written into main store. The ability to modify main store by using a CHIPS procedure permits the system to immediately incorporate generic program improvements without waiting for a generic update or an office data assembler (ODA) run. Hence, whenever a small software design improvement is made, the information can be disseminated via a broadcast warning message (BWM) and then incorporated in program store by the CHIPS procedure.

1.39 Plant measurements are maintained for each office. These involve both service measurements to reflect actual effects on service as seen by the customer (for example, total customer receiver timeouts) and performance measurements to reflect the basic health of the system. Performance measurements include such items as failure and error counts of various pieces of equipment. These measurements are useful in identifying areas where additional maintenance effort appears justified.

1.40 Traffic measurements are made throughout all phases of the call processing programs and are recorded in call store. This traffic data is printed out on the TTY on the quarter hour, hourly, daily, and weekly schedules or on demand. Various combinations of the three basic types of measurements (peg counts, usage, and overflow) are performed in such areas as networks, junctors, service circuits, trunks, and various other call processing counts. When this data indicates a need for relatively minor reconfigurations without hardware additions, translations can be changed by local RC procedures. In other cases, an ODA run may be required.

1.41 ***2B-EF-2 Generic Program:*** The 2B-EF-2 generic program provides a few improvements in traffic measurements and in the RC area. The administrative features available in the 2B-EF-1 generic program are included in the 2B-EF-2 generic program.

1.42 One of the improvements in the traffic measurement area consists of being able to get a TTY printout automatically or on request, which provides the number of trunks and service circuits assigned in each trunk group. In the past, office records had to be consulted for this information. In addition, traffic registers are provided for the following:

- Overflow measurements on up to four centrex lines
- First try failures to find a path for connecting an incoming trunk to a line
- First try failures to connect an incoming trunk to an outgoing trunk.

Another improvement is the addition of overflow registers for base and service measurement (BSM) counters of the plant measurement schedule. A detailed list of all the new traffic and RC features in the 2B-EF-2 generic program is provided in Section 232-190-015.

1.43 One of the new RC features is the ability to input a TTY message which will result in a TTY printout of the total number of spare 2-word, 4-word, 6-word, and 8-word expansion blocks in translations. The 2B-EF-2 generic program also gives the central office craft the capability of adding trunks and service circuits using a combination of help messages and manual procedures.

1.44 The EF-2 generic program was written to accept service order codes which are standard for all electronic switching systems. These service order codes consist of a maximum of four alphanumeric characters to be used for mnemonics. A No. 2B ESS can be arranged to accept and print either the old or the new (standard) codes.

SYSTEM COMPONENTS

1.45 The general equipment makeup of a No. 2B ESS system is categorized as follows:

- 2B Processor
- Peripheral communications bus system
- Peripheral equipment.

2. 2B PROCESSOR

2.01 The 2B processor is made up of the processor frame, two supplementary store frames, and the 2B maintenance frame.

PROCESSOR FRAME

2.02 The processor frame is a 2-bay frame which is 4 feet and 4 inches wide. Each bay contains the following equipment (Fig. 6):

- 3A central control (3A CC)
- Input/output (I/O) control circuit
- Main store (MAS)
- Power unit.

A. 3A Central Control

2.03 The 3A CC (Fig. 7) is a switching central control unit designed for electronic switching systems. The 3A CC contains all the necessary logic required to direct and control the processing and handling of data within the No. 2B ESS. One 3A CC always has active control over the system while the other 3A CC operates asynchronously in a standby mode. A 3A CC and its associated memory and I/O unit form a single switchable entity. Therefore, each 3A CC is a separate and complete unit capable of controlling the peripherals and system actions. The on-line 3A CC keeps both the on-line and standby memory up to date so that the standby 3A CC can assume control of the system as required.

2.04 The 3A CC is 23-1/2 inches wide, 12 inches high, and approximately 14 inches deep. Basically, it consists of a logic unit and front control panel. The logic unit contains the circuit packs and associated wiring. The control panel is hinged to one side of the logic unit for easy access to the circuit packs within (Fig. 8).

2.05 The 3A CC control panel (Fig. 7) consists of a 12-inch by 23-1/2 inch plastic panel, silk-screened black with the appropriate nomenclature. The panel includes the following apparatus:

(a) 3A CC status indicator lamps and switches

(b) Light emitting diodes (LEDs) which display the data or address of the memory or register

(c) Register select switches for loading or displaying purposes

(d) Switches for selecting a particular manual function.

2.06 All interconnections between the 3A CC and other units (except for relay and power units) are accomplished by one of two types of cabling techniques (Fig. 9). The first type of cable is a 30-gauge, 31-conductor flat ribbon cable which uses a paddleboard assembly at each end; the second consists of coaxial cable which may use a conductor and paddleboard assembly at each end or a standard coax connector.

2.07 The functional units within the 3A CC (Fig. 10) that enable it to perform its primary function are as follows:

(a) System Clock: The system clock provides the timing pulses for the system.

(b) 3A CC registers: The registers provide a quick access storage medium for storing data being used in the current processing operation. They also provide control and status information for system states, interrupts, and errors.

(c) Microprogram control: The microprogram control is the center of the 3A CC operation. It directs and controls the operations of the 3A CC by use of sequences of microinstructions.

(d) Data manipulation logic (DML): The DML is the section in which arithmetic and logic operations are performed upon one or two operands. This section is duplicated and matched within the 3A CC. All parity generation is done through this circuit.

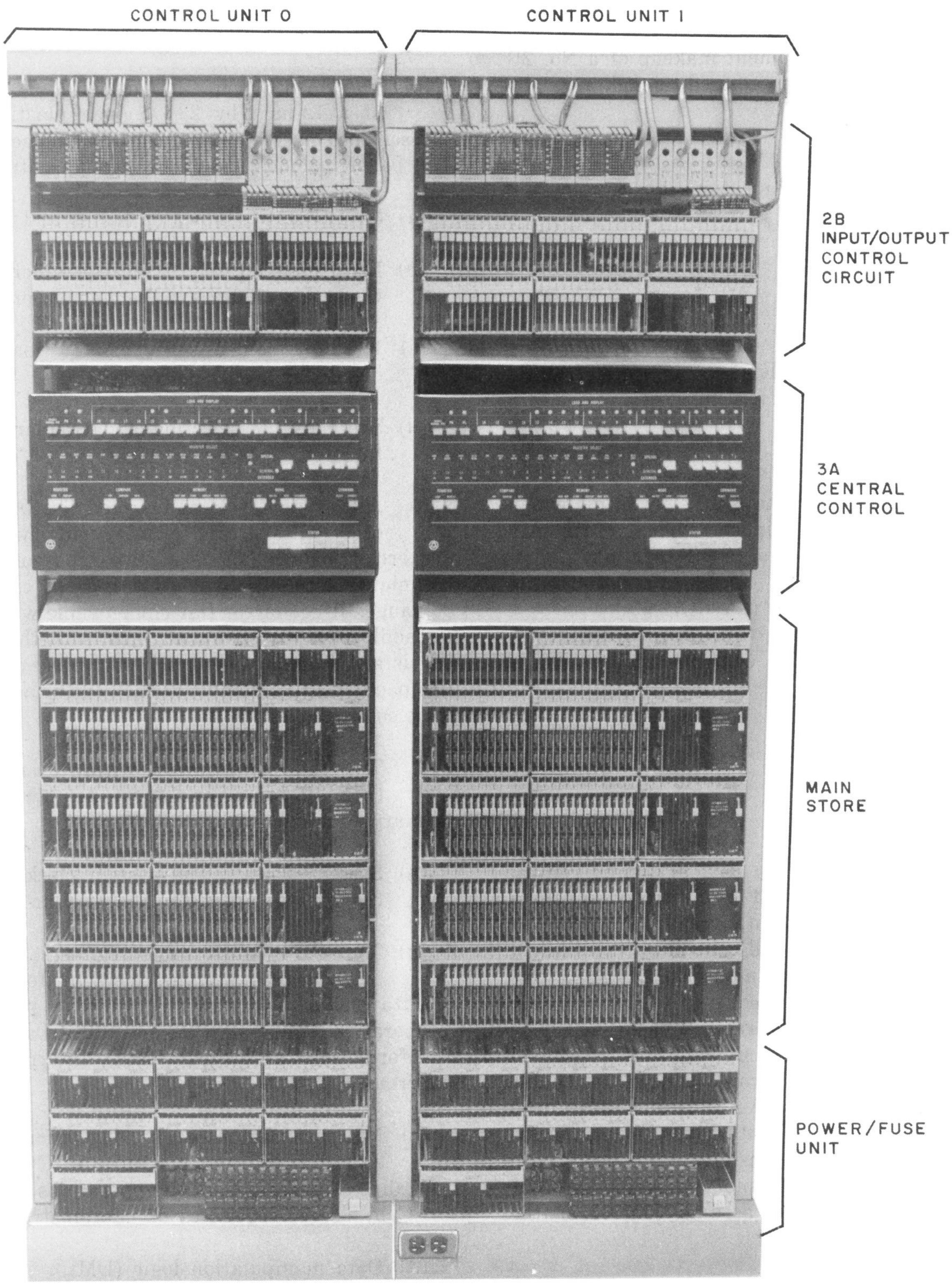


Fig. 6—No. 2B ESS Processor Frame

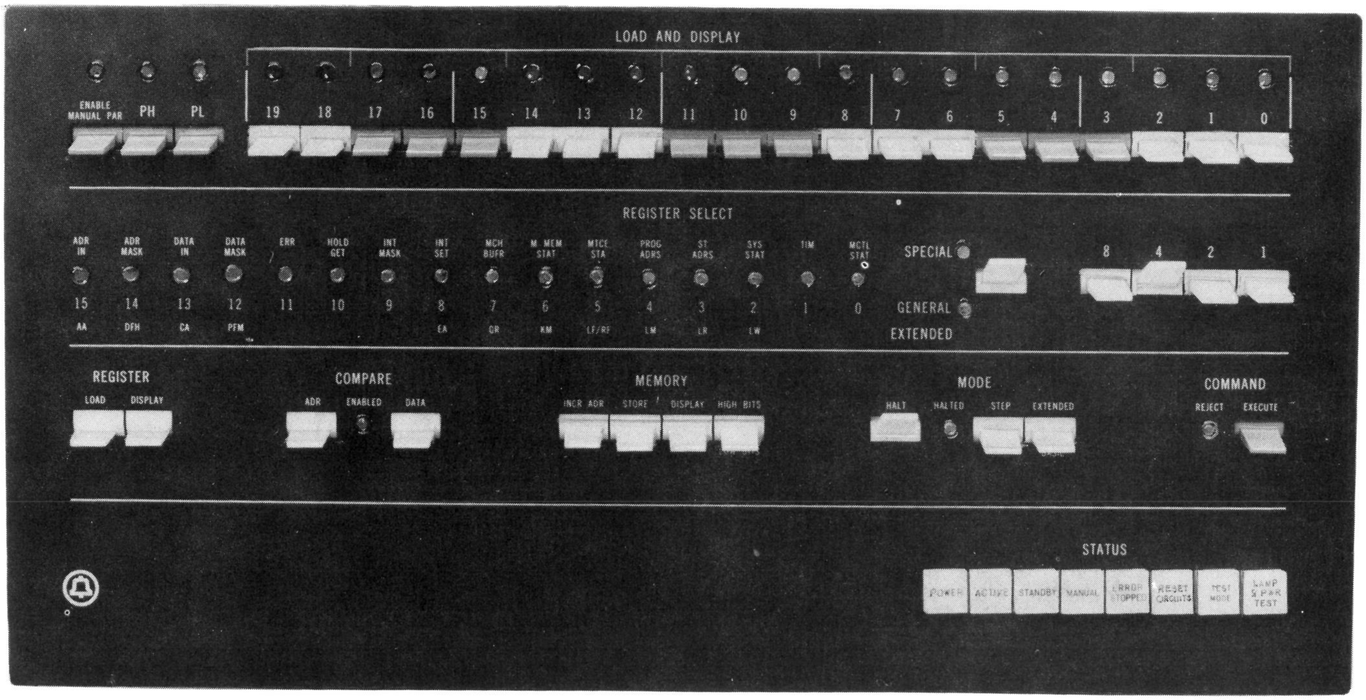


Fig. 7—3A Central Control Unit

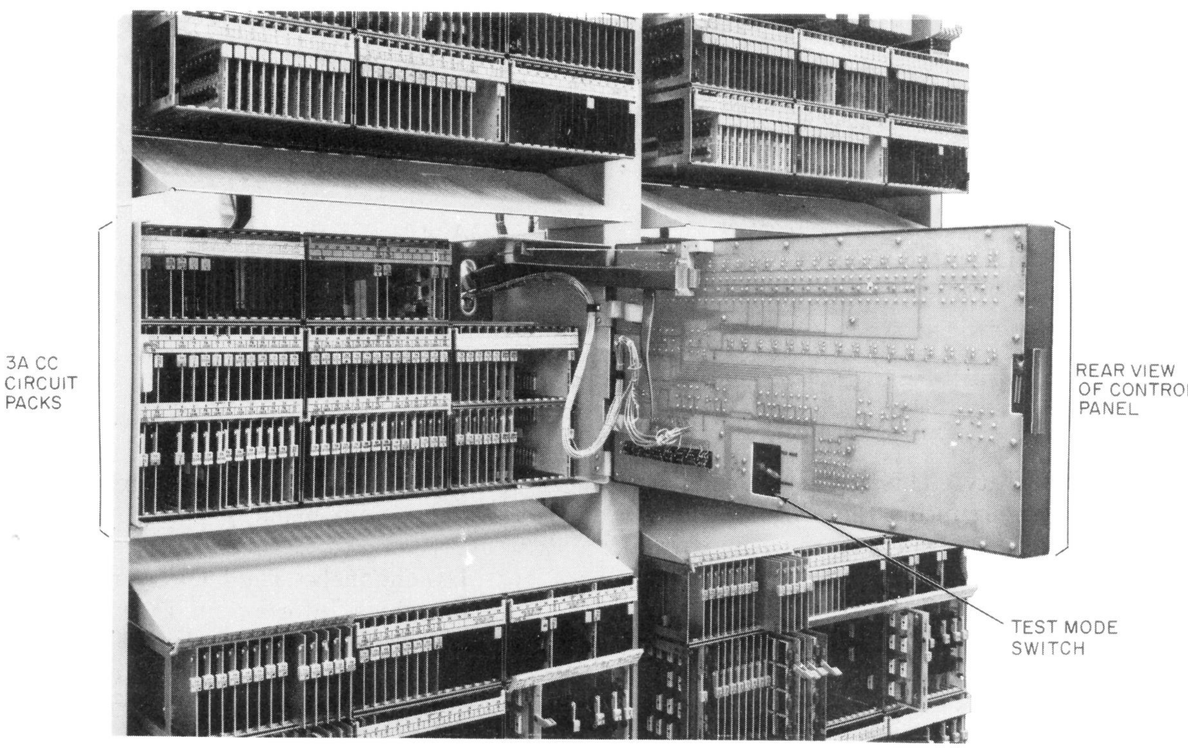
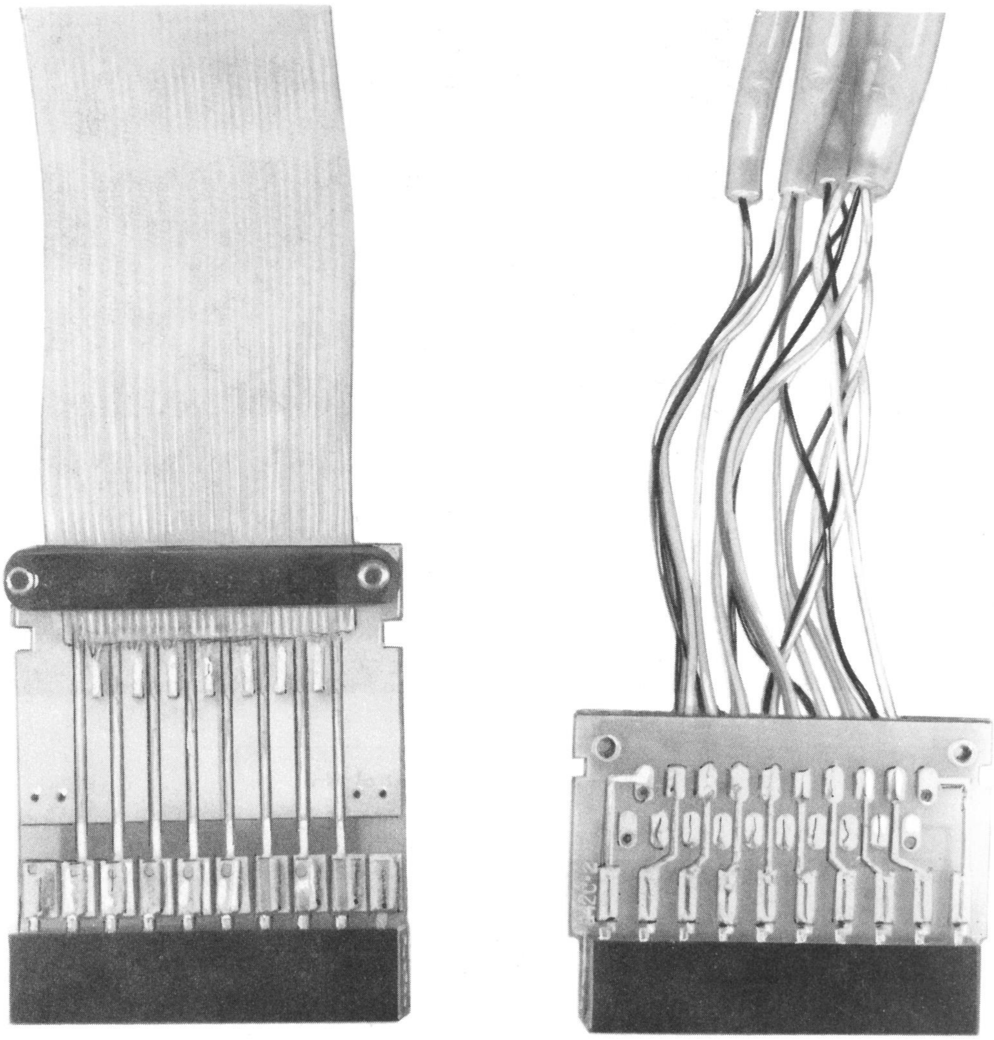


Fig. 8—3A Central Control Unit, Control Panel Open



31-CONDUCTOR RIBBON CABLE AND PADDLEBOARD CONNECTOR

COAXIAL CABLES AND PADDLEBOARD CONNECTOR

Fig. 9—Cabling and Connectors

(e) Interrupt facility: This facility provides the means for interrupting the program flow so that a timed task may be performed or so that some corrective maintenance action may be taken. There is also a utility interrupt and a panel interrupt and others may be added in the future. The 2B uses a 5 ms interrupt to drive both 5 and 25 ms I/O programs. The maintenance interrupts are initiated by control unit errors.

(f) Main memory control: The main memory sequencer is the 3A CC control interface by which information is transmitted to or received from the main memory.

(g) I/O channels: The I/O channels are a means by which information is transmitted to or received by the units of the 2B processor. The information may be transmitted serially over one of the 20 main channels. Two of the possible 20 main channel codes are assigned to the 2B I/O control circuit which transmits to the peripheral units in parallel. The 2B I/O control circuit is not a part of the 3A CC and will be covered separately as a part of the control unit.

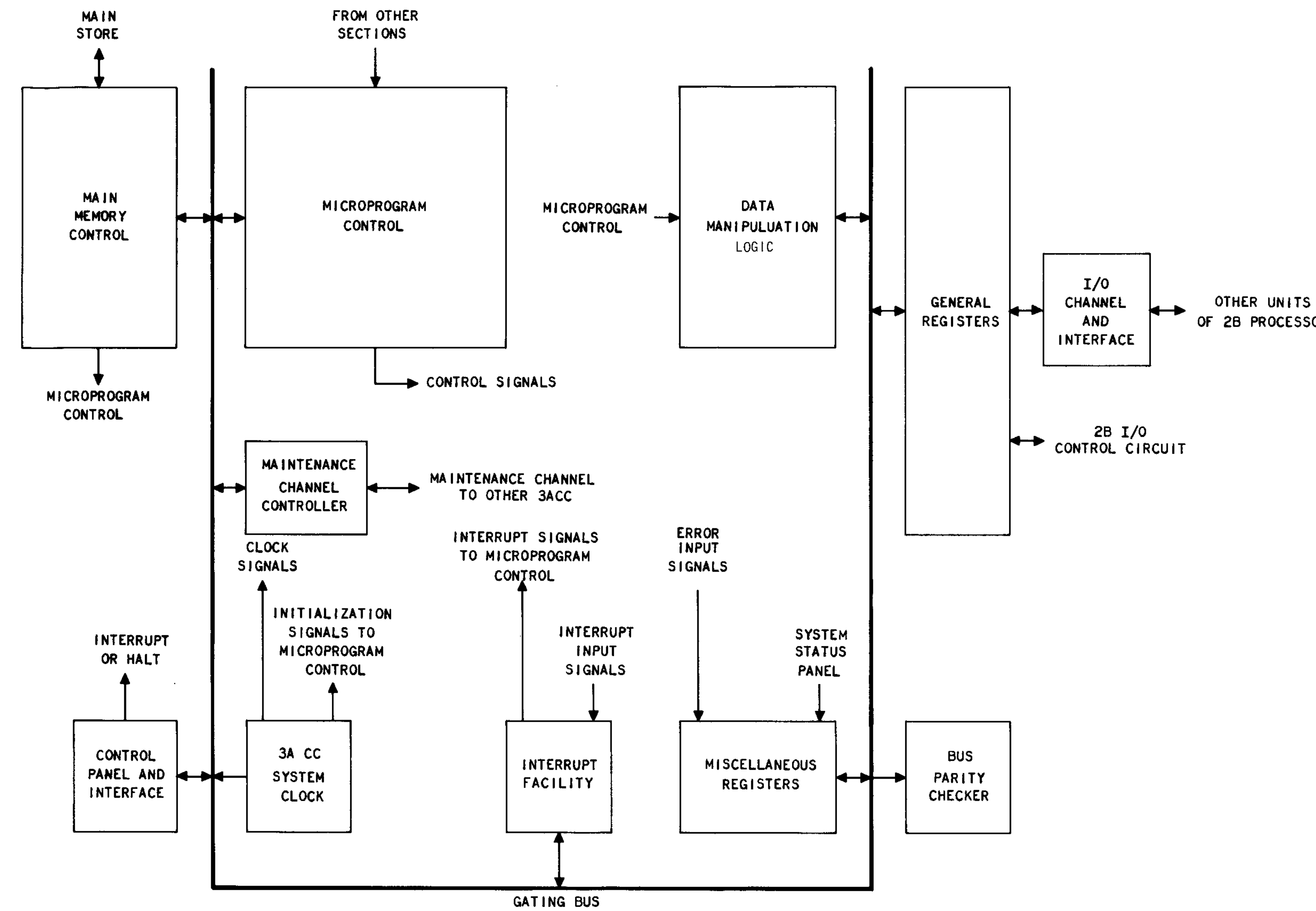


Fig. 10—Block Diagram of 3A Central Control

(h) Maintenance channel: The maintenance channel (MCH) provides the main source of communication between the 3A CCs for diagnostic and switching purposes.

(i) 3A CC control panel: The 3A CC control panel provides a manual means for communication between the maintenance personnel and the 3A CC to aid diagnostics and troubleshooting.

(j) Gating bus parity checker: The gating bus is the communication path over which information is transferred from register to register within the 3A CC. The bus parity checker tests the parity of the information placed on the data bus and fires an error signal if correct (odd) parity is not detected.

Microprogram Control

2.08 The internal sequencing of actions is controlled by a microprogram structure which results in a highly flexible means of implementing the instruction set and basic control functions. Each instruction which is read from main store is performed by a sequence of microinstructions within the microprogram control. The sequence of microinstructions performs various functions such as gating between registers, data manipulation, sending of control signals, etc, which are necessary to interpret and execute the instruction fetched from program store.

I/O Channels

2.09 The I/O channels are covered here in more detail because they provide the communication link between the 3A CC and the other units of the 2B processor. The I/O channels of the 3A CC are an asynchronous, semiautonomous data transfer system. This system performs serial ac data transfers at a bit rate of 6.67 megabits per second.

2.10 A maximum of 20 main channels may be provided with the 3A CC. Each main channel is identical to and operates independently of the other main channels. Each of the 20 main channels has a 20 subchannel capacity.

2.11 An I/O subchannel consists of a dedicated cable driver and a dedicated cable receiver. Each subchannel has a unique identification code within its associated main channel so that a particular one of the 20 subchannels may be activated. Only one of the 20 subchannels of a group can be active at a given time since they share the common control and sequencing logic of their main channel. More than one subchannel may be operated at a given time provided that the particular subchannels are located within different main channels.

2.12 An I/O subchannel is provided to each MAS controller, tape data controller (TDC), TTY controller and the system status panel controller (Fig. 11). The I/O subchannel from the 3A CC of the same control unit as the main memory has priority over the I/O subchannel from the duplicate 3A CC in controlling that memory.

Maintenance Channel

2.13 The MCH (Fig. 12) is elaborated on at this point because it interconnects and provides the main source of communication between the duplicated 3A CCs. It is a serial high-speed (6.67 MHz) data transfer system capable of transmitting a 30-bit message comprised of a 20-bit data field, two parity bits, and an 8-bit control field. The MCH controller contains the necessary sequence logic to execute the control function indicated by the control field contents. The result of these operations may be returned to the controlling processor via subsequent MCH transmissions for analysis. In this manner diagnostic routines may be executed under external control using the 3A CC microcontrol logic. By using this facility the MCH may cause execution of certain segments of 3A CC microcode and verify its correct operation.

2.14 The MCH may also execute microinstructions independent of the microstore by loading these instructions one at a time directly into the microcontrol logic. This ability allows certain diagnostic routines to be independent of the microstore contents.

2.15 Transmissions may be initiated by either of the 3A CCs independent of their on-line/off-line status. No fixed priorities exist, and the transmission link is seized on a first-come, first-served basis. The two MCH controllers are ac coupled to provide isolation, thereby preventing hard faults in one processor from affecting the other. These controllers operate asynchronously, deriving the necessary clocking directly from the incoming data message. A certain amount of error checking is integrated into the design of the MCH, and parity is preserved in the transmitted message.

2.16 The MCH also has the responsibility to initiate an automatic transmission if a fatal error is encountered within the 3A CC. This transmission results in the stand-by processor coming on-line to take over the call processing responsibility.

B. 2B Input/Output Control Circuit

2.17 The 2B input/output (I/O) control circuit performs the interfacing function between the new high-speed processor and the relatively low-speed peripheral equipment (Fig. 13). The I/O control circuit is the buffer circuit through which inputs are received into the processor and from which outputs are transmitted to the peripheral equipment. Most functions performed by the I/O control circuit are initiated by microprogram control leads from the 3A CC.

Communication Links to the Peripheral Units

2.18 Communication between the peripheral equipment is via the peripheral unit address bus (PUAB), the scanner answer (SA) bus, the central pulse distributor (CPD), the dial pulse timing bus, and the data timing bus (Fig. 13). The communication buses will be discussed in more detail in Part 3.

2.19 The CPD is an integral part of the 2B I/O control circuit and is directly controlled by input/output registers and control signals from the 3A CC. Signals from the CPD are used for:

- Selecting and enabling a peripheral unit to receive information from the output bus (PUAB)
- Communicating with a shift register device (peripheral decoder circuit) via a stream of positive and negative pulses.

There are up to 512 bipolar output points in the 2B I/O control circuit.

2.20 The CPD is used to perform either enabling or signaling. Many of the peripheral units receive their orders from the 2B I/O control circuit over a common bus system, the PUAB. Enabling pulses from the CPD are used to direct a particular peripheral unit to receive the information appearing on the PUAB. The enabling signal must be sent to a particular peripheral unit simultaneously with the data on the PUAB.

2.21 Signaling directly from the CPD (Fig. 14) is accomplished by sending bipolar outputs over single output pairs. These bipolar outputs can be used to load shift register circuits such as the peripheral decoders or network controllers.

2.22 A matrix CPD arrangement is employed to drive the 512 bipolar CPD points. A pair of 1-out-of-32 point 1A logic translators controls 32 horizontal and 32 vertical matrix driver circuits. The CPD matrix contains 512 transformers, each with a load resistor and a pair of selection diodes. A combination of digital and analog check circuits are used in order to make the CPD self-checking and easily diagnosable.

2.23 When more than 512 bipolar output points are required, supplementary CPD (SCPD) frames (Fig. 15) can be added to control peripheral decoders. Each SCPD frame contains 512 bipolar SCPD points. CPD and SCPD points are individually connected via dedicated pairs to the points controlled.

Communication Links to 3A CC

2.24 The 3A CC has nine miscellaneous decoder control signals, sixteen control leads and three general purpose registers (R9, R10, and R11) associated with I/O operations (see Fig. 13). The miscellaneous decoder signals are generated by the microprogram instructions in the 3A CC. These control signals are used in the I/O control circuit to enable gating paths to or from control registers in the I/O, set or reset registers, or initiate the execution of CPD and PUA pulses. The control leads include the 3A CC system clock phases, a 1.25 ms interrupt signal, I/O control circuit error checking information for the CU, and leads which determine if the I/O control circuit is on-line or off-line.

2.25 Register R9 enables access to the 2B I/O control circuit when loaded with the appropriate 3/6 selection code. Register R10 is used to buffer information from the 3A CC to the I/O control circuit. Register R11 is used to buffer information from the I/O control circuit. These three registers (R9, R10, and R11) can be loaded and read under control of either the microprogram or main store program.

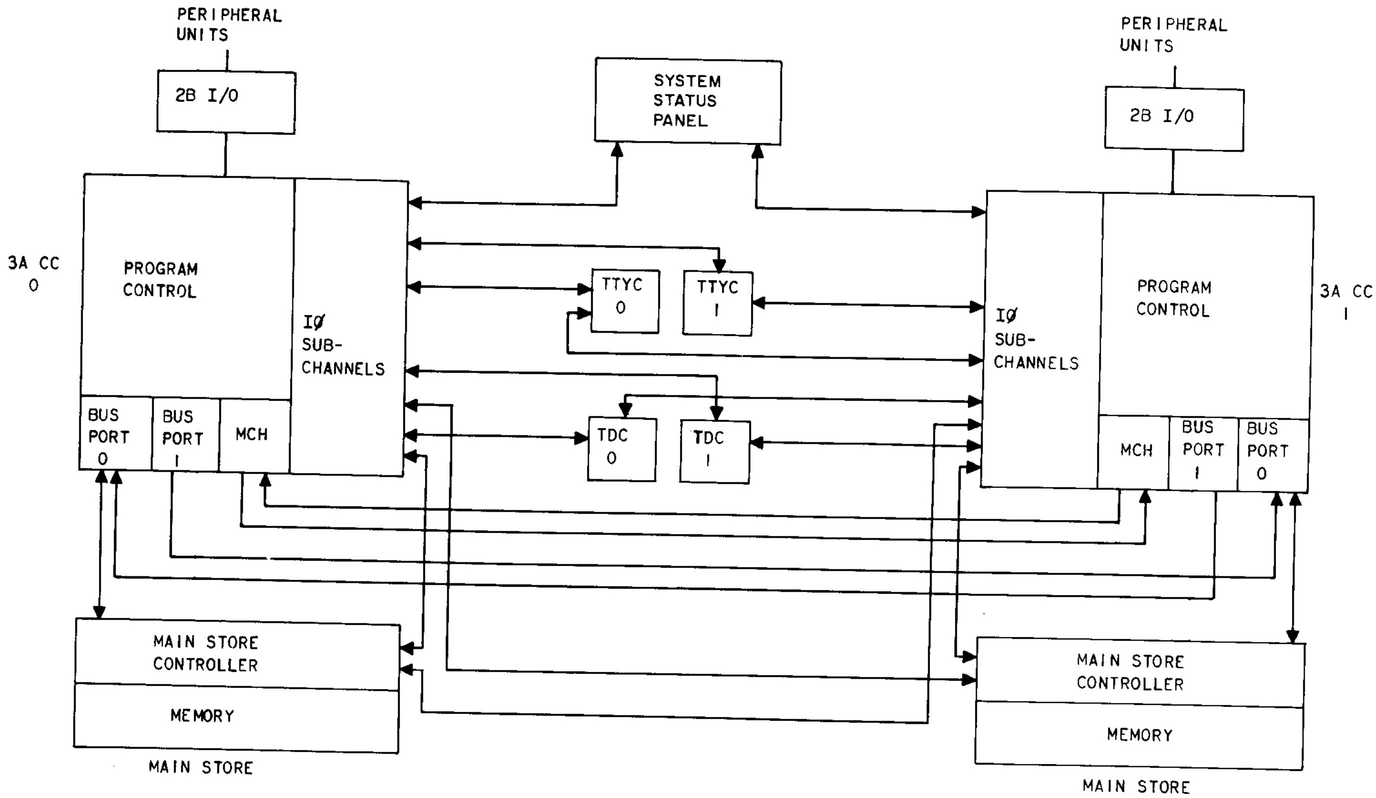


Fig. 11—Block Diagram of 2B Processor Illustrating 3A CC I/O Subchannel Interface

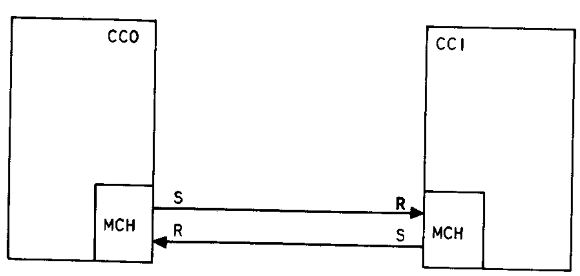


Fig. 12—Maintenance Channel Interconnection

C. Main Store

2.26 The main store (MAS) is the means of storage for the program instructions and temporary memory used by the 3A CC to direct the control system actions (see Fig. 6). The main memory of each 3A CC is composed of at least one main store. Two types of memory are used in the 3A CC. The original memory uses a 4K memory chip and the new memory uses a 16K memory chip. The 4K memory store contains a main store controller (MASC) and up to four main store memory units (MASM) for a maximum of 256K words of storage (where K = 1024 words). This memory is growable in increments of 32K words by the addition of a memory module. The 16K memory contains a MASC and memory unit with 256K words of storage growable in increments of 128K. Supplementary memory frames will allow the main store to grow to one million words of memory if needed.

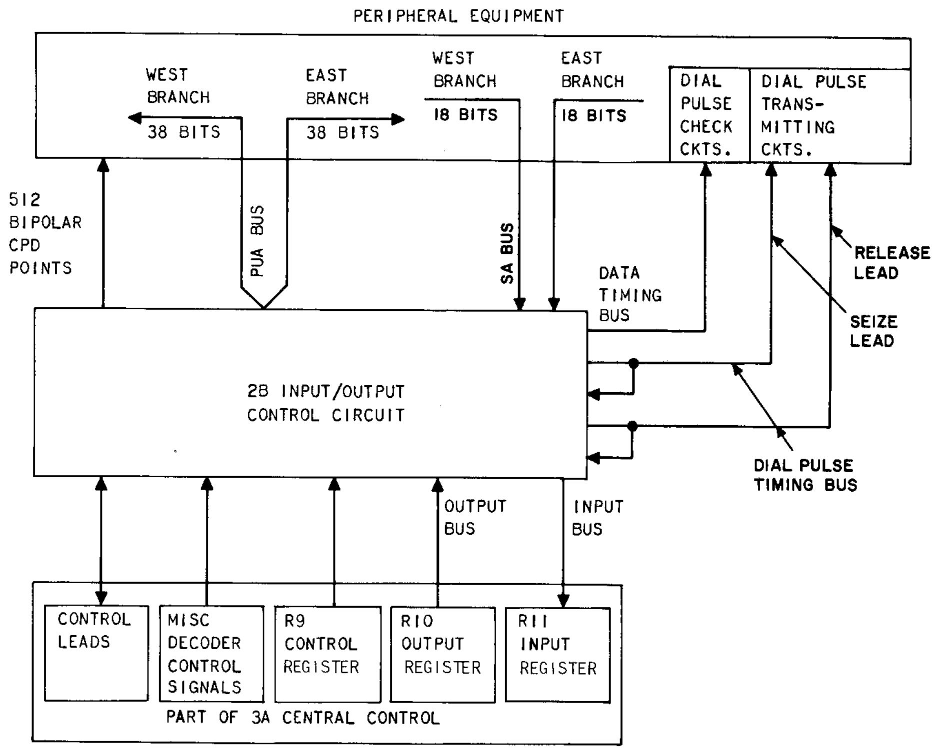


Fig. 13—Simplified 2B I/O Control Circuit Bus Connections

2.27 The main memory is divided functionally into the following areas:

- The program store which contains the generic program, office parameter, and translation data
- The call store which is used by the 3A CC as a means of storage for transitory data.

