

NO. 101 ELECTRONIC SWITCHING SYSTEM

GENERAL DESCRIPTIVE INFORMATION

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20. Port-A-Punch Card—Typical Example	75	1.01 This section describes the No. 101 Electronic Switching System (No. 101 ESS). This system is designed to provide private branch exchange (PBX), central exchange (centrex), and other calling service features for Bell System customers.	
21. No. 101 ESS—Block Diagram for Typical Calls (See Table G)	81	1.02 This section is reissued to:	
22. Call Transfer—Individual All Calls and 3-Way Calling (1A Switch Unit)	83	• Update the service feature descriptions (Part 4)	
23. Station-to-Station Call—Main-Satellite Installation	110		

- Delete PICTUREPHONE® information
- Incorporate miscellaneous revisions.♦

1.03 The No. 101 ESS:

- (a) Consists of equipment that is easily installed and housed in cabinets that blend with modern office furniture.
- (b) Provides a wide range of service features for customers whose needs range up to approximately 4000 PBX lines and 664 trunks.
- (c) Functions with most types of central offices (COs) (crossbar; step-by-step; panel; or ESS).
- (d) Offers flexibility in the administration of service and growth. Readily changeable magnetic memories permit service modifications or additions on a rapid basis. Normal growth line circuits, trunk circuits, and other similar variables are simply plugged into prewired equipment positions.
- (e) Provides for centralized maintenance and circuit redundancy for reliability. Continuous operation of the system is assured by: (1) selection and testing on a programmed basis of semiconductor and memory devices and (2) duplication of critical circuit blocks.

1.04 The No. 101 ESS is a stored program common control system utilizing solid state and magnetic memory devices. The system is functionally and physically divided into:

- (a) Control Unit—The control unit, usually located in the serving CO, consists primarily of: (1) a special purpose digital computer (the decision-making portion of the system) and (2) input-output equipment which interfaces with the computer and the switch units.
- (b) Switch Unit—The switch unit, usually located on the customer premises, functions to establish talking connections between PBX stations, trunks, and attendant consoles. These talking connections are established in accordance with information provided by the control unit.

1.05 The communication (transmitting and receiving) paths between the control unit and the switch units are:

- (a) Data Links—The 4-wire data links are used: (1) for sending on-hook and off-hook information from the switch unit to the control unit and (2) for sending instructions pertaining to switching from the control unit to the switch unit.
- (b) Digit Trunks—Digit trunks are used for sending dial pulses from the switch unit to the control unit. ♦Dial tones are sent over digit trunks to the switch unit.♦
- (c) CO Trunks—CO trunks provide the talking path between the switch unit and trunk circuits at the CO.

CAPACITY

1.06 The control unit located in the serving CO has the capacity to control up to approximately 4000 PBX or centrex extension lines, approximately 800 CO, tie, and foreign exchange (FX) trunks.

1.07 Table A lists extension line and trunk capacity for the switch units.

EQUIPMENT PACKAGING

1.08 Equipment packaging has been stressed in both the switch unit and control unit portions of the system. The 1A switch unit is completely assembled and wired at the factory in one cabinet. The 2A, 3A, and 4A switch units are assembled in sections to provide easy handling and installation. Line and trunk circuits are variable in number and ordered as required. They are assembled as modular circuit packages and are plugged into prewired equipment positions in the switch unit.

1.09 The common control portion of the control unit is required in every system. Frames comprising this equipment are ordered as packages. The control unit input-output equipment, associated with each switch unit, is variable. The quantity of such equipment is a function of the number and size of the connection switch units, their trunks, and customer traffic. The input-output frames are factory wired for the full complement of equipment units. These functional units are made up of groups of modular circuit packages.

TABLE A

SWITCH UNIT LINE AND TRUNK CAPACITY

SWITCH UNIT	LINES		TRUNKS		REFERENCE SECTIONS			
	MAX LINES	NOTES	CAPACITY	NOTES	SECTION NO.	TYPE OF INFORMATION		
						DESCRIPTION OF SYSTEM OPERATION	IDENTIFICATION AND INSTALLATION	CONNECTIONS
1A	200		40	1	240-101-101	✓		
					240-201-201		✓	
					240-202-201			✓
2A	340	2	80		240-101-102	✓		
					240-245-201		✓	
					240-245-202			✓
					240-245-203			✓
3A	820		112	1	240-101-103	✓		
					240-255-201		✓	
					240-255-203			✓
					240-255-204			✓
4A-1	2000	3	332		240-101-104	✓		
4A-2	4000	3	664		240-265-201		✓	
					240-265-203			✓

Note 1: Additional trunks are available by replacing line circuits with trunk circuits.

Note 2: An additional 24 lines are available by replacing 24 trunk circuits with 24 line circuits.

Note 3: Approximately. Actually, the 4A1 has 2048 terminals and the 4A2 has 4096 terminals. Theoretically the 4A1 can have a maximum of 2040 lines and the 4A2 can have 4080. In service, the maximum number of lines provided for a customer depends on the traffic ccs requirements per station.

OVERALL SYSTEM PLAN

A. Basic System Plan

1.10 The No. 101 ESS (Fig. 1) may be arranged to provide a wide choice of switch units, each with a different capacity, at a number of customer locations. All the switch units, up to 4000 lines, can be served by a common control unit. Each switch unit has provisions for attendant

positions, station lines, and CO trunks. Separate switch unit-control unit communication/control paths are provided for each switch unit.

1.11 Simplified examples of line and CO trunk connections via various switch unit time-division buses are shown in Fig. 2. Attendant and digit trunks are similarly connected. Also shown are control unit details. Additional system operation principles are provided in Section 240-100-101.♦

B. Main-Satellite System Plan

1.12 The No. 101 ESS may be arranged to provide service to a multilocation customer. This arrangement, called main-satellite (Fig. 3), is especially desirable where consolidation of attendant functions is required.

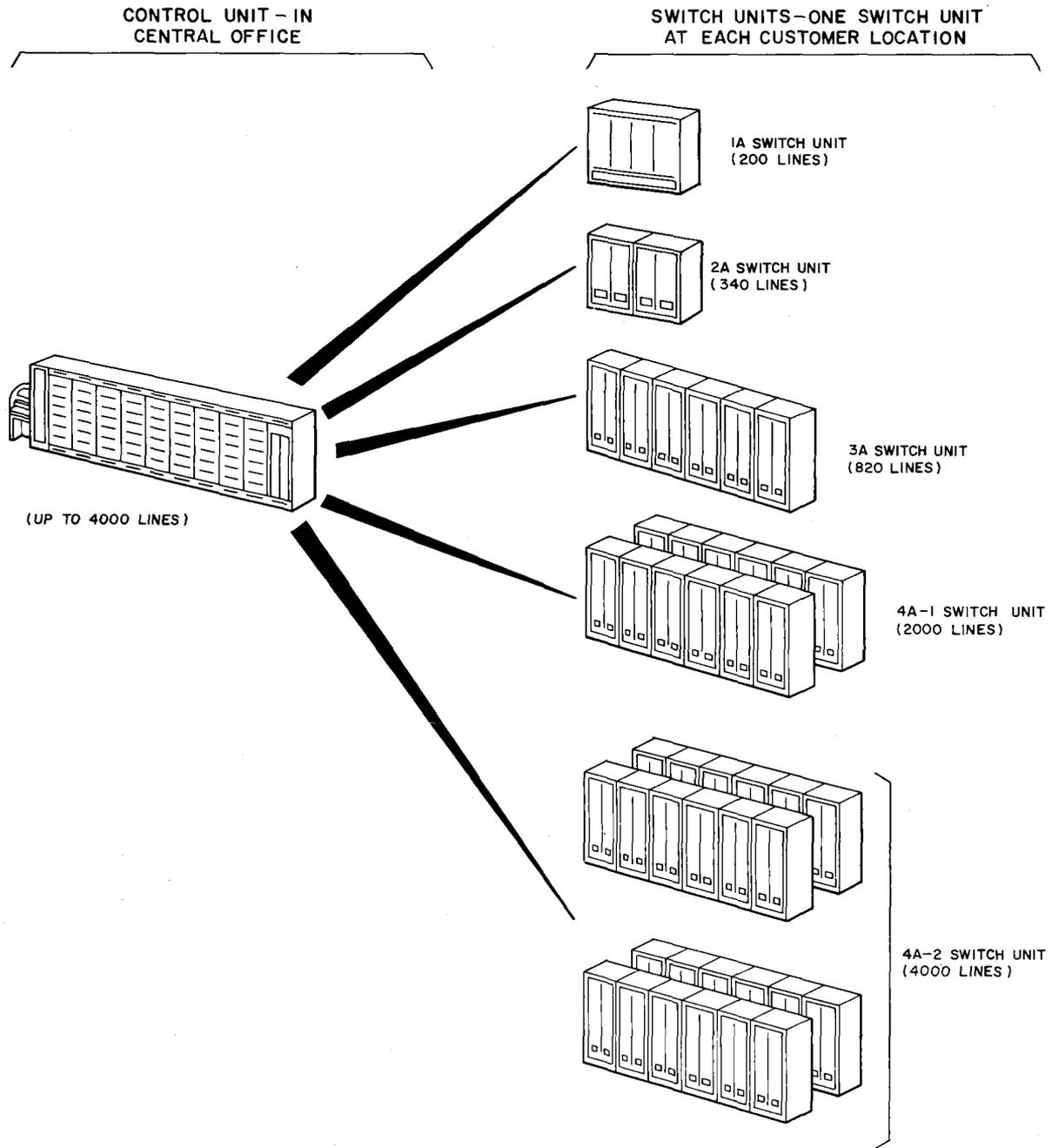
1.13 A main-satellite arrangement:

- (a) Provides a uniform numbering plan.
- (b) Provides Centrex I and II packaged features plus optional features.
- (c) May include two or more of any combination of 2A, 3A, 4A-1, or 4A-2 switch units and

one or more control units. Thus, customers beyond the size range of a single control unit may be served with the No. 101 ESS if the switching requirement can be satisfied with a main-satellite complex.

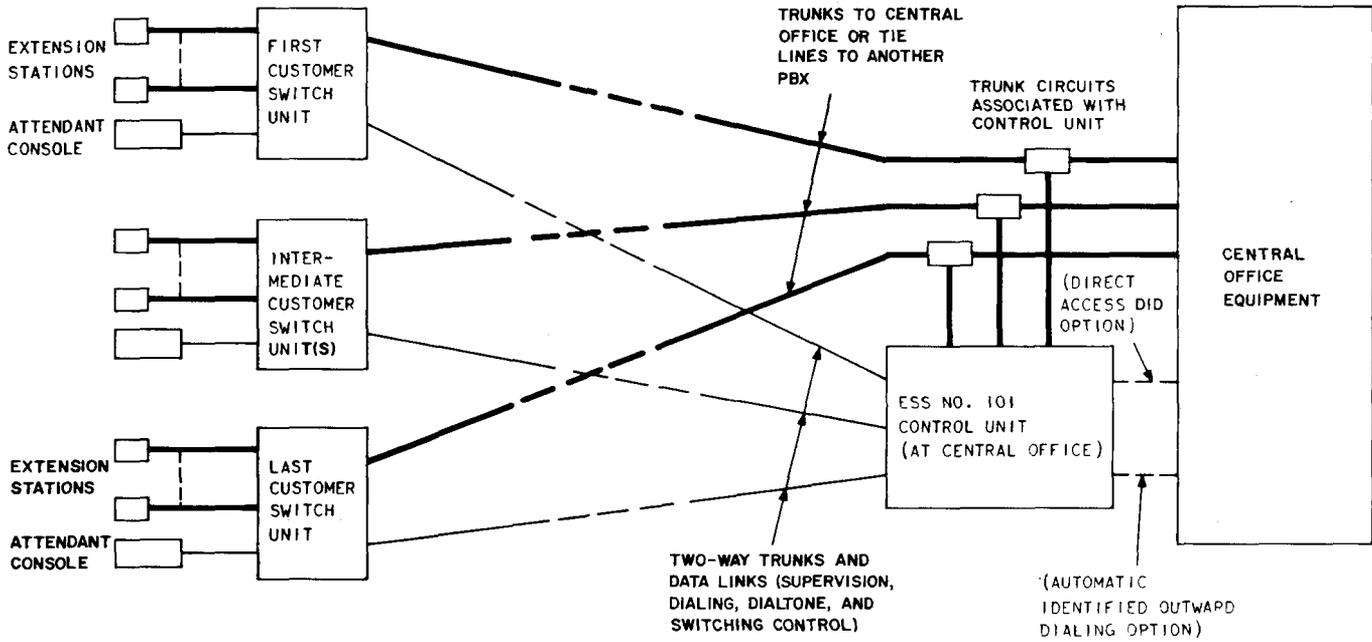
1.14 For a main-satellite complex:

- (a) Attendants are located at the main switch unit. The main-satellite complex may be provided with more than one main switch unit if attendants are required at more than one location. In this case, each satellite switch unit may have only one main for attendants.
- (b) Transmission links (T-links) interconnect all locations of the main-satellite complex.



A. BASIC PACKAGING

Fig. 1—No. 101 ESS—Overall System Plan (Sheet 1 of 2)



B. BASIC SYSTEM BLOCK DIAGRAM

Fig. 1—No. 101 ESS—Overall System Plan (Sheet 2 of 2)

2. SWITCHING PRINCIPLES

SPACE-DIVISION AND TIME-DIVISION SWITCHING

2.01 Time-division switching is used in all No. 101 ESS switch units and in the control unit. Part of the 4A switch unit also uses space division switching (continuous closure of individual paths).

2.02 Time-division switching is based on periodic sampling of a transmission. This sampling is repeated frequently to permit smoothing and restoring the sampled energy to the original transmission. At voice frequencies, sampling at 12,000 times per second provides high quality transmission.

2.03 In the No. 101 ESS switch units, the sampling process consists of closing the transmission paths between two circuits for a short period of time. Other pairs of circuits are then closed for a short period of time in sequence. The time interval in which circuit paths are closed is called a *time slot*. The time required to close all pairs of circuits in sequence is called the *sampling period* (82.5 microseconds at a sampling rate of 12,000 times per second). A connection between two circuits (line or trunk) is made through solid-state switches to a common bus during a time slot. The numbers of the line or trunk circuits to be connected are stored in a specific location in memory, which is read once each sampling period. Each location in memory, containing numbers of circuits to be connected, represents a time slot.

2.04 At the switch unit, each line or trunk has access to the common bus through a line or trunk circuit. The line circuit provides transmission, supervisory, and ringing functions for the associated extension. The transmission portion consists of the high-speed solid-state sampling switch, a low-pass filter, and a repeat coil. The switch connects the line to a common bus under the direction of a network control. The low-pass filter stores and integrates the energy between switch closures and prevents unwanted high-frequency signals, produced by switching, from reaching the subset and appearing as noise. The repeat coil provides dc power to the subset. It also connects the balanced line to the unbalanced time-division network. The supervisory circuit detects the supervisory state of the line and informs the scanner of the off-hook or on-hook

condition of the subset. Each station line circuit connects the ringing supply directly to the station line. This circuit is controlled by a dc signal transmitted to the line via the time-division network.

SWITCHING NETWORK AND CONTROL

2.05 The network control consists of: (1) a switch unit memory called the switch store which functions to record calls in progress; and (2) logic and translators which function to read memory and activate the appropriate time-division gates in the switching networks. The memory devices used in the switch units are ferrite cores. Information recorded in the store is generally referred to as *words*. Each word contains the binary representation of the two numbers (line or trunk) to be connected. During the talking time slots, words are read out of the store sequentially, and the information in each word controls the operation of the correct time-division switches. This information is received from the control unit over a data link and is written in the store by the switch control circuit.

SWITCH UNITS

A. 1A Switch Unit (Fig. 2 and 4)

2.06 The network control is duplicated so that a total of 50 simultaneous conversations may be established over two common buses. In case of a failure in one-half of the network control, the half that failed can be automatically switched out of service under control of the maintenance program. Service is maintained, but the traffic carrying capacity is reduced to one-half the number of time slots. Call transfer and 3-way calling capabilities are lost.

B. 2A Switch Unit (Fig. 2 and 5)

2.07 The network control is fully duplicated and each half is associated with one of two intergroup buses. Lines and trunks terminate on group buses in blocks of 64 with each block having access to both intergroup switches. There are up to seven such blocks for lines and trunks and one for tones, digit trunks, and attendant lines. Typical connections are shown in Fig. 6. A total of 60 talking time slots (30 in each switch store) make possible 60 simultaneous conversations. In case of failure in one-half of the network control, the half that failed can be automatically switched out of service under control of the maintenance program.

SWITCH UNIT CONFIGURATIONS

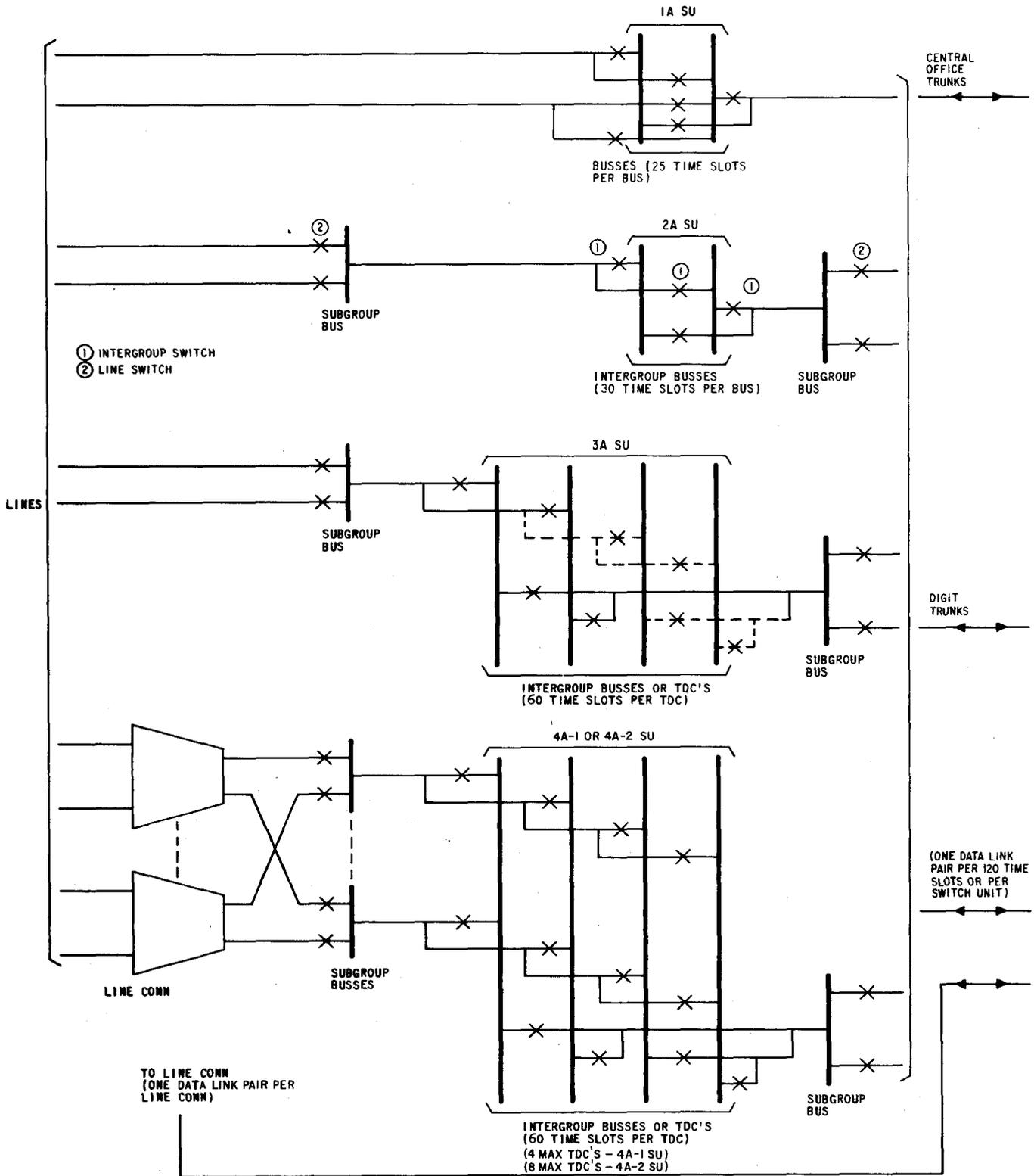


Fig. 2—No. 101 ESS—Simplified Block Diagram (Sheet 1 of 2)

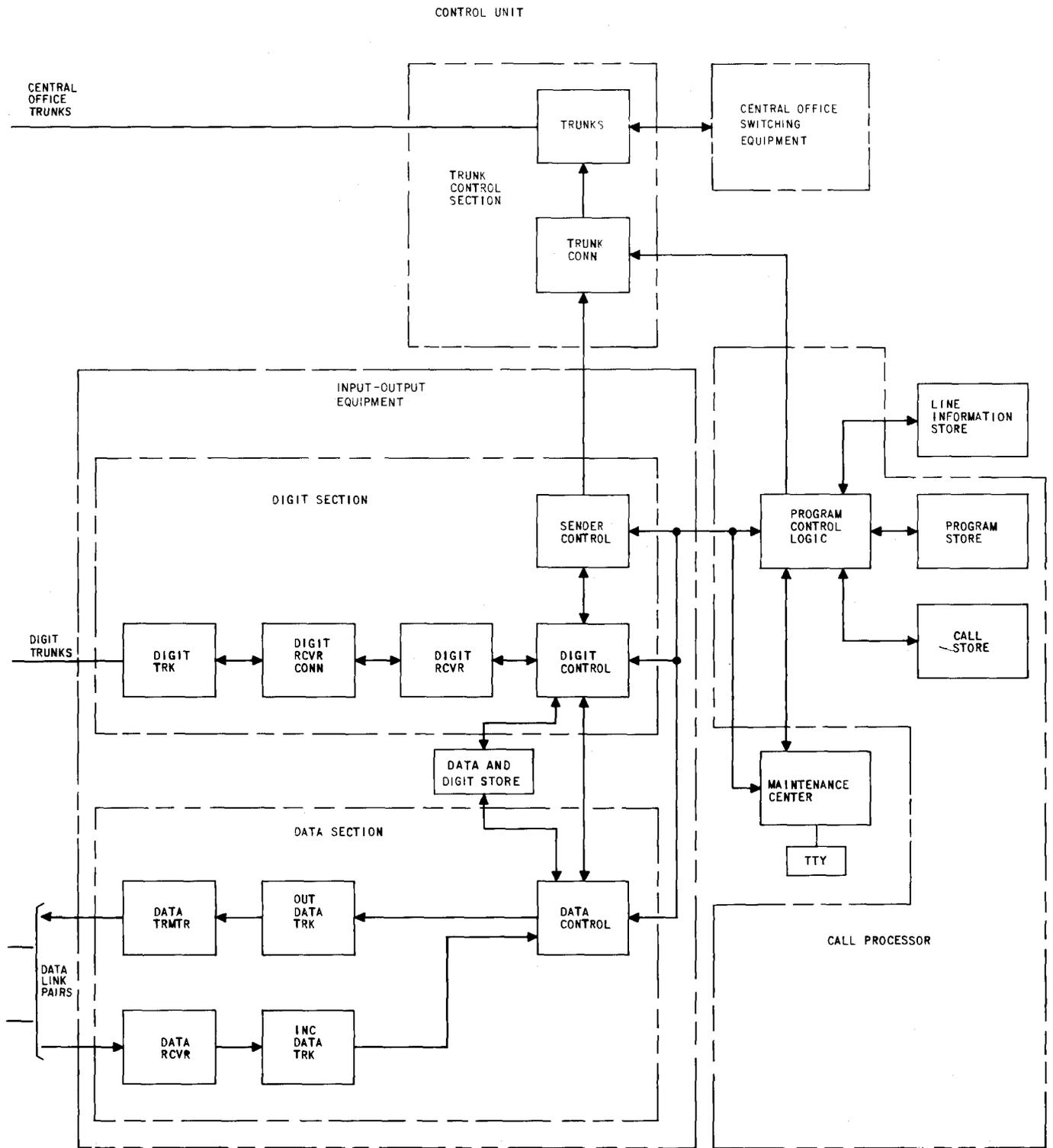
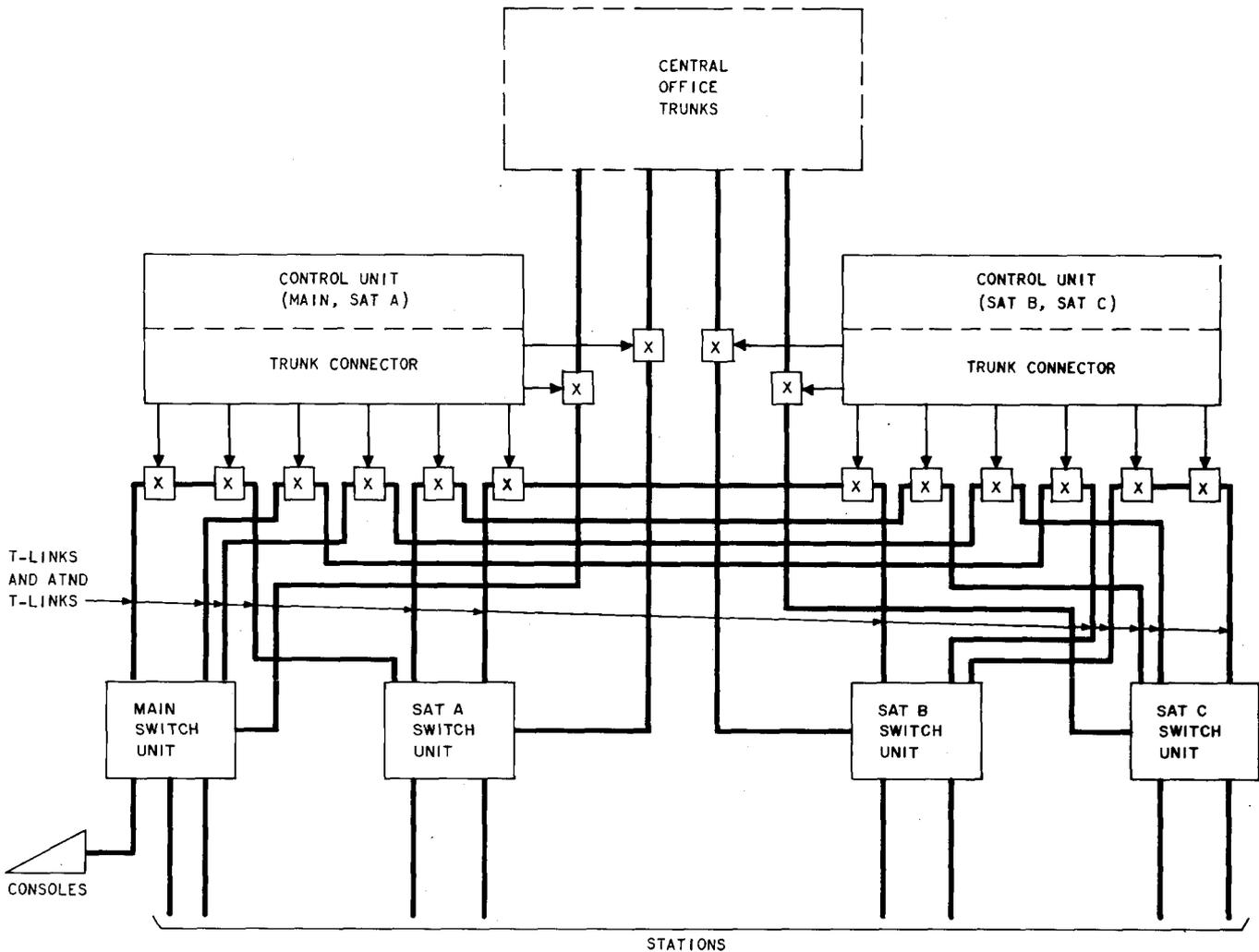


Fig. 2—No. 101 ESS—Simplified Block Diagram (Sheet 2 of 2)



NOTES:

1. DATA LINKS AND DIGIT TRUNKS ARE NOT SHOWN BUT HOME ON THE ASSOCIATED CONTROL UNIT.
2. TIE LINES AND MISCELLANEOUS SPECIAL SERVICE CIRCUITS ARE PROVIDED AS REQUIRED PER SWITCH UNIT AND ARE CONTROLLED BY THE ASSOCIATED CONTROL UNIT.

Fig. 3—No. 101 ESS—System Plan for Main-Satellite—Typical Example

Full service (all features for all lines and trunks) is maintained, but the traffic carrying capacity is reduced to one-half the total number of time slots.

C. 3A Switch Unit (Fig. 2 and 5)

2.08 A network control is provided for each of 2, 3, or 4 intergroup buses. Lines and trunks terminate on up to 15 buses. Each group bus has access to all intergroup buses that are equipped. Tone and digit trunk blocks terminate all the digit trunks, tone sources, and attendant

line circuits. A total of 60 talking time slots make possible 60 simultaneous conversations per intergroup bus. A failure in an intergroup bus causes it to be automatically switched out of service. Full service (all features for all lines and trunks) is maintained, but the traffic carrying capacity is reduced by the number of time slots on the bus.

D. 4A Switch Unit (Fig. 2 and 5)

2.09 4A-1 Switch Unit: The 4A-1 switch unit is a two-stage switching system with all

station lines connected to space division ferreed networks and all trunks connected to time division networks. The line input first-stage space division network (line connector equipment) uses ferreed networks. The second stage consists of a 120, 180, or 240 time slot 3A time division switch (3A TDS). The outputs from the first stage connect to line circuits (B-links) which are controlled by the second-stage 3A TDS. Both stages are controlled by the No. 101 ESS control unit. The line switching frame concentrator outputs may be multiplied to provide for maximum line concentration ratio of 4:1 (approximately 2000 lines).

2.10 4A-2 Switch Unit: The 4A-2 switch unit is a two-stage switching system that consists of two 3A TDSs. Line concentration is provided by two line connectors. Each line connector consists of up to eight line switching frames with eight concentrators per frame. Each concentrator provides a line concentration ratio of 2:1 for 32 lines to 16 B-links. Pairs of concentrators may be multiplied to provide for a maximum line concentration ratio of 4:1 (approximately 4000 lines). The resulting B-links to the 3A TDS are split into two equal groups with half of the B-links from each line switching frame terminating on each 3A TDS. Therefore, every line has access to both 3A TDSs, with eight B-links to each 3A TDS. Trunks, tie lines, and miscellaneous special service circuits, such as telephone dictation, paging, code call and digital inquiry voice answer (DIVA), or computer ports are divided in two equal groups and terminated directly on each of the 3A TDSs. Special purpose dial repeating tie lines (T-links) are used to interconnect the two 3A TDSs for completing certain outgoing tie line calls.

E. Characteristics Common to all Switch Units

2.11 Changes in supervisory states of lines, trunks, and attendant keys are detected by the switch unit scanner and transmitted over a data link to the control unit. Signals to the switch unit from the control unit are in the form of data messages. These are used to set up or take down network connections, operate signal lamps on the attendant consoles, or transmit corrective maintenance messages. The scanner, data receiving, and data transmitting equipment are duplicated for reliability and service protection. In the 4A, line originations are detected by a scanner in the line connector and transmitted over a data link to the control unit.

2.12 The data messages pertaining to attendant console lamps are handled separately from messages pertaining to talking connections. An attendant circuit translates the lamp message and lights the appropriate lamp on the console through solid-state lamp drivers. The attendant circuit also contains scan points for the console keys. Operation of any of the keys sends a coded message to the control unit indicating which key changed state. The system response is a message to control lamps on the console and/or a connection message for the network control.

2.13 Tone sources, including busy and audible ringing tones, have access, through sampling switches, to the common buses. A connection to a tone source is set up as described in 2.01 for line-to-line or line-to-trunk connections.

CALL PROCESSOR ORGANIZATION

A. General

2.14 The processor consists of (1) the program control logic; (2) the program store; and (3) the call store. A line information store is provided but is actually not a part of the call processor; the line information store works with the on-line call processor. Two call processors are provided for reliability; at all times one call processor is on-line (active) while the other call processor is off-line (standby).

2.15 The call processor makes use of a stored program which is contained in the program stores. The program stores contain the system commands. These commands are the instructions that guide the control unit as telephone calls are set up and supervised at the different switch units located at the PBX customer premises.

2.16 The input-output equipment serves as a buffer between the call processor and the switch units.

B. Program Control Logic

2.17 The program control logic contains logic gates, flip-flops, and registers that are used to read, interpret, and execute the commands in the program stores. The program keeps a continuously updated call record of all activity reported to it by the switch units. This record is kept for each

call in progress in the system and is found in the call store areas referred to as talking time slots.

C. Program Store

2.18 The program stores are semipermanent twister memories that contain (1) the sequence of logical operations (system commands) required for call processing and automatic maintenance of the system; and (2) administration information peculiar to each switch unit (customer) and to the control unit.

2.19 The number of program stores may vary from two to four, depending on the requirements of the particular No. 101 ESS installation. Each program store consists of 16,384 (22-bit) words. When a 22-bit word is to be read out (ie, gated out of the store and detected by the sense amplifiers), the contents of the program store address register are used to address the word as follows:

- (a) Two-store system: 12 bits to define the word; 2 bits to identify the quadrant; 1 bit to designate the store.
- (b) Three-store system: 12 bits to define the word; 2-bits to identify the quadrant; 2 bits to designate the store.
- (c) Four-store system: 12 bits to define the word; 2 bits to identify the quadrant; 2 bits to designate the store.

2.20 The program store utilizes a permanent magnet twister memory module. Information is stored in the form of small rectangular areas of magnetic material bonded to removable aluminum cards (Fig. 7). An area, when magnetized, forms a small bar magnet, which inhibits switching (changing the magnetic state) of the section of twister wire, resulting in a zero output signal (Fig. 7). When the magnetic material is demagnetized, the switching of the twister wire section produces a one-output signal. These signals propagate down the twister wire and are sensed by the readout circuitry.

2.21 A system command, or logical operation, is defined by a particular pattern of ones and zeros in the same word. These commands are the instructions that the control unit executes as telephone calls are set up and supervised at the different switch units located at the PBX customer

premises. These instructions are used to gate information from one register to another, clear registers, shift bits, interchange information, or cause the program control to transfer to a new address in the program store to execute a different sequence of instructions. The type of instruction or command found in the program, depends upon the logical operation to be performed. Each instruction is divided into two parts: the operation code and the address code. By definition, the operation code tells the system what to do; the address code tells the system where to do it.

2.22 The program store information can be changed by removing the card containing the information to be changed and changing the appropriate words as required, using a card writing unit. This characteristic of the twistor allows stored instructions to be changed very readily to provide new features or new modes of operation in the No. 101 ESS.

D. Call Store

2.23 Description: The call store is a writable ferrite sheet memory that is used for storing the temporary information necessary for processing calls and automatic system testing. For reliability, the call store is duplicated with one store contained in the active (on-line) call processor and the other in the standby (off-line) call processor.

2.24 Call Store Sector: The call store contains records of the exact state of every call being processed in the system and continually revises these records as the call progresses or as the state changes. Each call record in the call store is sometimes referred to as a talking time slot. The call store is subdivided into 16 areas called sectors. Each call store consists of 64 groups of 4 words, each word containing 16 bits. The sectors are numbered from 0 to 15. Sector 15 is used for control unit information; sectors 0 and 1 are used for switch unit information. Sectors 2 through 14 may be used for talking time slot areas which are assigned to particular switch units. The number of talking time slots allocated to a particular switch unit in the call store sectors may vary up to 480, depending upon the type of switch unit and the number of time division controls that each switch unit possesses.

2.25 Call Store Call Record: The call store call record contained in a talking time slot

consists of four sequential words of storage in the on-line call store. An important fact at this point in the discussion is that there is a call record in this store for each time slot in every switch unit. Since the content of this call record is necessary for setting up and maintaining the proper connections on the time division bus, the entire record is generally duplicated in the off-line call store and is periodically updated to agree with the on-line content by the stored program. The contents of a typical call store call record are:

- Word 1—progress mark
- Word 2—B party (called station), A party (calling station)
- Word 3—Digit receiver, digit trunk, and miscellaneous
- Word 4—Attendant, timer, and miscellaneous.

2.26 Progress Marks: In setting up a call, a prescribed sequence of events must take place before any actual talking connection is made. As the call advances through a sequence of logical instructions, it goes through many states and numerous actions are performed. The state to which a call has progressed is referred to as a **progress mark**. The instructions that pertain to each particular state of the call are assembled into sequential lists of commands called **progress mark routines**. The progress mark is recorded in the first word of every call store call record. This progress mark is actually a portion of the address of a word in a transfer table in the program store and is used to direct the processor to the proper routine in the program for a particular call.

2.27 The general operation involving the active call store is as follows: A progress mark is read from the call store and gated to the program store address register. This initiates the sequence of instructions that process the call. If this sequence causes any change in the state of the call because of new information being available, the appropriate information is added or deleted from the call store call record and a new progress mark is written. When this is done, the progress mark contained in the next call store call record is read out and a sequene for the next call is initiated. This process continues until all calls and all switch units have been processed. The process continues repetitively,

with the time for one cycle through the call store being a minimum of 0.064 second.

