

PLEASE NOTE:

FOREMAN 02... 3  
FOREMAN 03... 0  
FOREMAN 04...  
FOREMAN 05... 0  
FOREMAN 06...  
FOREMAN 07...  
FOREMAN 08...  
FOREMAN 09...  
FOREMAN 10...  
**770A PRIVATE BRANCH EXCHANGE**  
**GENERAL DESCRIPTIVE INFORMATION**

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**NOTICE**

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**1. INTRODUCTION**

**GENERAL**

**1.01** This section describes the dial crossbar 770A PBX. The 770A PBX:

- (a) Is a relay logic, common control system that uses a 3-stage crossbar switching network.
- (b) Is fully connectorized to:
  - (1) Provide flexibility
  - (2) Facilitate installation and expansion.
- (c) Is housed in equipment cabinets of sheet metal fabrication. Each cabinet may contain up to three roll-out equipment frames.
- (d) Is designed to provide Series 100, 200, and 300 and Centrex I and II communication service package features.
- (e) May grow in station lines from 40 to 400 in 40-line, plug-in unit increments.
- (f) May grow to approximately 100 trunks in single plug-in unit increments.

(g) Uses a self-contained, 48-volt rectifier, KS-type power supply that is housed in the equipment cabinet. Ringing current and tones are furnished as part of the power supply.

(h) Is designed to work with the 1-, 2-, 23A-, 43A-, 53B-, 53C-, 63-, and 83-type telephone consoles and the 1-type selector console. Switchboard operation is not provided.

(i) Is designed to provide hotel/motel and TOUCH-TONE® calling features on an optional basis.

(j) Contains traffic measurement leads for determining the use of all circuits that affect traffic.

**1.02** This section is reissued to:

- (a) Revise and make minor corrections to Fig. 2, 12, 17, 19, 20, 22, 29, and 30.
- (b) Provide Fig. 41 and add information for automatic voice network (AUTOVON) termination on the 770A PBX.
- (c) Add information for night service in systems equipped for direct inward dialing (DID).
- (d) Add information for timed reminder in systems equipped for switched loop operation.
- (e) Revise Table E to add class of service C16.
- (f) Add information for 20-Hz ringing.
- (g) Revise Part 7 to reflect the circuit drawings used for this issue of the section.

Changes to tables are indicated by shaded areas.

**1.03** The 770A PBX may be installed with the cabinets flush to the wall. The minimum aisle space required in front of the cabinets is 36 inches. The minimum ceiling height required in the installation area is 8 feet. The dimensions of each cabinet are 2 feet ♦2-1/2♦ inches deep, 4 feet 7 inches wide, 6 feet ♦10-1/2♦ inches high. A system with Series 300 and 400 line ports usually requires about four cabinets. Fig. 1 illustrates an equipment cabinet.

**Caution:** Care must be observed in selecting a location for this equipment.

- **Each equipped cabinet weighs approximately 1800 pounds. This represents a concentrated load of about 175 pounds per square foot. Cabinet size is 2 feet 4 inches by 4 feet 7 inches.**
- **Total maintenance area must be included to determine actual floor loading requirements. The maintenance area plus cabinet area (per cabinet) will be 5 feet 2 inches by 5 feet 7 inches for minimum maintenance area. The preferred area would be 6 feet 4 inches by 6 feet 6 inches.**

**1.04** This reissue is based on the drawings listed in Part 7. If this issue is used with equipment or apparatus reflecting later issue(s) of the drawing(s), reference should be made to the SDs and CDs to determine the extent of the changes and the manner in which the section may be affected.

## COMMUNICATION SERVICE PACKAGE FEATURES

### A. General

**1.05** The 770A PBX provides (1) Series 100, 200, 300, and centrex I and II PBX package features; (2) optional features; and (3) hotel/motel features listed in Table A.

### B. Attendant Position (Console)

**1.06** The attendant equipment used with the 770A PBX may be any of seven types of telephone consoles:

- (a) The 1-type (MD) console has a maximum of 12 pickup keys, for use with direct trunk termination (single- or multiplied-dual console operation) where no more than 12 trunks are terminated.
- (b) The 2-type (MD) and 43A consoles have a maximum of 30 pickup keys, for direct trunk termination operation where not more than 20 trunks are terminated.

- (c) The 23A console is used with switched loop operation.
- (d) The 53C console is equipped with direct station selection (DSS) keys and lamps for use with switched loop or direct trunk operation with DSS of 100 lines or less.
- (e) The 53B console is equipped with DSS keys and lamps for use with switched loop or direct trunk operation with DSS of 200 lines or less.
- (f) The 63A console is equipped with DSS keys and lamps, for use with switched loop or direct trunk operation of 400 lines or less.
- (g) For systems with more than 200 lines with DSS not using a 63A console, a 23A or 43A console will be used with two 1A2 selector consoles.
- (h) The 83-type console has 6 pickup keys for switched loop or 30 pickup keys for direct trunk, with a busy station display (BSD) field in place of the DSS field.

### C. Direct Outward Dialing (DOD)

**1.07** The DOD feature allows a PBX station user to gain access to the exchange network without attendant assistance. Restriction from this feature can be provided on a per-line basis.

### D. Station-To-Station Calling

**1.08** This feature allows a station user to call another station within the same PBX system without attendant assistance. The PBX provides 1-, 2-, 3-, or 4-digit dialing.

### E. Station Hunting

**1.09** This feature allows an incoming call to be routed to an idle station line in a prearranged group when the called station is busy. The PBX offers one-way (terminal) hunting in a consecutive or nonconsecutive arrangement within an equipment tens group.

### F. Call Transfer—Attendant

**1.10** This feature allows a station user, while connected to an incoming or outgoing (if

outgoing transfer is provided) call, to signal the attendant and to have the attendant switch the calling party to another station within the same PBX system.

#### G. Restriction From Outgoing Calls

1.11 This feature denies selected stations within the PBX system the ability to place outside calls and/or certain miscellaneous trunk calls without the assistance of the attendant. Calls from denied stations are routed to the attendant or busy tone trunk.

#### H. Power Failure Transfer—Station

1.12 In the event of commercial power failure, the 770A PBX permits emergency transfer of up to four stations in each line switch (group of 40 stations) to central office (CO) trunks. Thus, a 400-line system would permit a maximum of 40 stations to be arranged for power failure transfer. Any type, or combination of types, of CO trunks may be used. The station equipment numbers in each line switch are 00, 10, 20, and 30. The stations arranged for power failure transfer must be equipped with a nonlocking dial tone start key which must be momentarily operated to obtain CO dial tone. When power is restored, each emergency connection is automatically returned to normal.

#### I. Night Service

1.13 In systems equipped for DID, night service is provided in the form of a night station. When the night key is activated, the listed directory number (LDN) is translated to a predetermined station code and the connection is made in the same manner as described for a DID trunk-to-station call. (See 5.68.) When in the night mode, the call forwarding—busy line feature is disabled and busy tone is returned to the calling party. The call forwarding—don't answer feature is also disabled and the called line continues to ring.

1.14 In systems not equipped for DID, the following night service arrangements are available with the 770A PBX.

(a) **Fixed Night Station Connection Arrangement (Fig. 38):** Fixed night connections are associated with preassigned stations. The same four stations in each line switch which are associated with power failure

transfer are used to provide fixed night service. Traffic via trunks connected to fixed night stations is therefore unaffected by power failure since the trunk-to-station connections are functionally in a continuous power failure mode. Operation of the NITE key at any attendant console automatically establishes the night connections. For outgoing calls, a ground start button must be operated by each station user to seize the connected CO trunk circuit. When CO dial tone is returned, the station may dial the call through the CO in the normal manner.

(b) **Flexible Night Connections:** Unless otherwise specified, the 770A PBX with direct trunk termination is delivered with flexible night service connections provided. Connections permit the attendant to associate any 2-way combination CO trunk with any PBX station. With switched loop, 2-way trunks assigned flexible night dial codes may be similarly connected. When flexible night connections are used, it is important to know that a power failure during the night will disconnect all flexible night connections. Therefore, stations connected via the flexible night connection should include some stations which are also connected for power failure transfer. This arrangement would permit limited traffic (both incoming and outgoing) to continue during the power-off interval. When power on occurs, all incoming traffic is lost. For outgoing calls, an off-hook condition at any night station immediately seizes the connected CO trunk circuit. When CO dial tone is returned, the station may dial the call through the CO in the normal manner.

(c) **Trunk - Answer - From - Any - Station Arrangement (Series 300) (Fig. 39):** This arrangement permits any PBX station, by dialing the proper access code, to answer an incoming CO call. The answering station can also act as an attendant and complete the calls to any PBX station. Only two calls per dial transfer circuit can be extended at a time. The trunk-answer-from-any-station feature is active only when the Remote Answer (REM ANS) key is operated at the attendant console. When trunk-answer-from-any-station is used for night service, a centralized bell signal is locally provided.

1.15 If more than one of the three methods of providing night service is used within the

same 770A PBX, the sequence used to establish night service is: (1) operate the NITE key; (2) set up flexible night connections, if required; and (3) operate the REM ANS key, after momentarily operating the POS BSY key, if trunk-answer-from-any-station is used. If fixed night connections are provided, these connections are established simply by operating the NITE key. If flexible night connections are used and no fixed night connections are provided, each trunk-to-station flexible connection must be set up by the attendant after operating the NITE key. If both fixed and flexible connections are used, flexible connections must be set up (after operating the NITE key for direct trunk, or the POS BSY and then the NITE key for switched loop) between trunks and stations *not* associated with fixed connections. If only trunk-answer-from-any-station is used, the NITE key need not be operated. Operation of the REM ANS key, after momentary operation of the POS BSY key, conditions the system for night service. If either or both fixed and flexible connections are used, momentary operation of the POS BSY key, and operation of the REM ANS key (after operating the NITE key and establishing flexible connections) conditions those incoming and 2-way CO trunk circuits *not* associated with fixed or flexible connections to be in the trunk-answer-from-any-station mode.

**1.16** After night connections are established, each night station will be directly connected to a particular CO trunk and incoming CO calls on that trunk will ring the connected night station. The night-connected station is automatically made busy to the PBX switching equipment. Calls to and from each of the established night-connected stations must be made via established connections to the CO trunk circuits.

**1.17** Should a power failure occur after night connections are established, all night-connected stations except those night stations arranged for power failure transfer or fixed night connections will be released and the PBX power failure transfer arrangement will prevail. For this reason, care should be taken in the assignment of night connections and power failure transfer connections so that night-attended stations always have a means of making or receiving emergency calls.

#### **J. Attendant Camp-On With Indication of Camp-On**

**1.18** With camp-on, an attendant-handled incoming CO trunk call to a busy station will automatically

camp on the connection. The call will be immediately connected to the station when it becomes idle. Only one call can be camped on a busy station. The busy party and the attendant are provided with an audible indication of the camped-on condition. When an attempt is made to camp on a station with a camped-on condition existing, busy tone will be returned to the attendant.

#### **K. Attendant Conference**

**1.19** The conference circuit allows the attendant to establish a conference connection, via the switching equipment, of up to five conferees plus the attendant.

#### **L. Attendant DSS With Busy Lamp Field**

**1.20** This service feature allows an attendant at a console to complete a call to a station by operating a single pushbutton associated with that station. This service feature also provides the attendant with a visual indication of the busy or idle condition of stations at all times.

#### **M. Call Transfer—Individual**

**1.21** This service feature allows a station user to transfer an incoming or outgoing (if provided) exchange network call to another station within the PBX system without attendant assistance.

#### **N. Consultation Hold**

**1.22** This service feature allows a station user to hold an incoming or outgoing (if provided) exchange network call and, on the same line, to originate a call to another station within the same PBX system. After consultation, the station user may add this station to the original call (add-on), may return to the original call alone if the second station user hangs up, or may complete a transfer to the second station user by hanging up.

#### **O. Add-On**

**1.23** This service feature allows a station user to add another station within the same PBX system to an existing incoming or outgoing (if provided) exchange network call for a 3-party conference, without attendant assistance.

**P. Trunk-Answer-From-Any-Station**

1.24 This service feature allows any station user to answer an incoming exchange network LDN call, when the attendant position is on remote answer, by dialing a special code from a nonrestricted station. (See 1.14.)

**Q. TOUCH-TONE Calling**

1.25 Stations arranged for TOUCH-TONE calling are equipped with TOUCH-TONE service station sets. Operation of this set is the same in PBX service as in regular CO customer line service.

**R. Tie Trunks**

1.26 The 770A PBX provides only dial repeating tie trunks. Tie trunks may be accessed (when customer restrictions so allow) by stations, other tie trunks, and CO trunks.

**S. Toll Restriction**

1.27 This feature is a form of code restriction which permits *selected* station lines to access the local CO and to dial local service area calls but prevents completion of toll calls or calls to the toll operator without attendant assistance. The restricted calls are routed to reorder tone.

**T. Lockout**

1.28 This service feature prevents the attendant from reentering an established connection of an incoming CO call, which was completed through the attendant position, unless recalled by the station user. This feature is always provided with switched loop systems.

**U. Secrecy**

1.29 This service feature allows the attendant, upon reentering an established incoming CO call, to consult privately with the called party by automatically splitting the connection and holding the calling party at the equipment.

**V. Single-Digit Dialing**

1.30 This service feature allows a hotel/motel guest to dial a single digit to obtain room service, valet service, etc.

**W. Mixed-Length Station Access Codes**

1.31 With this feature, the following station code combinations are possible: one or two, and three digits or one, two, or three, and four digits. It is possible to have a single-digit station code that is the same as the first digit of a 3- or 4-digit room code. In addition, those digits used for single-digit trunk codes may also be used as the first digit of a 3- and a 4-digit station code. These trunk codes require a 4-second delay to recognize that single digit. However, no 2-digit trunk code may begin with the same digit as a station code. No flexible number pattern using a mix of code lengths may be provided with DSS. If DSS is required with a flexible numbering scheme, all station codes (except single digit) must be the same length. The allowed dial code combinations are shown in Table B.

**X. Station Message Registers**

1.32 This feature provides message register equipment which is centrally located on the customer's premises for use by the customer. The message registers, one associated with each station line, score on each completed outgoing local service call made by the station user. Optional surcharge arrangements may also be provided to score an additional predetermined number of units per call.

1.33 When the message registration feature is provided with SD-1E340-01, Issue 29B or later CO trunks, message registration circuit SD-1E345-01 must be provided. If SD-1E340-01, Issue 28B or earlier CO trunks are used in the system, all CO trunks must be updated to Issue 29B or later.

**Y. Message Waiting**

1.34 This feature provides the ability to light a lamp remotely (from a central location) on a station telephone set within the PBX system to indicate that a message is waiting for that station user.

1.35 The message waiting circuit is equipped with its own power supply, with an output voltage of +150 volts dc, interrupted at 60 ipm. This circuit requires an input of 117 volts ac (obtained from the 770A PBX ac distribution circuit).

**Z. Power Arrangements**

**1.36** The following power arrangements are available for use with the 770A PBX.

**(a) Basic Power Supplies for Standard Use:**

- Power, interrupter, and tone supply circuit SD-1E356-01—This circuit furnishes  $\pm 48$  volts to PBX circuits, 10 volts ac power to the position circuit for lamp supply to the consoles, and 10 volts ac power to operate the interrupter. The circuit also controls ringing, ringing interruptions, and supervisory tones required by the PBX.
- Power and ringing supply circuit SD-1E357-01—This circuit provides additional -48 volts and 30-Hz ringing power when the PBX requirements exceed the capacity of the basic power, interrupter, and tone circuit.
- For 770A PBX systems arranged for centralized attendant service (CAS) or off-premises stations that require 20-Hz ringing, the power and ringing supply circuits can be equipped for 20-Hz ringing on an optional or retrofit basis.
- Power and fuse circuit SD-1E360-01—This circuit provides -48 volts for the miscellaneous equipment.

The ac distribution circuit distributes commercial power to the ac-operated units of the PBX. This circuit also provides connectors and terminations to connect power to the 770A PBX power supplies.

**(b) Wide Frequency Power Supplies:**

For each 770A PBX power supply (previously described), a wide frequency tolerance supply that allows a frequency variation of  $\pm 3$  Hz with a guaranteed dc output within the operating range of the PBX may be optionally provided. This option is primarily intended for use with local alternators.

**(c) Battery Operation:** If battery operation is required, this feature optionally provides a power arrangement that functions with a locally provided 111A battery power plant. This arrangement includes a -48 volt dc to -10 volt

dc converter, a -48 volt dc to +48 volt dc converter, a 20-Hz ringing supply (including tone), and an optional precision dial tone supply for use with TOUCH-TONE service. The -10 volt dc supply is used for console lamps.

**1.37** The message waiting power supply obtains power from -48 volt dc to +48 volt dc converter modified per J58876PF.

**AA. Traffic Measurement System (TMS) Leads**

**1.38** The traffic measurement arrangement provides for determining the use of all the circuits that affect traffic in the 770A PBX. All circuits which plug into a trunk switch have a lead brought through the trunk port to a common connector on the trunk switch which gives the busy/idle status of that circuit. In addition, the busy/idle status of each trunk switch vertical (link) is also brought to the same connector. These leads account for 40 of the 50 available connections.

**1.39** All trunk circuits, registers, and transfer circuits bring their busy/idle status through the associated trunk port. For registers and 2-way trunks, no network connection is necessary for a busy status because registers are busy when connected directly to attendant positions or transfer circuits, and 2-way trunks are busy when connected to the attendant, before completion inward. These circuits indicate their true busy status on the traffic measurement lead. Intercom trunks have one lead associated with each trunk on which the trunk is indicated busy when either port is busy. When a conference circuit is occupied by the attendant, the information is furnished from the position circuit. All of this traffic data for a trunk switch, including the links in that switch, is brought to a connector located on that trunk switch.

**1.40** The position circuit is also modified to bring out various leads to monitor different forms of traffic in the attendant position. Including:

- Position occupied
- Position idle (includes unoccupied position)
- Position busy on conference circuit 1
- Position busy on conference circuit 2

- Incoming call peg count (pegs when attendant answers an incoming call, reenters a call on hold, releases destination, or makes a night connection)
- Night connection peg count
- Release destination peg count
- Hold key peg count.

By subtracting the total pegs on the last three counters from the incoming call peg count, a true incoming call peg count is obtained.

**1.41** On a switched loop system, a cable with a connector is used on each position circuit to bring out these leads. With a single-console, direct-terminated trunk system, the leads are brought through the CO trunk direct termination unit where a connector-ended cable is provided with the same pin configuration as on each connector in the switched loop case. With a dual-console, direct-terminated trunk system, the leads from both positions are brought through the dual-console circuit to a single connector-ended cable. The leads for the first position are in the same configuration as in the previous cases; the leads for the second position appear on different pins in the same connector.

**1.42** Miscellaneous TMS leads are provided throughout the system.

- The connecting links between the line switches and the midswitches are called "A" links. TMS leads for these links will be contained in a 25-pair connector-ended cable designated "TMSL" for cross-connection to the TMS panel.
- For systems with DID and/or common control switching arrangement (CCSA), leads are provided in each incoming register (IR) for measuring usage, peg count, and time-out. These leads are terminated in a 25-pair connector-ended cable designated "IRB- (A or B)" to the incoming register network (IRN) where all IR circuit leads are combined in the TMSIR connector cable which extends to the TMS panel.

- The automatic number identification (ANI) circuit comes equipped with two peg count registers.
- In systems arranged for centralized attendant service (CAS), usage (RLT) and peg count (RNG) leads are provided in the release link trunks. These are extended by cable through the cross-connect to the TMS panel.
- In the trunk selector, a TMS lead is provided to indicate the number of times the customer made tests using the trunk selector circuit.
- In the trunk junctor, a TMS lead is provided to indicate both usage and peg counts.
- The 770A PBX -48 volt power supply should not be used to power TMS-1A scanners. A separate power supply is recommended.

#### AB. Traffic Register

**1.43** The traffic register feature provides peg counts for recording traffic and overflow indications via the marker TR connector to the traffic register TMKR plug. Twenty registers are provided which allow recording a combination of traffic overflow conditions and traffic peg counts.

**1.44** Traffic overflow registers provide a record of the number of calls which encounter an all-busy condition on trunk switch links, registers, attendant trunks, CO trunks, busy tone trunks, intercom trunks, and level 6, 7, and 8 trunks.

**1.45** Traffic peg count registers provide a record of the number of call attempts on intercom, CO, attendant, and tie trunks, registers, level 6, 7, and 8 trunks, marker completions, and marker time-outs.

#### AC. Fully Restricted Station

**1.46** This feature denies the selected station from originating or receiving (if inward restriction is provided) any trunk calls except tie trunk calls which are considered station-to-station type calls and dial "0" calls to the attendant and receiving attendant-extended calls. It also allows station-to-station calls. Restricted calls are routed to the attendant or busy tone.

**AD. Executive Ringback**

1.47 This service feature allows certain designated stations to be called back automatically when another PBX station, found busy on an attempted intercom call, goes idle.

**AE. Executive Override**

1.48 This service feature allows certain designated stations to override a busy condition on attempted intercom calls, connecting the calling party to the busy line after application of a warning tone.

**AF. Direct Inward Dialing**

1.49 The DID feature allows completion of an incoming call from the CO to a specific station in the system (usually called centrex with DID) without attendant assistance.

**AG. Call Forwarding—Busy Line**

1.50 The call forwarding—busy line feature automatically routes incoming DID calls to the attendant when the called station line is busy.

**AH. Call Forwarding—Don't Answer**

1.51 The call forwarding—don't answer feature automatically routes incoming DID calls to the attendant when the called station does not answer within a timed interval (about 15 seconds).

**AI. Automatic Identified Outward Dialing (AIOD)**

1.52 The AIOD feature provides automatic identification of the calling station line number to permit individual station billing on toll calls.

**AJ. Common Control Switching Arrangement**

1.53 The CCSA trunk provides 2-way direct dialing service between a PBX and a CCSA network without attendant assistance. Signaling and pulsing are accomplished either on a duplex basis over the loop or on an E&M basis over E&M-signaling arrangements. The trunk may be arranged to function on a 2- or 4-wire basis.

**AK. Trunk Junctor**

1.54 The trunk junctor circuit provides on- and off-net access to or from a 2-way CO trunk to the CCSA network via a CCSA trunk with attendant assistance.

**AL. Timed Reminder**

1.55 With direct trunk terminated systems, the timed reminder circuit provides a delayed alerting signal to the attendant. This signal consists of a flashing source lamp and audible tone, and is applied to the console at some delayed time (15, 30, or 45 seconds) after release from an extended trunk (DID, CO, or CCSA) call, after the trunk call has been placed on hold, after a station camped-on, or after a called station rings without an answer. On switched loop systems, the circuitry necessary to provide timed reminders is provided on an optional basis in the attendant trunk. Operational features are identical to those described for direct trunk terminated systems.

**AM. Paging**

1.56 The universal interface circuit provides a loudspeaker paging feature. The paging feature can be provided with or without an isolation amplifier. Console key paging is provided and extendible paging is provided through a junctor circuit.

**AN. Trunk Selector**

1.57 The trunk selector provides a customer trunk test feature and can also be used as a maintenance test feature. The feature can be used to gain access and test certain trunk ports. A maximum of 20 trunk group circuits (20 trunk ports each) can be tested.

**AO. Modular Maintenance Arrangements**

1.58 The following circuits are available for arrangement with the modular maintenance feature.

- Maintenance control circuit—This unit provides a means of testing links, observing basic marker functions, inhibiting register and marker time-out, observing the busy/idle status of any trunk group, selecting and

testing a particular trunk circuit, and selection of dial pulse register.

- Marker display circuit—This unit displays inputs to the marker from the register or line group and marker translation circuitry. ♦Displays may be held for prolonged viewing until turned off by operating the DISPLAY switch to the RESET position.♦
- Switched loop and trunk maintenance circuit—This unit provides the circuitry to seize any incoming register, connect trunks and switched loops, monitor the busy/idle status of trunks, simulate incoming and outgoing trunks, and to insert loop resistance as required.

**AP. Centralized Attendant Service**

- 1.59 The CAS feature allows multilocation business customers (such as department stores) with

each location served by a separate PBX or centrex system to concentrate all attendants at one location. This location is referred to as the "Main."

**AQ. ♦AUTOVON Termination on 770A PBX**

- 1.60 The 770A PBX can be connected to a 4-wire AUTOVON switching center via AUTOVON access lines. (See Fig. 41 and Section 809-105-152.)♦

**OPERATING RANGE**

- 1.61 Maximum station loop resistance is 1400 ohms.
- 1.62 Maximum conductor loop resistance of leads from the switching cabinet to attendant is 25 ohms, 2.5 ohms for lamp battery supply.

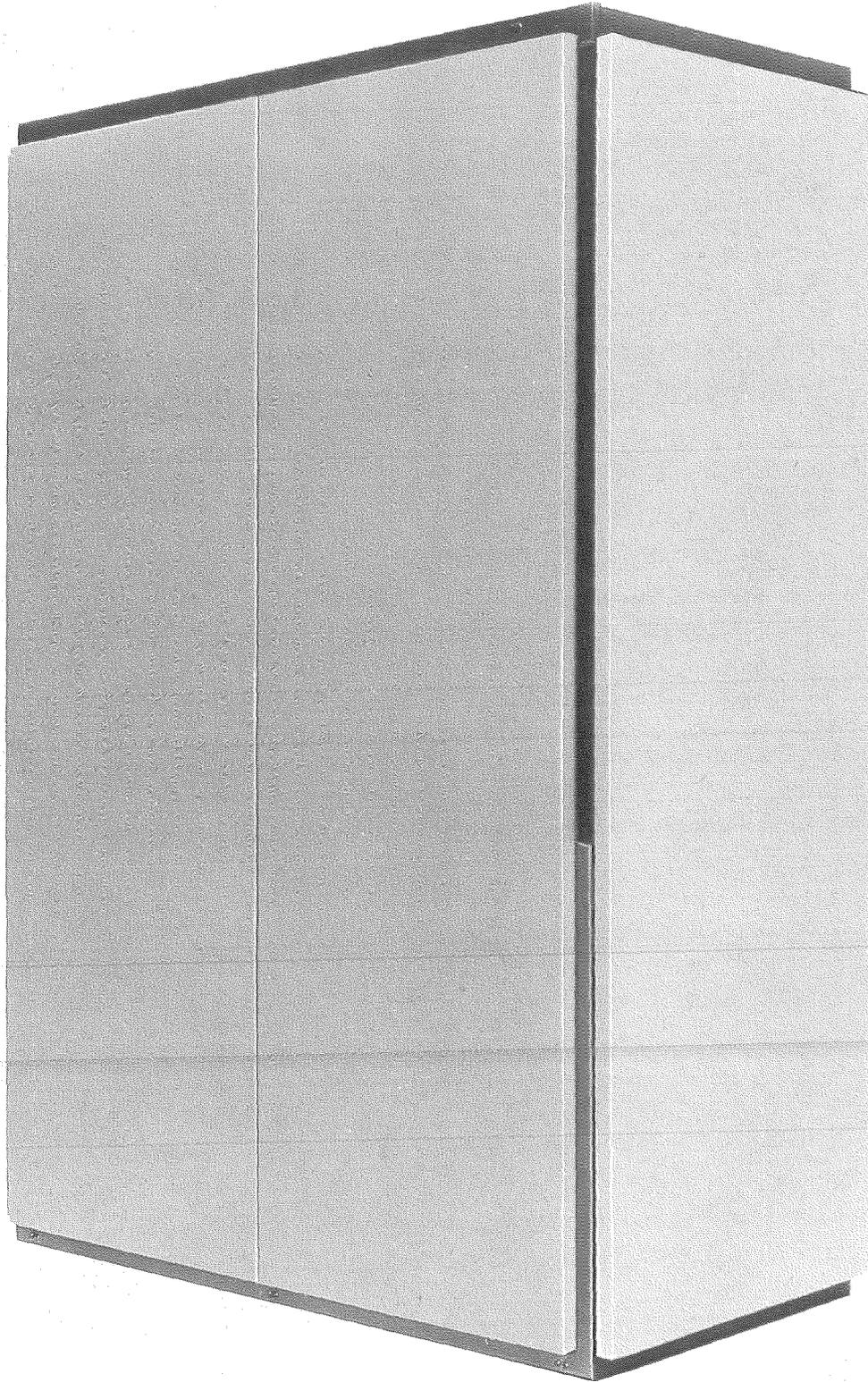


Fig. 1—Equipment Cabinet (Sheet 1 of 2)

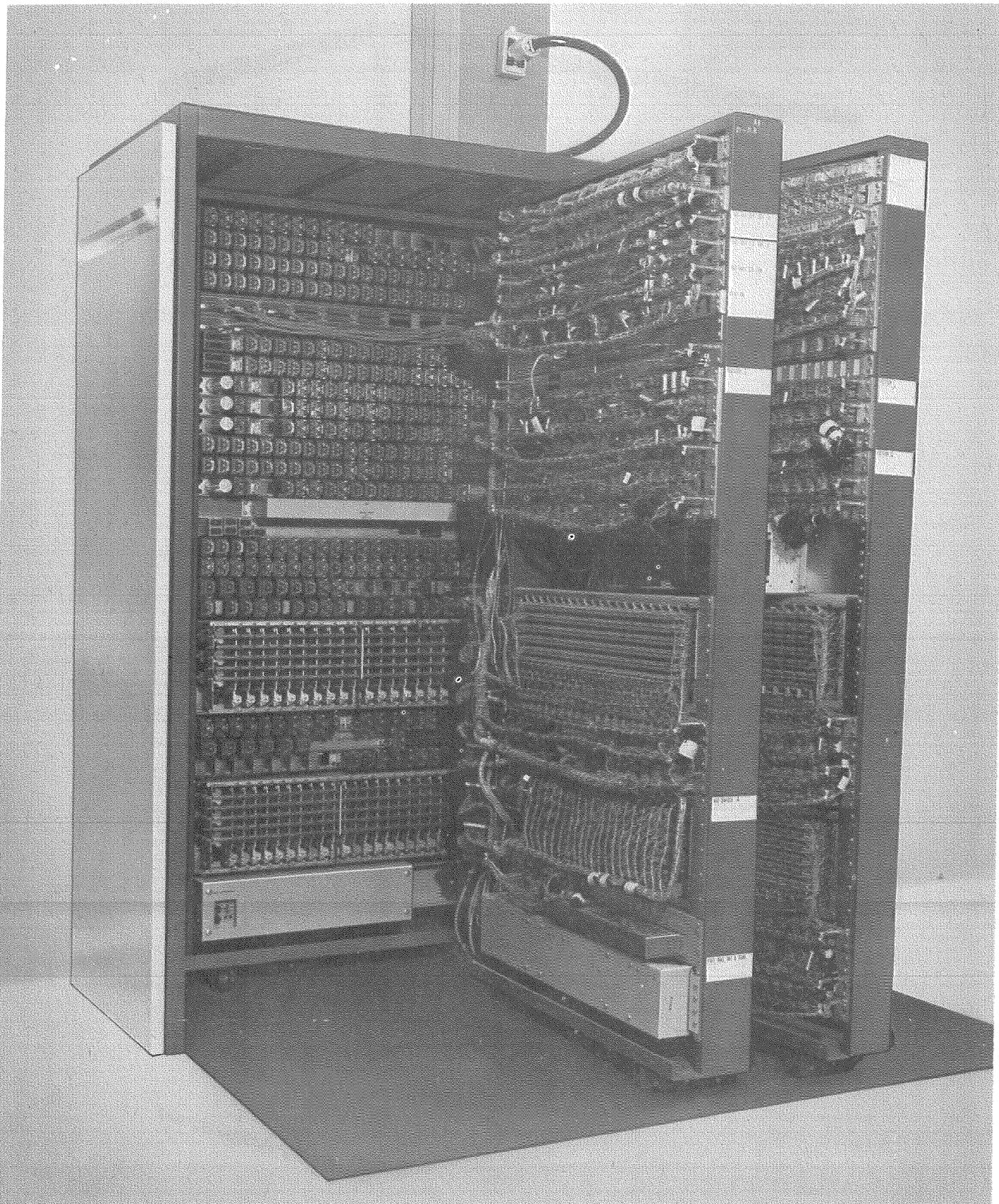


Fig. 1—Equipment Cabinet (Sheet 2 of 2)