2.28 The main memory is a dynamic, volatile semiconductor type of storage. Dynamic means that the memory is not permanent and must be refreshed at defined intervals (2 ms) to preserve the stored information. Volatile means that power is required to retain the store information. If a total power failure occurs, a "bootstrap" operation can be performed to reload the information into the MAS from the backup tape system.

Memory Cell

2.29 The insulated-gate-field-effect transistor (IGFET) is used in the memory cell of the main memory. The IGFET is a field effect transistor whose gate is insulated from the semiconductor by a thin intervening layer of insulator. Memory information is stored as the presence or absence of electrical charges on the parasitic capacitance of IGFET memory cells. Memory cells require periodic refreshing to maintain this electrical charge and ensure the integrity of the data. Refresh cycles are interspersed between normal MAS cycles on a periodic basis.

2.30 Three cycles are associated with the memory cell as follows:

- Read cycle

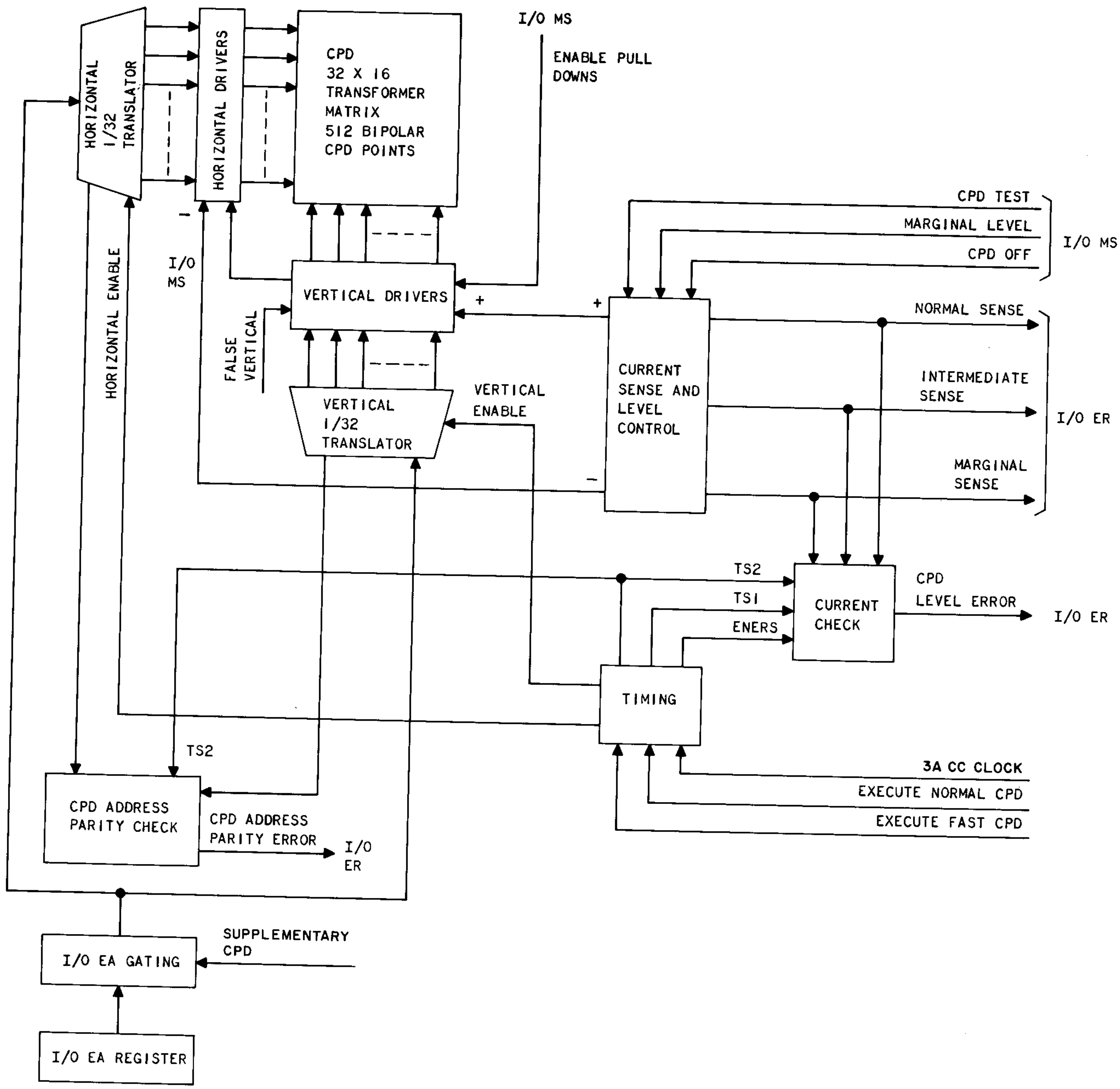


Fig. 14—Central Pulse Distributor

- Write cycle
- Refresh cycle.

Reading a memory cell involves determining whether the parasitic capacitor is charged. Writing into a memory cell is accomplished by either storing or removing a charge on the capacitor. A memory cell must be refreshed on a periodic basis since the capacitor will eventually discharge to a point that the stored information is lost. During a refresh cycle, the information read from a memory cell is automatically inserted back into that memory cell. A refresh is also automatically performed on read operations.

2.31 Program instructions and temporary memory are stored in a 26-bit word which consists

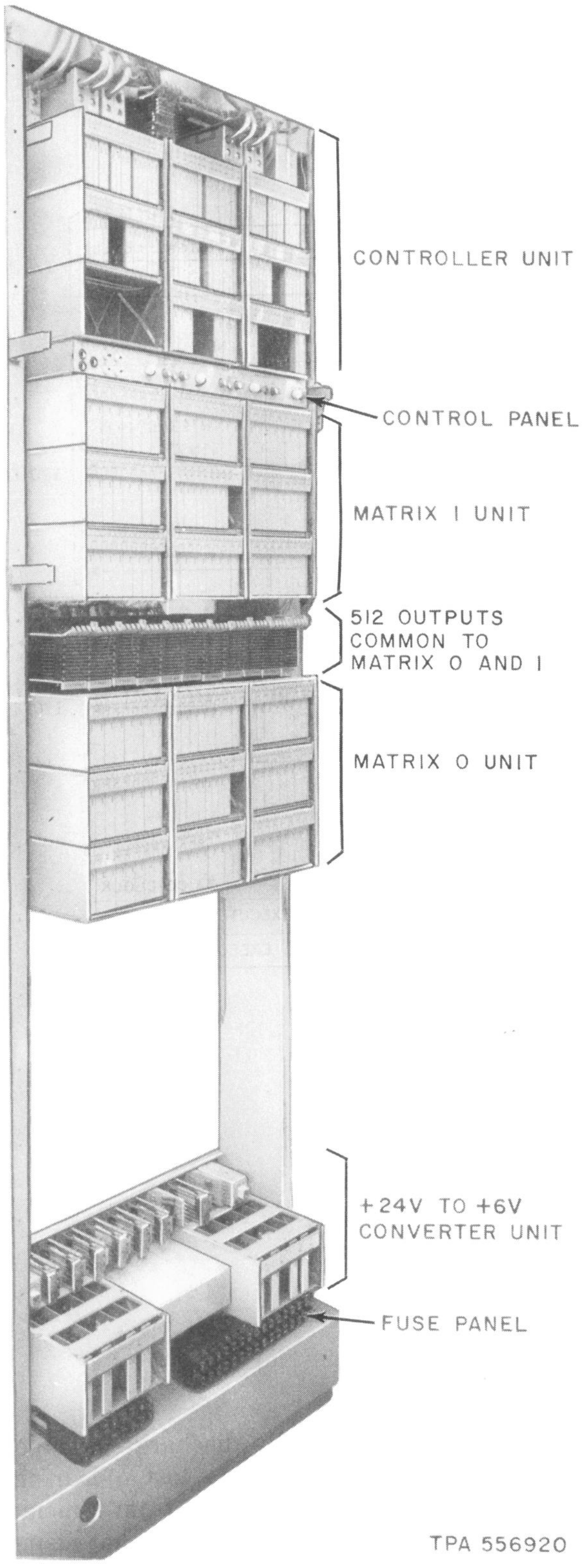


Fig. 15—Supplementary Central Pulse Distributor Frame

of 24-data bits and 2-parity bits (Fig. 16). The low parity bit (PL) provides parity for bits 0 through 7 and 16 through 19. The high parity bit (PH) provides parity for bits 8 through 15 and 20 through 23.

2.32 The MASC serves as the interface between the 3A CC and the MAS memory units. The MASC is composed of twenty circuit packs, thirteen bit-sliced boards (BSB), one timing board (TB), two check boards (CHKBA and CHKBB), two maintenance boards (MTCBA and MTCBB), one command board (CMDB), and one clock board (CKB). For more detailed information on the 2B main store refer to Section 232-309-103.

Main Store Bus

2.33 The primary means of communication between the 3A CC and the MAS is the MAS bus. The MAS bus is a dc coupled bus over which the read or write operation is performed by the 3A CC in an asynchronous mode.

2.34 The 3A CC and the MASs are series connected by the MAS bus (Fig. 17). Each MAS has a bus repeater to relay the information on to the next MAS via the MAS bus. A cross-coupling mechanism is used to allow the on-line 3A CC to communicate with the off-line store. This makes it possible to keep both stores updated.

2.35 The MAS bus is made up of 63 leads. The address portion of the bus is unidirectional while the data portion is bidirectional. The address portion defines the location at which the operation is to be performed. The data portion of the bus supplies either the 3A CC with the information read from memory or the MAS controller with the information to be loaded into a memory location. The address and data leads are bit-sliced so that the parity bits provide adequate error detection. The main memory sequencer in the 3A CC is not bit-sliced, so the commands sent to the memory are encoded in 2-out-of-4 codes to provide more extensive error detection.

D. Frame Power Unit

2.36 The power unit contains the dc-to-dc converters necessary to convert the -48 volts input to +3 volts at 8 amps and +5 volts at 4 amps. The +3 volt and +5 volt sources are required by the 3A CC. The main store and 2B I/O control circuit

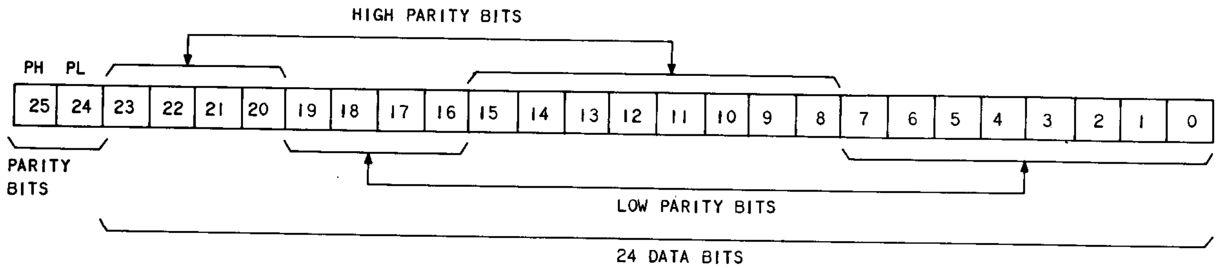


Fig. 16—26-Bit Data Word Layout

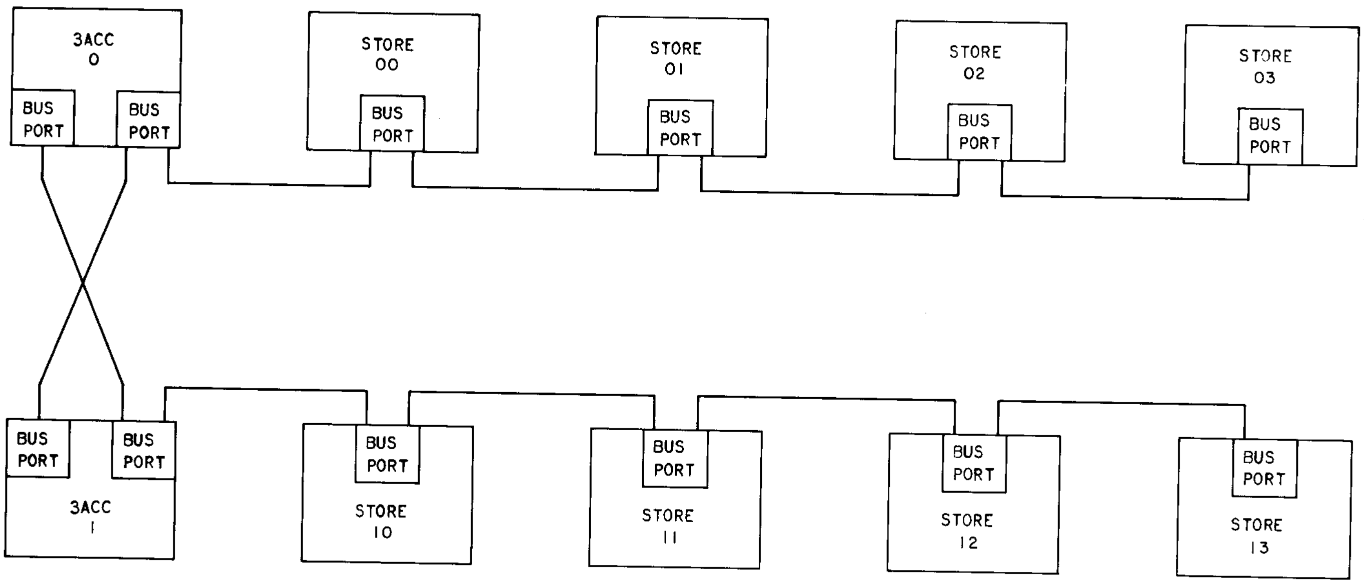


Fig. 17—Main Store Bus System

power converters reside in their own units but are fused at the frame power unit.

2.37 Power is supplied to the frame from a power distributing frame. A triple power feeder feeds +24 volts, -48 volts, and ground. The power feeders are connected to cables which run through the hollow frame uprights to the base of the frame. The filters in the base of the frame filter the 24-volt supply while the 48-volt supply is filtered by the converters. Cables connect the filters to the fuse panel providing fusing and power to all units in the frame and the fuse alarm circuitry.

SUPPLEMENTARY MAIN STORE FRAME

2.38 The supplementary main store (SMAS) frame is a single bay frame, 7 feet high and 2 feet 2 inches wide. Two SMASs are provided in an office when more than 256K of memory is needed. The SMAS contains up to three MASs and a power unit.

A. Main Store

2.39 Main stores must be added in pairs with one dedicated to each 3A CC. A maximum of three additional MASs may be connected to an existing 3A CC-MAS. Supplementary store frame

0 houses MASs 01 and 02 dedicated to 3A CC 0. The third MAS (MAS 03) can be added only when the second and third MASs are 16K chip configurations. When the 16K-bit chip configuration is used, three MASs may be added. Supplementary store frame 1 houses MASs 11 and 12 dedicated to 3A CC 1. The third MAS in frame 1 can be added only when the second and third MASs are 16K chip configurations. For possible MAS combinations, see Fig. 18 and Table A.

B. Power Unit

2.40 The power unit located near the bottom of the frame provides +5 volts to the connectors of the main store units. The power unit also contains fuse blocks which provide fusing and power to the frame units and the fuse alarm circuits. High- and low-voltage automatic shutdown and alarms (such as major, minor, and no power alarms) are provided within the power unit.

2B MAINTENANCE FRAME

2.41 The 2B maintenance (MTCE) frame provides the interface between the maintenance personnel and the system. The maintenance personnel can access and control the system through the TTY and the system status panel. The MTCE frame also provides a backup image of the program and translation data on the tape data controller (TDC) unit.

2.42 The MTCE frame (Fig. 19) is a single bay frame and contains the following equipment:

- Maintenance TTY
- Up to four TTY controllers
- Maintenance logic unit
- Maintenance relay unit
- Two TDC units
- Power unit
- Optional E2A telemetry unit.

A. Maintenance Teletypewriter

2.43 The primary means of communication between the maintenance personnel and the 3A CC is the MTCE TTY. The maintenance personnel can request via TTY input messages specific actions to be performed by the system. In reply to these input messages, the system acts on the requests and reports on the actions completed. The system reports on the actions through TTY printouts and lamp indicators on the system status panel.

B. TTY Controller

2.44 The purpose of the TTY controller (TTYC) is to provide a controlling interface between the 3A CC and the TTY for system maintenance and a variety of administrative tasks. The controller connects the 3A CC and up to four TTY ports in a hub arrangement whereby signals from any one are seen by the others.

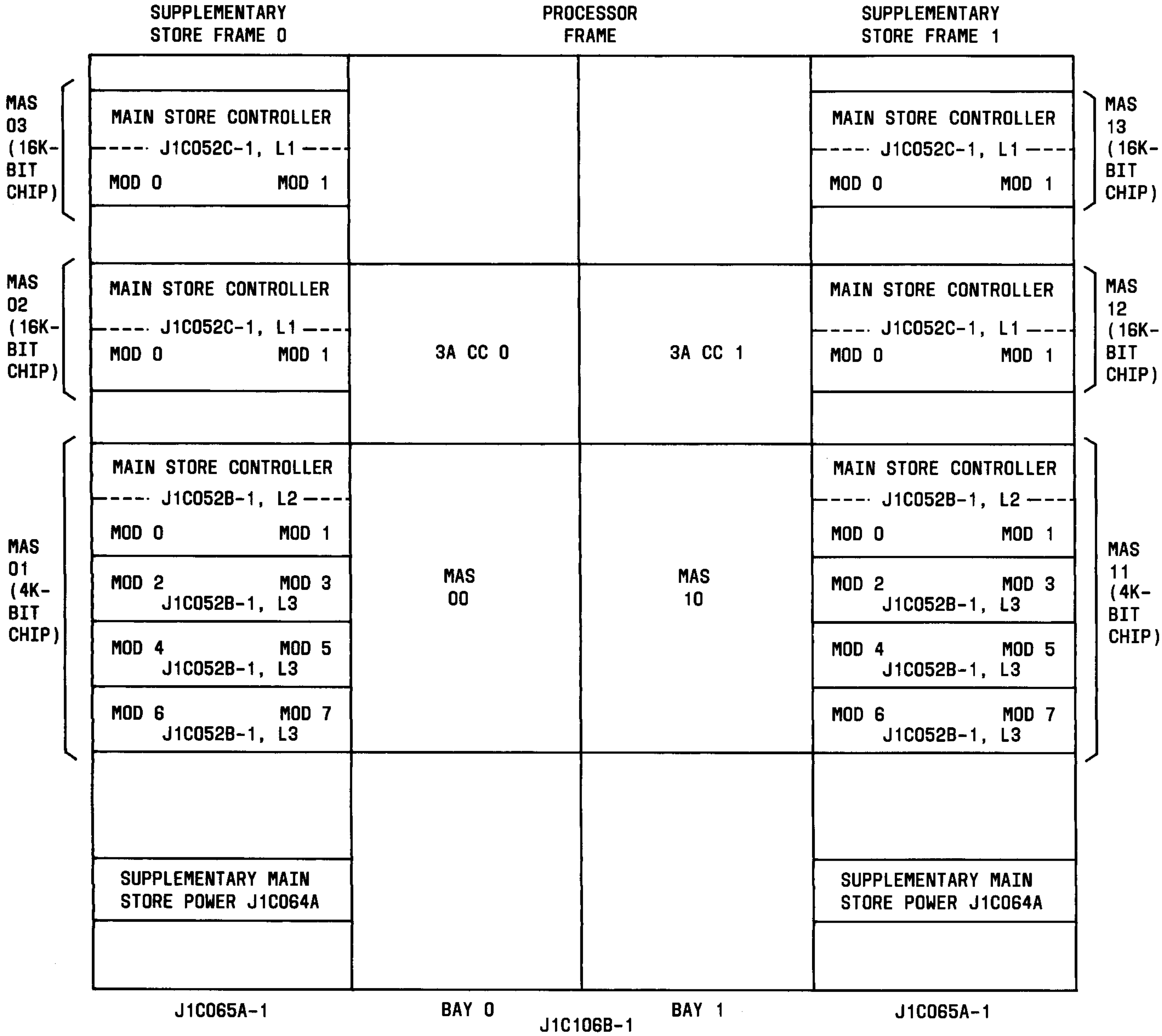
2.45 Each TTY unit contains mounting apparatus for two TTYCs. The unit provides self-contained dc-to-dc converters which have sufficient capacity to power both controllers. Since the controllers are provided on pluggable circuit packs only one TTYC may be equipped if desired. The unit also houses all required data sets for either local or remote TTY operation.

TTYC Mate Operation

2.46 Information which is transmitted to the local maintenance (LM) TTY from the 3A CC is also transmitted to the remote maintenance (RM) TTY through the mate operation of the TTYC (Fig. 20). Conversely, the same applies to information transmitted to the RM TTY. This is accomplished through a cross-coupling of TTYC-0 and TTYC-1. The LM TTY is connected to port 0 of TTYC-0 and the RM TTY is connected to port 0 of TTYC-1. Port 2 of TTYC-0 is cross-coupled to port 3 of TTYC-1 and port 2 of TTYC-1 is cross-coupled to port 3 of TTYC-0. If TTYC-0 is removed from service due to a fault, the 3A CC can communicate with the LM TTY through TTYC-1 via the cross-coupling mechanism. The 3A CC also has access to the RM TTY through TTYC-0, via the cross-coupling mechanism, if TTYC-1 is removed from service.

C. Maintenance Logic Unit

2.47 The maintenance logic unit consists of the system status panel and the maintenance logic circuitry. The system status panel is mounted



NOTE 1: WHEN MASs 00 AND 01 ARE 4K-BIT CHIP CONFIGURATION, ADDITIONAL MAS PAIRS MAY BE EITHER 4K OR 16K-BIT CONFIGURATION. WHEN MASs 03 AND 13 ARE ADDED, MASs 02 AND 12 MUST ALSO BE 16K-BIT CHIP CONFIGURATION.

NOTE 2: WHEN MASs 00 AND 01 ARE 16K-BIT CHIP CONFIGURATION, ADDITIONAL MASs MUST BE 16K-BIT CHIP CONFIGURATION

Fig. 18—Supplementary Main Store Arrangement

TABLE A

SUPPLEMENTARY MAIN STORE MEMORY

MAS 00 OR MAS 10	MAS 01 OR MAS 11	MAS 02 OR MAS 12	MAS 03 OR MAS 13
4K	4K	4K	—
4K	4K	16K	—
4K	16K	16K	16K
16K	16K	16K	16K

on the front of the maintenance logic unit and provides a communication link between the maintenance personnel and the system. Numerous lamps and keys appear on the panel (Fig. 21) which display the status of the system and provide control of the system. The main functions of the system status panel are as follows:

- Visual indicator of the status of the major system units
- Emergency control when manual intervention is needed
- Interface between E2A telemetry and the 3A CCs for switching control center (SCC) application.

2.48 The system status panel is divided into two parts: the SYSTEM STATUS AND CONTROL which reflects the general system condition, and the SYSTEM EMERGENCY MANUAL CONTROL which is used to stabilize the system via manual intervention during an emergency situation.

2.49 The SYSTEM STATUS AND CONTROL portion of the panel is primarily a display of system health. The display reflects the state of the flip-flop memory element in the maintenance logic unit. These flip-flops, in most cases, are controlled and, in all cases are readable via I/O messages and the 3A CCs. The only lamps or key/lamps not associated with a flip-flop logic element are CIRCUIT POWER, LAMP TEST, and LAMP POWER.

2.50 The SYSTEM EMERGENCY MANUAL CONTROL portion of the panel is a means to manually restore the system to a healthy state during service-affecting trouble conditions. Various stages of initialization can be initiated from the SYSTEM EMERGENCY MANUAL CONTROL portion of the panel. These include clearing of transient data and recent change information, initialization of hardware, program reloading, and TTY initialization. Also provided are control of the emergency manual line transfer and disabling of remote access.

2.51 The system status panel controller (SSPC) is the interface between the 3A CC and the E2A telemetry interface, system status panel and system status panel relay (SSPR) circuits. Figure 22 is a functional block diagram showing the units and their relationship to the rest of the SSPC.

2.52 The SSPC/3A CC interface packs contain the necessary registers, transmit and receiver transformers, parity checker and generator, etc, to allow communication between 3A CCs and the rest of the SSPC.

2.53 The system status panel interface packs contain the interlocking logic for certain keys and flip-flops associated with the system status panel keys and lamps.

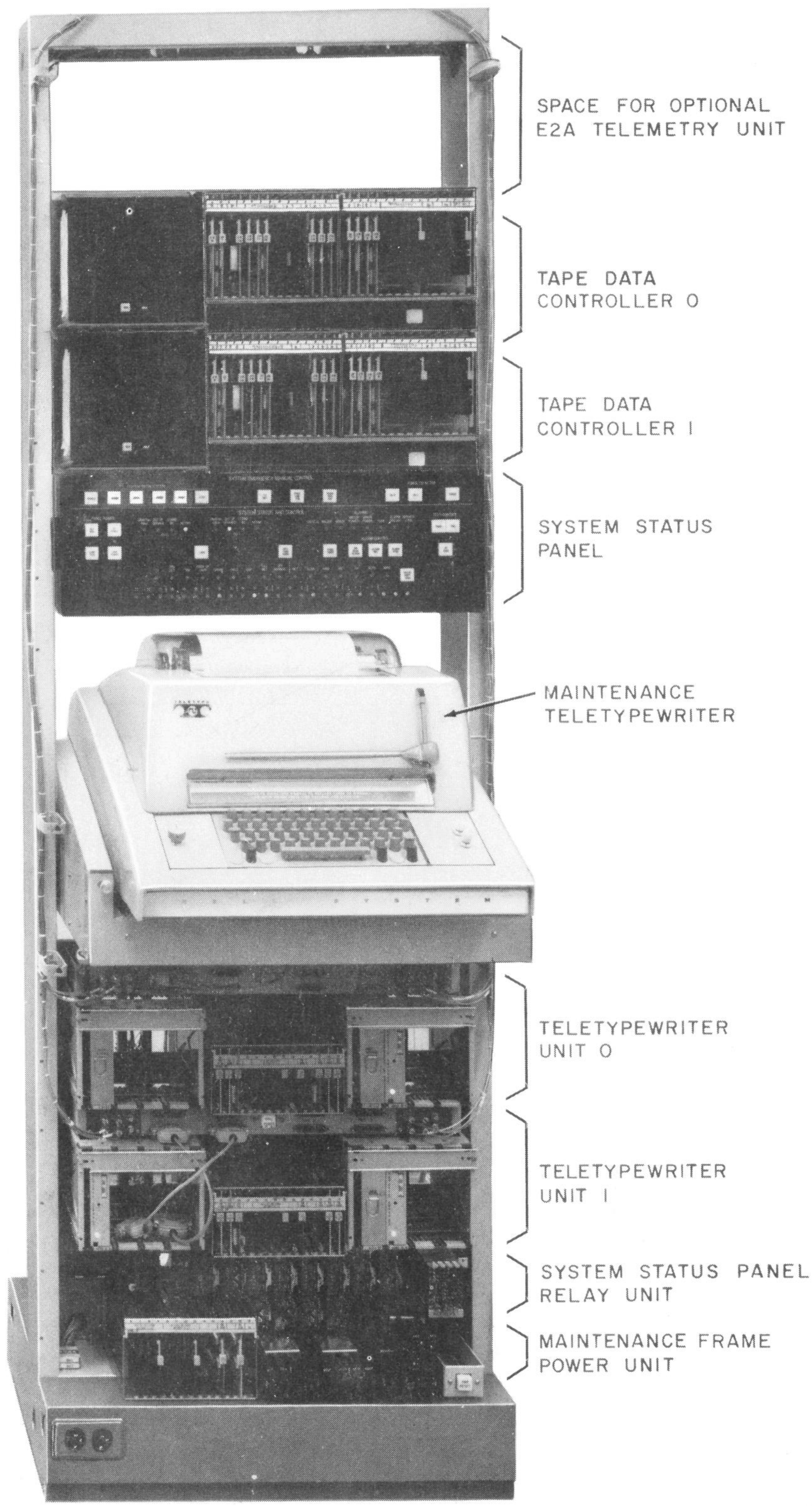


Fig. 19—Maintenance (MTCE) Frame

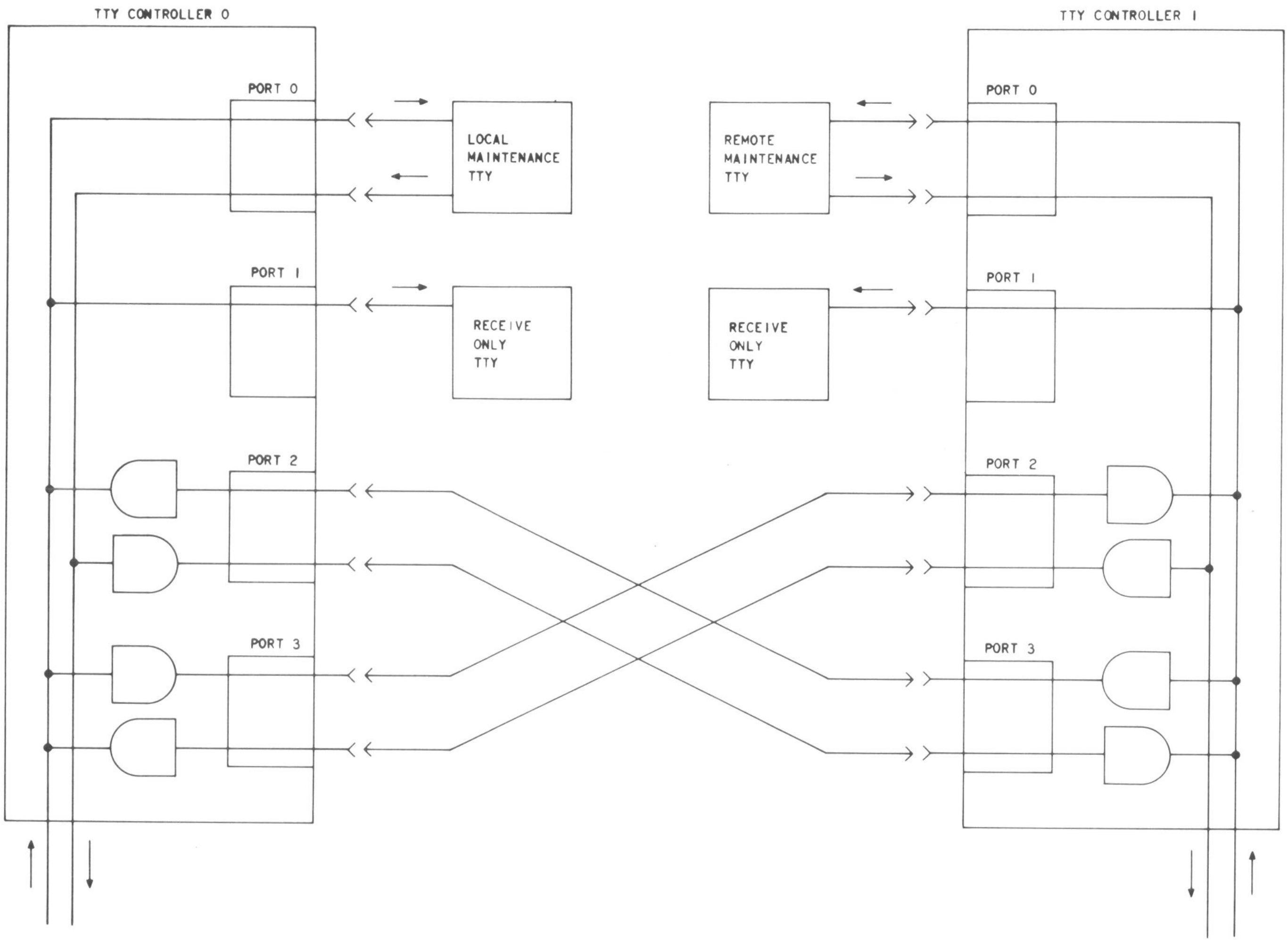


Fig. 20—TTY Controllers Arranged for Mate Operation

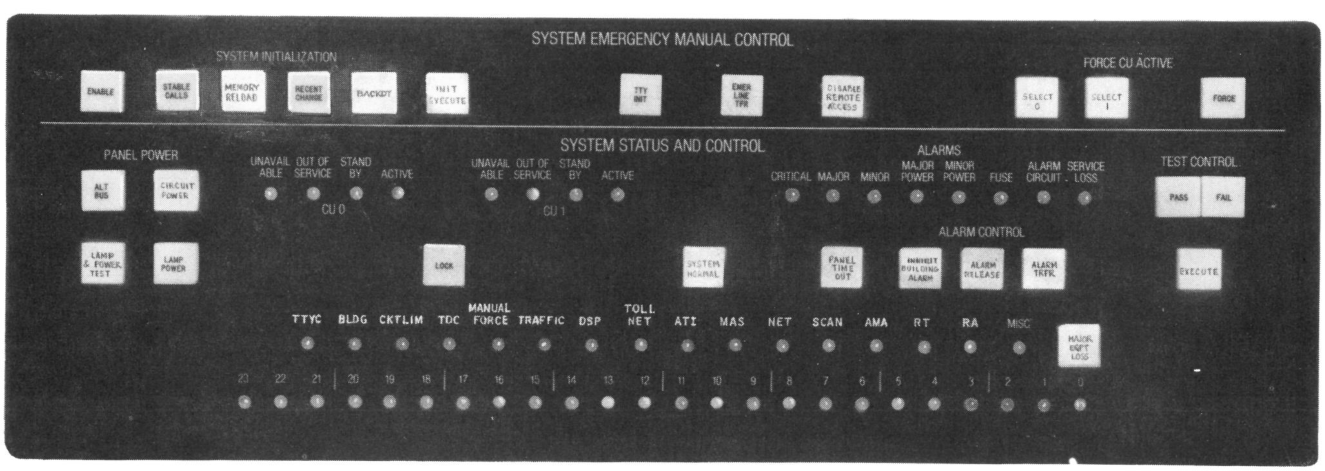


Fig. 21—System Status Panel

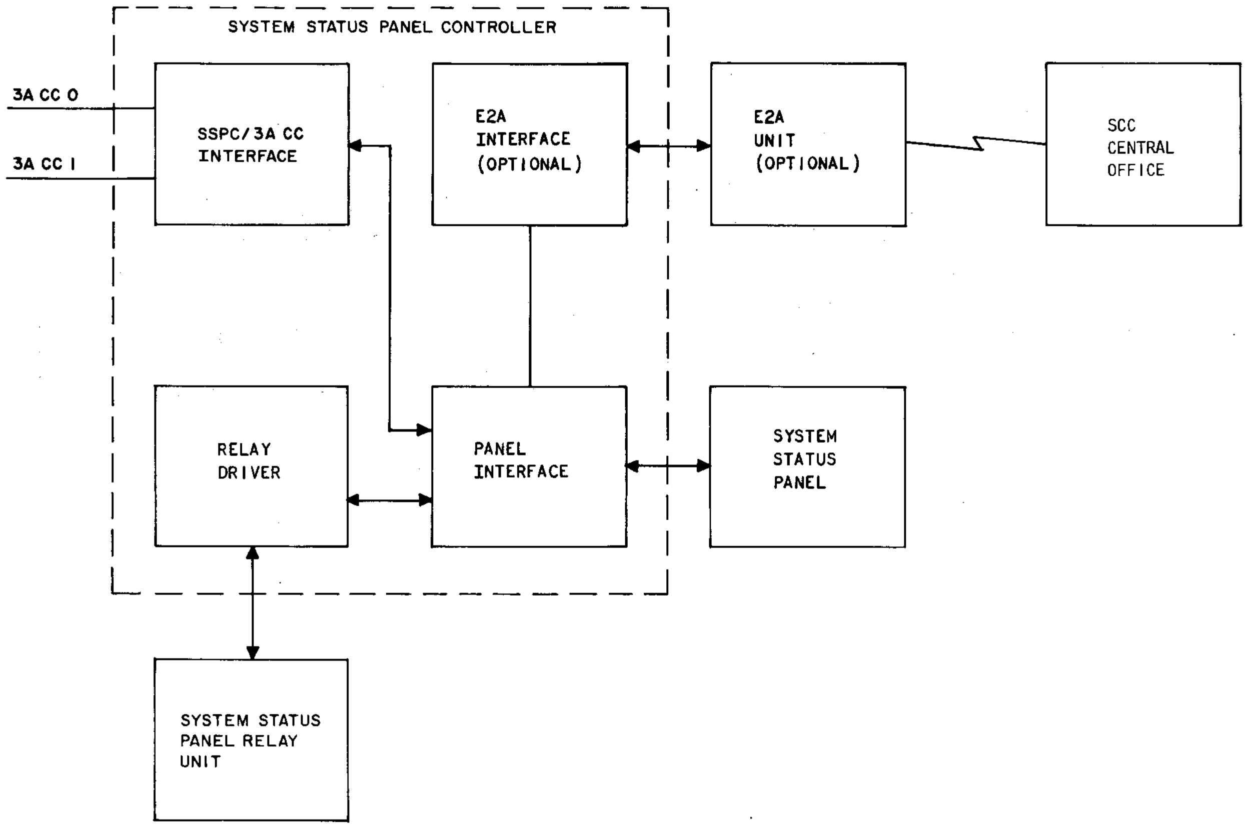


Fig. 22—Block Diagram of SSPC Logic Unit and Its Relationship to Maintenance Units

2.54 Both the E2A unit and the E2A interface packs are optional. If equipped, the E2A interface packs provide buffering between the panel interface and the E2A unit.