E. Line Information Store

2.28 The line information store is a twistor store identical to the program store but serves a different function.

2.29 Each PBX extension and trunk in the system is assigned at least two words of semipermanent information in the line information store. This information consists of class of service, hunt numbers, and other information relating to the service features described in Part 4. In addition, the line information store contains groups of speed calling per group translations, groups of speed calling per station translations, and numbers used for code restriction translations.

2.30 The line information store is read upon command from the program store whenever necessary for call handling. Information is read into the line information store output register. The desired information is then used by the program control to effect the necessary call processing.

2.31 The line information store is not duplicated in the system. However, if it fails, the system continues to operate except that features such as call restrictions and station hunting are denied, and certain special services such as speed calling, are deactivated for the duration of the failure. A failure of the line information store does not interfere with station-to-station, CO trunk-to-station and station-to-CO trunk calls.

2.32 Line information store information can be readily changed. Changes or additions in features provided are accomplished merely by changing the stored information in the line information store. This administrative process is described in Part 7.

F. Input-Output Equipment

2.33 The input-output equipment serves as a buffer between the call processor and the switch units. It communicates directly with the switch units and the CO to which the control unit is connected. This part of the system is capable of working with all of the switch units simultaneously. Information coming into the control unit in the form of dialed digits or supervisory data from

switch units is stored in the input equipment until the call processor requests it. Information leaving the control unit passes from the call processor to the output equipment where it is routed to the proper destination.

2.34 All of the digits dialed or keyed at the PBX station set are received by digit receivers and registered in a temporary memory at the control unit. Calls requiring out-dialing over CO

or tie trunks are handled by the sender control circuit. The sender control circuit, under instruction from the program control logic, uses the dialed or keyed digits to construct dial pulses and interdigital intervals. The dc form of the dial pulses is established in the outgoing trunk or tie line. The sender control circuit delivers the control signals to the outgoing trunk by way of the trunk connector circuit. The trunk connector directs the control signals to each trunk at the instant required.

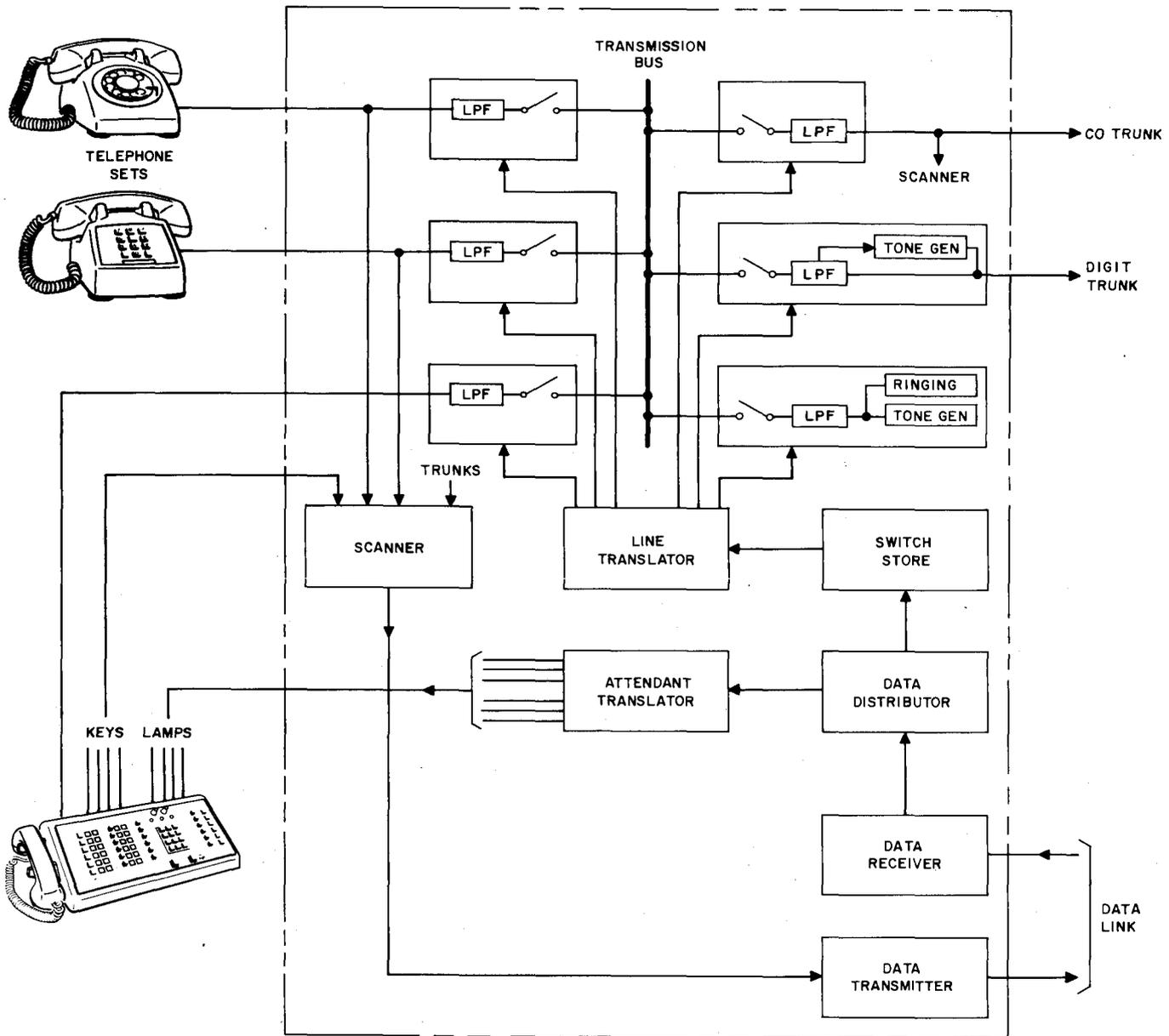


Fig. 4—1A Switch Unit—Block Diagram

COMMUNICATION PATHS FROM THE SWITCH UNIT TO THE CONTROL UNIT IN THE SERVING CENTRAL OFFICE

A. Data Links

2.35 Control information is transmitted between the switch unit and the control unit over data links. A data link consists of a voice frequency pair of wires for each direction of transmission plus associated data terminal equipment at the switch and control units.

2.36 Frequency shift modulation is used to transmit the data in tone signal form between the switch and control units. A logical one is transmitted as an 1150-Hz tone, and a logical zero is transmitted as an 1850-Hz tone. Timing signals in the data are used to indicate the beginning of each bit time. Data is transmitted from the control unit to the switch unit at a rate of 735.29 bits per second (bps), and from the switch unit to the control unit at a rate of 643.38 bps. The control unit-to-switch unit message is 47 bits long; the switch unit-to-control unit message is 14 bits long for the 2A-, 3A-, or 4A-type switch unit and 12 bits long for the 1A switch unit. The control unit also sends a 25-bit message to the line connector in the 4A-type switch unit.

2.37 In the event of unsatisfactory data link transmission, the data trunk pairs are interchanged with digit trunk pairs, and spare terminal equipment is substituted for the on-line circuits.

2.38 The function of the outgoing data trunk is to provide an interface between the data control logic and data transmitter. When the control circuit finds that it is time to send a one bit to a particular switch unit, a signal signifying this intention is presented to the outgoing data trunk. The signal is temporarily registered in the outgoing data trunk. The remaining function of the outgoing trunk is to use this signal, together with pulses from the system clock, to produce and deliver to the data transmitter a full length dc data bit.

2.39 The message to be transmitted is thus fed serially in a dc form to the data transmitter. The function of the data transmitter is to convert

this message into the tone signals suitable for transmission over the data trunk pair as described in 2.36.

2.40 The data receiver accepts the frequency-shift signals from the data trunk pair and converts them into dc logical ones and zeros for eventual use by the switch unit network control. The data receiver also generates the timing signals used to indicate the beginning of each bit time.

2.41 The output signals from the data receiver are translated in the switch unit, stored in the switch store, and used to make connections, light attendant lamps, and direct maintenance.

2.42 The data link from the switch unit to the control unit consists of the data transmitter at the switch unit; the data trunk pair; the data receiver and an incoming data trunk at the control unit; and data link transfer circuits at each end.

2.43 Data messages are presented to the data transmitter at the switch unit and transmitted to the control unit in the manner described in 2.36.

2.44 The incoming data trunk at the control unit receives timing and data bit signals from the data receiver. The signals are sampled and inserted in the data store for subsequent use by the call processing equipment.

B. Digit Trunks

2.45 Digit trunks provide separate signaling paths over voice frequency pairs from the switch unit to the control unit for direct access to centralized digit receiving equipment. Dialed or keyed digits originating at a switch unit are transmitted over one of a group of digit trunks to the control unit where they are registered. Dial tone is transmitted over the same trunk in the opposite direction.

2.46 Rotary dial pulses are converted into 50-ms bursts of tones and transmitted from the switch unit to the control unit over the digit trunks. The 50-ms bursts are recognized by a tuned digit receiver as special tones that must be counted to determine the digit dialed. TOUCH-TONE signals are passed directly through the digit trunk. The TOUCH-TONE signals at the control unit are recognized by the digit receiver at the control unit and interpreted as digits dialed from a TOUCH-TONE telephone. Thus, the same digit trunk circuit

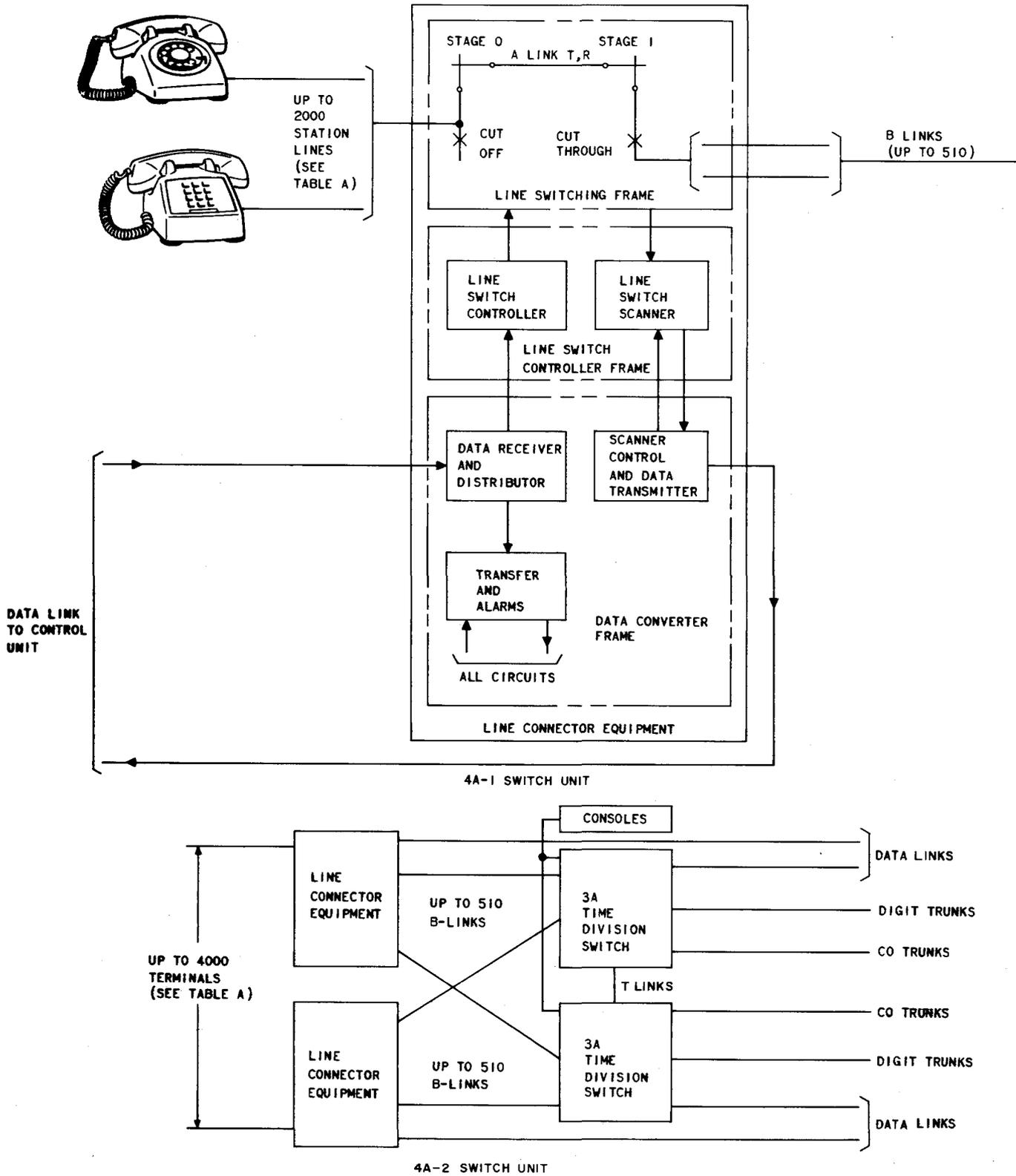
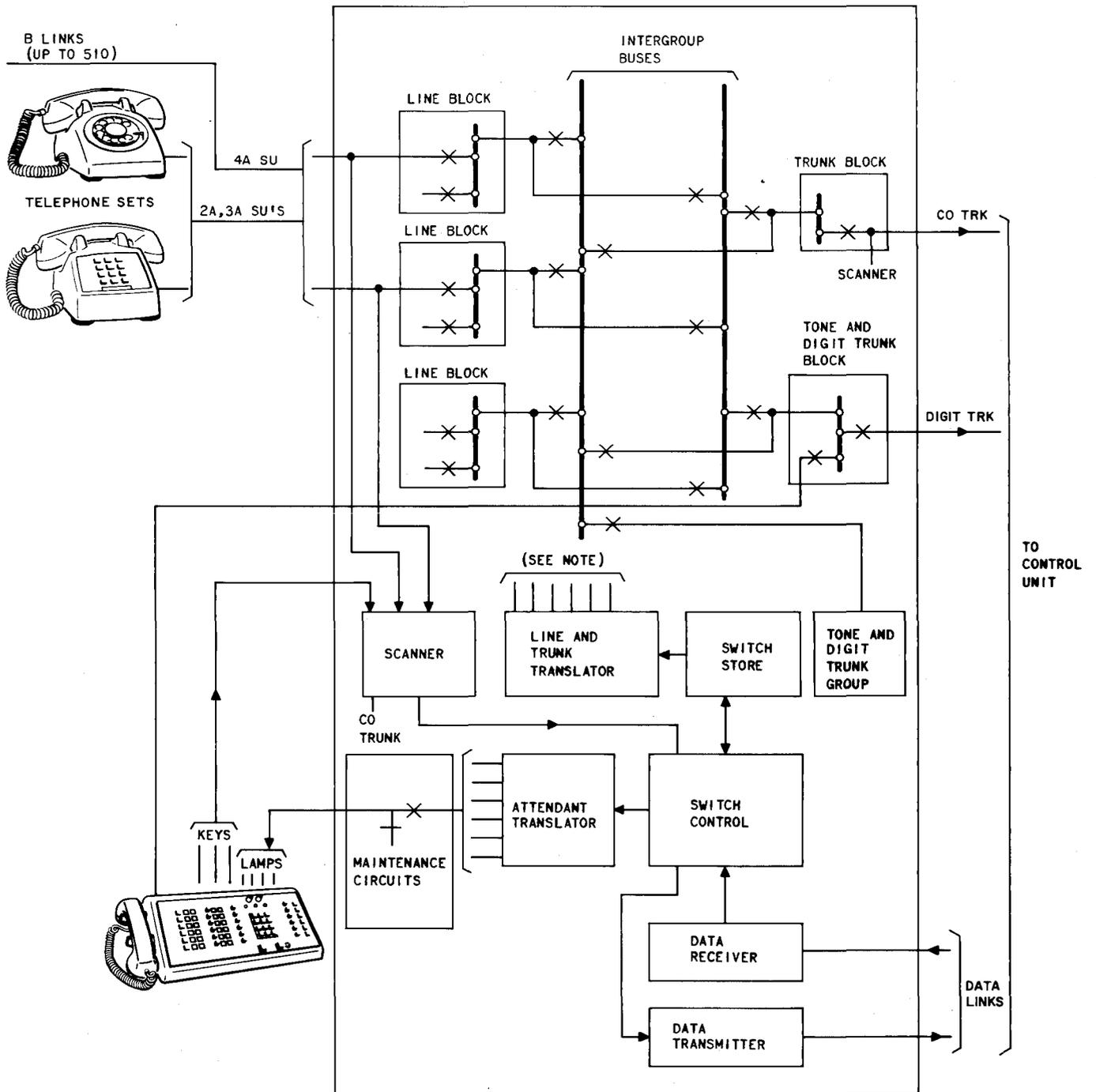


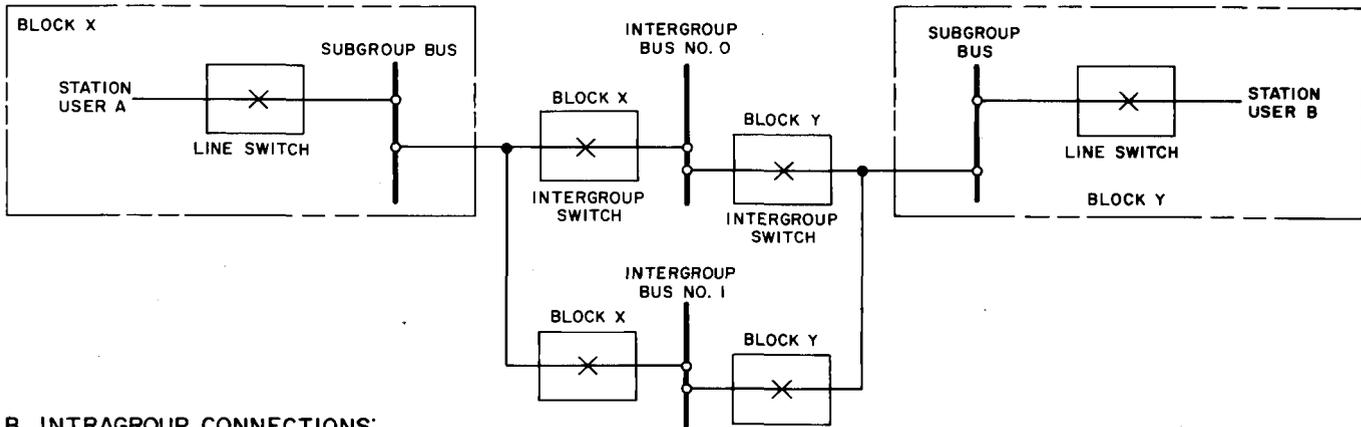
Fig. 5—2A, 3A, and 4A Switch Units—Block Diagram (Sheet 1 of 2)



NOTE:
TO ALL LINE AND TRUNK BLOCKS.
2A, 3A SWITCH UNITS

Fig. 5—2A, 3A, and 4A Switch Units—Block Diagram (Sheet 2 of 2)

A. INTERGROUP CONNECTIONS:



B. INTRAGROUP CONNECTIONS:

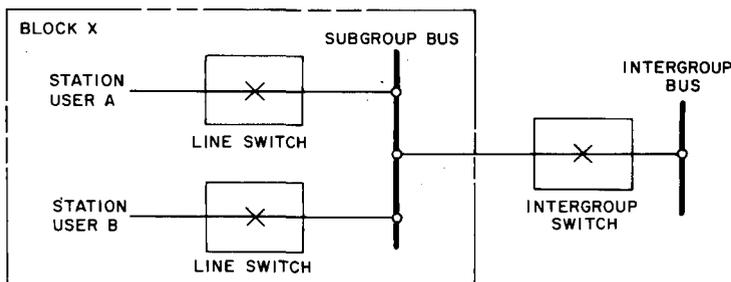


Fig. 6—Typical Bus Connections

permits dialing from either TOUCH-TONE or rotary dial telephone sets. Both types of telephone sets may be bridged on the same line.

2.47 The digit trunk circuit at the control unit provides a connection to one of a common pool of digit receivers. A time-division switching network, similar to that used in the 1A switch unit, called the digit receiver connector, is used for this purpose.

C. Central Office Trunks

2.48 The CO trunk circuits provide the means for interconnecting the No. 101 ESS switch unit, control unit, and associated CO. Trunk circuits for regular PBX service interconnect the No. 101 ESS with almost any type of CO. The standard No. 101 ESS trunk circuits for this type of service are 2-way trunks. The same trunk may be used for one-way incoming or one-way outgoing service where required.

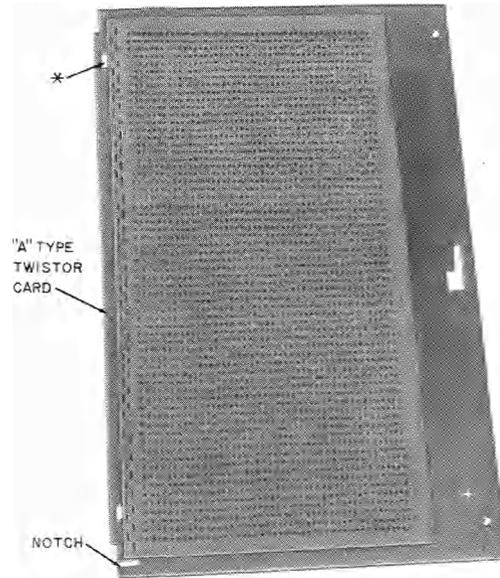
2.49 Each CO trunk for the No. 101 ESS has a circuit associated with the switch unit. The

switch unit portion is used to establish the transmission connection and is similar, except for ringing, to the extension line circuit described in 2.03. The control unit portion provides supervisory functions, including the application of dial pulses, toward the CO where necessary.

2.50 One-way or 2-way DID trunks are made available as required to interconnect the No. 101 ESS with those COs arranged to transmit extension number digits to the PBX. These include No. 1 ESS, crossbar tandem, No. 5 crossbar arranged for line link pulsing or direct access DID, and step-by-step COs.

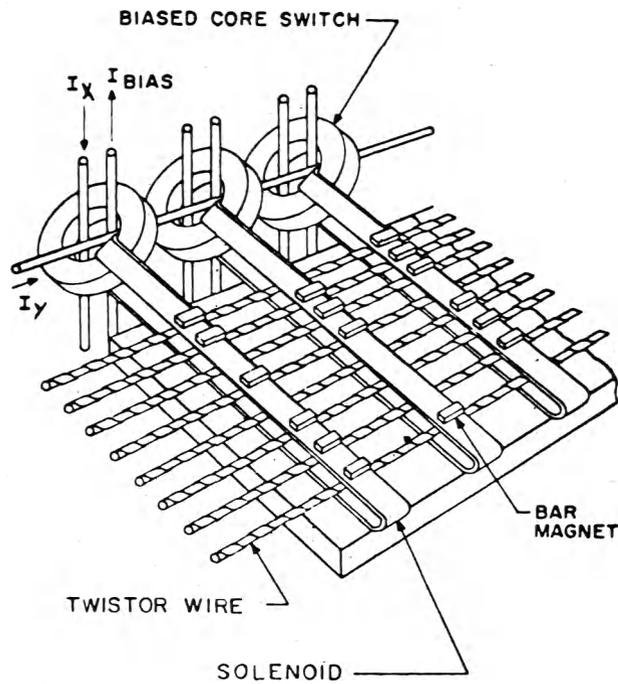
D. Tie Trunks

2.51 The No. 101 ESS provides facilities for long- and short-haul tie trunk operation. The 2-way automatic and 2-way dial repeating tie trunks are available for originating-terminating or tandem connections. See Section 240-107-101 for a complete description of trunks available for No. 101 ESS.



* "B" TYPE TWISTOR CARDS
HAVE A NOTCH AT THE TOP
LEFT PART OF THE CARD

A. Twistor Store Card



B. Permanent Magnet Twistor Store

Fig. 7—No. 101 ESS Twister Store

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2.52 The tie trunk circuit is composed of two sections, one section at the switch unit and the other at the control unit.

2.53 Long-haul tie trunks are provided with 4-wire transmission to the switch unit and 2-wire switching at the switch unit. This requires the 4-wire to 2-wire conversion facilities to be located at the switch unit. Repeaters can be located at the switch unit and/or control unit. Repeaters and terminal equipment cannot be installed in the switch unit cabinet.

2.54 At the control unit, the tie trunk circuit, which consists of the tie trunk logic circuitry, relays and associated circuits, and supervisory networks, provides the means of interconnecting the switch unit, the control unit, and a distant PBX. This circuit also provides a means for converting the supervisory signals used between the control unit and switch unit and external systems.

2.55 Pad control or the equivalent may be provided for tandem-switched tie trunks. For such trunks associated with a 1A switch unit, pad control and repeat coil circuits are provided at the control unit to control the operation of the switching pads that provide impedance matching. However, for 2A-, 3A-, and 4A-type switch units, fixed or switched gain is added to such trunks at the switch unit as required.

E. Miscellaneous Trunks

2.56 Foreign exchange (FX) and wide area telephone service (WATS) services are available with the No. 101 ESS. Trunk circuits similar to the CO trunks are used to provide these services. The provisions of these services must be coordinated with the associated COs and the numbering plan (Part 6).

2.57 Circuits for providing recorded telephone dictation, code calling, loudspeaker paging, and recorded intercept (DID calls only) facilities may be connected to a switch unit where required. These circuits are connected to the switching

network through the equivalent of extension line circuits.

STATION EQUIPMENT

2.58 The 500-type station sets or equivalent are recommended. Sets equipped with either rotary or TOUCH-TONE dials may be used. Both types of sets may be bridged on the same line. TOUCH-TONE sets may be used whether or not the serving CO, distant tie trunks, or FX trunks are arranged for TOUCH-TONE service because translation to dial pulses is done at the control unit.

2.59 Auxiliary station switching equipment using 1A, 1A1, or 1A2, key telephone systems or equivalent may be used. The 400D rather than the 400B key telephone unit is recommended.

3. INTERCONNECTION WITH CENTRAL OFFICES

GENERAL

3.01 The No. 101 ESS is arranged to interconnect with most types of COs to furnish PBX service. It can also furnish centrex service, including automatic identification of outward dialed calls. The inward centrex function can be activated in association with No. 1 ESS, wire spring No. 5 crossbar, step-by-step, or crossbar tandem COs arranged to transmit extension number digits toward the PBX. Direct inward dialing (DID) may also be provided by directly coupling the No. 101 ESS control unit to No. 1 or No. 5 crossbar completing markers. This arrangement is known as direct access direct inward dialing (DADID). It eliminates the need for using line link pulsing (LLP) and is applicable to both wire spring and flat spring No. 1 and No. 5 crossbar offices. The result is faster and more efficient operation, which in turn results in substantial savings in CO equipment for No. 101 ESS centrex installations.

3.02 The No. 101 ESS is designed to furnish automatic identified outward dialing (AIOD) or automatic number identification (ANI) to the CO. The CO must be a No. 1 ESS office or be equipped for local automatic message accounting (LAMA).

PBX OPERATION (NON-CENTREX)

A. General

3.03 The available CO trunks include a 2-way (non-DID) trunk for connection to a step-by-step or panel office and a 2-way (non-DID) trunk for connection to ESS or crossbar COs.

3.04 CO trunk pairs run from the switch unit on the customer premises to CO switching equipment through a trunk circuit at the No. 101 ESS control unit. The tip, ring, and sleeve are brought from CO switching equipment to the control unit trunk circuit. The sleeve lead is not extended beyond the control unit trunk circuit while the tip and ring leads are run to the switch unit. The program control has access through the trunk connector circuit to each trunk circuit for supervisory and dialing purposes.

B. Outward Call From PBX

3.05 System operation for an outward call dialed by a station user or the attendant on a dial selected trunk is described in the two following paragraphs. This description applies directly to operation with No. 5 crossbar and is similar in operation for other COs. Note that all digits dialed are received and registered by digit receiving equipment at the control unit.

3.06 The digit receiving equipment recognizes a dialed 9 and passes it to the program control. The program control selects an idle CO trunk and, through the trunk connector, directs that it go off-hook to the CO by applying a ground on the ring lead. The CO then makes the trunk busy by grounding the sleeve lead. When the CO is ready to receive dialing (when an originating register has been attached in No. 5 crossbar), a ground is applied to the tip lead. A relay operates in the trunk circuit at the control unit and places dc supervision on the tip and ring leads to the switch unit. The change in supervision is recognized by the scanner at the switch unit and transmitted over the data link to the control unit. Second dial

tone is given to the calling party after the register is attached on early systems; on later systems it is given without the above signal from the CO. Dial pulses or TOUCH-TONE signals are received and registered by digit receiving equipment at the control unit where the digits are analyzed for possible dialing restrictions. The sender control circuit and trunk connector circuit then operate to repeat the dialed digits on a dial pulse basis over the trunk to the CO switching equipment. When this is complete, a time-division connect is set up at the switch unit between the calling party and the CO trunk.

3.07 After the call has been completed, it is taken down as follows. If the No. 101 ESS customer disconnects first, the on-hook message is sent over the data link to the control unit where the program control causes the trunk connector to open the ring side of the loop to the CO. If the CO disconnects first, it removes the ground from the sleeve lead, which causes the trunk to go on-hook at the switch unit. An on-hook message is sent to the control unit where the program control causes the trunk to be disconnected. The line remains connected to the time division switch until it goes on-hook or to permanent signal. Either procedure initiates the action to take down the call.

C. Call to PBX Listed Number (Non-DID)

3.08 On an incoming call, the CO grounds the sleeve lead. The control unit trunk circuit recognizes this and places dc supervision on the tip and ring leads to the switch unit. The change in supervision is recognized by the scanner at the switch unit and an off-hook data message is transmitted over the data link to the control unit. The control unit alerts an attendant by sending a data message to light the appropriate lamp on the attendant console. When the call is answered by the attendant, the control unit is informed (by the scanner) and a transmission connection is established between the attendant and CO trunk. At this time the trunk is set in the off-hook state so that the call can be charged.

CENTREX OPERATION

A. Automatic Identified Outward Dialing

3.09 System operation for the dialing phase of an outward call is the same as described in

3.06 and 3.07. Automatic identification of the calling party extension number is accomplished as follows. No. 101 ESS trunks terminating in the CO are given an identifying mark so that CO automatic message accounting (AMA) equipment can recognize a call initiated by the No. 101 ESS. In LAMA offices the identifying mark is a special class of service; in ANI offices the mark is provided by a separate number network.

3.10 The CO AMA equipment recognizes a call originated by the No. 101 ESS. The CO AMA equipment suspends its normal procedure of applying the PBX listed number to the AMA tape and initiates a request to the No. 101 ESS control unit for identification of the calling party. The request to the control unit is in the form of a 4-digit trunk number asking the control unit for the extension number of the station connected to that trunk. The 4-digit number is derived from the CO equipment location of the trunk. When the control unit set up the call, it placed AIOD information in the call store. This is in the form of the 4-digit trunk number and the 4-digit DID extension number, plus the proper office index. The No. 101 can supply any one of three office index identifications to the CO. These are cross-connected in the CO to the proper office index lead. The control unit searches the control store and matches the incoming trunk number with the AIOD information for all outward calls recently set up. Upon finding a match, the control unit passes the calling extension DID number to the CO AMA equipment where it is recorded on the AMA tape. The time involved is comparable to that required for obtaining the PBX listed number for an AMA translator in LAMA offices.

3.11 In the event the No. 101 ESS control unit is not able to provide the extension number, the AMA equipment goes into an alternate procedure. The AMA equipment obtains the PBX listed number from the AMA translator (No. 5 crossbar LAMA and ANI and No. 1 crossbar LAMA offices) or calls in an operator for identification (No. 1 crossbar, panel, and step-by-step ANI offices).

B. Non-Direct Access Direct Inward Dialing (DADID)

3.12 One-way DID trunks are provided to interconnect the No. 101 ESS with crossbar tandem. One-way or 2-way DID trunks are provided for interconnection with No. 5 crossbar arranged for line link pulsing. One-way DID trunks interconnect

the No. 101 ESS with step-by-step COs. System operation, with crossbar tandem and No. 5 line link pulsing offices, is described in the following paragraphs. The CO signals to the control unit via the switch unit that it has a call and, in effect, requests permission to begin sending the extension number. The control unit, when it has set up a connection from the CO trunk to a digit trunk at the switch unit, signals to the CO by an off-hook signal that pulsing may begin. The dial pulses from the CO are converted to bursts of tone by the switch unit and sent over a digit trunk to a digit receiver at the control unit. Operation is the same as if digits were dialed by an extension line at the PBX.

3.13 If the extension is busy, connection to a busy tone generator is set up at the switch unit; otherwise, the connection is set up to the calling party in the normal manner. Audible ringback tone is supplied by the switch unit. When the calling party answers, a charge signal is given to the CO by the trunk circuit under direction of program control and trunk connector circuits.

DIRECT ACCESS DIRECT INWARD DIALING (DADID) CALL

3.14 DADID provides an arrangement that permits direct inward dialing to the No. 101 ESS from either a No. 1 crossbar or a No. 5 crossbar CO. Since a DADID call from either type of office is handled in a similar fashion, a call from only a No. 5 crossbar CO is described.

3.15 With the DADID arrangement, there is a direct association between the No. 101 ESS control unit and the No. 5 crossbar completing marker. This association is accomplished with the use of interface equipment between the No. 5 crossbar completing marker and the No. 101 ESS control unit that consists of: (1) a preference and control circuit and a direct access pretranslator connector in the No. 5 crossbar office and (2) direct access pretranslator in the No. 101 ESS.

3.16 The direct access pretranslator connector contains duplicate connector relays to provide for separate marker access to one of two direct access pretranslator circuits. A given direct access pretranslator circuit is associated with one of two call processors, only one of which is on-line and in service at a time. Transfer from one call processor to the other is controlled by the No. 101 ESS

equipment and may be initiated as required by programmed instruction. The direct access pretranslator circuit replaces the No. 5 crossbar number group for DADID calls from the No. 5 crossbar CO.

3.17 When a call is placed to a No. 101 ESS subscriber through the No. 5 crossbar CO, the following basic actions occur:

- (a) The No. 5 crossbar marker:
 - (1) Uses the office code and the thousands digit of the called number to direct a connection to the No. 101 ESS direct access pretranslator.
 - (2) Obtains a place in the preference circuit in competition with the markers.
- (b) The No. 101 ESS direct access pretranslator circuit:
 - (1) Translates the digits of the called number that have been received from the No. 5 marker into a format acceptable to the No. 101 ESS call processor:
 - (2) Translates the line link frame equipment location of the selected No. 101 ESS trunk that has been received from the No. 101 ESS control unit into a format acceptable to the No. 5 marker.
- (c) The No. 101 ESS program control:
 - (1) Retrieves the called number and the scan point of the trunk from the DADID buffer in which it was stored.
 - (2) Selects an idle time slot, and enters the trunk scan point in the call record.
 - (3) Translates the called number into a scan point number. After the called number is checked for an inward restricted number, a listed number, or an unused or illegal number, the scan point number of the called party is entered in the call record.
 - (4) Assigns a progress mark to keep a record of the state of the call being processed.

(5) Seizes the assigned trunk when the called party goes off-hook and updates the call record to the proper marks.

3.18 For a more detailed description on how a call to a No. 101 ESS subscriber through a No. 5 crossbar CO is processed, see Section 240-106-101

DID STEP-BY-STEP OFFICES

3.19 DID from a step-by-step office is accomplished by connecting the trunks from the switch unit of each No. 101 ESS customer to chosen levels of the fourth or fifth selector switches. For switch units using 3-digit numbers, a separate trunk group is provided for each 2 blocks of 100 extension line numbers. Only the last two digits of the called number are pulsed into the No. 101 ESS. Each trunk appears on two levels of the selector. The control unit determines the level used on a call and reconstructs the proper hundreds digit. For switch units using 4-digit numbers, a separate trunk group is provided for each 2 blocks of 1000 extension line numbers. The last three digits of the called number are pulsed into the No. 101 ESS. The No. 101 ESS must determine the thousands or thousands and hundreds digit from the trunk group and level indication. Because step-by-step offices do not wait for a signal to begin pulsing, the No. 101 ESS can provide a delay line in the dialing path to delay and reshape dial pulses and minimize the possibility of digit mutilation. If a 600-ms delay is not adequate, the trunk can be modified to store the dialed digits and transfer dial pulses to the switch unit after the digit receiver is ready (SFTR option).

4. SERVICE FEATURES

GENERAL

4.01 The No. 101 ESS meets a wide range of business customer requirements for PBX, centrex, and other new services. The properties and characteristics of the basic system design, which provide versatility and flexibility, are as follows:

- (a) Logical control and class-of-service information is centralized on readily changeable magnetic memories. The use of permanent magnet twistor stores for the program store (logical control) in memory and line information store (class-of-service

information) permits changes to be made easily and without additional capital investment. System operation, class-of-service information, and feature administration are altered at the control unit by magnetizing or demagnetizing certain of the magnetic bits on the twistor cards.