TABLE A

## 770A PBX SERVICE FEATURES

FEATURE	PAR.	SERIES			CENTREX		OPTIONAL FEATURES	HOTEL/MOTEL FEATURES
		100	200	300	I	II		
Attendant Position (Console)	1.06	X	X	X	X			
Direct Outward Dialing	1.07	X	X	X	X			
Station-to-Station Calling	1.08	X	X	X	X			
Station Hunting	1.09	X	X	X	X			
Call Transfer — Attendant	1.10	X	X	X	X			
Restriction From Outgoing Calls	1.11	X	X	X	X			
Power Failure Transfer — Station	1.12	X	X	X	X			
Night Service	Equipped for DID	1.13	X	X	X	X		
	Not equipped for DID	1.14						
Attendant Camp-On	1.18		X	X				
Indication of Camp-On	1.18		X	X				
Attendant Conference	1.19		X	X				
Attendant DSS With Busy Lamp Field	1.20		X	X				
Call Transfer — Individual	1.21			X		X		
Consultation Hold	1.22			X		X		
Add-On	1.23			X		X		
Trunk-Answer-From-Any-Station	1.24			X		X		
TOUCH-TONE® Calling	1.25						X	
Tie Trunks	1.26						X	
Toll Restriction	1.27						X	
Battery Operation	1.36				X		X	
Transfer of Outgoing Calls	Attendant	1.10					X	
	Individual	1.21						
Lockout	1.28						X	

TABLE A (Cont)

## 770A PBX SERVICE FEATURES

FEATURE	PAR.	SERIES			CENTREX		OPTIONAL FEATURES	HOTEL/MOTEL FEATURES
		100	200	300	I	II		
Secrecy	1.29						X	
Single-Digit Dialing for Room Service, etc	1.30							X
Mixed-Length Station Numbers Access Codes	1.31						X	X
Station Message Registers	1.32							X
Message Waiting	1.34							X
Direct Single-Digit Access — Station to Toll Operator (on a permissive basis)								X
Wide Frequency Power Supply	1.36						X	
Traffic Measurement	1.38						X	
Traffic Register	1.43						X	X
Fully Restricted Station	1.46						X	
Executive Ringback	1.47						X	
Executive Override	1.48						X	
Direct Inward Dialing (DID)	1.49				X		X	
Automatic Identified Outward Dialing (AIOD)	1.52				X		X	
Centralized Attendant Service (CAS)	1.59						X	
Call Forwarding — Don't Answer	1.51						X	
Call Forwarding — Busy Line	1.50						X	
Common Control Switching Arrangement (CCSA)	1.53						X	
CCSA On-Net/Off-Net Access (Trunk Junctor)	1.54						X	
Timed Reminder	1.55						X	
Extendible Paging	1.56						X	

TABLE A (Cont)

## 770A PBX SERVICE FEATURES

FEATURE	PAR.	SERIES			CENTREX		OPTIONAL FEATURES	HOTEL/MOTEL FEATURES
		100	200	300	I	II		
Trunk Selector	1.57						X	
Maintenance Control	1.58						X	
Marker Display	1.58						X	
Switched Loop and Trunk Maintenance	1.58						X	
<b>AUTOVON</b>	<b>1.60</b>						<b>X</b>	

**TABLE B**  
**ALLOWED DIAL CODE COMBINATIONS**

FIRST DIGIT DIALED	POSSIBLE COMBINATIONS
<b>4-Digit System</b>	
1 through 5	4-digit station and 3-digit delay station, or 4-digit station and 2-digit delay station, or 4-digit station and 1-digit delay station
6 through 9	4-digit station and 3-digit delay station, or 4-digit station and 2-digit delay station, or 4-digit station and 1-digit delay station, or 4-digit station and 3-digit delay station and 1-digit delay trunk, or 4-digit station and 1-digit delay trunk, or 2-digit trunk, or 1-digit trunk
<b>3-Digit System</b>	
1 through 5	3-digit station and 2-digit delay station or 3-digit station and 1-digit delay station
6 through 9	3-digit station and 2-digit delay station, or 3-digit station and 1-digit delay station, or 3-digit station and 2-digit delay station and 1-digit delay trunk, or 3-digit station and 1-digit delay trunk or 2-digit trunk, or 1-digit trunk
<b>2-Digit System</b>	
1 through 5	2-digit station and 1-digit delay station
6 through 9	2-digit station and 1-digit delay trunk, or 2-digit station and 1-digit delay station, or 2-digit trunk, or 1-digit trunk

**2. SWITCHING PRINCIPLES**

**SWITCHING PLAN**

- 2.01 The 770A PBX switching plan employs a crossbar switch network under control of a common group of circuits.
- 2.02 Fig. 2 is a block diagram showing the switching network and connected circuits for a PBX arranged for trunks directly terminated at the attendant console.
- 2.03 Fig. 3 is a block diagram showing the switching network and connected circuits for a PBX arranged for switched loop operation.
- 2.04 The 770A PBX switching network consists of line group switches, midswitches, and trunk group switches. The connection pattern is illustrated in Fig. 4.
- 2.05 The switching plan is illustrated in Fig. 5.
- 2.06 Connections between the line switch group and crossbar midswitches are listed in Table C.
- 2.07 Fig. 6 is a block diagram showing the circuits arranged for centrex with direct trunk termination.
- 2.08 Fig. 7 is a block diagram showing the circuits arranged for centrex with switched loop operation.
- 2.09 Fig. 8 is a block diagram showing the 770A PBX arranged in a centralized attendant service (CAS) system.

**NUMBERING PLAN**

- 2.10 Numbering plans within the 770A PBX are flexible. A typical 3-digit numbering plan for regular PBX service is:

DIALING CODE	DESTINATION
0	Attendant calls

1	Unassigned—The number "1" is not normally used as the first digit of a dialing code. This is done to eliminate registration of preliminary pulses caused by faulty use of station equipment.
2	Stations 200—299
3	Stations 300—399
4	Stations 400—499
5	Stations 500—599
6 or 6X	Miscellaneous trunks
7 or 7X	Miscellaneous trunks
8 or 8X	Miscellaneous trunks
9 or 9X	CO trunks, FX lines, WATS lines

- 2.11 The marker has been designed to recognize single digits. This permits the assignment of single-digit codes in the hotel/motel version of the 770A PBX.

- 2.12 Each group of CO trunks, tie trunks, and miscellaneous special service trunks may be assigned a separate single-digit code. However, where the number of trunk groups exceeds the number of available single-digit codes, 2-digit codes may be used. A maximum of 16 (two digits plus single digit) trunk codes will be provided. These codes are restricted to 6X, 7X, 8X, and 9X. No mix of single- and 2-digit codes may be made on the same level. (For example, 6 and 62 is not a permissible arrangement; however, 6, 72, 83, etc, is permissible.) The second digits of codes need not be any specific digits, nor need they be the same on each level. Class-of-service restrictions will operate based on the first digit of the code only. Therefore, a station may not access 81 and be restricted from 82.

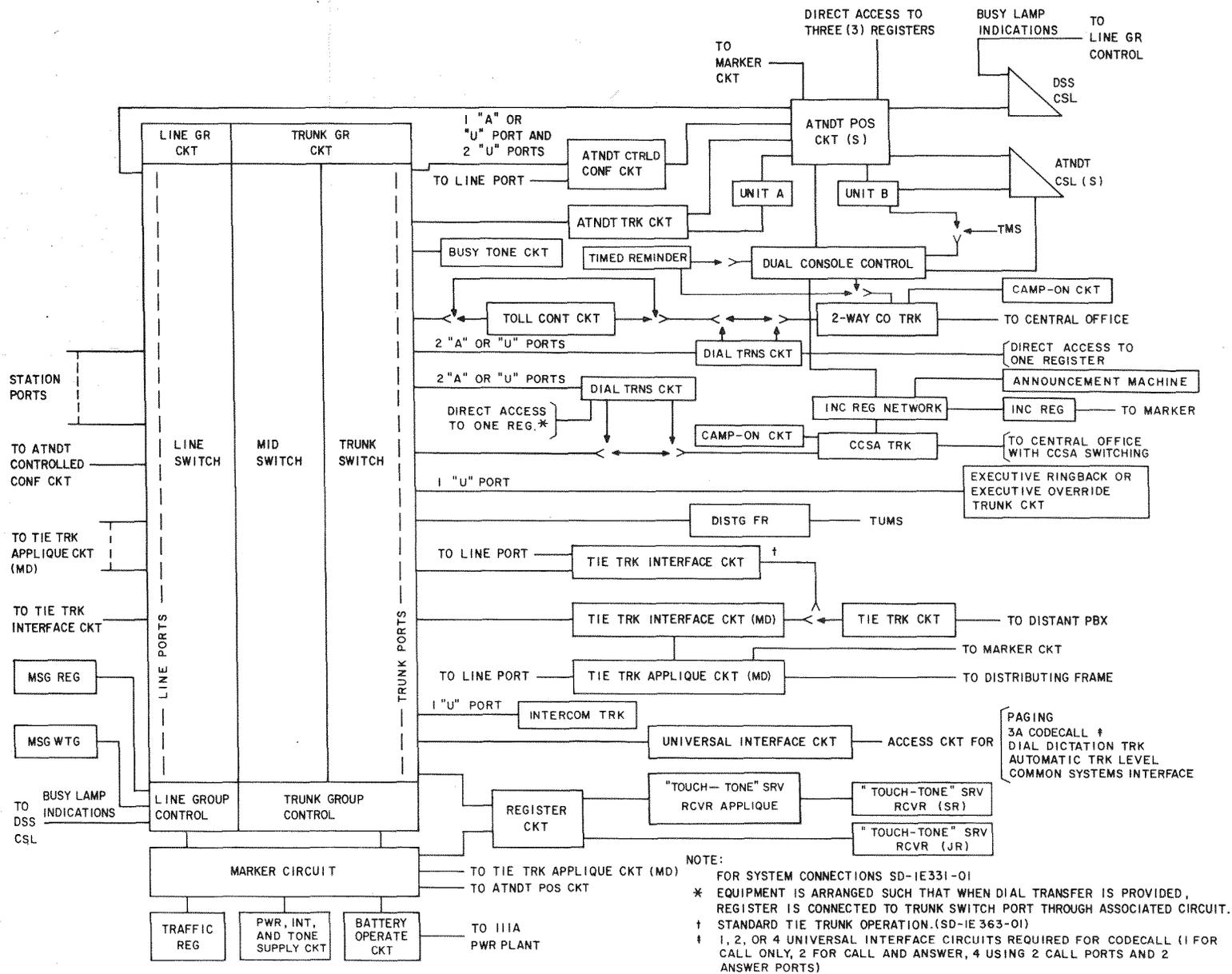


Fig. 2—Block Diagram Showing Direct Trunk Termination Systems (See Fig. 41 for AUTOVON system connection.)

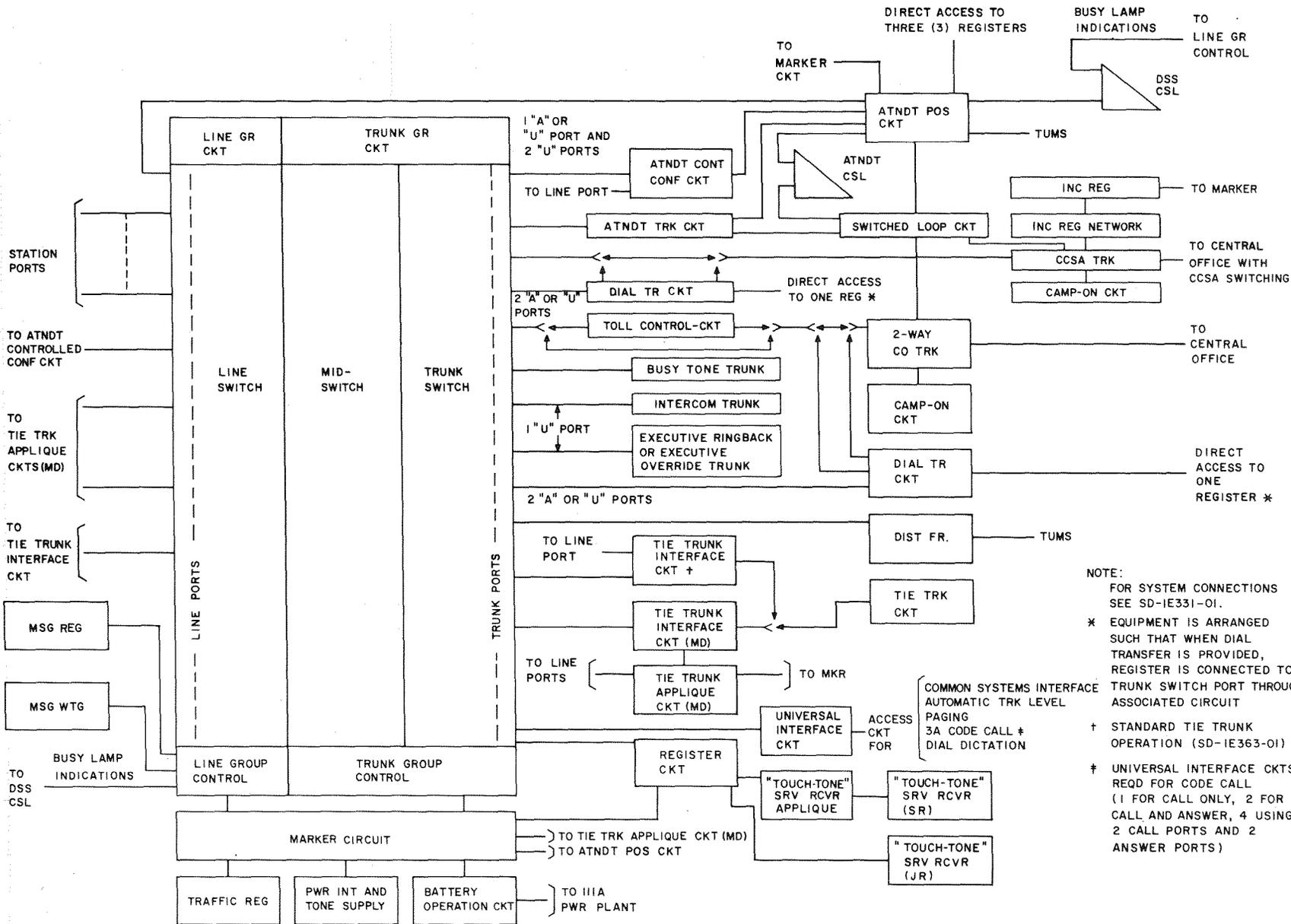


Fig. 3—Block Diagram Showing Switched Loop Trunk Termination System

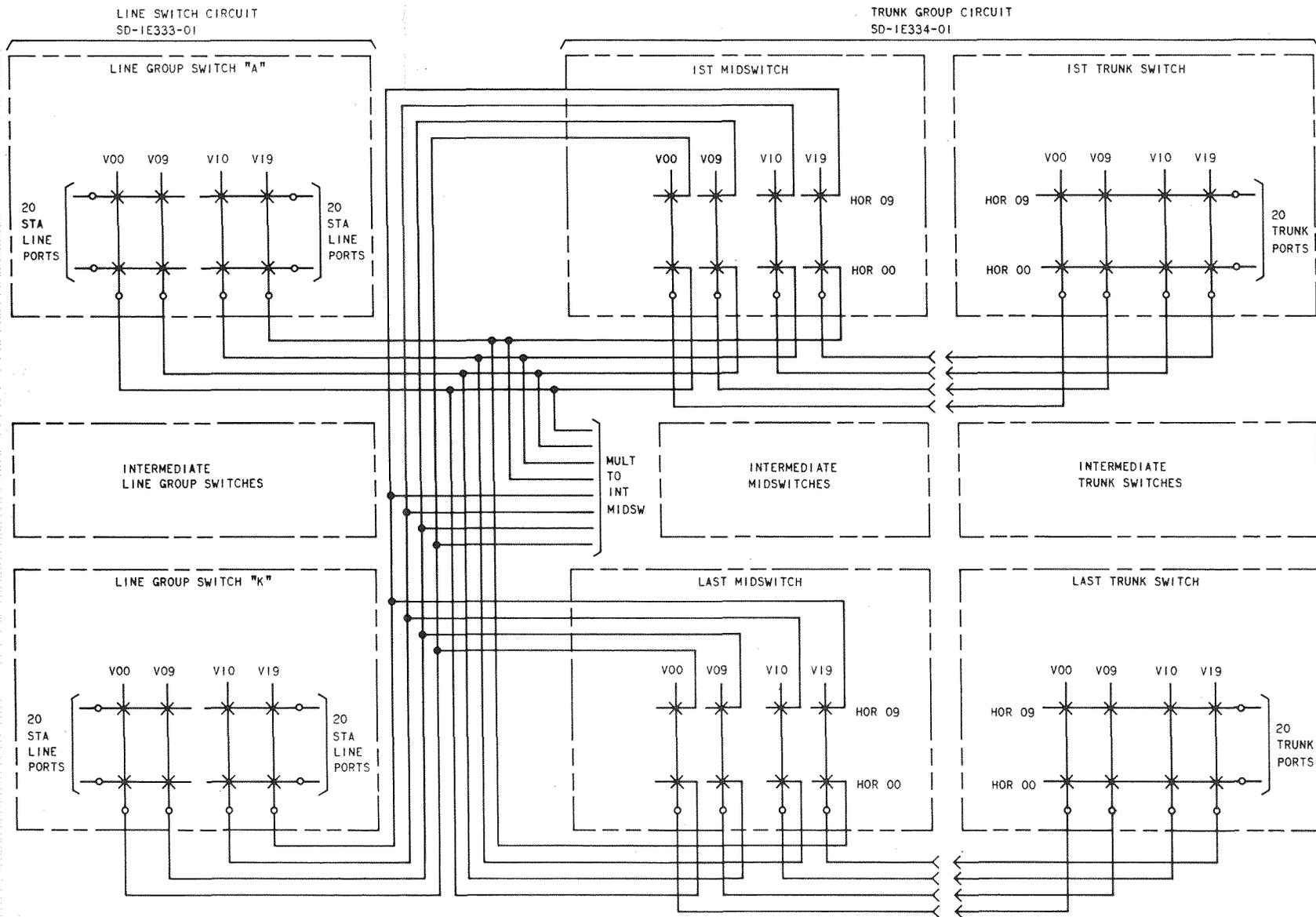


Fig. 4—Connection Pattern Using Crossbar Midswitches





TRUNK GROUP CIRCUIT SD-1E334-01

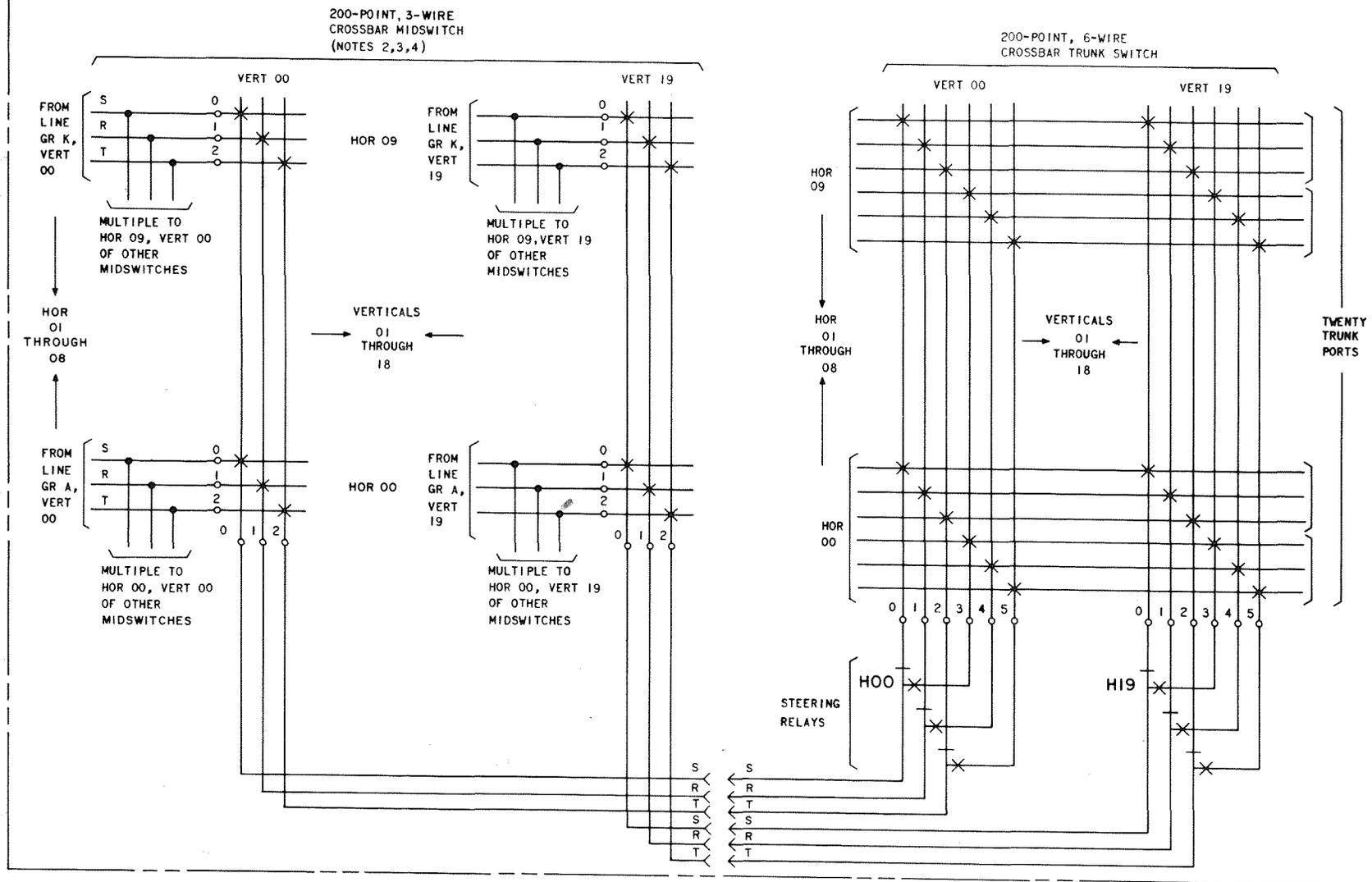


Fig. 5—Switching Plan (Sheet 3 of 3)

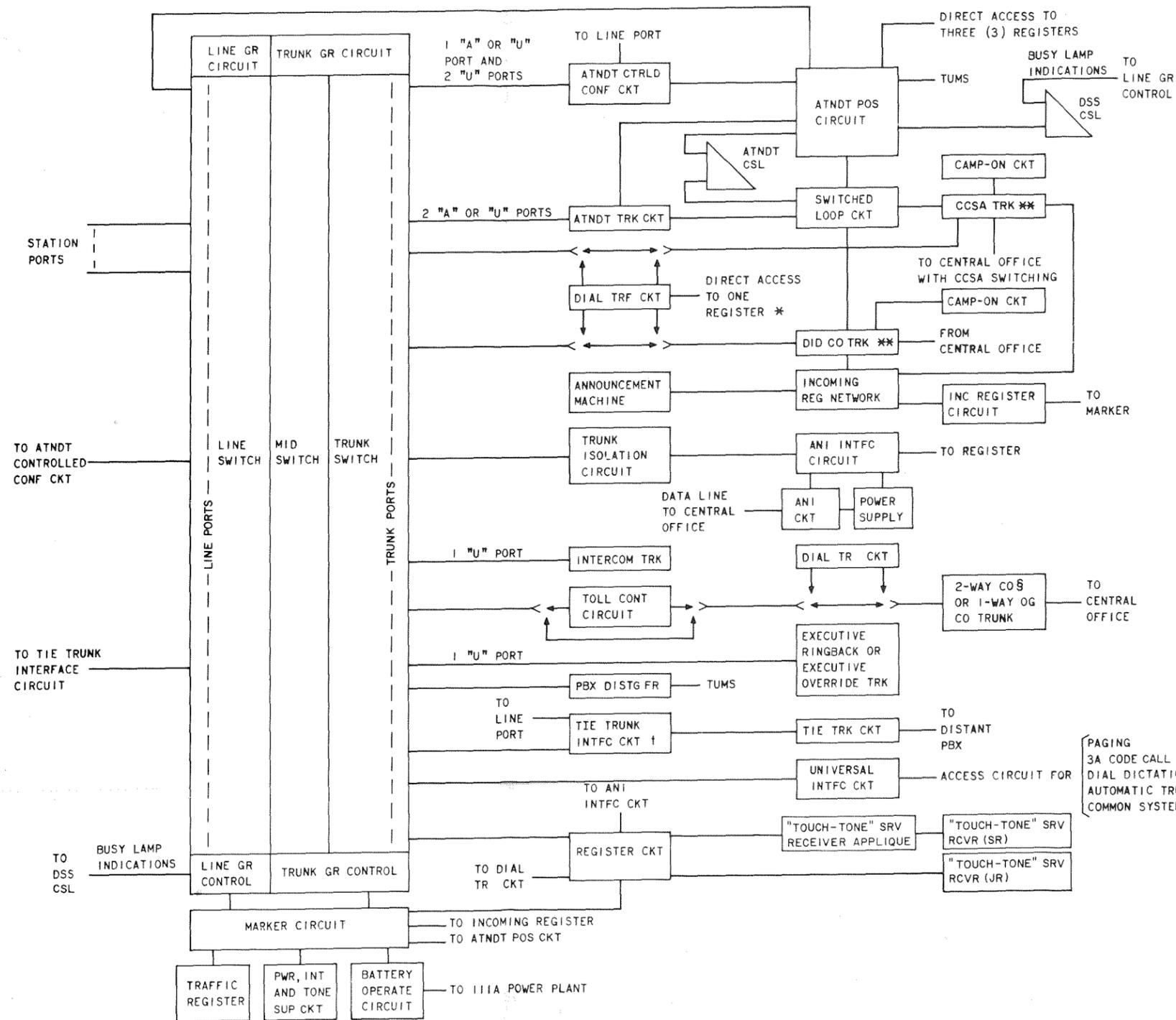
**TABLE C**  
**LINE GROUP SWITCH TO MIDSWITCH CONNECTIONS**

CONNECTIONS									
FROM		TO							
LINE GROUP SW (NOTE)		MIDSWITCHES ON A MULTIPLIED BASIS							
DESIG	VERT	1ST SW		2ND SW		INTERMEDIATE SWITCHES		LAST SW	
		HOR	VERT	HOR	VERT	HOR	VERT	HOR	VERT
A	00	00	00	00	00	00	00	00	00
	01	00	01	00	01	00	01	00	01
	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
	09	00	09	00	09	00	09	00	09
	10	00	10	00	10	00	10	00	10
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
19	00	19	00	19	00	19	00	19	00
B	00	01	00	01	00	01	00	01	00
	01	01	01	01	01	01	01	01	01
	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
	09	01	09	01	09	01	09	01	09
	10	01	10	01	10	01	10	01	10
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
19	01	19	01	19	01	19	01	19	01
INTERMEDIATE LINE GROUP SWITCHES C THROUGH J									
K	00	09	00	09	00	09	00	09	00
	01	09	01	09	01	09	01	09	01
	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
	09	09	09	09	09	09	09	09	09
	10	09	10	09	10	09	10	09	10
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
19	09	19	09	19	09	19	09	19	09

**Note:**

There may be a maximum of 10 line group switches.



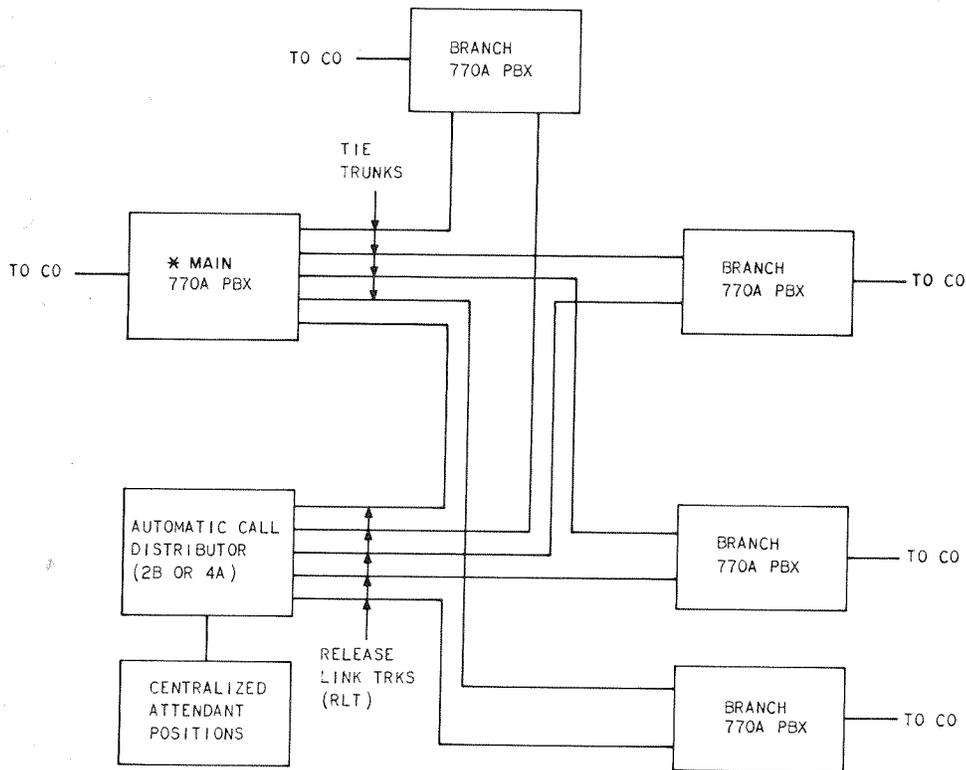


NOTE:  
 FOR SYSTEM CONNECTIONS SD-1E331-01

- \* - EQUIPMENT IS ARRANGED SUCH THAT WHEN DIAL TRANSFER IS PROVIDED, REGISTER IS CONNECTED TO TRUNK SWITCH PORT THROUGH ASSOCIATED CIRCUIT
- † - STANDARD TIE TRUNK OPERATION. (SD-1E363-01)
- ‡ - 1, 2 OR 4 UNIVERSAL INTERFACE CIRCUITS REQUIRED FOR CODECALL (1 FOR CALL ONLY, 2 FOR CALL AND ANSWER, 4 USING 2 CALL PORTS AND 2 ANSWER PORTS)
- § - 2-WAY CO TRK IS REQUIRED WHEN OUTGOING DIAL TRANSFER PROVIDED
- \*\* - MAXIMUM OF 80 DID CO AND/OR CCSA TRKS, 20 PER INCOMING REGISTER NETWORK CKT.

PAGING  
 3A CODE CALL ‡  
 DIAL DICTATION TRUNK  
 AUTOMATIC TRUNK LEVEL  
 COMMON SYSTEMS INTFC

Fig. 7—Block Diagram Showing Centrex Circuits for 770A PBX With Switched Loop Operation



\* MAIN AND BRANCH SYSTEMS MAY BE CENTREX

Fig. 8—Block Diagram Showing 770A PBX With Centralized Attendant Service (Typical)

## 3. CIRCUIT ELEMENTS

## MARKER

**3.01** One marker is provided with each 770A PBX. The marker is the basic control element of the system and is used in the completion of each connection through the switching network. The marker can process only one call at a time. To cope with simultaneous bids for service, a lockout and preference arrangement is provided. The marker will make only one attempt to complete a call. If unsuccessful within the predetermined time interval, the marker will release the call. Appropriate marker cross-connections establish the desired class-of-service option, trunk hunting, and intercept assignments.

## DIAL PULSE REGISTER

**3.02** The dial pulse register (register) functions as a dial pulse counter and digit call class and group information store on all calls within the PBX. The register does not perform any function on outgoing CO calls after the CO connection has been established unless toll denial is provided. The register provides dial tone prior to the first digit, signals the marker as to which type of call completion is to be made based on the calling and called party information within the register, and indicates to the marker the calling and called party identity and class of service, when required. Under certain conditions, the register also provides reorder tone to the calling party. One trunk port is required for each register. The number of registers required is determined by the PBX traffic load.

## LINE SWITCH UNIT

**3.03** The line switch unit consists of a line switch circuit and a 10-by-20, 6-wire crossbar switch. Each line switch unit provides 40 line ports which may be used for station lines, tie trunks, conference line ports, or attendant position circuits. The line switch circuit, after detecting a calling party off-hook condition (loop closure), functions to:

- (a) Lock out the other line switch circuits to ensure that only one line switch circuit is used at a time
- (b) Provide a chain circuit so that only one line out of all possible simultaneously requesting lines will be identified

(c) Indicate to the marker the location and class of service of the calling line

(d) Return busy-hunt-idle and class-of-service information concerning the called line to the marker.

**Note:** Appropriate line switch circuit cross-connections establish the desired line hunting. If a 770A PBX system does not require station hunting, a nonhunting line switch may be provided. However, if the system is later updated for station hunting, a station hunting line switch must be provided.