D. Maintenance Relay Unit

2.55 The maintenance relay unit contains ten AF-10 relays that connect power under certain conditions to the following circuits in the office:

(a) Alternate bus

(b) Alarm transfer

(c) Battery alarm

(d) Circuit power, Bus A

(e) Circuit power, Bus B

(f) Critical alarm

(g) Emergency line transfer

(h) Inhibit building alarm

(i) Major alarm

(j) Major power alarm

(k) Minor alarm

(l) Minor power alarm

(m) Pass

(m) Fail.

E. Tape Data Controller (TDC) Unit

2.56 Bulk storage on magnetic tape is provided on two duplicated TDC units (Fig. 23). The units are duplicated for system reliability. This storage serves several purposes. First, a backup image of the program and translation data is kept on tape in case a system failure should mutilate the store contents. Secondly, a copy of the data needed to return translations to the state prior to

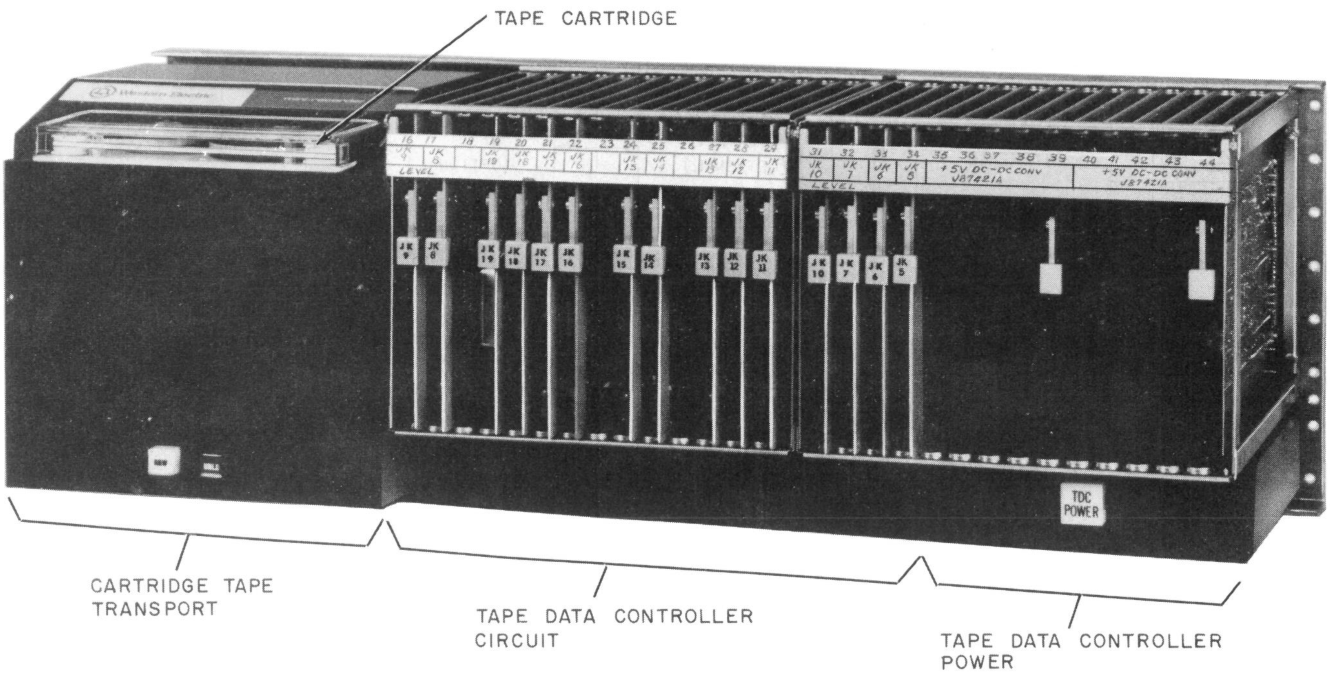


Fig. 23—Tape Data Controller Unit

the last update is kept on tape. Third, the CU diagnostics are paged from the tape for the 2B-EF-2 generic.

2.57 The TDC unit utilizes a KS-coded cartridge which uses a band drive system. Since there is only one point of contact between the transport and the cartridge for any tape motion, a single drive motor is used. The only motor to be controlled is the capstan motor, which is two speed, forward or reverse direction. Tape tension is internally controlled by the band in the cartridge. The cartridge has a storage capacity of 30 megabits and a transfer rate of 48K bits/second.

2.58 The TDC provides the following:

- An asynchronous interface and control unit between the 3A CC and a cartridge transport and a data set
- Bulk data storage.

F. Power Unit

2.59 The power unit contains the dc-to-dc converters necessary to convert -48 volts input to +3 volts at 4 amps. The +3 volts is required by the units located on the MTCE frame.

2.60 Power is supplied to the frame from a power distributing frame through a triple power feeder supplying +24 volts, -48 volts and ground. The power feeders are connected to cables which run through the hollow frame uprights to the base of the frame. The filters in the base of the frame filter the 24-volt supply while the 48-volt supply is filtered by the converters. The fuse panel provides fusing and power to all units in the frame and the fuse alarm circuitry which operates when a fuse fails.

G. E2A Unit

2.61 The optional E2A unit is part of a remote maintenance system that provides the following:

- Surveillance from a remote location
- Ability to remotely recover a system in trouble
- Means to assist local office personnel in diagnosis.

3. COMMUNICATION BUS SYSTEM

3.01 The No. 2B ESS communication bus system consists of four separate bus circuits:

- Peripheral unit address bus (PUAB)
- Scan answer bus (SAB)
- Dial pulse timing bus
- Data timing bus.

The cables for the bus system are contained on cable racks (Fig. 24) at the top of the frames. The cables are shielded by the rack and are divided into different groups in the racks to avoid transient noise and inductive currents.

A. Peripheral Unit Address Bus

3.02 The peripheral unit address bus contains the transmission lines over which the peripheral units receive address information from the 2B I/O control circuit (Fig. 13). The PUAB from each 2B I/O control circuit branches out of the PUAB drivers, Fig. 25 (one east branch and one west branch). Each branch contains 38-twisted pairs. Each twisted pair is an individual 100-ohm balanced ac transmission line. The CU 0 can communicate with either controller but only via PUAB 0. Likewise, CU 1 can communicate with either controller but only via PUAB 1.

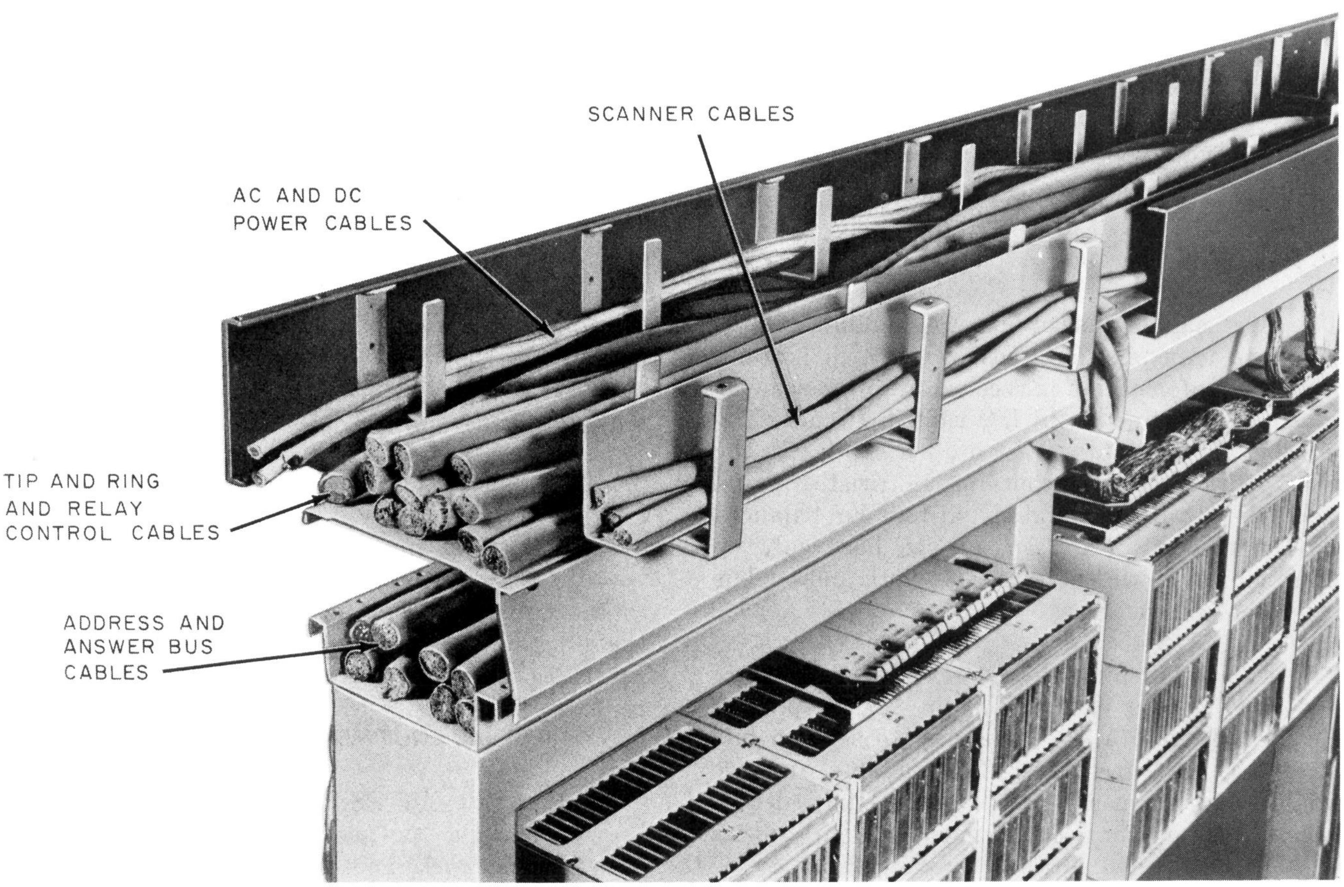


Fig. 24—Cable in Cable Racks—Typical

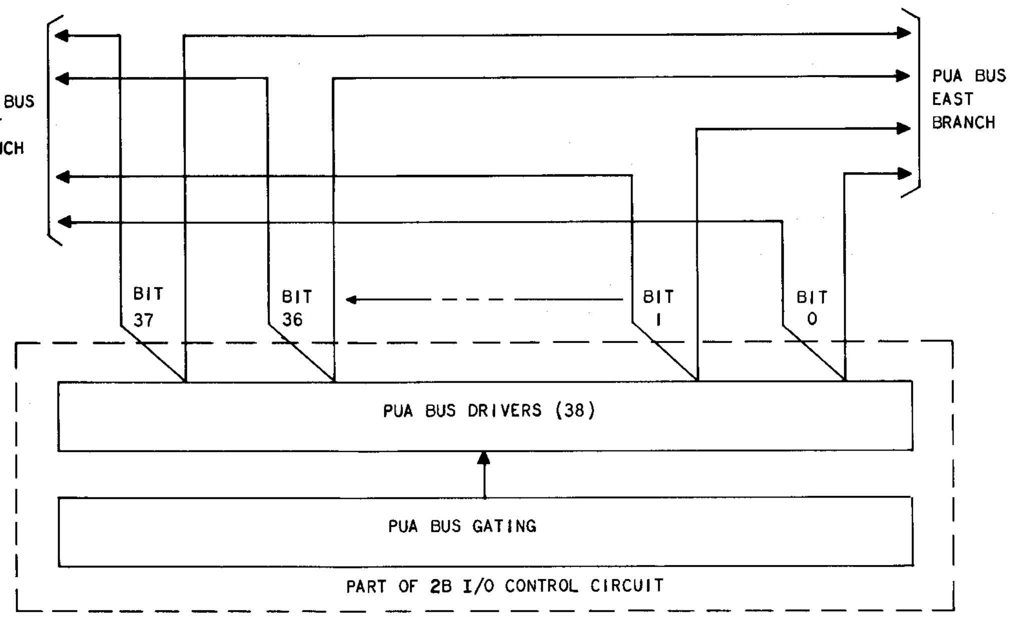


Fig. 25—Peripheral Unit Address Bus Branches

B. Scanner Answer Bus

3.03 The scanner answer bus (see Fig. 13) contains the transmission lines over which scanner ferrod row information is received into the scanner answer register in the 2B I/O control circuit. The SAB has an east and a west branch similar to the PUAB. Each branch contains 18 twisted pairs. Each twisted pair is an individual 100-ohm balanced ac transmission line. An answer bus reply by either controller will be placed on both answer bus 0 and answer bus 1.

3.04 Two other bits, all-seems-well (ASW) bit 16 and enable verify (EV) bit 17, are part of this bus. Bits 16 and 17 are used to set two bits of the I/O error register. The contents of these two bits can be used by the 3A CC in order to check for the proper execution of peripheral orders.

C. Dial Pulse Timing Bus

3.05 The dial pulse timing bus provides the seize and release pulses to the dial pulse transmitting circuits which are located in the peripheral equipment. The seize and release pulses are used to set and reset flip-flop in the dial pulse transmitting circuits. Timing is provided for a 10 pulse per second (10 pps) dial pulse sending rate by the 5 ms interrupt program. The seize and release pulses are transmitted to the dial transmitting circuits via separate wire pair (see Fig. 13).

D. Data Timing Bus

3.06 The data timing bus (see Fig. 13) provides a 600 nanosecond (ns) pulse every 1.25 ms to the dial pulse check circuit that is located in the peripheral equipment. The data timing bus consists of a single pair.

4. PERIPHERAL EQUIPMENT

4.01 The No. 2B ESS processor communicates with the peripheral equipment such as scanners, network, and trunk circuits to perform the functions of connecting a 2-wire talking path between two subscribers. The discussion of the peripheral equipment begins with a description of scanners which are electronic circuits used to detect the subscribers request for service and to provide supervision of the call until it is completed. The network which serves the primary function of interconnecting 2-wire circuits through metallic paths will be discussed in detail as will the other frames necessary to complete the secondary function of the central office.

SCANNERS

4.02 Electronic scanners may be broadly defined as circuits which sense or detect the absence or presence of voltage or current. In No. 2B ESS, scanners are used to detect the on-hook/off-hook status of a customer's line, to check the status of talking paths for flash and disconnect, to monitor certain test points in various frames, and to scan other miscellaneous points about which information is desired. In a certain sense, the scanners may be thought of as the primary source of information to the 2B processor regarding the actual physical state of the customer lines and circuits associated with the outside world. The basic sensing element in the No. 2B ESS scanners is the ferrod sensor. Each scanner is made up of rows and columns of ferrods.

4.03 ***Ferrod Sensor:*** A ferrod sensor (Fig. 26) is basically a magnetically saturable ferrite rod containing two control windings: an interrogate winding, and a readout winding. The control windings terminate at customer lines and various peripheral units. The interrogate winding is pulsed under the direction of the CU. This pulse is coupled to the readout winding if no current is flowing in the control winding of the ferrod. If current is flowing in the control windings, the ferrite rod is saturated which prevents the transfer of energy from the interrogate to the readout winding. Thus, the electrical status of each point monitored can be determined by the presence or absence of an output at the readout winding of the ferrod. This information may be read and processed by the CU to determine the busy/idle status of lines and equipment.

A. Line Scanner

4.04 There are two types of line scanners available in the No. 2B ESS System: ferreed line scanner and the remreed line scanner. In both cases, the line scanner is used for scanning customer lines for on-hook or off-hook conditions.

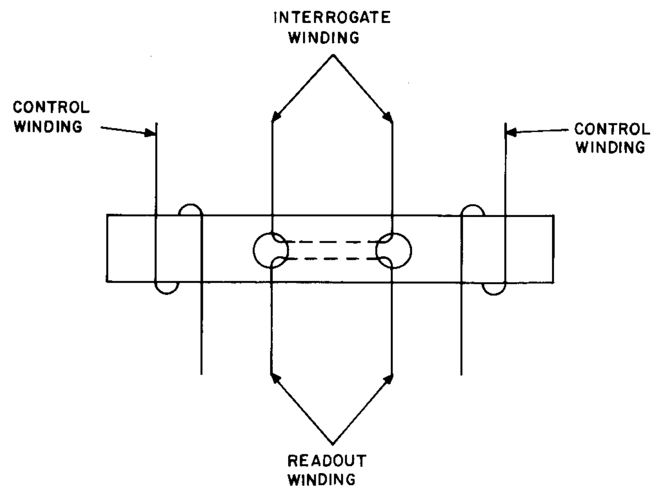


Fig. 26—Typical Ferrod Sensor

4.05 ***Ferreed Scanner:*** The ferreed line scanner circuits are divided between the line trunk switch (LTS) and network control junctor switching (NCJS) frames. The scanner ferrod matrix is located on the LTS frames. The line ferrods are connected to form two separate 16 by 64 (1024-point) matrices. Two 1024-point scanner control circuits are located on each NCJS frame. Each scanner controller has the capability of monitoring the status of the related 1024 ferrods independent of its mate controller.

4.06 ***Remreed Scanner:*** The remreed network (RN) frame and supplementary remreed network (SRN) frame each have a duplicated scanner controller. The scanner controllers on each frame monitor a maximum of 1024 lines for service requests. Each scanner controller has the capability of monitoring the status of the related 1024 ferrods independent of its mate controller. The ferrods, one per subscriber line, are contained in the first stage switch modules on the RN and SRN frames.

Ferreed and Remreed Line Scanning

4.07 Line scanning is performed under the control of the microcontrol circuit in the 3A CC and, once started, runs freely through the line ferrods until a request for service is encountered. The address of the busy ferrod is then placed in a hopper by the programs. Line scanning is resumed and allowed to progress through the line ferrods until another request for service is encountered.

4.08 Once an off-hook signal is recognized as a valid service request and a customer given dial tone, the associated line ferrod is removed from the line by means of the network cutoff switch. This ferrod returns to the idle state and remains idle as long as the cutoff switch remains open. This allows the line scanner to pass over the ferrods of calls which are in progress and to devote full time to searching for new service requests. The ferrod is restored when the call terminates.

4.09 Line ferrods may be strapped externally for ground start or loop start. When a terminal is assigned to a trunk or service circuit, the straps of the associated line ferrod are removed so that it will always appear to be idle when interrogated by the line scanner circuit.

B. Master Scanner

4.10 The master scanner (MS) circuit is located on the MS frame. The MS frame (Fig. 27) is a single-bay frame 2 feet, 2 inches wide and is used for administrative and diagnostic scanning of all other frames in the office. Mounted on the frame are 1024 ferrod sensors which make up the scanner matrix, control equipment (duplicated for reliability), frame control panel, fuse panel, and power supply filters. The MS monitors such items as miscellaneous trunks, service circuits, test circuits, as well as some fixed points including fuse alarms, AMA status, trunk test requests, and scan points for frame controllers.

4.11 Some of these fixed scan points are duplicated for system reliability. Circuit assignments are divided between the scan points in such a way that failure of a scanner does not deny access to a given peripheral frame. The two methods for duplicating these scan points are as follows:

(a) In most offices there is only one master scanner frame and the duplicated scan points are provided in the first universal trunk and junctor-home master scanner frame as described in paragraph 4.13.

(b) Two or more master scanner frames may be provided.

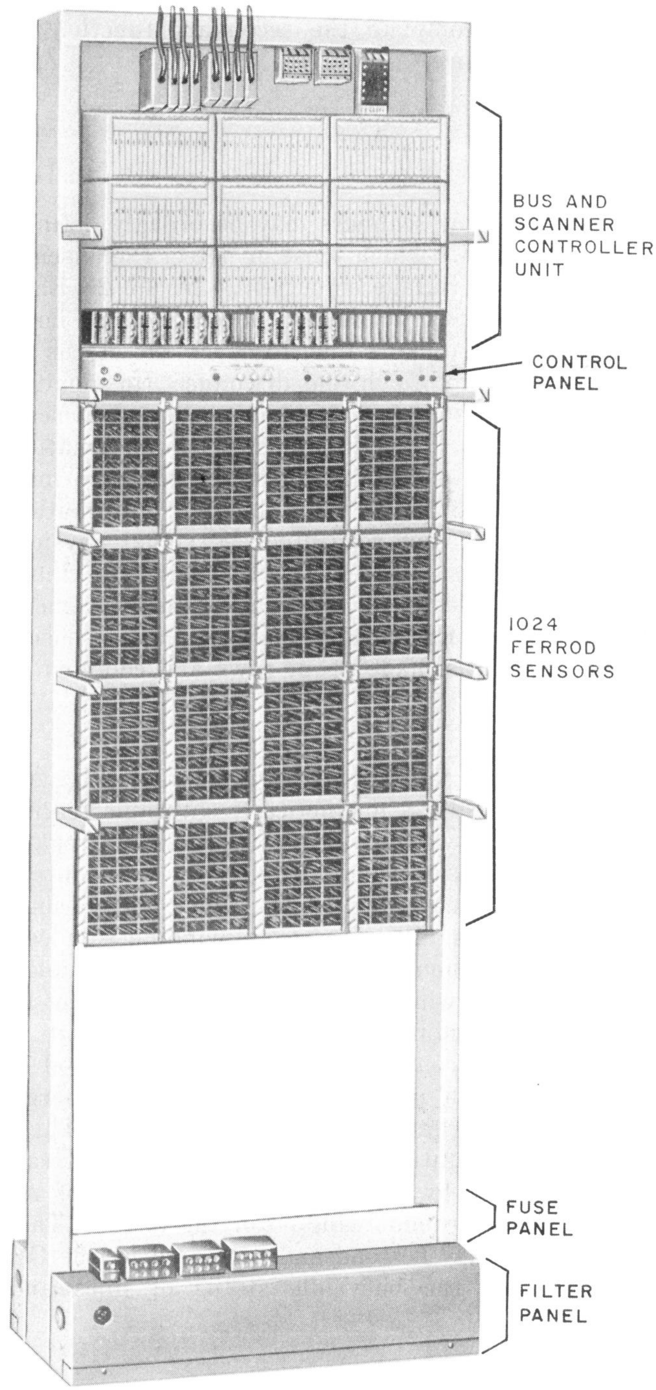


Fig. 27—Master Scanner (MS) Frame

C. Universal Trunk Scanner

4.12 The universal trunk scanner consists of the scanner control circuitry and the scanner matrix used to scan trunk circuits and circuit junctors. The universal trunk and junctor-home (UTJ-H) frame (Fig. 28) contains the 1024-point ferrod scanner control circuit and a partially equipped 1024-point scanner matrix. The mate frame (UTJ-M) of the UTJ-H frame contains the remainder of the 1024 points. The UTJ-M frame is identical to the UTJ-H frame with the exception of the scanner control circuitry and the master scanner option.

4.13 When a UTJ frame is used with the master scanner option, the home frame contains the entire 1024-point matrix with the additional points provided in bay 1 of the first UTJ-H (Fig. 28) frame with master scanner option. This additional matrix is assigned as a master scanner and operates under the control of the scanner control circuit located at the top of bay 1. The UTJ-H frame with master scanner option does not have an associated mate frame.

LINE TRUNK NETWORK

4.14 There are two line trunk networks (LTNs) available with a No. 2B ESS office; ferreed and remreed. Both perform the same function but the packaging and space requirements are different. The one RN frame performs the same function as two LTS frames and one NCJS frame. Four LTS frames and one NCJS frame perform the same function as a remreed network frame and a supplementary remreed network frame. The number of the switching networks in an office with ferreed LTNs may be increased by the addition of remreed LTNs. Ferreed and remreed frames cannot be mixed in an LTN to complete growth of a ferreed LTN.

FERREED NETWORK

4.15 The No. 2B ESS LTN is a space division network in which 2-wire metallic connections are switched through eight stages of ferreed switches. (See Fig. 2.) The LTN has lines and trunks assigned to terminals at one side of the 4-stage array with junctors interconnecting the switches on the opposite side to form a folded 8-stage network. In addition to the normal connection of lines to other lines, lines to trunks, and trunks to other trunks, the LTN can interconnect lines or trunks with tones, signal transmitters, signal receivers, coin control circuits, maintenance circuits, and other service circuits. To establish these interconnections, the control unit (CU) selects the desired network paths and sends peripheral orders to the network control circuits. This information is sent to a controller in the NCJS frame.

4.16 An LTN is composed of one to four LTS frames (Fig. 29) and an NCJS frame (Fig. 30). The first two of the four switching stages in the switching network are located in the LTS frame. The third and fourth switching stages are located in the NCJS frame. A maximum of 15 LTNs can be installed per office.

4.17 The LTN is designed as a single-sided folded network. A complete network path requires two segments: an input path for the originating party and a return path for the terminating connection. These two paths are connected by wire or circuit junctors. A typical path uses four stages of switching in the input path and four stages of switching in the return path.

4.18 The operation of the LTN is based on the central processor's ability to select specific paths through the ferreed switches. To provide this selection function, a record of the busy and idle state of all network connecting links and a record of the path of every established and/or reserved connection is maintained by the central processor. Addresses and orders defining new connections are computed by the central processor and sent to the network control circuits. The control circuits located in the NCJS frame in turn establish the new connections.

A. Line Trunk Switching Frame

4.19 The LTS frame is a 2-bay frame and is 3 feet 3 inches wide (Fig. 29). The LTS frame consists mainly of ferreed switches and comprises the first two stages of the folded 8-stage network (Fig. 2). A frame provides metallic contacts (crosspoints) and a relay switching circuit for switching talking paths. In addition to the crosspoint switches, each LTS frame contains one polar cutoff ferreed contact per input terminal to connect and disconnect the line ferrods. It also provides 512 terminals and their associated line ferrods for detecting service requests.

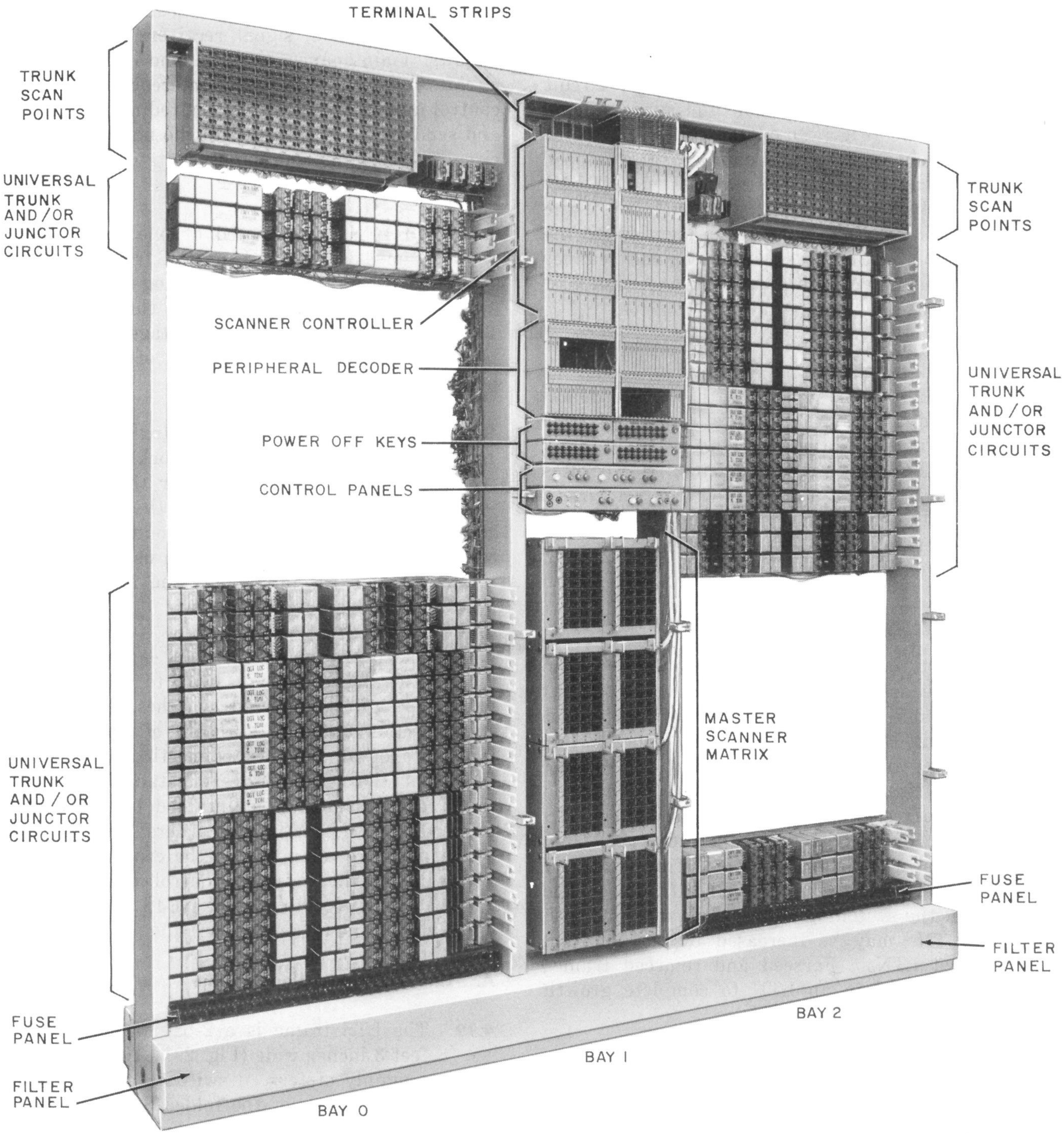


Fig. 28—Universal Trunk and Junctor-Home (UTJ-H) Frame

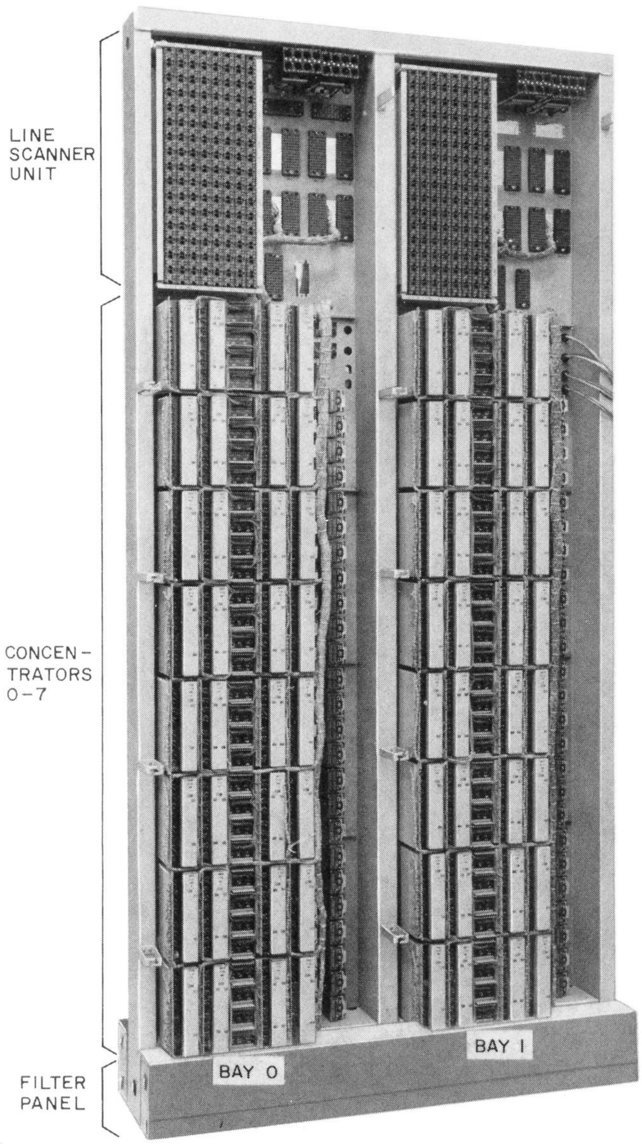


Fig. 29—Link/Trunk Switching (LTS) Frame

4.20 The frame is arranged to interconnect 512 lines and trunks to 256 B links from the NCJS frame via the switching path relays. The 512 terminals are divided into two concentrator groups and each group contains eight line concentrators (subgroups). Each subgroup is a 32-terminal concentrator (Fig. 31) that concentrates its terminals via the two switching stages to 16 B links from the NCJS frame. Thus, each concentrator group terminates 256 terminals on the input to the first-stage switches and 128 B links on the outputs of the second-stage switches.

B. Network Control Junctor Switching Frame

4.21 The NCJS frame is a 3-bay frame and is 6 feet 6 inches wide (Fig. 30). The NCJS frame is comprised of one control equipment bay and two junctor switching bays. The NCJS frame is a ferreed type of switching frame and comprises the last two stages of the 4-stage array. It provides metallic contacts (crosspoints) and a relay switching circuit for switching the talking paths.

4.22 An NCJS frame is arranged to interconnect 512 junctors with 512 B links from the LTS frames. The 512 junctor appearances are subdivided into eight grids (Fig. 32) each of which has 64 inputs (B links) and 64 outputs (junctors). Each B link is associated with a vertical 1 by 8 switch which provides access for false cross and ground tests or for making no-test connections to any third-stage input. Each NCJS has the control capacity for serving all of the grids and up to four LTS frames.