(b) Digit storage, translation and outpulsing—Dialed digits are received in the digit receiver and passed to the digit data store area of the data control memory. The program control and digit control determine the action to be followed. In the case of calls over trunks to the CO or over tie lines, the sender pulses out the necessary digits over the trunk. However, this outpulsing may be in a different form than that originally used to pulse information into the digit receiver. For example, TOUCH-TONE signals are always translated to rotary dial pulses before outpulsing because the receiving office or PBX may not be arranged for TOUCH-TONE calling. Likewise, a 2-, 3-, or 4-digit speed calling code may be translated to as many as 13 digits for outpulsing to the exchange network. This translation ability is also used to control outward calls on the basis of the code(s) dialed, thus providing code restriction.

(c) Ability to convey additional switching instructions on established connection—Once a call connection is established, an extension user can recall dial tone, in most cases, by flashing the switchhook. By subsequent dialing, the extension user can modify the established switching pattern; for example, to hold the existing call or to transfer it to another extension.

(d) Ability to alter routing of terminating calls by dialed instructions—The normal call routing can be changed temporarily by dialed instructions. This permits calls normally directed to a particular extension line to be redirected to a different line.

(e) Ability to hold in storage the identity of the calling line—The identities of the lines and trunks associated with each call are maintained in the call store for the duration of the call. This information is thus available for use as needed; eg, to furnish calling line identify to the CO AMA equipment for AIOD.

4.02 The No. 101 ESS furnishes a wide range of service features. Specific features can be

offered on an optional basis or in packages according to marketing recommendations.

4.03 Attendants are normally provided with a universal telephone console (Fig. 8) or other consoles per Section 240-200-301. The maximum number of these consoles that may serve a switch unit is:

- (a) Three consoles: 1A and 2A switch units
- (b) Three consoles: All switch units served by a 3-store control unit
- (c) Six consoles: 120 or 180 time slot 3A or 4A-1 switch unit
- (d) Twelve consoles:
 - (1) 240 time slot 3A or 4A-1 switch unit
 - (2) From 300 to 480 time slot 4A-2 switch unit.

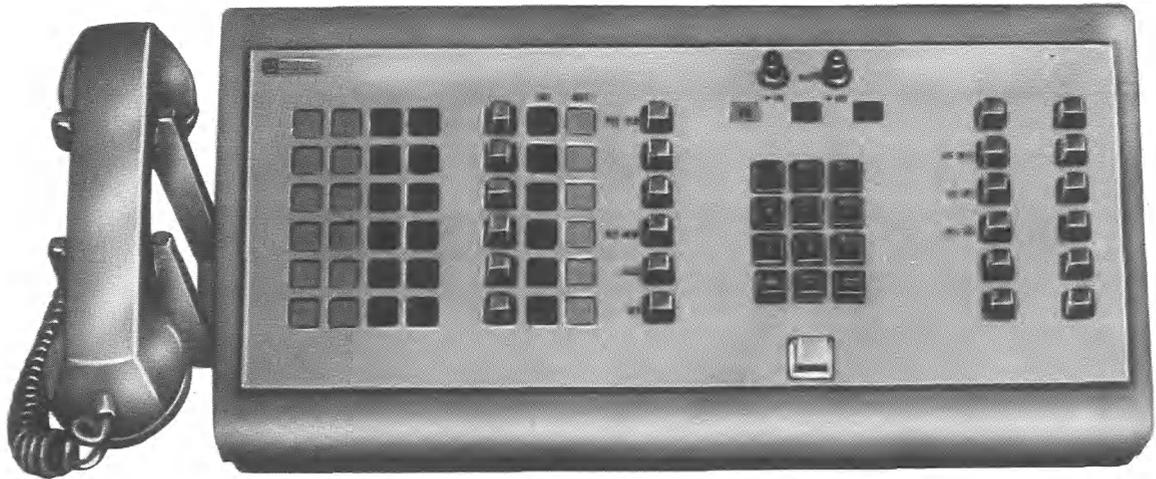
Each attendant uses pushbutton keys and a TOUCH-TONE dial to answer and complete calls. Tones and illuminated panels provide the necessary signaling and supervisory information. The actual switching occurs in the No. 101 ESS switch unit, not in the console itself.

4.04 Call queuing and distribution is provided to spread the load evenly to all attendants and to prevent a new call from being switched to a console before the attendant is ready to answer. The call waiting (CW) lamp lights steadily after a delay of about 3 seconds when one or two calls are in que, waiting to be switched to attendant console. Three or more calls waiting make the CW lamp wink at 30 interruptions per minute (ipm). If a supervisor turret is provided, the CW lamp on the attendant console lights steadily when one or more calls are waiting.

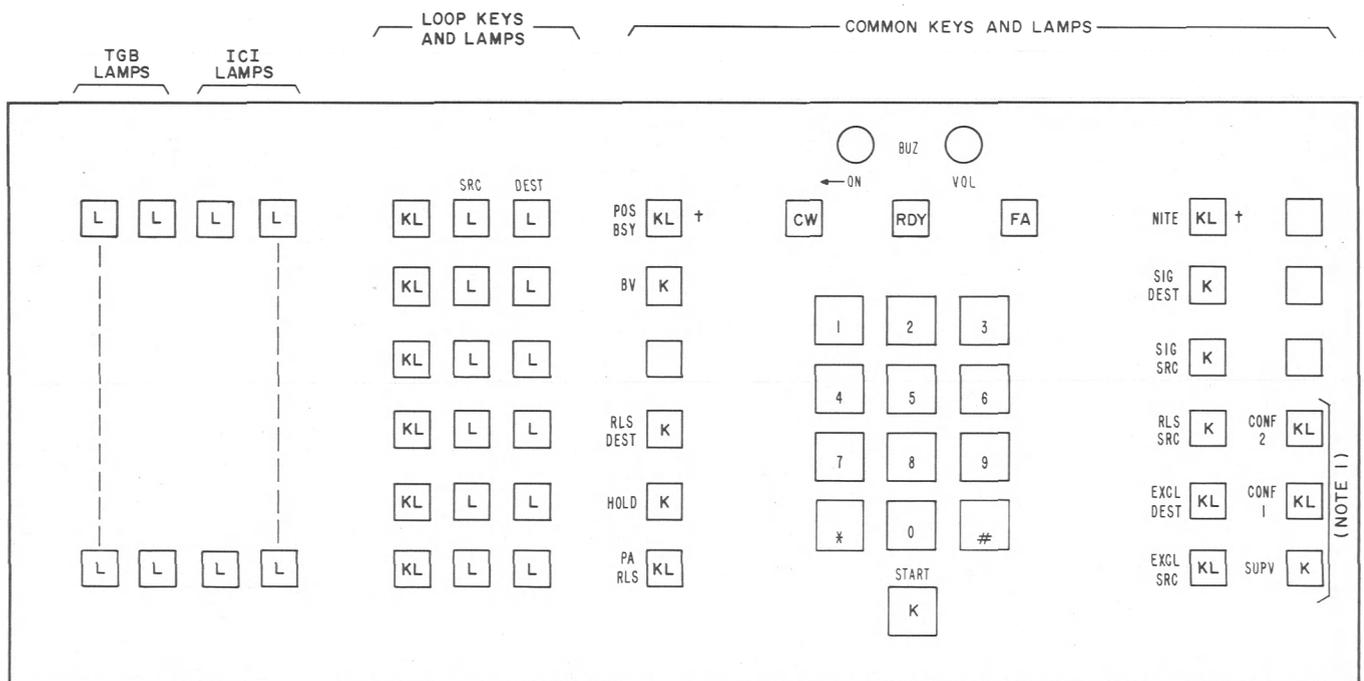
◆FEATURE DESCRIPTIONS

A. Add-On

4.05 The add-on feature permits the station user to add another station line within the same PBX system to an existing connection without attendant assistance. See Threeway Conference Transfer.◆



A. Attendant Console—Typical



NOTE:

I. CONF KEY LAMPS, SUPV KEY, BV KEY AND/OR ICI AND TGB LAMPS MAY BE SPARES ON A PARTICULAR CONSOLE.

LEGEND:

K -KEY
L -LAMP
KL-KEY AND LAMP COMBINATION
+ -LOCKING TYPE KEY

B. Console Layout

Fig. 8—Attendant Console—Typical Example

B. Attendant Camp-On With Indication to Busy Station

4.06 An incoming CO call that the attendant attempts to complete to a busy station is normally held waiting (camped-on) and automatically connected to the called line as soon as that line becomes idle. The busy called station receives a single spurt of 440-Hz tone, approximately one-half second duration, to indicate that there is a camped-on call waiting. This tone is sent only to the called line; the other party (or parties) involved in the busy connection do not hear it. This tone is sent whenever the attendant releases from or holds the incoming trunk on the attendant console. In some cases where the tone spurt is not desired, it can be denied by administering a bit in the LIS, to prevent interference on data lines, for example. To prevent sending a false camp-on indication signal when the calling party does not wait, the attendant may cancel camp-on by operating the RLS DEST key before releasing from the loop whenever the calling party does not wish to wait. In a main-satellite installation, camp-on of a satellite station results in the spurt of 440-Hz tone to the busy station in 10 seconds if the attendant does not release prior to that time.

C. Attendant Conference

4.07 The attendant conference feature permits the attendant to establish a conference connection of up to five conferees (plus the attendant). One or two 6-port gain type conference trunks may be provided and controlled by illuminated nonlocking keys on the first attendant console (Fig. 8). No more than two trunks (either two tie trunks or one CO trunk and one tie trunk) may be connected to a conference circuit at a time.

4.08 The general procedure for establishing an attendant controlled conference is:

- (a) A station or trunk party requests the attendant to set up a conference. After answering the call, the attendant transfers the

calling party to the first port of an idle conference circuit by operating the associated conference key.

- (b) To add a second party to the conference, the attendant calls the desired party on a loop and then reoperates the conference key to transfer the party to the second port of the conference circuit. This procedure may be repeated until the fifth conferee has been connected to the fifth port. The PA RLS key should not be operated until all parties have been added.

4.09 Each conferee is connected to a port in a different time slot, and the attendant is bridged on to the time slot with the last conferee added. The attendant may not add a conferee to the sixth port. This is usable only to reconnect the attendant to the conference, usually in response to a recall. Because attendant controlled conference is available only on the first console, in multiple console installations, a request for a conference directed to other than the first attendant must be transferred via an attendant interposition call and transfer, or handled on a callback basis from the first console.

D. Attendant Control of Trunk Group Access

4.10 This feature permits the attendant to restrict dial-access by all station lines to FX, WATS, and/or tie trunk groups by dialing a code. When control is activated, calls to controlled trunk groups will be routed to the attendant for subsequent completion, or to reorder tone when the restricted trunk is located in the other switch unit of a 4A-2 complex.

4.11 The activation/cancel procedure is to dial the activate/cancel code, receive second dial tone, then dial the trunk group access code. A confirmation tone is heard when the operation is complete.

E. Attendant Direct Station Selection With Busy Lamp Field

4.12 Attendant direct station selection (ADSS) permits the attendant to place and complete calls to PBX stations by depressing a single pushbutton. Operation of the appropriate nonlocking DSS pushbutton automatically furnishes the desired station number to the switching equipment. All necessary switching functions are carried out in the same manner as calls dialed in the normal way. This feature also provides the attendant with a busy lamp field which constantly indicates the on-hook, off-hook status of each line in the field. There are several cases where the busy lamp of a station may be dark but the station gives an indication of busy when dialed. If a station is being rung by another party, the busy lamp will be dark, giving a false idle indication, until the station goes off-hook. The busy lamp of a station having calls forwarded will be dark even though the station to which the calls are forwarded is busy. Certain line faults can also cause false operation of the busy lamps. In a switch unit, a busy lamp field can be used for one or two 100-line blocks. Each block must be a consecutively numbered hundreds block.

4.13 A selector console (Fig. 9), equipped with either 100 or 200 illuminated nonlocking

pushbutton keys, is associated with each attendant telephone console requiring ADSS service. The lamp in each DDS key performs the same function as operation of the START key followed by keying of a station number. Thus, an attendant, having answered a call on one of the loops, can complete it to an idle station merely by depressing the DDS key corresponding to the desired station and holding it depressed until audible ring is heard. If the desired station is busy and the attendant wishes to camp-on, the attendant depresses the lighted DDS key until the camp-on (or camp-on denied) signal is returned to the associated loop.

F. Attendant Interposition Calling

4.14 This feature is provided on some large systems to permit attendants 1 through 12 to call attendants 1 through 4 by dialing the interposition calling access code px. Assuming the digit p to be 1 for typical installations, the digits would be as listed below:

- Position 1 12
- Position 2 13
- Position 3 14
- Position 4 15

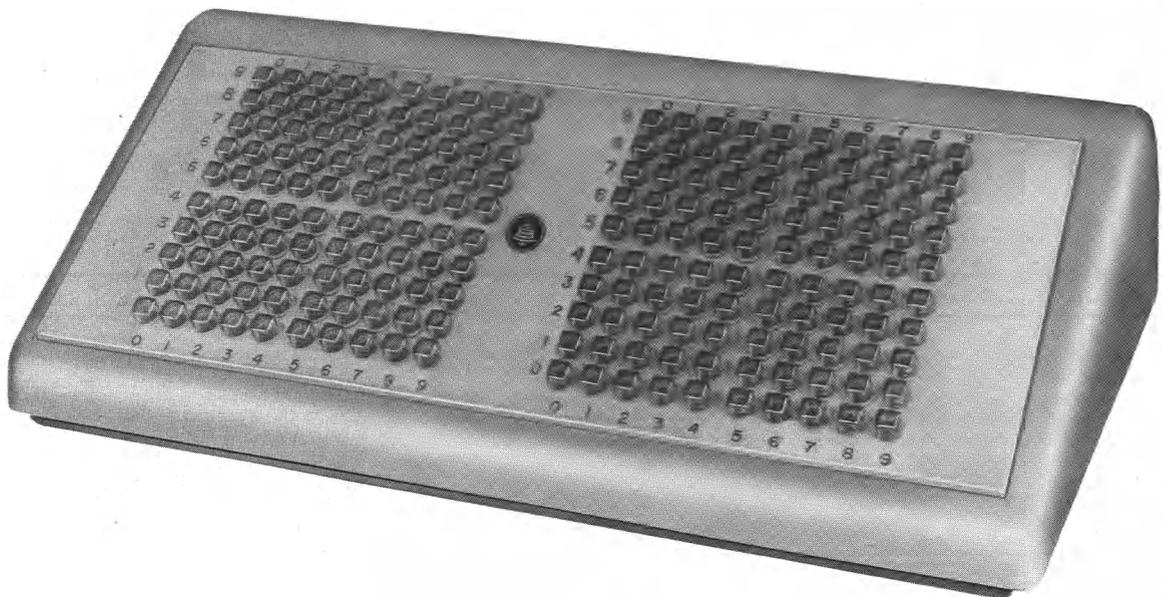


Fig. 9—Selector Console for Attendant Direct Station Selection

G. Attendant Position—Console

4.15 Console type attendant positions permit manual assistance when needed, for example, in completing incoming calls from the CO to stations. See 4.03.

H. Attendant Transfer

4.16 This feature permits the PBX attendant to be called into an existing inward connection and to transfer the called trunk party to another station. The system design also permits the attendant to be called into any existing outgoing or station-to-station call, thus providing attendant transfer on such calls, if desired. Access to the attendant is via station switchhook flash (recall) if the call was held on the console, or by station switchhook flash and dialing 0 on other calls.

I. Automatic Call Distribution to Attendant Positions

4.17 This feature automatically spreads incoming traffic to idle attendant positions on a rotating basis (4.04).

J. Automatic Facilities Testing

4.18 This feature automatically monitors trunk performance (outgoing CO trunks only) and alerts the CO via TTY.

K. Automatic Identified Outward Dialing

4.19 With this feature, charge data on dial 9 toll calls are billed by PBX extension number rather than by the number of the trunk used or the listed number. Charge data on outward calls handled by the PBX attendant are recorded against the PBX listed number. The recording can be made at No. 5 crossbar or No. 1 crossbar COs arranged for LAMA or CAMA operation, or at COs arranged for ANI.

L. Automatic Queuing to Attendant Positions

4.20 This feature queues incoming calls and distributes them to idle attendants on a rotating basis. One new call is presented to each attendant position at a time (4.04).

M. Busy Verification—Station Lines

4.21 Operation of the busy verification (BV) key permits the attendant to connect to any busy PBX line to verify that it is busy. The attendant can never connect another party to the busy connection. When the attendant interrupts a busy call, interrupted 440-Hz tone is heard. This lets the talking parties know that the attendant is listening. Only the first attendant console can have verification capability. Busy verification is denied if the station is in certain transient call states, such as dialing, waiting for completion of outpulsing, being rung, etc.

4.22 Busy verification is provided for main-satellite station; however, an attendant cannot busy verify a station on another main.

N. Call Forwarding—All Calls (Variable)

4.23 This feature permits all calls to a station to be routed to another station (or to an attendant), designated by dial code, regardless of the busy or idle state of the called station.

4.24 To activate forwarding by dialing, the station user proceeds as follows:

- (a) Goes off-hook (using own station line) and listens for a dial tone
- (b) Dials the call forwarding—all calls code; then listens for second dial tone
- (c) Dials the number of the line to which calls are to be forwarded (0 for attendant)
- (d) After hearing a steady 440-Hz tone, hangs up.

4.25 As long as call forwarding remains activated, all calls to the station are diverted to the designated alternate station. To cancel call forwarding by dialing, the station user proceeds as follows:

- (a) Goes off-hook and listens for a dial tone
- (b) Dials the cancel code
- (c) After hearing a steady 440-Hz tone, hangs up.

4.26 Call forwarding can be activated and canceled only from the attendant position or from the station line from which incoming calls are to be forwarded, never from another station. As long as call forwarding remains activated for a particular station, that station is only usable for originating calls to cancel forwarding or to call the attendant. If anything other than the cancel code or 0 is dialed from a station from which calls have been forwarded, a steady 440-Hz tone is returned as a reminder that call forwarding is activated.

Note: With attendant DSS, some indications of the busy lamp field may be false if a called line is having calls forwarded.

4.27 All lines can be allowed to forward calls by administering each line class of service. However, a maximum of (1) 24 lines in a 1A or 2A switch unit; (2) 60 lines in a 3A or 4A-1 switch unit; and (3) 120 lines in a 4A-2 switch unit can have calls forwarded simultaneously. If an additional line over the maximum should attempt to have calls forwarded, fast busy tone instead of second dial tone would be heard. If desired, several lines can have calls forwarded to the same alternate station. A line that has one or more calls forwarded to it can forward to another line without the other call forwarding assignments being affected. For example, if A forwards to B, B can forward to C. Calls to A will ring B, and calls to B will ring C. Calls to A will not be forwarded in tandem to C.

O. Call Forwarding—Busy Line

4.28 When this feature is provided, all DID (CO) calls to busy lines are transferred to the PBX attendant. Such a call is indicated to the attendant by loop lamps and optionally by incoming call identification lamp in the same way as a listed number call. Because the calling party is charged for the call when the attendant answers, the use of this feature results in charging on DID calls to busy lines.

P. Call Forwarding—Don't Answer

4.29 When this feature is provided, all DID calls encountering a don't answer condition are transferred to the PBX attendant. The called station is rung for 16 seconds before the call is transferred. Such a call is indicated to the attendant by loop lamps and optionally in incoming call

identification lamp in the same way as a listed number call. It is answered and completed in the same way as a listed number call. Because the calling party is charged for the call when the attendant answers, the use of this feature results in charging DID calls encountering a don't answer condition.

Q. Call Hold

4.30 This feature permits a station user to hold a call by flashing for a dial tone, and dialing a code, thus freeing the user line to originate another call without using a key telephone system hold key, pickup keys, or additional lines on the user station telephone.

4.31 To hold an existing call, the station user depresses the switchhook momentarily (flashes) to recall dial tone, then dials a p8 code (assume p equals 1). If there had been an incoming call camp-on (see 4.06), the station would be connected to the camp-on call. Otherwise, the station user receives dial tone to originate another call. The station user can hold the second call and return the first by flashing and dialing 18 again. This may be repeated any number of times, permitting the user to talk to the two parties alternately. If the station user hangs up with a held call, the telephone rings immediately; when answered, the station user is reconnected to the call that had been held. With this feature the three parties are never bridged together. In order for all three parties to talk together, 3-way conference transfer must be used.

R. Call Pickup

4.32 The call pickup feature enables a station user to answer incoming calls directed to other stations in the call pickup group by dialing a p9 code from the station telephone. No pickup buttons are required on the station telephone to provide this service. When a station user hears any other telephone in the pickup group ringing, the call can be answered by station user going off-hook, listening for dial tone, and dialing 19 (assuming the p digit equals 1). The incoming call is then transferred from the telephone that has been ringing to the one from which 19 had been dialed.

4.33 Switch units can have a maximum of 252 (29 for 1A switch unit) pickup groups. Any

number of station lines can be in a group; however, no line can belong to more than one group. As a practical matter, it is expedient that all the extension stations in a group be close enough together for the extension users to be able to hear and identify the ring of all other extension stations in the pickup group.

S. Call Transfer—Individual

4.34 This feature permits a station user to transfer only incoming trunk calls to another station line *within* the same PBX, without attendant assistance. This is accomplished by hanging up after using the consultation hold and/or add-on feature.

T. Call Transfer—Individual—All Calls

4.35 This feature permits a station user to transfer any established call to another station *within* the PBX without attendant assistance. This is accomplished by hanging up after using the consultation hold—all calls and/or the threeway calling features. Trunks cannot be added as a third party without attendant assistance. The feature is used as part of the threeway conference transfer feature package.

U. Calls Waiting Indication at Attendant Position

4.36 This feature provides a visual signal (CW lamp) to indicate that calls are waiting to be served by the attendant (4.04).

V. CCSA Access

4.37 This feature provides access to and from a CCSA network. Network inward dialing (NID), network outward dialing (NOD), and LDN service can be provided, which are similar to DID, DOD, and LDN service for the regular exchange network. The CCSA trunks are identified as tie trunks for programming, administration, and numbering plan (Part 6) purposes.

W. Centralized Attendant Service (CAS)

4.38 This feature permits multilocation PBX customers, served by separate switching units, to concentrate attendant positions at a single location. Incoming LDN calls come into each switch unit directly from the CO, and are switched to centralized attendant positions over released link

trunks (RLTs). Incoming LDN calls received over RLTs are always extended back over the same RLT and never tandemed. Once the attendant releases the call, these connections are made available for other calls.

X. Code Calling

4.39 This feature permits the station user or attendant to page a called party by a coded sound on a system of bells or gongs. An access code is dialed, followed by a 2- or 3-digit code per called party which enables the system of bells or gongs to sound the code of the called party. The called party, upon hearing the distinctive code, goes to any station telephone and dials an answering code to gain connection to the calling party.

Y. Conference Calling

4.40 This feature permits a station user to establish a conference connection of up to six conferees (including the originator) without the aid of an attendant. However, an attendant should add trunks, since a trunk busy tone or ringback tone cannot be flashed off at the station. Two trunks can be added, but only one can be a CO, FX, or WATS trunk. Any of the conferees may hang up and be disconnected from the conference without disturbing the other conference connections.

4.41 A conference is established by dialing the conference code and receiving a second dial tone before dialing the first party. After the party answers, a switchhook flash adds the party to a conference port. Additional parties are added by repeating a flash-dial-flash procedure. Busy, don't answer, or reorder conditions can be cleared by flashing.

4.42 Up to six 6-port gain type conference call trunk circuits can be provided in each switch unit (limit of three for 1A switch units), but the attendant conference circuits are included in the total allowed circuits (main only). Only stations on switch units which have conference circuits can *originate* conference calls.

Z. Consultation Hold

4.43 This feature permits a station user to hold *incoming* trunk calls by flashing the switchhook, and on the same line, originate a call to another station or the attendant *within* the

same PBX, for private consultation. After establishing the second call, a second switchhook flash will cause a return to the original call (if the second called party hangs up) or initiate use of the add-on or call transfer features. See Threeway Conference Transfer.

AA. Consultation Hold—All Calls

4.44 This feature permits a station user to hold *any* established call by flashing the switchhook and, on the same line, originate call to the attendant or to a party *within* the PBX for consultation. After establishing the second call, a second switchhook flash will cause a return to the original call (if the second called party hangs up) or initiate use of the threeway conference transfer feature.

AB. Controlled (Manual) Ring

4.45 This feature provides manually controlled ringing on attendant originated calls rather than automatic ringing. The attendant must operate a SIG SRC or SIG DEST key to start ringing. This feature is always provided with the joint holding feature. This feature is not available on main-satellite complexes.

AC. Data Restriction

4.46 This feature denies voice or tone access to connections involving lines or trunks having a data line class of service. The attempted call (camp-on, busy verification) will be intercepted.

AD. Dial Access to Attendant

4.47 This feature permits station user within the PBX or via tie trunks to reach the attendant by dialing 0.

AE. Digital Inquiry Voice Answer (DIVA)

4.48 This feature permits transmission of TOUCH-TONE signals to a computer over a computer access line and to receive a reply in voice form. The DIVA circuits in this system are used only for terminating calls from within the PBX or from the exchange network.

4.49 DIVA calls can be completed only from TOUCH-TONE stations. The DIVA port requires a ringing signal for activation, and the special circuit packs can be assigned only a few

special equipment locations. A block of ten directory numbers must be reserved for DIVA if access by DID is required.

AF. Direct Inward Dialing (DID)

4.50 This feature permits an incoming call from the exchange network to reach a PBX extension without attendant assistance. A customer outside the PBX dials a 7- or 10-digit CO number.

AG. Direct Outward Dialing (DOD)

4.51 This feature permits the PBX station user to gain access to the exchange network without the assistance of the attendant by dialing an access code and receiving a second dial tone. An unrestricted station user can always dial via a CO trunk (dial 9) or optionally via FX or WATS trunks (1-, 2-, or 3-digit codes). Called party digits (7- or 10-digit and toll access) are then dialed as required. Direct distance dialing (DDD) and international direct distance dialing (IDDD) is possible if the 9-1 and/or 9-01 access codes are valid in the CO.

4.52 For a main-satellite installation, DOD must be completed over a trunk originating on the dialing station switch unit.♦

AH. Directed Call Pickup With Barge-On Option

4.53 Directed call pickup permits a station user to answer the phone from any station in the system by dialing the personal answer code. If the phone has been answered in the normal manner and the answer code has been dialed, the call will still be cut through as before, with a barge-on tone to indicate a third party has entered the call. The barge-on feature is optional on a switch unit basis. Directed pickup with the barge-on option may be applied between switch units in main-satellite complexes by appropriate programming of the customer parameter data. Stations provided with this feature must be assigned a unique hundreds block of directory numbers. The method of signaling the station user that a call is waiting must be provided on a local basis. Station users may be notified of a call by means of a pocket radio pager or an audio loudspeaker paging system. The station user then dials the answer code on any available station and is automatically connected to the calling party.

AI. Dial Service—DID and Non-DID

4.54 This feature allows some station lines to receive DID calls while others are inhibited by administration of the station class of service.

AJ. Foreign Exchange Central Office Access

4.55 This feature provides access to a distant CO via FX trunks. All incoming calls are placed via a listed FX directory number to the attendant in a manner similar to LDN service. Outgoing calls are DOD or attendant assisted.

AK. Immediate Ring

4.56 The called station is rung and audible ring returned to the calling party (or attendant) as soon as the line is seized, without waiting for expiration of a silent interval. This feature can be activated or deactivated by administering a bit in the program store.

4.57 For a main-satellite installation, immediate ringing will be effective on an interswitch unit call. However, the ringing will be delayed by the outpulsing time.

AL. Incoming Call Identification (ICI)

4.58 This feature permits the attendant to visually identify the type of service or trunk group associated with an incoming call. Incoming calls flash the loop source lamp, with the speed of flash indicating the type of call. Optional incoming call identifier lamps (Fig. 8) give a more exact indication of the type of call. Three different lamp flashing rates are used to indicate the type of call involved and the status of each of the connected parties (Fig. 10).

4.59 ICI lamps may be cross-connected for a wide variety of indications (Section 240-200-301). Some examples are:

- Station-to-attendant call
- Call forwarded to attendant (variable, busy line, or don't answer)
- CO trunk
- FX trunk

- Tie trunk
- CCSA trunk.

The ICI feature cannot identify a trunk group or forwarded call on satellite calls.

AM. Intercept Treatment

4.60 General: This feature causes routing of calls which cannot be completed to an appropriate recorded announcement or to an attendant, depending on the condition preventing completion. Administration of program store bits controls the treatment given a particular condition.

4.61 Attendant Intercept: Intercepted calls are routed to the attendant for assistance. Charging starts when the attendant answers.

4.62 Recorded Announcement Intercept: Intercepted calls are routed to a recorded message. There is no charging. Specific switch unit scan points must be reserved for this purpose.

AN. Joint Holding

4.63 A calling PBX station (or the first called station in the case of attendant originated calls) connected to an attendant position is held busy, even if it goes on-hook, until it is released by the attendant. When this feature is provided, the controlled ring feature must also be provided.

AO. Listed Directory Number (LDN) Service

4.64 This feature provides for incoming exchange network calls to the PBX attendant. Network station users dial a 7-digit (or 10-digit) directory number listed in the telephone directory. When DID is not provided, all incoming calls must be made on an LDN basis. Two trunk groups may be provided for multiple LDN service if the second trunk group is treated as if it were an FX group.

4.65 In Main-Satellite Complexes: When one LDN is provided, incoming LDN traffic comes directly to the attendant at the main. When a secondary LDN for a satellite is required, the satellite LDN traffic is directed to the satellite by the CO and automatically completed over attendant T-links to the attendant at the main. The attendant then completes the call over the mating attendant T-link to the satellite. The attendant T-link will

TYPE OF SIGNAL	LAMP CONDITION		
	KEY	SOURCE	DESTINATION
INCOMING SIGNALS			
CENTRAL OFFICE TRUNK CALL	●	(60)	●
DIAL "0" CALL	●	(120)	●
RECALL	●	(120)	○
SUPERVISORY SIGNALS			
ATTENDANT ANSWER	○	○	●
CALLED STATION BUSY	○	○	(60) OR (W)
CALLED STATION BEING RUNG	○	○	(W)
ATTENDANT RELEASE DURING RINGING	●	○	(W)
ATTENDANT RELEASE DURING CAMP-ON	●	○	(60) OR (W)
STATION ANSWER WITH ATTENDANT CONNECTED	○	○	○
STATION ANSWER WITH ATTENDANT RELEASED	●	●	●
STATION ANSWER WITH LOOP HELD	(W)	○	○

LEGEND:

LAMP CONDITION	
○	STEADY LIGHTED
●	DARK
(W)	WINKING
(60)	FLASHING - 60 IPM
(120)	FLASHING - 120 IPM

Fig. 10—Typical Attendant Loop Indications

be released when the call is released from the attendant console. The call is always completed over the mating attendant T-link. If the call is not intended for the satellite, the satellite must complete the attendant T-link call by selecting a T-link to the appropriate satellite or main.

AP. Miscellaneous Trunk Restriction

4.66 This feature denies preselected stations access to specific miscellaneous trunk groups. The miscellaneous trunk groups can include tie trunks, FX trunks, and trunks for code calling, recorded telephone dictation, DIVA and paging.†

4.67 Each tie, FX, and miscellaneous trunk circuit is assigned one of three classes for restriction from access by stations. All trunks in a group must be assigned the same class. Each station may be permitted direct dial access to:

- Class I only trunks
- Class II only trunks
- Class III only trunks
- Class I and II trunks
- Class I and III trunks
- Class II and III trunks
- Class I, II, and III trunks
- No class I, II, or III trunks.

4.68 Incoming dial repeating tie trunk calls are also arranged for restriction from dial 9 calls, code restrictions (see 4.69), and restriction from any (or all) other groups of tie, FX, and miscellaneous trunks. Incoming calls from FX and automatic, tie trunks are automatically switched to the attendant who may complete them to the desired called party.

AQ. Mobile Radio Access

4.69 This feature provides access by the attendant and selected station users to privately owned 2-way radio systems. These systems provide voice communication and use control functions operated by the telephone dial or control buttons on special telephone instruments.

AR. Night Service

4.70 General: Fixed and flexible night service arrangements provide for handling attendant traffic when the console is not manned. Basically, the No. 101 ESS routes attendant-seeking traffic to one or more designated stations whenever night service is in effect. The pattern of designated stations is changed permanently by administrative changes in the control unit stored memory and temporarily by using call forwarding—all calls. In later systems, flexible night service control by call forwarding—all calls can only be accomplished if the night service stations are provided with call forwarding ability.

4.71 Call Transfer: Once a call has been answered at a designated night station, it may be completed to any other station in the PBX by call transfer. A nonrestricted station designated to receive dial 0 calls at night uses call transfer to complete outgoing calls for restricted stations.

4.72 Pattern of Night Designated Stations:

One regular night station plus a number of per trunk night stations may be designated. The regular night station receives all dial 0 calls. A CO trunk can be assigned to a particular night station for a non-DID CO trunk. The number of CO trunks that are assigned night station(s) is limited only by the amount of line information store space allotted to the particular switch unit over and above that actually needed for line and trunk information (see Part 7). Calls incoming on a particular trunk ring the station assigned to that trunk. Because the CO trunk normally is arranged to hunt at the CO, dialing the CO number of a particular trunk will not ring its night station if the trunk is busy. The actual station rung will be the one associated with the trunk selected after hunting in the CO. Calls incoming on trunks having no assigned night stations are routed to the regular night station.

4.73 Night Station Busy: If the night station is arranged for hunting, the call hunts in the normal manner. On non-DID CO trunks, if the night station is busy, the calling party hears an audible ringback which implies that the night station does not answer. If night traffic is sufficient, key equipment with multiple lines in a hunting sequence will enable the night station to handle multiple incoming calls. On DID trunks, the normal

busy tone is returned to the calling party when the night station is busy.

AS. Off-Premises Stations

4.74 This feature provides service between the PBX and a station(s) located some distance from the PBX premises.

AT. Overload Protection

4.75 This feature enables the system to provide service when the traffic load becomes greater than anticipated. The No. 101 ESS temporarily increases its call handling capacity by inhibiting maintenance programs, when the cycle time exceeds an administered constant.

AU. Paging—Loudspeaker

4.76 This feature permits attendants and station users to connect to customer-owned loudspeaker paging equipment by dialing an access code. Paging equipment may be provided at each switch unit, requiring a code for each paging system throughout the complex. Although paging equipment is accessed (or restricted) as a miscellaneous trunk, no equipment is required at the control unit.

AV. Paging—Radio

4.77 This feature permits attendants and station users to connect to customer-owned radio paging equipment. Radio pagers are generally selectively tuned for each station user. A call to the station user terminal causes the radio signaler to send a signal to a receiver assigned to the station user. The paged station user may then use the directed call pickup feature to answer the call.

AW. PBX Interface Trunk

4.78 This feature provides an interface connection between a miscellaneous trunk in a PBX, and customer-owned (paging or code call) equipment. The trunk provides for digital (dial controlled) inputs and one- or 2-way voice transmission. The interface trunk provides dialed digit translation and control outputs to the customer-owned equipment.

AX. Power Failure Transfer—Station

4.79 This feature provides direct connection to CO trunks for a few predetermined stations

during a power failure at a switch unit where reserve power is not provided or is exhausted. Each of these stations is equipped with a button to provide the ground start signal necessary to obtain CO dial tone on outgoing calls during a power failure. If the connecting CO is not arranged for TOUCH-TONE calling, these stations must be equipped with rotary dials. When the customer has centrex service, only outgoing calls can be made on power failure transfer lines.

AY. Recorded Telephone Dictation

4.80 This feature permits station users to dial an access code to gain connection to customer-provided dictating machines. Start, stop, playback, and other operating functions of such machines may be controlled by dialing from the call station. Start and stop functions may also be voice controlled in the dictation machine.

AZ. Remote Access to PBX Services

4.81 This feature allows a user outside the PBX to access the PBX services via an exchange network connection. The user dials a DID number to connect to the PBX and then dials an authorization code. All signaling is done by using TOUCH-TONE, and the authorization code is readily changed. In the No. 101 ESS, this feature is limited to accessing the DIVA feature.

BA. Reserve Power

4.82 This feature provides an alternate, independent source of power to maintain telecommunications service for a limited time (typically eight busy hours) during a power failure at the switch unit location. This feature is always provided with centrex service.

4.83 The 1A switch unit and 2A switch unit reserve power is a battery-to-ac supply.

4.84 The 3A switch unit and 4A switch unit reserve power is a battery-to-dc supply. The reserve power system for a 3A switch unit installation and for the 3A switch unit portion of a 4A switch unit installation may be either of the following systems:

- (a) **Switched Reserve Power System (Fig. 11) (A&M Only):** This system uses the 111A battery plant only when the commercial ac supply

fails. Voltage sensors operate switch gear to disconnect the switch unit from the commercial ac supply, and to connect it to the battery plant. The 111A battery plant provides +24 volt power directly to the switch unit. The dc-to-dc converters supply -24 volt and +6 volt power to the switch unit. A failure of any one of these converters will most likely cause a total system failure. Ringing voltage is normally provided by a 111A inverter powered from the commercial ac source. In the event of a commercial ac failure, a +24 volt dc powered inverter is switched into service.