The line switch circuit provides interface for the message register circuits and the message waiting circuits on a per-line basis. The line switch circuit also provides the switching necessary to control the steering that divides the 10-by-20, 6-wire crossbar switch into two groups of 20 lines each. The horizontals of the line switch serve as line ports, the verticals serve as links to the horizontals of the midswitch. Each group of 20 line ports has ten links (verticals) to the midswitch. Thus, ten line switches can have a maximum of 400 lines.

## MIDSWITCH UNIT

**3.04** There are two types of midswitches, and one arrangement which uses cables in place of a midswitch. Table D provides information as to the maximum line capacity with different midswitch arrangements.

**3.05** The crossbar midswitch is a 10-by-20, 3-wire crossbar switch serving as the second switch in the 3-stage network to provide connecting links between the line switch and the trunk switch. The horizontals of the crossbar midswitch are connected to the verticals of the line switch; the verticals of the crossbar midswitch are connected to the verticals of the trunk switch (Fig. 4 and 5).

**3.06** The relay midswitch is made up of a group of relays serving as the second stage in the 3-stage switching network to provide connecting links between the line switch and the trunk switch. The verticals of the line switch are connected to the verticals of the trunk switch through the relay contacts of the relay midswitch. Fig. 5 provides the switching plan using the relay midswitch. The relay midswitch has an 80-line (maximum) arrangement, an 80-line growth (160 line maximum) arrangement,

or a 160-line (maximum) arrangement as shown in Table D.

**3.07** A system requiring 40 lines (maximum) can be provided by using cables in place of a midswitch. The cables provide the connecting links between the verticals of the line switch and the verticals of the trunk switch. Table D lists this cable arrangement, and the interunit cable figure is shown in Section 551-770-200.

#### TRUNK SWITCH UNIT

**3.08** The trunk switch unit consists of a trunk switch circuit and a 10-by-20, 6-wire crossbar switch. Each trunk switch unit provides 20 trunk ports which may be used for CO, dial transfer, intercom, attendant trunks, tie trunks, conference circuits, and dial pulse registers. The trunk switch circuit has the following major functions.

- (a) Provides the marker with an interface to allow the marker to control the trunk-side circuits
- (b) Indicates to the trunk port circuits which type of circuit is desired by the marker
- (c) Provides an indication to the marker that an idle trunk of the desired type and an idle link to that trunk are available
- (d) Provides a hunting chain between the trunk switch circuits such that only one switch with an idle circuit of the selected type and an idle link to the selected line will be selected by the marker.

The trunk switch circuit also provides the switching necessary to control the steering that permits the horizontals to function as 20 trunk ports. The number of trunk switches required is determined by the PBX traffic load.

#### DIAL TRANSFER CIRCUIT

**3.09** A station dial transfer circuit is required to provide the call transfer—individual feature. One station dial transfer circuit provides two transfer ports on the trunk side of the switching network for each group of eight CO trunks. This ratio may be reduced by assigning fewer trunks to each dial transfer unit. The call transfer—individual feature may be utilized on incoming CO trunk-to-station

or outgoing station-to-CO trunk calls. A dial transfer circuit is also required when the trunk-answer-from-any-station feature is desired.

**3.10** The station dial transfer circuit can be arranged for service as follows.

- (a) To transfer incoming CO trunk-to-station calls using incoming CO trunks or 2-way CO trunks.
- (b) To transfer outgoing station-to-CO trunk calls only when outgoing trunks involved are 2-way CO trunks. (These trunks may be used as only outgoing trunks, but the equipment must be J58876UL.)
- (c) To transfer incoming CCSA trunk-to-station calls using CCSA trunks.
- (d) To transfer outgoing station-to-CCSA trunk calls using CCSA trunks.
- (e) To transfer incoming DID trunk-to-station calls using DID trunks.
- (f) To provide recall dial tone; that is, dial tone interrupted at 240 ipm. This recall dial tone signal indicates to the transferring party that the transfer circuit has recognized the flash for service and dial tone.

#### ATTENDANT POSITION CIRCUIT

**3.11** One attendant position circuit is required for each attendant console. The attendant position circuit has the following major functions.

- (a) Provides the attendant with direct access to idle registers through a chain circuit between registers when required for attendant completions
- (b) Stores the identity (equipment location) of the calling line in certain connections for later use
- (c) Provides the DSS console with an interface to the marker such that the DSS console is read like a register
- (d) Provides control of the attendant talking circuit and its interconnection to CO and attendant trunks.

### ATTENDANT TRUNKS

**3.12** Attendant trunk circuits are used in completing dial "0" calls. Tie line calls to the attendant are routed via the attendant trunks. Attendant trunk calls may be extended to the CO or to other stations. On systems equipped for switched loop operation, the attendant trunk contains the timer and necessary control circuitry to provide the timed reminder feature. Options are provided to allow selection of a 15-, 30-, or 45-second timed delay.

### CENTRAL OFFICE TRUNKS

**3.13** Trunks used as CO trunks may be one-way incoming, one-way outgoing, or 2-way combination. Complete flexibility is achieved since any CO trunk circuit is physically interchangeable with any other CO trunk circuit on a plug-in basis. The CO trunks may be divided into one or more trunk groups. When one trunk group is provided, all CO trunks are reached by dialing a single code. With two or more groups, the CO trunks may be reached by dialing different single- or 2-digit codes. Two-way combination and one-way outgoing CO trunks are generally arranged for dial "9" selection, or are assigned a code in the "90" series for 2-digit selection.

### TIE TRUNKS

**3.14** All tie trunk circuits are 2-way combination-type circuits having ringing, ring-trip, and talking battery facilities. Access to dial repeating tie trunks is achieved by dialing the appropriate single- or 2-digit code. A second dial tone should be provided by the distant PBX to indicate that dialing may continue. The called station number or distant attendant code is then dialed.

### BUSY TONE TRUNK

**3.15** Station-to-station or tie trunk-to-station calls are routed to a busy tone trunk if the marker cannot complete the connection due to a busy condition. A 60-ipm tone is supplied to the calling party. If the busy tone trunks are in use, reorder tone is furnished by a register. Attendant-handled incoming CO trunk calls to a busy station with camp-on will not be connected to a busy tone, but a "camp-on allowed or denied" indication will be provided to the attendant.

### ATTENDANT-CONTROLLED CONFERENCE CIRCUIT

**3.16** The 770A PBX provides the attendant with the capability of setting up a conference involving five other parties, one of which may be a CO trunk party.

### STATION LINES

**3.17** Station line ports are provided in groups of 40, and each line port has access to all trunk circuits in the system via the horizontals of the midswitch to which it has access. Station line ports are shared with stations, tie trunks, conference circuits, and position circuits. Each station has access to every other station via intercom trunks. Two links are required for station-to-station calls. Each station line may be assigned, on an individual basis, to one of the classes of service listed in Table E.

**3.18** Within any equipment tens group, station lines can be arranged for one-way (terminal) consecutive or nonconsecutive hunting, as desired. Terminal hunting can be arranged to hunt either higher or lower numbers in the tens group, but only from a primary station to an alternate station, not from alternate to primary.

### SWITCHED LOOP CIRCUIT

**3.19** The switched loop circuit provides an interface between the CO trunk circuits and the attendant loop circuits. The attendant trunks function as the attendant loops. The switched loop circuit also functions as follows.

- (a) Provides a connection to a CO trunk via an attendant trunk (loop) when the attendant dials the proper access code.
- (b) Provides distribution of incoming calls among the loops.
- (c) Provides incoming call identification to the attendant position circuits on the selected loop.
- (d) Provides the correct lamp indications to the position circuits when the loop is busy or held.
- (e) Maintains a connection through the switch loop for the duration of the held call.

- (f) Provides trunk group busy lamp indications.
- (g) Provides attendant trunk queuing feature, optionally, which distributes incoming CO trunk calls to the attendant which has been idle the longest and has access to the group in which the CO trunk appears. With queuing, any of the following conditions will light the CW lamp.

- All loops busy and a call waiting
- All attendant trunks busy and a call waiting
- All attendants busy and a call waiting in the queue.

Without queuing, the following conditions will light the CW lamp.

- All loops busy and a call waiting
- All attendant trunks busy and a call waiting.

#### **EXECUTIVE RINGBACK OR EXECUTIVE OVERRIDE TRUNKS**

**3.20** Executive trunks are provided when certain stations desire executive ringback (ability for a station to be called back when a busy station is called) or executive override (ability for a station to override a busy station condition and to be connected after a warning tone is applied to the busy station). Either the executive ringback or the executive override feature can be equipped on this trunk, but only one feature can be arranged for any 770A PBX system.

#### **DIRECT INWARD DIALING—CO TRUNK**

**3.21** The DID CO trunk circuit provides the supervisory, control, and transmission features required for terminating incoming DID calls to an attendant or a station in the PBX.

#### **INCOMING REGISTER CIRCUIT**

**3.22** The incoming register receives, counts, and stores the direct inward dialed station code information on incoming CCSA or DID calls. The register provides a wink-start signal if it is required by the CO. Stored digit data is transferred to the marker circuit and, under command of the marker, the register returns busy tone and recorded announcement messages, or signals the incoming

trunk to return reorder tone or to provide attendant transfer operation. The number of incoming registers required is determined by the traffic load.

#### **INCOMING REGISTER NETWORK**

**3.23** The incoming register network provides connections between the DID CO or CCSA trunks and the incoming registers. A crossbar switch is used to provide the connections from 1 to 20 DID CO and/or CCSA trunks on the verticals to 1 to 12 incoming registers on the 12 horizontal levels. A maximum of four incoming register networks may be provided.

**3.24** A relay preference circuit within the network selects one—**and only one**—trunk request at a time. Only one trunk-to-register connection can be processed at a time, though there can be one established connection to each incoming register provided.

#### **AUTOMATIC NUMBER IDENTIFICATION INTERFACE**

**3.25** The 770A PBX ANI interface circuit establishes information for automatic identification of calling station and trunk numbers on an outgoing CO trunk call. The interface circuit converts the decimal number (calling station and trunk number) to binary coded decimal (BCD) number for transmission to the ANI interface circuit and then to the associated CO.

**3.26** One-way or 2-way outgoing CO trunks may be arranged with a maximum of nine to a trunk switch in the 770A PBX. The ANI circuit has the capacity to identify 150 trunk circuits.

**3.27** The ANI interface contains a basic unit with circuits for control and for station and trunk identification. Supplementary trunk isolation units, each associated with 20 trunks, connect to the 770A PBX outgoing trunk circuits and assign the trunk numbers for processing in the basic unit. One of two optional arrangements (one for standard numbering and one for flexible numbering) is necessary for station line identification. Flexible number arrangements consist of two types of units, basic and supplementary. The basic unit accommodates the first 40 of 200 lines and a supplementary unit accommodates 40 lines. A second basic unit and additional supplementary units will be required for systems from 200 to 400 lines.

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**3.28** The ANI circuit available for use with the 770A PBX is a universal ANI circuit (SD-1E505-01).

### MESSAGE REGISTRATION

**3.29** The message registration circuit provides the necessary pulsing to score the associated station registers. This circuit is compatible with Issue 29B or later 2-way CO trunks.

### COMMON CONTROL SWITCHING ARRANGEMENT (CCSA)

**3.30** The CCSA feature allows completion as follows.

- (a) Of an incoming call from the CCSA network to a specific station in the PBX without attendant assistance
- (b) Of an outgoing call to the CCSA network without attendant assistance and, if required, returns a delay dial signal to the CO.

### TRUNK JUNCTOR

**3.31** The trunk junctor circuit provides the supervisory control and transmission features to allow:

- Off-network access from a CCSA trunk to a 2-way or one-way outgoing CO trunk
- On-network access from a 2-way CO trunk to the CCSA network via a CCSA trunk.

### TIMED REMINDER

#### Direct Terminated Systems

**3.32** The SD-1E376-01 timed reminder circuit for direct terminated systems monitors the state of relays in the CO trunk to determine call status. Lamp and audible tone leads are controlled by the timed reminder circuit to apply signals to the console. The timed reminder circuit also has the following functions.

- When the attendant is connected to a CO party, action in the trunk places the timed reminder circuit in an inhibit condition which prevents the timer from operating.

- When a CO trunk call is placed on hold, camped on, or rings without an answer, the trunk applies a timer start signal which starts the delay timing sequence and, upon completion, applies the reminder signal to the console.
- The timed reminder signal will be canceled if the attendant reenters the connection or if the held party hangs up.
- When a CO trunk call is extended to a PBX station, the trunk applies a timer start signal and, when the attendant releases, the timer sequence starts. The timer will be disabled when the called station answers.
- An inhibit condition is provided to prevent the operation of timed reminders on dial transfer calls.
- If the timing sequence is allowed to complete, the timed reminder signal, consisting of a 60-ipm flashing source lamp and audible tone, is applied to the console.
- Options are provided to allow selection of either 15-, 30-, or 45-second timed delay.

#### Switched Loop Systems

**3.33** On switched loop systems, the circuitry necessary to provide timed reminders is provided on an optional basis in the attendant trunk. Operational features are identical to those described under direct terminated systems. All control functions originate in the attendant trunk and no additional units are necessary to provide the service.

### PAGING

**3.34** The universal interface circuit provides the availability of dial access paging by nonrestricted stations or the attendant, key paging by the attendant, and extendible paging by the attendant via a junctor circuit.

### TRUNK SELECTOR

**3.35** The trunk selector circuit is required to provide the customer trunk test and maintenance trunk test features. The customer trunk test attendant unit with a telephone set can be used

by the attendant or telephone maintenance personnel to gain access and test certain trunk ports.

#### MAINTENANCE CONTROL CIRCUIT

**3.36** The maintenance control circuit acts as an interface between the customer trunk test attendant or maintenance unit and the 770A PBX system. This unit permits test calls to be made from lines 29 or 39 (maintenance) or line 39 only (attendant—line switch A only) to observe basic marker functions, to inhibit register and marker time-out, to observe the busy/idle status of any trunk group, and to select and test a particular trunk circuit.

#### MARKER DISPLAY UNIT

**3.37** The marker display circuit displays the register output to the marker (digits dialed into the register) of the called line number, the called line group and terminal, and the calling line group and terminal. The calling line class of service (AX through DX and ORD) is also displayed. When the DISPLAY switch is set to ON, the light emitting diode (LED) display indicators light when the register reads the dialed digits into the marker. The indicators remain lighted for prolonged viewing. They can be extinguished at any time by setting the DISPLAY switch to RESET. A rotary selector

switch, labeled DISPLAY SELECTOR, is used to select three separate displays. The three positions are CALLED LINE NO., CALLED LINE GRP & TERM., and CALLING LINE GRP & TERM.

#### SWITCHED LOOP AND TRUNK MAINTENANCE CIRCUIT

**3.38** The switched loop and trunk maintenance circuit enables maintenance personnel to selectively connect the assigned trunks and switched loops to facilitate an orderly test procedure. A total of 20 trunks are accessible for test purposes via trunk jacks. A supplementary unit is available to add more trunk jacks in groups of 30. When a trunk is busy, an LED indicator mounted directly above the trunk jack will light. A test trunk circuit, when plugged into one of the trunk jacks, permits the user to simulate an incoming or outgoing trunk call and to insert loop resistance.

#### CENTRALIZED ATTENDANT SERVICE

**3.39** CAS provides for incoming listed directory calls to each 770A PBX or branch location to be switched to the centralized attendants via a release link trunk (RLT). These calls are always completed back to the PBX through which they were originally switched and over the same trunk. CAS also routes dial "0" calls to the centralized attendant(s).

TABLE D  
MIDSWITCH ARRANGEMENT

FEATURE	LINE QUANTITY	J58876UC	
Midswitch	400 lines maximum (crossbar version)	L1	
	Relay version	160 lines maximum	L2
		80 lines maximum	L3
		Additional 80 lines (When only 80 lines are initially provided, provides for 160 lines maximum.)	L4 (In addition to the L3 installed initially)
Cables	40 lines maximum*	L5	

\*When no more than 40 lines are required, no midswitch is provided. Instead, cables (J58876UC, L5) are used to connect trunk and line switches.

TABLE E  
CLASS OF SERVICE

CLASS OF SERVICE	DIAL CODES ALLOWED				COLOR CODE FOR CROSS-CONNECT STRAPS
	6(X)	7(X)	8(X)	9(X)	
C0*					BL1Y
C1†					BL1W
C2	X				O1W
C3		X			G1W
C4			X		BR1W
C5	X		X		S1W
C6		X	X		BL1R
C7	X	X	X		O1R
C8				X	G1R
C9			X	X	BR1R
C10		X		X	S1R
C11	X			X	BL2BK
C12	X	X‡	X	X	O1BK
C13	X	X	X‡	X	G1BK
C14	X	X	X	X§	BR1BK
C15¶					S1BK
C16**					Not Required

\* CO provides intercept for unassigned line ports (vacant code intercept).

† C1 provides for fully restricted stations (inward and outward).

‡ C12 or C13 may be modified.

§ For systems with toll restriction.

¶ For executive override or executive ringback.

\*\* Allows testing of trunk ports — Cross-connect straps are not required.

#### 4. EQUIPMENT ELEMENTS

##### EQUIPMENT CABINET (Fig. 1)

**4.01** The basic 770A PBX uses standard crossbar switches and wire-spring relays. The equipment cabinets are of sheet metal fabrication. Each cabinet contains up to three roll-out equipment frames. These frames are locked against each other when the cabinet is closed, but roll out from a common pivot point to the front of the cabinet to give easy access to the front and rear of each frame and to the inside of the cabinet. The frames and cabinets are connected to each other and to the stations and trunks on a plug-in basis. The equipment units which mount on the equipment frames, such as the marker, trunks, registers, etc, are also plug-ended. A fully equipped, 400-line, Series 300 PBX usually requires about four 6 feet 10-1/2 inch high cabinets requiring about 40 square feet of equipment space. The dimensions of each cabinet are 2 feet 2-1/2 inches deep by 4 feet 7 inches wide by 6 feet 10-1/2 inches high.

##### ATTENDANT EQUIPMENT

**4.02** The attendant equipment used with the 770A PBX may be any of the following types of telephone consoles.

- The 1-type (MD) console with a maximum of 12 pickup keys. This console is used with direct trunk termination (single- or multiplied-dual console operation) when no more than 12 trunks are terminated.
- The 2A (MD) and 43A consoles with a maximum of 30 pickup keys. These consoles are used where not more than 30 trunks are terminated.
- The 23A console has six loop keys for switched loop operation. The 53B, 53C, and 63A consoles have 30 trunk pickup keys for direct trunk operations or six loop keys for switched loop operation. These consoles also have a lamp field for incoming call identification (ICI) and trunk group busy (TGB) indication.
- The 83-type console has 6 loop keys for switched loop operation or 30 pickup keys for direct trunk operation. The 83-type

console also has a busy station display (BSD) field in place of the DSS field.

**4.03** If the optional attendant DSS feature is provided, one or two 1A-type selector consoles are provided in addition to the 23A or 43A attendant console(s). Each selector console can be equipped with a maximum of 200 illuminating station pickup keys. The 53C telephone console, equipped with 100 illuminating station selection keys, may be used in systems with 100 lines or less. The 53B telephone console, equipped with 200 illuminating station selection keys, may be used in systems with 200 lines or less. The 63A telephone console, equipped with 400 illuminating station selection keys, may be used in systems with 400 lines or less. The 83-type telephone console, equipped with 400 illuminating station busy lamps, may be used with 400 lines or less.

##### CENTRALIZED ATTENDANT SERVICE

**4.04** If CAS is provided using the 770A PBX, the main and/or each branch PBX may have one attendant position (console) on the first position only. This position can serve the PBX in normal system operation and, while the position is busy, the succeeding calls will be extended to the CAS positions.

**4.05** A modified keyset will back up the CAS positions in place of a console on an optional basis. The keyset may also be used to control remote answer or fixed night connection calls.

**4.06** A special attendant console may be provided on an optional basis to process wide area telephone service (WATS), conference, foreign exchange (FX), and toll calls. This must be a direct trunk termination-type console and, as such, cannot process listed directory number (LDN) calls nor back up the CAS position.

**4.07** An auxiliary supervisory control module may be optionally provided. The control module contains a busy release key, remote answer key, fixed night key, and three busy keys for RLTs 1 through 3. Lamp indicators are provided for fuse alarm, remote answer, fixed night, and the three busy RLT keys.

**4.08** For additional information concerning CAS using 770A PBX, refer to Sections 551-770-205 and 981-012-100.

5. METHOD OF OPERATION

GENERAL

5.01 This part describes typical call operation and describes the sequence of calls through the switching network.

5.02 Chain circuits provide for one idle circuit (register, intercom trunk, attendant trunk, CO trunk, tie trunk, dial transfer, attendant conference, or busy tone trunk) per trunk group circuit to be selected. The marker hunts for a trunk group circuit having an idle circuit of desired type and at least one idle link. When a trunk group circuit is found, the marker selects one idle link and causes the network to operate, thus connecting the desired circuit to the calling line.

PBX DIAL TONE CONNECTION AND DIALING PATH (Fig. 9)

5.03 When a PBX station goes off-hook, the line switch circuit in which the calling line appears:

- (a) Detects a loop closure from the line and operates the line relay
- (b) Seizes the marker to initiate a register request
- (c) Transmits to the marker the equipment location and class-of-service identity of the calling line.

5.04 The marker:

- (a) Hunts for an idle register as described in 5.02
- (b) Selects an idle link through the network from the idle register port to the calling line port
- (c) Transmits to the register for future use the equipment location and class-of-service identity of the calling line
- (d) Actuates the switches and connects the idle link from the calling line to the register (hold magnets operated)
- (e) Releases for subsequent jobs.

5.05 The originating register:

- (a) Stores the equipment location and class-of-service identity of the calling line
- (b) Holds the transmission path through the network
- (c) Returns dial tone to the calling station.

STATION-TO-STATION CALL (Fig. 10)

5.06 The register:

- (a) Counts and stores the pulses or TOUCH-TONE service digits associated with each dialed digit (path 1)
- (b) Signals the marker to read out stored data from the register
- (c) Indicates to the marker the equipment location and class-of-service identity of both the calling and called lines.

5.07 The marker:

- (a) Checks busy or idle status of the called line
- (b) Hunts for an idle link through the network from calling line port to the originating port of an intercom trunk as described in 5.02
- (c) Hunts for an idle link through the network from the called line port to the terminating port of an intercom trunk
- (d) Makes a matching test to determine that the two available links will connect the calling and called line ports to an idle intercom trunk
- (e) Actuates the switches to make connection from the calling line port to the intercom trunk originating port (path 2)
- (f) Actuates the switches to make connection from the called line port to the intercom trunk terminating port (path 3)
- (g) Releases the register and then restores to normal for subsequent jobs.

**5.08** The intercom trunk circuit:

- (a) Applies interrupted ringing to the called party and couples an audible ringback signal to the calling station.
- (b) When the called station answers, removes (trips) ringing and completes the talking path.
- (c) Provides talking battery.
- (d) Provides disconnect supervision:
  - (1) If the **called** station goes on-hook first, its associated supervisory relay releases; no further action takes place at this time. When the calling station goes on-hook, its associated supervisory relay releases. The intercom trunk is now restored to normal (idle).
  - (2) If the **calling** station goes on-hook first, its associated supervisory relay releases; the originating end of the intercom trunk is now released. When the **called** station goes on-hook, its associated supervisory relay releases; the intercom trunk is now restored to normal (idle).

**STATION TO CENTRAL OFFICE TRUNK CALL (Fig. 11)****5.09** When the calling station dials the single digit "9" as the access code, the register:

- (a) Signals the marker to hunt for an idle CO trunk as described in 5.02
- (b) Transmits to the marker the equipment location and class-of-service identity of the calling party.

**5.10** The marker:

- (a) Selects an idle link between the calling station line port and the CO trunk port
- (b) Actuates the switches and connects the idle link from the calling station line port to the CO trunk port.

**5.11** The calling station:

- (a) Is connected to the CO.

- (b) Receives dial tone from the CO register; the dialed number is now transmitted directly to the CO register. About 1.5 seconds after the calling party hangs up, the CO trunk is restored to normal (idle).

**STATION-TO-ATTENDANT CALL (Fig. 11)**

**5.12** When a dialed "0" is recognized in the register, it requests readout immediately and signals the marker that an attendant call has been dialed; the marker then enables the attendant trunks. The marker hunts for a trunk group circuit having an idle attendant trunk and at least one idle link as described in 5.02. When loop supervision is detected toward the calling line, the attendant trunk circuit applies a holding ground toward the network, signals the marker that the connection is complete, and gives the necessary alerting signals to the attendant position circuits.

**STATION TO TIE TRUNK CALL (Fig. 11)**

**5.13** When a tie trunk code is recognized, the marker causes the register to gate out the calling line identity in order to check its class of service. If the line is allowed to complete to this type of tie trunk, the marker enables all tie trunk interface (TTI) circuits of this type. The marker now hunts for a trunk group circuit having an idle TTI circuit and at least one idle link to it, as described in 5.02. The tie trunk sends a seizure to the distant PBX when loop closure toward the calling line is detected. The distant PBX then returns dial tone (if the distant PBX is so equipped), indicating to the originating party that dialing may continue.

**RESTRICTED STATION TO CO TRUNK CALL—ON THROUGH-DIAL BASIS**

**5.14** At a station which is restricted from use of the CO access code, the station user may dial "0" and request the attendant to obtain a CO line. The attendant operates the START key and dials the CO access code. The marker then establishes a network connection from the calling station to the CO trunk. The previously established network connection from the calling station to the attendant trunk is still connected. Both the calling party and the attendant hear CO dial tone. The attendant then operates the release (RLS) key which breaks down the original connection (station

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to attendant trunk), allowing the calling party to dial out over the CO trunk.

### RESTRICTED STATION TO CO TRUNK CALL—ON CALLBACK BASIS (DIRECT TRUNK TERMINATION)

5.15 At a station which is restricted from use of the CO access code, the station user may call the attendant, as described in 5.12. The calling party gives the attendant the desired CO number, the calling station number, and then hangs up. The attendant operates the trunk key of an idle 2-way CO trunk, receives CO dial tone, and dials the CO number. After the CO party answers, the attendant completes inward to the original calling party as described in 5.16.

### INCOMING DIRECT TERMINATED CO TRUNK TO STATION CALL

5.16 Incoming calls from the CO are brought directly to the attendant position circuit and are indicated as incoming calls on the console in the case of direct terminated trunks. When the attendant answers the trunk, the connection is made directly to the CO party. When the attendant depresses the START key, the position circuit is directly connected to an idle register without establishing a network connection. If the attendant dials a station number, the register, on connecting to the marker, indicates that the call is an incoming CO trunk call. The called line is checked for busy/idle information and, if the call can be completed, the line is marked on the network, with the line group circuit indicating the idle links serving that line. The marker then causes the CO trunk connected to that position circuit to mark on the network (no trunk group circuit hunting function is performed at this time). The trunk group circuit containing the seized trunk indicates all the idle links serving that trunk. The marker then selects one link and causes the network to operate, establishing the connection from the incoming CO trunk to the called line. The trunk circuit supplies ringing and ring-trip supervision toward the called line. The attendant remains connected until releasing; the attendant may release the called line if it is not answered in order to attempt another call to a different number.

### INCOMING TIE TRUNK CALLS USING TIE TRUNK INTERFACE CIRCUIT SD-1E351-01 (MD) AND TIE TRUNK APPLIQUE CIRCUIT SD-1E350-01 (MD)

#### A. Incoming Tie Trunk to Station Call

5.17 When the tie trunk is seized by the distant end, it causes the TTI circuit to indicate an off-hook on its line-side port. The processing of this type call is the same as station-to-station. See 5.06 and Fig. 10.

#### B. Incoming Tie Trunk to Attendant Call (Fig. 11)

5.18 An incoming tie trunk call to the attendant is completed the same as the station-to-attendant call described in 5.12.

#### C. Incoming Tie Trunk to CO Call (Fig. 11)

5.19 An incoming tie trunk call to the CO is completed the same as a station-to-CO call described in 5.09, provided that the particular tie trunk is not restricted from dialing CO access code.

#### D. Incoming Tie Trunk to Tie Trunk Call

5.20 An incoming tie trunk may be completed to another tie trunk provided that the calling tie trunk is not restricted from the dialed tie trunk code. Completion is the same as the station to tie trunk call described in 5.13.

### STANDARD TIE TRUNK CALLS USING TIE TRUNK INTERFACE CIRCUIT SD-1E363-01

5.21 Standard tie trunk operation with TTI circuit SD-1E363-01 uses a trunk port and a line port but not an applique circuit.

#### E. Outgoing Tie Trunk Connection

5.22 When a station dials the tie trunk access code (single- or 2-digit trunk code), the selection is made in the same manner as any other trunk; the connection is made from the station to the trunk-port appearance of the interface. When the loop to the calling station is detected by the interface, it is cut through to the tie trunk which then controls the network connection through the interface circuit.

**5.23** When an attendant connected on an incoming CO trunk call dials the same tie trunk access code as a station, selection is made on the line side of an idle interface circuit. When the interface circuit is selected and marked, a link is then selected as on an incoming trunk to station call. However, if no link is available (but interface circuit is abandoned), another interface circuit is selected and the process is repeated. The second interface circuit is selected in a different half-line switch since all links to that half-line switch are busy. The process is repeated each time a circuit is selected with no links until one is found with an idle link, or until the marker times out. At that time, an all-links-busy indication is given to the attendant. When an idle interface circuit is found with an idle link to it, the connection is made from the line-side port to the incoming trunk. Control of the network is maintained by the incoming trunk. The tie trunk now sends a seizure to the distant end. The attendant then dials through the position circuit connection to the CO trunk, through the network and line-side appearance of the tie trunk interface, to the distant end.

**5.24** Supervision of the connection is maintained by the associated tie trunk, provided the far end returns answer supervision. A restriction occurs when the distant end does not return answer supervision such as in the case of a connection to a distant PBX CO trunk. Since no answer supervision is returned in this case, the connection must be supervised by the attendant. If a 770A PBX direct terminated trunk is the originating end, the 770A PBX attendant is able to supervise the call by picking up the trunk at intervals to determine if the connection is still busy. In this case, lockout must not be provided. However, in the case of a switched loop system, the originating 770A PBX attendant would be required to remain on the connection since an answered loop cannot be held at the console. Therefore, it is not recommended that tie trunk to CO trunk connections be allowed at a distant PBX when a CO to tie trunk call is provided in a switched loop 770A PBX.

**5.25** An improved tie trunk operation associated with Issue 29B of the 2-way CO trunk provides improved supervision functions. When an incoming CO trunk call is extended by the attendant to a tie trunk, the destination lamp will flash at 60 ipm while the distant end is ringing. The attendant can release from the connection and the call will remain on the loop in a switched loop

system. If the call is unanswered, the attendant can reenter the connection and release destination in order to attempt to complete to another station if desired. When the distant end returns answer supervision, the lamp will light steadily on a direct trunk system, and will extinguish at the console on a switched loop system.

**5.26** When the improved tie trunk supervision functions with a system equipped with dial transfer, a distant end flash on a CO to tie trunk connection results in attendant recall. This recall capability is functional only on incoming CO trunk calls to tie trunks, *not* on tie trunk originated calls to the CO.

#### F. Incoming Tie Trunk Connection

**5.27** An incoming tie trunk call from a distant end functions as a normal station call. The line-side port is used to seize a register. The connection is then established to an attendant trunk, CO trunk (if allowed), tie trunk, or to a station via an intercom trunk.

**5.28** When completing to a station, the intercom trunk is arranged to give answer supervision. When completing to another tie trunk, if answer supervision is returned from the distant end, it is related to the incoming tie trunk. When completing to a CO trunk, no answer supervision is returned, which requires the attendant to periodically monitor to determine the condition of the call. When completing to an attendant trunk, no answer supervision is given at the time the trunk is answered, but on an extended call, will return answer supervision when the called station answers.

#### G. Pad Control

**5.29** On certain connections, the TTI circuit has the capability of signaling the associated tie trunk to remove the transmission pad. On tie trunk to station, tie trunk to attendant trunk, and station to tie trunk calls, the pad is left in the tie trunk. On CO trunk to tie trunk, FX trunk to tie trunk, tie trunk to CO trunk, tie trunk to FX trunk calls, etc, removal of the pad in the tie trunk is optional depending on the trunk group. An option is applied within each trunk of a group requiring that the pad be removed.

## H. Conference

**5.30** The attendant may not add a tie trunk to an existing conference; however, an incoming tie trunk may originate a conference by either dialing the code directly or by dialing the attendant.