C. B-Link Interconnection

4.23 The wiring between the equipped concentrator groups and the eight grids is made using a fixed B-link interconnection pattern. Eight grids are interconnected with four concentrator groups to form a fully equipped 2:1 network (Fig. 33). The wiring pattern between concentrator groups and grids is such that two of the 16 outputs of a concentrator are wired to each of the eight grids. With this wiring pattern, each of 1024 terminals for the 2:1 concentration ratio has access to each of the 512 junctors over either of two paths.

4.24 A 4:1 concentration ratio is developed by multipling all of the B-link outputs from an LTS frame to those of another LTS frame before distributing the links to the inputs of the grids. A fully equipped 4:1 network will have two LTSs multipled to two other LTSs. A 2:1 network has two LTSs nonmultipled. A network may have two LTSs multipled and one LTS nonmultipled. With this configuration, 1024 terminals have a 4:1 ratio, and 512 terminals have a 2:1 ratio. The LTS and NCJS frames are connectorized to facilitate growth.

4.25 The outputs of the LTS frames are fully distributed over the inputs of the grids of

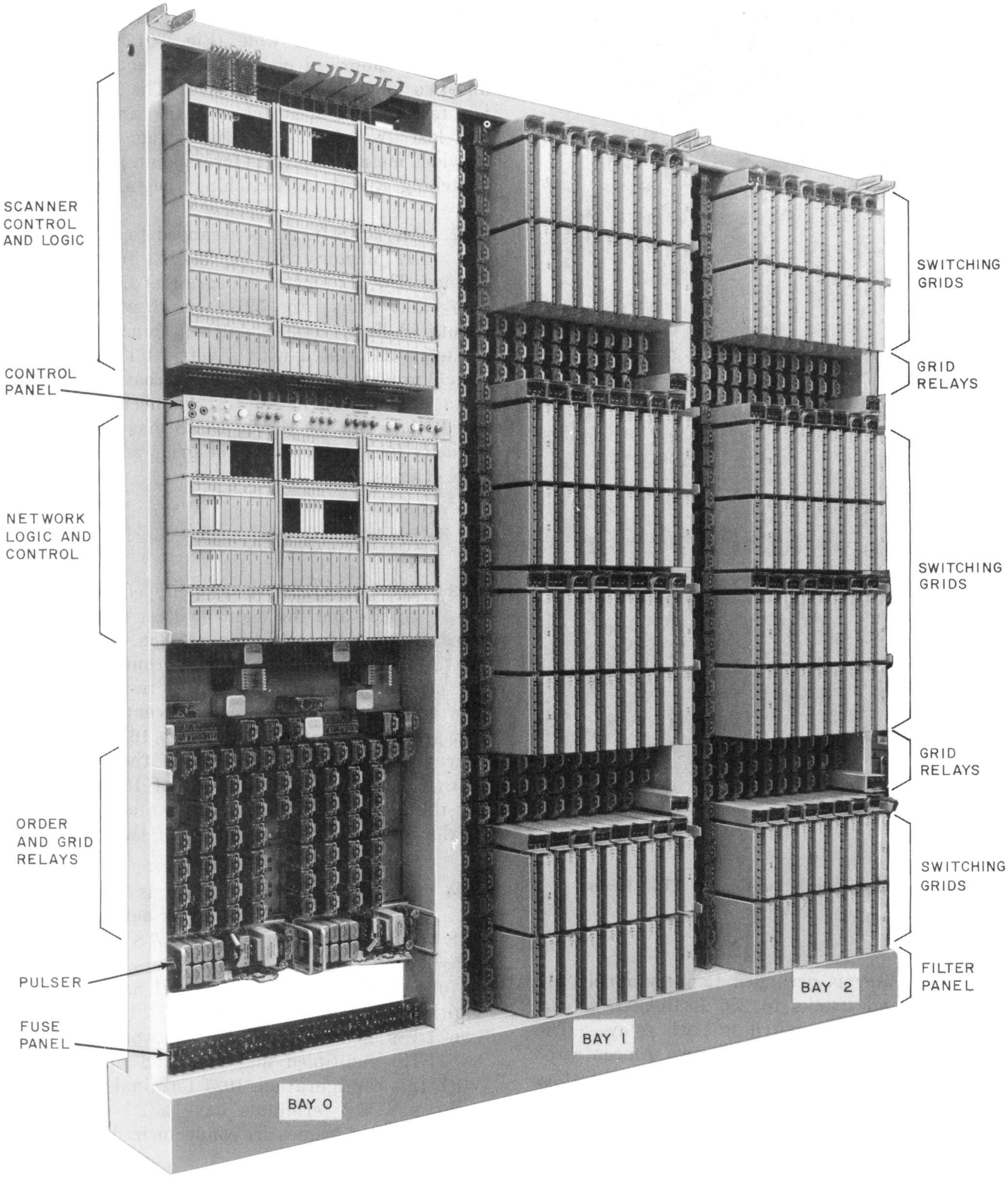


Fig. 30—Network Control Junctor Switching (NCJS) Frame

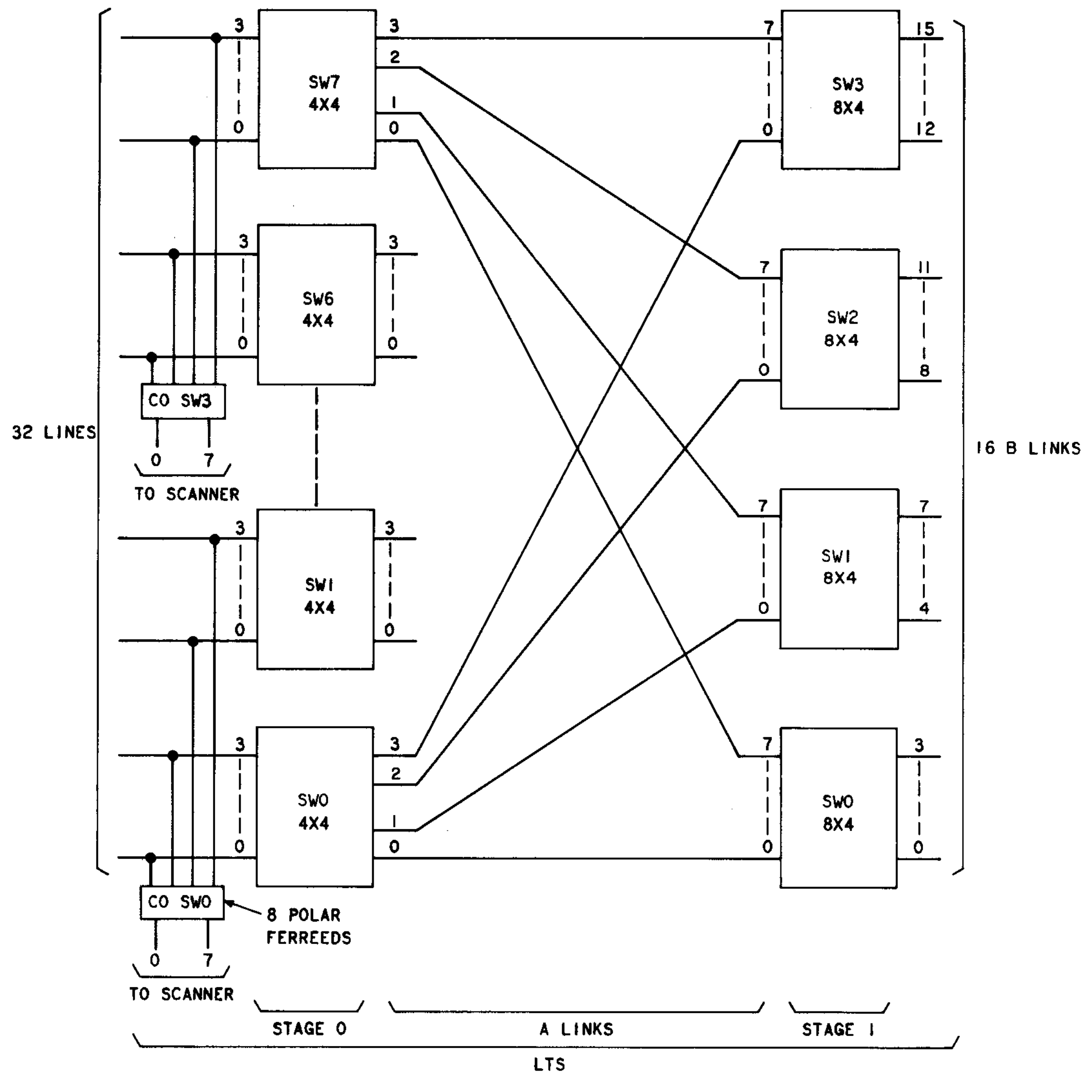


Fig. 31—Block Diagram for a 2:1 Concentator (Ferreed and Remreed)

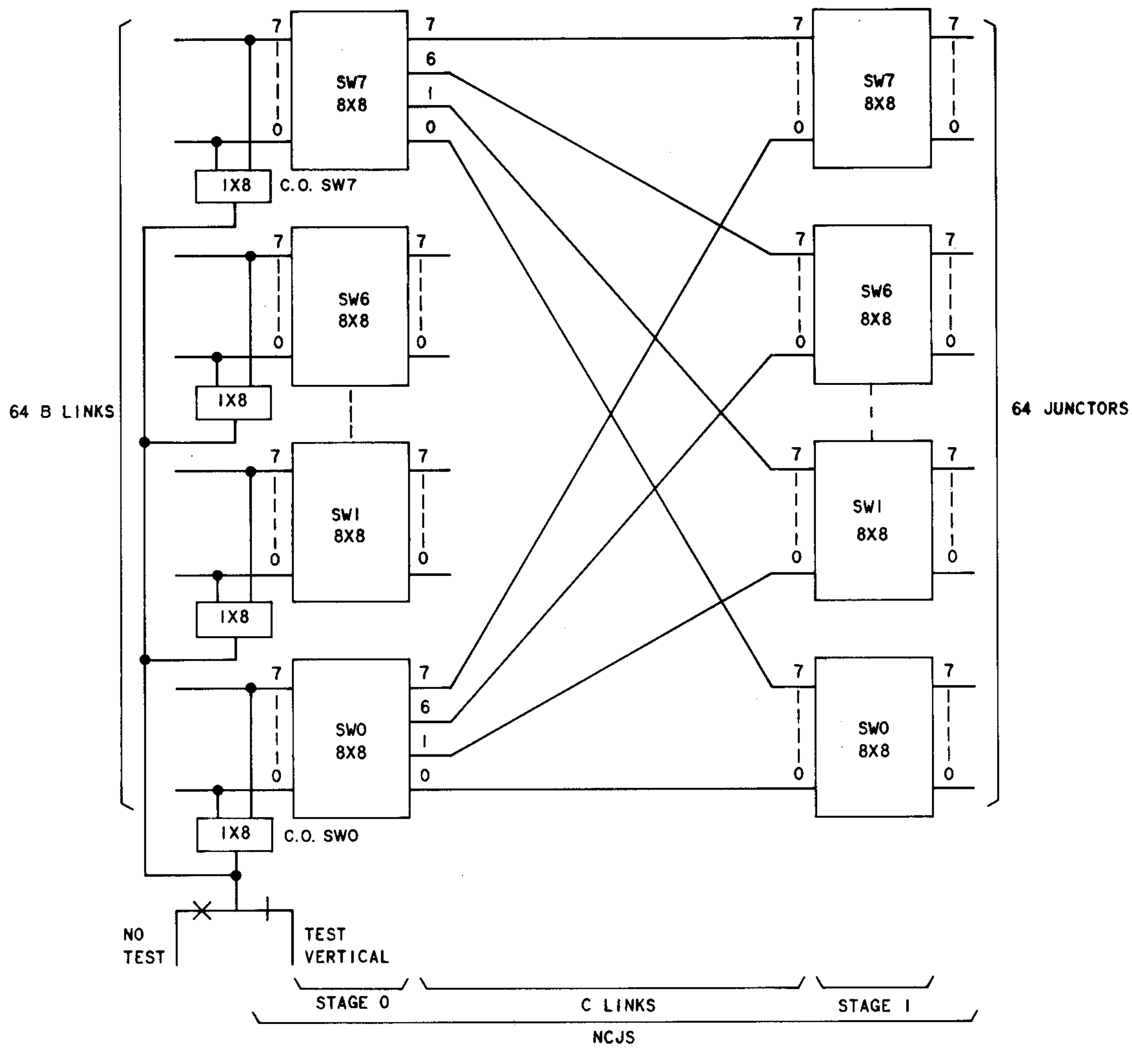


Fig. 32—JSF Grid Block Diagram (Ferreed and Remreed)

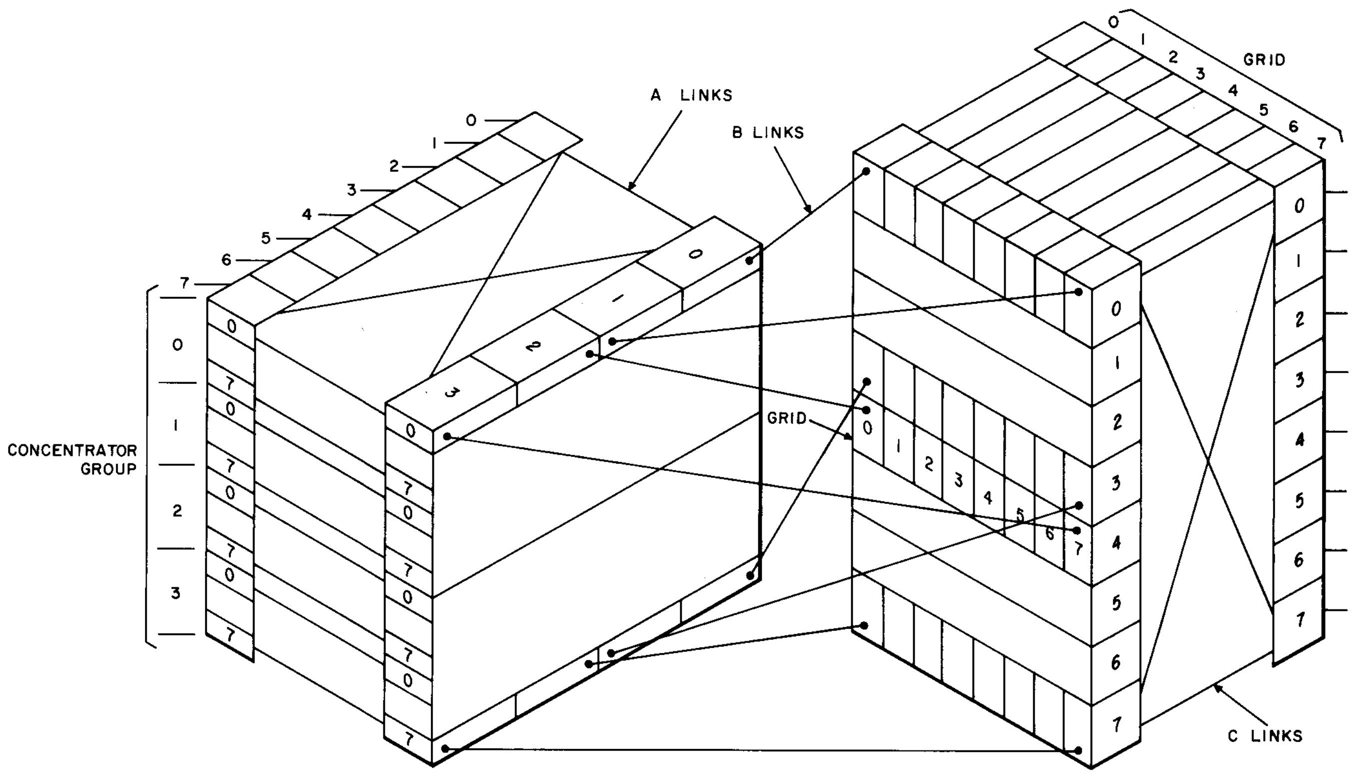


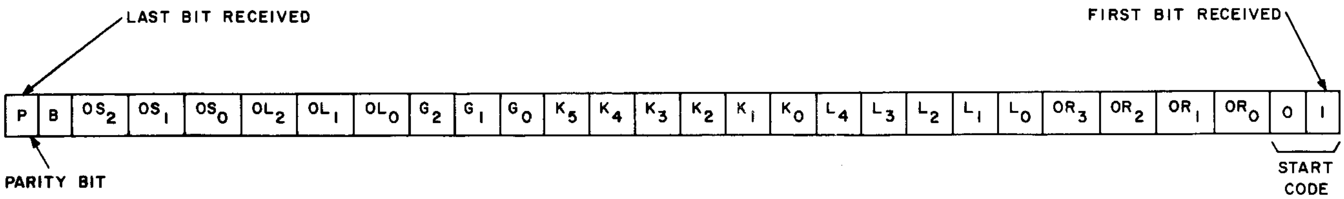
Fig. 33—2:1 Concentration Ratio Line—Trunk Network Fabric

the NCJS frame. A 4:1 LTN contains four LTS frames and one NCJS frame, thus providing 2048 terminals access to 512 junctors. An LTN can be partially equipped with LTS frames, but one NCJS frame must always be provided.

D. Network Controller

4.26 The input information received by the network controller from the CU consists of path data and order data sent in the form of a bipolar pulse stream from the CPD. The path data is received in several subgroups. These subgroups contain input terminal information which selects the concentrator, input switch and input level within the concentrator, and the junctor location (grid, the output level, and the output switch within the grid). In addition, information is given as to which of the two B links that interconnect these input and output points is the desired B link. The information is provided in binary form and a parity check is made on the overall received information including the path data, the order group data, and the start code. Parity will be odd; that is, an odd number of ones will be transmitted. Sixteen orders can be specified by the four order bits in the message. The binary information sent as bipolar pulses is received in a 28-bit shift register (Fig. 34). The network responds with an ***enable verify*** pulse at the time that it receives the ***first address bit*** if that bit is a ***one*** and if no bits have been received since the controller finished its previous cycle or since the controller was reset using the external reset. The frame also responds with a second ***enable verify*** pulse to the central processor at the time that it has received all 28 bits and has checked that the parity and the start code of the information it has received is valid.

4.27 The first- and second-stage ferreed switches in the LTS frame are operated along with the third and fourth stages in the NCJS frame by a duplicated controller also in the NCJS frame. Contacts on wire spring relays are inserted in the ferreed switch control winding links. The selecting circuits operate the relays to form a unique pulsing path over which a high-current pulse is sent through the selected path, closing crosspoints in all stages.



			NO. OF BITS
OR_3 OR_2 OR_1 OR_0	---	1/16 ORDER SELECTION	4
L_4 L_3 L_2 L_1 L_0	---	1/32 INPUTS	5
K_2 K_1 K_0	---	1/8 CONCENTRATORS	3
K_5 K_4 K_3	---	1/8 CONCENTRATOR GROUPS	3
G_2 G_1 G_0	---	1/8 GRIDS	3
OL_2 OL_1 OL_0	---	1/8 OUTPUT LEVEL	3
OS_2 OS_1 OS_0	---	1/8 OUTPUT SWITCH	3
B	---	1/2 B LINK SELECTION	1
		BIT	25
		START CODE & PARITY	3
		TOTAL BITS	28

NOTE:
OVERALL PARITY ON THE 28 BITS IS "ODD".

Fig. 34—Network Input Information Register

4.28 Hunting for an idle path between a line or trunk and a junctor is accomplished by storing a map of the busy conditions of all the network linkages in temporary memory. When a connection is to be made, this memory is interrogated after an eligible junctor group has been selected and the busy-idle condition of all the possible A, B, and C links between the terminal and the selected junctor group is examined. After an available path has been chosen, the corresponding addresses are sent to the control circuits causing the appropriate crosspoints to close. When a connection is no longer required the map is brought up to date by restoring the appropriate link indications to idle without releasing the actual crosspoints. When the linkages are selected for use in establishing another path, any closed crosspoint is automatically opened as a result of the pulsing of another crosspoint connected with the same link.

REMREED NETWORK

4.29 The remreed switching network is also a space division, 2-wire network in which metallic connections are established but they are established through remreed switches rather than ferreed switches. The remreed network functions identically to the ferreed network but takes advantage of a miniature sealed contact constructed of remendur, an all electronic control scheme, and modern interconnection techniques to achieve economy and 3:1 space reduction. The entire remreed switching network is contained in one frame, the remreed network (RN) frame (Fig. 35).

4.30 The combined line-trunk switching network has lines and trunks assigned to terminals at one side of the four-stage array with junctors interconnecting the switches on the opposite side to form the folded 8-stage network. The principle unit in the switching network (NW) is the remreed network. The NW consists of one RN frame and a maximum of one supplementary remreed network (SRN) frame. The NW is connected to the low profile conventional distributing frame (LPCDF) for connection to lines and trunks.

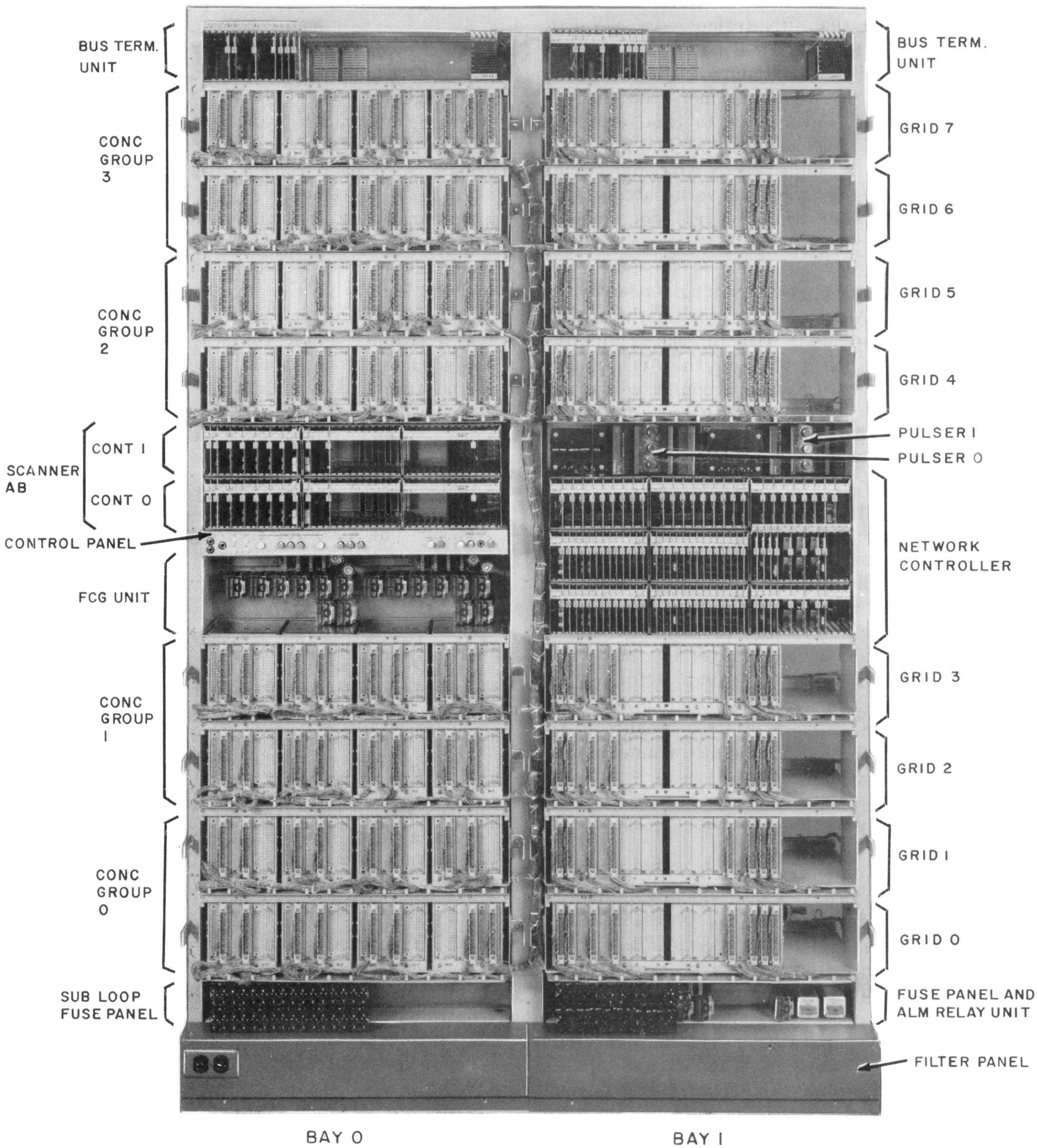


Fig. 35—Remreed Network (RN) Frame (J2H124A-1)

4.31 Lines, trunks, and service circuits are connected to the input or terminal side of the RN frame or the SRN frame. An NW can have as many as 1024 terminal points (RN frame) or can be increased to a maximum of 2048 terminals with the addition of an SRN frame. The units of growth for an NW is from zero to 1024 terminals and from 1024 to 2048 terminals. The grid side of the RN frame is connected to wire and circuit junctors. Junctors complete network paths within or between NWs (Fig. 3). The grid side (junctor side) of the RN frame contains 512 terminal points.

4.32 The NW is designed as a single-sided folded network. A complete network path requires two segments: an input path for the originating party and a return path for the terminating connection. These two paths are connected by wire or circuit junctors. A typical path uses four stages of switching in the input path and four stages of switching in the return path.

4.33 The operation of the NW is based on the central processor's ability to select specific paths through the remreed switches. To provide this selection function, a record of the busy and idle state of all network connecting links and a record of the path of every established and/or reserved connection is maintained by the central processor. Addresses and orders defining new connections are computed by the central processor and sent to the network control circuits. The control circuits located in the RN frame in turn establish the new connections.

A. Remreed Network (RN) Frame

4.34 The RN frame (Fig. 35) is a 2-bay frame, 4 feet 4 inches wide, which contains all stages of switching and control necessary for a network of up to 1024 terminals and 512 junctors with a 2:1 concentration ratio. Bay 0 contains the concentrators which provide the switches for the first and second stages of network switching. Bay 0 also contains the duplicated line scanner controllers, frame control, and false cross and ground circuits. Each duplicated scanner controller can handle all 1024 scan points of the 1024 input terminals which are contained in the four concentrator groups (0-3) of the RN frame. Bay 1 contains the eight grids (0-7) which provide the switches for the third stage and the fourth stage of network switching. Inputs to the grids (third stage) are the B links from the concentrators (second stage). The outputs from the grids (fourth stage) are cabled to junctor patching facilities.

4.35 The concentrators on the RN frame interconnect 1024 input terminals to 512 B links through two stages of switching. The first two stages of switching on an RN frame are interconnected by A links. Each RN frame contains four concentrator groups, with each concentrator group containing eight line concentrators. A line concentrator interconnects 32 input terminals to 16 B links. Thus, each concentrator group terminates 256 terminals on the input of the first stage switches and 128 B links on the output of the second stage switches. Each input terminal of the first stage has a scanner cutoff contact associated with it. The scanner cutoff contact removes the line scanner ferrod from the line during talking, because the ferrod would otherwise shunt the line and impair transmission. The scanner cutoff contacts are disconnected for trunks, service circuits, and tone circuits. Each grid interconnects 64 B links and 64 junctors through two switching stages. In addition, one polar remreed cutoff for each B link provides test vertical access. The interconnections between the two grid stages are called C links.

4.36 The duplicated network controllers control the network portion of the RN frame and one optional associated SRN frame. One network controller normally controls the switches on any one of the four concentrator groups in the RN frame or any one of the four concentrator groups on the SRN frame and any one of the eight grids on the RN frame. The other controller may be active at the same time but not in the same concentrator group and/or grid that is being controlled by the first controller.

4.37 The network controller (Fig. 35) located in bay one of the RN frame controls the operation of the switching network. The network controller, which is duplicated, is composed of an input register, translator, selectors, control logic, remreed pulser, and various test circuits. Duplication of the controller provides for increased reliability in case of equipment failure. If one controller fails, the remaining controller can handle traffic for the entire NW at a decreased capacity. Supervision for controller operation is provided by three scan points (T, S, and F). These scan points are terminated on trunk scanner 0 (controller 0) and the trunk scanner 1 (controller 1).

B. Supplementary Remreed Network (SRN) Frame

4.38 The SRN frame (Fig. 36) is a single bay frame, 2 feet 2 inches wide. The frame contains 1024 input terminals, four concentrator groups (4-7), scanner ferrods, duplicated scanner controllers, and 512 output terminals. The SRN frame interconnects 1024 input terminals to the 512 B links through two stages of switching. The two stages of switches on an SRN frame are interconnected by A links. Each SRN frame contains four concentrator groups, with each concentrator group containing eight line concentrators. A line concentrator interconnects 32 input terminals to 16 B links. Thus, each concentrator group terminates 256 terminals on the input of the first stage switches and 128 B links on the output of the second stage switches. The B links from the SRN frame are multipled onto the B-link connectors of the concentrators on the RN frame (Fig. 2). This arrangement provides a 4:1 concentration ratio. Each input terminal of the first stage has a scanner cutoff contact associated with it. The scanner cutoff contact removes the line scanner ferrod from the line during talking, because the ferrod would otherwise shunt the line and impair transmission. The remreed cutoff is disconnected for trunks, service circuits, and tone circuits. The SRN is connected to the RN through cables which terminate on the RN to provide control signals to the SRN.

JUNCTORS

4.39 Junctors are required on all switched connections in a No. 2B ESS office. Physically, the path from one terminal on the LTN to another terminal in the office is through a junctor. A maximum of 512 junctors are terminated on the output side of the fourth stage switches in each of the network control and junctor switching frames. There are some intranetwork junctors; hence, there are 512 junctor terminals, but somewhat fewer junctors. There are two types of junctors required for the system.

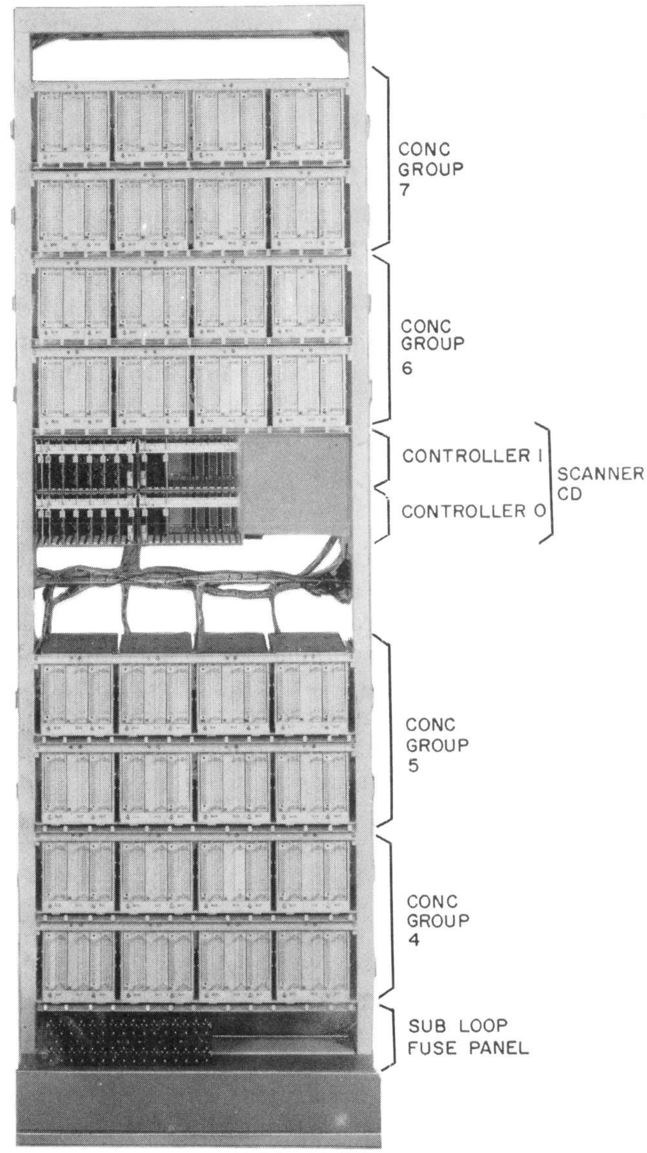


Fig. 36—Supplementary Remreed Network (SRN) Frame (J2H124B-1)

(1) Wire junctors—Wire junctors are as their name implies, simply wire paths which are physically connected on the junctor grouping frame.

(2) Circuit junctors—Circuit junctors provide a circuit connection for the talking path of intraoffice calls on the junctor grouping frame (Fig. 49). They are physically located on the universal trunk and junctor frame and are cabled to the junctor grouping frame. Each junctor circuit contains three relays and two scanner ferrods.

TRUNK FRAMES

4.40 There are two types of trunk frames: the universal trunk and junctor frame and the miscellaneous trunk frame. The universal trunk and junctor frame accommodates a maximum of 256 trunk circuits and the associated trunk control scanners and peripheral decoders. It also provides space for an optional 512-point scanner for miscellaneous trunk circuits.

A. Peripheral Decoder

4.41 The PD is used to deliver control signals to peripheral units. Signals are sent from central pulse distributor points to shift registers in the peripheral decoders in the form of serial bipolar pulse trains. In a typical application, each peripheral decoder is associated with four trunk circuits or circuit junctors, each having three relays. Each series of pulses is decoded to provide control signals for the three relays of one of the associated circuits. The peripheral decoder provides a low-cost, highly reliable signal distribution scheme.

4.42 The circuitry of the PD consists of 7-bit shift register, control logic, flip-flops, and relay drivers.

B. Universal Trunk and Junctor Frame

4.43 The universal trunk and junctor frame (Fig. 28) is universally wired so that any universal trunk or junctor unit consisting of four circuits arranged on a 2-inch mounting plate may be equipped in each of the 64 unit positions in bays 0 and 2 of the 3-bay frame. These bays also contain the scanner ferrod sensors needed for trunk circuit supervision. The center bay contains the trunk peripheral decoder (PD) and scanner control equipment. To save on control equipment, the universal trunk and junctor frames may be equipped with a 1024-point scanner control. If so equipped, it is called a home frame, or if not equipped with a scanner control, it is called a mate frame. The home frame operates either one-half of a 1024-point scanner matrix on each of the home and mate frames or a 512-point scanner matrix on the home frame and the optional 512-point master scanner on the home frame. The scanner control equipment is duplicated for reliability. The UTJ frame contains as many as 256 trunk circuits with 768 relays which are controlled by the PDs.

4.44 There are 64 PD circuit packs required to operate and release the relays in a fully equipped UTJ frame. A single PD circuit pack controls four trunk circuits. As only four trunks are lost in case of a PD circuit pack failure, duplication of the PD board is not necessary. Connectorized bus transformers are provided at the top of the UTJ frame for access to the peripheral bus.

C. Miscellaneous Trunk Frame

4.45 The miscellaneous trunk (MT) frames (Fig. 37) contain a variety of trunk and service circuits which do not fit the universal trunk size and control point requirements. The scanner function for these trunks is performed by a master scanner or by the master scanner option of a UTJ-HMS. The peripheral decoder points on the miscellaneous trunk frame are assigned as needed for trunk and service units located on each specific frame. Space is allowed for up to 16 PD packs per MT frame.

D. Trunks, Service Circuits, Wire Junctors, and Circuit Junctors

4.46 The relationship of wire junctors, circuit junctors, trunks, and service circuits in the No. 2B ESS is shown in Fig. 38. Customer lines, trunk circuits, and service circuits appear on one side of the network, and wire and circuit junctors appear on the other side. In general, circuit junctors are used in talking connections between customer lines of the same office or between lines and tones. In all other connections, wire junctors are used. Trunk circuits terminate or originate transmission facilities from or to other offices.