(b) **No-Break Reserve Power System (Fig. 12):**

This system uses the 111A and 105E battery plants to supply power to the switch unit continuously. The 111A power plant provides +24 volt power directly to the switch unit. The 105E power plant provides -24 volt power directly to the switch unit. All +6 volt power is supplied by dc-to-dc converters that are powered from the 111A power plant. The power is provided to each time division control on individual buses so that a failure of any single converter will not cause a complete system failure. Ringing voltage is provided by a +24 volt dc powered inverter that is electrically identical to the dc powered inverter used in the switched reserve system. A redundant inverter is automatically switched into service in the event of an inverter failure.

BB. Restrictions

4.85 General: The different restriction features, used in combination, permit stations (and dial-repeating tie trunks) to be given different classes of service. Unrestricted stations can dial-access any trunk and use any dial-controlled feature, while restricted stations can be selectively denied certain services. The type of restriction is recorded for each station in the line information store.

4.86 Outward Restriction: This feature denies access to CO, FX, WATS, or CCSA trunks without attendant assistance.

4.87 Inward Restriction: This feature denies access to a station by CO trunks (DID or via the attendant), FX, WATS, or CCSA trunks. However, calls can be transferred from a station to an inward restricted line.

4.88 Fully Restricted Station: This feature denies a station the ability to place or receive any calls except station-to-station. Attendant-to-station calls may be optionally permitted (not including attendant completion of trunk calls) but not station-to-attendant calls. Calls can be transferred from the other stations. This feature is implemented by combining the inward, outward, and miscellaneous trunk restrictions (4.55).

4.89 Toll Restriction: This feature is a limited form of code restriction which permits station users to access CO trunks and to dial local service area calls, but prevents completion of toll calls or calls to the toll operator without assistance from the PBX attendant.

4.90 Code Restriction: This feature permits stations (or dial repeating tie trunks) to make some outgoing calls but not others, depending on the dialed code and the originating station. Lists of permitted codes are stored in memory and referred to as Types I and II.♦

(a) Type I code restriction provides 3-digit translation where the allowed dial 9 calls placed over CO trunks are defined by a maximum of two lists per switch unit (up to 800 3-digit codes for each list). In addition, up to four FX trunk groups for each switch unit may each have a list of 800 3-digit codes which may be dialed directly by stations that have access to this trunk group. This is provided on a trunk group basis. Each code restricted station may have access to one of two dial 9-type lists and also access to the single miscellaneous trunk list. This means that effectively two levels of code restriction can be provided, if desired, by placing the codes from list 1 also in list 2. Stations with access to list 1 effectively have level 1 code restriction, and stations with access to list 2 have level 2 code restriction. In many cases where only one code restriction list for dial 9 calls over CO trunks is needed for a particular switch unit, the other list does not have to be provided. Also, in situations where switch units have identical lists, these lists can then be shared by several or all switch units in a control unit. Each list may define all CO 3-digit service codes and dial foreign areas as desired. Each list provides for all possible allowed 3-digit number combinations.

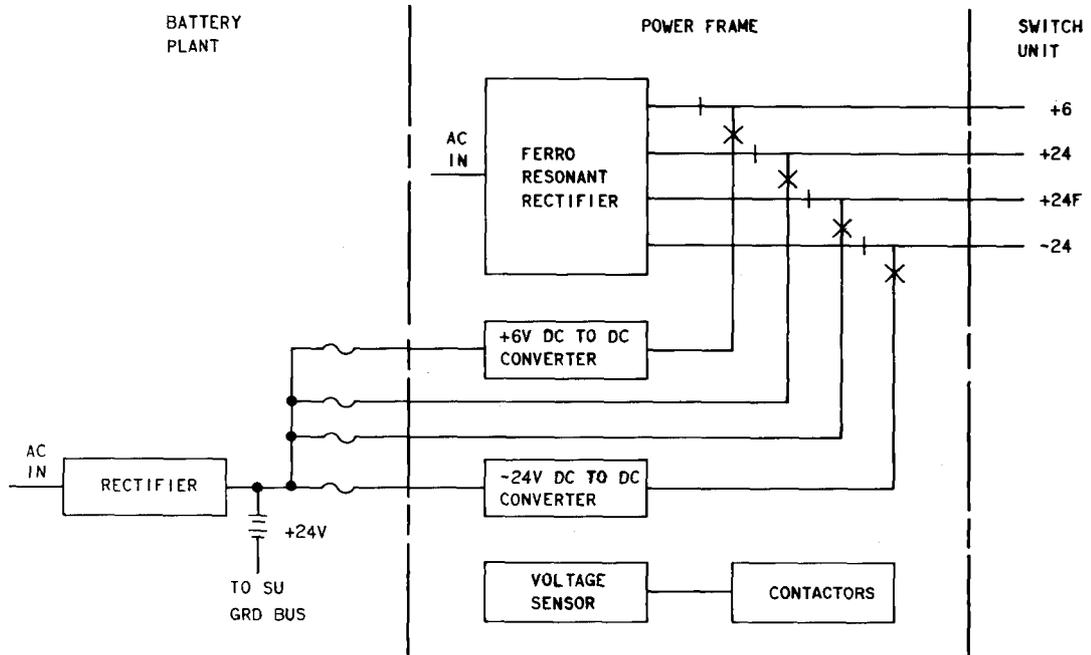


Fig. 11—Switched Reserve Power System (MD)—Simplified Schematic

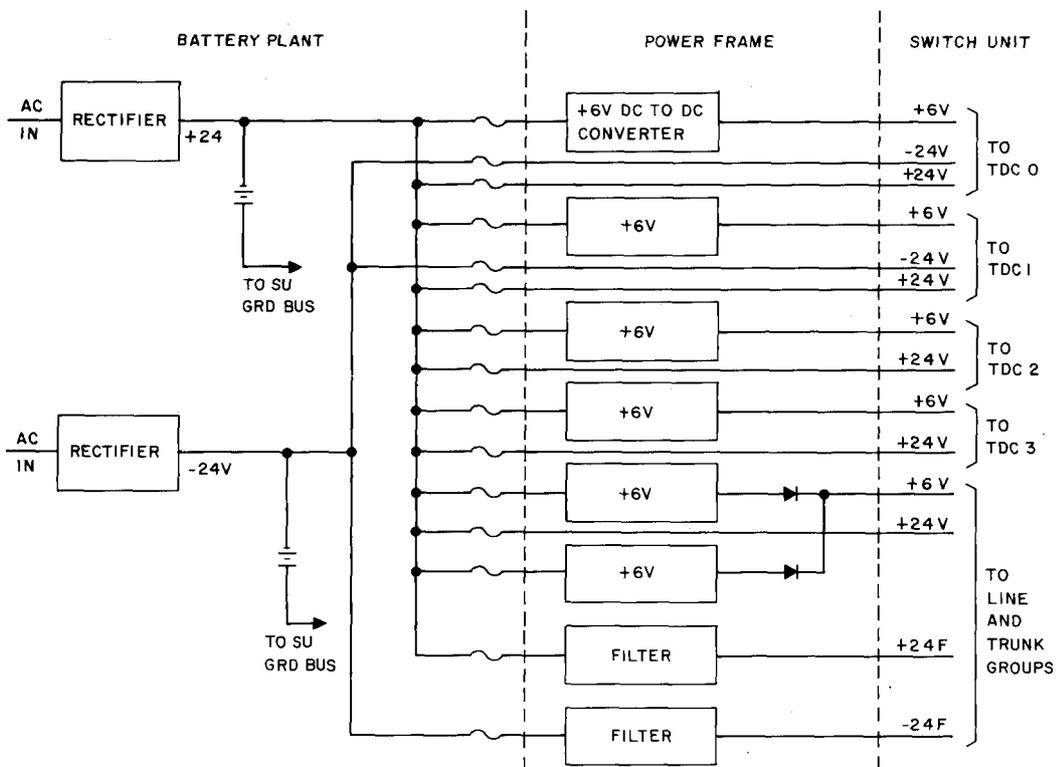


Fig. 12—No-Break Reserve Power System—Simplified Schematic

(b) Type II code restrictions provide 6-digit translation where the allowed dial 9 calls are defined by a maximum of four lists of up to 800 3-digit codes each. These lists are shared by all switch units in the control unit. The first list contains all the CO and 3-digit service codes in the home numbering area which may be dialed directly by code restricted stations. In addition, this first list may specify the area codes of any foreign numbering plan areas which may be completely allowed to such stations. The other three lists contain all CO and 3-digit service codes in each of three foreign numbering plan areas which may be dialed directly by code restricted stations. In addition, up to four FX trunk groups for each switch unit may each have a list of 800 3-digit codes which may be dialed directly by stations that have access to this trunk group. This is provided on a trunk group basis. Restricted stations are denied access to this trunk group. Thus, this option provides 6-digit translation on calls up to three foreign areas and 3-digit translation on calls to the home numbering plan area. Code restricted dial repeating tie trunks are treated the same as code restricted stations with this option. Thus, with Type II code restriction there are three classes of outward service (restricted from all dial 9 calls, code restricted, and unrestricted) for stations and dial repeating tie trunks.

4.91 The 800 NXX codes for each list consists of all possible 3-digit codes having the digits 2, 3, 4, 5, 6, 7, 8, or 9 as initial digits. Thus, each list has capacity for every possible exchange code, area code, and 3-digit service code (such as 211 or 411) to which direct dialed access could be desired. In those areas where 0+ and 1+ dialing is in effect, code restricted lines are handled as follows. A 9+0 (toll operator or IDDD) is not permitted and the calling party is connected to reorder as soon as the 0 is received. When 9+1 is dialed, the 3 (or in case of Type II call restriction, 6) digits following the 1 are translated to determine whether or not the call is allowed to proceed.

BC. Rotary Dial Calling

4.92 This feature utilizes a rotary dial at the calling station to provide dc pulses which represent either the address (directory number) of a called facility or an instruction to a dial-controlled device. Since all dialing in the No. 101 ESS is via digit trunks and outpulsed by the control unit if

necessary, rotary dial stations (2.58) do not require special provisions.

BD. Special (Attendant) Positions

4.93 This feature provides a console which handles calls not handled by other consoles. The No. 101 ESS provides busy verify and attendant controlled conference features only on console 1. The attendant interposition calling feature may be used to transfer these calls to console 1.

BE. Speed Calling per Group

4.94 This feature permits station users and attendants to place certain outgoing calls (normally requiring the directing digit 9 plus a 7- or 10-digit number) by using 4-digit codes. Thus, frequently called local and long distance points can be reached in a manner similar to calling stations in the PBX.

4.95 When a speed call code is dialed, the No. 101 ESS automatically seizes a trunk on a designated trunk group (usually a CO trunk) and outpulses the full number corresponding to the code dialed. A control unit can have up to 15 repertories of 30 frequently called numbers each and any switch unit can be assigned part or all of the capacity. Each station is allowed access to either 1, 2, or none of these repertories. ♦Attendants are allowed access to only the first two repertories.♦

BF. Speed Calling per Station

4.96 A station arranged for this feature has its own repertory of up to six frequently called numbers which are reached by dialing 2-digit codes px instead of the normal called number (assume a p digit of 1, and x digit, 2 through 7). The called numbers may be either station or outside numbers. The six possible codes are paired (12 and 13; 14 and 15; 16 and 17). Both numbers of a pair must be either inside or outside numbers. For example, if 12 is an extension code, 13 must also be an extension code.

BG. Splitting—2-Way Manual

4.97 The 2-way splitting feature enables the attendant to talk to either the calling or called party with the other party held away from the connection. To effect such a split, the attendant operates the appropriate split key, EXCL SRC or

EXCL DEST (Fig. 8). The associated key lamp lights when the split condition is in effect. The split condition is removed and the lamp extinguished when the attendant reoperates the LOOP key or releases from the connection. To announce a call, the EXCL SRC key should be operated before the attendant keys the called number. Otherwise, the calling party may tend to abandon the call after first hearing the ringback tone and then suddenly hearing nothing when the split goes into effect.

BH. Station Hunting

4.98 Calls incoming to a station arranged for this feature are redirected to another predetermined station in the PBX whenever the called station is busy. Any number of lines can be in a hunting group, and they do not have to be numbered consecutively. The hunting can be terminal, linear, or circular (hunting over all lines in a hunting group regardless of starting point). However, a combination of linear and circular hunt is not permitted. ♦Hunting groups must be in the same switch unit, in main-satellite complexes. The hunt feature does not operate on calls forwarded into the hunt group by the call forwarding—all calls feature. Hunting can be stopped at any station within a hunt group by using the call forwarding—all calls feature.

BI. ♦Station-to-Station Calling

4.99 This feature, always provided, permits station users to directly dial other stations within a PBX, including main-satellite complexes. ♦Station-to-station calls are normally made by dialing 3- or 4-digit station codes as required. (See 6.01 and 6.02 for description of numbering plan.)

4.100 For a main-satellite installation, station-to-station dialing between satellites uses T-links and 4-digit station codes. Dialing procedures are unchanged. Ringing is delayed by the time required for outpulsing over the T-links. Station-to-station calls on a single switch unit do not require T-links.

BJ. Straightforward Outward Completion

4.101 This feature permits attendants to complete outgoing calls without the station user having to hang up and be called back. The attendant can dial the complete called number, or

allow the user to through-dial if that feature is available.

BK. Supervisor Display Unit

4.102 The supervisor display unit (turret) is optional and provides supervision of the attendant consoles for 3A or larger switch units. The supervisor turret console provides visual and audible signals indicating which attendant consoles are available, busy, or unattended, as well as **summon supervisor** signal, call waiting signals, a night closing key, and an audible signal in association with the summon supervisor and call waiting signals.

BL. Switched Loop Operation

4.103 ♦This feature provides console-associated circuits for switching and monitoring the progress of calls on each console (Fig. 8 and 10). Switching is done by switch unit circuits under control of the console keys and the software program. ♦Calls are switched to a console when attendant handling is needed and are released from the console when attendant work is completed. Attendant circuits, called loops, are brought into a connection somewhat like senders or other common control dial switching equipment in that they are associated with each call only long enough to do the job; then they become available for another call. Each loop circuit is terminated in a nonlocking illuminated pushbutton and associated source and destination lamps on an attendant console.

4.104 Six such loops, as well as a number of common call handling keys and lamps, are provided on each console (Fig. 8). The loop key lamp provides supervisory information relating to the attendant association with the particular call; the green source and white destination lamps provide supervisory signals relating to the calling and the called parties, respectively. Operation of the START key calls in a digit trunk and associated digit receiver. When dial tone is returned and the RDY lamp lights, the attendant dials the called number into the digit receiver. By using the various common control pushbuttons, the attendant can perform such functions as releasing a connection to a busy or don't answer station, flashing a toll operator, or splitting the transmission connection to announce calls privately.

BM. Tandem Tie Trunk Switching

4.105 This feature permits tie trunk-to-tie trunk, tie trunk-to-CCSA, and tie trunk-to-CO trunk connections through the PBX switching system (2.51), and to other PBXs. The switching path is selected by dialing appropriate trunk access codes at stations or consoles.

BN. 3-Way Conference Transfer

4.106 This feature permits a station user to add a third party to any established call for a 3-party conference without the assistance of the attendant. The third party is added by flashing the switchhook after using the consultation hold—all calls feature (similar to add-on). The following limitations apply:

- (a) Only one of the three parties can be outside the PBX. Unless attendant assistance is used, the trunk party cannot be the third party in main-satellite complexes.
- (b) On incoming and outgoing trunk calls, the third party cannot be added until the attendant releases from the call.
- (c) When attempting to transfer to or add on a station that is busy or does not answer, a subsequent switchhook flash releases the busy tone or ringing signal and restores the original connection. Once a CO trunk has been added to a connection, it cannot be released without terminating the conference.
- (d) A station user can hang up anytime after ringing starts for the third party, and the call transfer feature will be used to connect or retain the other two parties on the call. The remaining off-hook party(ies) will hear tones or be in the talk state as appropriate.

BO. Thru Dialing

4.107 This feature permits station or tie line users to complete dialing on attendant assisted outgoing calls after the attendant selects the trunk facility and releases from the call. The tie-line must be TOUCH-TONE equipped.

BP. Tie Trunk Service (Non-Tandem)

4.108 This feature provides dedicated one- or 2-way circuits between two PBX switching systems without any intermediate CO switching. Automatic or dial repeating tie trunks can be used.

BQ. Timed Reminders

4.109 This feature provides automatic timed indications to remind the attendant to make progress reports on slow answer and long camp-on. After 30 seconds, the source lamp signal changes from steady to 60-ipm flash notifying the attendant to report to the waiting trunk caller. Each time the attendant releases from the call, a new timing interval is started and another indication of camp-on is sent to the called extension except when the camped-on station is located in a satellite switch unit that is a main-satellite switch unit configuration.

BR. Toll Terminal

4.110 This feature permits a station user to dial a toll operator directly with a single-digit code. Upon termination of the call, the toll operator can ring the PBX attendant to report time and charges. Numbering plan limitations must be considered (Part 6).

BS. TOUCH-TONE Calling and TOUCH-TONE to Dial Pulse Conversion

4.111 These features provide greater speed and convenience in dialing through the use of pushbutton dials to transmit digits via audible tones to the switching equipment. The No. 101 ESS provides TOUCH-TONE calling service without changes in CO equipment, since either dial or TOUCH-TONE pulses are converted to data link signals and stored. The control unit then translates the digits (station calls or special services) and outputs the digits when required (trunk calls). Both rotary and TOUCH-TONE dial stations may be bridged on the same extension line.

BT. Traffic Data Collection

4.112 This feature provides the capability for measuring the peg count and usage of traffic engineered facilities (6.11). In the No. 101 ESS, traffic data is accumulated in the call store and printed out on the TTY.

BU. Trunk Answer Any Station

4.113 This feature permits attendant seeking calls to be answered from any PBX station when the system is in the night service mode. Such calls will operate one or more bells or gongs provided at the customer premises. Using any station (except one that is inward restricted), a station user can go off-hook, obtain dial tone, and dial the trunk answer code to silence the bells and obtain connection to the calling party. After answering the call, the station user can use call transfer to complete the call to any other station.

4.114 For a main-satellite installation, trunk answer any station is trunked to the main over T-links; a night service check and the pickup search are made on the main, if applicable. Any call terminating on a night service station at the main can be picked up in this manner. Remote bells for signaling must be provided at the satellite location by the telephone company.

BV. Trunk Group Busy Lamp

4.115 This feature provides the attendant with a visual indication (Fig. 8) when all trunks in a trunk group are busy. Trunk groups may be selectively provided a busy lamp via console cross-connect circuits.

BW. Trunk Hunting

4.116 This feature provides automatic hunting and selection of an idle trunk within a trunk group.

BX. Trunk-to-Trunk Connections

4.117 This feature allows PBX attendants to extend an incoming or outgoing trunk call to another outgoing trunk. In the No. 101 ESS, only one connected trunk can be a CO trunk.

BY. Two-Party Hold on Console

4.118 This feature allows an attendant to hold on the console a call with both calling and called parties (or two attendant-called parties) connected. The parties may be stations or trunks.

BZ. Universal Numbering Plan

4.119 This feature provides the capability for tailoring the station, feature, and trunk access code numbering plan to meet general customer needs (within DID numbering constraints). See Part 6.

CA. Voice Message Service

4.120 This feature provides access to a customer-owned voice message recording (telephone answering) device which is connected by dialing a station number (DID or station-to-station). When a message is recorded, the customer equipment displays a visual indication. The message is played back at the customer equipment.

CB. WATS Access

4.121 This feature provides access to and/or from a WATS serving office. All incoming calls are via the attendant, similar to LDN service. Outgoing calls may be via the attendant or dialed direct.

ADMINISTRATION OF SERVICE FEATURES

4.122 Service features are administered as shown in Table B.

5. EQUIPMENT ELEMENTS**DEVICES**

5.01 The No. 101 ESS makes extensive use of solid-state and magnetic memory devices. Some relays are used in the trunk circuits interconnecting the No. 101 ESS and the serving CO. Relays are also used in various maintenance circuits to switch duplicated functional units in and out of service. Also, in 2A, 3A, 4A-1, and 4A-2 switch units, relays are used to apply ringing voltage to extension lines or B-links.

5.02 Most of the components used are low-power resistors, transistors, diodes, and capacitors. The transistors include general purpose types for use as amplifiers, logic gates, and switches; PNP transistors used principally in memory access circuits; and PNP triodes used in the 1A switch unit to apply ringing power to extension lines, and in the 2A and 3A switch units as lamp drivers. The

◆ TABLE B ◆
ADMINISTRATION OF SERVICE FEATURES

FEATURE	PROVIDED				ADMINISTERED BY		
	ALWAYS	PER SWITCH UNIT	PER STATION	PER TRUNK	NONE REQUIRED	STORED DATA	EQUIPMENT OR WIRING
Add-On		X				X	
Attendant Camp-On (with Indication of Camp-On)		X	X			X	
Attendant Conference		X		X		X	Conference circuit trunk
Attendant Control of Trunk Group Access		X		X		X	
Attendant DSS with Busy Lamp Field		X				X	Selector console and circuits
Attendant Interposition Calling		X				X	
Attendant Position — Console	X					X	Console(s) and circuits
Attendant Transfer	X				X		
Automatic Call Distribution to Attendant Position	X				X		
Automatic Facilities Testing		X				X	
Automatic Identified Outward Dialing (AIOD)		X				X	AIOD interface
Automatic Queuing to Attendant Position	X				X		
Busy Verification — Station Lines (First Attendant Console Only)		X	X			X	Wire BV key, add circuit pack
Call Forwarding — Variable	X		X			X	
Call Forward — Busy Line		X				X	
Call Forwarding — Don't Answer		X				X	
Call Hold			X			X	
Call Pickup			X			X	

◆ TABLE B ◆

ADMINISTRATION OF SERVICE FEATURES (Cont)

FEATURE	PROVIDED				ADMINISTERED BY		
	ALWAYS	PER SWITCH UNIT	PER STATION	PER TRUNK	NONE REQUIRED	STORED DATA	EQUIPMENT OR WIRING
Call Transfer — Individual*			X			X	
Call Transfer — Individual — All Calls*			X			X	
Calls Waiting Indication at Attendant Position		X					Wire console lamp
CCSA Access				X		X	Trunk circuits
Centralized Attendant Service (CAS)		X				X	Release link trunk circuits
Code Calling		X		X		X	Code call circuits
Conference Calling		X	X	X		X	Conference circuit trunk
Consultation Hold*		X				X	
Consultation Hold — All Calls*		X				X	
Controlled (Manual) Ring		X				X	Wire console keys
Data Restriction			X			X	
Dial Access to Attendant	X				X		
Digital Inquiry Voice Answer				X		X	DIVA circuits, trunks, TT stations
DID				X		X	DID trunk circuits
DOD	X			X		X	CO/FX/WATS trunk circuits
Directed Call Pickup†		X	X			X	
Dual Service — DID and Non-DID			X			X	DID trunk circuits
FXCO Access		X		X		X	FX trunk circuits
Immediate Ring		X				X	
Incoming Call Identification (ICI)		X		X		X	Wire console lamps

* Part of feature-combination

† Customer signaling via radio paging

◆ TABLE B ◆

ADMINISTRATION OF SERVICE FEATURES (Cont)

FEATURE	PROVIDED				ADMINISTERED BY		
	ALWAYS	PER SWITCH UNIT	PER STATION	PER TRUNK	NONE REQUIRED	STORED DATA	EQUIPMENT OR WIRING
Intercept Treatment — Attendant		X				X	
Intercept Treatment — Recorded Announcement		X				X	Announcement circuits
Joint Holding		X				X	
LDN Service		X		X		X	CO trunk circuits
Miscellaneous Trunk Restriction			X			X	
Mobile Radio Access		X		X		X	Access trunk circuits
Night Service — Fixed		X				X	
Night Service — Flexible †		X				X	
Off-Premises Stations			X				Long line circuit pack
Overload Protection	X					X	
Paging — Loudspeaker		X				X	Public address circuits
Paging — Radio		X				X	Radio paging circuits
PBX Interface Trunk				X		X	Trunk, paging, code call circuits
Power Failure Transfer — Station	X		X				Special wiring for a few stations and CO trunks
Recorded Telephone Dictation		X				X	Recording circuits
Remote Access to PBX Services		X		X		X	
Reserve Power		X					Power supply
Restriction — Inward			X			X	
Restriction — Outward			X			X	
Restriction — Full			X			X	

† Call forwarding used for flexible night station assignment

TABLE B

ADMINISTRATION OF SERVICE FEATURES (Cont)

FEATURE	PROVIDED					ADMINISTERED BY		
	ALWAYS	PER SWITCH UNIT	PER STATION	PER TRUNK	NONE REQUIRED	STORED DATA	EQUIPMENT OR WIRING	
Restriction — Code		X	X			X		
Restriction — Toll			X			X		
Rotary Dial Calling	X						Rotary-dial telephone	
Special (Attendant) Positions		X				X		
Speed Calling		X	X			X		
Splitting — 2-Way Manual	X				X		Wire console keys	
Station Hunting			X			X		
Station-to-Station Calling	X				X			
Straightforward Outward Completion	X				X			
Supervisor Display Unit		X					Display circuits	
Switched Loop Operation	X					X	Console circuits	
Tandem Tie Trunk Switching				X		X	Tie trunk circuits	
Threeway Conference Transfer		X				X		
Through-Dialing	X				X			
Tie Trunk Service				X		X	Tie trunk circuits	
Timed Reminders	X				X			
Toll Terminal			X			X		
TOUCH-TONE Calling			X				Special telephone set	
TOUCH-TONE to Dial Pulse Conversion	X				X			
Traffic Data Collection	X	X			X			
Trunk Answer Any Station		X				X	Bells and gongs	
Trunk Group Busy Lamps		X				X	Wire console lamps	
Trunk Hunting	X			X		X		
Trunk-To-Trunk Connections	X				X			
Two-Party Hold on Console	X				X			

◆ TABLE B ◆

ADMINISTRATION OF SERVICE FEATURES (Cont)

FEATURE	PROVIDED				ADMINISTERED BY		
	ALWAYS	PER SWITCH UNIT	PER STATION	PER TRUNK	NONE REQUIRED	STORED DATA	EQUIPMENT OR WIRING
Universal Numbering Plan	X					X	
Voice Message Service		X	X				Recording/playback circuits
WATS Access				X		X	Trunk circuits

diodes include the high-speed diodes, voltage regulator diodes, and high-speed PNP diodes.

5.03 The system uses four different types of memory devices. A permanent magnet twistor is used for the program store and the line information store. In the twistor memory, information is stored in an array of small permanent magnets mounted on removable aluminum cards (Fig. 8). To write information into this memory or to change information written into it previously, magnet cards are withdrawn, and the state of magnetization of the individual magnets is changed in accordance with the new information pattern.

5.04 The call store contains temporary information used in call processing. This function is provided by a ferrite sheet store. The store uses a multi-apertured ferrite sheet as a building block. Each 3/4-inch square ferrite sheet contains 256 holes in a 16 by 16 array and a printed conductor. It is electrically equivalent to a matrix of 256 individual ferrite cores with a conductor threading all cores in series. The data and digit store in the input-output section of the control switch is also a ferrite sheet store.

5.05 The memory used to record the assigned transmission connections at the 1A switch unit is called an inhibited fluxor store. A similar magnetic store is also used in the time-division switching network connecting digit trunks to digit receivers at the control unit. Both operate in the coincident flux mode. The 2A, 3A, and the 3A portion of a 4A-1 and 4A-2 installation use ferrite sheet core memories.

CIRCUIT PACKS

5.06 The control unit and all switch units employ plug-in type circuit packs (Fig. 13) to provide the needed circuit components and facilitate maintenance. For more information concerning the electrical configuration of each type of circuit pack used in the No. 101 ESS, see:

- (a) ED-type apparatus coded circuit packs—SD-1H000-01

- (b) S-type apparatus coded circuit packs—SD-1H125-01

- (c) U-type apparatus coded circuit packs—SD-1H126-01.

MOUNTING AND CONNECTORS

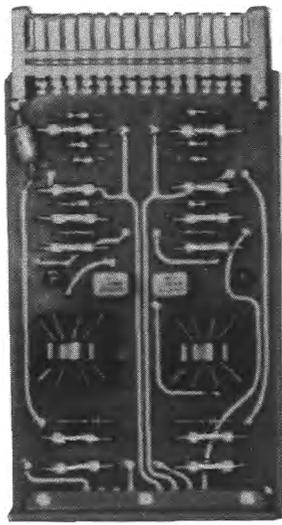
5.07 A special connector is integrated into the plug-in package design. The connector provides gold plated contact springs that mate with gold plated terminals mounted in a terminal field at the back of the package mounting. The contact springs and the associated female terminals are designated to provide a redundant contact structure.

5.08 A typical control package mounting is illustrated in Fig. 14. The switch unit package mountings are similar. The package mounting is arranged to accommodate packages of 0.6, 0.8, and 1.2 inches in width for the control unit and the 1A switch unit, and from 0.4 to 2 inches in increments of 0.2 inch in the 2A and 3A switch units. Each mounting has attached to it a designation bar which provides a securing device and services to identify package position, type of circuit pack information, and functional titles for sections of the equipment.

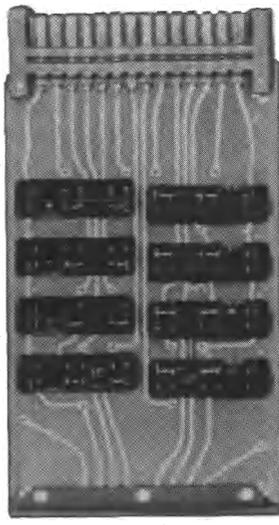
1A SWITCH UNIT (MD—Fig. 1 and 15)

5.09 The 1A switch unit is housed in a welded aluminum cabinet. This cabinet contains equipment for: 200 station lines; 40 CO, tie, and miscellaneous trunks. The trunk capacity may be increased to a maximum of 56 by using 16 line positions; this decreases the number of line positions to a maximum of 184.

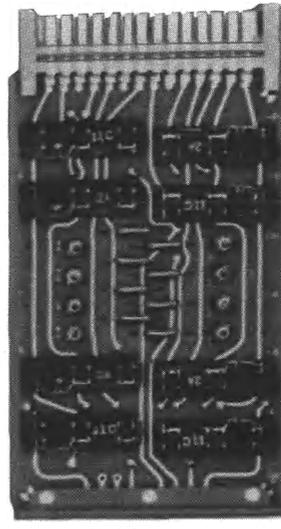
- 5.10** For more detailed information on the 1A switch unit, see Table A.



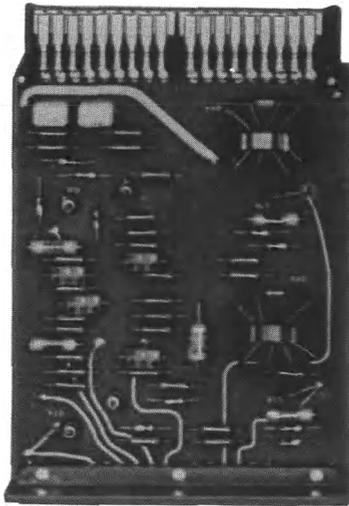
MEMORY WRITE



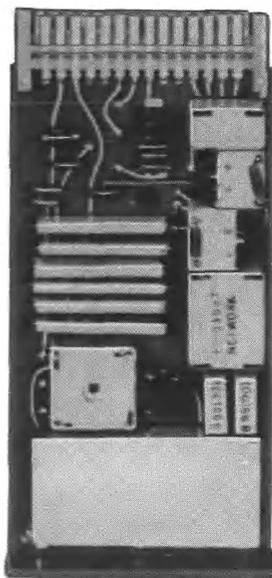
LOGIC



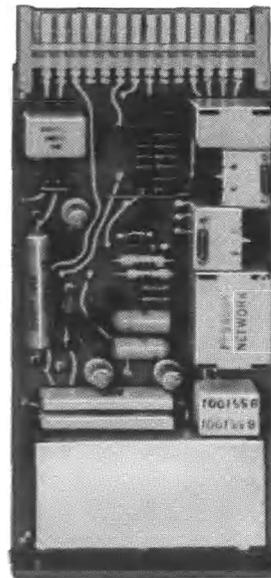
LOGIC



MEMORY READ



TRUNK



LINE

Fig. 13—Typical Circuit Packs

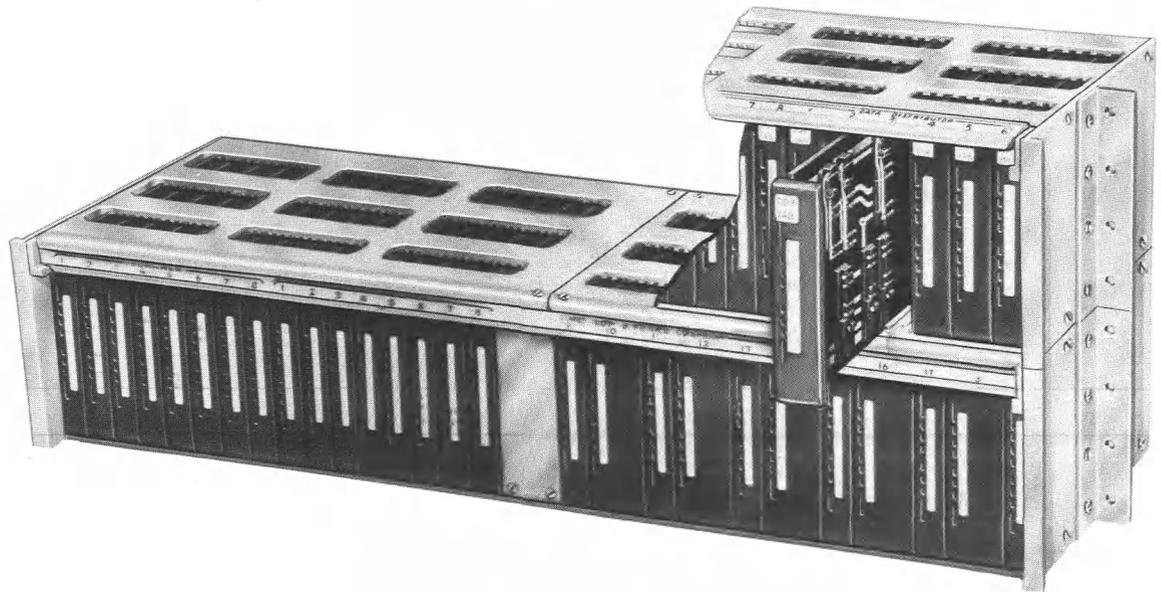


Fig. 14—Typical Control Unit Package Mounting



2A SWITCH UNIT (Fig. 1 and 16)

5.11 The 2A switch unit is housed in aluminum cabinets. The basic switch unit consists of two cabinets. One basic cabinet provides power, fuses, alarms, transfer, switch store, and switch control circuits for the various lines and trunks. The other basic cabinet contains equipment for up to 180 lines and 56 trunks where maximum lines are required of 156 lines and 180 trunks where maximum trunks are required.

5.12 The auxiliary link group cabinet may be added to provide up to 184 additional lines. This addition would make the maximum line and trunk capacity 364 lines and 56 trunks, or 340 lines and 80 trunks.

5.13 An optional feature cabinet may also be provided to accommodate such special features as attendant direct station selection, trunk repeaters, recorded telephone dictation, code call, key telephone sets, station line transfer relays, emergency power, trunk group busy, incoming call identification, loudspeaker, and paging.

5.14 For more detailed information on the 2A switch unit, see Table A.

3A SWITCH UNIT

5.15 The 3A switch unit is housed in aluminum cabinets. The basic 3A switch unit consists of three cabinets that provide:

- (a) Fuse, alarm, transfer, switch store, and switch control circuitry for the various lines and trunks.
- (b) Circuitry for up to 436 lines and 112 trunks when maximum lines are required, or 312 lines and 220 trunks where maximum trunks are required.
- (c) Circuitry for the intergroup switch and the data transmitter and receiver.

5.16 An auxiliary line group cabinet may be added to provide up to 384 additional lines. This addition makes possible a maximum 3A switch unit line capacity of 820.

5.17 An auxiliary switch control cabinet may also be provided to increase the traffic handling capacity.

5.18 The 3A switch unit may also be equipped with an optional feature cabinet to provide such special features as attendant direct station selection (ADSS), trunk repeaters, recorded telephone dictation circuits, code call circuits, key telephone sets, station line transfer relays, emergency power, trunk group busy and incoming call identification, loudspeaker, and paging.