### ATTENDANT-ORIGINATED CO TRUNK CALL

**5.31** The attendant may originate calls without being connected to a trunk initially. By depressing the START key, the attendant position circuit is connected to an idle register. If a CO trunk code is dialed, the hunt for a CO trunk is made as in the station-dialed CO call. However, the attendant position marks its appearance on the line side, and the connection is made from the line side of the attendant position circuit to the CO trunk. Upon loop detection toward the position circuit, the trunk sends a seizure toward the CO while applying a holding ground to the network. The attendant may now complete dialing and converse with the CO party.

### ATTENDANT-ORIGINATED TIE TRUNK CALL

**5.32** An attendant may originate a tie trunk call by initiating a start sequence and dialing the tie trunk code. The TTI circuit trunk-side appearance is selected and marked in the same manner as in the station-dialed tie trunk call. The attendant position circuit marks its line-side appearance, and the connection is made from the TTI circuit trunk-side port to the attendant position circuit line-side port. Upon loop detection, the TTI circuit applies holding ground to the network, a network path completion indication to the marker, and cuts the loop through to the tie trunk. The tie trunk sends seizure to the distant PBX when it detects loop supervision, allowing the attendant to proceed with the dialing.

### CAMP-ON CALL

**5.33** When the attendant is completing an incoming CO call and finds the called line busy, camp-on allows the attendant to provide for completion of that call when the called line becomes idle. The incoming and 2-way trunks of a PBX so equipped require a camp-on circuit per trunk. If the called line is found busy, the marker completes the connection to that line. The tip and ring, however, are open in the camp-on circuit associated with the trunk. The trunk party is placed on hold,

and a burst of audible tone is applied to the busy party and the attendant to indicate that an incoming call is camped-on. When the busy line becomes idle, the camp-on unit detects this and cuts the tip and ring through to the trunk, allowing the trunk to apply ringing and ring trip supervision toward the called line. The camp-on unit now appears transparent and the connection functions as an incoming call completion.

**5.34** When the trunk circuit is camped-on, a solid ground is applied to the sleeve lead of the called line. The solid ground prevents further camp-on attempts to that line. Thus, no more than one call may be camped on the same line at any time. When the camped-on call is completed, the sleeve is returned to resistive ground, allowing another camp-on.

### ATTENDANT-CONTROLLED CONFERENCE CALL

**5.35** An attendant may originate a conference call between five PBX stations, or between four PBX stations and one CO trunk, by momentarily operating a conference key on the console. This causes the CONF lamp to flash at 30 ipm, indicating that the conference circuit has been seized. The attendant then momentarily depresses the START key and dials the first station conferee. When the conferee answers, the attendant will then announce the setting up of a conference call, momentarily operate the CONF key, and place the conferee on a conference port. The remaining station conferees are placed on the conference in the same manner. As each conferee answers, a private 2-way conversation is established between the attendant and the answering station party. When the attendant operates the CONF key, adding the conferee to the conference call, all connected conferees and the attendant are connected for conversation. When the attendant momentarily operates the START key in preparation for dialing the next conferee, the attendant is removed from the conference conversation leaving the connected conferees in conference conversation.

**5.36** A station party may originate a conference call by dialing the conference trunk access code, which causes the conference lamp on the attendant console to flash at 120 ipm and an audible tone. When the attendant has answered, by depressing the conference key associated with flashing lamp, the lamp changes to 30 ipm. The

station user requests a conference. The attendant then proceeds as described in 5.35.

**5.37** A station party may obtain a conference call by dialing "0" and requesting a conference. The attendant operates the START key and dials the conference trunk access code which causes the conference lamp to flash at 120 ipm and the destination lamp of the associated attendant trunk to light steadily. The attendant operates the RLS key and then the CONF key causing the conference lamp to change to 30 ipm. The calling party is now connected to the conference circuit. The dial "0" trunk is disconnected and returned to idle. The attendant then momentarily operates the START key and dials the station code for the second conferee, etc., as described in 5.35.

**5.38** If an incoming trunk caller requests a conference call, the attendant momentarily operates the START key and dials the conference line access code, causing the destination lamp to flash at 120 ipm and audible ringback tone to be heard by the attendant. The attendant then operates the release key, then the conference key, and proceeds as described in 5.35.

**5.39** In establishing a station-originated conference call (see 5.36 or 5.37), if a CO trunk party is requested as a conferee, the attendant momentarily operates the RLS key and then seizes an idle CO trunk circuit by operating the associated TRK/LOOP key. When the CO returns dial tone (see note), the attendant dials the CO party. When the CO party answers, the attendant announces the conference call and connects the CO party to the conference call by momentarily operating the START key and dialing the conference line access code, etc, as described in 5.38.

**Note:** With switched loop, the attendant must operate the OUT key and dial the trunk access code before receiving CO dial tone.

#### STATION DIAL TRANSFER CALL

**5.40** A dial transfer circuit serves up to eight incoming or outgoing trunks. The incoming trunks can be one-way incoming or 2-way trunks, but the outgoing trunks must be 2-way. The circuit provides two trunk-side network appearances, allowing two simultaneous uses of the circuit. If the PBX party, connected on an incoming CO trunk call or originating an outgoing CO trunk call, should

flash, the trunk party is placed on hold (from dial transfer circuit) and the trunk bids for connection directly to its dial transfer circuit. If one of the two ports serving the requesting trunk is idle, the trunk is connected to dial transfer. The dial transfer circuit, having recognized the flash from the PBX station, returns a dial tone signal interrupted at 240 ipm (optional recall dial tone). This indicates to the transferring party that the flash has been recognized, and action has been taken to ensure that it is not misinterpreted as a disconnect. Also during the 1-second application of recall dial tone, the PBX party should not dial. If the register is not available at the time the flash occurs, the dial transfer circuit continues to return recall dial tone until the register is available and is connected. This recall dial tone signal is then a waiting signal, indicating to the transferring party that the flash has been recognized and dial tone will be forth-coming when the register becomes idle. The transferring party may not dial until steady dial tone is returned from the register. If the register is available, the dial transfer circuit is connected to the register without using a network path and the register returns dial tone to the PBX party who now dials a station code. The register requests readout from the marker and indicates the type of call; the marker causes the called line to be marked and the idle links serving that line to be identified. The station dial transfer circuit port is also marked on the trunk side and the idle links serving it are identified. The marker selects a link and causes the network to establish the connection. The transfer circuit applies a network holding ground to the network and ringing and ring-trip supervision toward the called line. Upon answer, the two PBX parties are connected for the consultation phase with the trunk party still on hold. Either PBX party may flash to reconnect the trunk party, resulting in a 3-way conference.

**5.41** If the added-on PBX party hangs up, the transfer circuit port is made available and subsequent requests for transfer act in the same manner. However, if the original PBX party should hang up, the connection is maintained through the transfer circuit, holding up one port of that circuit for the duration of the call. If another add-on is made by that party, the connection is established via the original trunk-side appearance of the incoming trunk. If the party on the transfer circuit port should hang up, the transfer port is again made available.

5.42 If "0" or a trunk access code is dialed, the attendant is called in directly on the trunk circuit. If the register serving the transfer unit is busy when flash occurs, the connection to the trunk party is maintained until the register becomes idle.

#### TRUNK-ANSWER-FROM-ANY-STATION

5.43 Trunk-answer-from-any-station is provided by the station dial transfer circuits. When an incoming trunk activates the audible indication, a station may dial the code for trunk-answer-from-any-station. When this code is recognized, the marker enables the transfer circuit serving the group of eight trunks containing the incoming call; the transfer circuit then marks one of its two ports on the trunk side. The calling line is marked by the information stored in the register and the marker then selects a link and causes the network to operate. When the transfer circuit detects a closed loop toward the calling line, it indicates network completion to the marker and applies a holding ground to the network. The transfer circuit then cuts through to the incoming trunk circuit, tripping ringing and connecting the calling trunk party of the calling line. The PBX party may now transfer that call to another PBX party.

5.44 The use of the transfer circuit for trunk-answer-from-any-station limits the number of simultaneous answers to two per group of eight trunks. However, assuming that the PBX party originating the trunk answer was not the desired party (which would usually be the case), that party may now transfer the incoming call to the desired party, dropping the transfer circuit and making it available for subsequent trunk answers.

#### TOLL RESTRICTED OUTGOING CALL

##### I. Toll Restriction by Recognition of Digits "0" and "1"

5.45 The 770A PBX provides the capability of restricting designated CO codes from certain lines in the PBX. If a code-restricted line dials "9," the connection is established to the CO trunk as described in 5.09. However, the register is left bridged to the connection in the network with its digit storage reset to provide the code detection. A toll control unit is required between the network and any CO trunks that may be used for outgoing

calls. For nonrestricted stations, the toll controller remains transparent and the register releases. For code restricted rotary dial stations, the toll controller provides local battery feed, dial pulse detection, a holding bridge to the CO trunk which is opened to repeat dial pulses. For code restricted TOUCH-TONE service stations, the toll controller remains transparent. However, the register remains bridged to provide diversion.

##### J. Toll Restriction by Battery Reversal

5.46 This arrangement permits recognition of a tip-ring reversal from the serving CO to restrict the call. One battery reversal toll control circuit (four or eight circuits per plate) is required per trunk (one-way outgoing, 2-way CO, WATS, FX, etc). In addition to serving those areas where "0" and "1" toll access is not provided, this feature also allows the capability of providing toll restriction on trunk groups other than the digit "9" access code. As a function of a station's class of service, this feature can only be provided on the ninth level. Toll control units can be placed on any number of 2-digit trunk groups on the ninth level. A nonrestricted station will be allowed toll access from all trunk groups, while a restricted station will be restricted from all trunk groups on the ninth level when battery reversal is recognized. Toll control units may be provided on other levels; however, any trunk group so equipped will restrict all stations, regardless of class of service, when battery reversal is recognized. When battery reversal is received, the outgoing call is dropped; reorder tone is returned to the calling party from the toll control units associated with the trunk. With a direct trunk system, the source lamp remains steady on a 2-way trunk. The trunk is held busy to outgoing calls, but 2-way trunks appear idle to the CO and may be seized incoming. When a trunk is seized while a station is connected to the associated toll control unit, the station is dropped and receives dial tone. This action frees the toll control unit and allows the trunk to complete to the attendant.

#### EXECUTIVE RINGBACK OR EXECUTIVE OVERRIDE CALL

5.47 The executive trunk circuit can be arranged for the ringback or override feature. All executive trunks in a given system must be arranged with the same feature. Each station which will be given provision to use the ringback or override

feature must have C15 class of service (Table E) wired on its line switch. Each executive trunk circuit must be cabled to a U trunk port and, effectively, uses the A trunk port as well.

**5.48** When a station is equipped with class of service C15 in addition to its other class mark (C2 through C14) and dials another station, the marker checks whether the called station is busy or idle. If the called station is busy, the marker opens the operate path to route the call to a busy tone trunk and, instead, extends a ground over the IO lead to the executive trunk. This ground operates the OF relay of the first idle executive trunk of each trunk switch. Additional marker action preferences a particular executive trunk and adds the executive trunk to the crosspoint connections. The calling station receives busy tone at this time.

#### K. Executive Override

**5.49** Executive override provides the ability for certain designated stations to override a busy condition on attempted intercom calls, connecting the calling party to the busy line after application of a warning tone.

**5.50** When a station with C15 class of service allowing executive override dials a busy station, a special executive override trunk is selected rather than a busy tone trunk. This trunk, which returns busy tone to the calling party, is also connected to the busy line with the transmission path open. If the calling party hangs up while receiving busy tone, the connection is dropped. If, instead, the calling party flashes the switchhook to activate the override, busy tone is removed and a 3-second burst of 440-Hz tone is applied to both the calling line and the busy station connection. Immediately following application of the tone, the calling party is bridged onto the original connection.

**5.51** With this connection established, the calling party may disconnect leaving the original connection established or, alternatively, the called party may hang up, disconnecting from the original connection. In this case, if the calling party remains off-hook, the called party will be rung in about 4 seconds and, upon answer, an intercom connection will be established via this executive override trunk.

**5.52** If the called party goes idle prior to the calling party flashing the switchhook for

override, a subsequent switchhook flash for override results in the busy tone being removed, followed ~~3 seconds later by ringing being applied to the~~ called line.

#### L. Executive Ringback

**5.53** Executive ringback provides the ability for certain designated stations to be called back when another PBX station, found busy on an attempted intercom call, goes idle. Executive ringback utilizes the same trunk circuit as executive override, arranged with different options. The same class of service is used for ringback as for override, and, consequently, any system can only be arranged for one of the features.

**5.54** When a station user with C15 class of service, which allows executive ringback, dials a busy station, an executive ringback trunk is selected rather than a busy tone trunk. This trunk, which returns busy tone to the calling party, is also connected to the busy line with the transmission path open. If the calling party hangs up while receiving busy tone, the connection is dropped. If the calling party flashes the switchhook, busy tone is removed and a 750-millisecond burst of 440-Hz tone is applied to the calling party and to the busy station connection, indicating a call is waiting.

**5.55** The calling party may now go on-hook, leaving the trunk in the callback state. When the called line goes on-hook, both parties are rung and, when both answer, they are connected via this trunk. Should one party answer prior to the other, audible ringback will be heard until the other party answers. Should the originating party not answer, the call is abandoned after about eight ringing cycles.

**5.56** If the called party goes idle prior to the calling party activating this service, the switchhook flash will immediately initiate ringing to the called station.

**5.57** During the time that the originating party is awaiting callback, the line is held busy to incoming calls and cannot be used for outgoing calls without taking the following action: To place an outgoing call, the station user goes off-hook and flashes the switchhook, at which time busy tone will again be returned as an indication that the callback service has been cleared. Subsequent

hang-up drops the connection, freeing the phone for use, but also losing the callback condition.

#### SWITCHED LOOP OPERATION (Fig. 12)

**5.58** With switched loop operation, the 23A, 53B, 53C, 63A, or 83A console is used. These consoles have six keys for attendant loops and a lamp field to be used for ICI and TGB indications. A maximum of three attendant positions is provided with switched loop operation. Each of these attendant positions may have up to six individual (nonmultiple) loops dedicated to that position. An additional console may be provided and arranged for direct trunk termination. The additional attendant console will require an additional position circuit, CO trunk termination unit, and attendant trunk termination unit. Separate attendant trunks are required for the additional position.

**5.59** The switched loop circuit consists of one switched loop control unit and one or more switched loop units. One switched loop unit is provided for every twenty 2-way or one-way incoming trunks. These trunks are normally under attendant control. There is no limit to the number of trunks that may be provided.

**5.60** The attendant trunks also serve as attendant loops. The attendant loop or trunk which appears on the console has two ports other than the console. One port terminates on the network by which it is accessed on a dial "0" basis; the second port terminates on the switched loop unit by which it is accessed from incoming trunks.

#### M. Incoming Trunk Calls

**5.61** On incoming trunk calls, a seizure from the distant end will cause the trunk circuit to bid for an idle loop which will then appear on the console as an incoming call with the normal incoming indications. The attendant, upon answering a call, may converse with the CO. The attendant can then extend the call inward either by operating the START key and dialing the station code or by depressing a DSS key, if available. The loop remains busy during the ringing even if the attendant releases from the call. However, upon answer, the loop will drop. Without queuing, as long as there is an idle loop, an incoming call will come into the console, even if the position is busy on another loop. An option is provided in the position circuit which allows the attendant's audible

indication to be silenced if it is busy. If all loops are busy, an incoming trunk call will light the calls waiting (CW) lamp. An incoming dial "0" call at this time will receive reorder since all attendant trunks are busy.

**5.62** In the case of two attendant positions, an even distribution is made between attendants on loop assignment such that the first loop is connected to the first console, the second to the second console, the third to the first, fourth to the second, etc. In the case of three attendant positions, an even distribution is made between attendants on loop assignments except loops 10, 11, and 12. The distribution shown in Table F will occur if all 18 loops are provided. Without the queuing option, there is no switching from one attendant to an idle attendant once the call has been routed to a loop. If attendant 2 should operate quickly and finish the calls, the second call waiting on attendant 1 will not switch over to attendant 2; rather the call waits for attendant 1 to finish. Should all loops become busy, the incoming call will continue giving ringback to the distant end and wait at the switched loop circuit for an idle loop. At the same time, the calls waiting lamp for the attendant at all consoles will light. As soon as a loop becomes idle, this call will connect to that loop and be brought into whichever attendant position corresponds to the idle loop. In the case of incoming attendant trunk calls (dial "0" calls from stations), there is no queuing between attendants. The selection is done on the network side such that a call will come into the first idle loop in the normal trunk selection sequence. Thus, there is no control over which attendant receives the incoming attendant call with the exception that when the position is busied out by the position busy key, all loops (attendant trunks) are indicated as busy both to network calls and to incoming calls.

**5.63** The preference for loop assignment with queuing is one or two (high/low) attendant trunk chains for each attendant position. Queuing provides for distributing calls inside the gating circuit one at a time to the attendant position which has been idle longest and, at that time, is able to connect the bidding CO trunk. This prevents one attendant from having to handle all the associated high or low group calls during a low traffic period. It also prevents one attendant from having several unanswered calls (with the associated tone oscillator signal) while another attendant sits idle merely because that attendant is situated

lower in the attendant trunk chain. Since each attendant can receive one call at a time with queuing, additional calls inside the gate are in a call-waiting state. When an attendant goes idle by releasing, camping on, holding, or completing the call, the highest priority CO trunk within the gate will be connected to that attendant by the queuing circuit. A call waiting lamp signal will be supplied to all consoles by the queuing circuit as long as there is a call inside the gate waiting to be routed by the queuing circuit. Once the incoming call is connected to a console, the switched loop circuit is used only to maintain the necessary connections via its crosspoints.

#### N. Dial "0" Call

**5.64** A dial "0" call from a station can be extended by the attendant to another trunk or to a station by simply depressing the START key and dialing the appropriate station code or trunk access code. In which case, when the attendant releases and the connection is established completely, the loop will drop away. A trunk dialed in this manner provides "through dial" only. If the attendant desires to use straightforward outward completion, the "Dial Out" key must be operated. Straightforward outward completion can be provided only with switched loop terminated trunks and only a maximum of four trunk groups. In addition to standard operation, the switched loop operation will also provide secrecy. On a recall with secrecy, the attendant can never converse on a 3-way conversation with the trunk party and PBX party simultaneously. The connection is always in the exclude source or exclude destination mode at the attendant's control. If the attendant enters on a recall, the trunk party will be split and the attendant is connected to the station. On a recall without secrecy, the attendant will reenter, bridged with both the trunk and the station party. The attendant may then exclude source or destination if desired. All other console functions—conference keys, position busy, remote answer, etc—function in the normal manner.

#### O. Night Connections

**5.65** If fixed night connections are provided, operation of the night key will establish night connections as illustrated in Fig. 38. If flexible night service is provided, operation of the position busy and the night key will prepare the connections for the attendant to set up the flexible night connections. The attendant picks up a loop,

operates the Dial Out key, and receives dial tone. The attendant then dials a 2-digit code (see Note 1) assigned to the trunk and the connection will be completed through the switched loop. The attendant then operates the START key and dials a station code associated with that trunk for night service. If the station is busy and camp-on is provided for this system, the call will camp-on and make the night connection at the end of the busy call. If camp-on is not provided, the connection cannot be established unless the station is idle. A maximum of 20 trunks (on 3- or 4-digit systems—see Note 2) may be arranged for flexible night service, all of which must be located within the first three switched loop units. If DID service is provided, operation of the night service key will route an incoming LDN call to a night station.

#### Note 1:

One digit on a 2-digit system  
Two digits on a 3-digit system  
Three digits on a 4-digit system

**Note 2:** With a 2-digit system, a maximum of five CO trunks may be so arranged.

#### P. Incoming Call Identification

**5.66** The 23A, 53B, 53C, 63A, or 83A console provides 24 lamps to be used as ICI or TGB lamps. Since more than one loop may be incoming on a console at a time, the ICI lamps must be associated with each loop key. Several optional arrangements are provided. One option (with a full six loops per position) provides no TGB lamps and four ICI lamps per loop. Alternatively, the first column of lamps on the left of the console may be dedicated to TGB display, showing the busy/idle status of six different trunk groups, and provides only three ICI lamps per loop. Another possibility exists if only five loops per console are equipped. Four ICI lamps per loop for the five loops that are available may be provided, with the four lamps associated with the vacant key used as TGB lamps. Only trunks which appear on the switched loop unit will have ICI lamps.

#### Q. Trunk Group Busy

**5.67** The TGB lamps indicate the busy/idle status of selected trunk groups. The busy/idle status will be indicated when a loop key is depressed, and, since some loops may not have access to all

trunks in a group, two situations can occur. For installations with ten or less loops, the busy/idle status will indicate the true condition of the entire trunk group. For installations with more than ten loops, the busy/idle status will indicate the condition of that portion of the trunk group that the selected loop can access.

#### DIRECT INWARD DIAL CALL

**5.68** When the incoming DID CO trunk is seized from the CO, the trunk signals the incoming register network to attach an idle incoming register. The incoming register network is a single-stage, crosspoint matrix utilizing a small crossbar switch on which the horizontal levels are connected to the incoming registers and the vertical levels are connected to the DID incoming CO trunks. The preselected register operates its associated select magnet in the network and, when the incoming trunk is connected to the register through the crosspoints, the hold magnet under control of the trunk circuit operates and holds the crosspoint connections. The register will return wink start, if required. The incoming register receives, counts, and stores the direct inward dialed station code information. The register tests the stored digit data to see whether it is an LDN or a station number.

#### R. Incoming Call to Idle Station (Fig. 13)

**5.69** If a station number is dialed, the incoming register bids for the marker. When the marker is idle, the incoming register calls the information to the marker, which attempts to complete the call from the incoming DID CO trunk through the trunk group circuit (trunk and midswitch) to the line switch and the line circuit. When connection to the line circuit is made, the incoming register and incoming register network release, and talk connection is through the trunk group circuit and the line switch circuit.

#### S. Incoming Call to Listed Directory Number (Fig. 14)

**5.70** If an incoming DID call is to the LDN, the call progresses inward as indicated per 5.66. When the incoming register, upon testing, recognizes the call as an LDN, the AT relay in the register operates, in turn operating the AT relay in the DID CO trunk over the AT lead. The incoming call now progresses to the attendant through the switched loop unit, dual console control circuit, or

B unit (single console). The incoming register and register network release when the CO trunk AT relay operates. The call can now be answered by the attendant, who can extend the call inwardly through the PBX system.

#### T. Incoming DID Call to Busy Line

**5.71** When an incoming DID call seizes the DID CO trunk, the circuit action is the same as in 5.68 and 5.69 until reference is made concerning the marker connecting through to the station line. In this case, the marker indicates a busy line condition to the incoming register. The incoming register returns busy tone to the calling party until the register times out. When the register times out, the register then releases after signaling the DID CO trunk to return reorder tone and the DID CO trunk returns reorder tone to the CO party until this party releases.

**5.72** If optional call forwarding—busy line is provided, when the marker returns a busy line indication to the incoming register, the register AT relay operates, grounding the AT lead to the DID CO trunk. The CO trunk AT relay operates from this ground after which the register releases. The DID CO trunk processes the call the same as LDN call per 5.59.

#### U. Incoming DID Call to Station Line—Call Forwarding—Don't Answer Transfer

**5.73** The call forwarding—don't answer transfer (DAT) feature is provided on direct dialed station calls only. When a DID call to a station line is processed per 5.68 and 5.69 and the called station does not answer in about 15 seconds, the DAT timer operates. Operation of the DAT timer operates the trunk AT relay, and the trunk transfers the call to the attendant the same as an LDN call per 5.70.

#### V. Incoming DID Call to Vacant Code

**5.74** When the incoming call is to a vacant code, the call is processed per 5.68 and 5.69. The marker identifies the dialed code as a vacant code to the incoming register. The register optionally can return a recorded announcement (Fig. 13), then releases after signaling the DID CO trunk to immediately return reorder tone to the calling party.

### **AUTOMATIC IDENTIFICATION OF OUTGOING DIALING** (Fig. 15)

**5.75** When a station originates an outgoing CO call, the 770A PBX marker circuit determines that an outgoing trunk call has been initiated. The marker will send the calling station line number and the trunk number to the ANI interface circuit. These numbers are loaded into decimal to binary coded decimal (BCD) converters within the interface circuit and, when the ANI circuit is idle, the interface transmits the BCD numbers to the ANI circuit. The ANI circuit will transmit the numbers to the CO to be recorded over a data line. Then, as the marker processes the call to completion, the ANI interface and the ANI circuit release to idle status.

**5.76** A signal from the marker allows the ANI interface circuit to distinguish between dial 9 and dial other-than-9 calls. Then the circuit commands the ANI circuit to use its data channel 0 (first data channel) for dial 9 calls and data channel 1 for dial other-than-9 calls.

### **MESSAGE REGISTRATION**

**5.77** The message registration circuit provides a positive pulse on the sleeve lead to the calling line regardless of the type CO the system is working on. This circuit is compatible with both camp-on and outgoing call transfer, scoring the associated station register once at the beginning of such a call or scoring the register on every pulse from the CO in the case of offices arranged for multiple pulsing.

### **COMMON CONTROL SWITCHING ARRANGEMENT**

**5.78** When the trunk is seized by the CCSA switcher, a start signal is sent to the incoming register network to bid for, and attach, an idle incoming register. The incoming register network is a single-stage, crosspoint matrix utilizing a small crossbar switch on which the horizontal levels are connected to the 2-way CCSA trunks. The preselected register operates its associated select magnet in the network and, when the incoming trunk is connected to the register through the crosspoints, the hold magnet under control of the trunk circuit operates and holds the crosspoint connections. The register then sends a momentary on-hook (or wink start) signal to the CCSA switcher as a start-dial signal or the CCSA trunk provides a delay dial

signal, whichever is required. The incoming register receives, counts, and stores the dialed station code information. The register tests the stored digit data to see whether it is an LDN or a station number.

### **W. Incoming Call to Idle Station (Fig. 16)**

**5.79** If the registered digits correspond to a working station line, the incoming register bids for the marker. When the marker is idle, the incoming register calls the information to the marker. The marker proceeds to complete the call, if the station is idle, from the CCSA trunk through the trunk group circuit (trunk and midswitch) to the line switch and the line circuit. Upon completion to the called station, the incoming register and register network both release. When the station answers, the trunk removes ringing, provides talking battery to the station, and sends answer supervision back to the CCSA switcher. The talk path is through the trunk group circuit and the line switch circuit. The source and destination lamps are lighted steadily on a direct terminated console when the station answers.

### **X. Incoming Call to Listed Directory Number (Fig. 17)**

**5.80** If an incoming CCSA call is to the LDN, the call progresses inward as indicated in 5.78. When the incoming register, upon testing, recognizes the call as an LDN, the AT relay in the incoming register operates, in turn operating the AT relay in the CCSA trunk over the AT lead. The incoming call now progresses to the attendant through the switched loop unit, dual-console control circuit, or B unit (single console). The incoming register and register network release when the CCSA trunk AT relay operates. The call can now be answered by the attendant, and can be extended inward through the PBX system.

### **Y. Incoming CCSA Call to Busy Line**

**5.81** When an incoming CCSA call seizes the CCSA trunk, the circuit action is the same as in 5.78 and 5.79 until reference is made concerning the marker connecting through to the station line. In this case, the marker indicates a busy line condition to the incoming register. The incoming register returns busy tone for a timed interval to the calling party. At the conclusion of the busy tone interval, the register may signal the trunk to return reorder tone until the calling party releases.

The register may optionally connect a call to a busy station to an announcement trunk.

**5.82** If optional call forward—busy line is provided, when the marker returns a busy line indication to the incoming register, the register AT relay operates, grounding the AT lead to the CCSA trunk. The CCSA trunk AT relay operates from this ground after which the incoming register and register network release. The CCSA trunk processes and routes the call to the attendant the same as an LDN call per 5.80.

**Z. Incoming CCSA Call to Station Line—Call Forwarding—Don't Answer Transfer**

**5.83** When the call forwarding—don't answer transfer (DAT) feature is provided, the CCSA call is processed per 5.78 and 5.79. If the called station does not answer in about 15 seconds, the DAT timer operates. Operation of the DAT timer operates the CCSA trunk AT relay, and the trunk transfers the call to the attendant as in the case of an LDN call per 5.80.

**AA. Incoming CCSA Call to Vacant Code**

**5.84** When the incoming call is to a vacant code, the call is processed per 5.78 and 5.79. The marker identifies the dialed code as a vacant code to the incoming register. The incoming register (optionally) returns a recorded announcement (Fig. 16), then releases after signaling the CCSA trunk to immediately return recorder tone to the calling party.

**AB. Outgoing CCSA Call to CCSA Network**

**5.85** When a nonrestricted station dials the CCSA trunk access code, the register requests the marker to establish a connection to an idle CCSA trunk. The marker operates the OF relay of the first idle CCSA trunk of each trunk group circuit equipped with CCSA trunks. The marker then selects the first trunk group circuit with idle links between it and the station line switch of the calling station. Operation of the hold magnets in the switching network establishes a link from the calling station to the CCSA trunk circuit. When the CCSA switcher connects a register to the CCSA trunk, dial tone is transmitted to the calling party. Then the calling party may dial outgoing into the CCSA network.

**TRUNK JUNCTOR** (Fig. 18 and 19)

**5.86** All on- and off-net calls must be handled by the attendant. To accomplish this action, the attendant registers must be arranged for thru-dial operation. The originating port of the trunk junctor is not assigned a class of service. The port may be reached by the attendant only when completing an inward CO or CCSA call to the junctor.

**5.87** The CCSA switcher can be a wink-start or a delay-dial office and will provide disconnect supervision to the junctor. The 2-way CO trunks provide disconnect supervision to the PBX.

**CCSA TO CO OR CO TO CCSA CALL** (Fig. 18 and 19)

**5.88** When the attendant receives a request to extend an incoming CCSA or CO call to either the CO or the CCSA network, the trunk junctor access code is dialed by the attendant. If a trunk junctor is idle, the marker connects the trunk port of the incoming trunk to the originating port of the trunk junctor. The trunk junctor responds to the seizure and seizes the line circuit on the terminating junctor port. A second marker operation functions to attach a register to the terminating port. Second dial tone is received by the attendant when the register is attached. The attendant proceeds to dial the access code for either a CO trunk or the CCSA network depending on the direction of the call. Third dial tone is received when connected to the CO or CCSA switcher. After dialing the required digits to complete the call, the attendant may release upon hearing ringing tone or remain on the connection until the called party answers. If the distant end is busy, the attendant may operate the RLS DEST key, dropping the junctor connection, and must start over to extend the call.

**TIMED REMINDER** (Fig. 20)

**Direct Trunk Systems**

**5.89** When the attendant operates a console trunk pickup key to answer an incoming CO trunk call, the PU relay in the CO trunk operates. Operation of the PU relay operates the TC relay in the timed reminder circuit. As long as the attendant remains on the call, the TC relay remains operated, preventing the TR timer from operating. When the attendant places the call on hold or

releases from the call, relay operation in the CO trunk causes the TC relay in the timed reminder circuit to release. This closes the operate path for the TR timer to start the timing sequence. When the timing sequence is completed, the TR relay operates applying the timed reminder signals to the console as follows:

- (1) 60-ipm signal on source lamp
- (2) Audible tone.

#### ◆Switched Loop Systems

**5.90** On switched loop systems, the circuitry necessary to provide timed reminders is provided on an optional basis in the attendant trunk. Operational features are identical to those described in 5.89. All control functions originate in the attendant trunk and no additional units are necessary to provide the service.◆

#### PAGING (Fig. 21)

**5.91** A nonrestricted station or the attendant may dial-access the paging circuit by dialing the trunk code assigned. When provided, the attendant may access the paging circuit by operation of a nonlocking key on the console with an optional arrangement to override a dial-selected call.

**5.92** When the extendible paging feature is provided, the attendant may complete an incoming call to the line port of the junctor by dialing a station number. The attendant then pages by dial selection or key paging, indicating that the paged party should dial the trunk access code associated with the junctor portion of the paging trunk. When the paged party picks up any nonrestricted station and dials the trunk access code, the paged party is connected to the trunk port of the junctor and, therefore, to the incoming call. The incoming calling party hears an audible ring until the page is answered.

#### TRUNK SELECTOR (Fig. 22)

**5.93** The trunk port to be tested is selected by operating the trunk port selector thumbwheels on the remote test unit to the desired trunk port positions. With the test mode switch set to ON, the selected trunk circuit is connected when the test telephone set goes off-hook. The maintenance line is L29 of line switch A and the customer line is L39 of line switch A. When circuitry is being

used by maintenance personnel, the maintenance unit has priority over the customer unit. When the test line goes off-hook, a relay in the marker which provides a test class of service operates. This gives the test line priority over all other marker service requests except for a DID request. The marker services the call as a normal register request. The trunk selector circuit momentarily disables all idle trunk port circuits and enables only that trunk port chosen to be tested. When the trunk port under test is busy, the test line is switched to a busy tone trunk in the trunk selector circuit and reorder tone is returned to the tester.