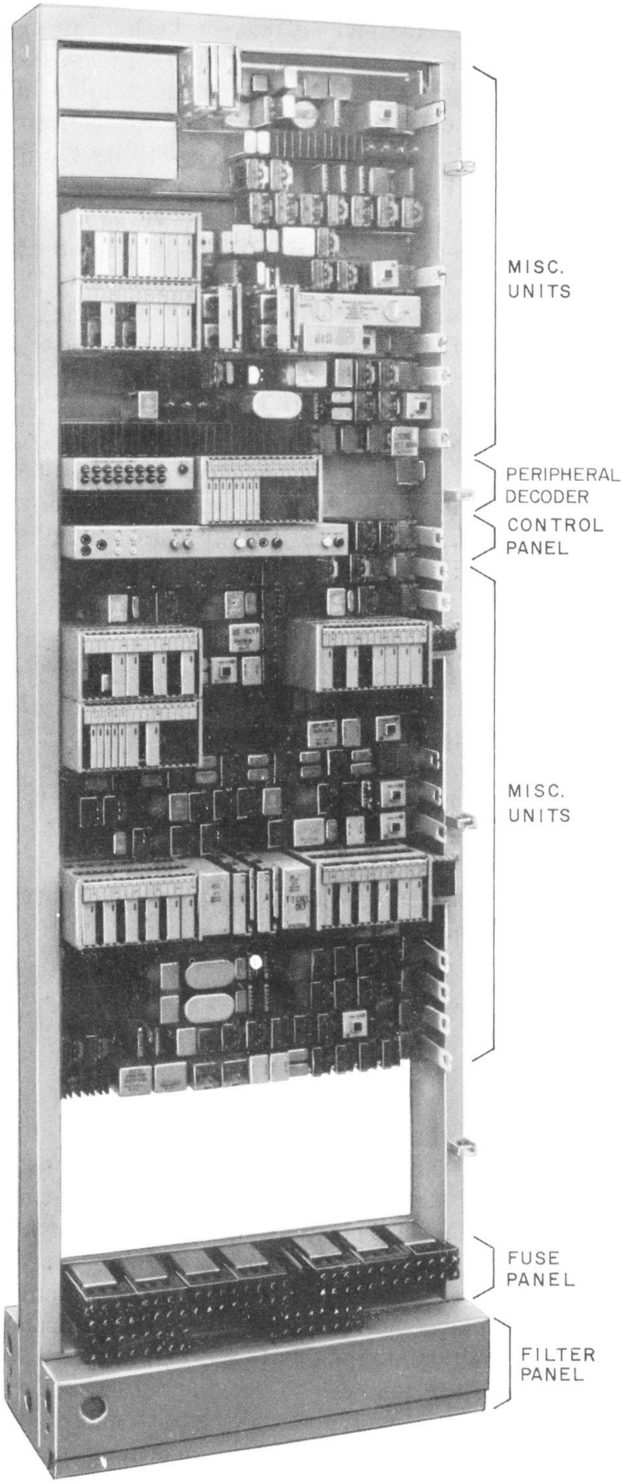


Fig. 37—Miscellaneous Trunk (MT) Frame (Typical)

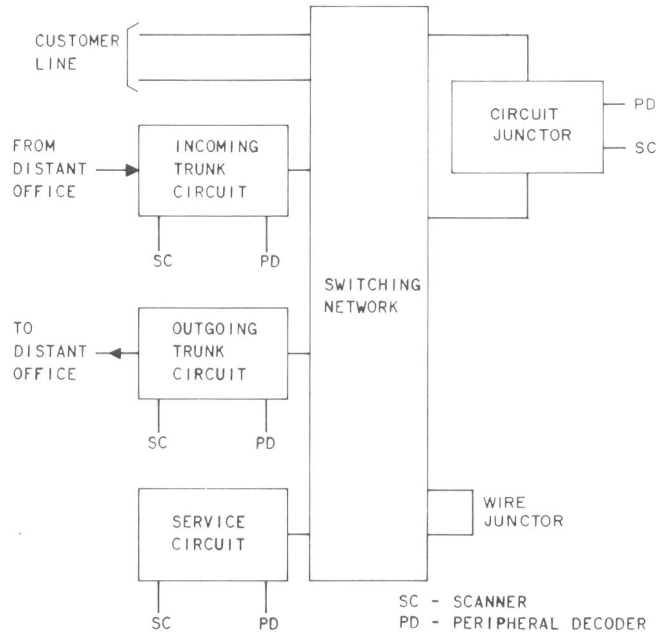


Fig. 38—Relationship of Lines, Trunks, and Service Circuits to Switching Networks

These circuits can be connected to each other or to customer lines through the network and wire junctors to establish telephone connections. Basically, circuit junctors and trunk circuits provide talking battery to customers and means for receiving or transmitting call status signals (supervision).

4.47 The circuit junctor supplies audible ring tone to the calling line, battery to calling and called lines on an intraoffice connection, supervision of these lines for disconnect indications, and a transmission path between the two lines. The circuit junctor may also be used as a wire junctor if all relays are released.

4.48 The No. 2B ESS service circuits perform specialized functions, such as digit reception and transmission, alerting, informing, etc. These circuits, like trunk circuits, communicate with the system control via scan points and PDs. Their holding time is lower than that of trunk circuits, and their usage is primarily confined to the setup period of a call with a few exceptions such as conference circuits.

T-CARRIER DIRECT INTERFACE

4.49 The T-carrier direct interface provides an option that enables the functions normally performed by a trunk circuit and a channel unit to be performed by a direct interface channel unit. However, a conventional channel unit can be connected to an ESS trunk circuit via an interface frame and the intermediate distributing frame (IDF). The special ESS interface frame is installed adjacent to a standard D3 or D4 complex frame or between two complex frames as shown in Fig. 39. The D3 or D4 complex will house both direct interface and conventional channel units.

4.50 The interface frame contains an interface circuit for each of the complex frames. This circuit provides the PD packs and PD power control units necessary for operating the direct interface channel units. The interface circuit also contains peripheral decoder bypass (PDB) circuit boards which are used to connect 4-wire trunks to conventional channel units. In addition the interface frame houses a power filter and alarm circuitry.

4.51 The T-carrier system relationship block diagram in Fig. 40 shows the customer line or trunk connecting through the switching network and IDF to the direct interface channel unit. The trunk circuit functions are controlled from the interface frame via a +24 volt lead and peripheral decoder leads 0, 1, and 2. The central pulse distributor controls the outputs of leads 0, 1, and 2 via the PD packs located in the interface frame. Audible ringing tone is sent to the channel unit through the IDF. The condition of the channel unit is monitored by the master scanner using channel (SC) leads.

REMOTE OFFICE TEST LINE

4.52 The remote office test line (ROTL) is a feature that allows interoffice trunk testing automatically from a centralized automatic reporting on trunks (CAROT) system. The CAROT system is a computerized system that automatically accesses and tests trunks in up to 14 offices simultaneously. Manual trunk testing may be performed locally or remotely using a manually controlled interrogator and ROTL control unit equipment combination (MCI/RCU) (Fig. 41) or a ROTL system test set (H-310-150) (Fig. 42).

4.53 The No. 2B ESS can serve as a "near-end" office, a "far-end" office, or both near and far. A near-end office contains equipment necessary to select and set up testing of trunks terminating in a distant office. A far-end office contains equipment necessary to permit access to its trunks and test lines by a near-end office or CAROT test center for testing purposes. Figure 43 shows the relationship between the CAROT system and the near-end and far-end ROTL applications. The near-end feature is provided in all generics in No. 2B ESS offices. Translation changes are also required for the ROTL feature. The far-end application can be obtained with any generic. The equipment necessary to support the different office applications is mounted on the ROTL frame. This equipment, mounting location, and application is detailed in Fig. 44. The type of tests which can be made by ROTL are:

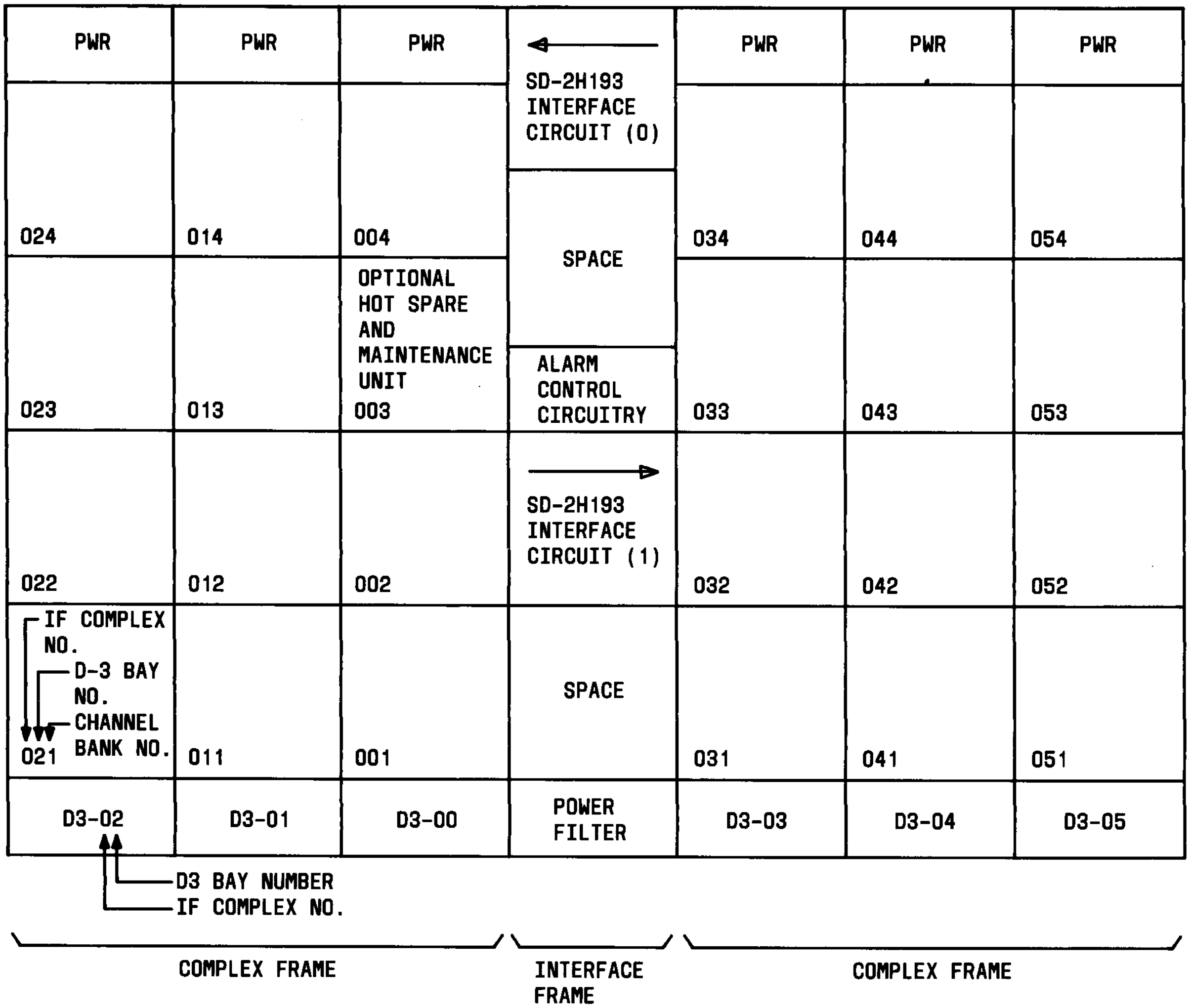
(a) Automatic and manual tests to a 100-type test line (1000 Hz followed by quiet termination)

(b) Automatic and manual tests to a 102-type test line (1000 Hz)

(c) Responder-to-responder testing to a 105-type test line.

CENTREX

4.54 A block diagram of a typical centrex customer group is shown in Fig. 4. Only one console is shown, although on larger centrex installations additional consoles may be provided to handle greater attendant traffic. The centrex station telephones are connected directly to the switching network just as noncentrex subscribers are connected. The universal attendant trunk and loop circuits are connected to the network to provide a talking path for the attendant. Only one talking path is provided for each attendant console since an attendant can be connected to only one call at a time. The data loop provides the 2-way data path. The system is controlled by the No. 2B ESS control unit. Tie trunks and ***foreign exchange (FX)*** trunks through which a centrex customer group may have access to other switching systems are also connected to the network.



NOTE:
A OPTIONAL HOT SPARE AND MAINTENANCE UNIT CAN BE IN ANY D3 COMPLEX FRAME IT IS RECOMENDED THAT THE UNIT BE PLACED IN BAY 00 POSITION 003.

Fig. 39—No. 2B ESS-D3 Complex Arrangement of Frames

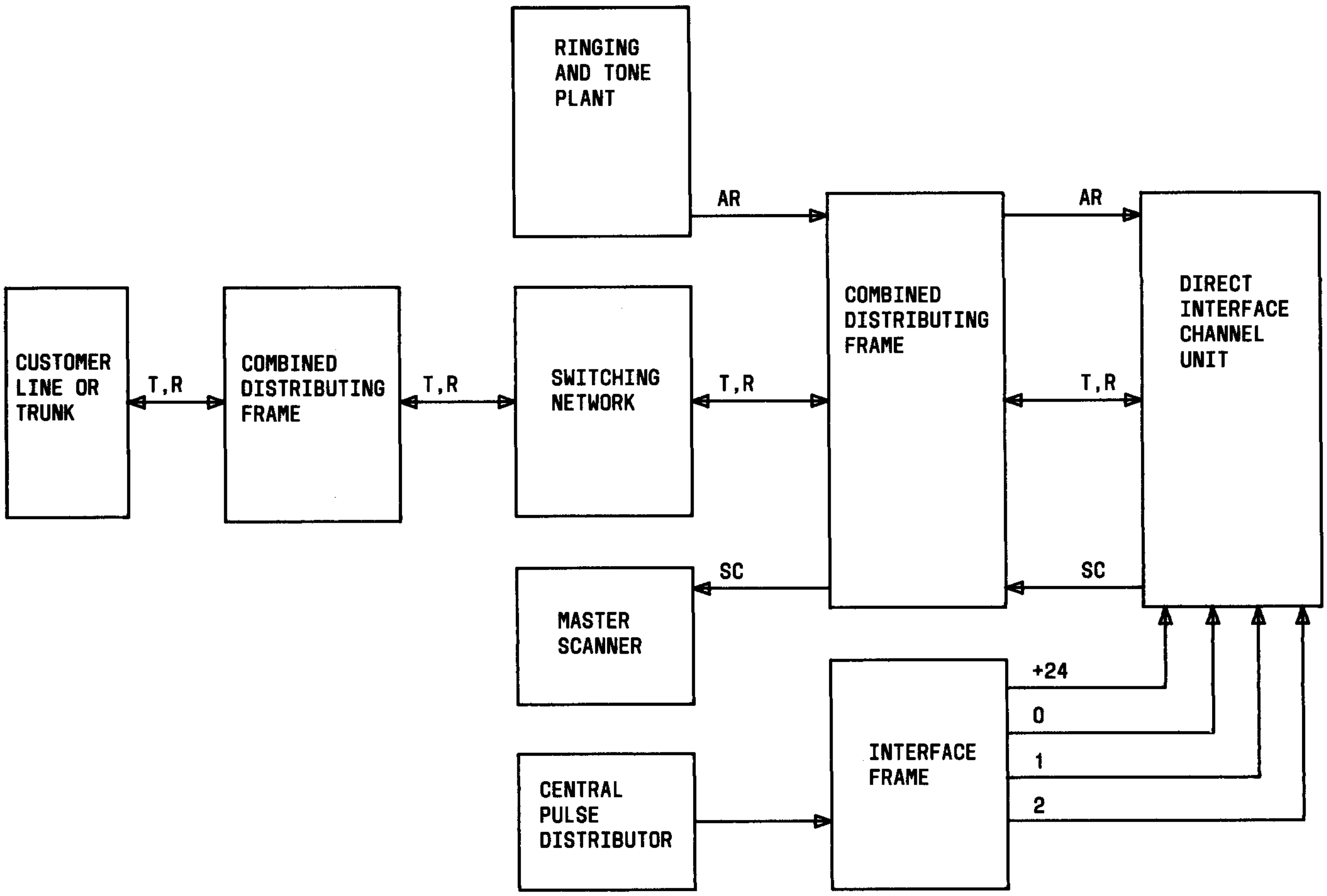


Fig. 40—Block Diagram of T-Carrier Interface

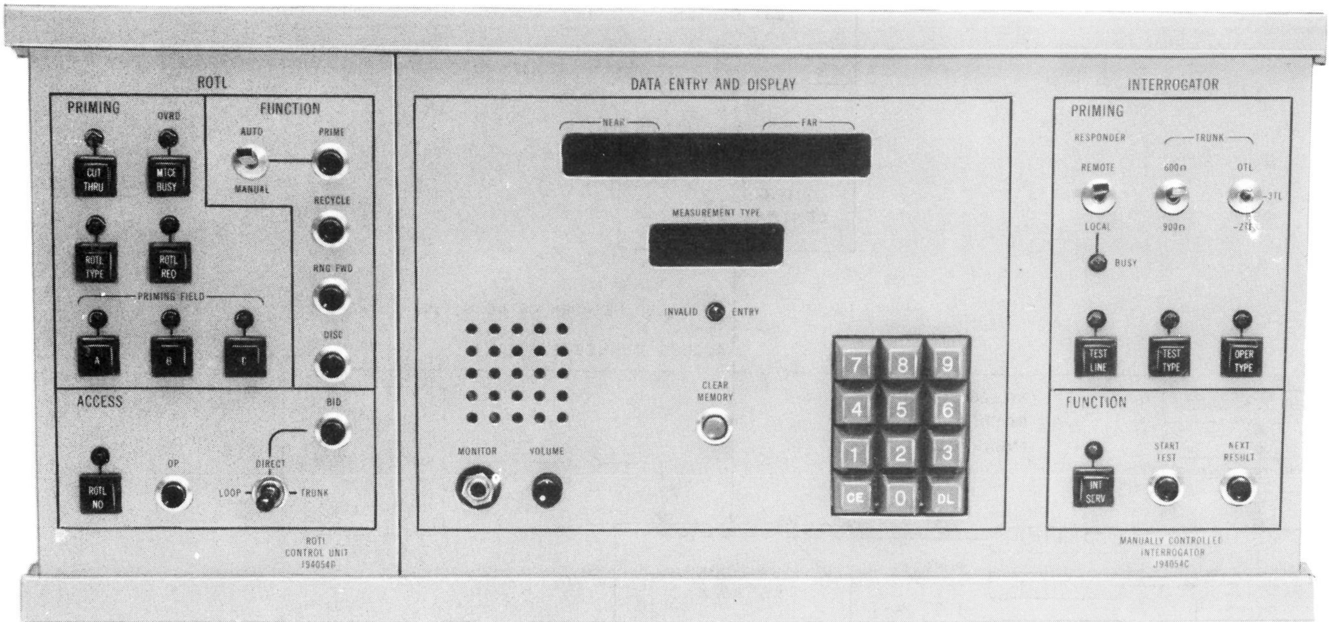


Fig. 41—RCU and MCI Control Panel

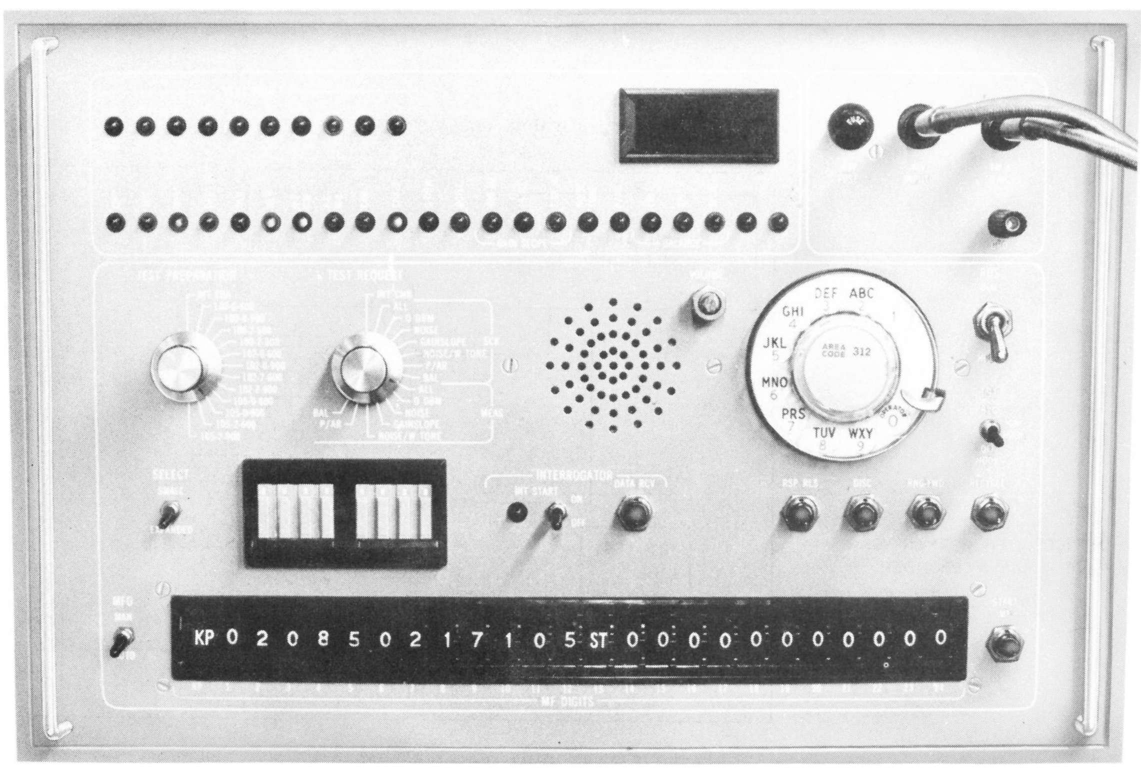


Fig. 42—ROTL System Test Set (H-310-150)

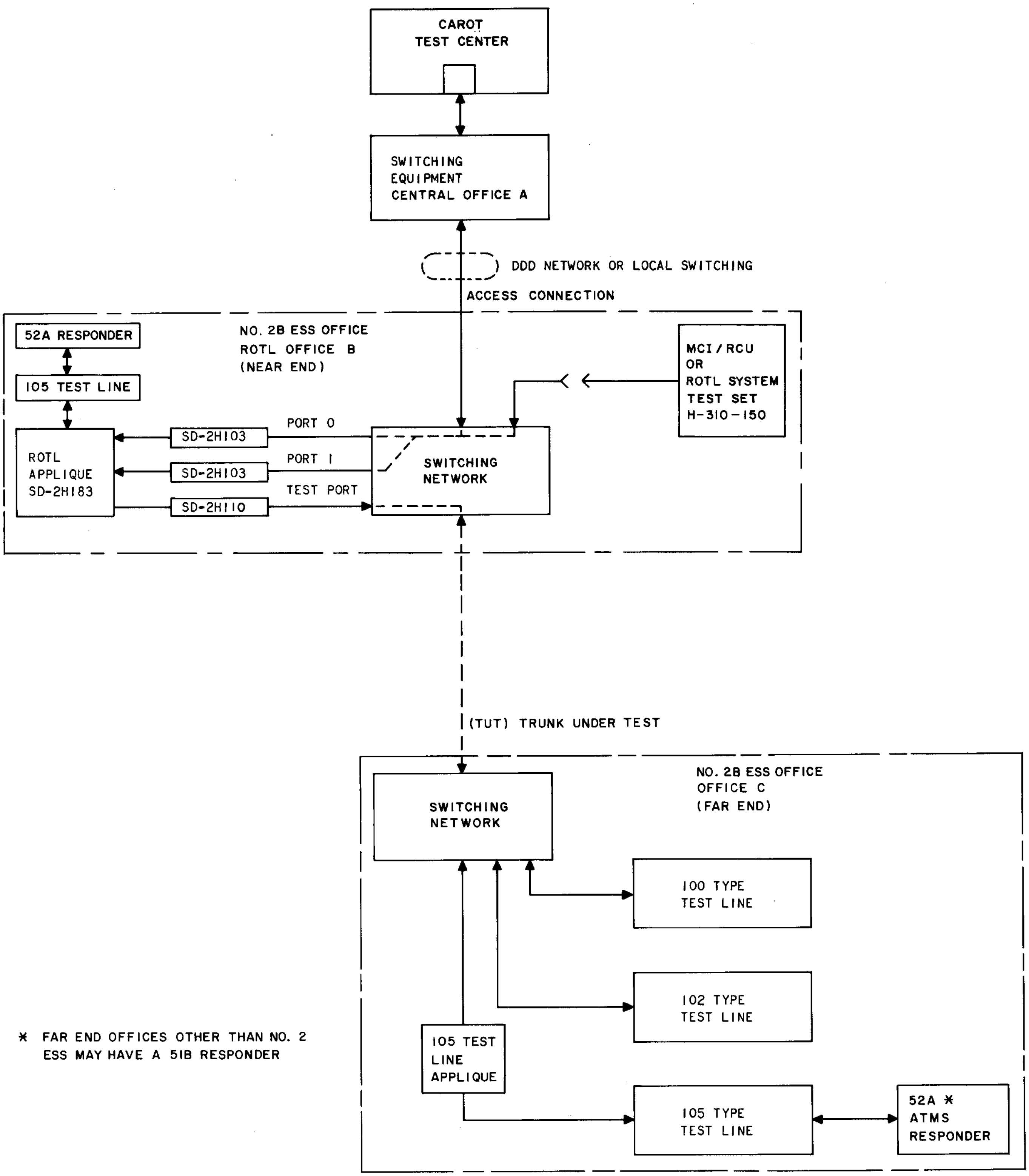


Fig. 43—No. 2B ESS ROTL Application

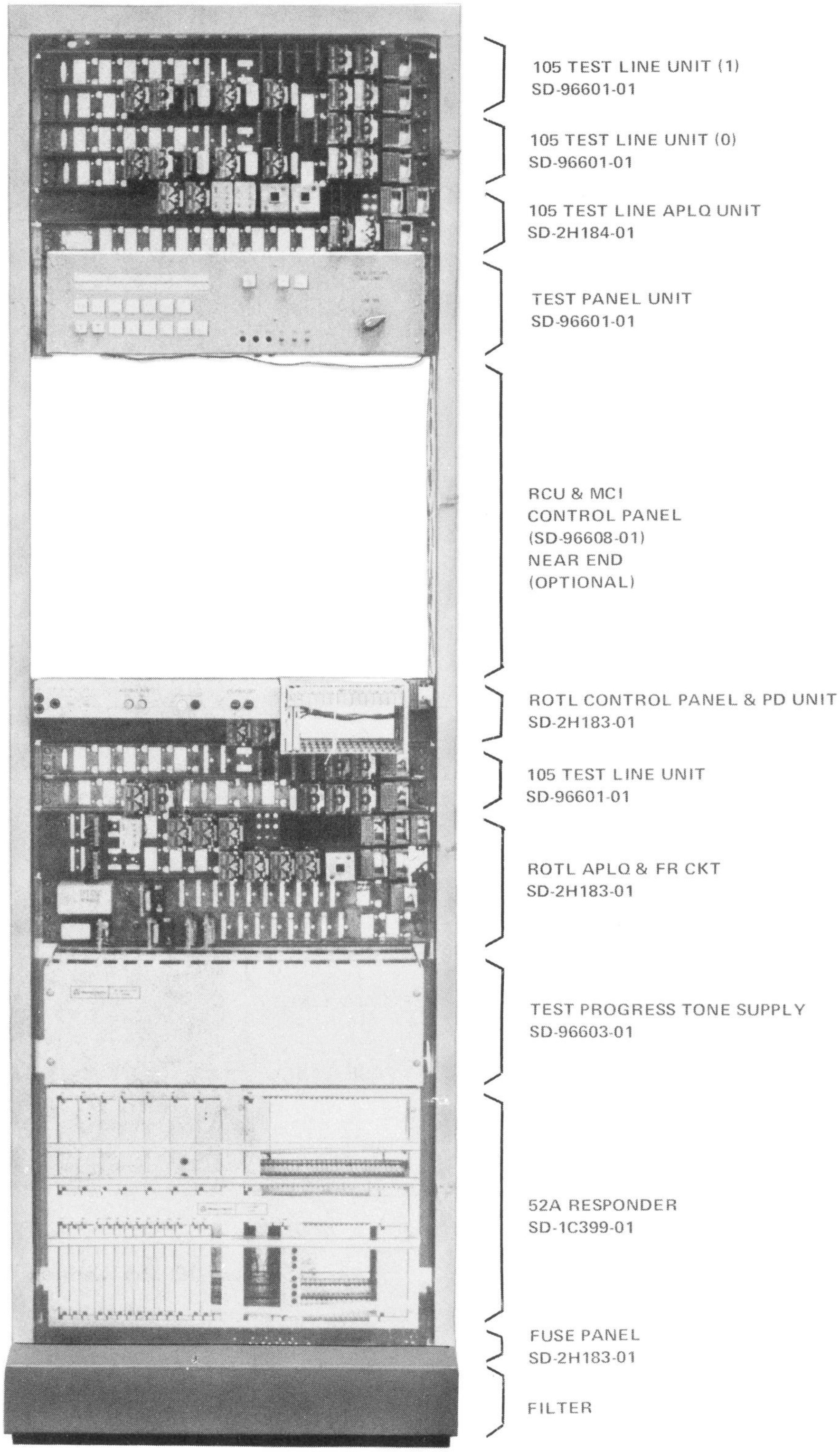


Fig. 44—ROTL Frame

4.55 The centrex system is also available with the Simplified Console Attendant (SCA). The SCA feature provides attendant capabilities to business customers requiring centrex service without using the universal console and associated data link equipment. The attendant uses simplified consoles to assist on incoming and outgoing calls of various types.

A. System Organization and Operation

4.56 Centrex operation is under control of the control unit in a No. 2B ESS central office. Portions of the existing call store and program store are assigned for the use of each customer group. Scan points, peripheral decoder points, duplicated central pulse distributor points, and connections to the duplicate peripheral buses are supplied for centrex operation.

4.57 A centrex data link frame (Fig. 45) which provides the interface between the central office and the data loop, is located in a No. 2B ESS central office. One data link unit is used in conjunction with each data loop. Up to eight data links and one data link controller are mounted in each frame. Each data link contains a key signal receiver circuit, a lamp data transmitter circuit, and connections to the common control equipment.

4.58 The data link controller appears as a peripheral unit on the system peripheral unit bus. The main function of this controller is to receive data messages from the control unit and to steer them to the proper data link.

4.59 A centrex console control cabinet is located on the customer premises. This cabinet provides the interface between the consoles and the data loop. Up to four consoles may be controlled by one attendant console control cabinet. Each console control cabinet can accommodate a maximum of four console control units. A console control unit is required for each attendant console. In addition to the console control units, each console control cabinet contains a transmitter, a receiver, a lamp control circuit, and a power supply, all of which are common to all consoles connected to the console control cabinet.

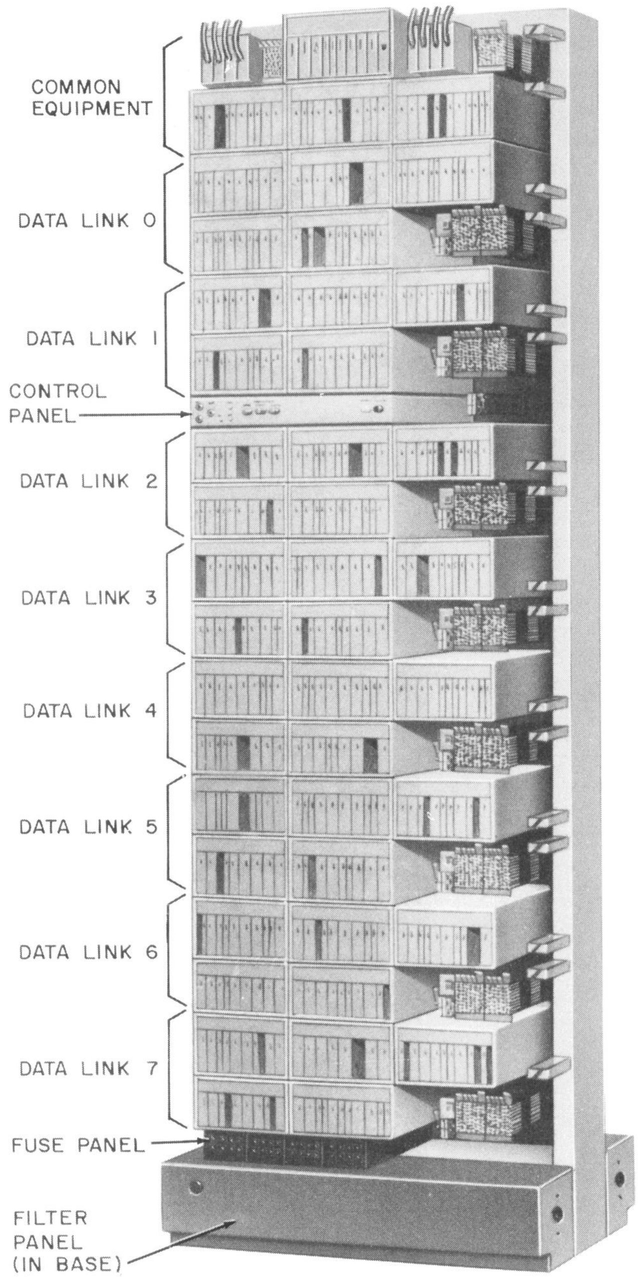


Fig. 45—No. 2B ESS Centrex Data Link Frame

4.60 Refer to Section 232-190-012, General Description Centrex CO Feature Document, for additional information on centrex.

DISTRIBUTING FRAMES

4.61 ***Combined Distributing Frame (ED-1A222):*** The combined distributing frame (CDF) is a combination of a main distributing frame and a trunk distributing frame. The CDF provides for connections of 6080 central office pairs.

4.62 The CDF (Fig. 46) faces the protector frame across a 4-foot aisle and the two frames grow perpendicular to all other frame lineups. The combined distributing frame provides a means for interconnecting:

(a) Lines terminated on the protector frame to network terminals

(b) The network side of trunk circuits and service circuits, to network terminals, and

(c) Lines terminated on the protector frame to miscellaneous circuits.

Service observing jack panels, which provide access for service observing circuits for every line within the office, are mounted on the rear of the CDF as needed.

4.63 ***Intermediate Distributing Frame:*** The IDF is the same framework used by the No. 1 ESS as a trunk distributing frame. It should be placed in an equipment frame lineup which is located centrally in the office. The IDF is used to cross-connect:

(a) Trunks terminated on the protector frame or voice frequency carrier to miscellaneous circuits; ie, E6 repeaters, 4-wire terminating sets, E&M appliques, etc.

(b) Trunks terminated on the protector frame or voice frequency carrier to trunk circuits,

(c) Trunk cable to trunk cable, and

(d) Trunk cable to subscriber line equipment (via tie cable to the CDF).

4.64 ***Low Profile Conventional Distribution Frame (ED-97754-70):*** The ED-97754-70 low profile conventional distributing frame (LPCDF), was designed for use with the remreed network; however, the LPCDF is optional since the ED-1A222 combined distributing frame may be used with the RN. The LPCDF combines all cross-connection capability into a single unit (Fig. 47). This unit is dual-sided, containing both horizontals and verticals. The horizontal side terminates central office equipment, and the vertical side terminates outside plant cable pairs. The LPCDF eliminates the need for the single-sided protector frame, intermediate distributing frame, and ED-1A222 combined distributing frame which were used with the No. 2B ESS ferreed network.

4.65 The LPCDF is 8 feet high, 4 feet 3 inches wide at the rails and employs an 8-inch center-to-center spacing both between verticals and between horizontal shelves. The frame contains 10 horizontal shelves each of which is approximately 20 inches deep.

4.66 The LPCDF, equipped with high density 305 connectors, can terminate 1000 outside plant cable pairs on each vertical. The horizontal side of the LPCDF is equipped with 89-type connecting blocks for terminating inside plant equipment. The 89-type connecting block can terminate 96 pairs.