5.19 For more detailed information on the 3A switch unit, see Table A.

4A-1 SWITCH UNIT

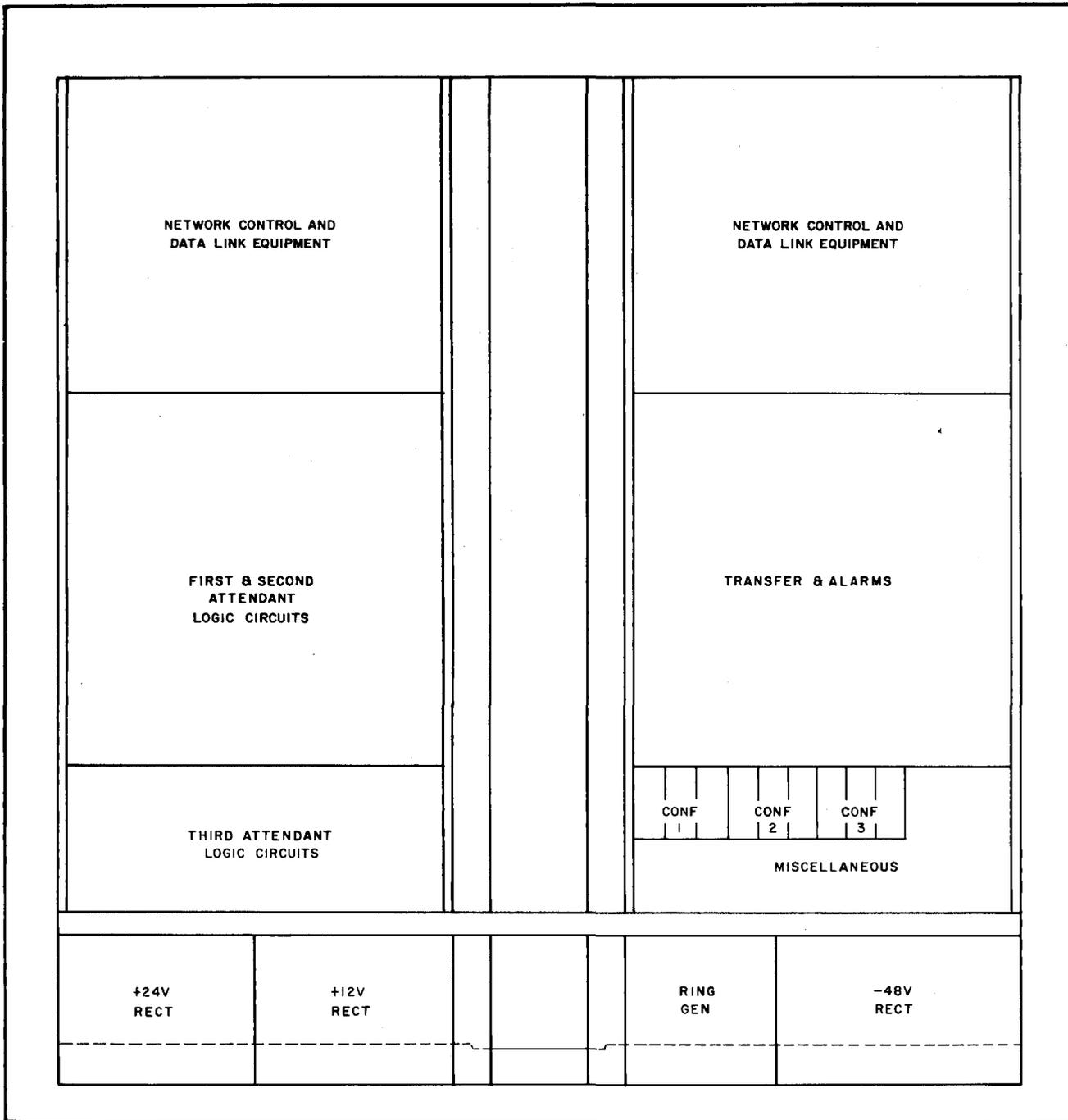
5.20 The equipment associated with a 4A-1 switch unit installation consists of one 3A TDS and one line connector.

5.21 The line connector circuits are physically divided into:

- (a) **Data Converter Frame:** The data converter frame contains data receiver and distributor circuits and scanner control and data transmitter circuits. Data messages are handled through these circuits. All translation and distribution of message and formation of messages takes place here. The scanning of lines is also controlled by circuits of this frame.
- (b) **Line Switch Controller Frame:** Circuits associated with this frame carry out orders for tests and changes in station line and B-link connections, and perform scanning functions to locate station lines that go off-hook.
- (c) **Line Switching Frame:** This frame contains the circuits that actually connect and disconnect the station lines and the B-links. It also contains the ferrod sensors that are used in the detection of station requests for service.

5.22 A 4A-1 switch unit can accommodate up to 332 trunks and 2000 lines (see Table A), depending on the line concentration ratio.

5.23 For more detailed information on the 4A-1 switch unit, see Table A.



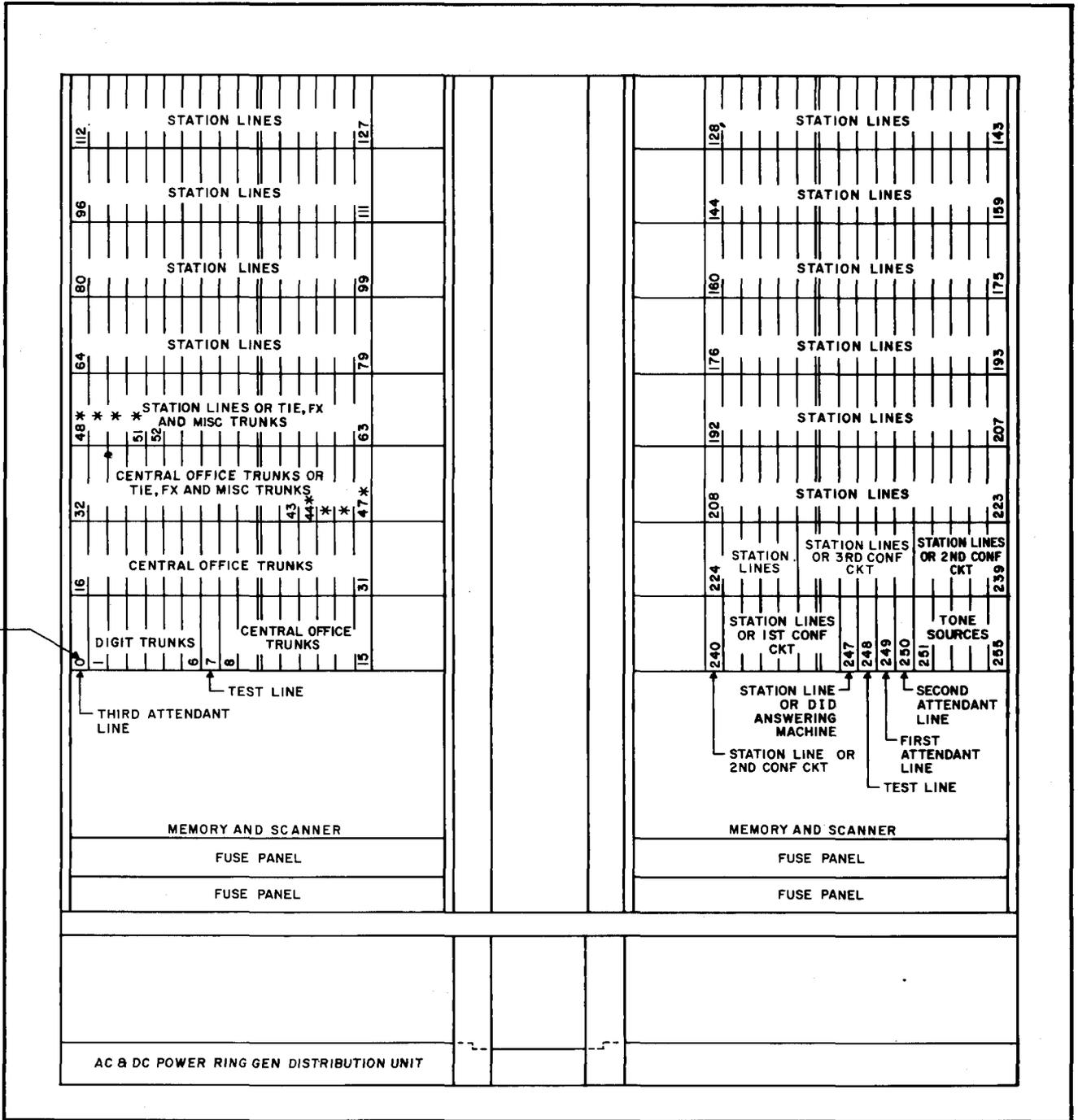
BAY 1

BAY 2

FRONT VIEW
HINGED BAYS
 (DOORS NOT SHOWN)

Fig. 15—1A Switch Unit Showing Equipment Locations (MD) (Sheet 1 of 2)

EQUIPMENT
NUMBER
(SCAN POINT)



BAY 3

BAY 4

**FRONT VIEW
FIXED BAYS**

(HINGED UNITS AND POWER UNITS NOT SHOWN)

* ONLY EQUIPMENT NUMBERS 44-51 MAY BE USED FOR MISCELLANEOUS TRUNKS (TELEPHONE DICTATION, CODE CALL, AND PAGING).

Fig. 15—1A Switch Unit Showing Equipment Locations (MD) (Sheet 2 of 2)



4A-2 SWITCH UNIT

5.24 The equipment associated with a 4A-2 switch unit installation consists of two 3A TDSs and two line connectors.

5.25 A 4A-2 switch unit can accommodate up to 664 trunks and 4000 lines, depending on the line concentration ratio.

ATTENDANT CONSOLES

5.26 One- and two-type Universal Telephone Consoles (Fig. 8) are used with the No. 101 ESS. The console is a small key operated switchboard that may be placed on a desk or table. It is equipped with both lighted and nonlighted keys and a TOUCH-TONE dial for the attendant to use in answering and completing calls. Other consoles (described in Section 240-200-301) are:

- 26A9T
- 46A9T (Additional TGB, ICI Lamps)
- 56A9T (with ADSS).

5.27 The Universal Telephone Console measures approximately 15-1/2 inches by 9 inches at the base and is available in four colors (gray, green, white, and beige). Either a matching plug-in handset or standard operator headset may be used.

CONTROL UNIT

5.28 The control unit equipment is mounted on six 7-foot high double bay frames, one 7-foot high triple bay frame, and from one to four double bay relay frames. The frames are made of extruded aluminum with each bay forming a standard 23-inch mounting bay 7 feet high with the exception of the trunk relays frames. The 7-foot height of the frames allows the installation of the control unit in a low ceiling area if desired. However, an extension frame for growth items that will extend the height to 11 feet 6 inches is available so space economy can be realized in high ceiling areas.

5.29 Trays similar to those described for the switch unit are also used in the control unit.

Up to five trays are grouped to form a functional equipment unit. These trays are secured together by a mounting bar, and the trays are wired as one unit. Wiring has been designed to be compatible with the high-speed circuits used in the system.

5.30 The nine frames containing the common circuits for handling up to 4000 extension lines, traffic requirements permitting, may be arranged in one of several different lineups depending upon the CO floor space available. The first is a continuous equipment lineup requiring approximately 39 feet of linear space. Growth beyond eight sectors (each 1A and 2A switch unit requires one sector; each 3A and 4A switch unit requires a sector for each 60 time slots; in addition, each line connector used with a 4A switch unit requires one sector) is handled by 4-foot, 6-inch extension frames mounted on top of the basic 7-foot frames as described in Part 6. Three digit data extension frames, each accommodating growth items for eight sectors, expand the control unit capacity to its full complement of 32 sectors (Fig. 17). Trunk growth beyond the capacity of 32 trays of logic circuits is provided by the addition of an extension trunk logic frame and by the corresponding trunk relay frame.

5.31 The second equipment arrangement available is a split lineup requiring approximately 15 feet of linear space in one lineup and approximately 24 feet of linear space in an adjacent lineup. Growth beyond eight sectors may be handled in either of two ways. Where sufficient ceiling height is available, a floor-supported 7-foot frame mounted adjacent to the digit frame plus one 4-foot, 6-inch extension frame mounted on top of the 7-foot frames bring the capacity up to 32 sectors (Fig. 18). Where sufficient ceiling height is not available, growth can be accommodated on two floor-supported, 7-foot frames mounted adjacent to the digit data frame.

5.32 Trunk relay equipment will normally be mounted on 11-foot, 6-inch frames, but when ceiling heights are restrictive, it can be engineered to mount on 7-foot frames. The maximum linear space required is 18 feet and 26 feet, respectively. Trunk relay equipment may be located remotely from the common equipment, if desired.

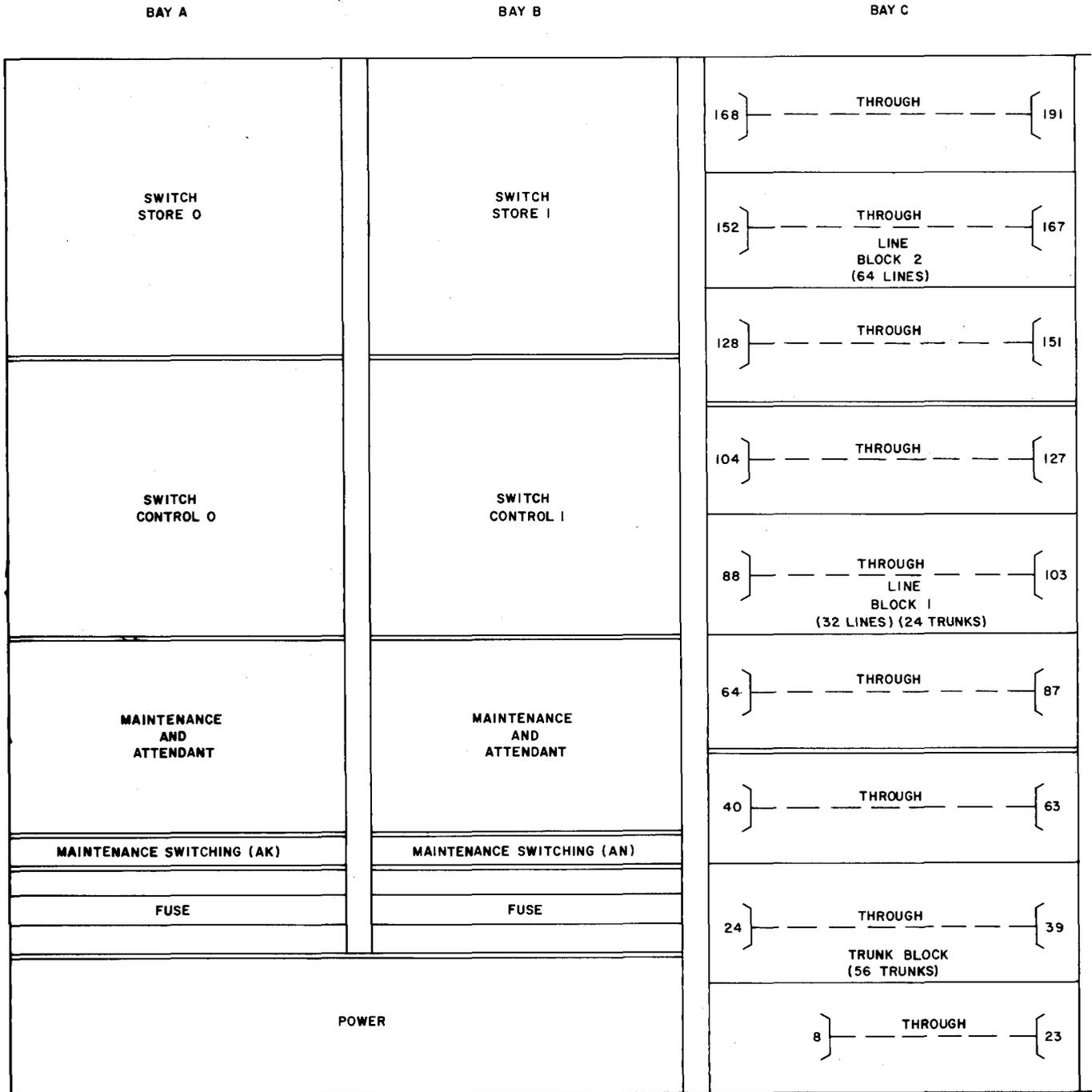


Fig. 16—2A Switch Unit Showing Circuit Locations (Sheet 1 of 2)

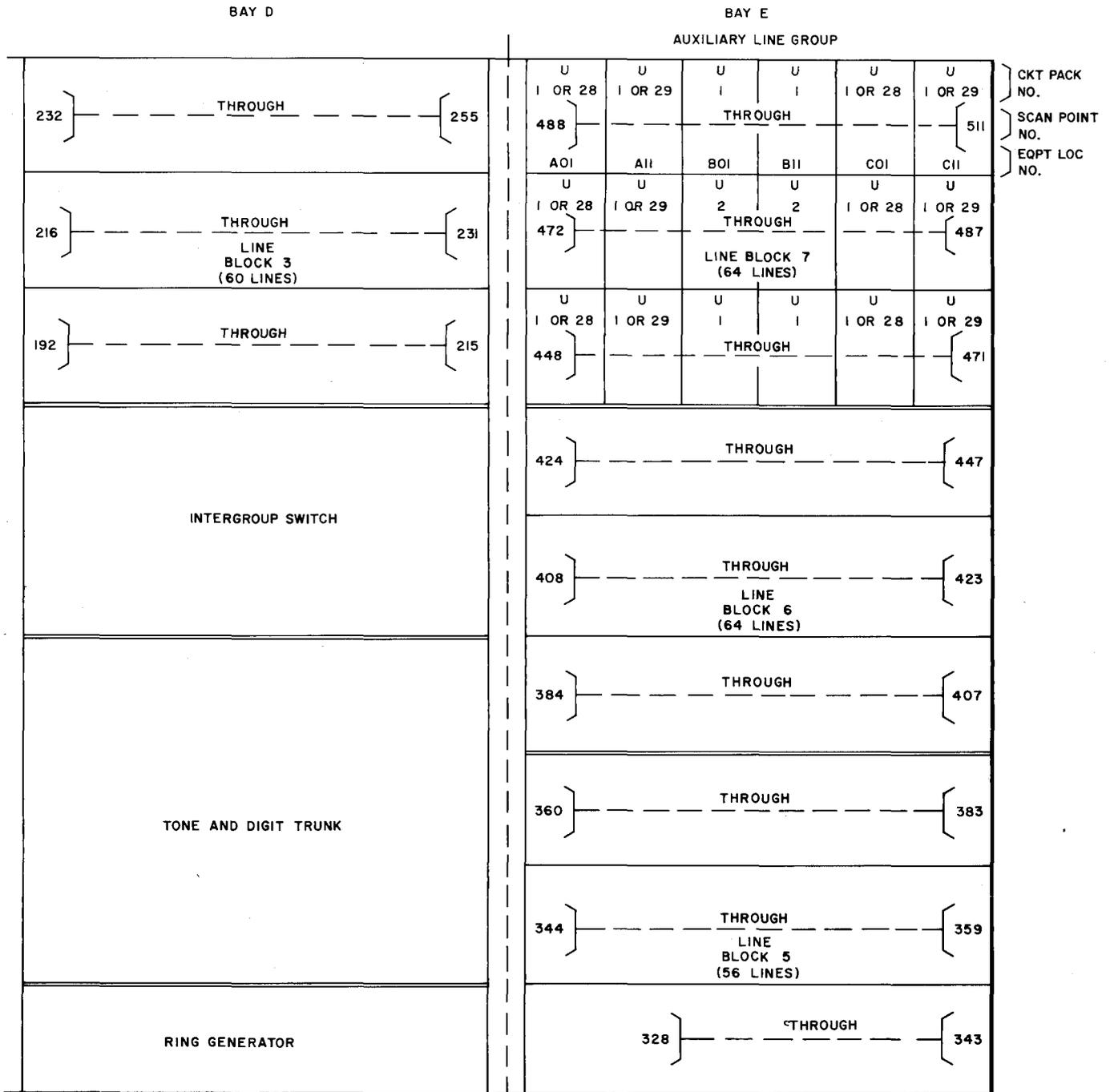


Fig. 16—2A Switch Unit Showing Circuit Locations (Sheet 2 of 2)

COMMON EQUIPMENT

5.33 The nine frames of common equipment are designated the maintenance center, auxiliary call processor No. 1, call processor No. 1, call processor No. 2, auxiliary call processor No. 2, line data frame, digit frame, trunk control frame, and power frame. The following paragraphs describe the equipment units mounted on each frame and the trunk relay frames.

5.34 Maintenance Center: The maintenance center contains logic circuits to control which of the duplicated circuits of the system are to be on-line and which are to be standby, in response to orders from the maintenance portions of the stored program. It also contains various timers and test circuits. An alarm circuit interconnects the control unit with the audible and visual alarm system in the CO building. ♦Alarms in the CO can be masked when under control of the centralized status alarm and control system.♦ A control panel provides maintenance personnel with controls to exercise portions of the system and with visual outputs from the system to inform personnel about its operations. A type 28 TTY is used to bring out information about troubles within the system and to type requests for specific actions or tests into the system.

5.35 Call Processor No. 1: This is the triple bay frame that contains two program stores, one call store, one line information store, and their associated control circuits. It also contains the system clock.

5.36 Auxiliary Call Processor No. 1: This frame contains the digit access pretranslator (direct access DID), the third, and if required, the fourth program store for call processor No. 1.

5.37 Call Processor No. 2: This frame contains the duplicate program store and call stores, and their associated control circuits. It also contains the AIOD interface.

5.38 Auxiliary Call Processor No. 2: This frame contains the same equipment as described in 5.37 for call processor No. 2.

5.39 Line Data Frame: This frame contains the data and digit store, data and digit

control, sender control, and trunk connector circuits. Each circuit is duplicated.

5.40 Digit Data Frame: This frame contains two digit receiver connector circuits and their duplicates. It also contains data terminal equipment and digit receiving equipment for up to eight sectors. Data terminal and digit receiving equipment for additional sectors are mounted on extension frames as described in 5.30 and 5.31.

5.41 Trunk Control Frame: This frame contains trunk connector circuits, cross-connection terminal strips, and the logic portions of the various types of trunk circuits. Plug-in circuit packs provide all the necessary logical controls for the trunks. Trunk relays are mounted on separate frames. Mounting space is available in the trunk control frame for approximately 800 trunks.

5.42 Power Frame: Solid-state dc-to-dc conversion equipment to power the control unit is mounted on this frame. Three 24-, six 12-, and three 6-volt converters provide the necessary power in addition to that drawn directly from the CO battery.

5.43 Trunk Relay Frame: The relay portions of the various types of trunk circuits are mounted on the trunk relay frames. Standard 11-foot, 6-inch double bay frames are used. Relays are mounted on standard 23-inch mounting plates. Relays for approximately 200 trunks are accommodated on one double bay 11-foot, 6-inch frame.

POWER AND TONES

5.44 Power is supplied to the switch units from a 120-volt commercial ac power outlet provided by the customer. The 1A switch unit uses three ferroresonant-type rectifiers to supply power to the switch unit circuits of +12, +24, and -48 volts. The 2A and 3A switch unit rectifiers supply +24, -24, and +6 volts to switch unit circuits. The 4A switch unit power circuits supply +24, -24, and +6 volts to the 3A switch unit circuits and -48 and +24 volts to the line connector circuits. The solid-state components used in the rectifiers are duplicated for reliability.

5.45 Solid-state oscillators at the switch unit generate busy tone, audible ringback tone, 440-Hz tone, and dc ringing control signals.

NOTES:

1. TRUNK RELAY FRAMES MAY BE LOCATED REMOTELY FROM THE COMMON EQUIPMENT.
2. THE TWO PORTIONS WILL BE MOUNTED IN A FACING LINEUP WITH THE TELETYPEWRITER OPPOSITE MAINTENANCE CENTER.

LEGEND:

- TO BE USED WHERE 11 FT-6 IN. CEILING SPACE IS AVAILABLE.
- — — TO BE USED WHERE A FLOOR MOUNTED EXTENSION FRAME IS DESIRED.

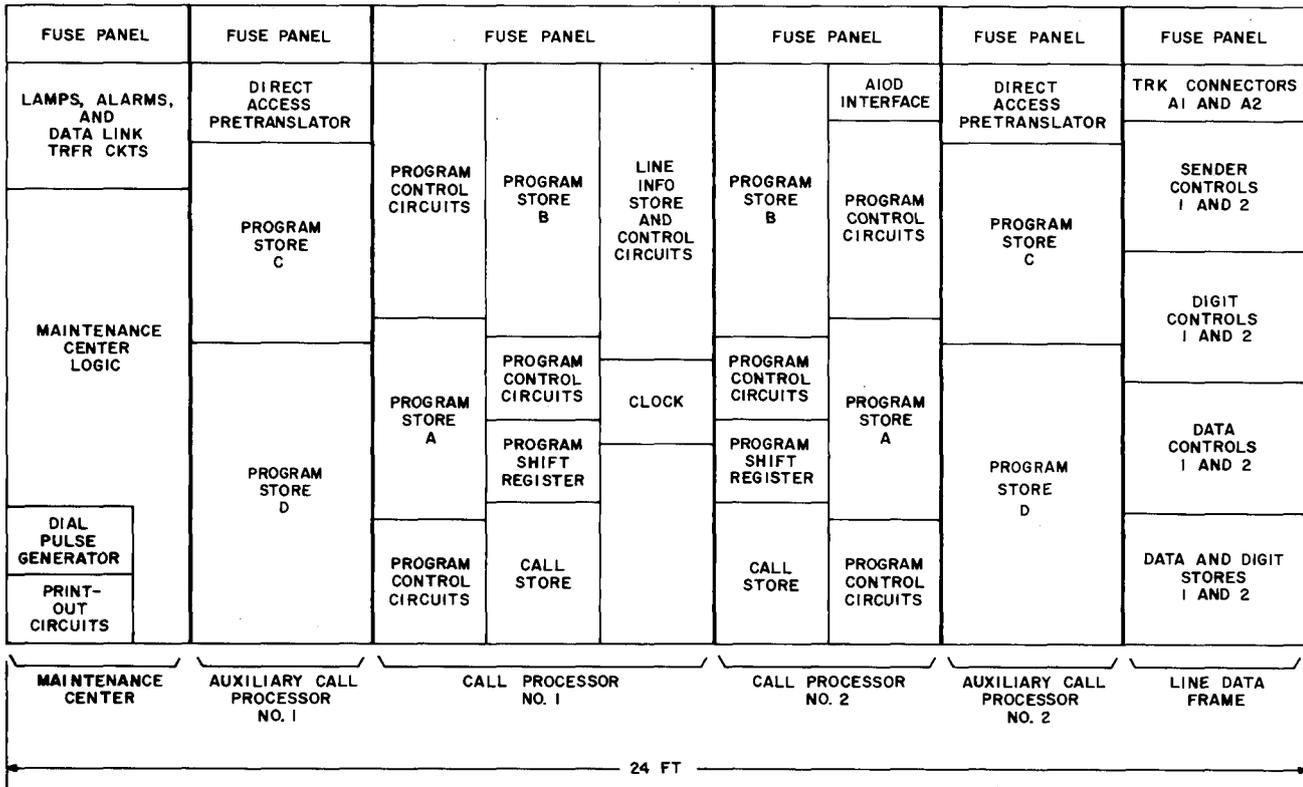


Fig. 18—Control Unit Common Equipment Split Lineup Sequence (Sheet 1 of 2)

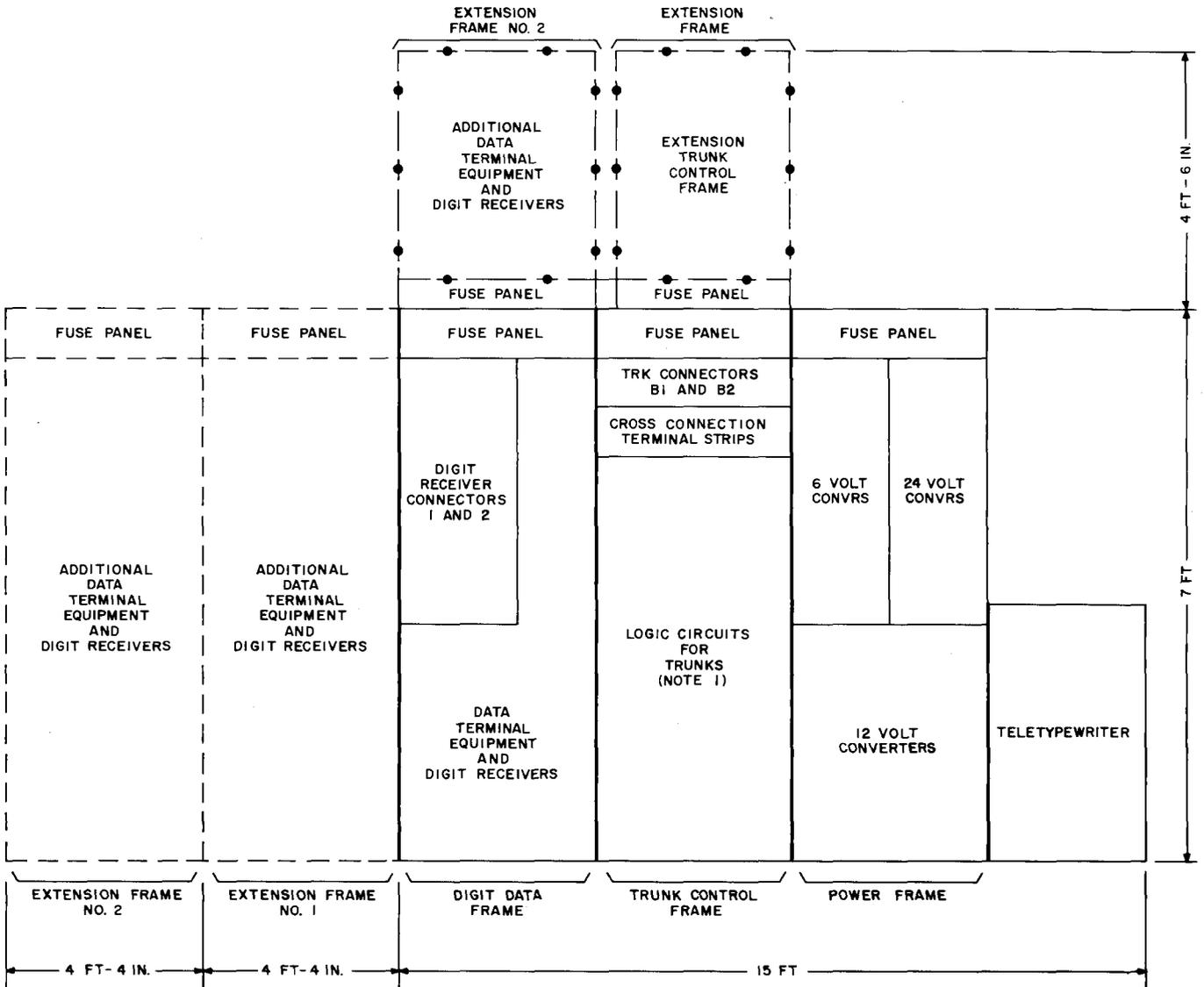


Fig. 18—Control Unit Common Equipment Split Lineup Sequence (Sheet 2 of 2)

5.46 A *subcycle* generator at the switch unit operating directly from the 120-volt ac supply provides 20-Hz ringing power.

5.47 The control unit requires dc power at four voltages: -48, +24, +12, and +6 volts. The first is supplied directly from the CO battery. The other three voltages are supplied by dc-to-ac converters powered from the CO battery. For reliability there are two feeders for each voltage with the load split so that failure of a single feeder does not disable the control unit. Spare converters are manually switched into service when the output voltage of the on-line units falls below prescribed levels. Two 6-volt converters plus one spare, two groups of three 12-volt converters, plus one spare are mounted on the control unit power frame.

5.48 The drain on the -48 volt CO battery ranges up to approximately 160 amperes for the control unit frames, not including the trunk relay frames. The drain for the trunk relay frames is dependent upon the type and usage of the trunk circuits.

5.49 Dial tone is supplied to the lines and trunks from the control unit. The dial tone used is the same as required for COs equipped for TOUCH-TONE calling. Where the No. 101 ESS control unit is installed in COs equipped for TOUCH-TONE calling, the CO dial tone plant may be used to supply No. 101 ESS dial tone, provided the CO plant is engineered for the additional capacity. Where a CO TOUCH-TONE dial tone plant is not available, a separate dial tone plant is required. It is a solid-state unit operating from the 48-volt CO battery. Two complete generators are provided in the unit for reliability. Internal monitoring circuits check the output of the on-line generator and switch in the standby generator in the event of a failure. The plant is mounted externally to the control unit.

6. ENGINEERING CONSIDERATIONS

NUMBERING PLAN

6.01 Table C gives the numbering plan for all switch units in the No. 101 ESS.

OPERATING RANGES

6.02 Talking battery is supplied at the switch unit to all stations, including the attendant

console. The control unit is normally located in the same building as the serving CO. Therefore, the range limitations of the CO are not a contributing factor in determination of the station range capabilities of No. 101 ESS. Table D shows operating ranges for the 1A, 2A, 3A, and 4A switch units.

SYSTEM CALL CARRYING CAPACITY

6.03 System call carrying capacity is flexible and depends upon the following major factors:

- (a) Control unit—busy hour calls, digit receiver traffic capacity, line information store memory space, and call store space.
- (b) Switch unit—the number of time slots and digit trunks 1A, 2A, 3A, and 4A switch units and the line connector traffic capacity (4A switch unit).

EQUIPMENT ENGINEERING

A. Switch Unit

6.04 *General:* The switch unit cabinet is completely wired for its full capacity of line and trunk circuits. The 1A and 2A switch unit cabinets are wired for three attendant console circuits. The 3A and 4A switch unit cabinets are wired for six or twelve attendant console circuits. Substantially, all of the circuits are contained in plug-in packages. All of the packages comprising the common circuits, such as switch and scanner stores, clocks, translators, and one attendant circuit are always provided with the basic switch unit. Other packages, such as line and trunk packages, are variable in number and are ordered and plugged in as required. Certain attendant and miscellaneous equipment is also provided as needed.

6.05 *Line and Trunk Packs:* A direct relationship exists between the equipment number (scan point number) and the switch unit equipment location for all station lines and trunks. In the case of station lines for all but 4A switch units, there is also a relationship fixed by administration between the equipment number and the directory number. There is always a direct relationship between the equipment numbers of the lines and trunks and the associated line information store word which is used to store its class-of-service information at the control unit. Fig. 15 shows the equipment numbers for the 1A switch unit.

◆ TABLE C ◆

STANDARD NUMBERING PLAN FOR NO. 101 ESS

INITIAL DIGIT	NUMBER OF DIGITS REQUIRED FOR ACCESS (EXCLUDING ANY DIGITS TO BE OUTPULSED OVER TRUNKS)			
	1	2	3	4
0	Attendant (fixed)	—	—	—
9	CO trunks (fixed)	—	—	—
8 (Any one of the indicated functions)	Common control switching arrange- ment (CCSA) or 1 tie or miscella- neous trunk group	10 tie and miscel- laneous trunk groups	100 stations or 100 tie and miscellaneous trunk groups	1000 stations
7 6 5 4 3 2	(Any one of the indicated functions for each)	1 tie or miscella- neous trunk group	10 tie or miscel- laneous trunk groups or 10 special services	100 tie or miscel- laneous trunk groups or 100 stations or 100 special services
1*† (All of the indicated functions)	—	6 speed calling codes per station (12 through 17) and 2 special services (Call hold = 18) (Call pickup = 19)	10 special service (10X)	60 speed calling codes per group (11UX where U = 2-7) and 40 special services (111X, 118X, 119X, and 110X)

* If desired, the initial digit 1 may be interchanged with any one of the digits 2 through 8; however, use of initial digit 1 for special service features is recommended.

† TOUCH-TONE dial buttons 11 and 12, designated * and # symbols, can be redesignated and used for special service functions.

Fig. 16 shows the equipment numbers assigned to the line and trunk groups for the 2A switch unit. Line groups (top of bay E) show the locations and types of circuit packs.

6.06 Attendant Equipment: All equipment needed within the switch unit cabinet for the first attendant console is provided with the switch unit. Plug-in circuits packs are added for additional consoles. For 1A switch units, additional circuitry is added for the third console as described in the equipment engineering practice. Attendant consoles (maximum three for 1A and 2A switch units, six for 120 time slot 3A switch unit, and

twelve for 240 time slot 3A or 4A switch unit) and the associated handset or headset and connecting cables are provided as required.

6.07 Miscellaneous Equipment: The 6-port conference circuits (maximum six, three for 1A switch unit) for conference calling and attendant controlled conference are added as needed.

6.08 Each of the following items is ordered as required and mounted in the miscellaneous equipment frame (2A, 3A, and 4A switch units) on one or more relay racks, or in suitable locations.