#### TYPICAL OPERATION AND TESTING PROCEDURES USING MAINTENANCE CONTROL CIRCUIT (Fig. 23)

**5.94** The 770A PBX maintenance control unit permits maintenance test calls to be made from line terminal 29 or 39 (from any line group A through K in order to test all links) to observe basic marker functions, to inhibit register and marker time-out, to observe the busy/idle status of any trunk group, and to select and test a particular trunk circuit. Outgoing trunk calls can be made from this unit by maintenance personnel. A customer trunk test feature is also available with the maintenance control circuit.

#### TYPICAL OPERATION AND TESTING PROCEDURES USING MARKER DISPLAY CIRCUIT (Fig. 23 and 24)

**5.95** The marker display circuit displays the register output to the marker (digits dialed into the register) of the called line number, the called line group and terminal, and the calling line group and terminal. The calling line class of service (AX through DX and ORD) is also displayed. When the DISPLAY switch is set to ON, the LED display indicators light when the register reads the dialed digits into the marker. The indicators remain lighted for prolonged viewing. They can be extinguished at any time by setting the DISPLAY switch to RESET. A rotary selector switch, labeled DISPLAY SELECTOR, is used to select three separate displays. The three positions are CALLED LINE NO., CALLED LINE GRP & TERM., and CALLING LINE GRP & TERM.

#### TYPICAL OPERATION AND TESTING PROCEDURES USING SWITCHED LOOP AND TRUNK MAINTENANCE CIRCUIT (Fig. 25)

**5.96** The switched loop and trunk maintenance circuit enables maintenance personnel to

selectively connect the assigned trunks and switched loops to facilitate an orderly test procedure. A total of 20 trunks are accessible for test purposes via trunk jacks. Supplementary units are available to access more trunks via trunk jacks in groups of 30. When a trunk is busy, an LED indicator

mounted directly above the trunk jack will light. A test trunk circuit, when plugged into one of the trunk jacks, permits the user to simulate an incoming or an outgoing trunk call and to insert loop resistance.

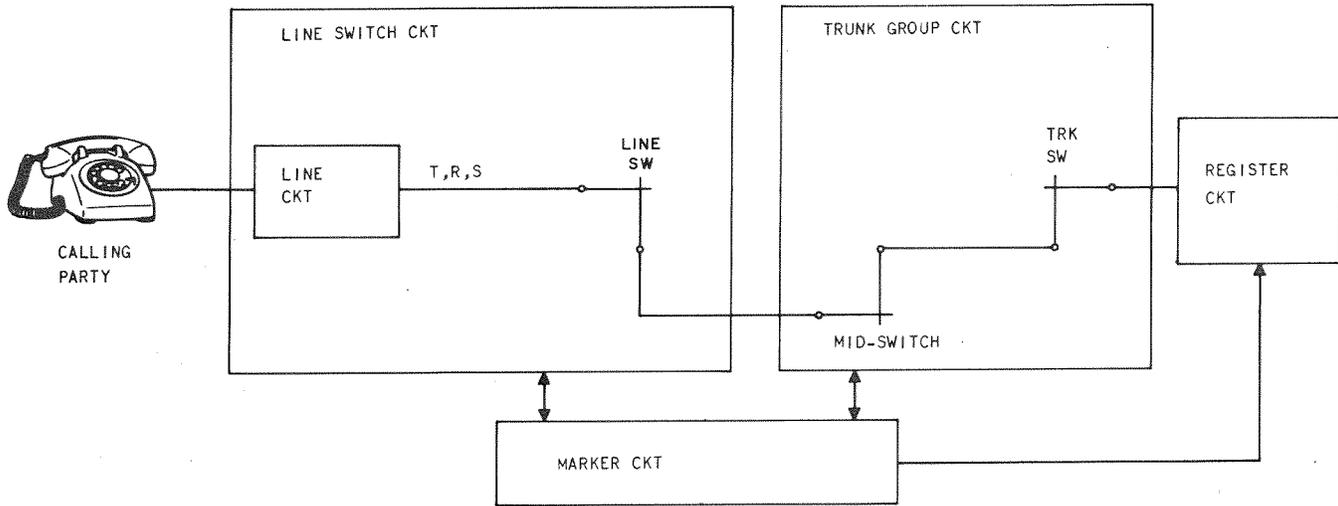
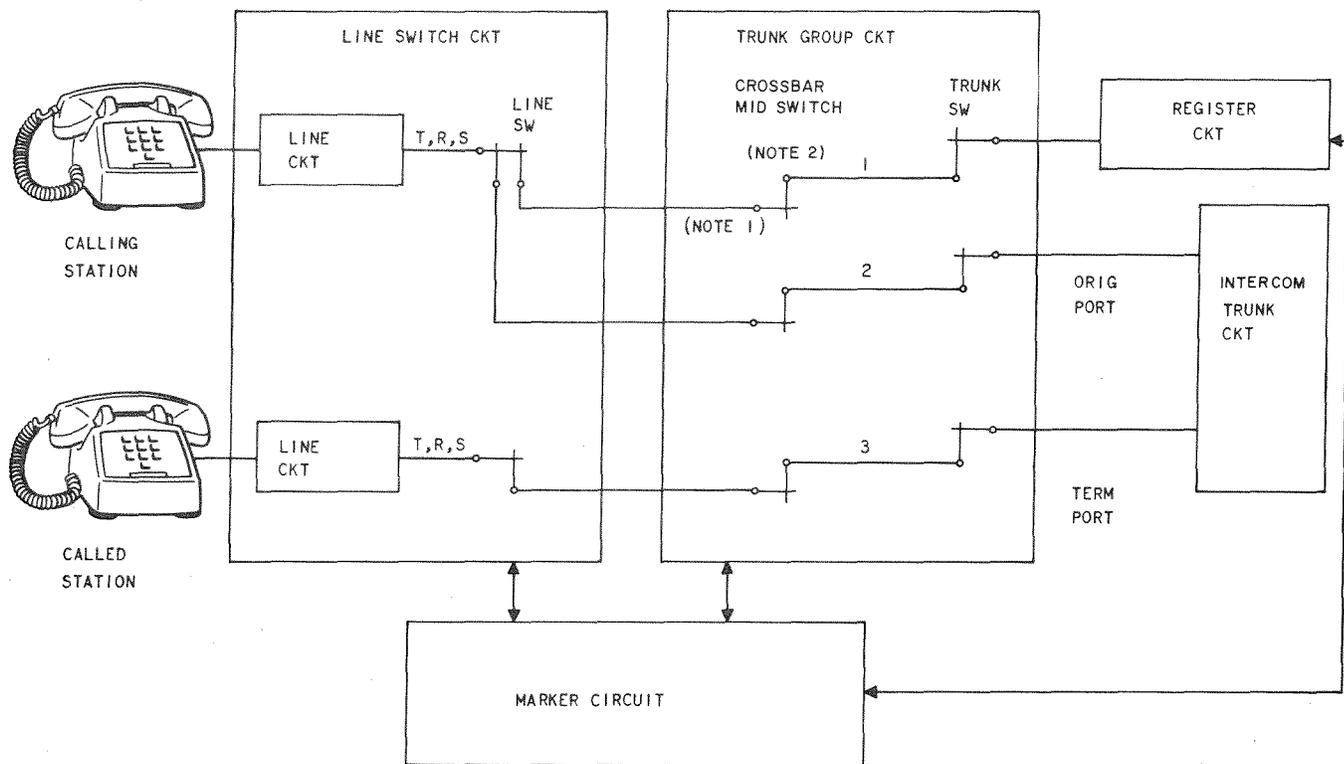


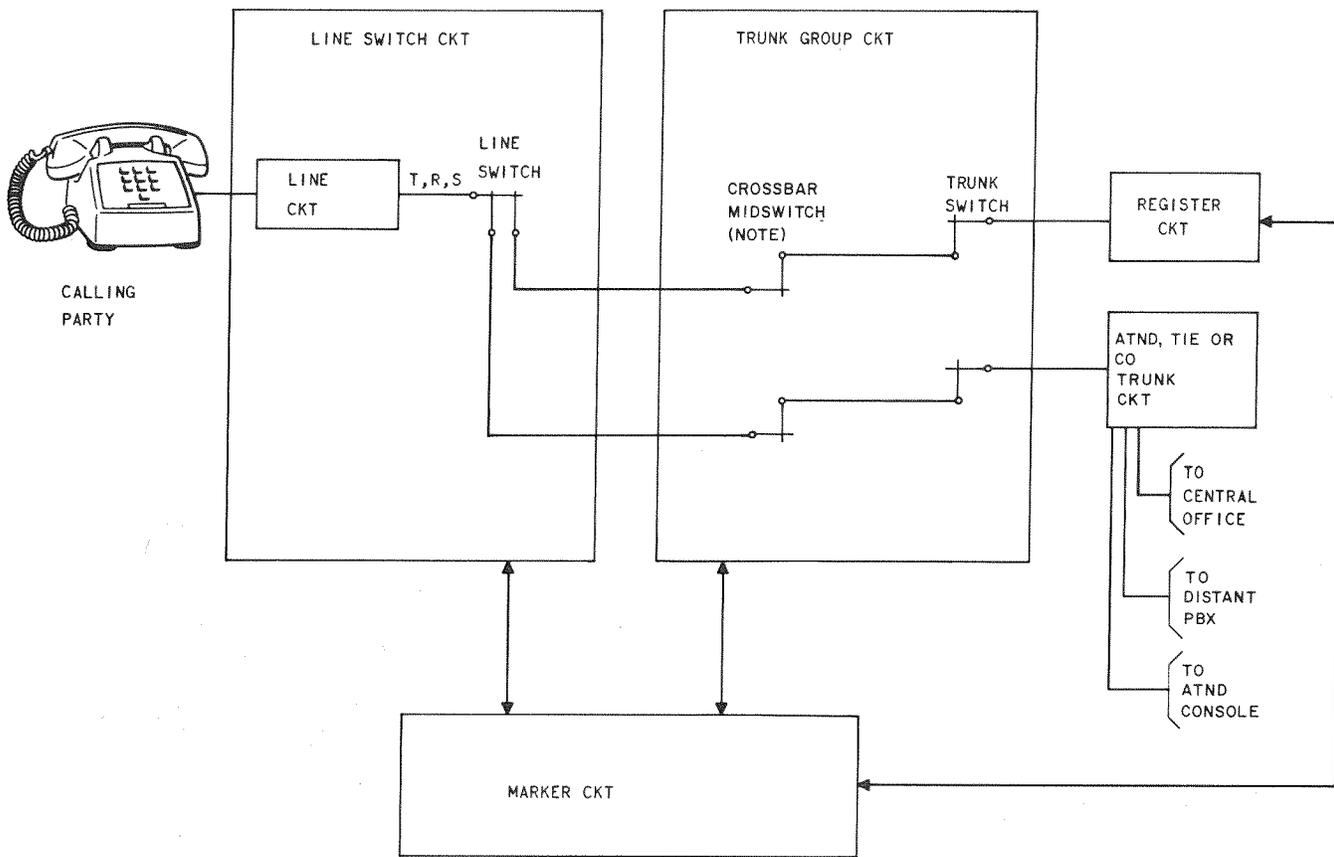
Fig. 9—Dial Tone Connection and Dialing Path



NOTES:

1. THE DIAL TONE CONNECTION IS ALSO THE DIALING CONNECTION FOR A STATION-TO-STATION CALL. THE LINE SWITCH TO MIDSWITCH LINK FOR THE DIALING CONNECTION MAY OR MAY NOT BE SELECTED AS PART OF THE TALKING PATH FOR THE STATION-TO-STATION CALL.
2. MIDSWITCH CAN BE CROSSBAR OR RELAY TYPE, RELAY MID SWITCH CAN BE USED ONLY ON 40 LINE TO 160 LINE SYSTEM (3.04)

Fig. 10—Station-to-Station Call



NOTE:  
 MID SWITCH CAN BE CROSSBAR OR RELAY TYPE, RELAY MID SWITCH CAN  
 BE USED ONLY ON 40 LINE TO 160 LINE SYSTEM (3.04).

Fig. 11—Station to Attendant, Tie, or Central Office Trunk Call

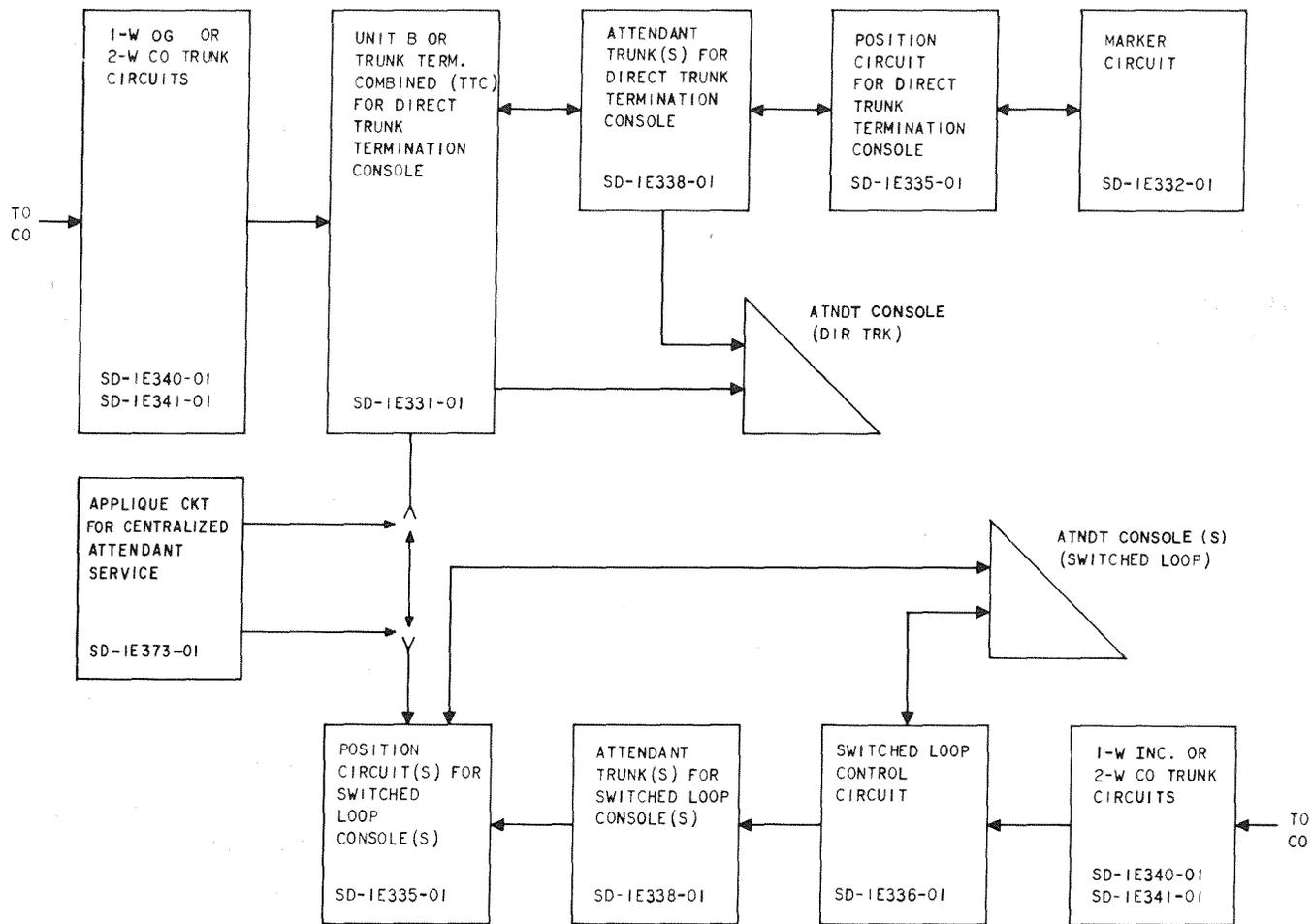


Fig. 12—Switched Loop Operation With Direct Trunk Console

TABLE F

## ATTENDANT LOOP ASSIGNMENT

Loop:	1	2	3	4	5	6	7	8	9
Position:	A	B	C	A	B	C	A	B	C
Loop:	10	11	12	13	14	15	16	17	18
Position:	C	B	A	A	B	C	A	B	C

The sequence of loops on incoming calls is as follows:

- *For ten or fewer loops:* Incoming calls appear sequentially on loops 10, 9, 8, 7, 6, 5, 4, 3, 2, 1 (beginning with the highest loop equipped) each call selecting the first idle loop in that sequence.
- *For more than ten loops:* Each sequence is partially determined by the order of "high" and "low" CO trunk incoming calls. "High" incoming and 2-way CO trunks are those with connections to T10—T19 connectors on switched loop units(s). "Low" are those with connections to T00—T09. In each case, an incoming call selects the first idle loop in either the "high" or "low" assignment of the trunk.

Sequences are as follows:

ATTENDANT POSITIONS	ATTENDANT TRUNKS	LOW	HIGH
2	11	6, 10, 9, 8, 7, 5, 4, 3, 2, 1	11, 10, 9, 8, 7, 5, 4, 3, 2, 1
2	12	5, 6, 10, 9, 8, 7, 4, 3, 2, 1	12, 11, 10, 9, 8, 7, 4, 3, 2, 1
3	11	6, 7, 9, 8, 10, 5, 4, 3, 2, 1	11, 7, 9, 8, 10, 5, 4, 3, 2, 1
3	12	3, 6, 4, 8, 10, 7, 5, 9, 2, 1	12, 11, 4, 8, 10, 7, 5, 9, 2, 1
3	13	3, 6, 9, 8, 7, 5, 4, 2, 10, 1	13, 12, 11, 8, 7, 5, 4, 2, 10, 1
3	14	3, 6, 9, 20, 8, 7, 5, 4, 2, 1	14, 13, 12, 11, 8, 7, 5, 4, 2, 1
3	15	3, 4, 6, 9, 20, 8, 7, 5, 2, 1	14, 13, 15, 12, 11, 8, 7, 5, 2, 1
3	16	3, 4, 6, 8, 9, 10, 7, 5, 2, 1	14, 16, 15, 13, 12, 11, 7, 5, 2, 1
3	17	3, 4, 6, 7, 8, 9, 10, 5, 2, 1	17, 16, 15, 14, 13, 12, 11, 5, 2, 1
3	18	3, 4, 5, 6, 7, 8, 9, 10, 2, 1	17, 16, 18, 15, 14, 13, 12, 11, 2, 1