4.67 ***Protector Frame:*** The protector frame (Fig. 48) provides protectors for 6000 outside plant pairs. A protector (without heat coils) guards against lightning and other foreign potentials and serves tip and ring conductor pairs. The connector for 100 protector units is shipped with a stub cable long enough to reach its termination in a cable vault or on a wall rack. The module has 12 verticals of five connectors each. A compact loudspeaker system is provided for intraoffice communication. No plugging-up panels are required since lines in trouble are automatically routed to trouble intercept by the program. A conductor identification circuit permits a cable splicer to identify pairs without assistance.

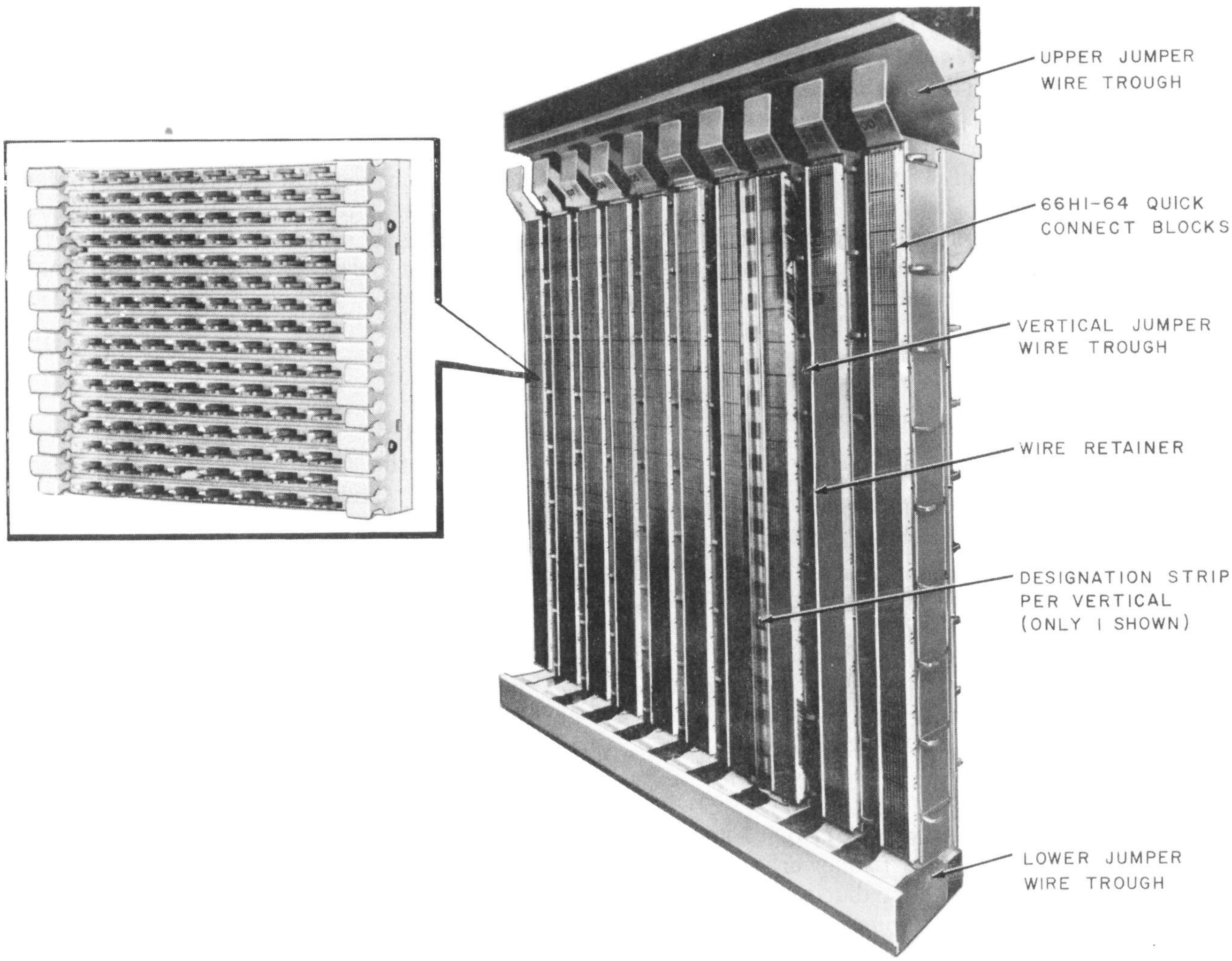


Fig. 46—Combined Distributing Frame (ED-1A222)

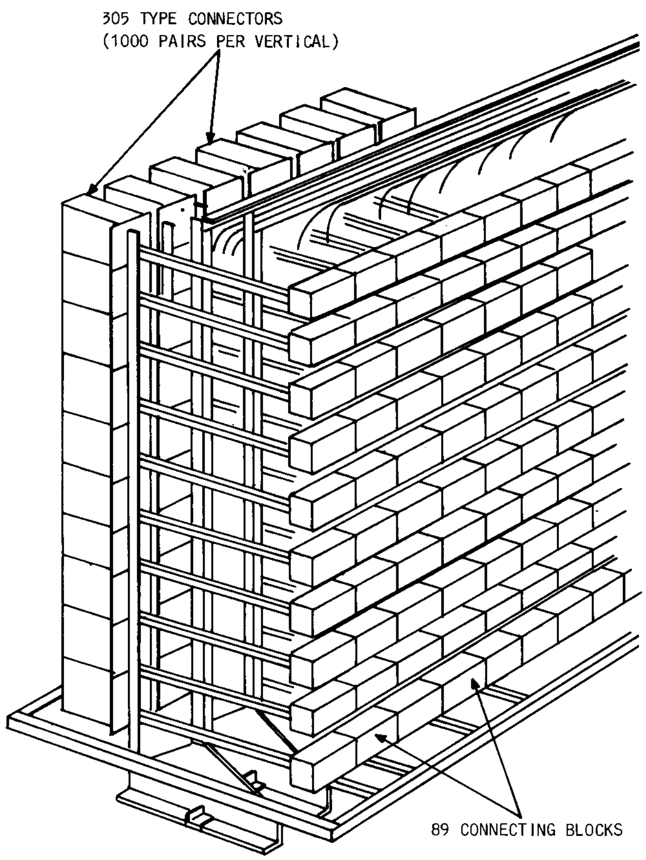


Fig. 47—Low Profile Conventional Distributing Frame

4.68 ***Junctor Grouping Frame:*** The junctor grouping frame (JGF) which is used for the distribution of network junctors, provides up to ten vertical files for network or junctor appearances (see Fig. 49). Each vertical file contains 32 plugs and 32 jacks which may be used to interconnect either the junctors from one network (64 eight-pair junctor subgroups) or 32 junctor circuit subgroups.

AUTOMATIC MESSAGE ACCOUNTING

4.69 The optional automatic message accounting (AMA) frame (Fig. 50) contains two 9-track incremental tape recorders that are used for recording customer billing information.

4.70 The customer billing information is assembled into entries and then transferred to the tape in the triple-entry system similar to No. 5 Crossbar. The entire process is under stored program control, and the only special office equipment required is the AMA frame which should be located near the MTCE for operating convenience. Small offices may use centralized automatic message accounting (CAMA) centers without the local AMA frame.

4.71 The No. 2B ESS, with the 2B-EF-1 generic program, can record call details on approximately 12,700 calls per busy hour. With the 2B-EF-2 generic program plus certain optional AMA hardware modifications, the recording capacity is increased to approximately 18,500 busy hour calls. By increasing the system recording capacity, the operating companies are enabled to implement usage sensitive pricing (USP) tariffs in approved areas.

RECORDED ANNOUNCEMENT FRAME

4.72 The recorded announcement (RA) frame, when equipped with a 7A announcement machine (Fig. 51), provides for a maximum of six announcements on a small magnetic drum recorder. Each announcement channel has a record-reproduce amplifier associated with it. Distributing resistors are provided for each announcement channel to isolate the outputs, which may total 120 (20 per channel maximum).

4.73 The supervisory control unit, a 624 telephone set, is used to select the desired channel for recording or monitoring. This unit, which may be located in another room, can serve two recorded announcement frames.

4.74 The J1A058C recorded announcement frame (Fig. 52), equipped with the 13A announcement system, replaces the J1A058A recorded announcement frame. The J1A058A frame is no longer manufactured. The J1A058C RA frame, designed to use from one to eight variable length message modules in the 13A announcement system, can presently be equipppd with from one to six modules. The limit to six channels is to maintain compatibility with the J1A058A RA frame, which is designed for six channels. The RA frame equipped with the 13A system will provide a fanout capability of 120 service circuits per channel. Wiring in the RA frame will limit the total fanout of 720 circuits per frame.

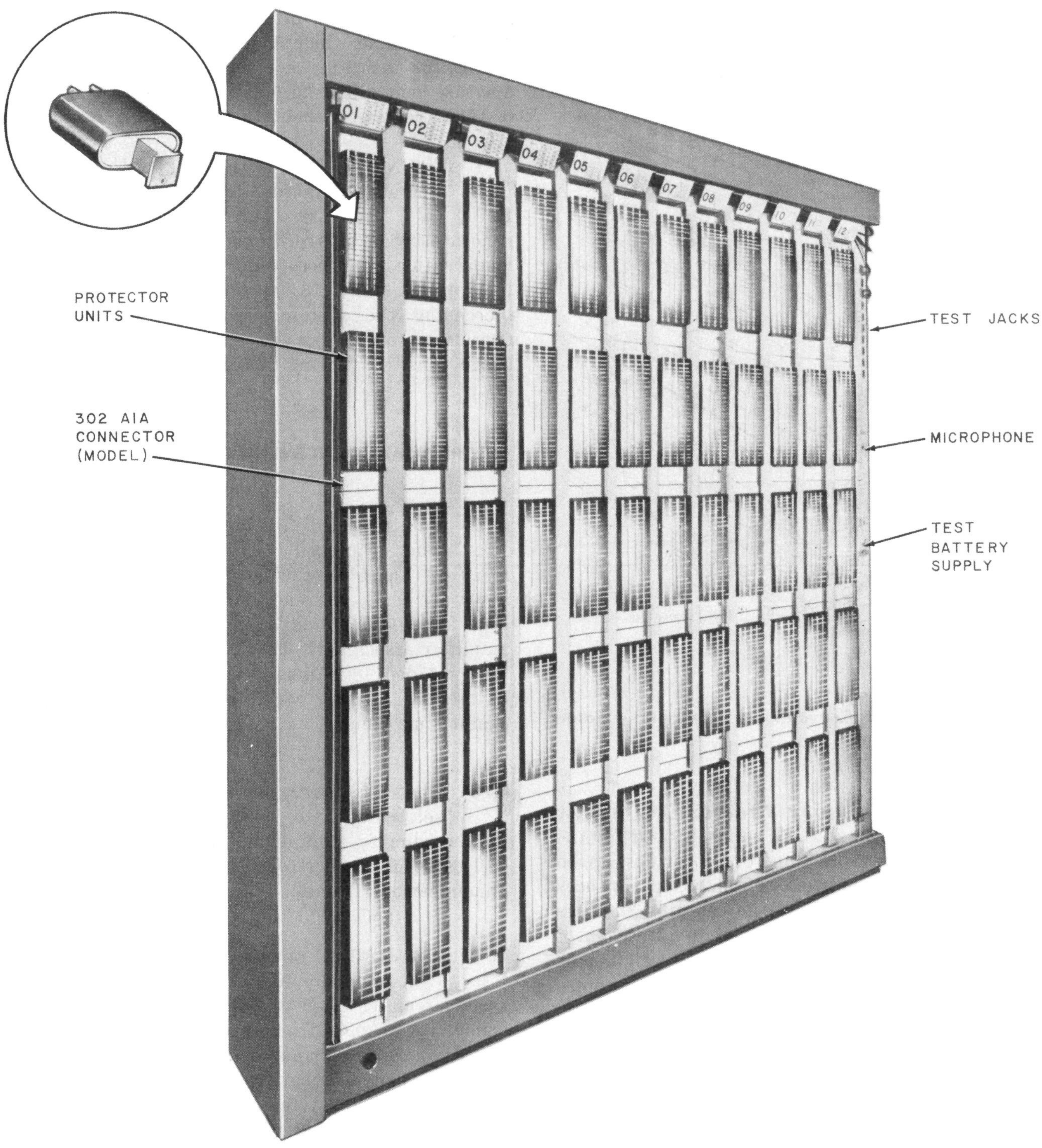


Fig. 48—Protector Frame

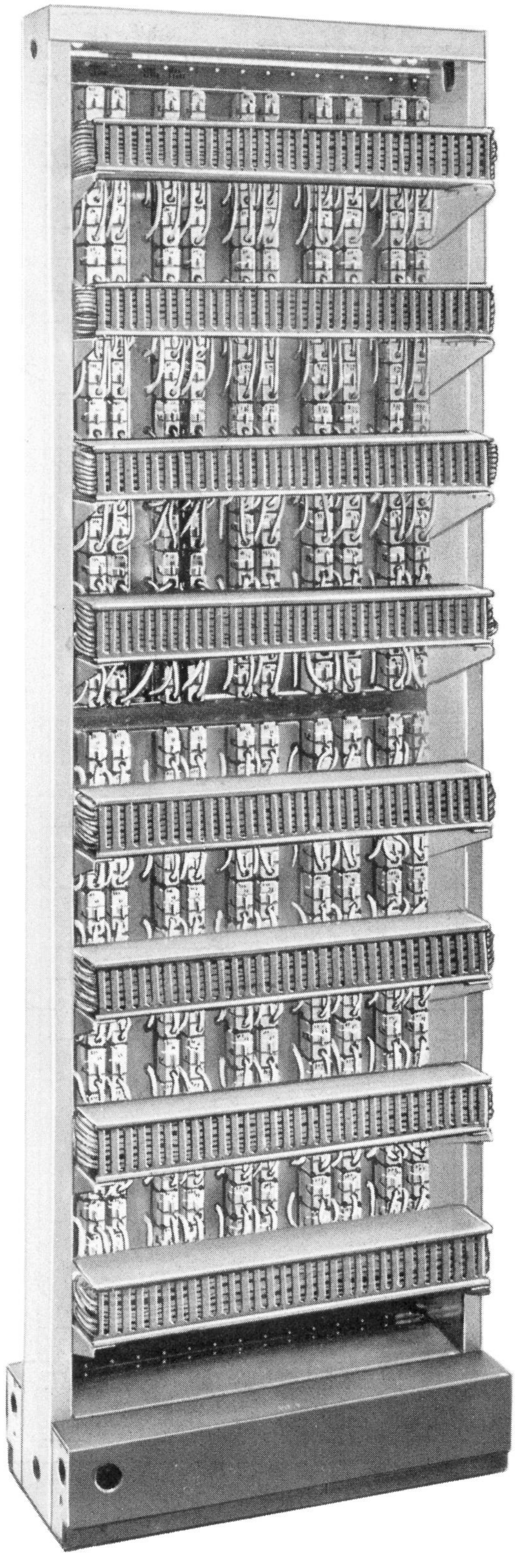


Fig. 49—Junctor Grouping Frame (Fully Equipped)

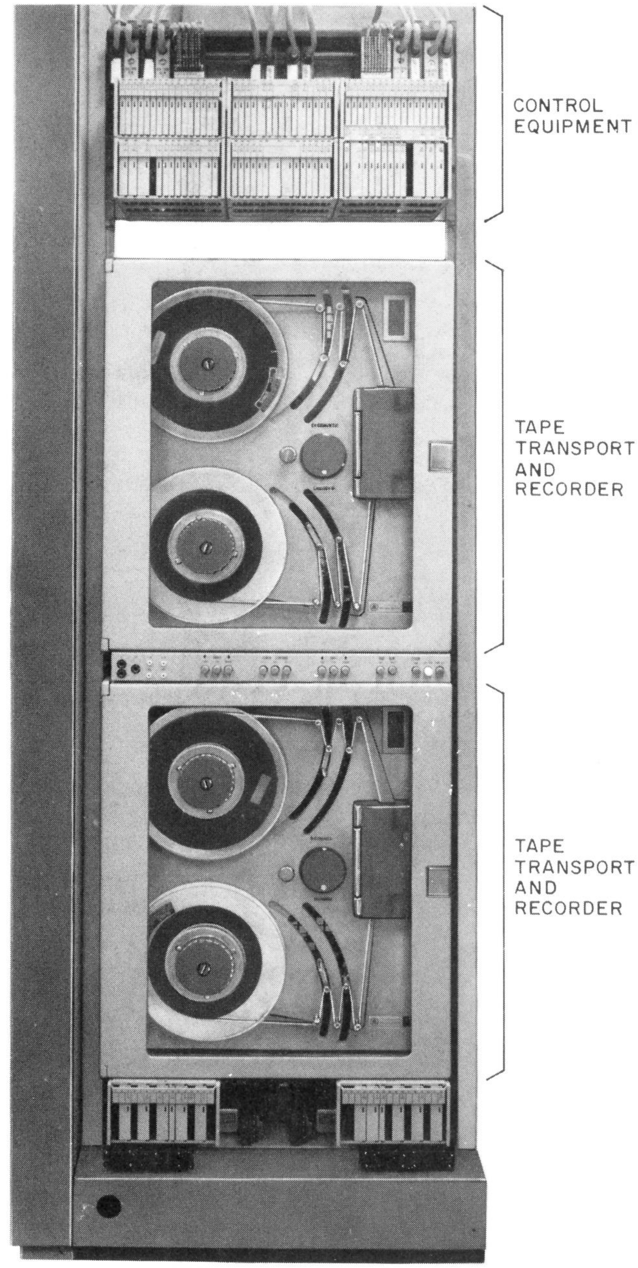


Fig. 50—AMA Frame

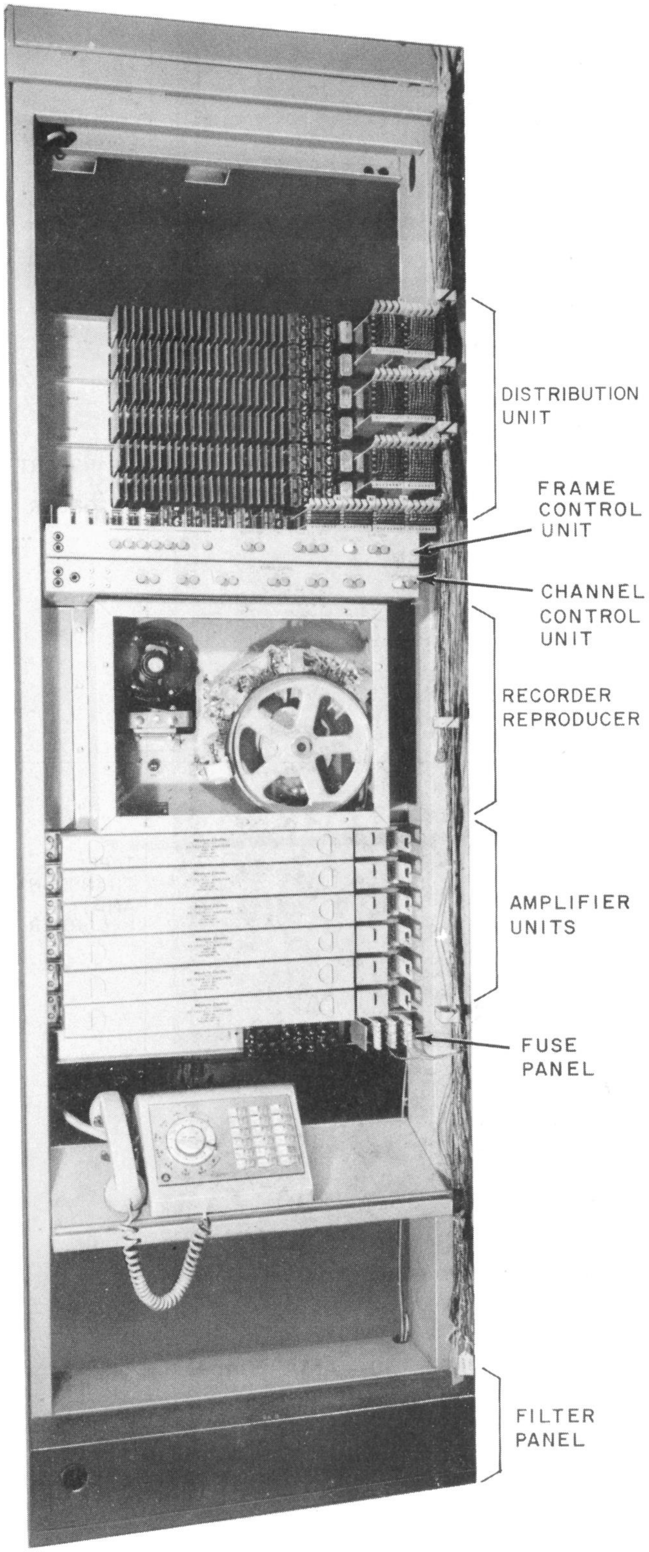


Fig. 51—Recorded Announcement (RA) Frame (J1A058A)

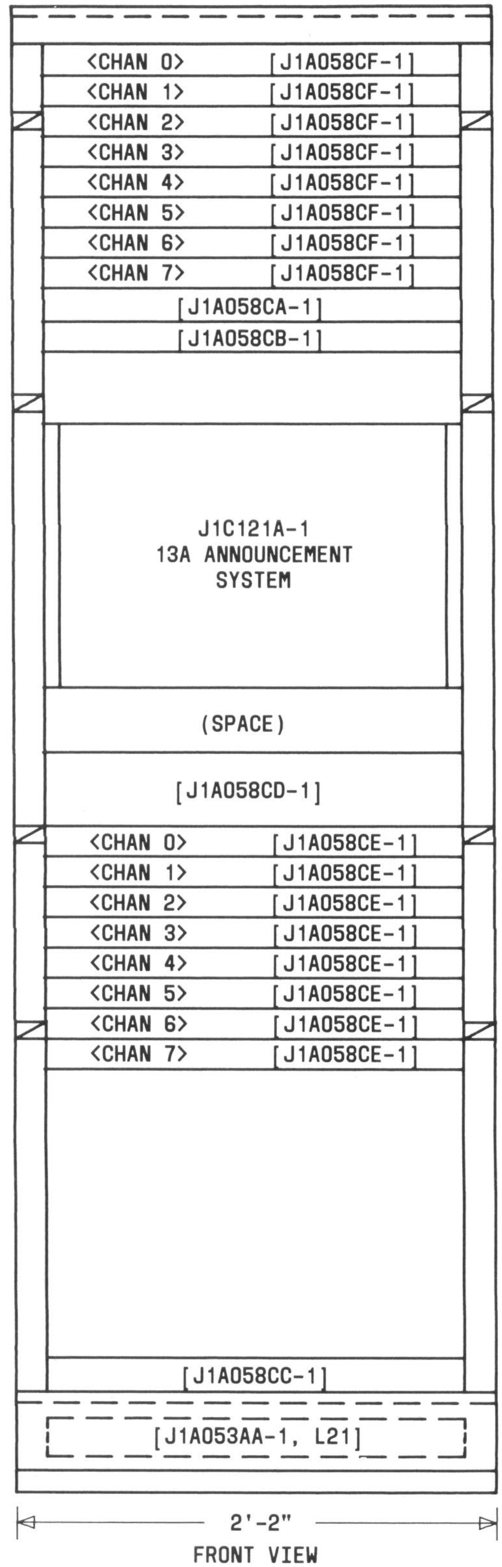


Fig. 52—Recorded Announcement (RA) Frame (J1A058C)

4.75 Recordings may be made at the RA frame by a G-type handset plugged into the jacks provided, or by a tape player connected to the tape input. The tape input will also allow dubbing of professionally prepared prerecorded messages on the 13A system.

RANGE EXTENSION FRAME

4.76 The range extender circuits are mounted on plug-in circuit packs in range extension frames (Fig. 53). The units are arranged to be growable in increments of 24 circuits to a maximum of 144 per frame.

4.77 Range extenders, when required, are provided in 16-circuit increments, corresponding to the 16 B links on a network concentrator. For reliability, each concentrator is range-extended from two different range extension frames. Therefore, range extension frames should always be furnished in pairs.

4.78 Unlike No. 5 Crossbar, separate 72V power frames are not required in No. 2B ESS. Each range extender circuit pack contains its own dc-to-dc converter which provides the required increased voltage.

MISCELLANEOUS FRAME

4.79 The miscellaneous (M) frame is designed to accommodate a variety of units which require neither peripheral decoders nor scanner access. These units include emergency manual lines, a multiplicity of common systems units, the test battery supply, etc. They are designed to accept a number of standard power filter, fuse panel, and control panel combinations to meet varying office requirements.

AUTOMATIC IDENTIFIED OUTWARD DIALING (AIOD)

4.80 The Automatic Identified Outward Dialing (AIOD) feature provides the means for identifying a PBX or Centrex-CU telephone extension number when that telephone is used to make an outward call requiring AMA recording. In the past, calls requiring billing of the extension number required the manual intervention of an operator. The AIOD feature provides a means of billing the PBX or Centrex-CU extension number.

4.81 In the No. 2B ESS, the AIOD feature is available to any PBX or Centrex-CU customer. However, the PBX or Centrex-CU customer must be equipped with automatic number identification (ANI) equipment. In order to implement this feature, the No. 2B ESS must be equipped with local automatic message accounting (LAMA), and a 2 foot 2 inch wide AIOD frame (Fig. 54).

4.82 There are four principal items of equipment involved in providing AIOD with No. 2B ESS:

A Central Office Trunk—A central office trunk is used to describe the talking connection that exists between the Centrex-CU and the No. 2B ESS. The central office trunk is treated as a line in the No. 2 ESS and it is treated as a trunk at the Centrex-CU. At the No. 2B ESS, each line is a member of a multiline hunt group (MLHG), not because of any need to do multiline hunting, but because all of the lines need to be grouped, need to share a common listed directory number billing number, and need to use the buffer table associated with the MLHG.

- ***ANI Equipment At Customer's Location***—The ANI equipment is used to identify the Centrex-CU station and the particular central office trunk being used to connect the station to the central office. This equipment is usually located on the customer's premises.

- ***AIOD Interface Circuit***—The AIOD interface circuit (AIODIC) is used to receive the coded station and trunk numbers from the ANI equipment and to perform data validation checks. This equipment is located in the No. 2B ESS office. The AIODIC consists of the receiver, check circuitry, shift register, test transmitter, and ANI connecting unit.

- ***Dedicated Data Link***—The data link is a dedicated voice grade pair between the ANI and AIODIC. It is used to signal between the ANI and the AIODIC and to transmit the coded information from the ANI to the AIODIC.

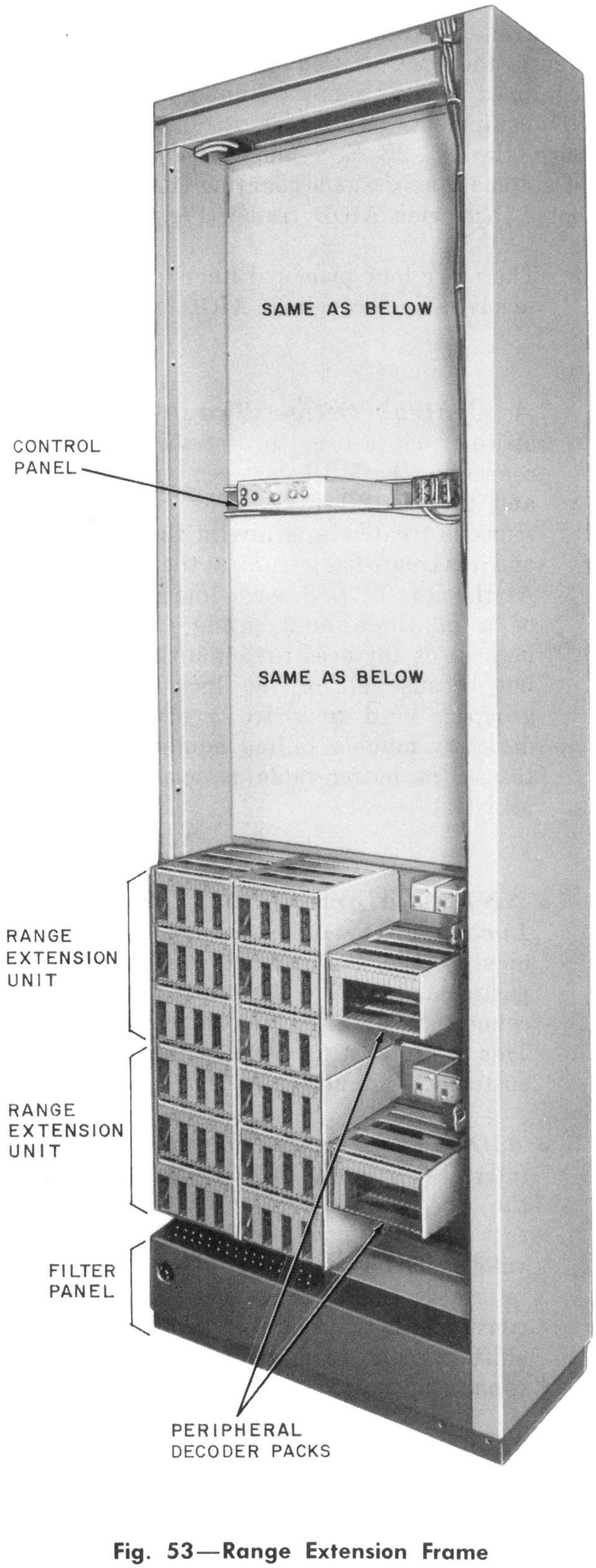


Fig. 53—Range Extension Frame

TRUNK TEST FRAME

4.83 The trunk test frame (Fig. 55) is located adjacent to the MTCE and provides the following test facilities for the No. 2B ESS:

- Manual testing for trunks, service circuits, lines, junctor circuit, range extension circuits, and attendant loop circuits
- Monitoring of busy connections in the office
- Talking connections over lines or trunks for intra or interoffice communication
- Means to remove circuits from service and to restore circuits to service.

4.84 Connection of a circuit to the trunk test frame is accomplished by dialing prescribed data formats on the panel mounted TOUCH-TONE® dial. The trunk test frame has three access trunks, each of which is assigned a directory number and has appearances on the line trunk network. Operating specific keys on the panel sends test call information to the 3A CC. Lamps on the panel indicate the type of test being performed and the success or failure of a request for system action. Optional test gear required by the operating company is mounted on this frame.

LOOP RANGE EXTENSION FRAME (J2H048A)

4.85 The loop range extension (LRE) frame (Fig. 56) consists of a single bay framework 2 feet 2 inches wide, 1 foot deep, and 7 feet high. Each frame contains as many as four range extension units, a control panel, a fuse and power distribution unit, and a peripheral decoder (PD) unit.

4.86 Each of the four range extension units can accommodate forty 7A range extender plug-in boards. Each board contains two range extension circuits. A complete frame can accommodate 160 plug-in boards (320 range extension circuits). Range extension units can be added to the frame one at a time.