TABLE D
OPERATING RANGES

FACILITY	1A SWITCH UNIT		2A SWITCH UNIT		3A AND 4A SWITCH UNIT	
	AC LOSS (DB)	EXTERNAL CONDUCTOR RESISTANCE (ECR) (Ω)	AC	ECR (Ω)	AC	ECR (Ω)
Digit trunk No.						
1, 2	7	—	9	—	9	—
3	7	*2900	9	*3200	9	*3200
4-6	7	—	9	—	9	—
7	—	—	9	—	9	—
8	—	—	—	—	9	—
9	—	—	—	—	9	†1800
10-24	—	—	—	—	9	—
Data Trunk	10	2000	15	2000	‡15	2000
Line Circuit	—	600	—	200	—	200
Extended Range Line Circuit						
1) Station Dial Long	—	600	—	600	—	600
2) Line	—	1100	—	2000	—	2000
CO Trunk	—	5500	—	5500	—	5500
DID CO Trunk	—	1400 with loop pulsing, 4200 with battery and ground pulsing	—	5500	—	5500

* Requirement for power failure circuit.

† Requirement for requested switch to reserve power circuit.

‡ AC loss is 10DB for 4A switch unit

- 3A code call systems
- Recorded telephone dictation trunk circuits
- Signaling and lamp lighting circuitry required to provide attendant with direct station selection
- Any circuitry required to control the locally engineered bells or gongs used in connection with the trunk answering from any station feature

- Any repeaters and associated circuitry needed for long-haul FX and tie trunks

- Power supply for special services.

B. Control Unit

6.09 All of the common control portion of the control unit is provided initially for every system. However, the quantity of equipment provided to perform the input-output functions associated with each switch unit is variable, depending

upon the number of switch units provided and the number and type of trunks.

6.10 Table E describes the engineering variables in the control unit; the detailed engineering information is covered in the pertinent equipment engineering sections.

TRAFFIC MEASURING ARRANGEMENTS

6.11 Arrangements are provided for automatically making *usage counts* and *peg counts* of the important elements subject to traffic engineering. These measurements are made centrally at the control unit since it maintains a record of every call in progress in the system.

6.12 A traffic measurement program in the program store is available for use when directed. Traffic is initiated by a request from the maintenance TTY. The TTY information is recorded in the Input Message Manual. Traffic measuring can be obtained for several switch units at the same time.

6.13 Where the desired item is a sampling or *usage count*, it is determined by scanning for the number of circuits in use at intervals of 100 seconds and accumulating these counts for one hour in the off-line call store. The sum of 36 consecutive counts (one hour) is a close approximation of the average traffic level expressed in hundred-call-seconds (CCS) which prevailed during that hour.

6.14 Where the desired item counts the number of occurrences over the period (peg counts), these are accumulated in the off-line call store and printed at hourly intervals on the TTY page, along with accumulated usage count.

6.15 Traffic printouts on the TTY page are interspersed with maintenance printouts and can be identified by the prefix letters TR. These are followed by:

- (a) Printout number starting with 01 each day
- (b) The number of the switch unit being counted
- (c) Traffic item and its corresponding counts
- (d) Number of days remaining in the traffic count period specified in the TTY request.

6.16 Table F lists items now arranged for counting.

OUTSIDE PLANT ENGINEERING

6.17 Outside plant facilities which meet transmission and signaling objectives normally provided for conventional PBXs, such as CO and miscellaneous trunks, are suitable for No. 101 ESS. The 101 ESS must have: (a) a connection to the control unit, as well as to the switch unit; and (b) digit trunks and data links which are not required by conventional PBXs. Additional outside plant facilities must be provided for the digit trunks and data links.

6.18 All trunks may have gain added between the switch unit and the control unit. For DID trunks, gain units may be added: (a) between the control unit and CO and (b) in the cable plant between the control unit and the switch unit.

6.19 For each switch unit, two pairs of voice facilities, each having a dc path, must be provided for the data links.

6.20 One pair of voice facilities must be provided for each digit trunk. Each sector (60 time slots) requires at least three digit trunks. The 2A switch unit can have a maximum of 7 digit trunks. For 3A and 4A switch units, each sector can have a maximum of 6 digit trunks.

6.21 Loaded facilities should be used when the CO trunk loop is greater than 12,000 feet. Gain should be added when the CO trunk loop is greater than 18,000 feet.

6.22 Long-haul tie and FX trunks can have 4-wire voice facilities between the control unit and the switch unit. Gain can be added to these facilities with the repeaters located at the switch unit.

6.23 Short-haul tie, FX, and other miscellaneous trunks will generally use conventional 2-wire voice facilities.

7. ADMINISTRATION OF GROWTH AND MEMORY FACILITIES

GENERAL

7.01 Many of the services and features which are available in the No. 101 ESS require that

TABLE E

CONTROL UNIT ENGINEERING VARIABLES

FRAME	ENGINEERING FACTORS
(a) Call processor No. 1	Always fully equipped; no engineering required.
(b) Auxiliary call processor No. 1	Provision for adding third and fourth PS and direct access DID equipment.
(c) Call processor No. 2	Always fully wired; fully equipped, except that circuit packs for AIOD are plugged in as required.
(d) Auxiliary processor No. 2	Provision for adding third and fourth PS and direct access DID equipment.
(e) Line data frame	Always fully equipped; no engineering required.
(f) Digit data frame	Always fully wired for all digit and data equipment needed for the first 8 sectors and the first 15 digit receivers. Detailed engineering of individual plug-in circuit packs required.
(g) Digit data extension frames for growth beyond capacity of (f)	
(1) Arrangement for single lineup and 11-foot, 6-inch ceilings	A maximum of three piggy-back extension frames, each wired for a maximum of eight sectors and nine digit receivers, may be provided as needed. Detailed engineering of individual plug-in circuit packs is required for each.
(2) Arrangement for split lineup and 11-foot, 6-inch ceilings	Initial growth handled by an auxiliary 7-foot floor supported digit data frame, which is always fully wired for 16 sectors and 18 digit receivers. Growth beyond this is handled by one piggy-back extension frame identical to those used for the single lineup.
(3) Arrangement for split lineup and 7-foot ceilings	This arrangement is the same as item (2) except that no piggy-back frame is ever provided. When any of the last eight sectors and/or nine digit receivers is required, a second 7-foot floor supported auxiliary frame must be provided and equipped only as required.

TABLE E (Cont)

CONTROL UNIT ENGINEERING VARIABLES

FRAME	ENGINEERING FACTORS
(h) Trunk control frame	Basic frame furnished with trunk connector circuits only (cross-connection terminals are also required for a system with two PSs). Provision for adding wired trunk logic equipment trays and individual plug-in trunk circuit packs as needed. Detailed engineering required.
(i) Trunk control frame extension	Provision for adding additional logic circuit equipment
(j) Trunk relay frame	The relay portion of each trunk circuit is mounted on one of the trunk relay frames (maximum of 6 double bay frames for cross-bar central office or approximately 12 single bay frames for step-by-step central office) and wired directly to its corresponding logic circuitry on the trunk control frame. Detailed engineering required.
(k) Maintenance center	Always fully equipped for six switch units. The relays and circuit packs needed for data link switching and switch unit power failure recognition for additional switch units is ordered and installed as required.
(l) Power	Either of two coded power frames is used, depending upon whether the single lineup or split lineup is used.

information be stored in two semipermanent twistor type memory stores: the line information store and the program store.

7.02 The information in these stores must be established or changed as new switch units are added to the system, and when extension lines, trunks, speed calling codes, night extensions for CO trunks, code restriction numbers, the number of attendant positions, etc, are changed from or added to those initially provided.

7.03 Forms recording the exact administration information in the twistor stores can be used to tabulate the basic customer requirements in a suitable manner so that the IBM cards can be

produced and used along with encoding equipment to magnetize twistor cards.

7.04 Information is stored in binary form in the memories by magnetizing or demagnetizing spots on the twistor cards. This is accomplished by first removing the twistor cards from the memory, and then magnetizing the desired permanent magnets by use of twistor card encoding equipment.

7.05 Switch unit equipment is added by the insertion of circuit packs. Lines and trunks come four to a circuit pack. Telephones, house cable, outside plant are required as in other systems.

TABLE F

TRAFFIC MEASUREMENTS

CIRCUIT OR FEATURE	USAGE COUNT	PEG COUNT
Per Control Unit		
Maintenance alarms		X
Digit receivers	X	X
Dial tone delay over 3 sec		X
Main-Satellite T-links	X	
Per Switch Unit		
Maintenance alarms		X
CO trunk groups (two maximum)	X	
Digit trunks	X	X
CO trunks	X	
DID trunks	X	
CCSA trunks	X	
CCSA DID trunks	X	
Misc trunk grp	X	
B-Link concentrator	X	
Attendant-off-hook	X	
Number of loops busy (per attendant)	X	
Dial tone delay over 3 sec		X
Time slots	X	

CIRCUIT OR FEATURE	USAGE COUNT	PEG COUNT
Per Switch Unit (Cont)		
Digital inquiry voice answer (DIVA)		X
DIVA overflow		X
Dial conference	X	X
Attendant loop seizures		X
Attendant listed number calls		X
DID and DADID calls		X
Outgoing CO trunk calls		X
Attendant calls waiting	X	
4A-2 T-links	X	
Counts of Use of Features (Per Switch Unit)		
Speed calling per group		X
Speed calling per station		X
Call forwarding-variable		X
Call hold		X
Call pickup		X
Three-way calling and call transfer-individual-all calls		X
Directed pickup		X
Barge-on		X

GROWTH AND SERVICE FEATURES

7.06 When a new switch unit is added to the system, it is necessary to record, on appropriate forms, information relating to all lines, trunks, and services, and then to code the twistor memories. Lines and trunks can be installed and the facilities will not be operational until the memories are updated to recognize the new services. In general, removal of facilities from service can be made with the facilities left in place but the memory updated to show the removal. As switch units change in

size, it may be necessary to increase or decrease the number of time slots assigned per switch in the call store.

PERMANENT MAGNET TWISTOR STORES

7.07 The line information store contains information pertaining to features, services, and restrictions that are individual for each line and trunk. There is one nonduplicated line information store with 128 twistor store cards for the entire control unit.

7.08 The program store contains all the instructions for guiding the system in processing calls and, in addition, has certain necessary supplementary information that pertains to each switch unit, such as the numbering plan for extension lines, the number of CO trunks, the location in the line information store of the stored information for each switch unit, the dialing codes used for miscellaneous trunks, and other related data.

7.09 There are two program controls each having two, three, or four twistor store memory modules. Each memory module contains 128 twistor cards. When the system is functioning, one program control is on-line and the other is off-line. The system automatically interchanges on-line and off-line program controls several times each day and whenever trouble occurs in the on-line program control.

7.10 All the 128 twistor cards in the line information store are subject to administration by the telephone company, whereas only eight twistor cards in each 2-program store system, 32 cards in the 3-program store system, and 36 cards in the 4-program store system are subject to change. The remaining cards are reserved for generic programs and must be coded by Western Electric.

7.11 Each switch unit requires two or more line information store cards and from about one-half to two program store cards for each switch unit which is subject to change.

7.12 The line information store is divided into 64 pairs of twistor cards called planes, numbered from 0 to 63. A plane contains an "A" card and a "B" card; therefore, there is a total of 128 cards in the complete store. Each program store consists of either 2, 3, or 4 stores containing modules of 128 cards each. A 3-module store system is required for direct access DID or for 3A and 4A switch units with greater than 120 time slots. A 4-module store system is required for 4A switch units with more than 2000 lines (4A-2), for switch units used in a main-satellite arrangement, and for more than 3 consoles at a switch unit.

7.13 The twistor store cards are rectangular aluminum cards (approximately 6-1/2 by 11-1/2 inches) with 64 horizontal rows of 44 magnet spots in each row (45 magnet spots is a row, but the column at the edge with the notch is not used). See Fig. 19.

7.14 The magnetic spots are on one side of the card only and are used to store information in binary form. They are either magnetized or demagnetized prior to being inserted into the memory unit.

7.15 Two types of twistor store cards, designated "A" and "B", are used in memories. Each plane has one of each. The two types of cards are distinguished by the location of a notch near the end of one of the long edges. Fig. 19 illustrates the difference.

7.16 In the line information store, "A" cards are always used for line and trunk (1A, 2A, and 3A switch units) information and some miscellaneous information, while "B" cards are used to store speed calling numbers, 4A trunk information, and other miscellaneous information. Each twistor card is divided into two parts called quadrants, so that the first 22 magnetic spots on each horizontal row are in one quadrant, and the last 22 are in another quadrant. Each group of 22 spots is defined as a memory word. Quadrants are numbered as shown in Fig. 20. "A" cards contain quadrants 0 and 1, and "B" cards contain quadrants 2 and 3.

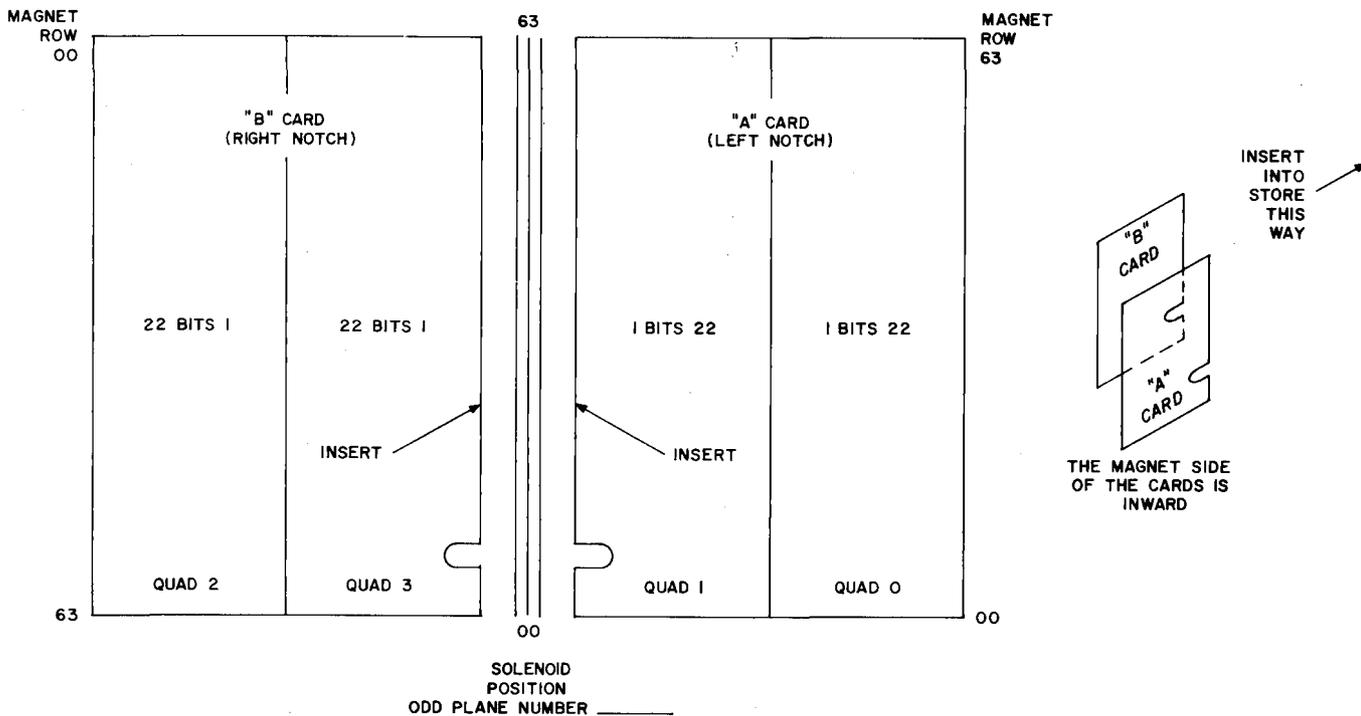
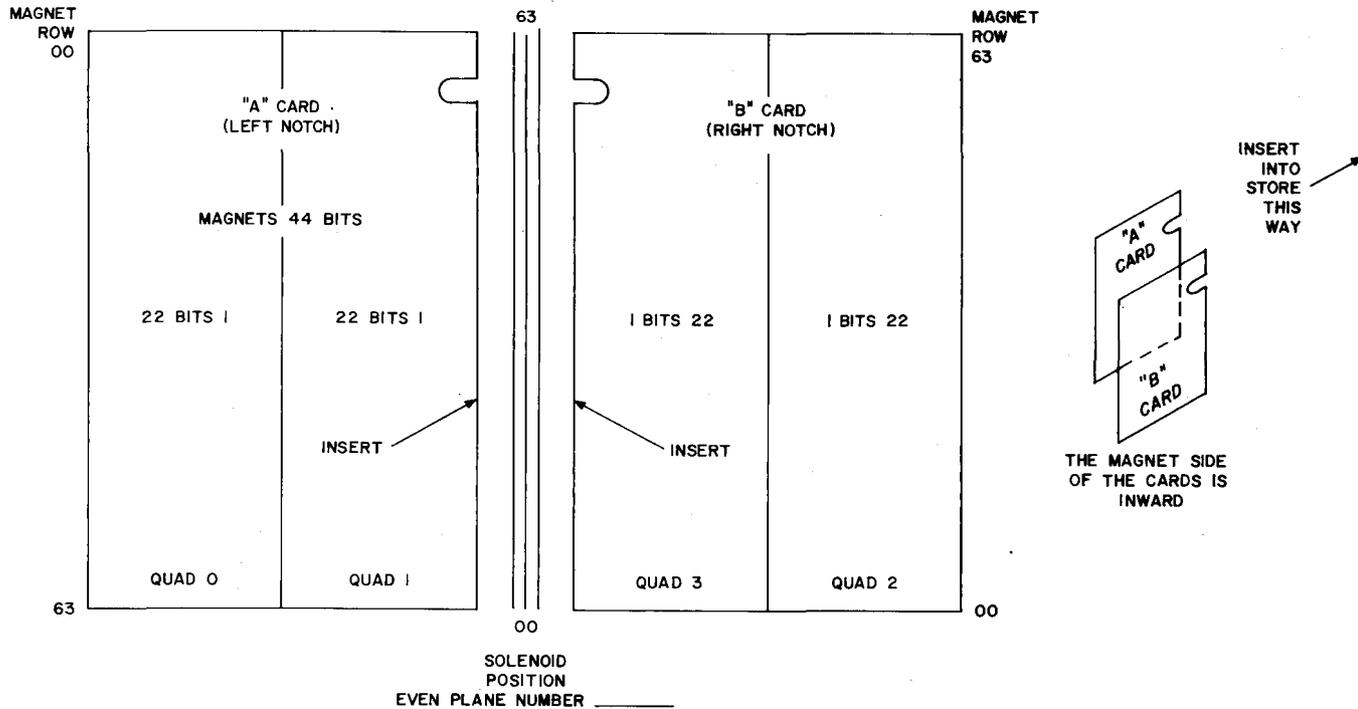
7.17 A solenoid is used to read the information stored on a horizontal row of magnet spots on a twistor card.

7.18 Each line or trunk has an equipment number (scan point number). Extension numbers and equipment numbers have direct association with each other except in 4A switch units. Equipment numbers correspond to the address of the trunk information locations in the switch unit.

TWISTOR STORE CARD CHANGES

7.19 For the purpose of this description, feature changes as recorded on service orders are assumed to be transferred by a clerk who keeps record of administration information in the two twistor memories (line information store and program store) on Port-A-Punch cards.

7.20 If, for example, an extension is changed to allow call forwarding—variable, a single spot in the line information store would have to be changed. The clerk would identify the memory (line information store), twistor card number, magnet row number, quadrant number, and magnet numbers to be changed.



- NOTES:
1. ALL MAGNETS ARE ON THE SIDE OF THE CARDS SHOWN.
 2. "A" CARD MAGNET ROWS CORRESPOND WITH SOLENOID POSITION IN ODD PLANES ONLY. "B" CARD MAGNET ROWS CORRESPOND WITH SOLENOID POSITION IN EVEN PLANES ONLY.

Fig. 19—Twister Card Nomenclature

and continuous equipment tests that include procedures for:

- (a) Detecting failures in the on-line equipment on a *single fault detection basis*.
- (b) Reconstructing the system by automatically removing redundant operating equipment that is known to have a fault and by switching in standby equipment.
- (c) Executing diagnostic tests on the off-line equipment.
- (d) Printing a TTY message to describe what is wrong with the failing equipment.

Appropriate alarms accompany the TTY printouts. These alarms inform the maintenance personnel of the trouble detected and the action taken by the maintenance programs. Since the maintenance philosophy is basically dependent upon single-fault detection, it is important that known troubles, regardless of their significance, be cleared by maintenance personnel as rapidly as possible.

MAINTENANCE PROGRAM TESTING IN RELATION TO THE CALL PROCESSING ACTIVITY

A. General

8.03 The maintenance programs, with the use of the call processor equipment, perform operational tests of the time division switches, the various types of stores, the registers, counters, comparators, and the wired logic of the No. 101 ESS. These tests are performed by interspersing them with the call processing activity. Individual link circuits, attendant circuits, and parts of the maintenance center are not checked by the maintenance programs because the subscribers, attendants, and maintenance personnel perform adequate tests of these circuits through normal use.

8.04 The maintenance programs may be divided into three basic categories as follows:

- (a) Call processor maintenance programs
- (b) Data control or input-output maintenance programs
- (c) Switch unit maintenance programs.

B. Call Processor Maintenance Programs

8.05 The call processor consists of: (1) a program control logic and its associated program store; and (2) a call store. The line information store is actually not a part of the call processor and is capable of working with either call processor.

8.06 The program control and the call store are duplicated for reliability. Therefore, there is an other-program-control and an other-call-store. The other-program-control and the other-call-store are referred to as the off-line portions of the call processor. For example, if program control 1 is on-line, processor control 2 is the other-program-control. The program control and call store are always associated with each other.

8.07 The line information store is not duplicated; therefore, each program control must have access to it. If the line information store goes out of service, basic call processing continues. However, all calling restrictions are suspended and some of the special services which make use of the line information store are lost to the customer while other services are given to all extensions.

8.08 Call processor maintenance can be divided into three categories: (1) on-line tests; (2) off-line tests; and (3) line information store tests.

8.09 The on-line tests are used to detect trouble in the on-line program control and the on-line call store. If a trouble is detected, no attempt is made to isolate it; the on-line and off-line program controls are simply switched. However, the switch of program controls does not take place immediately. Most of the tests are arranged so that a failure will result in a retry of all the on-line maintenance tests. The second failure causes the switch of program controls.

8.10 The off-line tests of the other-program-control and the other-call-store are performed under control of the on-line system. In this case, the tests are diagnostic in function. The troubles are not only detected, but a printout message is printed out on the TTY to determine where the trouble is. The equipment is taken out of service when the test retry fails.

8.11 The line information store tests are also diagnostic in function. A failure in the line information store results in a maintenance printout

for the purpose of helping locate the trouble. The equipment is taken out of service when the test retry fails.

C. Data Control Maintenance Program

8.12 The data control maintenance program is used to test the input-output equipment that is common to all the switch units. This includes the data control, the digit control, the sender control, the data store, the digit receivers, and the digit receiver connectors, as well as the trunk connectors. These tests are performed during the end-of-scan portion of the program and are independent of the individual switch unit tests.

D. Switch Unit Maintenance Programs

8.13 The switch unit maintenance programs are used to test the various features of all the switch units. Outgoing messages are sent from the control unit to the switch unit. These messages direct the switch unit to connect test lines to the time division bus in various combinations. The resultant responses (on-hook and off-hook supervision) are sent back to the control unit and analyzed by the program to determine the success or failure of the test.

OTHER MAINTENANCE PROGRAMS

8.14 24-Hour Maintenance Program: This program provides, once per day, at a predetermined time when service requests are low, a means of printing a permanent maintenance record of busy or bad equipment and of testing certain pieces of maintenance equipment that do not need a continuous check. To accomplish this objective, the 24-hour maintenance routine exercises the system to:

- (a) Test the transfer and alarm circuits in the control unit and in the switch units to insure correct response and switching performance. Tests of the transfer and alarm circuits require the simulating of a fault; therefore, it is necessary that this testing be done during periods of light traffic.
- (b) Print out via the TTY the status of equipment such as dial digit receivers or scanners. A record of busy time slots is also provided. Use of the TTY printout assists maintenance personnel in determining whether or not a particular digit

trunk is marked bad and, therefore, not available for service.

- (c) Check the proper operation of certain special maintenance commands and of the program store readout error detection circuitry.

8.15 Other Maintenance Programs: For a description of other maintenance programs associated with the No. 101 ESS, see Section 240-110-101.

MAINTENANCE MESSAGE MANUALS

A. Teletypewriter

8.16 Maintenance personnel have to be familiar with system operation. This familiarity includes not only a knowledge of how the maintenance programs function and perform their tests, but also the ability to (1) interpret quickly and accurately TTY printouts; and (2) formulate a message that can be transmitted from the No. 101 ESS TTY to effect a specific system action.

8.17 The TTY is the basic communication link between the control unit and the maintenance personnel. The main functions of the TTY are to:

- (a) Print out trouble messages.
- (b) Print out traffic measurements.
- (c) Print out the results of a requested routine or of a test routine.
- (d) Request maintenance routines.
- (e) Request traffic measurements.
- (f) Request the interchange of on-line and off-line equipment.
- (g) Request the readout of information in the memory stores.

B. Input Message Manual IM-1H000

8.18 The purpose of the input message manual for the No. 101 ESS is to provide a comprehensive description of all the input messages that can be transmitted from the TTY to effect a particular system action. These input messages are described in terms of: (1) message format; (2)

use of each message; (3) precautions; and (4) expected results for each message. Also included in the manual are: (1) a list of the TTY characters with the associated binary and octal codes; and (2) a procedure for converting a TTY coded number to octal. This manual must be available to all maintenance personnel.

C. Output Message Manual OM-1H000

8.19 The output message manual is provided to describe in detail all output messages printed out on the local and remote maintenance TTY channels. This description includes: (1) a detailed analysis of message formats; (2) supporting information necessary for an interpretation of the message; and (3) recommended action that must be taken in response to the printed TTY message. Also included in the manual are: (1) a tabular listing of the TTY characters with the associated binary and octal codes; and (2) a procedure for converting a TTY coded number to octal. This manual must be available to all maintenance personnel.

D. Trouble-Locating Manual TLM-1H030-01

8.20 The maintenance manual is provided to assist personnel in finding the faulty circuit pack which has caused a maintenance test to fail. This manual contains: (1) instructions for use of the manual; (2) trouble numbers for faults that do not have a TTY printout; (3) a TTY printout to trouble number listing; (4) trouble number to circuit pack listing, etc. This manual must be available to all control unit maintenance personnel.

9. TYPICAL CALLS

TYPICAL CALLS FOR A NON-MAIN-SATELLITE INSTALLATION

9.01 Fig. 21 provides, in block diagram format, the basic switch unit and control unit interconnecting paths that are used to establish connections for the typical calls described in Table G.

9.02 Table G lists:

- (a) The type of call or connection
- (b) The particular sequence of action that is required to establish the connection

- (c) The key numbers associated with the particular interconnecting paths.

9.03 ♦Fig. 22 provides, in block diagram format, the basic switch unit and control unit interconnecting paths that are used in the 1A switch unit to establish connections for a typical call using the call transfer feature as described in Table H.♦

TYPICAL CALLS FOR A MAIN-SATELLITE INSTALLATION

9.04 For a main-satellite complex:

- (a) Attendant T-links are used to complete incoming trunk calls on a satellite to the attendant. The call may be either a listed number call on an incoming trunk or a station requesting an attendant transfer of an incoming trunk call.

- (b) Each satellite should be provided with DID trunks and DOD trunks directly from the CO. There will be no provision for completing dial 9 calls or outgoing CCSA calls over a main-satellite T-link except for attendant assisted calls. If an attendant completes a trunk call for a satellite station, the complete number must be dialed. DID calls should terminate directly on the appropriate switch unit in order to minimize switching and T-link usage.

- (c) Tie lines and some miscellaneous circuits, such as code call and paging, may be concentrated at one SU location, or they may be split with some provided on each switch unit with overflow provided. Access codes are the same at all locations regardless of where the tie lines are located. Recorded telephone dictation circuits must be equipped at each location where dial stations have access to the circuits or the double-headed adapter circuit must be used. If, however, all the stations that have access to recorded telephone dictation circuits are TOUCH-TONE callers, it is permissible to select a recorded telephone dictation circuit at any location.

- (d) Special prefixes will be generated by the system on those calls directed to a satellite by an attendant for either camp-on or busy verification. The prefix will cause the satellite to complete the call properly.

(e) Up to 15 switch units may be included in a main-satellite complex. The switch units for a single customer may be controlled by a single control unit or several control units. Also, a single control unit may provide service to one, two or more main-satellite customers.

9.05 Table I describes some of the typical calls associated with a main-satellite installation. Listed in Table I are:

- (a) The particular type of call
- (b) The sequence of action required to establish the connection
- (c) The key numbers associated with the interconnecting paths (Fig. 23, 24, 25).

9.06 ♦Fig. 26 shows, in simplified block diagram format, the interconnecting paths which are used to establish an attendant interposition call and transfer described in Table J.♦

10. GLOSSARY

10.01 The following glossary of terms is used in this practice. The definitions are appropriate for the No. 101 ESS and are not necessarily applicable to other switching systems employing comparable techniques. ♦Service feature definitions are found in Part 4.♦

A-Link: The connection in a 4A1 or 4A2 line connector between the stations and the B-links.

Address: Information (usually a number) that indicates a location in a memory or equipment unit.

Attendant Console: See *Console*.

Attendant Loop: One of a group of circuits that provides access between the switching network and attendant console(s).

Attendant Position: The equipment, usually a console, where listed directory number and other calls requiring attendant assistance are answered and completed.

Attendant Translator: The No. 101 ESS switch unit circuit that translates binary information read from the switch store to an input signal used to activate the attendant sampling switch.

Automatic Diagnostic Routines: See *Diagnostic Routines*.

B-Link: The talking path between the line connector and the 3A switch unit.

Bay: That portion of a relay rack or frame between any two vertical channels or angle irons.

Binary Number System: A number system that uses two symbols usually denoted by 0 and 1 with 2 as its base, just as the decimal number system uses 10 symbols (0 through 9) with 10 as its base.

Bit (Binary Digit): The binary unit of information. It is represented by one of two possible conditions such as: the digit 0 or 1, electrical charge or not electrical charge, etc.

Blocking: Failure of a telephone connection to be completed to an idle party due to the temporary unavailability of some piece of common equipment.

Bus: A path over which information is transferred; an electrical connector, channel, or line.

Busy Lamp Field: A field of lamps with one busy lamp per station which lights whenever the associated station is off-hook.

Call Processor: That portion of the No. 101 ESS control unit which sets up and supervises calls at the various switch units.

Call Store (CS): In the No. 101 ESS, the temporary memory equipment unit used to store the information pertaining to calls in progress.

Central Office Trunk: See *PBX Trunk*.

Centrex Service: A telephone service to business customers which provides ♦a package of features including♦ DID, AIOD, station-to-station dialing, and attendant transfer.

Circuit Card: See *Circuit Pack*.

Circuit Pack (Package): 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, which are interconnected to perform one or more circuit functions such as amplification, gating, timing, etc, required in a circuit.

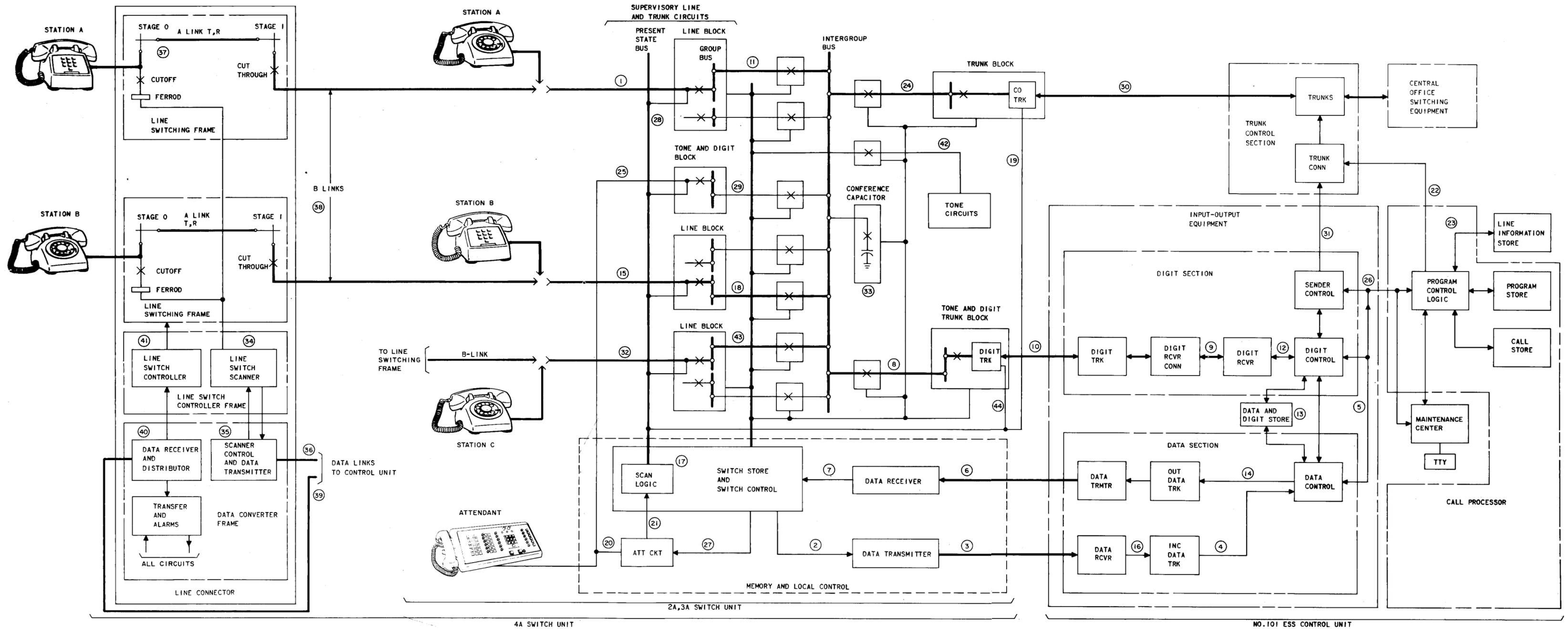


Fig. 21—No. 101 ESS—Block Diagram for Typical Calls (See Table G)

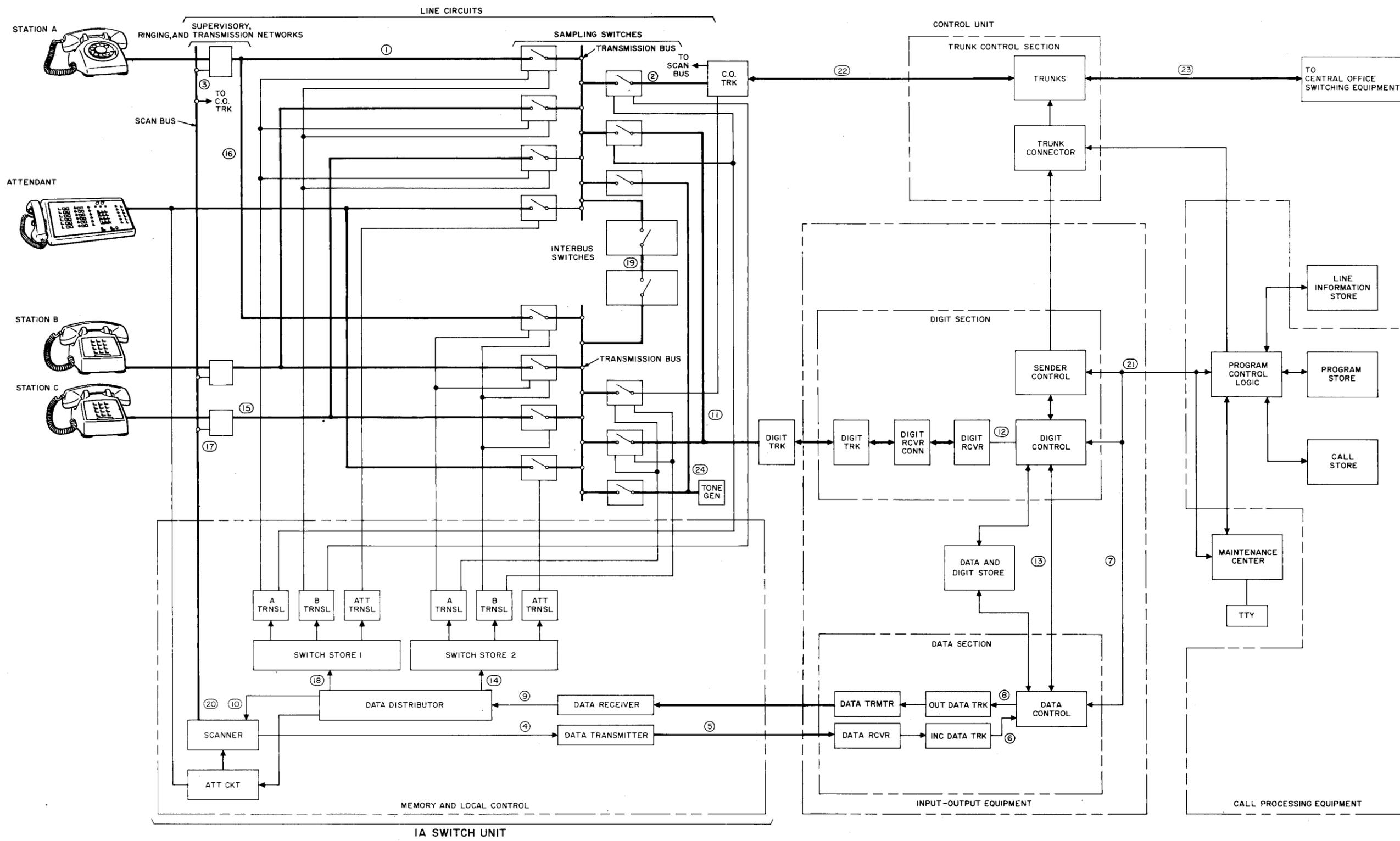


Fig. 22—Call Transfer—Individual All Calls and 3-Way Calling (1A Switch Unit)