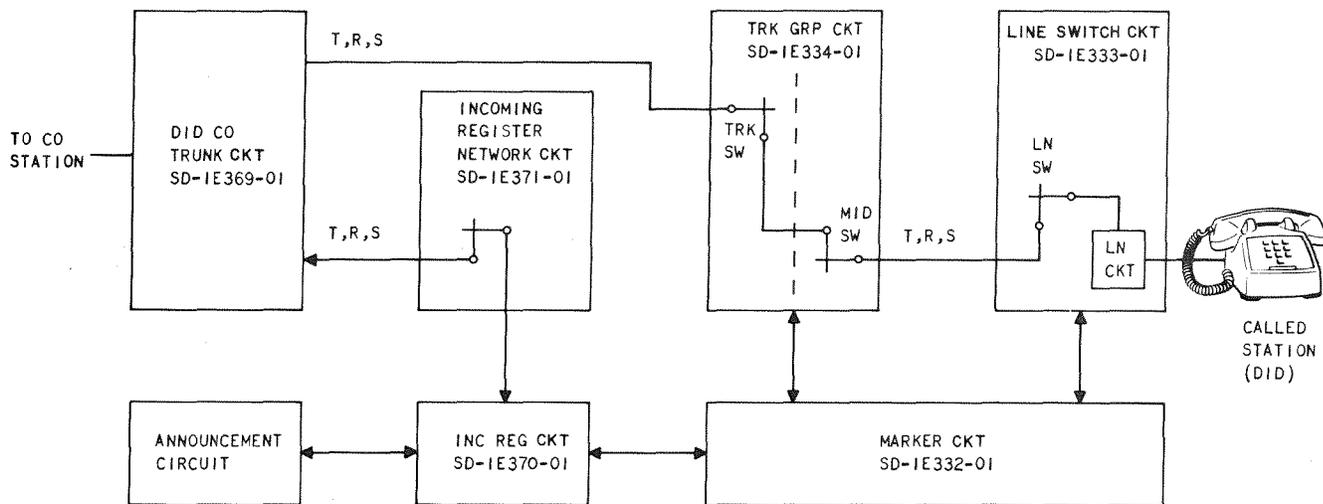


Fig. 13—Incoming DID Central Office Call to PBX Station

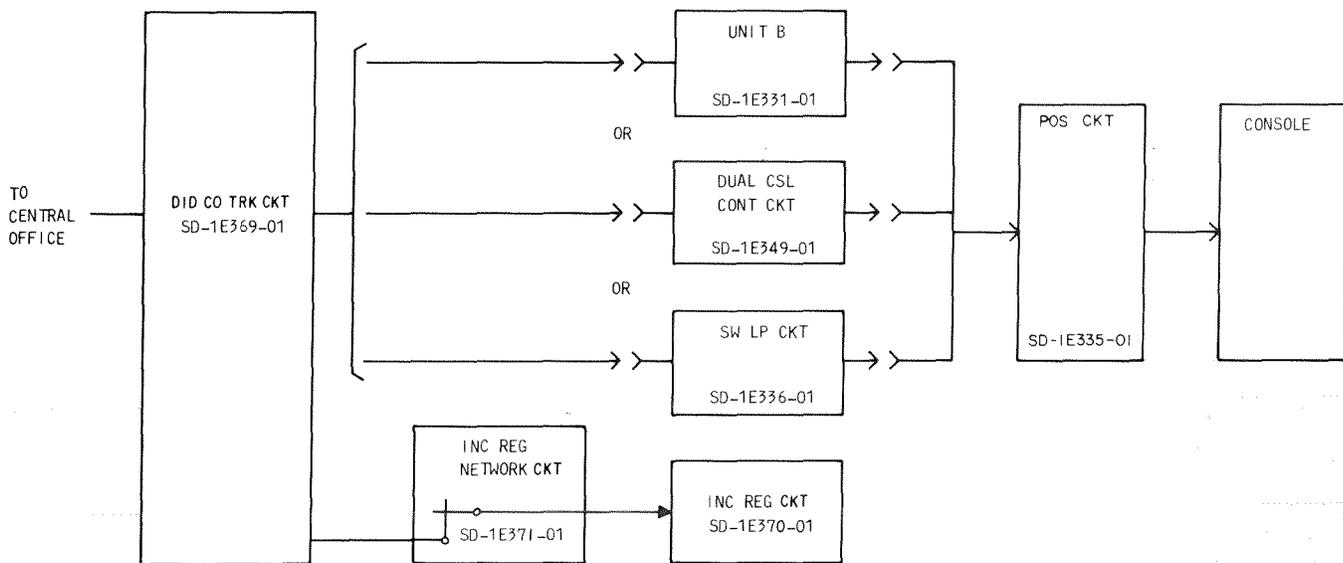


Fig. 14—Incoming DID Call to Listed Directory Number

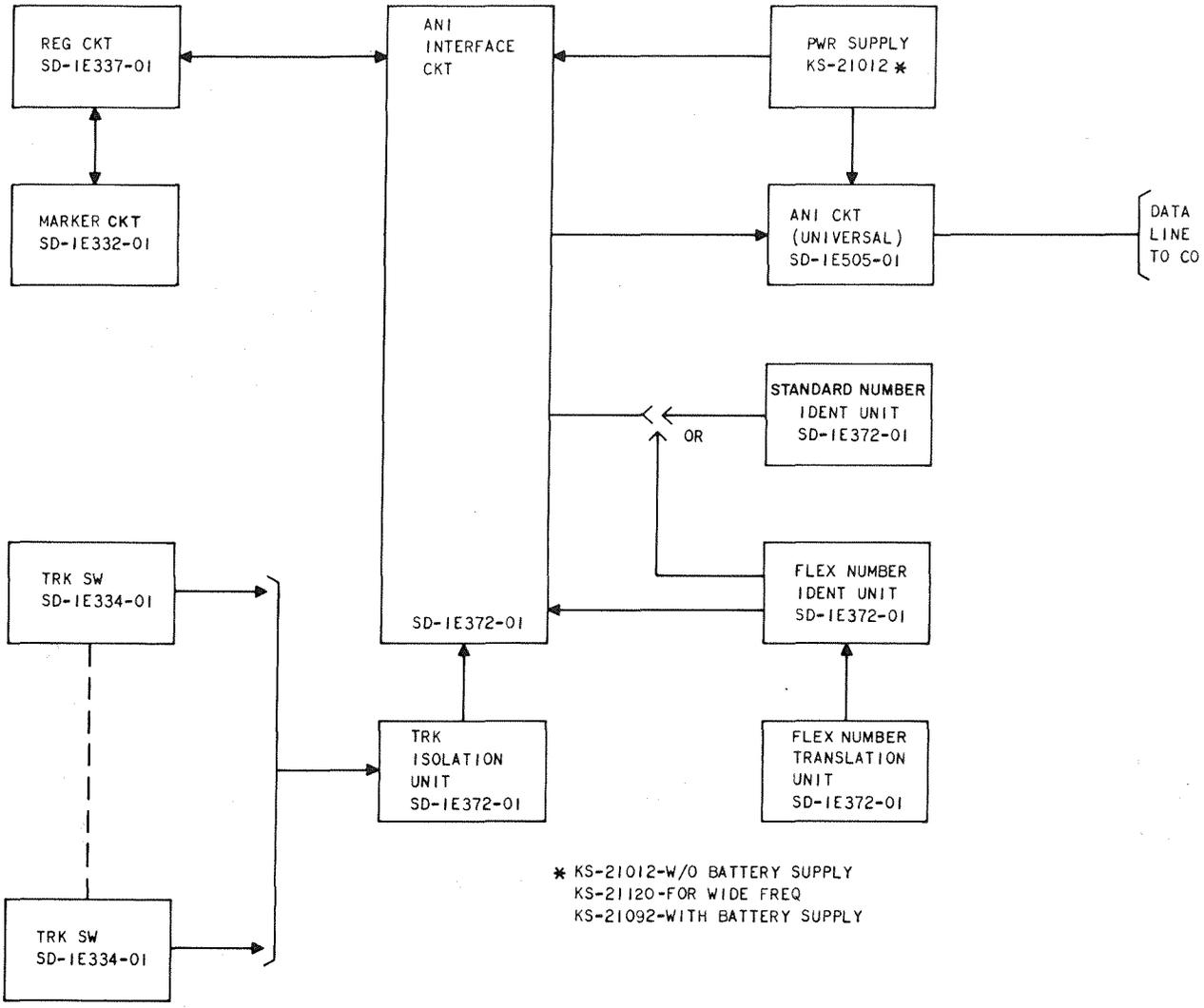


Fig. 15—Outgoing Call From Station With Automatic Number Identification

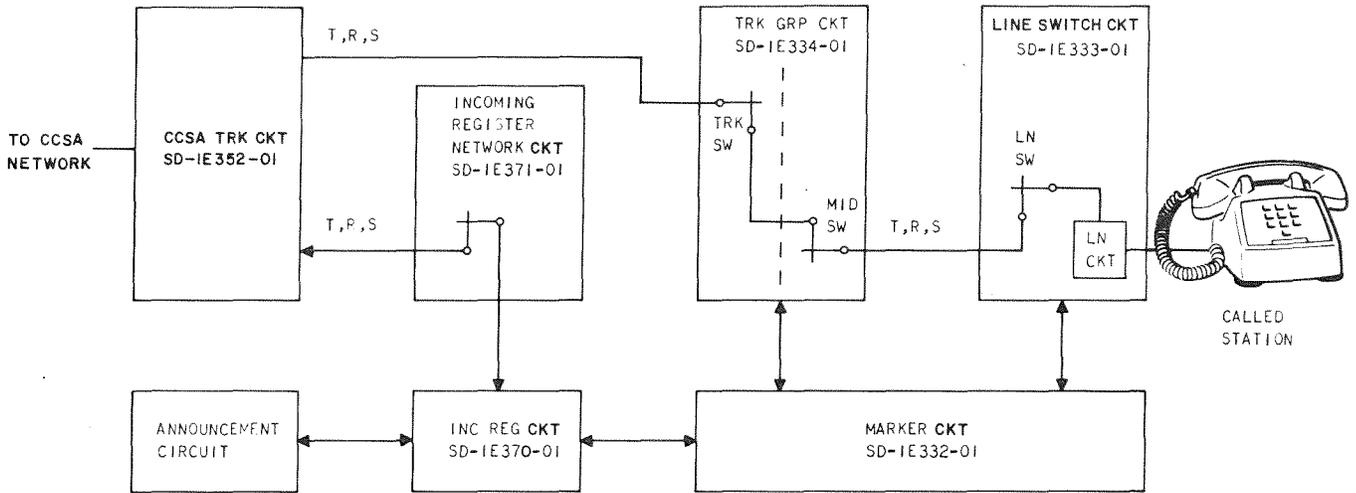


Fig. 16—Incoming Call From CCSA Network to Idle PBX Station

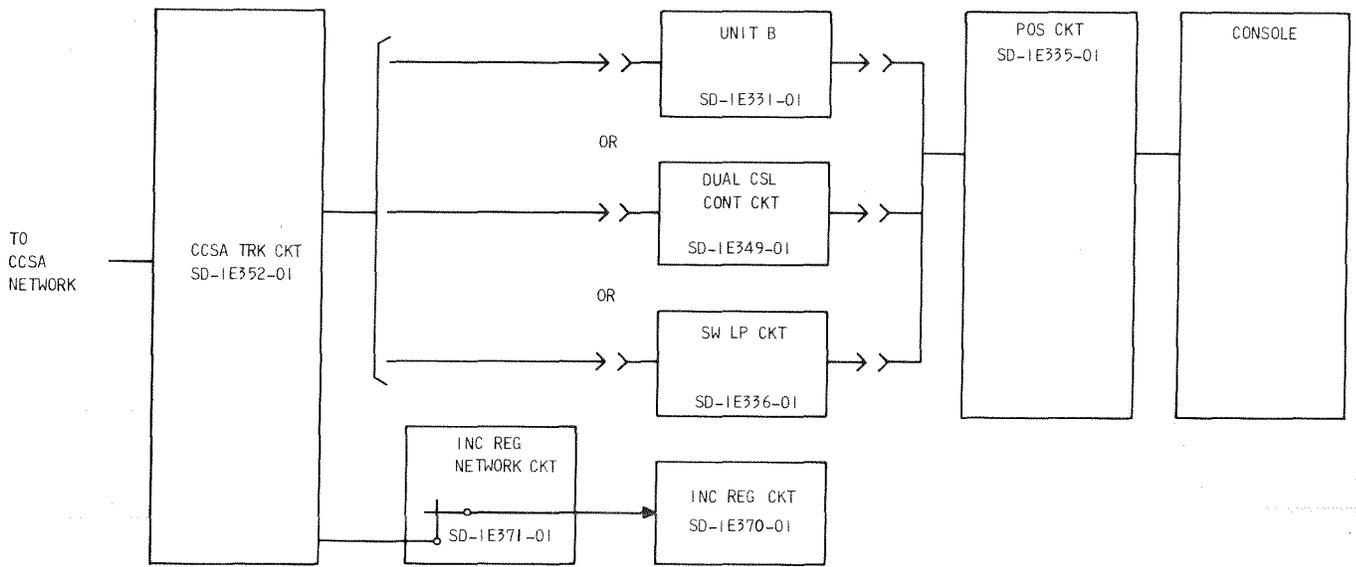


Fig. 17—Incoming CCSA Call to Listed Directory Number

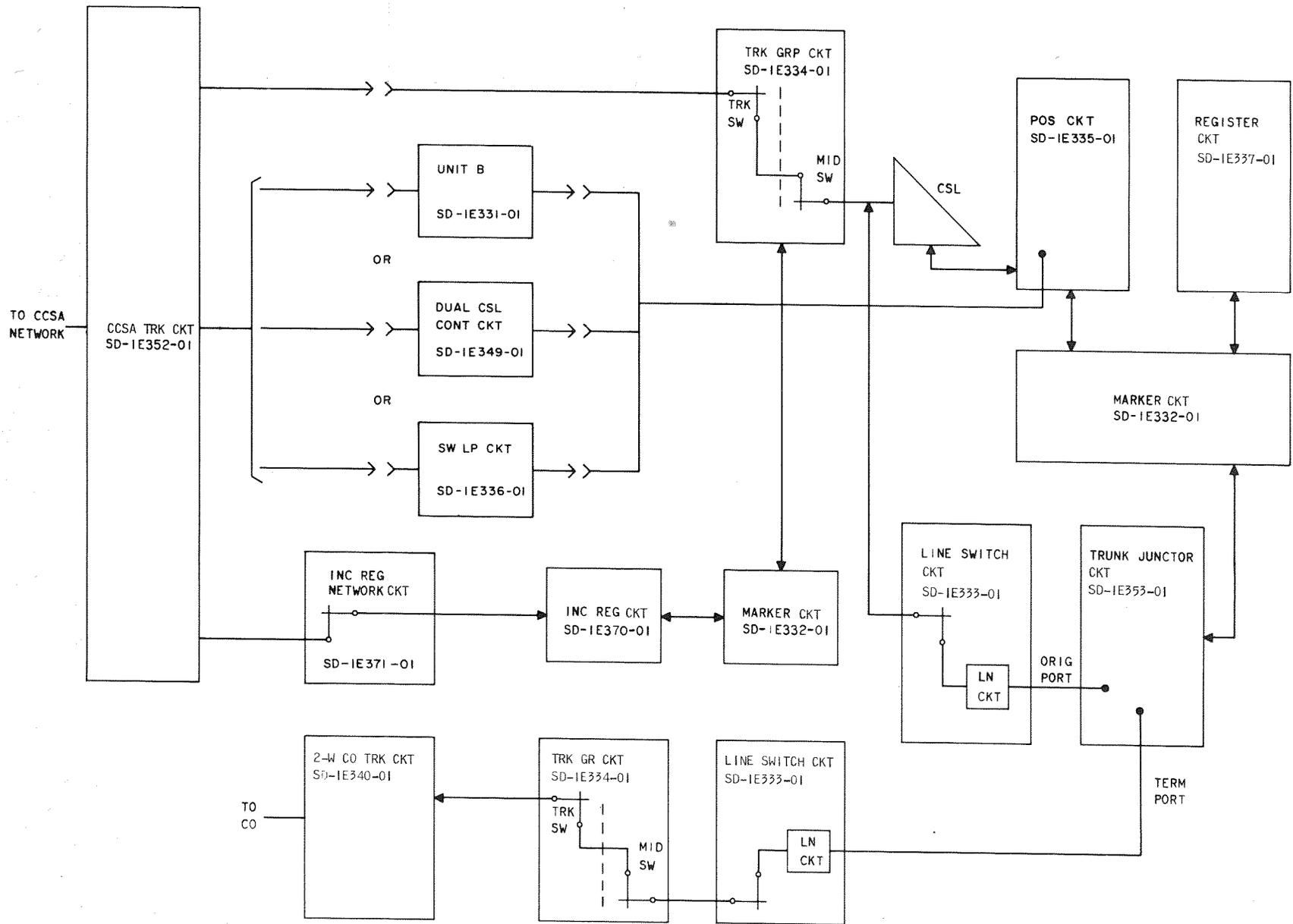


Fig. 18—Incoming CCSA Call Switched Through Trunk Junctor to CO Trunk

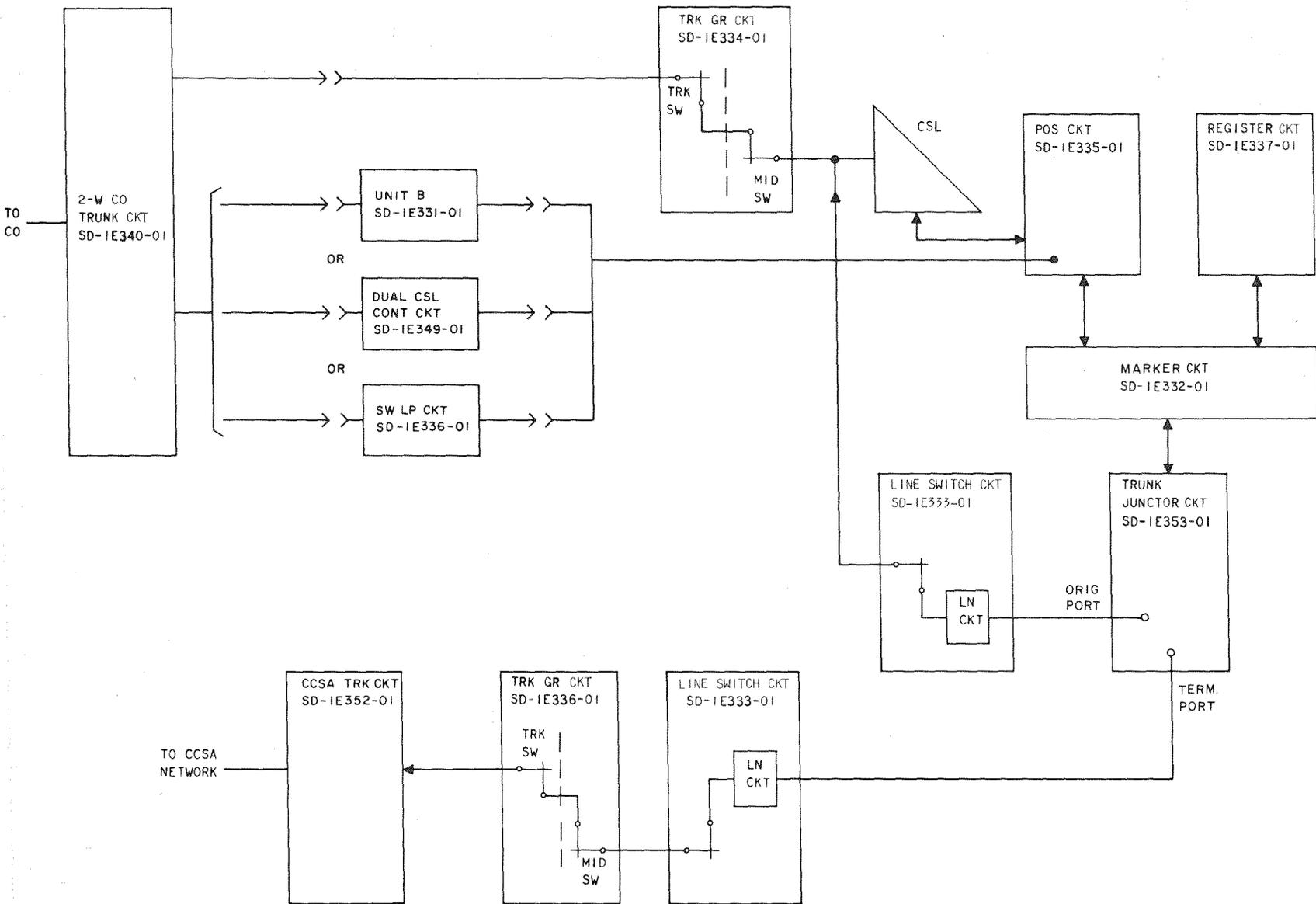
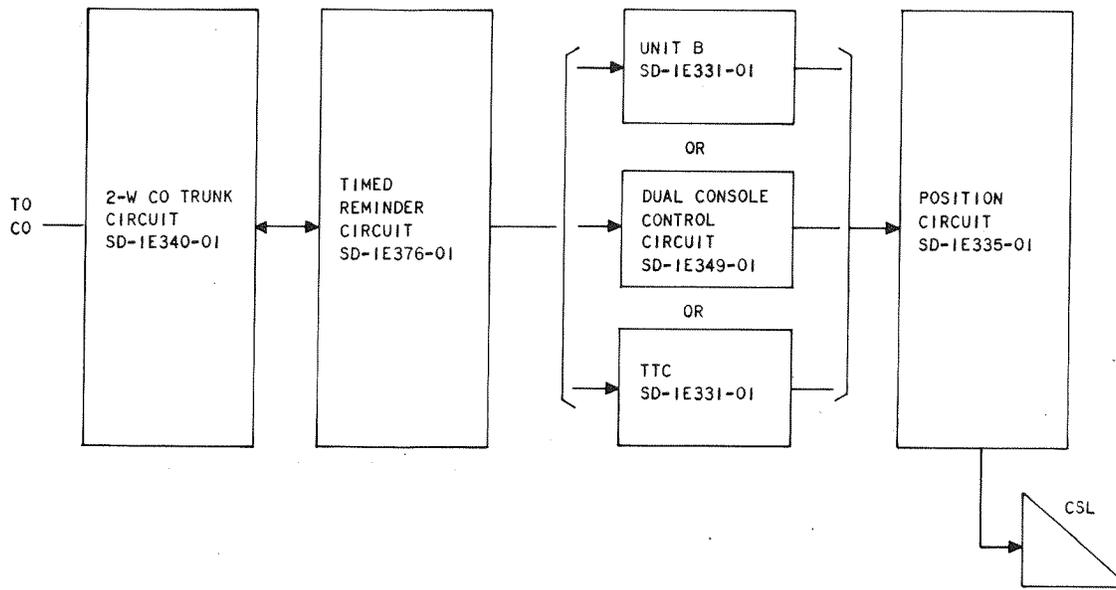


Fig. 19—Incoming CO Trunk Call Switched Through Trunk Junctor to CCSA Network



**Fig. 20—Incoming CO Call With Timed Reminder Signaling Attendant Console for Direct Terminated Systems**  
 (See 3.33 for explanation of timed reminder feature with switched loop systems.)

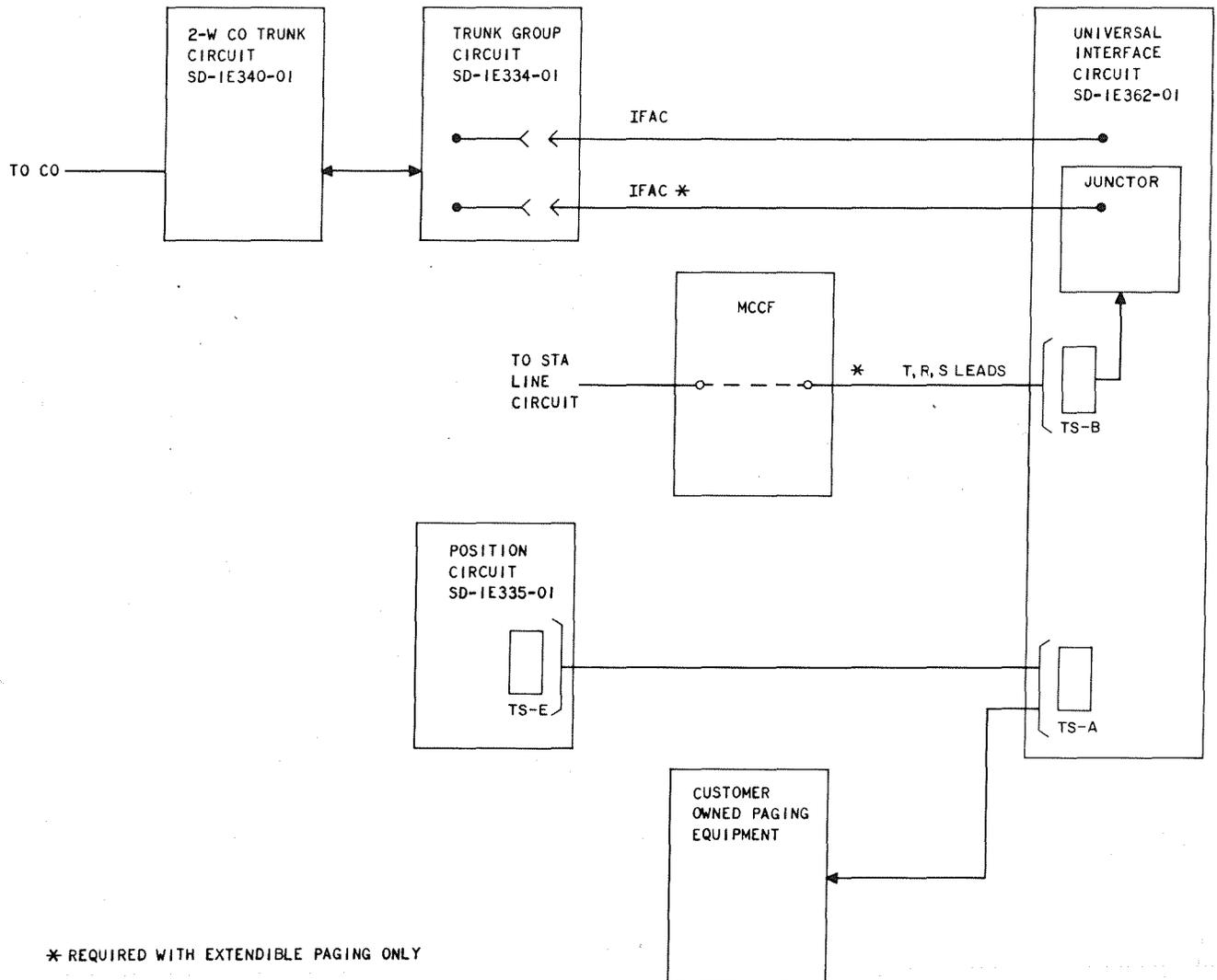


Fig. 21—Paging Call

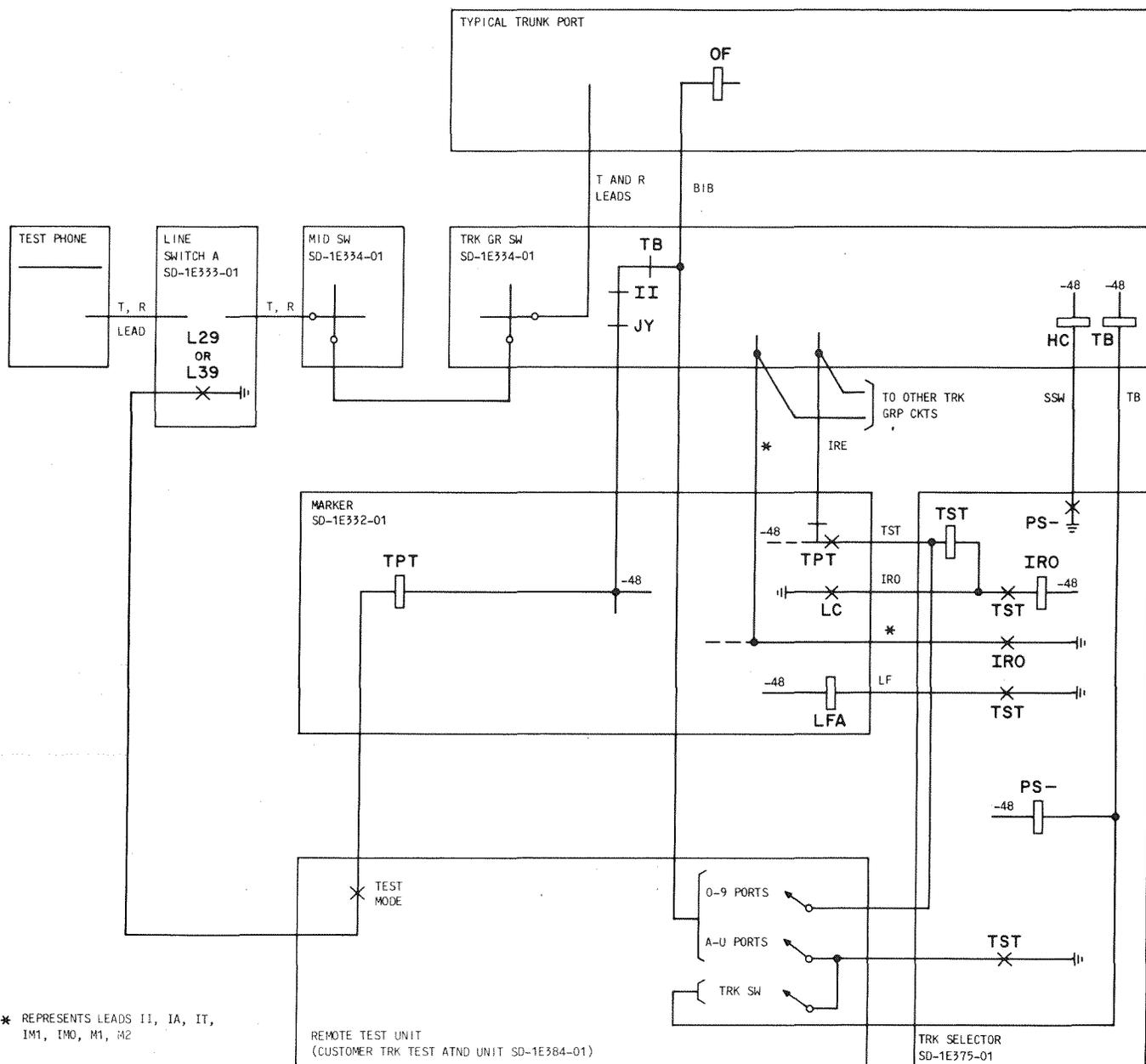
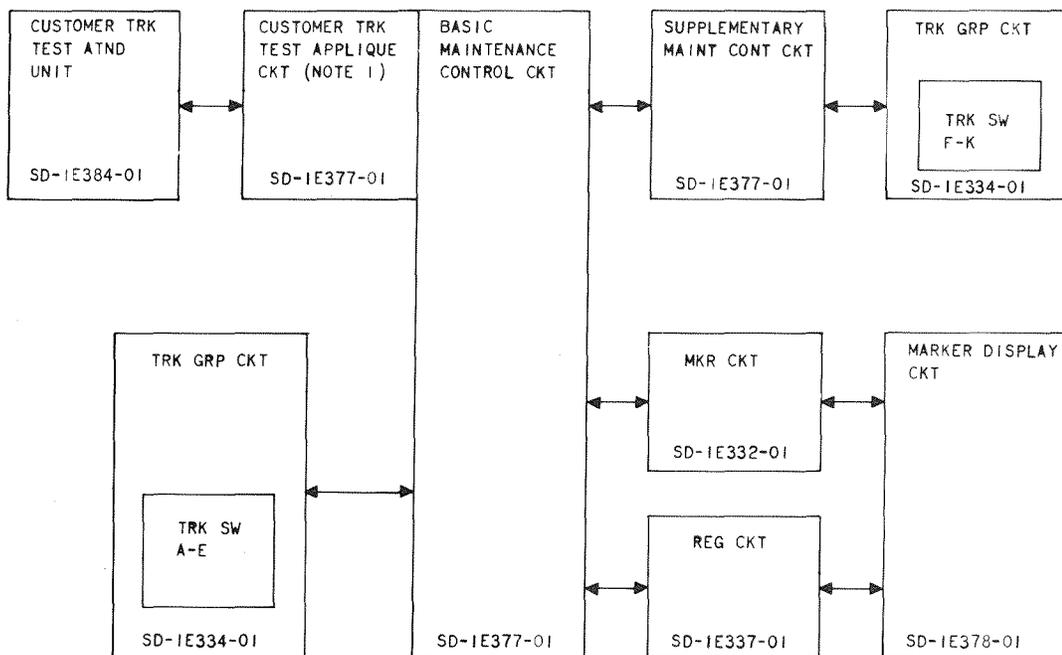


Fig. 22—Trunk Selector and Related Circuits



NOTES:

1. WHEN CUSTOMER TRUNK TEST APPLIQUE IS PROVIDED, THIS UNIT WILL BE SURFACE WIRED (HARDWIRED) TO THE BASIC MAINTENANCE CONTROL CKT.
2. THE MARKER DISPLAY CKT MAY BE PROVIDED WITH THE BASIC MAINTENANCE CKT OR MAY BE PROVIDED WITHOUT THE BASIC MAINTENANCE CKT

Fig. 23—Maintenance Control, Marker Display, and Related Circuits

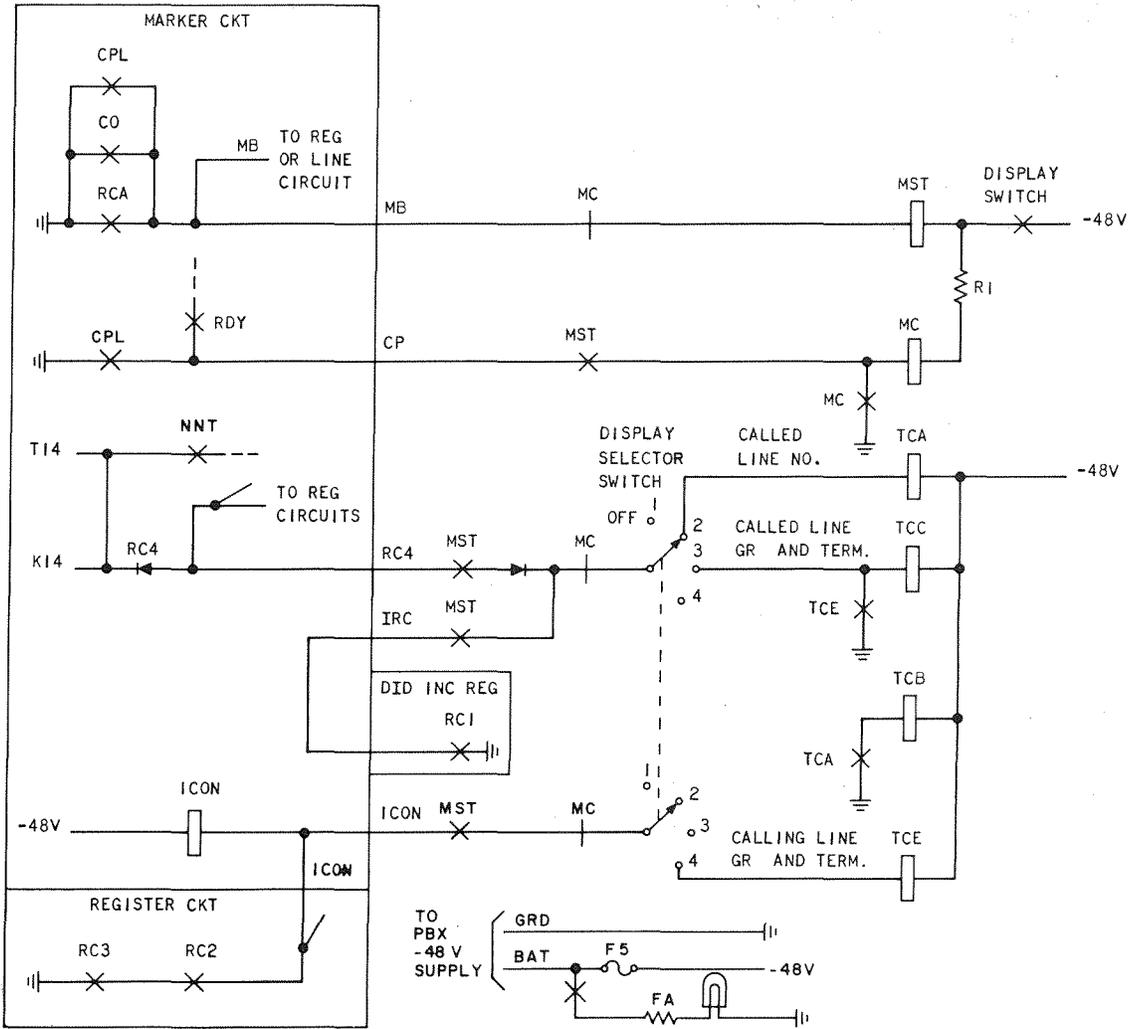


Fig. 24—Marker Display—Called Line Number—Simplified Schematic

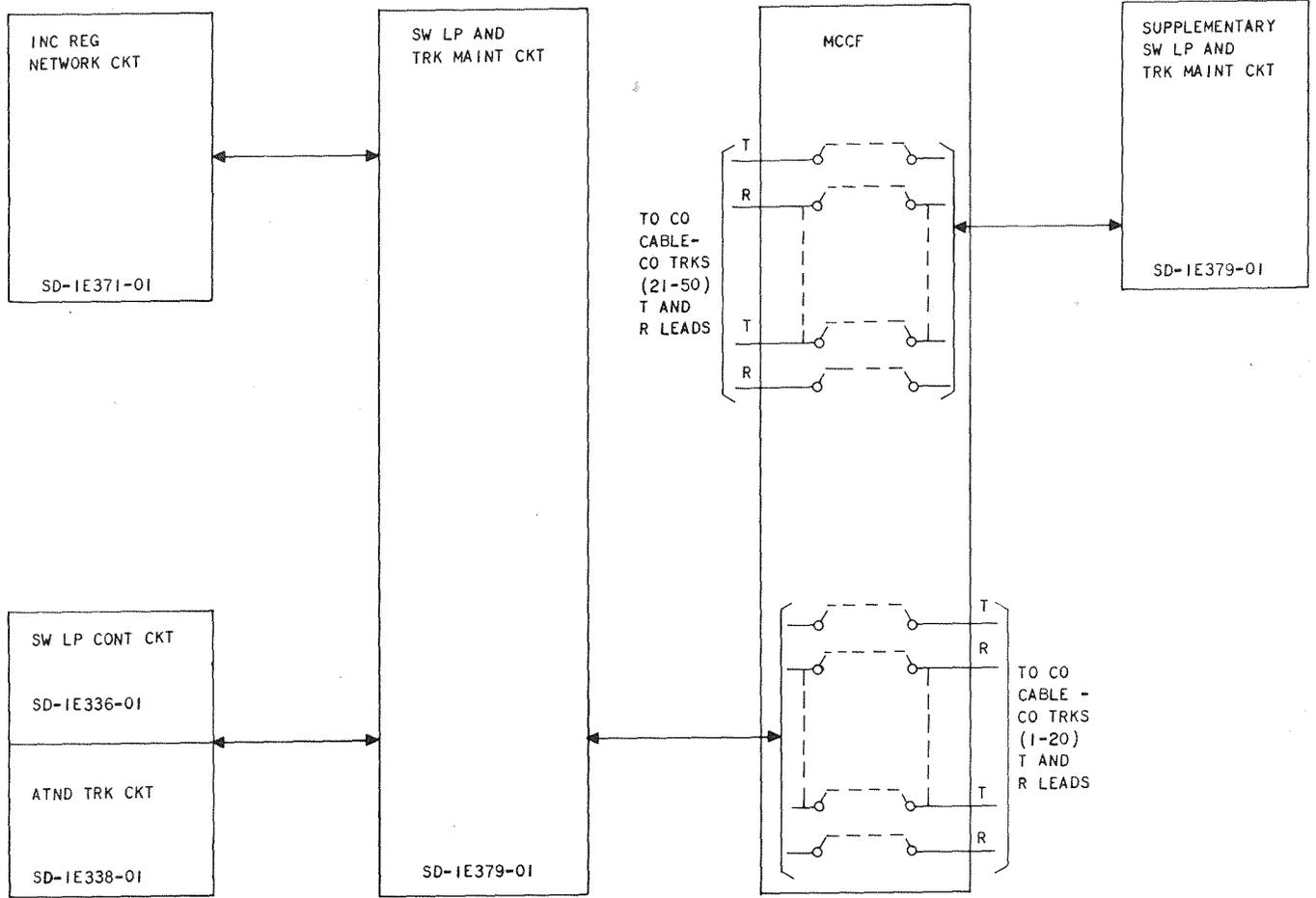


Fig. 25—Switched Loop and Trunk Maintenance and Related Circuits

6. DESCRIPTION OF SYSTEM OPERATION

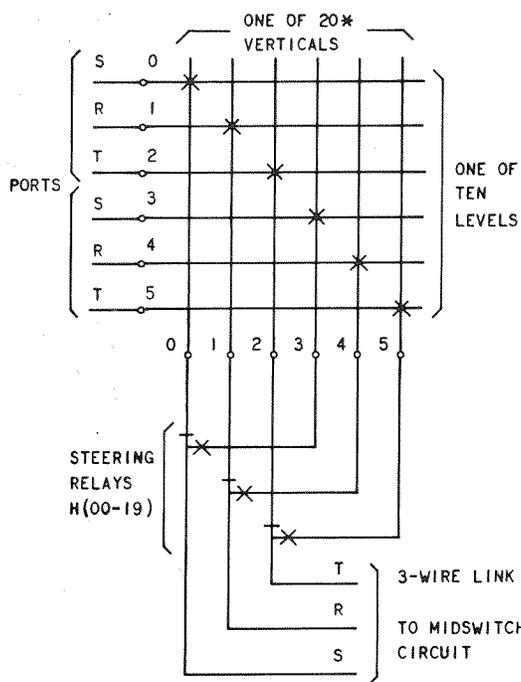
6.01 This part describes in some detail:

- (a) Flowchart symbols (Fig. 26)
- (b) Line switch port (Fig. 27)
- (c) Trunk switch port (Fig. 28)
- (d) Register seizure for dial tone connection and dialing path (Fig. 29)
- (e) Translation of a dialed number into an equipment location (Fig. 30)
- (f) Trunk group selection circuit (Fig. 31)
- (g) Line switch preference circuit (Fig. 32)
- (h) Power failure transfer arrangement (Fig. 33)
- (i) Cabling arrangement for direct trunk termination with unit A (Fig. 34)
- (j) Cabling arrangement for direct trunk termination with unit B (Fig. 35)
- (k) Cabling arrangement for direct trunk termination with TTC unit (Fig. 36)
- (l) Cabling arrangement for direct trunk termination with dual console operation (Fig. 37)
- (m) Fixed night station connection arrangement (Fig. 38)
- (n) Trunk-answer-from-any-station arrangement (Fig. 39)
- (o) Switched loop termination (Fig. 40)
- (p) ♦AUTOVON system connections (Fig. 41).♦

SYMBOL	EXPLANATION
	<p>START - USED TO REPRESENT THE BEGINNING OF A TEST OR PARTICULAR SEQUENCE.</p>
	<p>OPERATION - USED TO DESCRIBE THE ACTIONS TAKEN AT THIS POINT IN THE PROGRAM.</p>
	<p>BINARY DECISION - USED TO DESCRIBE THE DECISION THAT IS REQUIRED AT THIS POINT IN THE TEST OR SEQUENCE.</p>
	<p>ANNOTATION - NOT A PART OF THE OPERATION. USED AS AN AID IN DESCRIBING THE TEST PROCEDURE OR SEQUENCE AT THIS POINT.</p>
	<p>ENTRANCE OR EXIT - USED TO REPRESENT THE BEGINNING OF A MAJOR OR MINOR BLOCK OF THE TEST OR PARTICULAR SEQUENCE.</p>
	<p>ENTRANCE OR EXIT - USED TO REPRESENT THE BEGINNING OF A MAJOR OR MINOR BLOCK OF THE TEST OR PARTICULAR SEQUENCE.</p>

NOTE:  
 NORMALLY, THE DIRECTION OF FLOW ON A FLOWCHART IS FROM TOP TO BOTTOM AND FROM LEFT TO RIGHT.

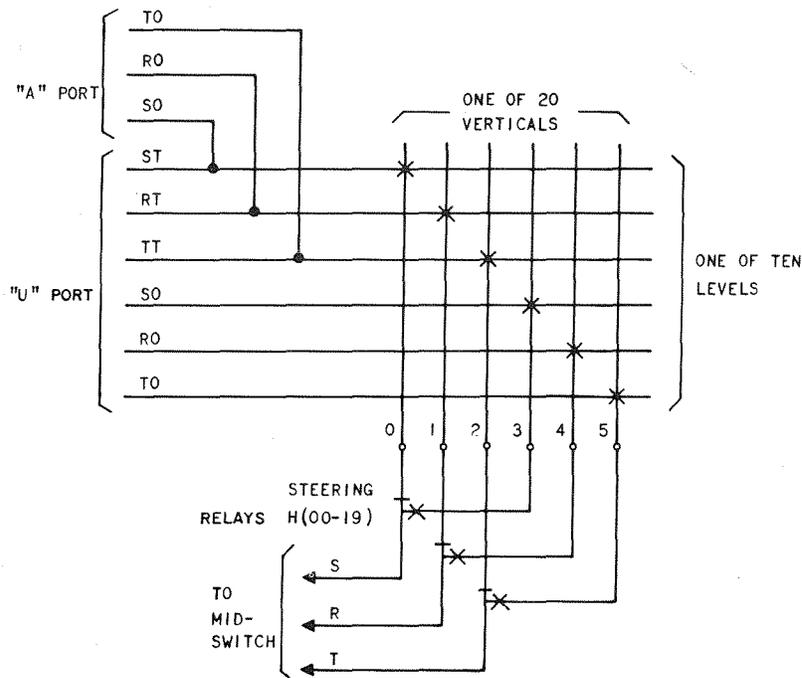
Fig. 26—Typical Flowchart Symbols



NOTES:

1. EACH LINE SWITCH CIRCUIT (FIG.4) HAS 40 LINE PORTS (T, R, S). THESE LINE PORTS MAY BE USED FOR: (1) STATION LINES; (2) TIE TRUNK CIRCUITS; (3) POSITION CIRCUITS; AND (4) CONFERENCE CIRCUITS.
  2. THE SIX WIRES ASSOCIATED WITH EACH LEVEL PROVIDE FOR TWO (2) 3-WIRE PORTS (T, R, S).
  3. ONE OF THE 3-WIRE PORTS ON EACH LEVEL ACCESSES THE SWITCHING NETWORK VIA A 3-WIRE LINK ON A NON-STEERED BASIS (STEERING RELAY RELEASED.) THE OTHER 3-WIRE PORT ON THE SAME LEVEL ACCESSES THE SWITCHING NETWORK VIA A 3-WIRE LINK ON A STEERED BASIS (STEERING RELAY OPERATED.)
  4. EACH 3-WIRE LINE SWITCH PORT HAS TEN POSSIBLE ACCESS PATHS (VERTICALS TO THE SWITCHING NETWORK. (SEE FIG. 4).
- \* EACH LINE SWITCH IS DIVIDED INTO TWO 10 X 10 SWITCHES (SEE FIG.4)

Fig. 27—Line Switch Port



## NOTES:

## 1. "A" PORT:

(A) DOES NOT REQUIRE STEERING.