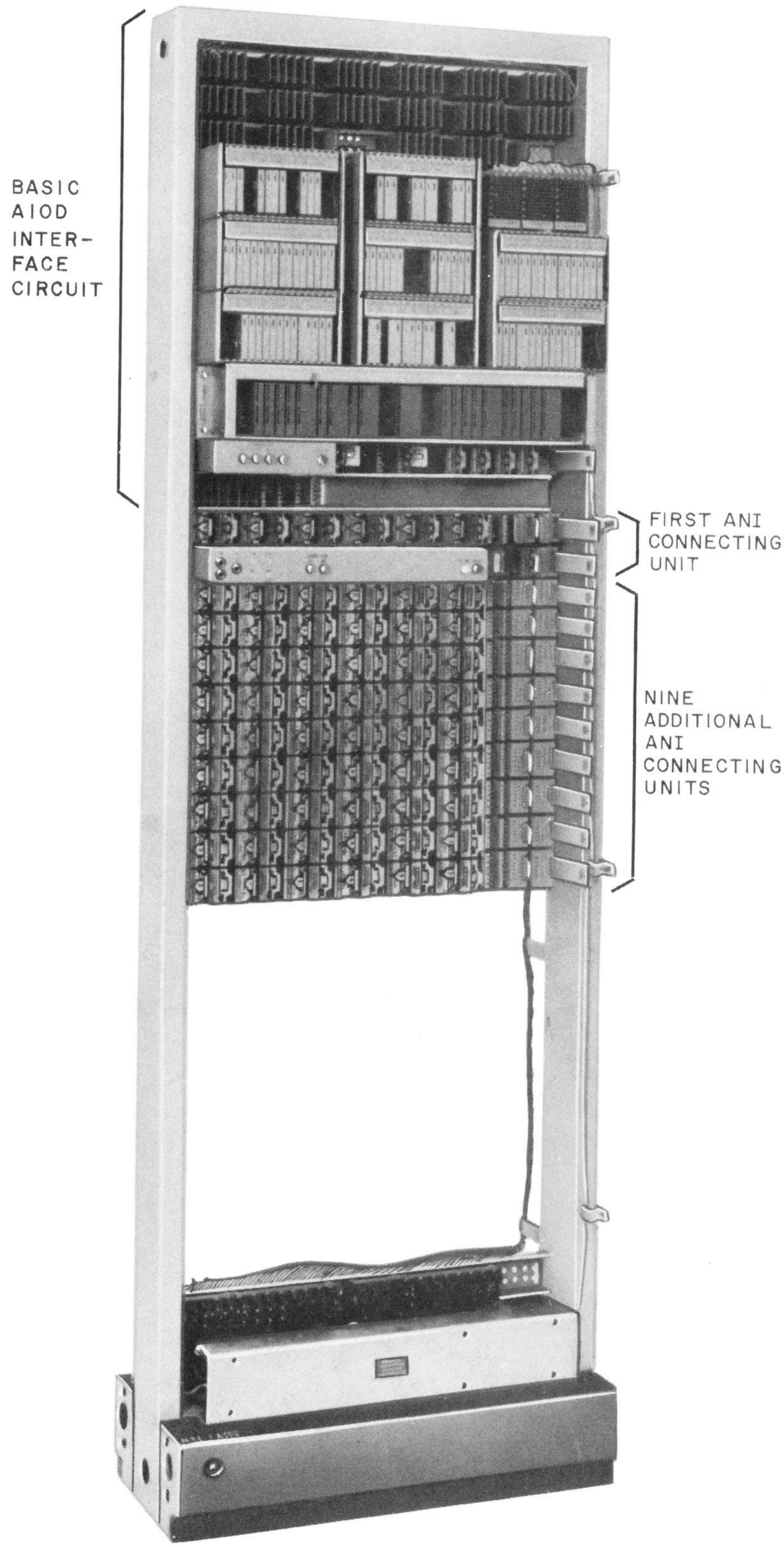


Fig. 54—Fully Equipped AIOD Frame

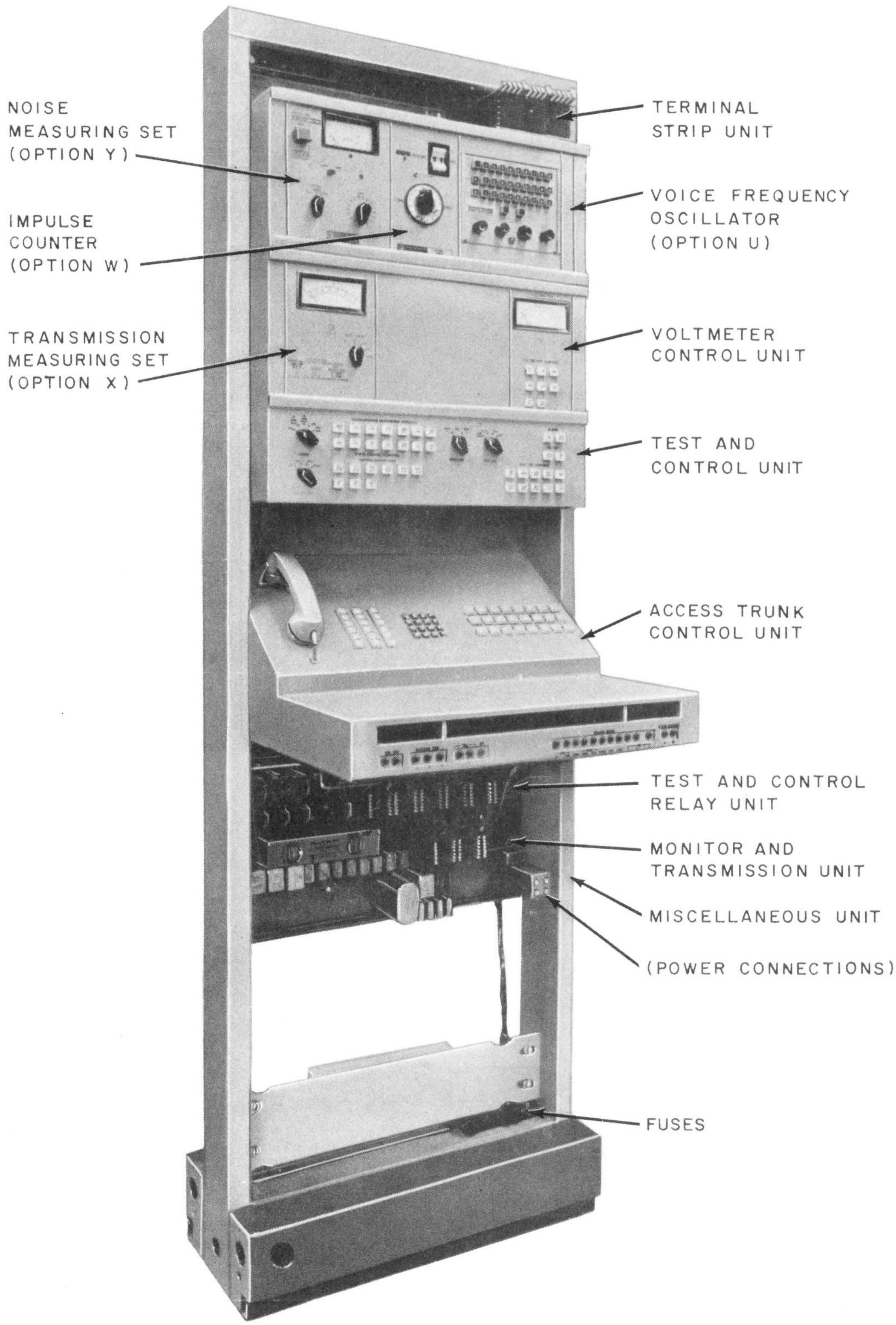


Fig. 55—Trunk Test Frame

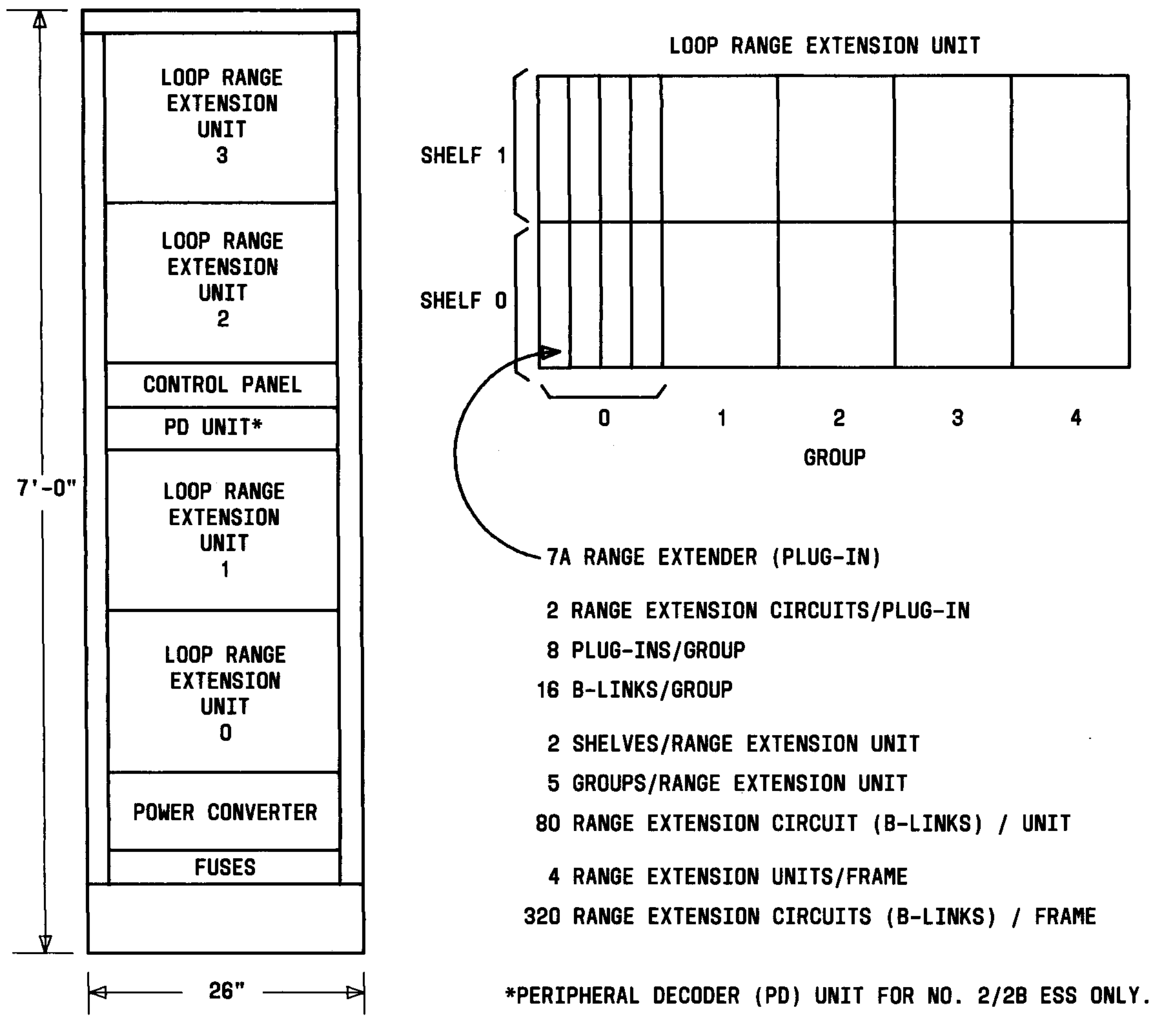


Fig. 56—Loop Range Extension (LRE) Frame

4.87 The power distribution unit, located at the bottom of the frame, consists of two 136-type plug-in power units and the necessary -48V and -78V fusing. The power units also provide the -78V boosted battery for the range extension circuits.

4.88 The control unit provides control and alarm circuitry for the frame.

4.89 Each frame can be equipped with as many as thirty-two A794 peripheral decoder circuit packs. These circuit packs are provided in groups of eight and require ten PD points per pack. In reality, there are 12 points per pack, but only 10 of them may be used for LRE. The last two points must remain unused.

4.90 The frame should be located within 50 cable feet of the network being equipped.

5. POWER EQUIPMENT

POWER ROOM

5.01 The power plants associated with No. 2B ESS include the following:

(a) Two 111A battery plants, with large battery voltage swing tolerances, which avoid emergency cell switching and countercell switching. Two 326 battery plants may be used in lieu of the 111A battery plants if warranted by increased current requirements. One is a -48 volt plant and the other is a +24 volt plant. Power from these plants is delivered to two or more power distributing frames.

(b) The +130 and -130 volt dc-to-dc converters (610B power plants) which convert the -48 volts to the potentials needed for coin control and NW diagnostics. Power from these plants is delivered to fuse panels on a miscellaneous power frame and is then distributed to all frames which require these potentials.

(c) A small emergency 523A or 504B ac plant (having an alternator driven by a dc motor) which provides ***protected*** ac power. A distribution panel on a miscellaneous frame provides a centralized point in the switchroom for all frames (in the office) which require ac power even when commercial power fails.

(d) An engine alternator which substitutes for commercial ac power to charge batteries and supplies essential ac loads after a commercial power failure has persisted for a certain period of time.

SWITCH ROOM

A. Power Distributing Frame

5.02 The power distributing frame (Fig. 57) is the distribution point of +24 volts and -48 volts from the power plants to the various ESS frames in the central office. The frame has a fusing capacity of eighty-eight +24 volt circuits and one-hundred-one -48 volt circuits with a combined maximum current capacity of 400 amperes. For reliability, at least two of these frames must be provided per office.

B. Ringing and Tone Frame

5.03 The No. 2B ESS uses an 841A plant (Fig. 58) which provides interrupted and continuous 20-Hz ringing current. Continuous and interrupted call progress tones and signaling interruptions are generated by transistor circuits which count down from the 20-Hz rate.

5.04 Balanced distribution of all tones is also provided. All the ringing and tone generators, both regular and reserve, are continuously monitored for low voltage. The monitor outputs are fed to the ferrod sensors in the master scanner. In the case of failure of any element in the 0 or 1 side of the plant which feeds the office loads, the system automatically transfers the loads to the other side and provides the necessary alarms. Manual controls are provided to override automatic control when necessary.

5.05 Either ac to dc or superimposed ringing is provided as required. All coded ringing is provided in the connecting circuits. In superimposed offices, the +48 volt tripping supply is obtained from the 610D power plant (dc-to-dc converter) mounted on the frame. Terminal strips, power connectors, and output distribution fusing are provided in these plants for connection to associated office equipment.

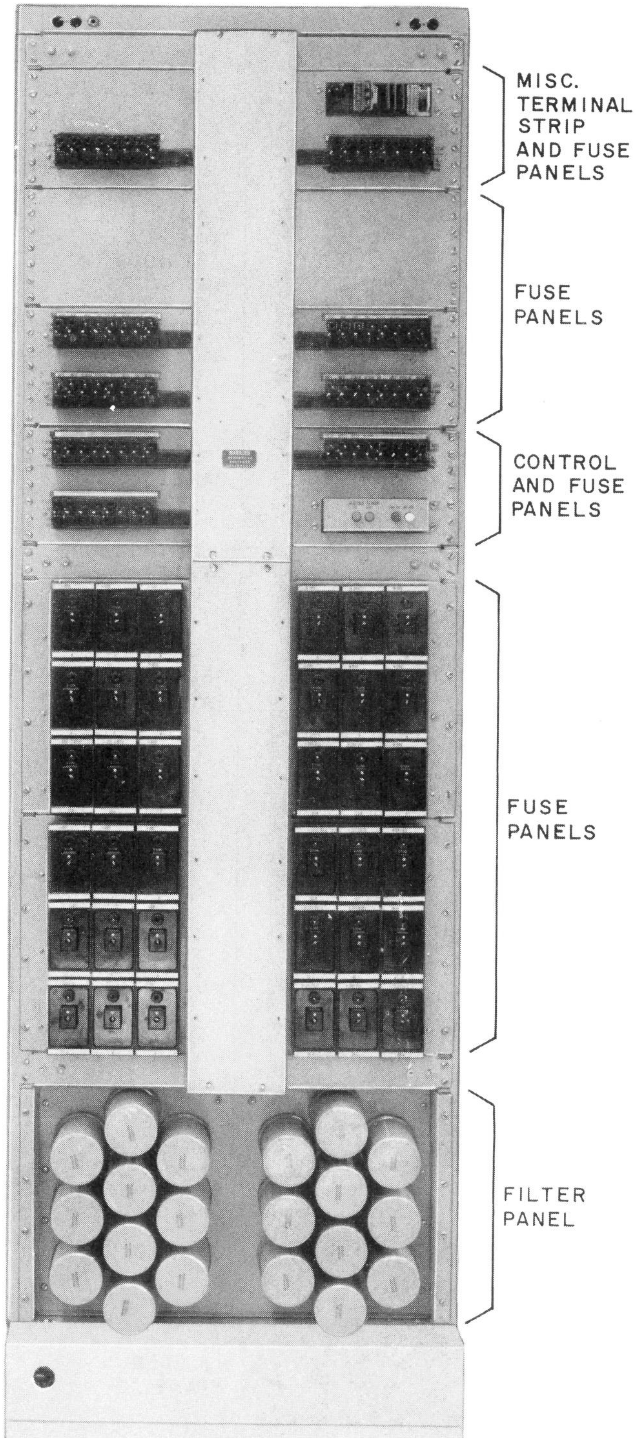


Fig. 57—Power Distributing Frame

C. Processor Frame Power Requirements

5.06 The processor frame power requirements are given in Table B. The +3V and +5V power is derived from the 48V via a switching converter. The +16V and +19.5V power is derived from the +24V via a series regulator. The +24V and -48V power is supplied from the power distributing frame and is fused at the 3A CC power unit.

D. Miscellaneous Power Frame

5.07 The miscellaneous power (MP) frame is a miscellaneous frame equipped with an ac distribution panel for 120-volt single phase loads requiring protected or essential 60-Hz supply, the +130 volt and -130 volt fuse panels, the floor alarm units, and a +48 volt supply (via a 662A) which is bused to those frames requiring dial tone first voltage.

POWER DISTRIBUTION

A. DC Power Distribution

5.08 Even-numbered miscellaneous (M), miscellaneous trunk (MT), and range extention (RE) frames are fed from even-numbered power distributing frames, and odd-numbered M, MT and RE frames are fed from odd-numbered power distributing frames. In the processor, control unit 0 is fed from power distributing frame 0 (PD-0). Control unit 1 is fed from PD-1. Equipment frames having duplicated control equipment (UTJ, MS, AMA, SCPD, AIOD, RA, RT, NCJS and LTS) are supplied by two sets of feeders, one set from each power distribution frame. The maintenance (MTCE) frame is also powered from both sets of feeders but is normally powered by Bus A.

5.09 In order to minimize noise caused by either stray circulating ground currents or transient noise potentials within the building, the No. 2B ESS equipment is grounded at a single point.

B. AC Power Distribution

5.10 Only single-phase 120-volt ac power is required in the No. 2B ESS switchroom, and the only units requiring protected alternating current are as follows:

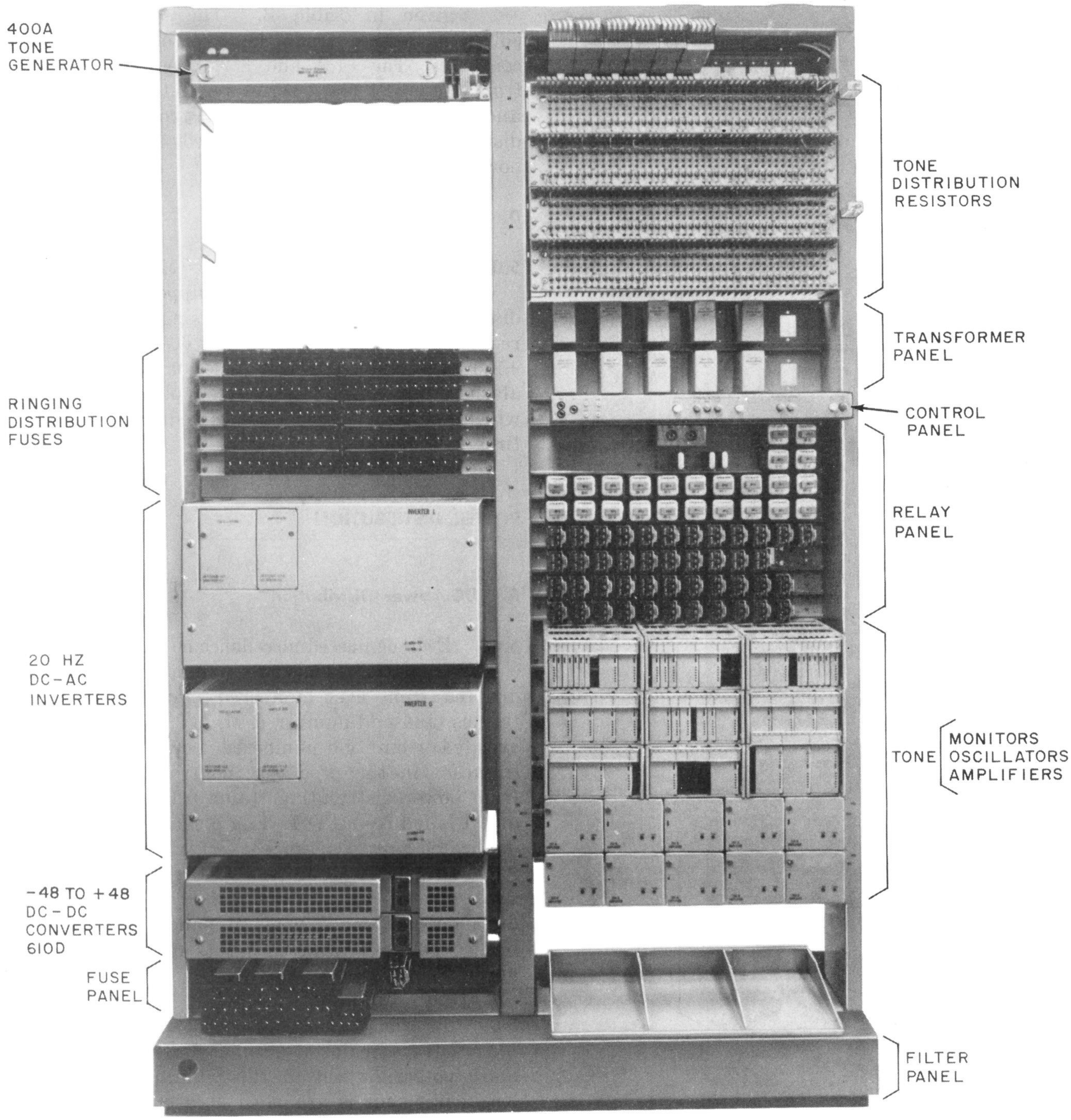


Fig. 58—Ringing and Tone Frame

TABLE B

PROCESSOR FRAME POWER REQUIREMENTS

POTENTIAL	PWR UNIT	3A CC	MAIN STORE	2B 1/0 CONTROL CIRCUIT
+3V		LOGIC	LOGIC	LOGIC
+5V		CLOCK, PANEL LEDS, MICRO STORE	MEMORY	
+16V			MEMORY	
+19.5V			MEMORY	
+24V	POWER CONTROL ALARMS CONVERTER	POWER LAMPS POWER CONVERTER	POWER CONVERTER	POWER CONVERTER
−48V	POWER CONVERTER		POWER CONVERTER	POWER CONVERTER

(a) The recorded announcement machine

(b) Maintenance TTY

(c) Alternating current data sets

(d) Key telephone equipment, when provided.

All loads are normally supported by commercial ac power. In the event of a power failure, the emergency power plant supplies the required protected alternating current within 5 seconds. The remainder of the load, the essential alternating current, is furnished by the standby engine alternator. The protected and essential alternating current is distributed from an ac distribution panel located on the miscellaneous power frame.

5.11 Table C is a listing of all power and power frames associated with No. 2B ESS.

6. EQUIPMENT ARRANGEMENT

NO. 2B ESS FLOOR PLANS—TYPICAL

6.01 Standard frame arrangements in an office minimize engineering and installation costs. Universal floor plans have been developed for No. 2B ESS offices which have ferreed or remreed switching networks. These floor plans allow an office to grow naturally from the smallest to the largest installation. The patterns applied to typical offices with ferreed and remreed switching networks are shown in Fig. 59 and 60 respectively. Some important features of these patterns are as follows.

(a) The 2B processor (maintenance frame, processor frame, supplementary store frame) and trunk test frame have a fixed relationship in every office.

TABLE C

NO. 2 ESS POWER SUPPLIES

POWER SUPPLY	TYPE OF PLANT OR UNIT	CAPACITY (RATED) AMPERES	CODE
—48 volt dc (—43.75 to —52.5V) +24 volts dc (+21.75 to +26.25V)	Storage batteries (without emergency cell or counter cell switching). Rectifier charged.	10-800	111A
+130 volt dc —130 volt dc	Dc-to-dc solid-state conversion from —48 volts for coin control.	2, 3, 4, and 5	610B 651A
Reserve ac supply.	Dc motor-driven alternator for 120-208 volt single-phase power.	(1-1/2 kW)	504B or 523A
Ringing and tones.	Solid-state generator with a precise tone plant.	0.5	841A
6.7 volt power plant.	Dc-to-dc converter with sequence controller.	200	J86859A
PBX talking battery filter on miscellaneous frame.	Coil and capacitor panels.	15, 25, and 60	
120 volt ac for maintenance center frame.	Commercial power with or without reliable supply distributed from MP frames.		
RA frame.			
RT frame.			
Miscellaneous frame for ac TTY data sets, test battery supply unit.			
Appliance outlets frame lighting.	Distributed from ceiling-supported busway.		
+48 volt dc tripping supply.	Dc-to-dc solid-state conversion from —48 volts for tripping in superimposed offices.	1, 1-5, and 3	610D
+48 volt dc dial tone first.	Dc-to-dc solid-state conversion from —48 volts for dial tone first.	2, 3	662A

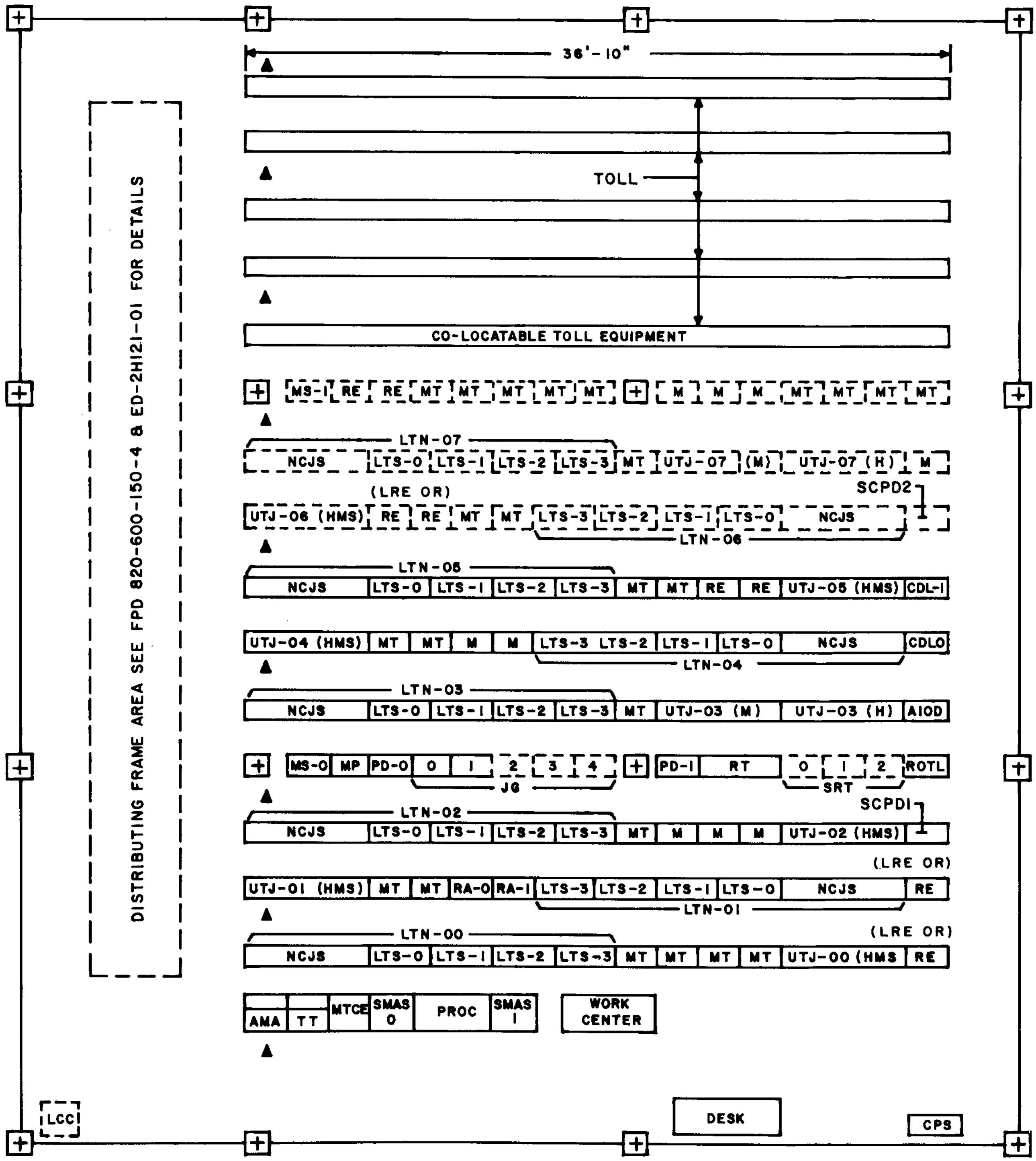


Fig. 59—Typical No. 2B ESS Office Floor Plan With a Ferreed Network

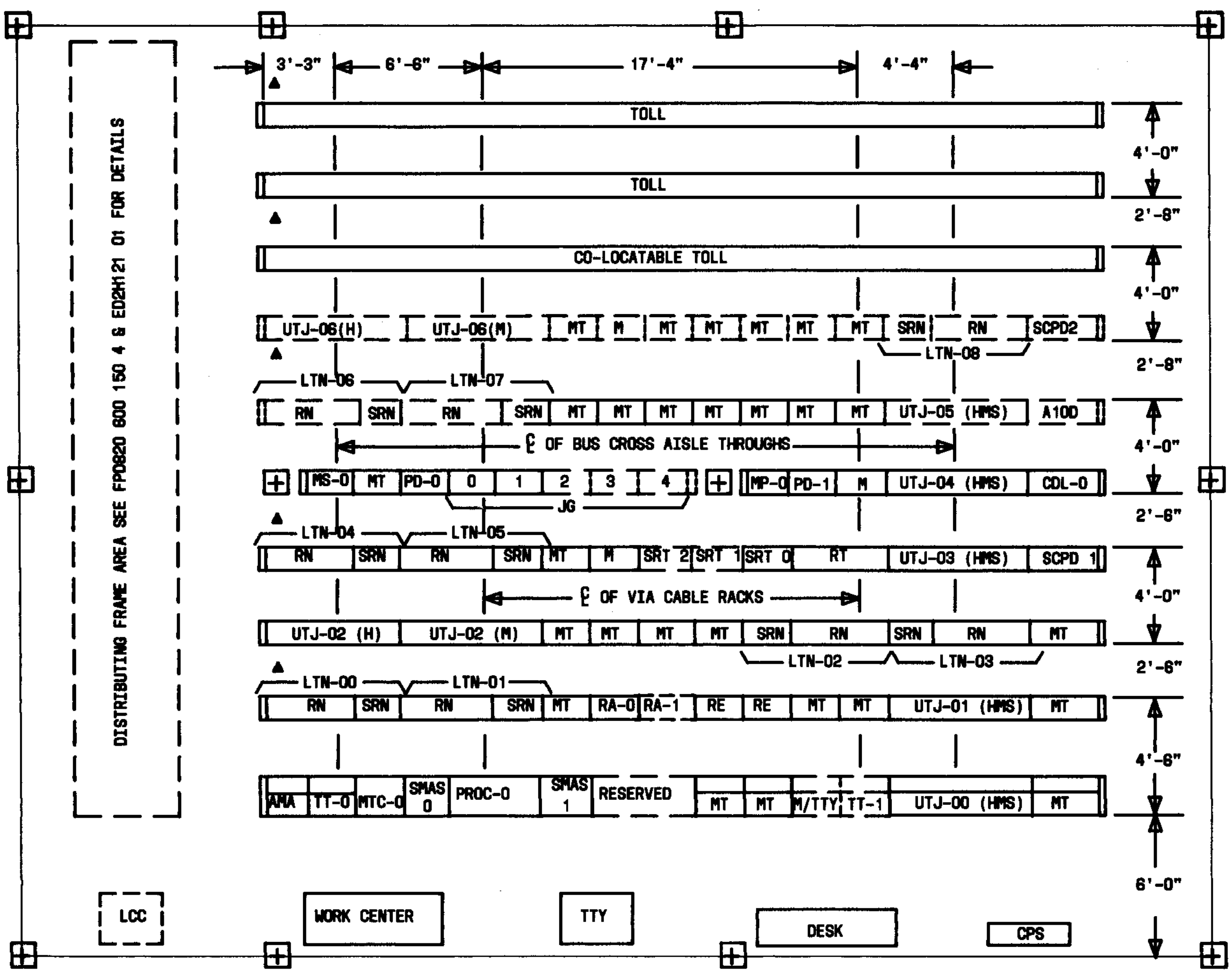


Fig. 60—Typical No. 2B ESS Office Floor Plan With a Remreed Network

(b) The frame lineups are so arranged that the office will grow approximately one lineup for every ferreed network added or one lineup for every two remreed networks added. However, the standard frame lineup is readily flexible if the limiting conductor lengths are not exceeded.

(c) The protector and combined distributing frames in a ferreed network office and the low profile conventional distributing frame in a remreed network office grow perpendicularly to the frame lineups. These frames are aligned with the associated network frames for orderly growth together in a way that automatically minimizes cable and combined distributing frame jumper lengths.

(d) The floor plan fits standard building bays of new buildings and can be readily adapted to existing buildings.

6.02 Standard frame requirements for a No. 2B ESS office are listed in Table D.

7. STORED PROGRAM CONTROL

7.01 The No. 2B ESS performs the functions of a local telephone central office under the control of a stored program acting through data processing, input/output, and 2-wire switching equipment. Virtually all the actions of the system are determined by the sequences of instructions coded and stored in memory. This data is grouped into functional categories called programs. A program contains all the data necessary to control the accomplishment of a specific task. These programs consist of combinations of precisely defined instructions which are read from memory and transmitted one at a time to the 3A CC for execution via microcode. The stored program makes use of stored data called translation data which contains information pertaining to customer lines. Frequently to alter system operation, only changes to the stored program need be made, rather than to hardware or wiring.

7.02 The No. 2B ESS stored program may be divided into three parts: the call processing programs, which provide telephone service and operational features; the administrative programs, which permit changes to system operations; and the maintenance and administrative programs, which maintain an operational system in the presence of troubles and diagnose the faulty units. The existing No. 2 ESS call processing and administrative programs and much of the existing maintenance programs are exactly emulated on the 2B processor. This represents approximately 75 percent of the total No. 2B ESS program words. Programs which are processor dependent, such as processor diagnostics, TTY interface, memory update procedures, and some trouble recovery procedures are implemented for the 3A CC and modified No. 2 ESS programs.

USE OF SUBROUTINES

7.03 The subroutine is widely used to keep program size small, even though some real time is used in preparing data and transferring to the routine. A subroutine is a relatively short program that is accomplished on a called-in basis (not a part of the main program). The No. 2 ESS programs make use of many levels of nesting (subroutines calling other subroutines) such that the lowest level subroutine does a very specific task in a very straightforward manner. Higher level subroutines have larger tasks to perform, but these tasks are accomplished primarily by manipulating data and calling on lower level subroutines for further action. This structure leads to a compact basic call handling program which consists mainly of calls to subroutines.

STORED PROGRAM ORGANIZATION

7.04 Stored programs in the No. 2B ESS are grouped according to the functions they perform. The No. 2B ESS contains the following three major classifications of programs:

- Administrative programs
- Operational programs
- Maintenance programs.

A. Administrative Programs

7.05 Administrative programs include all programs that pertain to the control of administrative tasks, such as adjustment of service provided and adjustment of equipment to meet changing traffic conditions or to report on areas that need maintenance attention. Some of the functions performed by these programs are as follows:

TABLE D

EQUIPMENT FRAME REQUIREMENTS

FRAME	J-CODE	ABBREVIATION	NUMBER REQUIRED	NO. 2 ESS	NO. 2B ESS
Automatic Identified Outward Dialing	2H018A	AIOD	0 or 1 per office	✓	✓
Automatic Message Accounting	2H021A	AMA	0 or 1 per office	✓	✓
Centrex Data Link	1A068	CDL	0 to 4 per office	✓	✓
Circuit Pack Storage	—	CPS	As required	✓	
Combined Distributing	ED-1A222-31	CDF	1 to 8 per office	✓	✓
Intermediate Distributing	ED-1A224-31	IDF	1 to 5 per office	✓	✓
Junctor Grouping	2H022A	JG	1 to 4 per office	✓	✓
Line Trunk Switching	2H025A	LTS	1 to 4 per line trunk network*	✓	✓
Loop Range Extension	2H048	LRE	***LRE Circuits***†§ 320	✓	✓
Maintenance Center	2H003A	MC	1 per office	✓	
Maintenance	1C060A	MTCE	1 per office; includes tape memory backup system		✓
Master Scanner	1A043B	MS	Minimum of 1 per office‡	✓	✓
Memory Card Storage	—	MCS	As required	✓	
Miscellaneous	1A048A	M	As required (no max.)	✓	✓
Miscellaneous Power	1A048C	MP	1 per office	✓	✓
Miscellaneous Trunk	2H018A	MT	0 to 99 per office	✓	✓
Network Control Junctor Switching	2H026A	NCJS	1 per line trunk network (0 to 15 per office)*¶	✓	✓
Power Distributing	1A035C	PD	2 or 4 per office	✓	✓
Processor, 2B	1C058B	PROC	1 per office; includes duplicated 256K words of storage and 512 central pulse distributor points		✓
Processor, Central	2H002A	CP	2 per office	✓	
Program Store	2H027A	PS	4, 6, or 8 per office	✓	
Protector	ED-1A220-31	PROT	1 to 5 per office	✓	✓
6.7V, 200A Power Plant	86859A	PWR	2 per office	✓	
Range Extension	2H034A	RE	0 to 20 per ofice (in pairs)§	✓	✓
Recorded Announcement	1A058C	RA	1 to 16 per office	✓	✓

TABLE D (Contd)

EQUIPMENT FRAME REQUIREMENTS

FRAME	J-CODE	ABBREVIATION	NUMBER REQUIRED	NO. 2 ESS	NO. 2B ESS
Remote Office Test Line	2H039A	ROTL	0 to 8 per office	✓	✓
Remreed Network	2H124A	RN	0 to 15 per office*¶	✓	✓
Ringing and Tone Power Plant	87804B	RT	1 per office	✓	✓
Supplementary Central Pulse Distributor	2H023A	SCPD	0 to 7 per office; supplements central pulse distributor in central processor or 2B processor	✓	✓
Supplementary Call Store	2H005A	SCS	0 or 2 per office	✓	
Supplementary Main Store	1C065A	SMAS	2 per office		✓
Supplementary Remreed Network	2H124B	SRN	0 to 15 per office	✓	✓
Supplementary Ringing and Tone	87804C	SRT	0 to 3 per office	✓	✓
Trunk Test	2H024A	TT	1 or 2 per office	✓	✓
Universal Trunk and Junctor	2H017A	UTJ	1 to 11 per office‡ (1 to 30 per office for 2B-EF-2)	✓	✓

* An LTN is made up of 1 NCJS and 1 to 4 LTS frames.

† This determines the number of LRE frames required. The quotient is rounded to next integer.

‡ A maximum of 12 (31 for 2B-EF-2) MS plus UTJ and UTJ-HMS frames may be provided.

§ An office can have RE or LRE but not both.

¶ Total of NCJS and RN frames cannot exceed 15.

- To administer changes to stored data to accommodate service orders or plant changes
- To record office traffic characteristics
- To report on plant measurements including service measurements and performance measurements which reflect the basic health of the system through cumulative error counts and failure rates
- To modify system configurations.