◆ TABLE G ◆

NO. 101 ESS – TYPICAL CALLS (NON-MAIN-SATELLITE)

TYPE OF CALL OR CONNECTION	SEQUENCE OF ACTION REQUIRED TO ESTABLISH CONNECTION	FIG. 21
		KEY NUMBER(S)
DIAL TONE CONNECTION	Station A goes off-hook and the scanner detects this change of state.	1, 28, 17
	The scanner passes the off-hook condition to the switch store which passes the calling party equipment number and off-hook condition to the data transmitter.	17, 2
	The data transmitter at the switch unit sends this message to the data receiver at the control unit.	3
	The data receiver passes this message to the data and digit store under the direction of the data control.	4, 13
	Upon request of the call processor, the message is passed forward from the data and digit store to the call processor. The call processor compares this message to the existing CS records to determine whether this is a new call, an answer to ringing, or a flash. Assuming a new call, the call processor then selects an idle digit trunk, digit receiver, and time slots in the switch store and digit receiver connector.	13, 5
	The digit trunk number, calling party equipment number, time slot number, and scanner start signal are passed to the data and digit store for transmission to the switch unit.	5, 13, 14
	The data transmitter at the control unit transmits this message to the data receiver at the switch unit	6
	The data receiver passes the incoming message to the switch store.	7
	The calling party equipment number and the digit trunk number are written into the proper time slot in the switch store, thus connecting the calling party to the selected digit trunk.	11, 8
	The call processor writes the digit trunk number and the digit receiver number into the chosen time slot in the digit receiver connector, connecting the select digit trunk and digit receiver.	9
Dial tone is then passed from the digit receiver via the digit trunk to the calling party.	10, 8, 11, 1	

◆ TABLE G (Cont) ◆

NO. 101 ESS – TYPICAL CALLS (NON-MAIN-SATELLITE)

TYPE OF CALL OR CONNECTION	SEQUENCE OF ACTION REQUIRED TO ESTABLISH CONNECTION	FIG. 21
		KEY NUMBER(S)
INTRA-PBX CALL	Station A goes off-hook and receives dial tone.	
	TOUCH-TONE or dial pulse digits are transmitted from calling party A, over the digit trunk to the digit receiver in the control unit.	1, 11, 8, 10, 9 (TT) 1, 28, 17, 44, 10, 9 (ROT)
	The digit control samples the output of the digit receiver.	12
	Under direction of the digit control, the dialed digits are placed in that portion of the data and digit store associated with the digit receiver used.	13
	Upon the request of the call processor, the digits and the digit receiver number are passed forward from the data and digit store to the call processor. The call processor translates the dialed digits into station B equipment number and checks the CS record to determine if station B line is busy. Assume that station B is idle.	13, 5
	The time slot number, station B equipment number, and immediate ring instructions are passed to the data and digit store for transmission to the switch unit. The call processor begins timing for 2 seconds.	5, 13
	The data and digit store sends the message to the switch stores at the switch unit.	14, 6
	A switch store writes station B equipment number and the ringing bits into its memory. The called line (B) rings immediately and audible ringback is applied to the calling line (A).	7
	Having timed for 2 seconds, the call processor reformulates the previous message, except for the substitution of interrupted ringing, and the same series of actions takes place.	5, 14, 6, 7
	The called line (B) goes off-hook, and ringing is tripped at the line circuit. The scan logic detects the off-hook.	15, 17
The scan logic passes the off-hook condition of station B equipment number to the data transmitter for transmission to the control unit.	2, 3	

◆ TABLE G (Cont) ◆

NO. 101 ESS – TYPICAL CALLS (NON-MAIN-SATELLITE)

TYPE OF CALL OR CONNECTION	SEQUENCE OF ACTION REQUIRED TO ESTABLISH CONNECTION	FIG. 21
		KEY NUMBER(S)
INTRA-PBX CALL	The data receiver at the control unit passes the message to the data and digit store. It is passed forward to the call processor when requested. The call processor compares the message to existing records in the CS and identifies the message with the call being set up.	16, 4, 13, 5
	The scanner start signal, station B equipment number, station A equipment number, and the time slot number are passed to the data and digit store for transmission to the switch unit.	5, 13
	The data and digit store sends the message to the switch stores at the switch unit.	13, 14, 6, 7
	The switch control sends a start message to the scan logic and writes stations A and B equipment numbers into the switch store.	17
	The transmission connection is now established between station A (calling party) and station B (called party).	1, 11, 18, 15
INCOMING CALL VIA ATTENDANT	On an incoming call the central office grounds the sleeve lead. The control unit trunk circuit recognizes this and places dc supervision on the tip and ring leads to the switch unit. The change in supervision causes the switch unit CO trunk circuit to appear off-hook.	30, 19
	An off-hook from the CO trunk at the switch unit is detected by the scan logic and transmitted to the call processor at the control unit in the normal manner. Upon receiving the trunk number, the call processor selects an idle attendant loop and an idle time slot.	19, 17, 2, 3, 4, 5
	A scanner start signal and an attendant lamp message are sent to the switch stores at the switch unit.	5, 14, 6, 7
	The scanner start signal is passed to the scanner. An attendant lamp message is passed to the attendant circuit which translates it and flashes the appropriate SRC lamp in the attendant console at 60 ipm.	17, 27, 20
	The attendant answers the call by depressing the associated loop key. The answer is detected by the scan logic.	20, 21

◆ TABLE G (Cont) ◆

NO. 101 ESS – TYPICAL CALLS (NON-MAIN-SATELLITE)

TYPE OF CALL OR CONNECTION	SEQUENCE OF ACTION REQUIRED TO ESTABLISH CONNECTION	FIG. 21
		KEY NUMBER(S)
INCOMING CALL VIA ATTENDANT	The loop key equipment number is transmitted to the call processor at the control unit. The call processor recognizes the loop pickup (answer by the attendant) and associates it with the call being processed.	17, 2, 3, 4, 5
	A CO trunk number, time slot number, attendant line circuit number, and attendant lamp information is transmitted to the switch unit.	5, 14, 6
	An off-hook signal is sent to the CO trunk by means of the trunk connector which trips ringing and sends a charge signal to the central office.	22
	The CO trunk number and attendant line circuit number are written into a switch store in the time slot indicated.	7
	The appropriate sampling switches are then activated to connect the CO trunk to the attendant line circuit, thereby establishing a transmission path between the calling party and the attendant.	24, 29, 25
	Attendant lamp information is passed to the attendant circuit which translates it and changes the SRC lamp to steady and lights the associated loop pickup key on the attendant console.	27, 20
	The calling party asks the attendant for a connection to the desired extension. The attendant depresses the START button on the attendant console. This action is detected by the scan logic.	20, 21, 17
	The START button equipment number is transmitted to the call processor at the control unit. The call processor recognizes the activation of the START button, associates it with the call being processed, and selects an idle digit receiver and digit trunk.	2, 3, 4, 5
	The digit trunk number and digit receiver number are passed to the digit receiver connector. The necessary sampling switches are activated to connect the appropriate digit receiver and digit trunk at the control unit.	26
	A digit trunk number, original time slot number, attendant line circuit number, and attendant lamp message are transmitted to the switch unit.	5, 14, 6

◆ TABLE G (Cont) ◆

NO. 101 ESS – TYPICAL CALLS (NON-MAIN-SATELLITE)

TYPE OF CALL OR CONNECTION	SEQUENCE OF ACTION REQUIRED TO ESTABLISH CONNECTION	FIG. 21
		KEY NUMBER(S)
INCOMING CALL VIA ATTENDANT	The digit trunk number and the attendant line circuit number are written into a switch store in the time slot indicated, and the CO trunk is deleted from the time slot at the switch unit.	7
	The appropriate sampling switches are then activated to connect the digit trunk and the attendant line circuit.	25, 29, 8
	Attendant lamp information is passed to the attendant circuit.	27
	The attendant circuit translates the attendant lamp message and lights the RDY lamp on the attendant console. The digit receiver sends dial tone to the attendant.	20
		9, 10, 8, 29, 25
	The attendant keys the desired extension number into the digit receiver which passes it to the call processor via the data and digit store. The call processor translates the digits into the called party equipment number and checks the CS to determine if the called line is busy.	25, 29, 8, 10, 9 12, 13, 26
	If the called line is idle, its equipment number, the CO trunk number, attendant line circuit number, original time slot number, immediate ringing instructions, and attendant lamp information are passed to the data and digit store for transmission to the switch unit. The call processor begins timing for 2 seconds.	5
	The data and digit store sends the message to the switch store at the switch unit.	14, 6
	The called party equipment number, CO trunk number, attendant line circuit number, and ringing bit are written into a switch store in the time slot indicated, and the digit trunk is deleted from the time slot. Immediate ringing and subsequently regular ringing are applied in the normal manner. Both the calling party and the attendant receive audible ringback tone.	7
42, 24, 11		
An attendant lamp message is passed to the attendant circuit which translates it and causes the destination lamp at the attendant console to wink.	17, 20	

◆ TABLE G (Cont) ◆

NO. 101 ESS - TYPICAL CALLS (NON-MAIN-SATELLITE)

TYPE OF CALL OR CONNECTION	SEQUENCE OF ACTION REQUIRED TO ESTABLISH CONNECTION	FIG. 21
		KEY NUMBER(S)
INCOMING CALL VIA ATTENDANT	At this point the attendant normally releases from the loop.	
	When the attendant releases from the loop by depressing the RLS key, this action is detected by the scan logic and transmitted to the call processor.	20, 21, 17, 2, 3
	The called line goes off-hook. Ringing is tripped at the line circuit. The scan logic detects the off-hook and transmits this change of state to the call processor. The call processor compares the message to the existing record in the CS and identifies it with the call being set up.	1, 28, 17, 2, 3
	A CO trunk number, called party equipment number, original time slot number, and attendant lamp message are transmitted to the switch unit.	5, 14, 6
	The CO trunk number and called party equipment number are written into a switch store in the time slot indicated.	7
	The appropriate sampling switches are then activated to connect the CO trunk to station A, thereby establishing a transmission path between the calling and the called parties.	24, 11
	The attendant lamp message is passed to the attendant circuit which translates it and extinguishes both the source and the destination lamps.	27, 20
OUTGOING CALL VIA ATTENDANT	Station A goes off-hook and receives dial tone.	
	Calling party A keys or dials 0 to reach the attendant. The digit 0 is passed to the call processor by the digit receiver by way of the data and digit store. The call processor selects an idle attendant loop for the call.	1, 11, 8, 10, 9, 12, 13, 26 (TT)
		1, 28, 17, 44, 10, 9, 12, 13, 26 (ROT)
	An attendant lamp message for the selected loop is sent to the switch unit.	5, 14, 6
	The attendant lamp message is passed to the attendant circuit which translates it and flashes the appropriate SRC lamp on the attendant console at 120 m.	27, 20
	The attendant answers the call by depressing the associated loop key. This is detected by the scan logic.	21, 17

◆ TABLE G (Cont) ◆

NO. 101 ESS – TYPICAL CALLS (NON-MAIN-SATELLITE)

TYPE OF CALL OR CONNECTION	SEQUENCE OF ACTION REQUIRED TO ESTABLISH CONNECTION	FIG. 21
		KEY NUMBER(S)
OUTGOING CALL VIA ATTENDANT	The loop key equipment number is transmitted to the call processor at the control unit in the normal manner	2, 3, 4, 13, 5
	The call processor recognizes the loop pickup and associates it with the call being processed. Station A equipment number, time slot number, attendant line circuit number, and attendant lamp message are transmitted to the switch unit.	5, 14, 6
	Station A equipment number and attendant line circuit number are written into a switch store in the time slot indicated.	7
	The appropriate sampling switches are then activated, thereby establishing a transmission path between calling party A and the attendant. The attendant lamp message is passed to the attendant circuit which translates it and changes the SRC lamp to "steady" on the attendant console and steadily lights the associated attendant pickup key.	1, 11, 29, 25
		27, 20
	The calling party asks the attendant for the desired outside connection.	
	The attendant depresses the START key. This action is detected by the scan logic and the START key equipment number is transmitted to the call processor at the control unit. The call processor recognizes the activation of the START key, associates it with the call being processed, and selects an idle digit receiver and digit trunk.	20, 21, 17, 2, 3, 4, 5
	The digit trunk number and digit receiver number are passed to the digit receiver connector. The necessary sampling switches are activated to connect the appropriate digit receiver and digit trunk at the control unit.	26, 12, 9
A digit trunk number, original time slot number, attendant line circuit number, and attendant lamp message are transmitted to the switch unit. The digit trunk number is written into the time slot and station A is deleted from the time slot at the switch unit.	5, 14, 6, 7	

◆ TABLE G (Cont) ◆

NO. 101 ESS – TYPICAL CALLS (NON-MAIN-SATELLITE)

TYPE OF CALL OR CONNECTION	SEQUENCE OF ACTION REQUIRED TO ESTABLISH CONNECTION	FIG. 21
		KEY NUMBER(S)
OUTGOING CALL VIA ATTENDANT	The digit trunk number and the attendant line circuit number are written into a switch store in the time slot indicated. The appropriate sampling switches are then activated to connect the digit trunk and the attendant line circuit.	7, 25, 29, 8
	An attendant lamp message is passed to the attendant circuit.	27
	The attendant circuit translates the attendant lamp message and lights the RDY lamp on the attendant console.	20
	The digit receiver sends dial tone to the attendant.	9, 10, 8, 29, 25
	After dialing the trunk access code, the attendant has a choice of three methods:	25, 29, 8, 10 (TT)
	(1) The attendant may depress the RLS key, thereby releasing from the call and connecting station A to the digit trunk. In this case, station A thru-dials the desired outside connection as in a direct dialed outgoing call, with the exception that the PBX listed number, rather than station A directory number, is presented to the AMA equipment (if the customer has AIOD).	1, 11, 8, 10 (TT)
	(2) The attendant may depress the HOLD key, and station A may thru-dial the outside connection as in (1) above. In this case, the attendant may return to the connection at any time after station A has completed dialing.	1, 11, 8, 10 (TT)
(3) The attendant may key the desired outside connection for station A. When outpulsing is completed by the sender control, the RDY lamp goes dark, and station A is connected to the trunk with the attendant bridged on to the connection. The attendant may now release from the connection at any time.	11, 29, 24, 30	
INCOMING DIRECT INWARD DIAL CALL – FROM NO. 5 CROSSBAR (LINE LINK PULSING OR CROSSBAR TANDEM)	The scan logic detects the off-hook signal from the CO trunk.	30, 19, 17
	The switch control and data transmitter send the off-hook condition and trunk number to data and digit store.	2, 3, 16, 4, 13

◆ TABLE G (Cont) ◆

NO. 101 ESS – TYPICAL CALLS (NON-MAIN-SATELLITE)

TYPE OF CALL OR CONNECTION	SEQUENCE OF ACTION REQUIRED TO ESTABLISH CONNECTION	FIG. 21
		KEY NUMBER(S)
INCOMING DIRECT INWARD DIAL CALL – FROM NO. 5 CROSSBAR (LINE LINK PULSING) OR CROSSBAR TANDEM	The information is passed to the call processor. Upon receiving the trunk origination the call processor chooses an idle time slot, digit trunk, and digit receiver.	13, 5
	The control unit passes the time slot, digit trunk number, and CO trunk number to the switch unit.	5, 14, 6
	A switch store writes the digit trunk and CO trunk numbers into its memory.	7
	The call processor writes the digit trunk number and the digit receiver number into the chosen time slot in the digit receiver connector.	26, 12, 9
	A connection is now established from the CO trunk through the digit trunk at the switch unit to the digit receiver at the control unit.	30, 24, 8, 10, 9
	The call processor sends the sender start signal through the trunk connector to the central office.	22
	Digits outputted from the central office are passed to the digit receiver at the control unit through the digit trunk at the switch unit.	30, 19, 17, 44, 10, 9
	The digit control samples the output of the digit receiver. (Three receivers are sampled on each scan cycle of the data and digit store.)	12
INCOMING DIRECT INWARD DIAL CALL	Under direction of the digit control, the dialed digits are placed in that portion of the data and digit store associated with the digit receiver used.	13
	Upon the request of the call processor, the digits and the digit receiver number are passed forward from the data and digit store to the call processor. The call processor translates the dialed digits into station A equipment number and checks the CS record to determine if the A line is busy and the LIS for restrictions. Assume that station A is idle and unrestricted.	13, 5, 23
	The time slot number, station A equipment number, the trunk number, and immediate ring instructions are passed to the data and digit store for transmission to the switch unit. The call processor begins timing for 2 seconds.	5, 13
	The data and digit store sends the message to the switch stores at the switch unit.	14, 6

◆ TABLE G (Cont) ◆

NO. 101 ESS – TYPICAL CALLS (NON-MAIN-SATELLITE)

TYPE OF CALL OR CONNECTION	SEQUENCE OF ACTION REQUIRED TO ESTABLISH CONNECTION	FIG. 21
		KEY NUMBER(S)
INCOMING DIRECT INWARD DIAL CALL	A switch store writes station A equipment number, the trunk number, and the ringing bits into its memory. The called line (A) rings immediately and audible ringback is applied to the trunk.	7 42, 24, 30
	Having timed for 2 seconds, the call processor reformulates the previous message, except for the substitutions of interrupted ringing, and the same series of actions takes place.	5, 14, 7 42, 24, 30
	The called line (A) goes off-hook, and ringing is tripped at the line circuit. The scan logic detects the off-hook.	1, 28, 17
	The scan logic and switch control pass the off-hook condition and station A equipment number to the data transmitter for transmission to the data receiver at the control unit.	2, 3
	The data receiver at the control unit passes the message to the data and digit store.	16, 4, 13
	The message is then passed forward to the call processor when requested by the call processor. The call processor compares the message to existing records in the CS and identifies the message with the call being set up.	5
	Station A equipment number, the trunk number, and the time slot number are passed to the data and digit store for transmission to the switch unit.	5, 13
	The data and digit store sends the message to the switch stores at the switch unit.	13, 14, 6
	A switch store writes station A equipment number and the trunk number into its memory.	7
	The transmission connection is now established between the incoming CO trunk (calling party) and station A (called party).	30, 24, 11
OUTGOING DIRECT DIAL CALL	Station A goes off-hook and receives dial tone.	
	Calling party A keys or dials 9. The digit is passed to the call processor via the digit receiver.	1, 11, 8, 10, 9, 12, 26 (TT)
		1, 28, 17, 44, 10, 9, 12, 26 (ROT)

◆ TABLE G (Cont) ◆

NO. 101 ESS – TYPICAL CALLS (NON-MAIN-SATELLITE)

TYPE OF CALL OR CONNECTION	SEQUENCE OF ACTION REQUIRED TO ESTABLISH CONNECTION	FIG. 21
		KEY NUMBER(S)
OUTGOING DIRECT DIAL CALL	The call processor interrogates the LIS for dialing restrictions. If this station is restricted, a connection is established at the switch unit to return "fast busy" signal to the station. Assume that station A is not restricted. The call processor selects and seizes an idle CO trunk and orders the digit receiver to return dial tone over the digit trunk to station A.	26, 12,9, 10, 8, 11, 1
	The called party directory number, including area code and/or prefix digits, if applicable, is transmitted from calling party A over the digit trunk to the digit receiver in the control unit.	1, 11, 8, 10, 9 (TT)
		1, 28, 17, 44, 10, 9 (ROT)
	Under the direction of the call processor, the digits are placed in the data and digit store.	12, 13
	If calling station A is code restricted, the call processor compares the first 3 or 6 digits (excluding the prefix) with a list of allowed codes (area codes and central office codes) in the LIS. If the call is not allowed, station A is diverted to the attendant and the trunk is released. If the call is allowed, either because the dialed code is found on the list of allowed codes or because station A is unrestricted, the dialed digits are outpulsed under the direction of the sender control. In either case, outpulsing does not begin until after the first 3 or 6 digits (excluding the prefix) have been examined.	31
	After outpulsing to the central office is completed, the call processor sets up the transmission connection from calling station A to the CO trunk and the calling party A hears the ringback or busy tone from the central office. (Line-to-trunk connections are set up in the same manner as line-to-line connections described in the intra PBX call.)	1, 11, 24, 30
CALL TRANSFER – INDIVIDUAL – ALL CALLS AND 3-WAY CALLING (2A, 3A SWITCH UNITS)	Station A and a CO trunk are in an established talking connection. Station A initiates a flash by depressing the switchhook.	1, 28, 17
	The scan logic detects the on-hook condition and passes station A equipment number and the change of state to the data transmitter.	17, 2

◆ TABLE G (Cont) ◆

NO. 101 ESS – TYPICAL CALLS (NON-MAIN-SATELLITE)

TYPE OF CALL OR CONNECTION	SEQUENCE OF ACTION REQUIRED TO ESTABLISH CONNECTION	FIG. 21
		KEY NUMBER(S)
CALL TRANSFER – INDIVIDUAL – ALL CALLS AND 3-WAY CALLING (2A, 3A SWITCH UNITS)	The data transmitter at the switch unit sends this message to the data receiver at the control unit.	3
	The data receiver passes this message to the data and digit store under the direction of the data control.	4, 13
	Upon the request of the call processor the message is passed forward from the data and digit store to the call processor. The call processor recognizes the on-hook condition and begins to time for a maximum of 1.6 seconds.	13, 5
	Station A releases the switchhook within 1.6 seconds, thus completing the flash. The switch unit detects this off-hook condition.	1, 28, 17
	The switch unit now sends the appropriate message to the call processor in the manner previously described.	2, 3, 16, 4, 13, 5
	The call processor sends a message to the switch stores at the switch unit to remove that trunk from the time slot in the switch store and to connect station A to an idle digit trunk. The call processor also selects an idle digit receiver and sets up a connection in the digit receiver connector between the digit trunk in the control unit and the digit receiver.	5, 14, 6, 7
		26, 12 9
	Dial tone is passed from the digit receiver via the digit trunk to station A.	9, 10, 8, 11, 1
	Station C extension number in the form of TOUCH-TONE signals or dial pulse digits is transmitted from station A over the digit trunk to the digit receiver in the control unit.	1, 11, 8, 10, 9 (TT)
		1, 28, 17, 44, 10, 9 (ROT)
	The digit control samples the output of the digit receiver.	12
Under the direction of the digit control, the dialed digits are placed in that portion of the data and digit store associated with the digit receiver used.	13	
Upon the request of the call processor the digits and the digit receiver number are passed forward from the data and digit store to the call processor.	13, 5	

◆ TABLE G (Cont) ◆

NO. 101 ESS – TYPICAL CALLS (NON-MAIN-SATELLITE)

TYPE OF CALL OR CONNECTION	SEQUENCE OF ACTION REQUIRED TO ESTABLISH CONNECTION	FIG. 21
		KEY NUMBER(S)
CALL TRANSFER – INDIVIDUAL – ALL CALLS AND 3-WAY CALLING (2A, 3A SWITCH UNITS)	The call processor translates the dialed digits into station C equipment number. The call processor recognizes that station A is initiating a transfer or 3-way connection. A new pair of time slots (both on the same intergroup bus) equipped for conference is selected. Stations A and C are written into one of these time slots and the trunk is written into the other time slot. The original time slot is released. The call processor interrogates the CS to determine if station C line is busy. Assume that station C is idle.	
	The time slot number, station C equipment number, immediate ring instructions, and the conference bit are added to the data and digit store for transmission to the switch unit. The call processor begins timing for 2 seconds.	5, 13
	The data and digit store sends the message to the switch stores at the switch unit.	14, 6
	A switch store writes station C equipment number ringing bits into memory. Station C rings immediately. Twenty-cycle ringing power is applied to station C.	7
		32
	Audible ringing is applied to station A.	42, 11, 1
	Having timed for 2 seconds, the call processor reformulates the previous message, except for the substitution of regular ringing, and the same series of actions take place.	5, 14, 6, 7
	The called line (station C) goes off-hook and ringing is tripped at the line circuit. The scanner detects the off-hook.	32, 17
	The scanner passes the off-hook condition and station C equipment number to the data transmitter for transmission to the control unit.	2
The data transmitter at the switch unit passes the message to the data and digit store at the control unit.	3, 16, 4, 13	

◆ TABLE G (Cont) ◆

NO. 101 ESS – TYPICAL CALLS (NON-MAIN-SATELLITE)

TYPE OF CALL OR CONNECTION	SEQUENCE OF ACTION REQUIRED TO ESTABLISH CONNECTION	FIG. 21
		KEY NUMBER(S)
CALL TRANSFER – INDIVIDUAL – ALL CALLS AND 3-WAY CALLING (2A, 3A SWITCH UNITS)	The message is passed forward to the call processor when requested. The call processor compares this message to existing records in the CS and identifies the message with the call being set up.	13, 5
	Station C equipment and the time slot number are passed to the data and digit store for transmission to the switch unit.	5, 13
	The data and digit store sends this message to the switch store in the switch unit.	13, 14, 6, 7
	The transmission connection is now established between station A (calling party) and station C (called party).	1, 11, 43, 32
	After a consultation between station A and station C, if station A wishes to establish a 3-way call with station C and the trunk, station A flashes.	1, 28, 17, 2, 3, 4
	By the timing method previously described the call processor recognizes that station A has flashed and sends a message to the switch store to write the trunk and conference bit into memory.	5, 15, 14, 6, 7
	Connection to the conference capacitor is made in both time slots.	33
	Stations A and C are now in a conference connection with the CO trunk.	11, 18, 43
	If station A wishes to transfer the trunk to station C, station A hangs up.	1
	By the timing process previously described, the call processor recognizes the on-hook condition of station A and takes the appropriate action to connect the trunk into the time slot in place of station A. The time slot in which the trunk had been written is cleared.	28, 17
CALL TRANSFER – INDIVIDUAL – ALL CALLS AND 3-WAY CALLING (1A SWITCH UNIT)	See Table H.	

◆ TABLE G (Cont) ◆

NO. 101 ESS – TYPICAL CALLS (NON-MAIN-SATELLITE)

TYPE OF CALL OR CONNECTION	SEQUENCE OF ACTION REQUIRED TO ESTABLISH CONNECTION	FIG. 21
		KEY NUMBER(S)
SPEED CALLING PER GROUP	Station A goes off-hook and receives dial tone.	
	Station A keys or dials a 4-digit abbreviated central office number. The TOUCH-TONE or dial pulse digits are transmitted from calling party A, over the digit trunk, to the digit receiver in the control unit.	1, 11, 8, 10, 9 (TT)
	The digit control samples the output of the digit receiver.	1, 28, 17, 44, 10, 9 (ROT)
		12
	Under the direction of the digit control, the dialed digits are placed in that portion of the data and digit store associated with the digit receiver used.	13
	Upon the request of the call processor, the digits and the digit receiver number are passed forward from the data and digit store to the call processor. The call processor checks station A line information for possible speed calling restrictions. If station A is restricted from speed calling per group, a connection is set up to "fast busy" tone at the switch unit. Assume station A is allowed speed calling.	13, 5
		23
	The call processor now selects and seizes the appropriate type trunk.	22
	After the receipt of a "register attached" signal from the central office, the speed calling per group number in combination with the switch unit number is used to address a specific location (word) in the LIS. This LIS word contains the called party directory number.	23
	The LIS word is read and the information is transferred to the sender control, which places the digits in the data and digit store.	26, 13
Outpulsing begins under direction of the sender control.	13, 31	
After outpulsing is completed, the call processor sets up the transmission connection from calling station A to the CO trunk, and station A hears the ringback or busy tone from the distant end. (Line-to-trunk connections are set up in the same manner as line-to-line connections described in the intra PBX call.)	30, 24, 11, 1	

◆ TABLE G (Cont) ◆

NO. 101 ESS – TYPICAL CALLS (NON-MAIN-SATELLITE)

TYPE OF CALL OR CONNECTION	SEQUENCE OF ACTION REQUIRED TO ESTABLISH CONNECTION	FIG. 21
		KEY NUMBER(S)
ROUTING CALLS THROUGH THE LINE CONNECTOR – 4A SWITCH UNIT	Station A goes off-hook and the line switch controller frame scanner in the line connector detects this change of state.	34
	The line switch scanner passes the off-hook condition to the scanner control and data transmitter.	35
	The data transmitter sends this information to the control unit over the data link.	36
	The control unit determines the A-link (the connection between the two ferreed switches) and the B-link that are to be connected in the circuit.	37, 38
	A 25-bit message is transmitted to the line connector data receiver and distributor.	39, 40
	Also the control unit alerts the 3A switch unit portion of the program to expect a message from the 3A switch unit indicating the B-link has gone off-hook. The 25-bit message contains the order to be carried out (connect in this case) and the line switching frame, concentrator, concentrator line, and B-link on the concentrator which are involved in the connection.	
	The data distributor gates the message to the line switch controller.	41
	The line switch controller will operate path select relays and pulse the ferreed cross points of the line switching circuits. The selected ferreeds close to connect the line, A-link, and B-link together. For a connect order a cut-off ferreed is also operated to disconnect the ferrod sensor for the line so that additional off-hooks will not be detected. The B-link will now appear off-hook in the 3A switch unit. This will be handled just as in normal 3A switch unit operation. In this instance the B-link will be connected to a digit trunk so that dialing may occur.	37, 1, 11, 8, 10 (TT) 37, 1, 28, 17, 44, 10 (ROT)

◆ TABLE G (Cont) ◆

NO. 101 ESS – TYPICAL CALLS (NON-MAIN-SATELLITE)

TYPE OF CALL OR CONNECTION	SEQUENCE OF ACTION REQUIRED TO ESTABLISH CONNECTION	FIG. 21
		KEY NUMBER(S)
ROUTING CALLS THROUGH THE LINE CONNECTOR – 4A SWITCH UNIT	When the line goes on-hook, the 3A switch unit detects the change in scan point condition and sends a 14-bit data message to the control unit. The control unit determines from its memory what changes need to be made in the 3A switch unit and in the line connector. A 47-bit message is sent to the 3A switch unit to cause it to disconnect the time division connection in the 3A switch unit and a 25-bit message is sent to the data receiver and distributor. The 25-bit message is similar to the connect message except that the order is now a disconnect which causes the line switch controller to disconnect the line from the A-link and to release the cut-off ferreed, thus restoring the ferrod sensor so that the next off-hook occurrence of the line will be detected.	37, 1, 28, 17

Common Control System: A switching system which makes use of common equipment which is not part of a switching connection but is used to establish a connection and then becomes available to establish other connections.

Concentrator: That equipment used to connect thirty-two or sixty-four station lines into sixteen B-links.

Conference Capacitor: In 2A, 3A, and 4A switch units a capacitor which stores talking energy providing a 3-way connection between two associated time slots.

Console: ◆ A key operated equivalent of a switchboard that may be placed on the surface of a desk or table for use by a PBX attendant. Actual switching is external to the console (Parts 2 and 9).◆

Control Logic: The circuitry used to control other equipment according to a predetermined set of rules.

Control Unit: That part of the No. 101 ESS which is located at a centralized location (usually the CO).

Crosstalk: Interface in which intelligible signals on one telephone circuit appear on another circuit.

Cutoff Frequency: The frequency at which the attenuation constant changes from 0 to 3 db.

Data: ◆ Generally, any coded information. In the No. 101 ESS, the binary information which is transmitted from the control unit to the switch unit to instruct the switch unit to perform switching functions and which is transmitted from the switch unit to the control unit giving information as to the supervisory condition of lines and trunks. Information which is manipulated by a computer.◆

Data and Digit Store: The No. 101 ESS equipment unit which consists of temporary memory and is used to store data messages and dialed digits at the control unit until the call processor is ready to use them.

Data Control: The No. 101 ESS control unit circuit used to transfer data and dialed digits into and out of the data and digit store.

Data Distributor: A group of circuits in the switch units that function to accept serial data from the data receiver and gate the message, in parallel

◆ TABLE H ◆

**CALLS TRANSFER INDIVIDUAL ALL CALLS AND 3-WAY
CALLING (1A SWITCH UNIT)**

SEQUENCE OF ACTION REQUIRED TO ESTABLISH CONNECTION	FIG. 22
	KEY NUMBER(S)
Station A and a CO trunk are in an established talking connection. Station A initiates a flash by depressing the switchhook.	<u>1, 2, 22, 23</u> 1
The scanner detects the on-hook condition and passes station A equipment number and the change of state to the data transmitter.	3, 20, 4
The data transmitter at the switch unit sends this message to the data receiver at the control unit.	5
The data receiver passes this message to the data and digit store under the direction of the data control.	6, 13
Upon the request of the call processor the message is passed forward from the data and digit store to the call processor.	13, 7
The call processor recognizes the on-hook condition and begins to time for a maximum of 1.6 seconds. The scanner start signal is sent to the scanner via the data distributor at the switch unit.	7, 8, 9, 10
Station A releases the switchhook within 1.6 seconds, thus completing the flash. The scanner detects this off-hook condition and sends the appropriate message to the call processor in the manner previously described. Upon receipt of the off-hook from station A, the call processor recognizes that station A has flashed.	3, 20, 4, 5, 6, 7
The call processor then sends a message to the data distributor at the switch unit to remove the CO trunk from the time slot in switch store 1 and to connect station A to an idle digit trunk. The call processor also selects an idle digit receiver and sets up a connection in the digit receiver connector between the digit trunk in the control unit and the digit receiver.	7, 8, 9, 18
	21, 12
Dial tone is passed from the digit receiver via the digit trunk to station A.	12, 11, 1
Station C extension number in the form of TOUCH-TONE signals or dial pulse digits is transmitted from station A over the digit trunk to the digit receiver in the control unit.	1, 11, 12

◆ TABLE H (Cont) ◆

**CALLS TRANSFER INDIVIDUAL ALL CALLS AND 3-WAY
CALLING (1A SWITCH UNIT)**

SEQUENCE OF ACTION REQUIRED TO ESTABLISH CONNECTION	FIG. 22
	KEY NUMBER(S)
The digit control samples the output of the digit receiver. (Three receivers are sampled on each scan cycle of the data and digit store.)	12
Under the direction of the digit control, the dialed digits are placed in that portion of the data and digit store associated with the digit receiver used.	13
Upon the request of the call processor the digits and the digit receiver number are passed forward from the data and digit store to the call processor.	13, 21
The call processor translates the dialed digits into station C equipment number. The call processor recognizes that station A is initiating a conference connection. A new pair of mating time slots (one on each bus) is selected. Stations A and C are written into the time slot to be associated with switch store 2 in the switch unit. The CO trunk is written into the time slot to be associated with switch store 1. The original time slot is released. The call processor interrogates the CS to determine if station C line is busy. Assume that station C is idle.	
The time slot number, station C equipment number, immediate ring instructions, and the number of the interbus switch associated with switch store 2 are passed to the data and digit store for transmission to the switch unit. The call processor begins timing for 2 seconds.	7
The data and digit store sends the message to the data distributor at the switch unit.	8, 9
The data distributor writes into switch store 2, station C equipment number, ringing bits and instructions to close that interbus switch associated with switch store 2.	14
Station C rings immediately. Twenty-cycle ringing power to station C and audible ringing to station A are applied alternately.	24, 1
Having timed for 2 seconds, the call processor reformulates the previous message, except for the substitution of regular ringing, and the same series of actions take place.	7, 8, 9, 14

◆ TABLE H (Cont) ◆

CALLS TRANSFER INDIVIDUAL ALL CALLS AND 3-WAY
CALLING (1A SWITCH UNIT)

SEQUENCE OF ACTION REQUIRED TO ESTABLISH CONNECTION	FIG. 22
	KEY NUMBER(S)
The called line (station C) goes off-hook and ringing is tripped at the line circuit. The scanner detects the off-hook.	16, 20
The scanner passes the off-hook condition and station C equipment number to the data transmitter for transmission to the control unit.	4
The data transmitter at the switch unit passes the message to the data and digit store at the control unit.	5, 6
The message is passed forward to the call processor when requested. The call processor compares this message to existing records in the CS and identifies the message with the call being set up.	7
A scanner start signal, station C equipment number, the time slot number, and the number of the interbus switch associated with switch store 2 are passed to the data and digit store for transmission to the switch unit.	7, 13
The data and digit store sends this message to the data distributor in the switch unit.	13, 8
The data distributor sends the start message to the scanner and writes station C equipment number and the interbus switch number into switch store 2.	10, 14
The transmission connection is now established between station A (calling party) and station C (called party).	16, 15
After consultation between station A and station C, if station A wishes to establish a 3-way call with the trunk and station C, station A flashes.	3, 20
By the timing method previously described, the call processor recognizes that station A has flashed and sends a message to the data distributor to write the trunk into the mating time slot in switch store 1 and to energize the interbus switch associated with switch store 1.	7, 8, 9, 18
Station A, the trunk, and station C are now in a 3-way connection using the interbus switches.	16, 19, 2, 22, 15

◆ TABLE H (Cont) ◆

**CALLS TRANSFER INDIVIDUAL ALL CALLS AND 3-WAY
CALLING (1A SWITCH UNIT)**

SEQUENCE OF ACTION REQUIRED TO ESTABLISH CONNECTION	FIG. 22
	KEY NUMBER(S)
If station A wishes to transfer the trunk to station C without introducing the parties first, station A hangs up.	3, 20
By the timing process previously described the call processor recognizes the on-hook condition of station A and takes the appropriate action to connect the trunk into the time slot in place of station A. The time slot in which the trunk had been written is cleared.	
Call transfer and 3-way calling has been previously described for a trunk and two PBX stations. However, three PBX stations may be involved in either of these types of connections.	

form, to its proper destination within the switch unit.