(B) MAY BE USED FOR ANY CIRCUIT THAT REQUIRES ONLY ONE PORT APPEARANCE SUCH AS A REGISTER, ATTENDANT TRUNK, ETC.

NOTE: WHEN AN "A" PORT IS USED, LEADS TT, RT, AND ST OF THE "U" PORT ARE NOT AVAILABLE FOR USE.

## 2. "U" PORT:

(A) REQUIRES STEERING FOR LEADS TO, RO, AND SO; DOES NOT REQUIRE STEERING FOR LEADS TT, RT, AND ST.

(B) MAY BE USED FOR ANY CIRCUIT THAT REQUIRES ONLY ONE PORT APPEARANCE (LEADS TO, RO, SO) SUCH AS A REGISTER, ATTENDANT TRUNK, ETC.

(C) MUST BE USED FOR A CIRCUIT THAT REQUIRES TWO PORT APPEARANCES.EXAMPLE - AN INTERCOM TRUNK WOULD REQUIRE LEADS TO, RO, AND SO FOR THE ORIGINATING PORT; LEADS TT, RT, AND ST WOULD BE REQUIRED FOR THE TERMINATING PORT. THE TERMINATING PORT WOULD BE ACCESSED VIA A SECOND VERTICAL ON A NON STEERED BASIS.NOTE: WHEN LEADS TT, RT, AND ST ARE REQUIRED, THE "A" PORT IS NOT AVAILABLE FOR USE.

Fig. 28—Trunk Switch Port

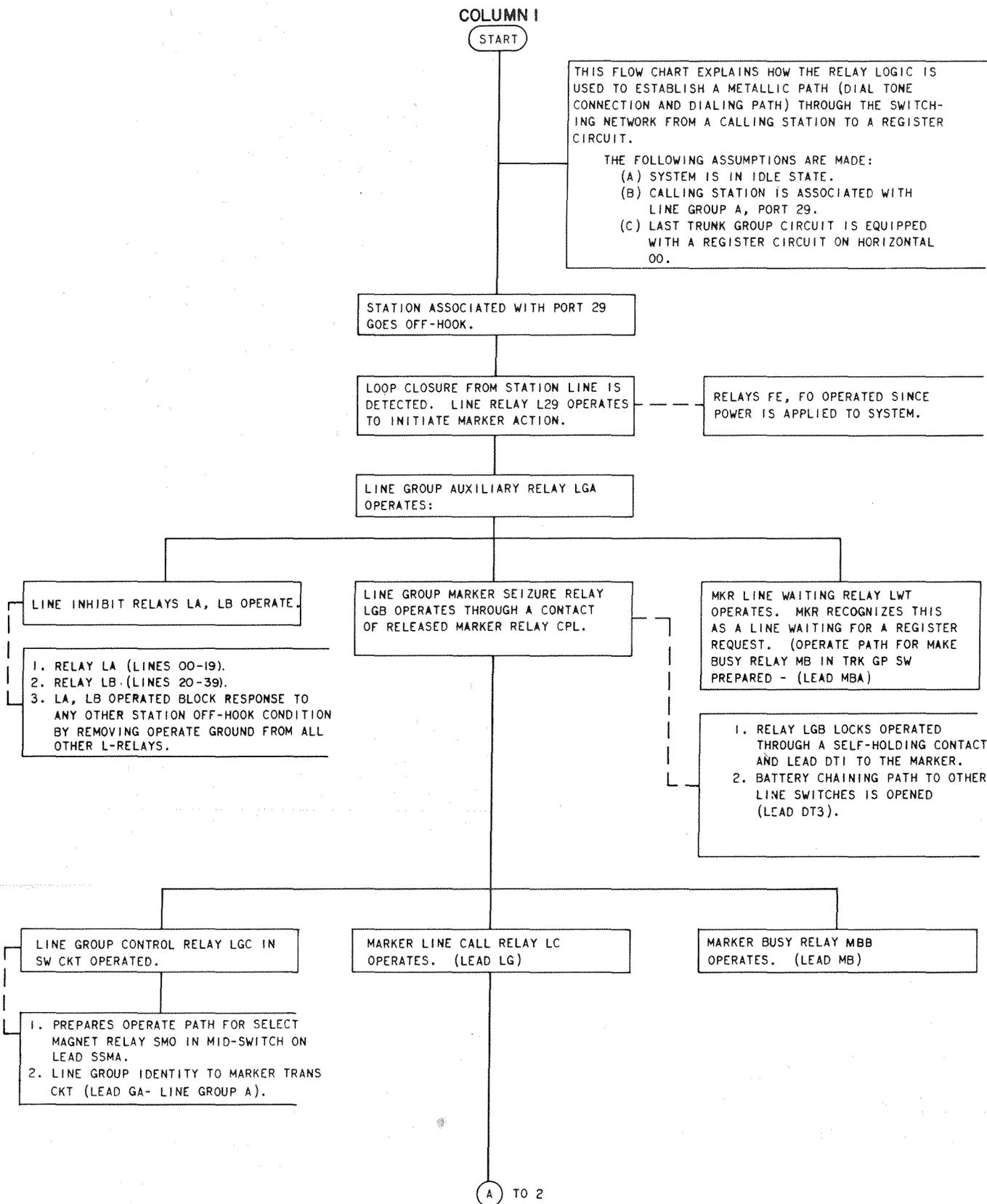


Fig. 29—Register Seizure for Dial Tone Connection and Dialing Path (Sheet 1 of 5)

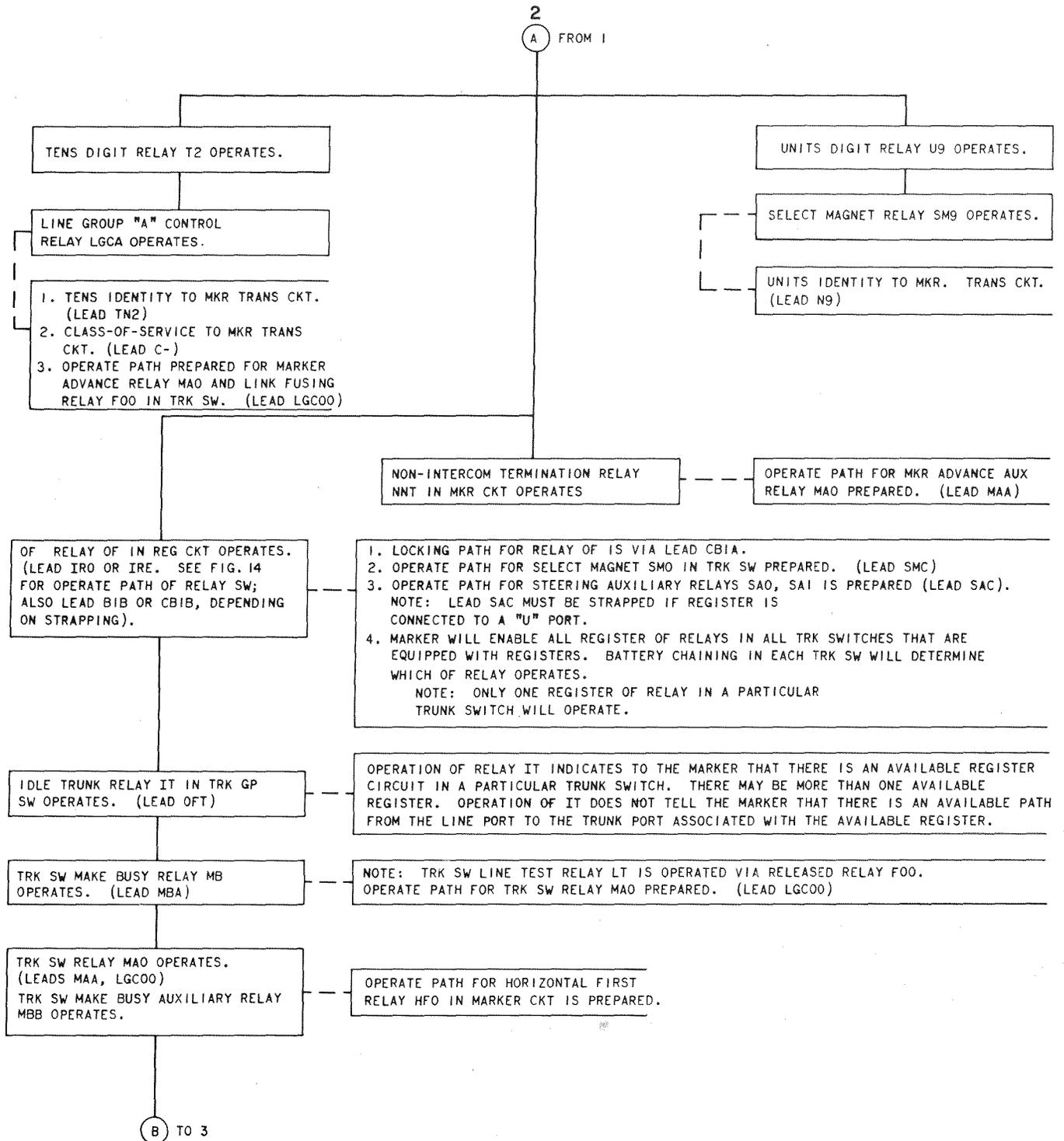


Fig. 29—Register Seizure for Dial Tone Connection and Dialing Path (Sheet 2 of 5)

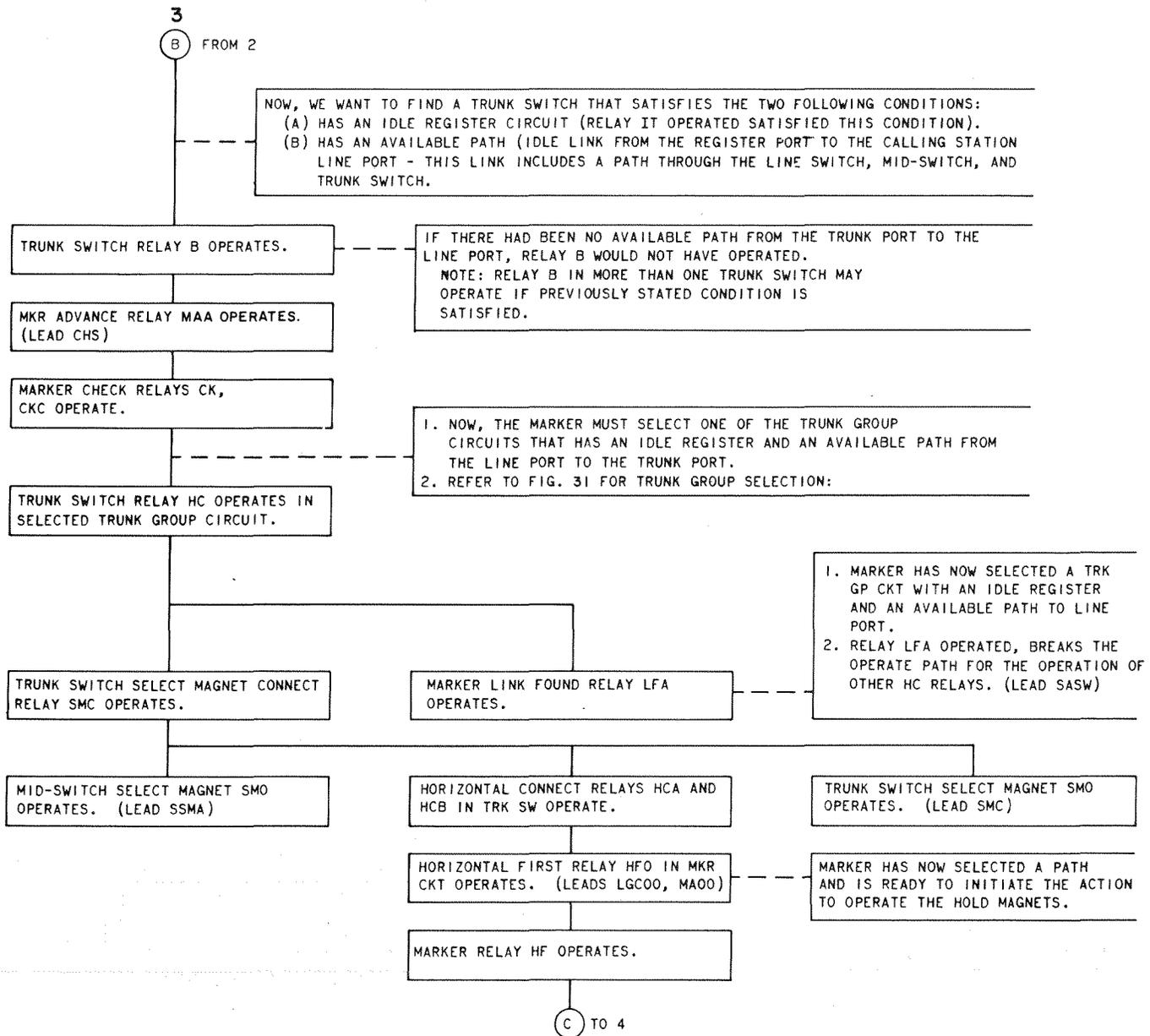


Fig. 29—Register Seizure for Dial Tone Connection and Dialing Path (Sheet 3 of 5)

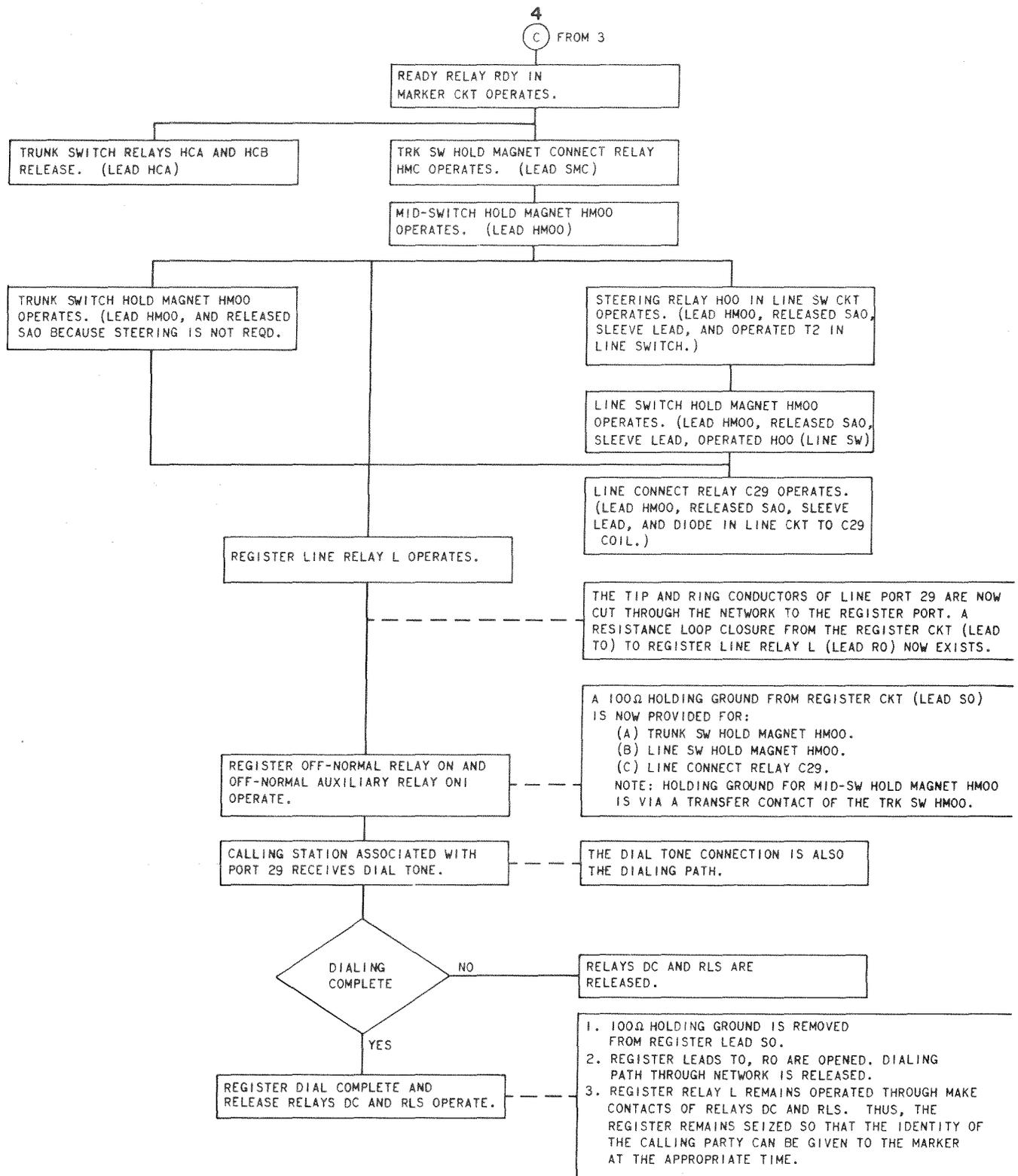


Fig. 29—Register Seizure for Dial Tone Connection and Dialing Path (Sheet 4 of 5)





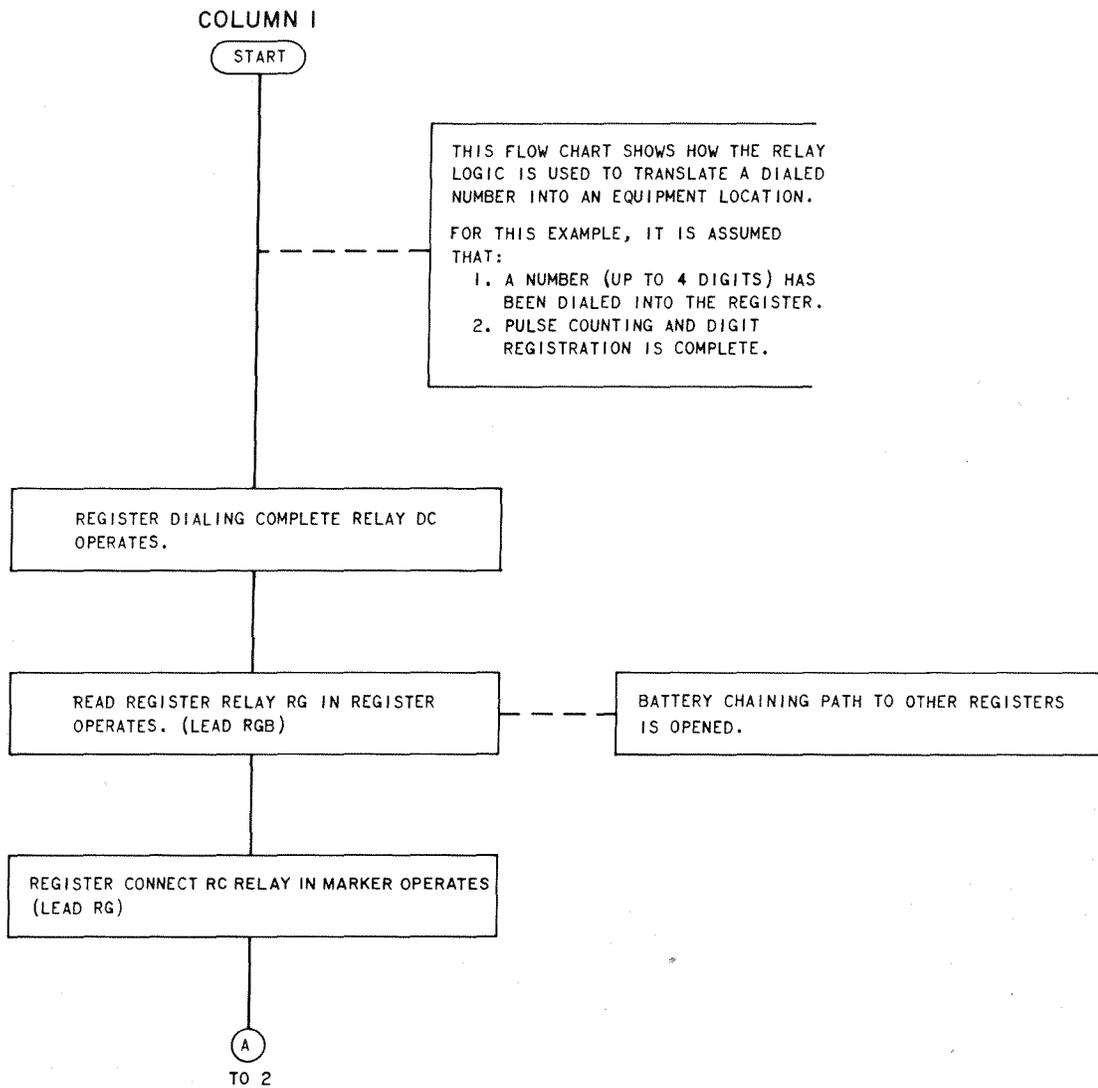


Fig. 30—Translation of Dialed Number Into Equipment Location (Sheet 1 of 3)

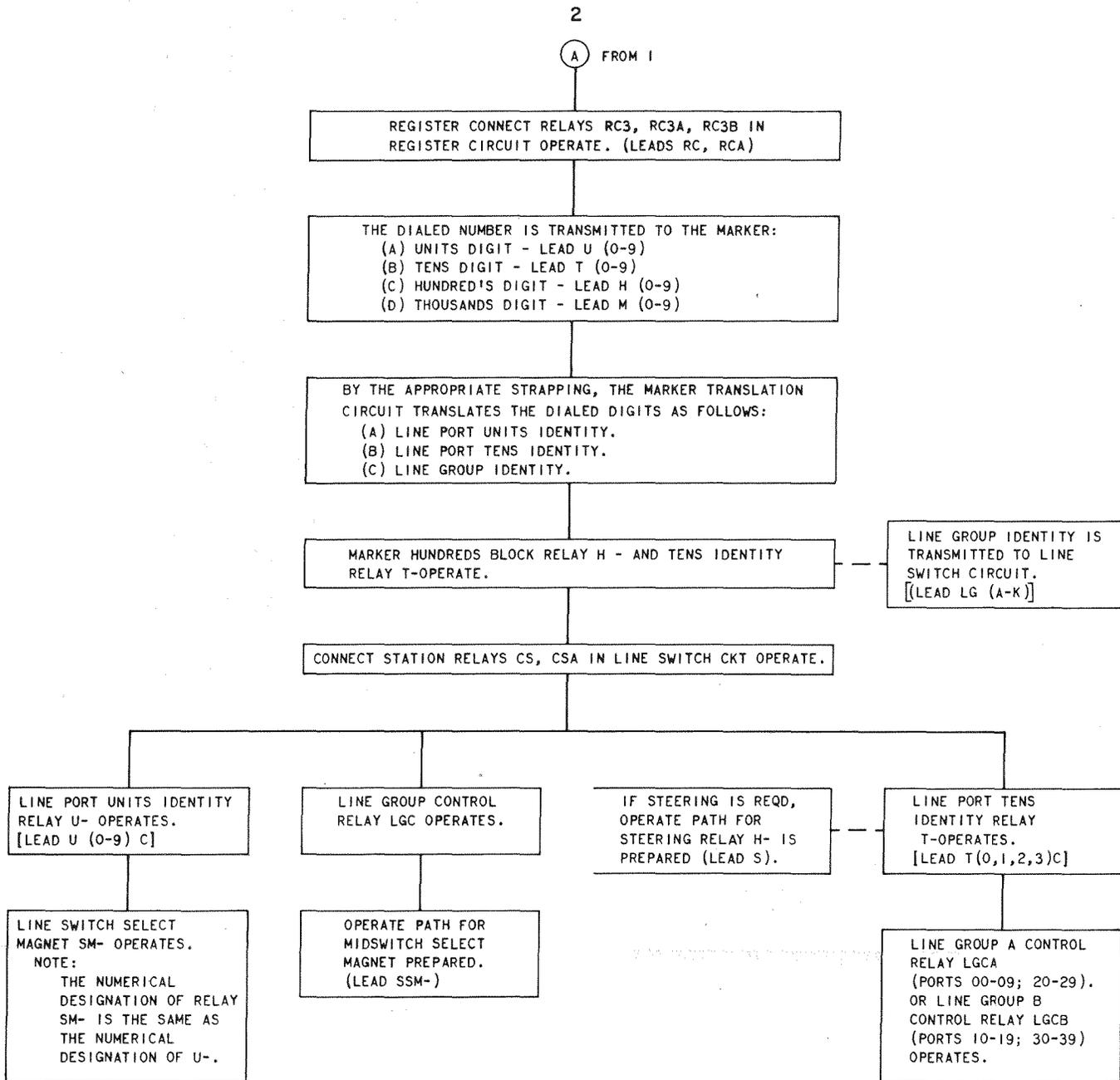


Fig. 30—Translation of Dialed Number Into Equipment Location (Sheet 2 of 3)

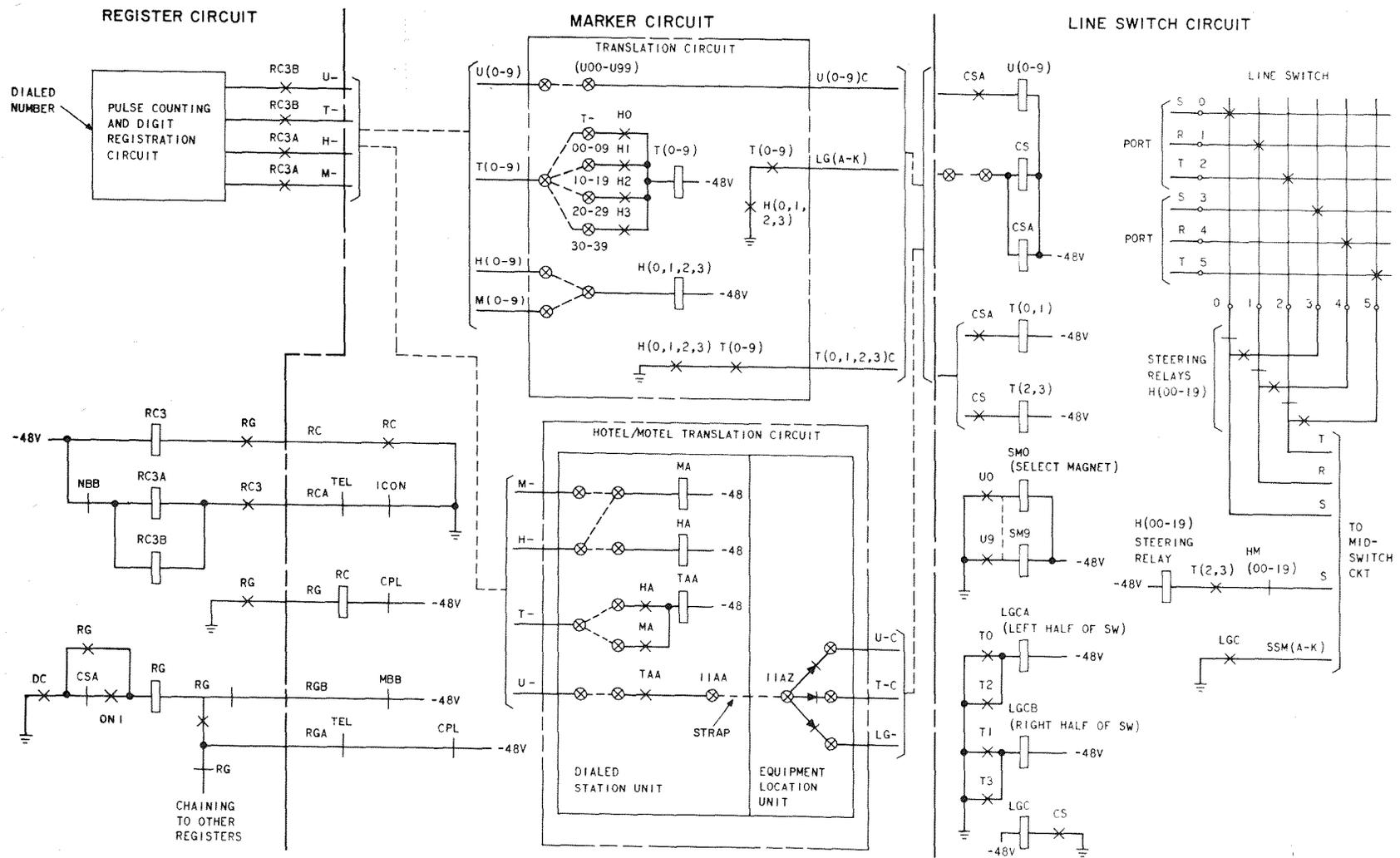


Fig. 30—Translation of Dialed Number Into Equipment Location (Sheet 3 of 3)

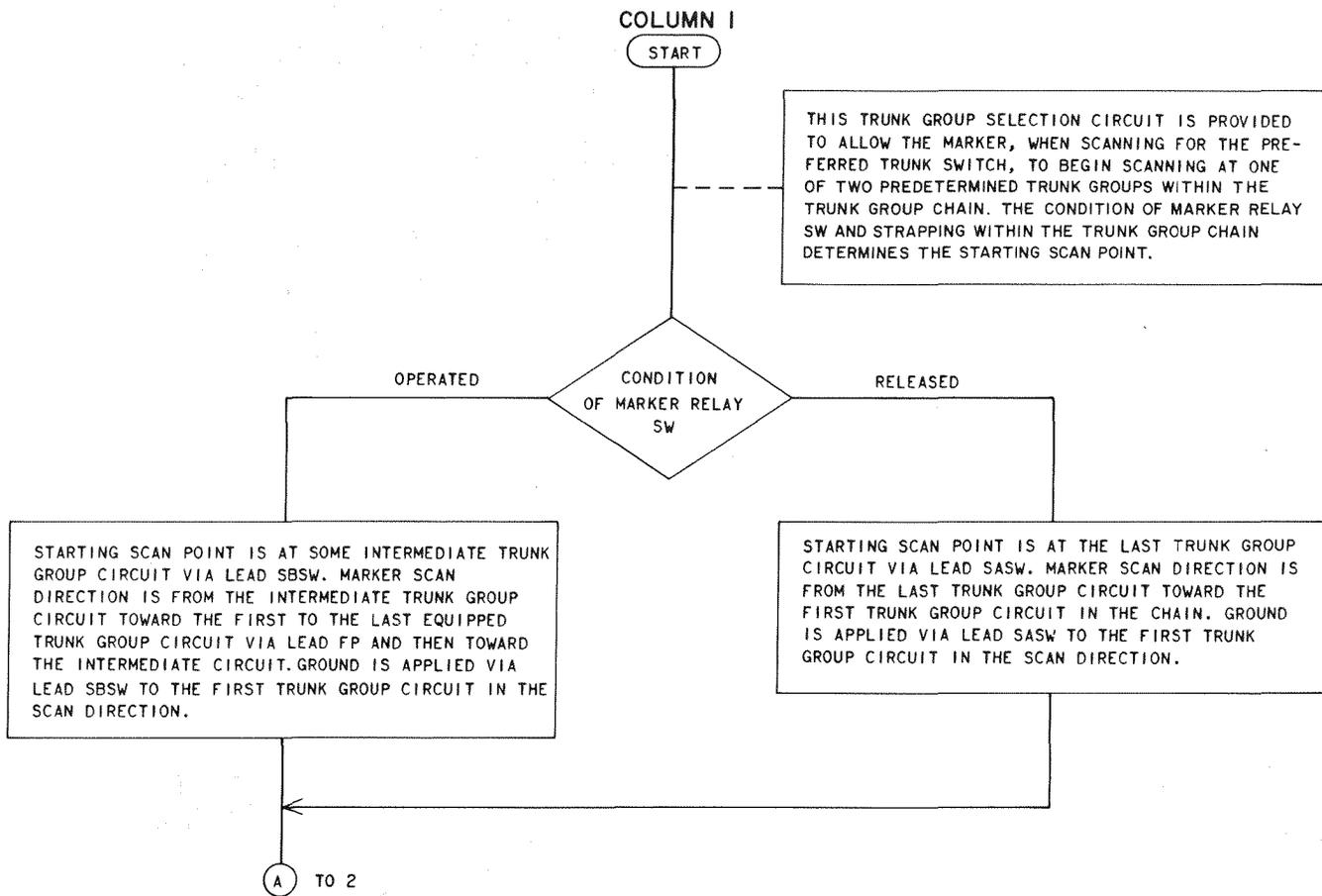


Fig. 31—Trunk Group Selection Circuit (Sheet 1 of 3)