B. Operational Programs

7.06 Operational programs include all programs that pertain to operation of the system. The bulk of these programs deal with the processing of calls. Some of the functions performed by these programs are as follows:

- Input and output of data
- Line scanning to detect originations
- Digit receiving
- Digit interpretation
- Digit outpulsing.

C. Maintenance Programs

7.07 The No. 2B ESS maintenance programs include all programs which relate to maintenance of the system hardware or stored program. The functions performed by these programs are as follows:

- Detecting and reporting of equipment troubles and/or stored program inconsistencies
- Attempting to recover a working system when a failure occurs
- Diagnosing the system or specific units to pinpoint the location of troubles
- Troubleshooting aids.

STORED PROGRAM HIERARCHY

7.08 Certain system economies are achieved through the use of a simple processing hierarchy consisting of three major levels: the normal call processing (***base level***) programs, programs which must execute on a regular basis to handle time critical operations through a timed interrupt, and programs which are called in by unusual trouble conditions through a demand interrupt.

A. Base Level Programs

7.09 The base level includes most call processing programs plus all deferrable or low priority maintenance tasks which are called in at the end of the normal call processing loop. Some of the tasks at this level are as follows:

- Distribution of supervision to appropriate call records
- Call processing scan—Process each transient call record (TCR) and perform any task resulting from new information
- Maintenance monitor—Process essential maintenance and administrative tasks such as recording traffic data, TTY routines, and audits.

All base level tasks are scheduled by a base level maintenance monitor program that determines which additional tasks are to be performed after the normal call processing scan.

B. Interrupt Level Programs

7.10 Interrupt level programs break into the base level loop on a periodic timed basis (input/output interrupt). When the interrupt level program has completed its allotted work, control is returned to the base level program at the point of interruption.

Input/Output Timed Interrupt

7.11 In the No. 2B ESS the 5-ms interrupt program (I/O 5) and 25-ms interrupt program (I/O 25) are used primarily for the input and output of data. The I/O 5 interrupt occurs precisely every

5 ms. The I/O 5 performs the originating register (OR) scanning and drives the I/O 25. The I/O 25 allows various functions requiring close timing, such as the following:

- Scanning for supervisory changes in lines, trunks, and service circuits
- Distribution of orders to networks, trunks, and service circuits
- Scanning all TTYs for new inputs or outputting new characters to active TTYs
- Trunk and service circuit tests requiring precisely timed actions.

Demand Maintenance Interrupts

7.12 The demand maintenance interrupts immediately initiate corrective action. After the appropriate recovery action is taken, control is returned to the base level program which was interrupted. The demand maintenance interrupts are initiated by the following control unit errors:

- Attempted on-line or off-line store write in write protected area
- Off-line store parity error
- Off-line fast time-out on read or write function
- Error in I/O main channel selection or error in 3-out-of-6 code check circuit
- On-line 3A CC program timer error
- Switch message received by on-line 3A CC telling it to go on-line
- I/O subchannel selection error or I/O channel sequence error
- I/O bad parity
- Utility interrupt
- Other CC interrupt.

C. Initialization Restart

7.13 Initialization restarts are handled by the common system initialization (CINIT) program and the applications initialization (INITA) program. The stimulus of an initialization is the failure of a check that indicates the integrity of the processor and/or its data base is questionable. An initialization consists of:

- Restoring the CU to a known good state
- Restoring the periphery to a known good state
- Aborting certain activities
- Zeroing or otherwise initializing temporary data
- Reloading the programs from tape.

Not all of the preceding are performed on every initialization. An initialization can be more or less drastic depending on which, and to what extent, the preceding routines are invoked. For example, a given initialization may zero none, some, or all of temporary store. In general, the system reaction becomes more drastic each time a previous recovery attempt fails. The escalation is encoded in the level number of the initialization, which is incremented on each failure. The higher the level number, the more drastic the recovery routine becomes.

7.14 The CINIT program is divided into three parts as follows:

- Restoring the CU to a known good state
- Zeroing common system temporary data
- Performing bookkeeping tasks (formatting TTY output messages, alarms, etc).

After each of the three parts are performed an entry is made to the INITA program. The INITA program is also divided into three parts which correspond to the entry points from the CINIT program. The three parts of the INITA program are as follows:

- Analysis of data and determination of level of initialization to be performed
- Initializaton of periphery and temporary store at level determined in first entry
- Bookkeeping tasks are performed and finally the restart of normal processing.

7.15 A count of the number of restarts incurred during a given amount of time is used to progressively clear out the call store until the system has eliminated the difficulty and is able to restore the system to a working condition. This strategy involves clearing or releasing various transient- and maintenance-only areas of memory while preserving stable talking path records. An initialization restart of this type may also be manually initiated (Section 232-313-301) including the complete call clearing capability when necessary.

8. CALL PROCESSING

8.01 The following section describes the processing of several typical types of calls. The processing of each call is controlled by an 8-word block of call store called a transient call record (TCR) which is associated with the call during the setup (nontalking) period.

TYPICAL INTRAOFFICE CALL

A. Call Origination

8.02 When a customer originates a call (Fig. 61A) by going off-hook, current flows through a sensing element (ferrod sensor) associated with the line. The off-hook state is recognized by the 25 ms input/output program (I/O 25). To avoid transmission degradation, a cutoff contact is placed between the line terminal and the ferrod windings. When a connection from a line to a receiver (dial pulse or TOUCH-TONE calling) is established on a service request, the cutoff contact is opened, removing the ferrod from the path.

B. Dialing Connection

8.03 Rather than attempt to cover the details of each type of signaling, the description of dial pulse sending and receiving is used in the following description of various types of office calls.

8.04 Upon detection of a service request, a TCR is selected to control the call. Another 8-word call store block called an originating register (OR) is also selected to contain the dialed digits. Next a customer dial pulse receiver (CDPR) and a path from the line to the CDPR via a wire junctor are selected and connected, and supervision is transferred from the calling line to the CDPR (Fig. 61B). The CU, via a PD, operates relays in the CDPR which cause dial tone to be sent to the calling line. Dial tone will be removed by releasing a relay in the CDPR as soon as the first pulse of the first digit is received.

C. Digit Analysis

8.05 Dial pulses are counted and recorded in the originating register. A digit is considered to be completed when the line is off-hook and no changes have been detected for a period of at least 125 milliseconds. When the first digit is completed, a check is made to see if a 0 or a 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) gives the CU the call type (intraoffice, interoffice, etc) and the number of digits to expect (seven, in the case of an intraoffice call).

D. Ringing Connection

8.06 After receipt of the dial pulse information, the digits are translated to determine the terminal number of the called party so that a connection is established between the called line and a ringing circuit (Fig. 61C). A half path is established from an idle circuit junctor to the calling line, and another path is reserved from that circuit junctor to the called line. Audible ringing tone is applied to the calling line through the circuit junctor while the called line is being rung. Every 50 milliseconds, the ringing circuit is scanned for off-hook, ie, answer, and every 100 milliseconds the circuit junctor is scanned for on-hook, ie, abandonment.

E. Talking Connection

8.07 When the called line answers, the ringing circuit is released and the previously reserved

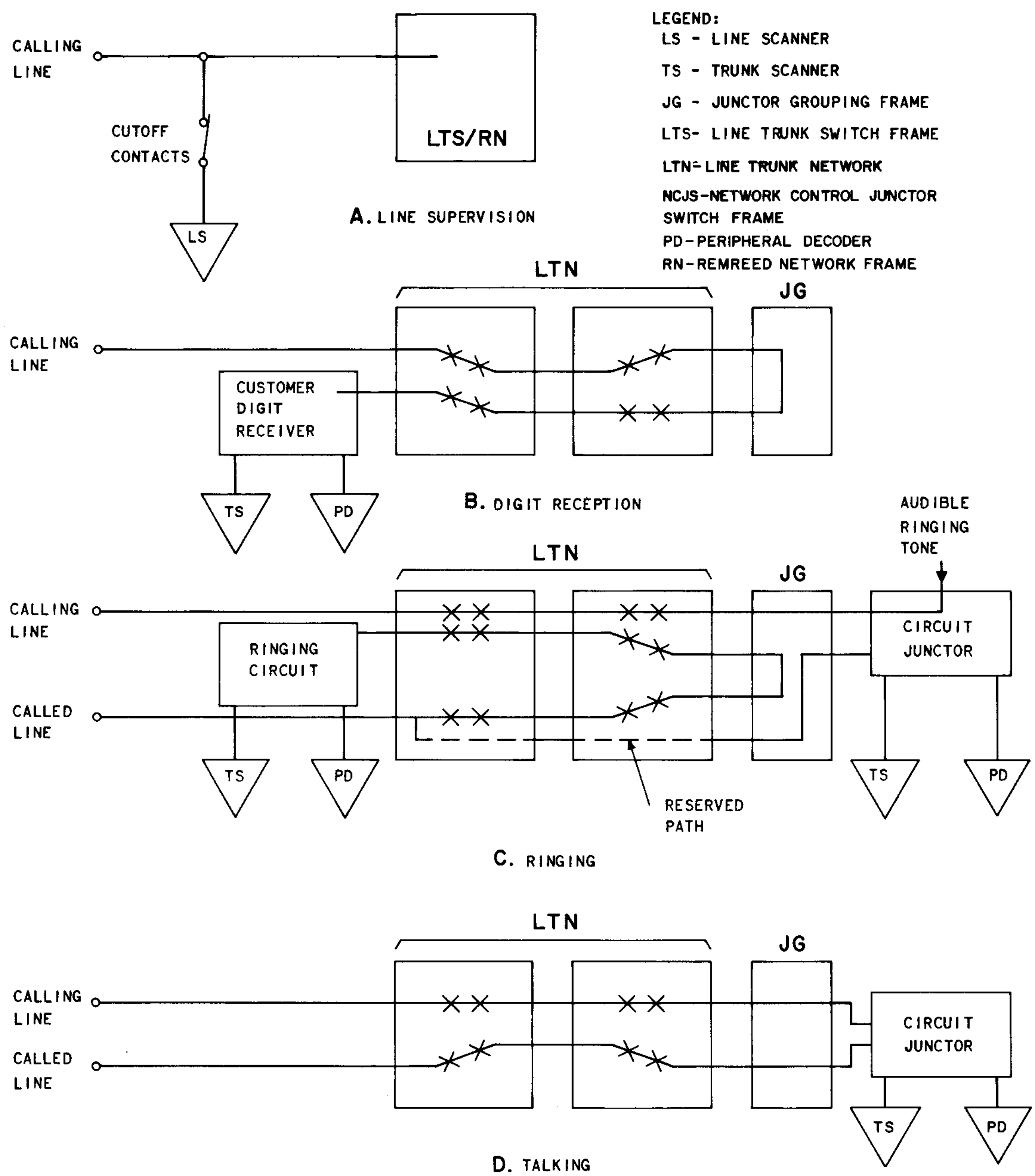


Fig. 61—Typical Connections for an Intraoffice Call

talking path (Fig. 61D) is then established. During talking, the circuit junctor is scanned every 100 ms for supervision. The TCR is then idled and the terminal memory record (TMR) maintains a record of the call during the talking state.

F. Disconnect

8.08 When a change to on-hook by either calling or called line is detected, an interval of 200 to 300 ms 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 to prevent the calling customer from holding the called line out of service indefinitely by failing to hang up the receiver. After a 250-ms time-out following on-hook, the system times an interval of 11 seconds if the calling party remains off-hook. During this interval, if the called line returns to off-hook, the network path is left established. If an on-hook is detected from the calling line or if the time-out occurs, the connection is released. If the calling party hangs up first, the called line is given 11 seconds to go on-hook before interpreting this action as a new origination and returning dial tone.

TYPICAL OUTGOING CALL

8.09 When translation of the first three dialed digits (assuming a 0 or 1 has not been dialed) indicates an interoffice-type call, the number of digits to expect (seven or ten) and a route index are obtained from the translation information. 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 (Fig. 62). With this information, the calling lines continue to be supervised from the CDPR, and the CU proceeds as follows:

(a) Selects an idle outgoing trunk

(b) Selects an idle transmitter

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

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

8.10 The trunk circuit is put into a bypass state (clear metallic path) and a seize signal is sent to the distant office from the connected transmitter. The CU proceeds to make a continuity check and, if successful, a start dial signal is received from the distant office when a receiver is attached to allow outpulsing to start. At the completion of outpulsing, the transmitter is released by the CU 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 ms the trunk ferrods are scanned, via the scanner associated with the trunk, for answer (off-hook), or for a possible abandon (on-hook) by the calling line. When the called line answers, the CU recognizes the change in supervision from the distant office, via the trunk ferrod, and trunk memory in the call store is changed to the talking state. A similar disconnect program and timing, as described for intraoffice calls, is used for interoffice calls.

TYPICAL INCOMING CALL

8.11 Incoming calls are detected by the supervisory scan of trunk circuit ferrods. When a seizure is detected, the trunk scan point number is used by translation subroutines to provide trunk class information necessary for processing the call. From this information, the CU determines the type of interoffice receiver to be used (multifrequency, dial pulse, etc), the number of digits to be received, and the type of supervisory signals required in receiving digits from the calling office. The CU proceeds by selecting an idle receiver (Fig. 63) and establishing the network path between the trunk circuit and the receiver.

8.12 The incoming trunk circuit is put in the bypass state and supervision of the trunk is maintained from the receiver. A start signal is transmitted to the distant office which, in turn, transmits three or more digits of the called line directory number. When all of the digits have been received and recorded in the call store, a directory number translation is performed. This translation provides the terminal equipment number or location and the terminating class-of-service information of the called directory number.

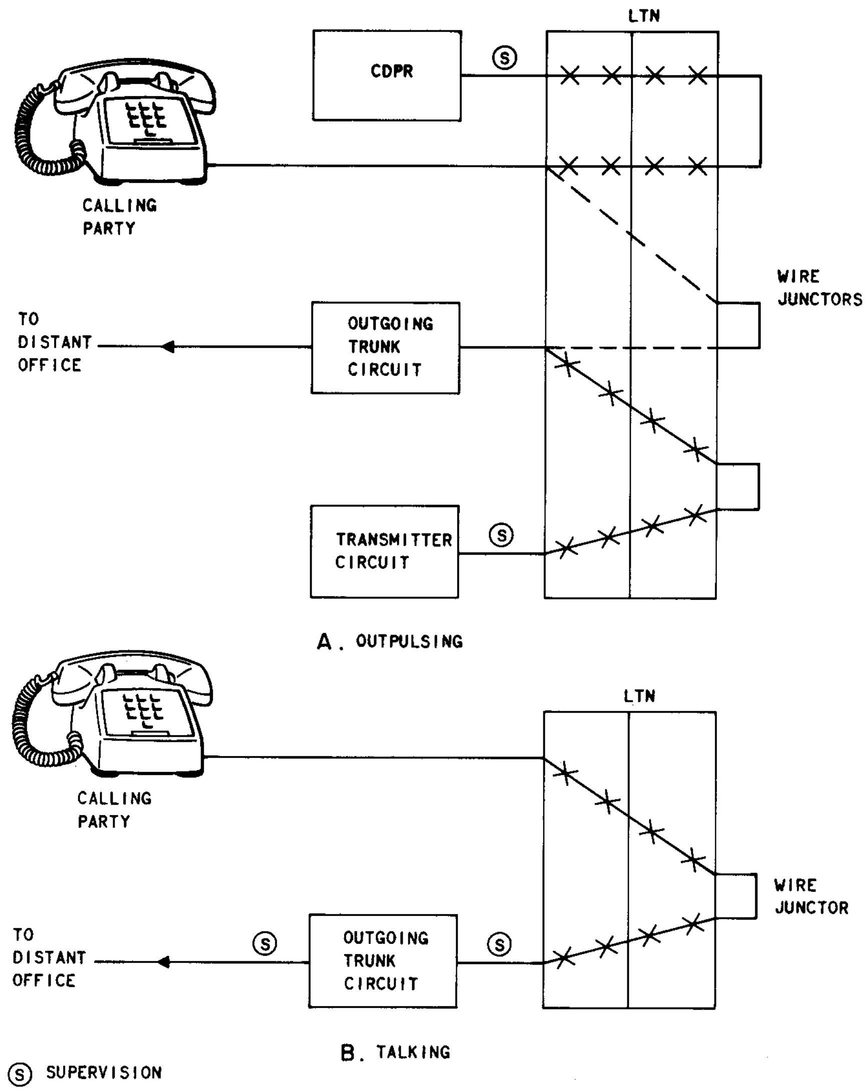


Fig. 62—Sequence of Actions on an Outgoing Call

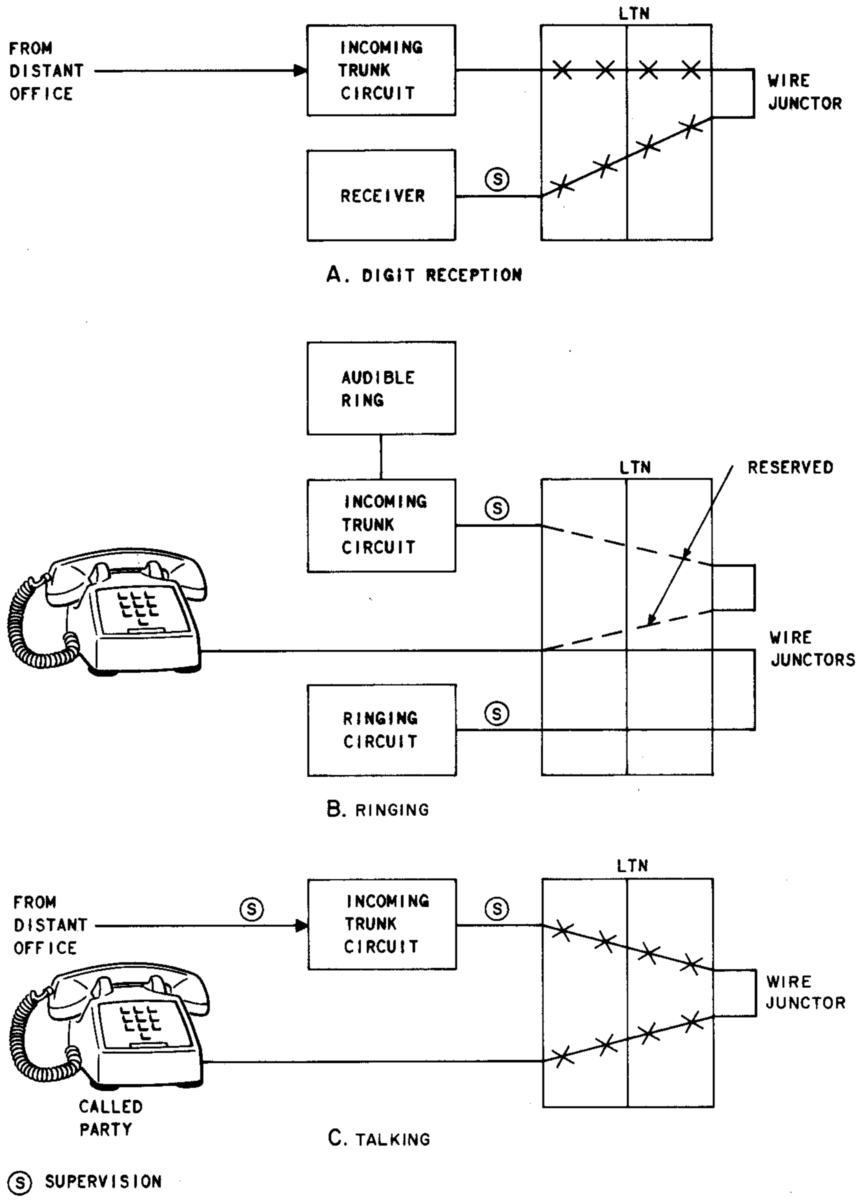


Fig. 63—Sequence of Actions on an Incoming Call

8.13 Audible ringing tone connections are permanently assigned in No. 2B ESS trunk circuits and are applied by internal relay contacts. Therefore, separate network paths from these circuits to separate audible ringing tone circuits are not necessary. If the line is idle, a talking path is reserved, ringing is applied to the called line, and audible ringing tone is returned by the incoming trunk. When the called line answers, a relay is operated in the ringing circuit and ringing is automatically tripped. This is detected by the CU which releases the previous connections and establishes the reserved talking path. If the called number is found to be busy (from line busy-idle memory in the call store), a tone circuit supplying busy tone is connected to the incoming trunk.

8.14 The 100-millisecond trunk supervisory scan program scans for disconnect (on-hook) on both the line and trunk ferrods of the incoming trunk circuit. Either end disconnecting starts hit timing (200 to 300 ms). If the distant end has disconnected first, the trunk is made available for reseizure and a timed-release period of 11 seconds is started. During this time, the called line is scanned at the incoming trunk circuit every 100 ms for on-hook. Should the trunk be reseized during this timing period, the connection to the previously called line is released and if, after the timed-release period, the called line remains off-hook, it is treated as a new origination. If the called line is the first to disconnect, on-hook is transmitted to the distant office.

9. SYSTEM MAINTENANCE

MAINTENANCE PLAN

9.01 The No. 2B ESS is equipped with maintenance circuits and programs designed for detection and diagnosis of failures automatically or by manual request. Detected failures may call for preventive maintenance or corrective maintenance. Some failures are indications of component deterioration which may in the future be service affecting if preventive maintenance is not performed. Failures which are caused by operational faults require immediate corrective maintenance to ensure system integrity.

9.02 Whenever a failure is detected by the system, it is recorded on a TTY printout. The significance of the TTY printout may be determined by using the output message manual OM-2H200. The output message manual lists in alphanumeric order all the system output messages printed by the TTY. This document contains a description of each message, the reason each message was issued, the actions to be taken, if any, as a result of the message and the alarm indications that should accompany the message. When a failure occurs, the appropriate diagnostic test should be run. In some cases the system will automatically run diagnostics. If it is necessary to manually implement a diagnostic test, the appropriate message can be found in the input message manual IM-2H200.

9.03 The input message manual lists TTY messages that can be typed on the maintenance TTYs to request a system action or function. A description of the format and the use of each message, as well as cautions and expected results, are given for each message. The messages are arranged in alphanumerical order, and a topical index guides the reader to the specific message to be used. Some of the types of actions and functions that these messages request are:

(a) To diagnose a system unit,

(b) To initiate traffic counts,

(c) To trace a call, and

(d) To read from or write into memory locations.

9.04 The automatically or manually implemented diagnostic test carefully checks the unit causing the failure printout. If the unit passes the diagnostic test, the fault is considered transient. However, if the unit fails the diagnostic test, the results are provided in a TTY printout which contains a trouble number. This trouble number can be used in conjunction with the Trouble Locating Manual (TLM) to isolate the fault to a replaceable unit such as a circuit pack.

9.05 The TLM is a maintenance document which supplements the OM to help in locating troubles within system units. The TLM lists trouble numbers that match trouble numbers provided in the TTY printout generated by the system when the failure occurred. There are also special instructions and comments in the TLM that facilitate the required maintenance and understanding of why the failure occurred.

9.06 In addition to the maintenance circuits and programs which provide for detection and diagnosis of failures automatically or by manual requests, a maintenance center provides a centralized control point for communicating, controlling, testing and recording requirements of the system. An office alarm system also notifies office personnel of failures.

9.07 The heart of a successful maintenance program is proper preventive maintenance. Preventive maintenance is the identification, isolation, and correction of faults before they become service effecting. Therefore, those circuits which are not checked automatically by the system on a periodic basis must be checked manually in accordance with the Equipment Test List, 232-001-011. This list contains all the manually implemented test requirements for No. 2B ESS, both preventive and corrective maintenance and provides the interval for all the preventive maintenance tests.

9.08 Many of the tests prescribed by the ETL must be run from the trunk test panel which provides the facility for connecting test equipment to trunks and service circuits. Trunk circuits may also be tested automatically from a centralized automatic reporting on trunks (CAROT) system provided the office is equipped with the remote office test line (ROTL).

9.09 The maintenance plan is supported by:

(a) Circuits that are made reliable by using long-life components and by providing liberal operating conditions

(b) Circuits which are made rapidly repairable by the use of plug-in units

(c) Duplication of equipment which is provided throughout the system except where a failure should affect only a small number of subscribers

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

(e) Various types of redundancy used in the information transmitted between units in order to detect errors.

9.10 Maintenance programs include the following:

(a) Routine tests which detect the existence of trouble.

(b) The 2B processor uses various automatic error checking techniques such as bit slicing, parity checks, m-out-of-n codes, duplication, and program times. Detection of an error initiates appropriate recovery action.

(c) Fault checking routines which in response to the detection of a failure determine which major unit is in trouble and cause appropriate switching actions to be taken.

(d) Diagnostic tests which pinpoint the location of a trouble within a unit and make this information available as a printout on the TTY.

(e) Peripheral unit testing which provides diagnostic tests for operational testing and X-ray tests which are used for the factory and initial testing at the site, and/or for testing frames being added to an operational office. The X-rays may only be requested manually.

EXERCISE PROGRAM (FAULT DETECTION)

9.11 The exercise program is composed of a short-term and a long-term periodic test. The short-term periodic tests run frequently and quickly detect certain peripheral unit faults missed by check circuits. The long-term periodic exercise tests detect control unit troubles in circuits not normally tested by other programs and circuits. These tests include control unit switching and the ability of the detection check circuits to detect troubles.

TROUBLE RECOVERY PROGRAM

9.12 When the check circuits detect a CU error and calls in the interrupt monitor, a trouble recovery program is selected to detect the circuit(s) that have caused the error. The recovery program then switches the on-line and standby CUs to achieve a working mode. Similar programs exist for troubles detected in various peripheral units.

DIAGNOSTIC PROGRAMS

9.13 Diagnostic programs are automatically called in by the base level maintenance monitor after trouble detection and recovery have been completed. They can also be manually requested via the TTY or called in by the call processing program which detects abnormal conditions. The objective of the diagnostic program is to produce a TTY printout which isolates the fault to as small an area as possible. After the faulty circuit has been replaced or repaired, the diagnostic program is run again to verify that the fault has been corrected.

MAINTENANCE DOCUMENTATION

9.14 For operating instructions or maintenance instructions on the No. 2B ESS equipment, refer to the BSP Numerical Indexes 232-000-000 and 254-000-000. These BSP indexes have an up-to-date listing of all BSPs presently available for use on the No. 2B ESS. Section 232-000-010, Configuration of Support Documents and Bell System Practices; lists the documents necessary to support a No. 2B ESS office.

10. GLOSSARY

10.01 The following is a glossary defining terms used in No. 2B ESS.

Asynchronous Operation—Refers to the operation of the CUs which is not synchronous. This means that the CUs do not execute the same instruction in synchronism and match the results as an error check. However, the store of the off-line CU is kept up to date so the off-line CU can assume control if necessary due to trouble in the on-line.

Automatic Identified Outward Dialing (AIOD)—Provides the means for indentifying a PBX or Centrex-CU telephone extension number when that telephone is used to make an outward call requiring AMA recording.

Bipolar Pulse—A pulse that may have either of two polarities: positive or negative.

Bit (Binary Digit)—A binary unit of information. It is represented by one of two possible conditions, such as the characters 0 or 1, on or off, high potential or low potential, conducting or not conducting, magnetized or not magnetized.

Buffer—(a) An isolating circuit used between two other circuits. The isolation may be between high- and low-speed circuits or between high- and low-impedance circuits, (b) A section of call store used to store information until it can be used by the system, (c) That portion of a peripheral decoder which controls relays.

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.

Circuit Pack—A unit used as a convenient means for assembling on a single mounting one or more components, such as capacitors, inductors, diodes, resistors, transistors, etc. The components are interconnected to perform one or more circuit functions, such as amplification, gating, timing, etc, required in a circuit.

Central Pulse Distributor (CPD)—The CPD enables peripheral frames, such as scanners, and provides facilities for transmitting ac signals to peripheral decoders which controls trunks, service circuits, and circuit junctors.

Centrex—Centralized telephone communications exchange service using the data handling capabilities of the No. 2B ESS central office.

Control Unit (CU)—That part of a 2B Processor which consists of a 3A central control and its associated main store(s), store buses, 2B I/O control circuit, and access to the system status panel.

Enable Pulse—A pulse that permits a unit or a 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.

Ferreed Network—A space division, 2-wire network in which metallic connections are switched through eight stages of ferreed switches.

Flip-Flop—A device capable of assuming two stable states (set or reset), thereby storing a bit of information. It remains in either state until a signal changes it to the other state.

Ground Start—A ground start line requires a ground on the ring conductor to saturate the line ferrod as a request for dial tone.

Hopper—An area in call store memory used to record a list of items for communication between programs.

IGFET—Insulated gate field effect transistor used in 2B memory cell.

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

Input/Output (I/O)—The process of transmitting information from an external source to a system or from a system to an external source.

I/O Channel (IOC)—One of 20 communication links associated with the 3A CC which provide communication to the periphery. This may connect to 20 serial I/O subchannels or with the 2B I/O control circuit.

I/O Subchannel (IOSC)—One of 20 communication paths associated with a serial I/O channel. Each path provides a dedicated 6.7 MHz link to a peripheral unit.

Instruction—A word which directs the central processor to perform a particular function.

Loop Range Extension with Switchable Gain—A method for providing range extension in a loop for both signaling and transmission.

Loop Start—A loop start line requires a short on the tip and ring conductors to saturate the line ferrod as a request for dial tone.

Main Store (MAS)—That part of the control unit which is used for program, translation, and temporary storage of information for system operation. This is an IGFET memory which is organized into 256K word physical stores each having its own controller. The first physical store of 256K is on the processor frame and the remaining 512K is on a supplementary main store frame.

Main Store Bus (MASB)—The input/output paths of the main store which provide address, data, and control information.

Main Store Controller (MASC)—That part of the main store which receives and transmits main store information to and from the 3A central control and main store memory modules.

Main Store Controller and Memory Unit (MASCM)—A 10-inch mounting plate which contains one main store controller and one or two MAS memory modules. This unit is the minimum main store configuration.

Main Store Memory Unit (MASM)—A 6-inch mounting plate which can be equipped with one or two main store memory modules. Up to three of these units may be provided per main store. Note that up to eight MAS memory modules can be added to a MASC.

Main Store Memory Module (MASMO)—The smallest growth increment (32,768 words) of that part of the main store used to retain information. With 16K devices the growth increment is 128K.

Maintenance—The process of keeping equipment in proper working condition.

Maintenance Channel (MCH)—The serial communication link between 3A central controls which provides maintenance, access, and control information.

Maintenance Frame (MTCE)—The single-bay frame that contains 2 TDCs, a system status panel, 4 TTYCs, a maintenance TTY, E2A telemetry interface, and power for the above items.

Microstore (MIS)—A read-only memory used in the 3A CC for instruction decoding, interrupt administration, bootstrapping, and interface to the 3A CC panel. This memory is available in 512-word modules (with double density boards, the growth increment is 1024 words) to a maximum of 4096 words.

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.

Memory Device—Apparatus having the faculty of retaining one bit of information. A relay, flip-flop, or an insulated gate field effect transistor (IGFET) memory cell.

Off-Line—A condition in which equipment is operating correctly but is not called on to perform its primary function.

On-Hook—The condition that indicates the idle state (loop open) of a station line or other circuit. When a telephone handset is resting on its switchhook, the loop is open and the line is in the on-hook condition.

On-Line—A condition in which equipment is performing its primary function.

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.

Processor Frame (PROC)—A double-bay frame containing a duplicated set of the following: 2B I/O control circuit, 3A CC, a main store, and power for these units. Two control units, each equipped with a 256K main store, is a fully equipped processor frame.

Program—A logical sequence of instructions used to control system functions.

Program Store (PS)—The area of the main memory which is used to store the sequences of logic operations required for call processing.

Progress Mark—The first word of a transient call record which designates the state of a call in progress in the No. 2B ESS and the address of the routine that processes the call state.

Random Access—The ability to gain access to any location of a memory unit in a time that is essentially independent of the location.

Read—To extract the information stored in a memory device.

Read Only Memory—Memory which can only be changed by the replacement of micro store boards.

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

Register—A functionally associated set of word storage elements with or without its controls and access; a word repository.

Remote Office Test Line (ROTL)—Allows interoffice trunk testing automatically from a centralized automatic reporting on trunks (CAROT) system.

Remreed Network—A space division, 2-wire network in which metallic connections are established but they are established through remreed switches rather than ferreed switches.

Scanner—A circuit that allows the processor to sample or interrogate the state of lines and trunks or equipment units in the No. 2B ESS.

Scan Point—A scanning address (in binary form) of a line, trunk, or equipment unit.

Semiconductors—Materials which are between metals and insulators in their ability to conduct electricity. Also, devices such as diodes and transistors made from semiconductor material.

Serial—Pertaining to time-sequential transmission or storage, such as transfer or store in a digit-by-digit time sequence.

Space Division—A method of serving a number of simultaneous calls by assigning to them different transmission paths through a switching network.

Standby—The state of a unit when it is not handling customer switching functions but is ready and able to do so. Units in the standby state may perform checking operations or be matched against the active units.

Store—A unit containing memory devices in which information is kept until the system is ready to use it. A repository for information comprising memory, access, and control.

Subroutine—A sequence of programmed instructions to perform a particular function which is common to several programs.

Supervisory Scan—The sequential reading of groups of scan points to determine the state of lines, circuit junctors, trunks, or service circuits.

Supervision—An action or operation that performs a service of inspecting or directing other actions or operations such as off-hook and on-hook detection.

Supplementary Main Store Frame (SMAS)—A single-bay frame that contains up to an additional 512K words (two main stores). (For 16K devices, the frame can contain three main stores; ie, 768K.) The first physical MAS (256K words) is on the processor frame.

Switching Network—A network of switches arranged to perform an interconnection function.

System Status Panel (SSP)—The panel located on the maintenance frame which provides status displays and key control of the 2B Processor, as well as status of the entire office.

T-Carrier Direct Interface—Provides an option that enables the functions normally performed by a trunk circuit and a channel unit to be performed by a direct interface channel unit.

Tape Data Controller (TDC)—The unit which contains the cartridge tape transport and the interface between the 3A CC and both the cartridge tape transport and the 3A CC data link facility. Two of these units mount in the maintenance frame for use in 2B.

Teletypewriter controller (TTYC)—The interface between the 3A central control and 1 to 4 teletypewriter ports each comprising a TTY communication channel. (Note: There are two controllers per unit.) The first four TTYCs are contained on the maintenance frame and the remaining are mounted on miscellaneous frames.

Temporary Memory—The read and write portion of the MAS which contains information that can be changed by the internal circuitry of the system and is not write protected.

Time-Shared Circuit—A common circuit whose services are used by a number of circuits during separate time intervals.

Translation Information—Information contained in the main memory pertaining to individual lines or trunks. It may be used, for example, to convert a directory number into an equipment location, to derive the class of service, etc.

Translator—A circuit or program used to change information from one form of representation to another.

Trouble—A malfunction or other condition that causes a deviation from normal system operation.

Trunk Circuit—A circuit of a switching system which may be required to supervise a connection within the system and/or to associate the system with a transmission facility or another switching entity.

Unipolar Pulse—A pulse of one polarity only.

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

3A Central Control (3A CC)—The combination of logic, microstore, I/O channels, and control panel which is primarily utilized to interpret and act upon information read from the main store. The 3A CC is mounted in the processor frame.

3A CC Control Panel—The panel associated with the 3A central control which provides manual access and display of internal registers and main memory associated with the 3A central control. The panel also provides additional functions such as the ability to step through a program and compare on main store locations and/or data.

2B Input-Output Control Circuit—The circuit that provides the interface between the 3A CC and the No. 2 ESS Peripheral Equipment. This circuit contains a 512 point bipolar CPD matrix, a peripheral unit address bus (PUAB), scan answer bus (SAB), and dial pulse and data timing circuitry. The 2B I/O control circuit is located in the processor frame.

2B Process—The equipment in a 2B ESS office consisting of the maintenance frame, a processor frame, and up to two supplementary main store frames that provide control and maintenance of the office.