Data Link: A voice frequency signaling path for transmitting data messages between the switch unit and control unit.

Data Message: In the No. 101 ESS, the information that the control unit sends to the switch unit to establish switching connections, disconnect, light lamps on the console, etc; the information required for system operation, other than dial pulses, that the switch unit sends to the control unit (lines off-hook and lines on-hook).

Data Receiver: ◆The No. 101 ESS circuit that accepts frequency shift modulated signals from the data trunk pair and converts them into logical ones and zeros for use by the appropriate equipment.◆

Data Transmitter: ◆The No. 101 ESS circuit used to convert logical ones and zeros into frequency shift modulated signals for transmission over the data trunk pair.◆

Data Trunk Pair: In the No. 101 ESS, the voice frequency pair of wires that is used in conjunction with data trunk circuits to make a data link.

Destination: The called party or the equipment associated with the called party.

Diagnostic Routine: A test program used to locate faulty circuit equipment within a unit.

Dial: Specifically, a calling device which, when wound up and released, generates dc pulses for establishing telephone connections. The term *dial* is sometimes used in a broader sense to designate any calling device which generates signals (ac or dc) for establishing telephone connections.

Dial Pulsing: A system of dc pulsing in which the digits are transmitted by the interruption of the dc circuit a number of times, one to ten, corresponding to the digits 1 to 0.

Digit, Least Significant: The digit which when changed, least affects the magnitude of a number. For example, the unit (last digit) in a decimal number is the least significant, as 5 in 9345.

Digit, Most Significant: The digit which when changed, most affects the magnitude of a number. For example, in any decimal number the first digit is the most significant, as 5 in 5892.

◆ TABLE I ◆

NO. 101 ESS – TYPICAL CALLS (MAIN-SATELLITE)

TYPE OF CALL	SEQUENCE OF ACTION REQUIRED TO ESTABLISH CONNECTION	KEY NUMBER(S)
STATION-TO-STATION (SATELLITE A TO SATELLITE B: FIG. 23)	Station A goes off-hook. Call processor 1: (1) Selects digit receiver 1 and a digit trunk. (2) Closes switches a and b. Station A now hears dial tone.	1
	Station A dials station B. Call processor 1 selects and seizes a T-link to Satellite B.	2
	Satellite B recognizes request for service on T-link. Call processor: (1) Selects digit receiver 2 and a digit trunk. (2) Closes switches f and e in Satellite B.	3
	CU1 connects sender to T-link and outputs directory number of Station B. At completion of dialing: (1) CU1 releases DGR1 and closes switches a and c in Satellite A; and (2) CU2 releases DGR2 and closes switches d and e in Satellite B. Station A hears ringback. When Station B answers, answer supervision is returned to Satellite A.	4
THREE-WAY CALLING (SATELLITE A AND SATELLITE B: FIG 24)	First, it is assumed that a call is established between Station A and Station B.	1, 4, 5
	Station A flashes. The flash is repeated on the T-link by the call processor. The flash is interpreted by Satellite B as a request for a three-way calling check. Since Satellite B has three-way calling and the only station on the connection is station B, Satellite B by means of the call processor: (1) Selects DGR1. (2) Operates switches f and g. (3) Releases switch d. (4) Puts the trunk in the register attached state by releasing T2.	2

◆ TABLE I (Cont) ◆

NO. 101 ESS — TYPICAL CALLS (MAIN-SATELLITE)

CALL OR CONNECTION	SEQUENCE OF ACTION REQUIRED TO ESTABLISH CONNECTION	KEY NUMBER(S)
THREE-WAY CALLING (SATELLITE A AND SATELLITE B: FIG. 24)	The register attached signal detected at Satellite A results in the selection of DGR1. The call processor operates switches a and b in Satellite A. Station A hears dial tone.	3
	Station A dials Station C. Satellite A, via the call processor, connects the sender to the T-link and outpluses the directory number of Station C. When dialing is complete, Satellite A operates switches a and c and releases switch b and DGR1.	4
	Satellite B via the call processor: (1) Determines that Station C is in Satellite B. (2) Sets up a ringing connection between the T-link and Station C by operating switches g and e. Switch d is still released. Answer supervision is returned to Satellite A to indicate H Station C is still on-hook, or has answered.	6
	If Station A flashes, the flash is repeated on the T-link. If Station C is still on-hook, Station C is released and Satellite B: (1) Releases switch e. (2) Operates switches g and d, restoring the original Station A to Station B connection. If Station A flashes and Station C has answered, Satellite B operates switches e and d. Stations A, B, and C can now talk in a three-way call.	1, 4, 5, 6
ATTENDANT TRANSFER (MAIN-SATELLITE) OPERATION FIG. 25	It is assumed that a normal connection exists between a DID trunk and Station A in the satellite.	1, 2
	Station A flashes. The satellite via the call processor: (1) Selects DGR2 and a digit trunk. (2) Operates switches j and f. (3) Releases switch i. Station A hears dial tone and dials 0.	2, 7
	The satellite selects an attendant T-link pair to the main and seizes ATL1. Switches j, i, and h are operated; DGR2 is released.	3

◆ TABLE I (Cont) ◆

NO. 101 ESS – TYPICAL CALLS (MAIN-SATELLITE)

TYPE OF CALL	SEQUENCE OF ACTION REQUIRED TO ESTABLISH CONNECTION	KEY NUMBER(S)
ATTENDANT TRANSFER MAIN SATELLITE OPERATION FIG. 25	<p>The main:</p> <ol style="list-style-type: none"> (1) Detects the seizure on ATL1. (2) Selects and connects an attendant to ATL1 by operating switches a and c. <p>The attendant can now talk to the trunk and Station A in the satellite. At this point, only the attendant SRC lamp is lighted to indicate a T-link on source.</p>	4
	<p>The attendant operates the START key.</p> <p>The main via the call processor:</p> <ol style="list-style-type: none"> (1) Selects DGR1 and a digit trunk. (2) Operates switches a and b. (3) Releases switch c. <p>The attendant now hears dial tone. The attendant dials Station B in the satellite.</p>	5, 4
	<p>The main:</p> <ol style="list-style-type: none"> (1) Seizes ATL2 (the terminating attendant T-link). (2) Waits for start dial supervision (Satellite Step 4) (3) Outpulses the directory number of station B (into DGR2) 	6
	<p>The satellite:</p> <ol style="list-style-type: none"> (1) Recognizes the request for service on ATL2. (2) Selects DGR2 and a digit trunk. (3) Operates switches f and h (4) Gives register attached supervision back to the main via the trunk connector. <p>The Satellite now processes the ATL2 to Station B call.</p>	7
	<p>When dialing is completed, the main:</p> <ol style="list-style-type: none"> (1) Releases DGR2. (2) Operates switches a, c, and d. (3) Lights the DST (destination) lamp. <p>The Satellite operates switches g and e. The attendant, Station A, and the CO trunk hear ringback; Station B is ringing.</p>	1, 2, 6, 4
	<p>Station B answers. The satellite relays answer supervision on ATL2. The DST lamp now goes steady.</p>	6, 4

◆ TABLE I (Cont) ◆

NO. 101 ESS – TYPICAL CALLS (MAIN-SATELLITE)

TYPE OF CALL	SEQUENCE OF ACTION REQUIRED TO ESTABLISH CONNECTION	KEY NUMBER(S)
ATTENDANT TRANSFER MAIN SATELLITE OPERATION (FIG. 25)	The attendant releases. The main: (1) Releases ATL1 and ATL2. (2) Releases switches c, d, and a.	3, 4, 6
	Simultaneous on-hook for ATL1 and ATL2 are recognized at the satellite. Switches e and i are operated. Switches j, h, and g are released. Station A is given fast busy (via another switch). Station B and the CO trunk are now talking. The attendant T-link pair is now released and available for service. If the attendant operated the HOLD key before the RLS key, the attendant T-link pair would not have been released.	

Digit Receiver: In the No. 101 ESS, the circuit which receives dialed digits from the switch units and stores them in an associated multifrequency receiver.

Digit Receiver Connector: In the No. 101 ESS, the switching network and control circuits used to connect digit trunks to a common pool of digit receivers. The switching network and control operates on a time-division basis and is similar to the switching network used at the 1A switch unit.

Digit Trunk: In the No. 101 ESS, a voice frequency signaling path for transmitting dialed or keyed digits from the switch unit to a common pool of digit receivers at the control unit.

Diode: A 2-electrode device, containing an anode and a cathode, that is a good conductor for one polarity of voltage and a poor conductor for the opposite polarity.

Direct Distance Dialing (DDD): The completion of long distance calls by customer dialing from the originating location.

Double Bay (Frame): A frame consisting of two bays.

Equalization: Compensation for an undesired amplitude-frequency and/or phase-frequency characteristic of a circuit or system.

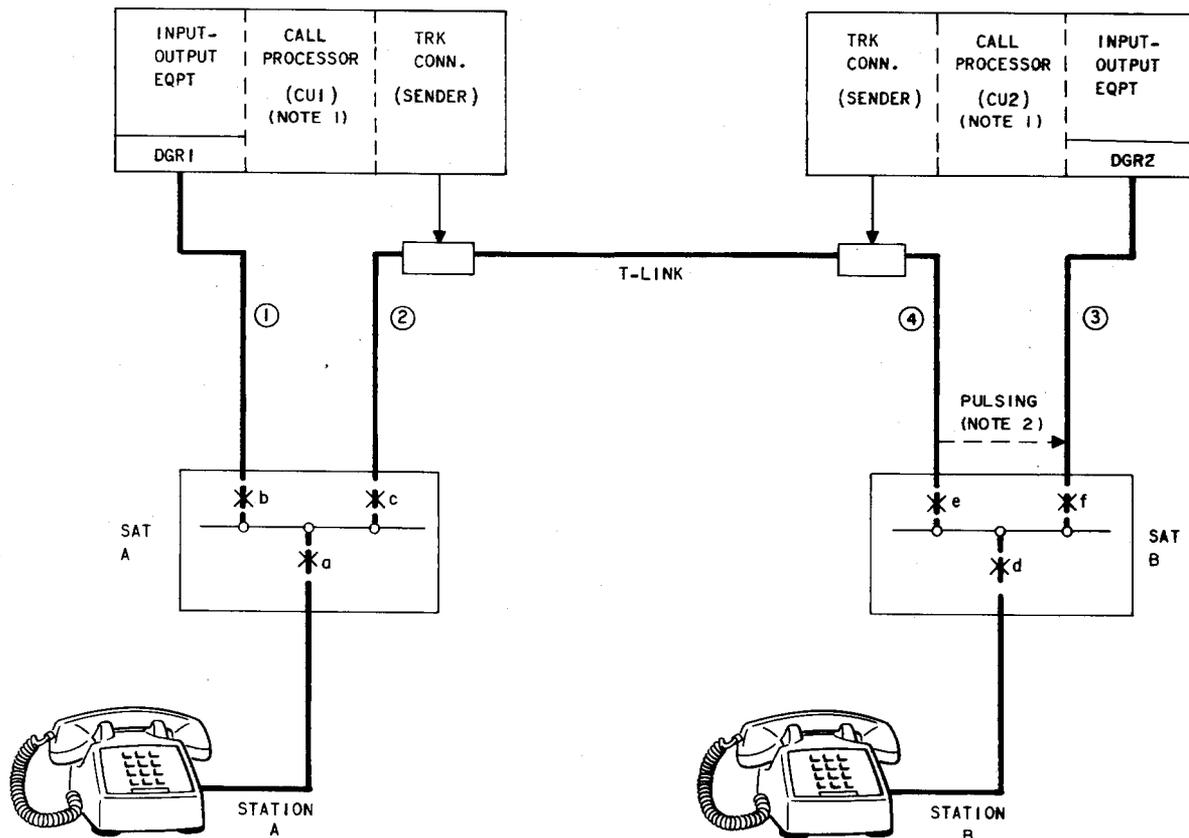
Equipment Number: A number assigned to each line, trunk, and tone source in a No. 101 ESS switch unit. This number corresponds to its location on the time-division matrix and is also referred to as scan point number.

Fast-Busy Tone (Reorder Tone): In the No. 101 ESS, a tone interrupted at 120 ipm used to indicate that a requested service is denied.

Fault: A failure of an electronic circuit to perform a function for which it was designed.

Ferreed: A two-wire, magnetically latched, pulse operated device. It consists of two small sealed reed switches which are operated and released magnetically.

Ferrite Sheet: A temporary memory using a multiapertured ferrite sheet as a building block.



NOTES:

1. CU1 AND CU2 MAY BE THE SAME CONTROL UNIT; IN THIS CASE, HOWEVER, CU1 AND CU2 ARE TWO SEPARATE CONTROL UNITS (FIG. 3).
2. FOR SIMPLICITY, ONLY TALK/DIAL TONE PATHS ARE SHOWN — SUPERVISION/DIAL PULSE/TRUNK PULSING/DATA LINK SIGNALS DO NOT GO THROUGH TIME DIVISION SWITCHES.
3. FOR MORE CONTROL UNIT AND SWITCH UNIT DETAIL, SEE FIG. 21.

Fig. 23—Station-to-Station Call—Main-Satellite Installation

Each such sheet is the electrical equivalent of a matrix of individual ferrite toroids with a conductor threading all toroids in series.

Ferrod: A current-sensing device operating on electromagnetic principles used in the line switching circuits to detect station requests for service.

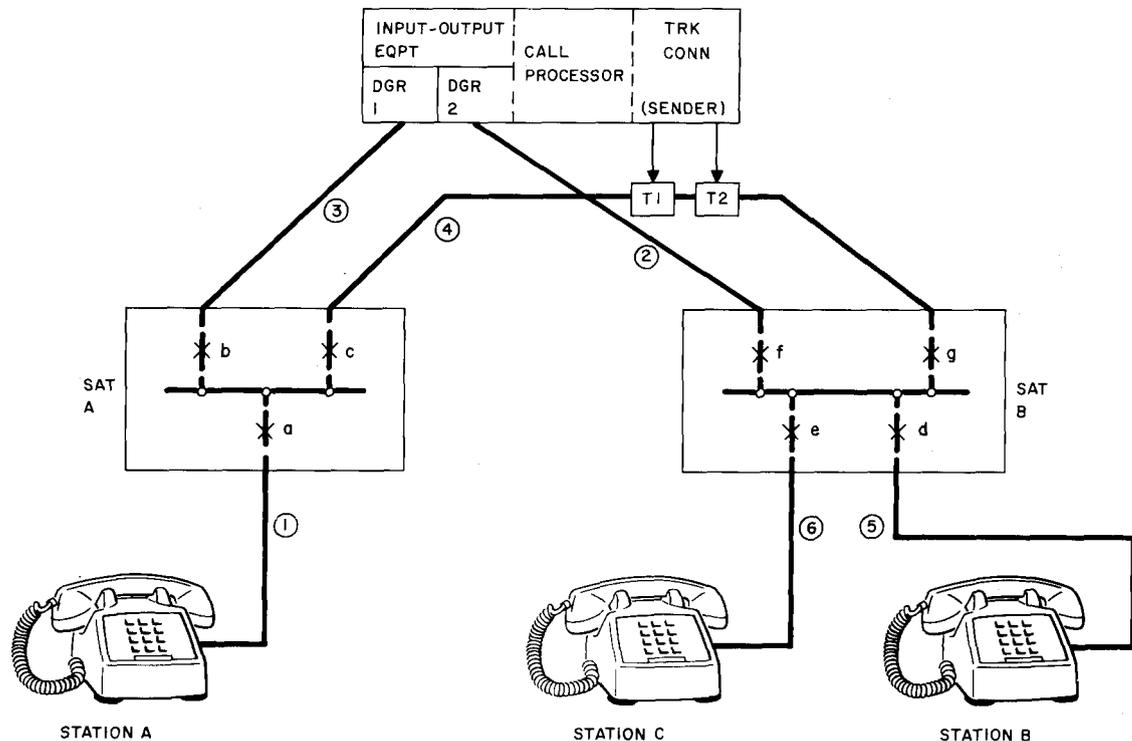
Flip-Flop: A device capable of assuming two stable states (set or reset), thereby storing a bit of information. It remains in either state until a signal changes it to the other state.

Foreign Exchange (FX) Trunk: A CO trunk connecting a PBX with any CO other than the one normally serving that PBX.

Frame: A metal framework, such as a relay rack, on which equipment is mounted.

Frequency Shift Modulation: In the No. 101 ESS a means of transmitting data between the switch unit and the control unit by encoding the data into a serial code and transmitting the resultant data train by frequency shift modulating a voice frequency carrier. A logical one becomes an 1150-Hz tone, and a logical zero becomes an 1850-Hz tone.

Gate: A circuit which has the ability to produce an output dependent upon a specified input or the coincident nature of the input(s).



NOTES:

1. FOR SIMPLICITY, ONLY TALK/DIAL TONE PATHS ARE SHOWN — SUPERVISION/DIAL PULSE/TRUNK PULSING/DATA LINK SIGNALS DO NOT GO THROUGH TIME DIVISION SWITCHES.
2. FOR MORE CONTROL UNIT AND SWITCH UNIT DETAIL, SEE FIG. 22.

Fig. 24—3-Way Calling—Main-Satellite Installation

Group Bus: The common transmission path for the 64 lines or trunks in a switch unit line or trunk block for 2A and larger switch units.

Hybrid (Coil or Set): The bridging transformer used in coupling a 2-way telephone circuit to a repeater station, or for coupling two one-way circuits to a 2-way circuit. The coil is so wound that when the line is properly balanced by a balancing network there is no reaction between the output and input connections of the transformer.

Inhibited Fluxor: A temporary memory consisting of 2- or 3-holed ferrite cores and associated circuitry.

Input/Output: The process of transmitting information from an external source to a system or from the system to an external source.

Insertion Loss: The loss at a given frequency caused by the insertion of apparatus in a transmission system. It is the ratio, expressed in decibels, of

the powers at that frequency delivered to that part of the system beyond the point of insertion before and after the insertion.

Interbus Switch: A circuit which provides a transmission connection between corresponding time slots in two different time-division buses. It is used in the 1A switch unit of No. 101 ESS to provide 3-way calling service.

Intergroup Bus: The common transmission path which provides interconnection between group buses in the 2A and 3A switch units.

Line and Trunk Block (Also called Line and Trunk Group): Provides translation, timing signals, and bus clamps for a group of up to 64 line or trunk circuits (2A and 3A switch units).

Line Circuit: In the No. 101 ESS the circuit associated with an extension (station) line.

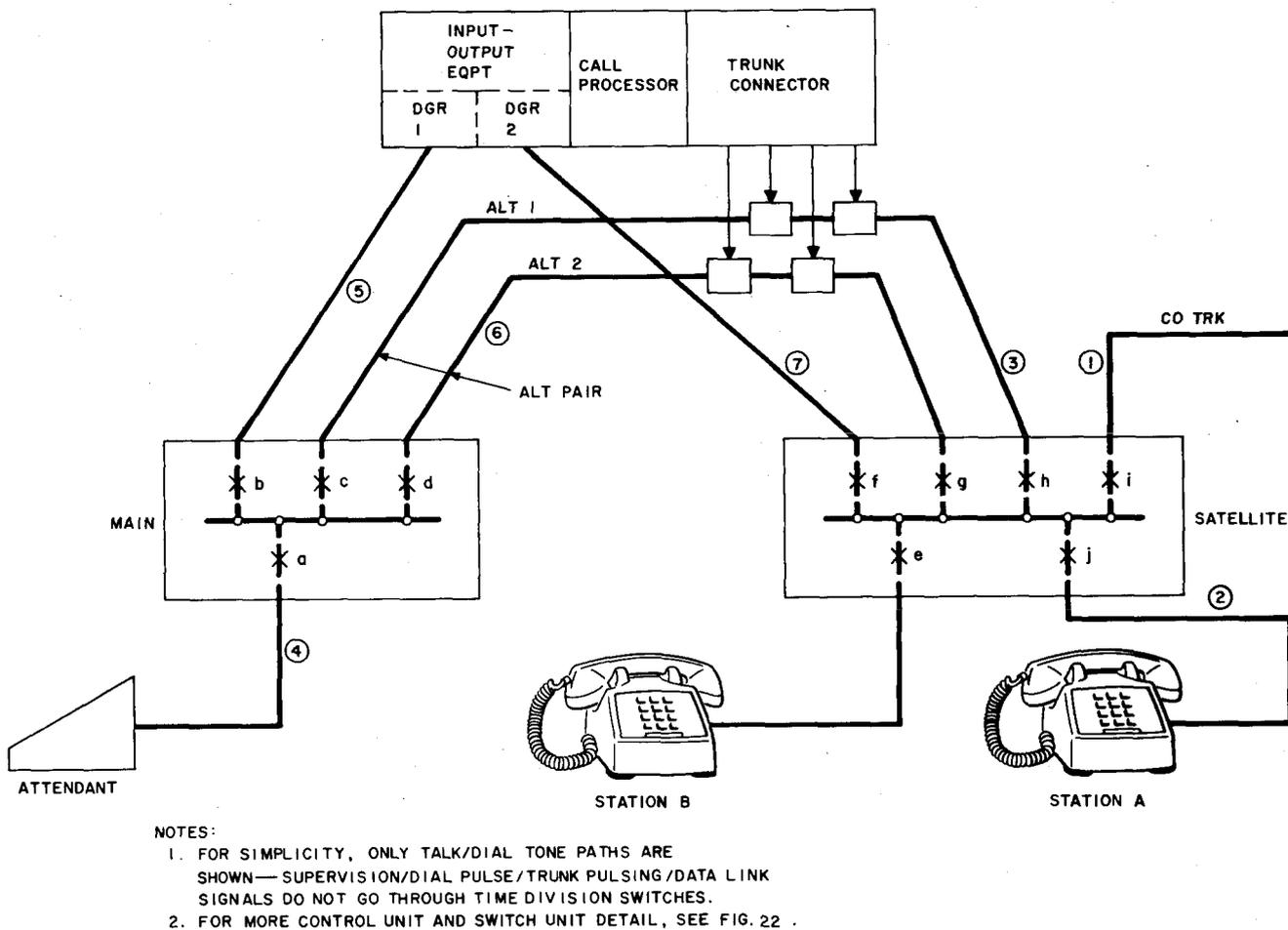


Fig. 25—Attendant Transfer—Main-Satellite Installation

Line Concentration Ratio: The relationship between the number of lines and the number of B-links in a 4A-1 and 4A-2 switch unit.

Line Connector: That equipment used to connect station lines to B-links in response to messages on the data-link from the control unit.

Line Switch Frame: That equipment containing eight concentrators forming part of the line connector.

Line Information Store (LIS): The No. 101 ESS equipment unit which consists of semipermanent memory and is used to store class-of-service and related information pertaining to lines and trunks as well as certain miscellaneous information.

Line Link Pulsing: That feature of some No. 5 crossbar COs which provides direct inward dialing

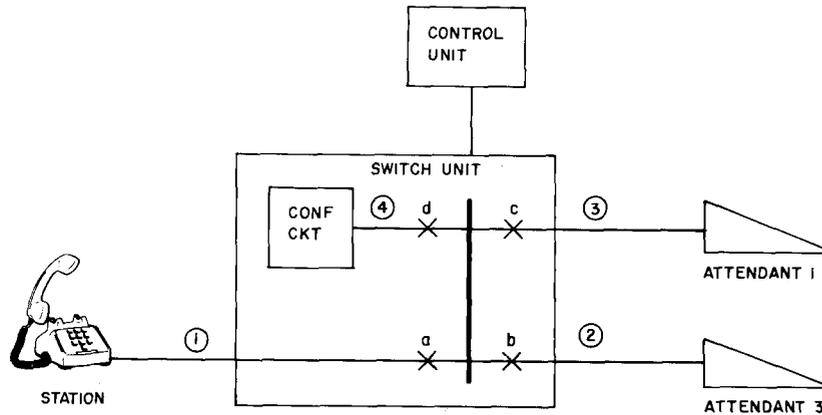
to PBXs over trunks terminated on the No. 5 crossbar line link frame.

Logic Circuit: A circuit configuration which selects one of many possible outputs depending upon the nature and sequence of one or more inputs.

Long-Haul (Tie) Trunk: In general, a tie trunk which exceeds approximately 30 miles in length. These tie trunks should be provided on a via net loss basis with pad switching and require 4-wire facilities from PBX to PBX. For further details, see Section 310-350-100.

Loop: See *Attendant Loop or Switched Loop*.

Magnetic Core: A toroidal device capable of storing information by means of its two directions of polarization.



NOTE:
FOR SIMPLICITY, ONLY TALK PATHS ARE SHOWN - SEE FIG. 22 FOR MORE CONTROL UNIT AND SWITCH UNIT DETAIL.

Fig. 26—Attendant Interposition Calling and Transfer of Station

TABLE J

NO. 101 ESS - INTERPOSITION CALL AND TRANSFER

TYPE OF CALL OR CONNECTION	SEQUENCE OF ACTION REQUIRED (TO ESTABLISH CONNECTION)	FIG. 26 KEY NUMBER(S)
DIAL TONE CONNECTION AND OUTGOING CALL VIA ATTENDANT (PARTIAL)	Station goes off-hook, hears dial tone, dials, and is connected to console 3, Fig. 21 and Table G. Station requests attendant controlled conference, not accessible from console 3.	1, 2
ATTENDANT INTERPOSITION CALL AND TRANSFER	Attendant depresses START key, hears dial tone, and dials 12. When call appears on console 1, attendant depresses LOOP key. Console 1, 3 and station are connected, and station request is repeated.	1, 2, 3
	Attendant 3 depresses PA RLS key, and is disconnected from call.	1, 3
ATTENDANT CONFERENCE	Attendant 1 can now add station(s) and trunk(s) to attendant conference ports (4.07) by operation of START, dial and CONF 1 (or 2) keys.	1, 2, 4

Main: The switch unit that contains the attendant consoles in a multiswitch unit configuration. A main-satellite system may be provided with more than one main if attendants are required at more than one location. In this case, each satellite switch unit may home on **one main switch unit only** for attendants.

Main-Satellite: A system whereby several units may be used for a single customer. In this system, the switch unit(s) that contain the attendant consoles are designated the **main**. The remaining switch units in the system are designated the **satellites**.

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

Maintenance Center: That part of the No. 101 ESS control unit equipment which deals with maintenance of the system.

Memory and Local Control: See **Network Control**.

Memory Devices: Apparatus having the faculty of retaining one bit of information. A relay, a flip-flop, or a twistor card magnet acts as a memory device.

Microsecond (μ sec): One-millionth of a second.

Millisecond (ms): One-thousandth of a second.

Module: A plug-in type package containing components connected to form a circuit. Also, a unit of equipment capable of being combined with others to form a larger unit.

Multifrequency (MF) Pulsing: A system of ac pulsing where the identity of each digit is determined by a specific pair of frequencies.

Nanosecond: One-thousandth millionth of a second.

Network: A system of interconnected elements consisting of such devices as inductors, resistors, capacitors, diodes, etc.

Network Control: The memory, logic, and translators used to activate the time-division sampling switches.

Octal (Number System): A number system that uses eight symbols, usually denoted by 0, 1, 2, 3,

4, 5, 6, and 7 with 8 as its base; just as the decimal number system uses 10 symbols (0 through 9) with 10 as its base.

Off-Hook: The condition that indicates the active state (loop closed) of a station line or other circuit. When a telephone handset is removed from its switchhook, the loop is closed and the line is in the off-hook condition.

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.

Outpulsing: The process of transmitting digital information over a trunk from one system to another. In the No. 101 ESS, signals are in dc pulse form.

Output: See **Input/Output**.

Package Mounting: See **Tray**.

Package (Pack or Circuit Pack): See **Circuit Pack (Packaged)**.

Parity Check: A check on the validity of a **word**. One method is to check the number of ones in a word, for example, whether number of ones is odd or even.

PBX: See **Private Branch Exchange**.

PBX Trunk: A subscriber line used as a trunk between a PBX and the CO which serves it. When taken from a PBX point of view, the term **CO trunk** may be used in a synonymous sense.

Permanent Magnet Twistor: See **Twistor Store**.

Plane: A pair of twistor cards.

PNPN Diode: A 2-terminal solid-state component exhibiting the following characteristics:

- (1) High impedance in the **off** state to a forward voltage.
- (2) Switches to a low impedance **on** state when the forward voltage exceeds a specified limit.
- (3) Remains in the **on** state until switched off by reducing the forward current below a specified value.

PNPN Triode: A 3-terminal solid-state component exhibiting the following characteristics:

- (1) High impedance in the **off** state to a forward voltage.
- (2) Switches to a low impedance **on** state when the forward voltage exceeds a specified limit, or when a pulse is applied to the gate lead.
- (3) Remains in the **on** state until switched off by reducing the forward current below a specified value.

Port-A-Punch Card: A special type of IBM card used to administer growth and memory facilities in the No. 101 ESS.

Private Branch Exchange (PBX): A switching system providing internal telephone communications between stations located on customer premises as well as between these stations and the exchange network.

Program: An organized set of instructions used to control a sequence of events.

Program Control Logic: The No. 101 ESS control unit circuits used to read, interpret, and execute the commands contained in the program store.

Program Store (PS): The No. 101 ESS equipment unit which consists of semipermanent memory and is used to store the sequences of logical operations required for call processing.

Progress Mark: A code number used to designate the state of a call in progress in the No. 101 ESS.

Quadrant: One-half of a twistor card.

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

Redundancy: Duplication of a device or functional unit to prevent an overall failure in the event that all but one fails.

Register: A functional set of memory elements word repository. A specialized storage device where word repository. A specialized storage device where data may be operated upon.

Repeater (Telephone): A combination of one or more amplifiers together with their associated equipment.

Reset: (1) To restore a storage device to a prescribed state. (2) A flip-flop reset in one of its two stable states, namely the rest or zero state.

Return Loss: At a discontinuity in a transmission system, the ratio, in decibels, of the power incident upon the discontinuity to the power reflected from the discontinuity.

Routine. ♦A program, or part of a program to control specific tasks.♦

Sampling Switch: The high-speed solid-state switches used to connect the terminals of each No. 101 ESS line and trunk circuit to a common bus.

Satellite: A 2A, 3A, 4A-1, or 4A-2 unit without attendant consoles in a multiswitch unit system.

Scan Bus: ♦A time-division bus used to connect the scanner to each line, trunk, and attendant key circuit in turn.♦

Scanner: A circuit that automatically samples or interrogates the state of lines, trunks, and attendant keys in the No. 101 ESS and initiates action in accordance with the information obtained.

Scan Point: Each line, trunk, or attendant key is defined by an address, in binary form, referred to as its scan point.

Sector: A portion of the No. 101 ESS call store assigned to a switch unit. Each 1A or 2A switch

unit will have one sector assigned. A 3A switch unit may have more than one sector.

Semiconductors: Materials which act between metals and insulators in their ability to conduct electricity. Also devices such as diodes and transistors made from semiconductor material (see **Solid State**).

Semipermanent Memory: A device for storing information to be retained for a relatively long time. The stored information is retained until changed by external means. The No. 101 ESS program and line information stores are semipermanent stores.

Sender: A circuit that performs an outpulsing function.

Sender Control (Circuit): The circuit used in conjunction with the program control and trunk connector circuits to outpulse digits, whether over a CO or FX trunk to a CO, or over a tie line to another PBX.

Sense: A specialized mechanism or function by which a machine or device is receptive and responsive to certain stimuli.

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

Short-Haul (Tie) Trunk: In general, a tie trunk connecting two PBXs which are less than 30 miles apart. These tie trunks are usually provided on voice frequency cable facilities and may be either 2-wire or 4-wire. For further details and exceptions, see Section 310-350-100.

Six-Digit Translation: The process of examining the first six digits (area code plus office code) of a called telephone number.

Solenoid: An electrical conductor current which establishes a magnetic field.

Solid State (Device): A component of an electrical circuit which is made from semiconductor material, as a transistor, resistor, or diode.

Source: The calling party or the equipment associated with the calling party.

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 in the off-line state. Units in the standby state may perform checking operations or be matched against the active or on-line units.

State of Repair Register: A 16-bit register devoted to retaining information relating to the out of order, out of service, and other similar information concerning the condition of major portions of the control unit.

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.

Stored Program: See **Program**.

Supervision: ♦The function of indicating and controlling the status of trunks, lines, or calls.♦

Supervisor Turret: A position with visual and audible signals at which the customer can supervise attendant console operation (3A and larger switch units only).

Switched Loop (Attendant) Operation: A method of operation in which calls are switched to an attendant console when attendant handling is needed and can be automatically released from the console when work on the call is completed.

Switching Network: A network of switches arranged to perform an interconnecting function.

Switching Pad: A transmission pad which is switched into a trunk circuit on terminating calls and out of the trunk on tandem switched calls.

Switching System: An integrated and self-contained arrangement of interconnecting and control elements used for the controlled establishment of changeable communication paths.

Switch Store: The equipment unit which contains temporary memory and provides memory for incoming and outgoing messages between the switch unit and the control unit, talking connections, scanner last look information, and attendant lamp lighting

in the 2A and 3A switch units, and for talking connections and attendant lamp lighting in the 1A switch unit.

Switch Unit: The part of the No. 101 ESS that performs the switching of lines and trunks. This equipment is normally located on the customer premises.

T-Links:

4A-2 Switch Unit: The T-links are dial-repeating tie lines which connect the two 3A time-division switches together for tie line access only.

Transmission Links (Main-Satellite System): The transmission links (T-links) interconnect all locations of the main-satellite complex.

Attendant T-Links (Main-Satellite System): These T-links are used to complete incoming trunk calls on a satellite to the attendant. The call may be either a listed number call on an incoming trunk or a station requesting an attendant transfer of an incoming trunk call.

Note: There is no provision for completing dial 9 calls or outgoing CCSA calls over a main-satellite T-link except for attendant assisted calls. If an attendant completes a trunk call for a satellite station, the complete number must be dialed.

Talking Bus: See *Transmission Bus*.

Tandem Switching: The interconnection of two or more trunk circuits in series.

Temporary Memory: A device for storing information to be retained for a relatively short time such as storing information for the duration of a call. In the No. 101 ESS, the call store and switch store are temporary memories.

Terminating Equipment (4-wire): See *Hybrid*.

Three-Digit Translation: The process of examining the first three digits (area code or office code) of a called telephone number.

Tie Trunk: A trunk for direct voice communication between two PBXs.

Time Division: A method of serving a number of simultaneous calls by means of a common transmission path by assigning the transmission path sequentially to the various calls, each assignment being for a separate and distinct time interval.

Time Slot: The time interval allotted to each connection through a time-division switch.

Transistor: An active semiconductor component with three or more electrodes. It is used for rectifying, switching, and/or amplifying signals.

Translate: To change information from one form of representation to another without significantly affecting the meaning.

Translator: In switching systems, a device which is capable of converting information to a new form required to perform the desired subsequent operation.

Transmission Bus: A time-division bus used for transmitting voice signals.

Tray: In the No. 101 ESS, a wired equipment unit (similar to a shelf in electromechanical telephone systems) into which circuit packages are plugged. It is sometimes referred to as a package mounting.

Triode: A 3-electrode electronic device containing an anode, a cathode, and a control electrode.

Triple Bay (Frame): A frame consisting of three bays.

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 other switching entity.

Trunk Connector: The No. 101 ESS circuit used to translate binary addresses from the program or data controls into a trunk number for a particular switch unit. A particular trunk is selected for such purposes as originating a call, answering an incoming call, disconnecting, and dial pulsing.

Trunk Control Frame: The No. 101 ESS control unit frame comprising the trunk connector circuit

and its duplicate, a cross-connection field, and the logic portions of the various trunk circuits.

Twistor: See *Twistor Card*, *Twistor Store*, and *Permanent Magnet Twistor*.

Twistor Card: A thin aluminum card having small vicalloy bar magnets on one side; used to retain binary information in a twistor store.

Twistor Store (Permanent Magnet): A semipermanent memory employing the twistor principle. A twistor store module provides a storage capacity for 16,384 words of 22 bits each.

Word: A set of binary data which occupies one location in storage and is treated by the system as a unit.

Write: To insert information into a memory device.