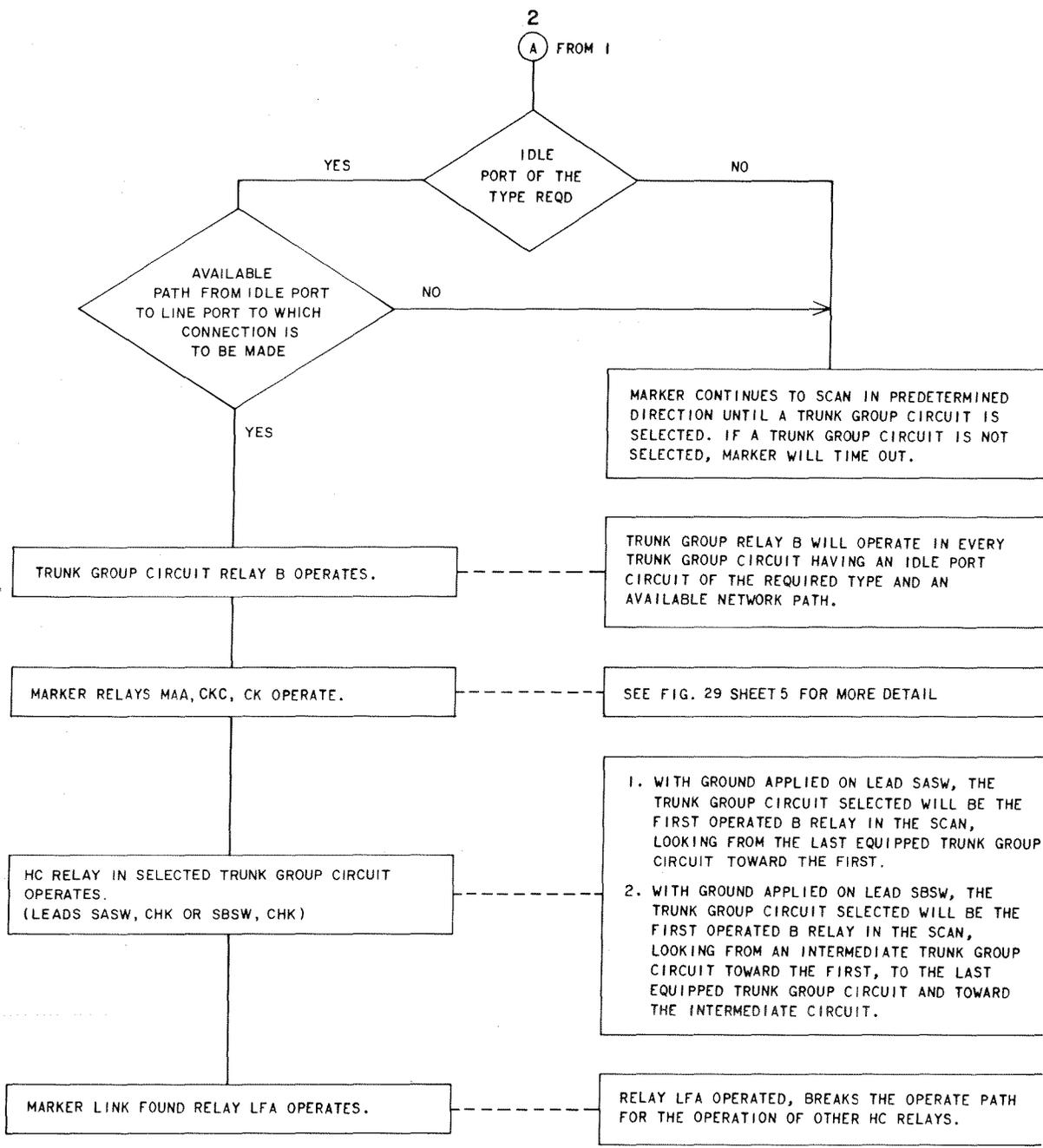


Fig. 31—Trunk Group Selection Circuit (Sheet 2 of 3)

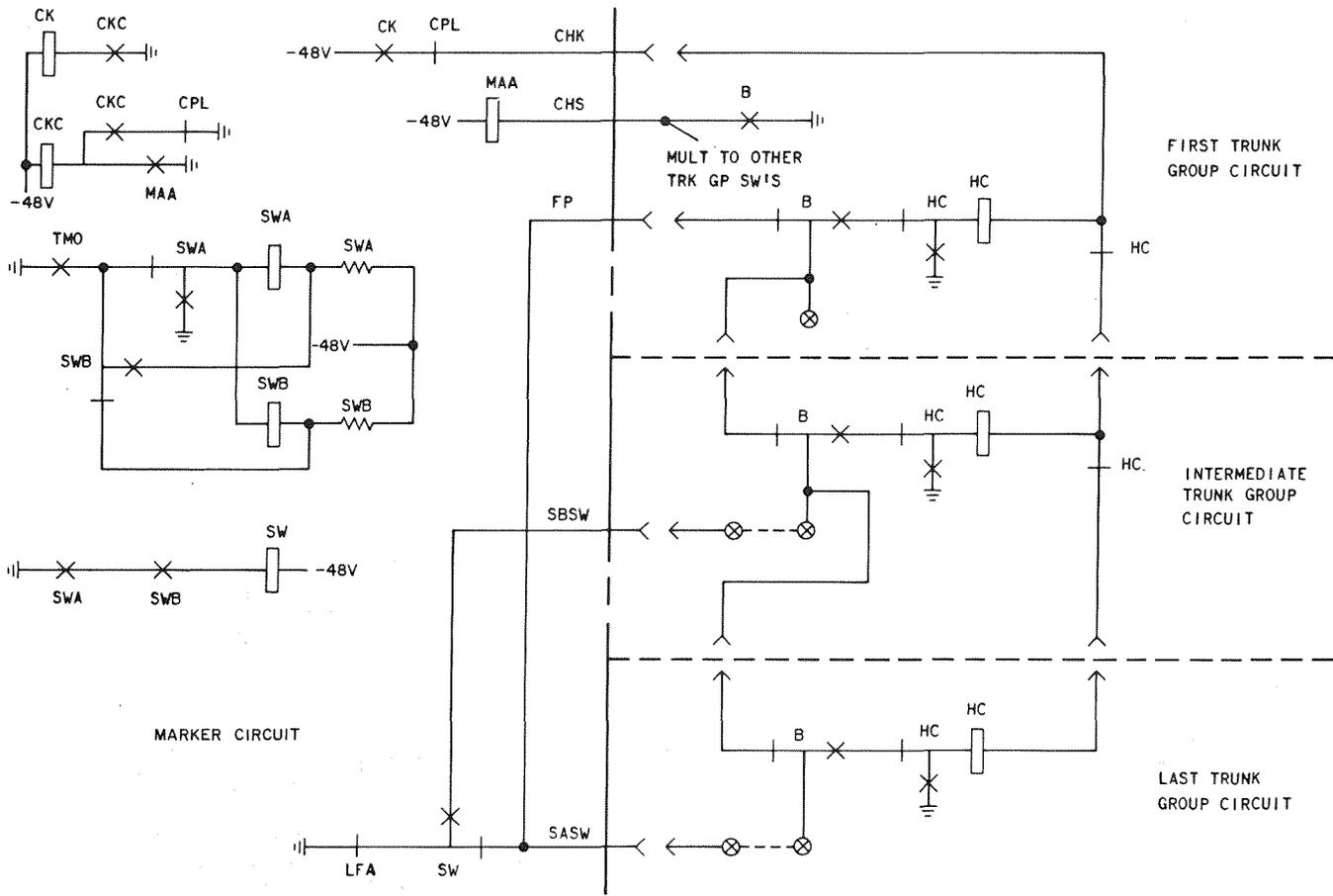


Fig. 31—Trunk Group Selection Circuit (Sheet 3 of 3)

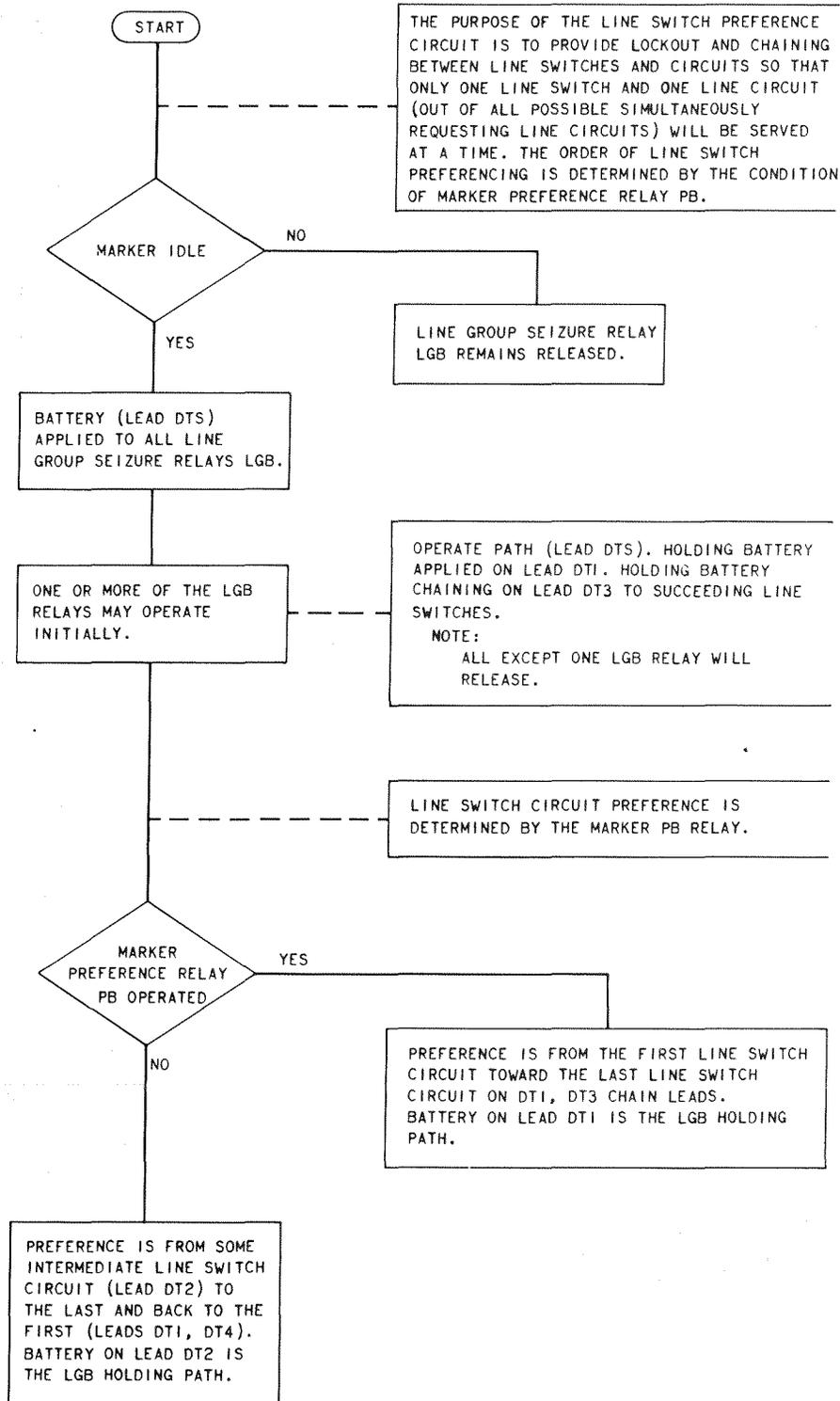


Fig. 32—Line Switch Preference Circuit (Sheet 1 of 2)

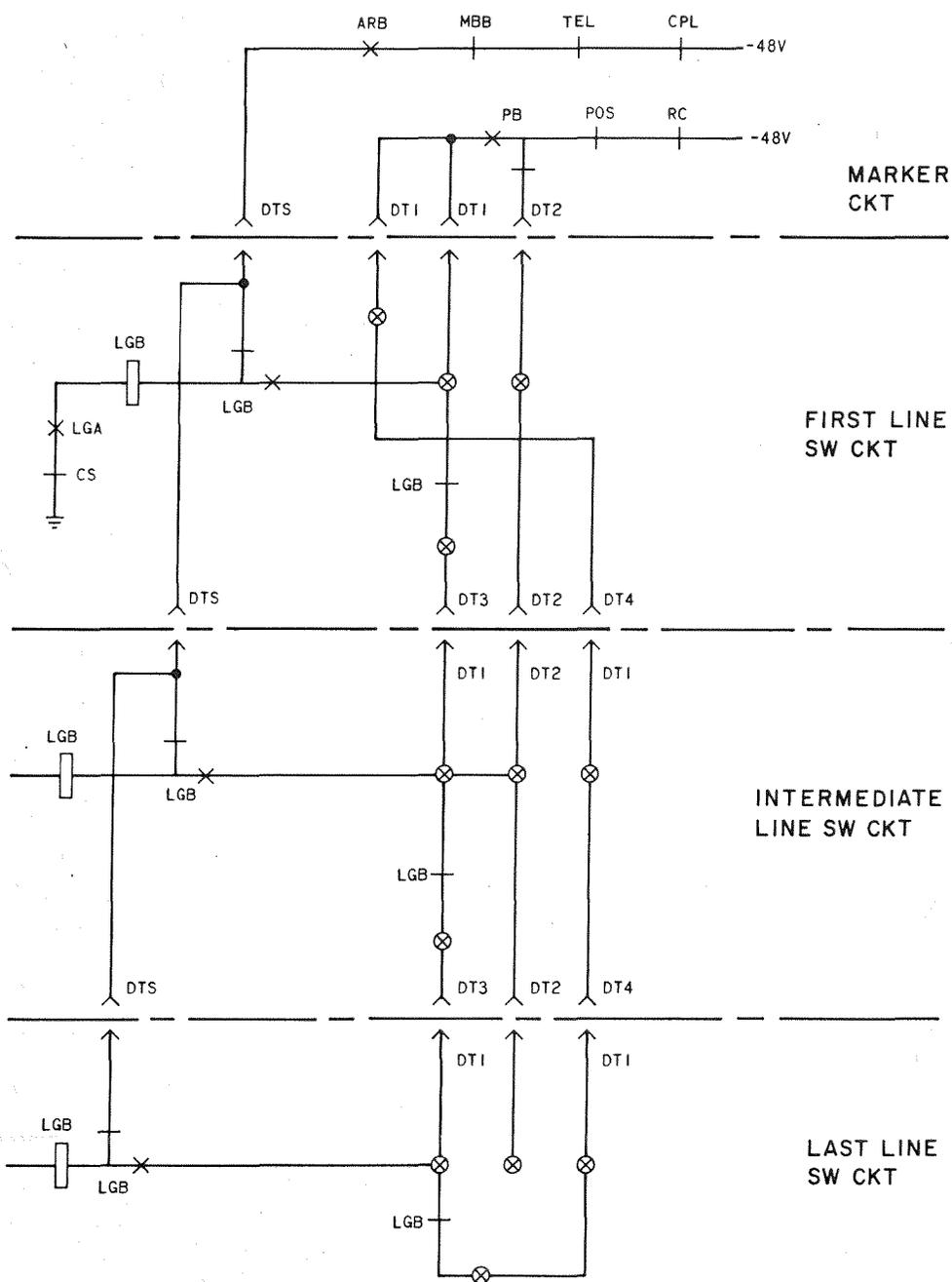
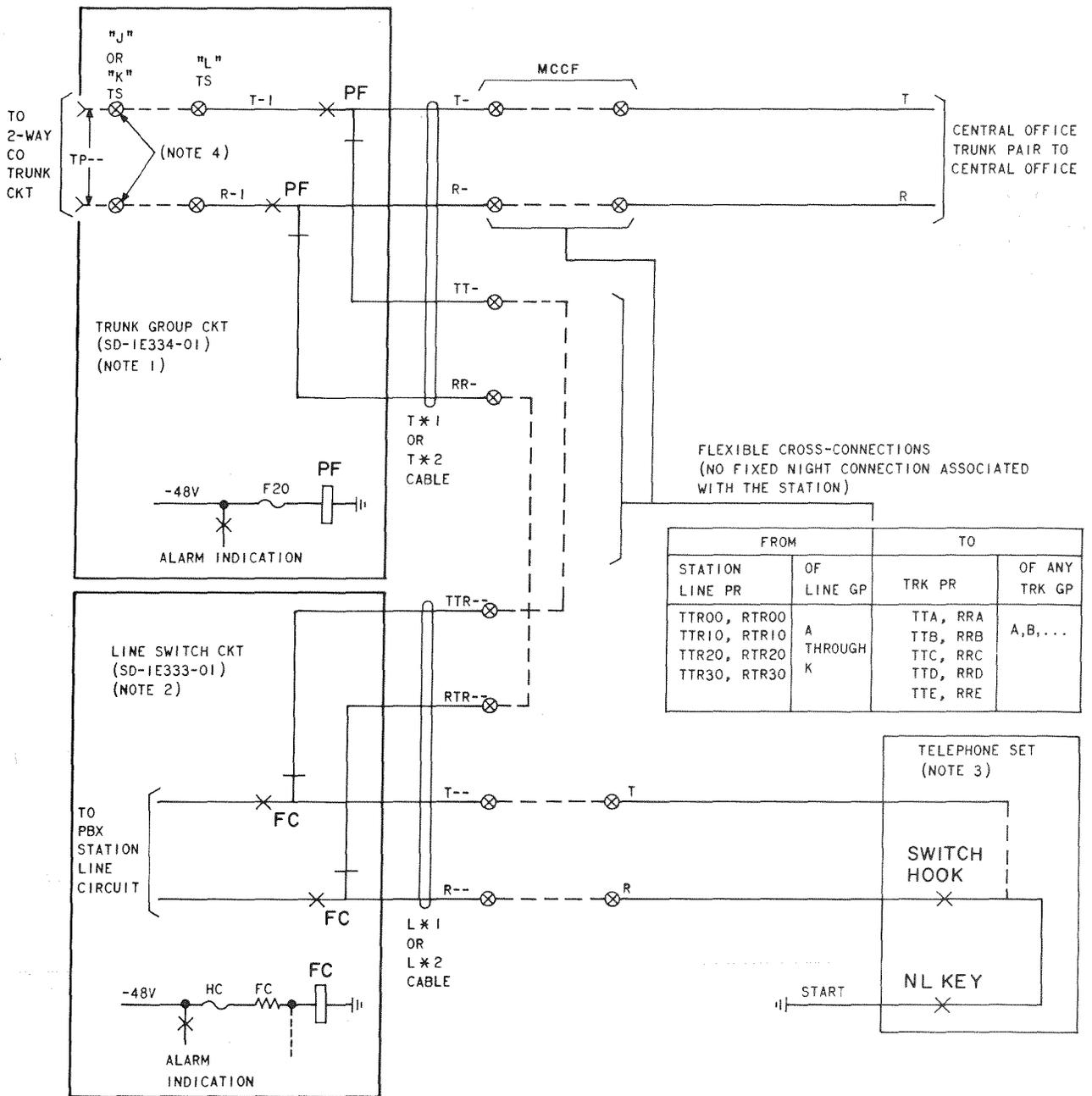


Fig. 32—Line Switch Preference Circuit (Sheet 2 of 2)



NOTES:

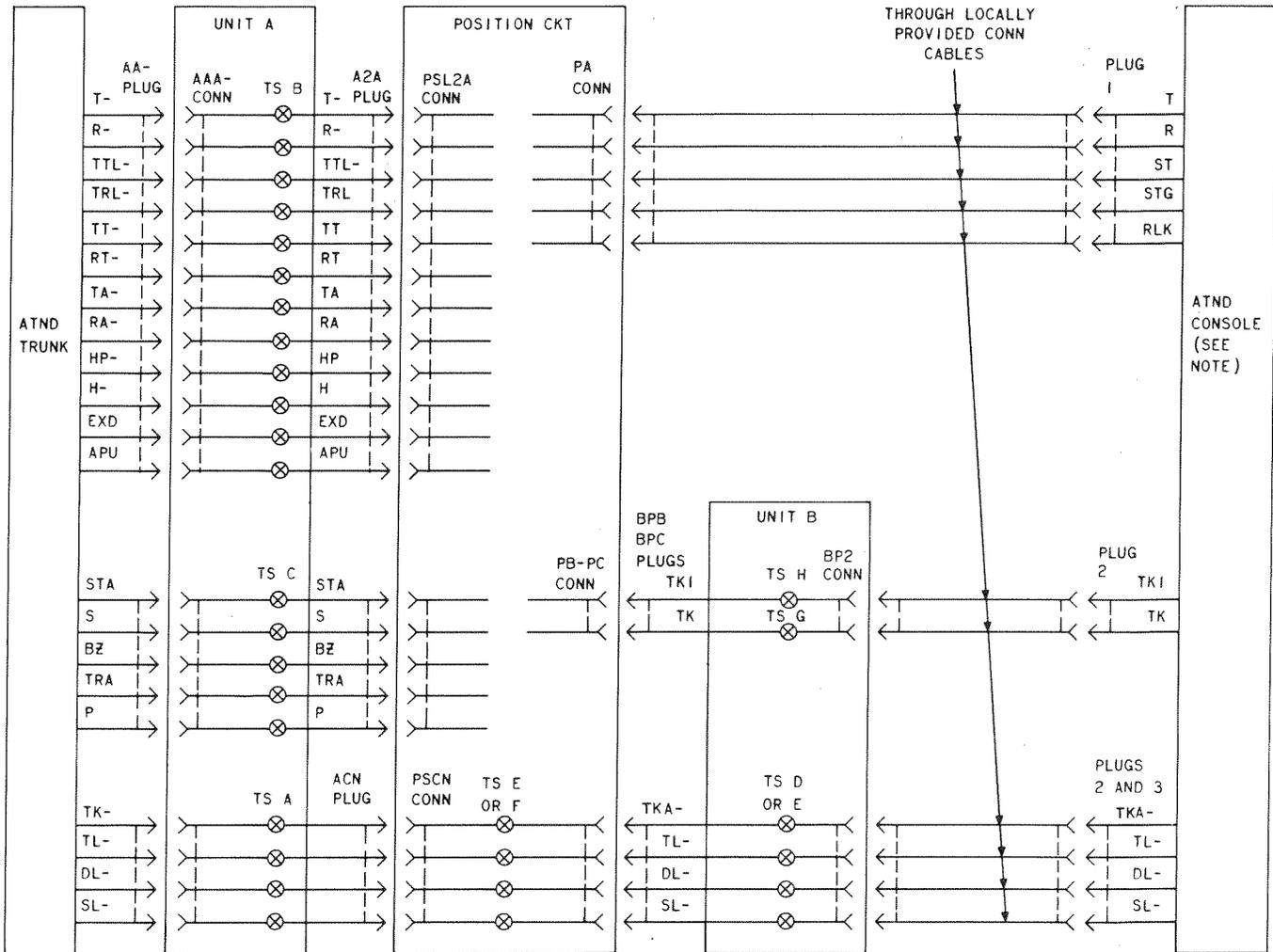
1. UP TO FIVE (5) CENTRAL OFFICE PAIRS OF EACH TRUNK GROUP MAY BE ARRANGED FOR POWER FAILURE TRANSFER.
2. UP TO FOUR (4) STATION LINE PORTS (00,10,20,30) OF EACH LINE GROUP MAY BE ARRANGED FOR POWER FAILURE TRANSFER. THE FOUR POWER FAILURE TRANSFER STATIONS OF A SINGLE LINE GROUP MAY BE CROSS-CONNECTED TO FOUR DIFFERENT TRUNK GROUPS.

3. TELEPHONE SETS ASSOCIATED WITH LINE PORTS DESCRIBED IN NOTE 2 MUST BE EQUIPPED WITH A NONLOCKING START KEY.

4. SEE SECTION 551-770-201 FOR EQUIPMENT SERVICE OPTION CROSS-CONNECTIONS.

\* = (A, B, C---)

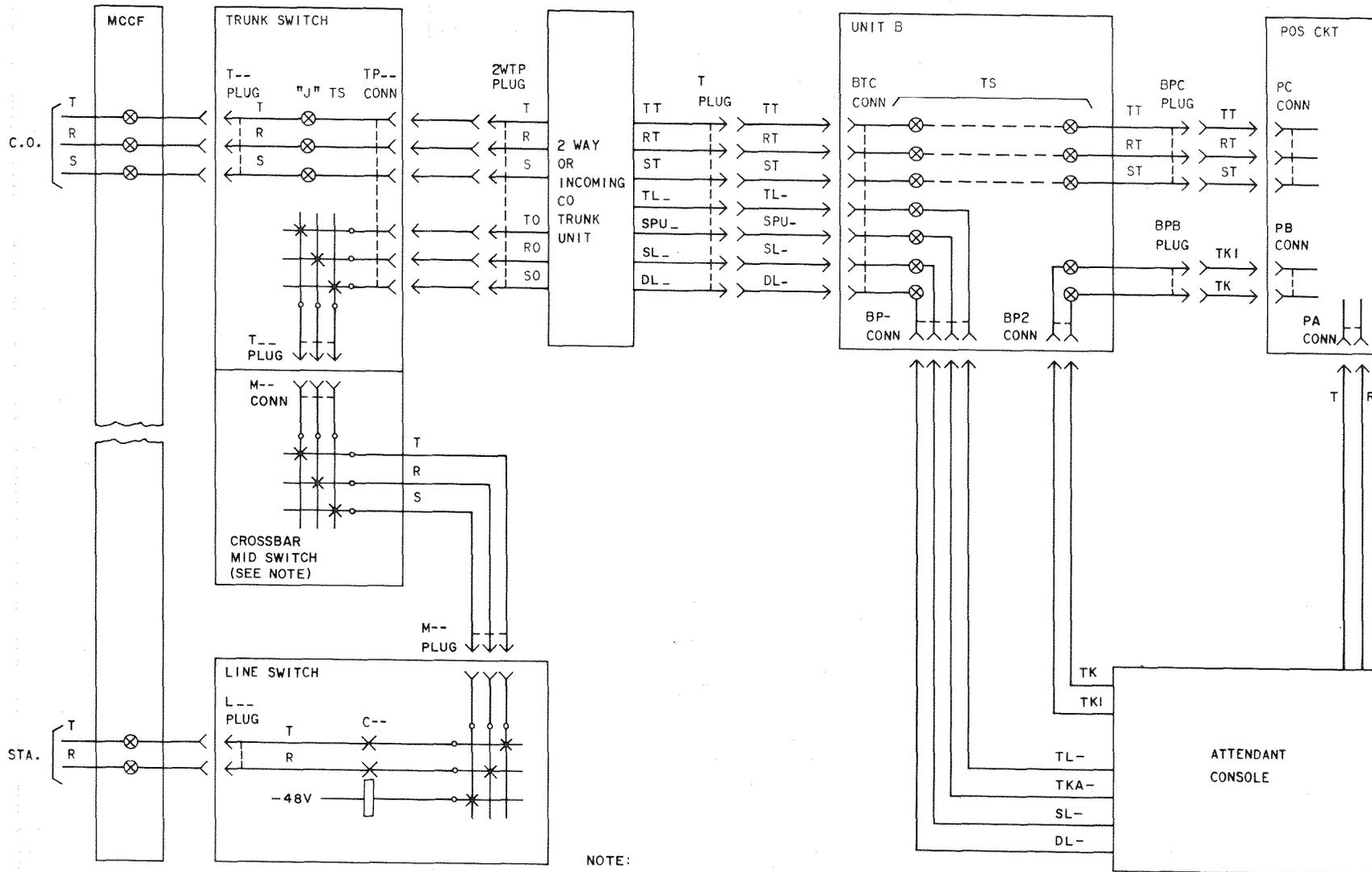
Fig. 33—Power Failure Transfer



NOTE:

ONLY LEADS NECESSARY FOR ATND  
TRK OPERATION ARE SHOWN.

Fig. 34—Direct Trunk Termination—A Unit



NOTE:

MID SWITCH CAN BE CROSSBAR OR RELAY TYPE. RELAY MID SWITCH CAN BE USED ONLY ON 40 LINE TO 160 LINE SYSTEM.

Fig. 35—Direct Trunk Termination—B Unit

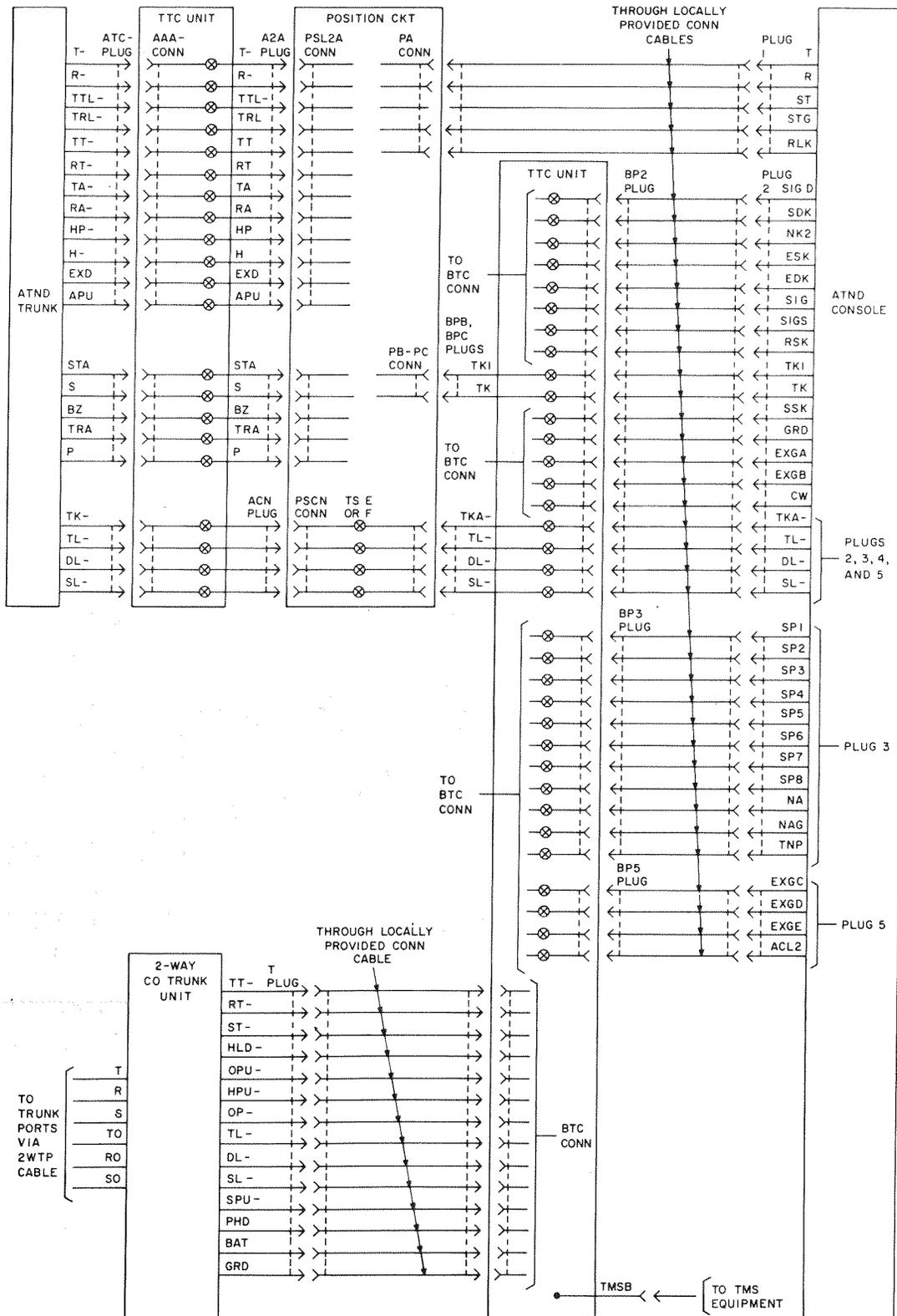


Fig. 36—Direct Trunk Termination—Trunk Termination Combined Unit

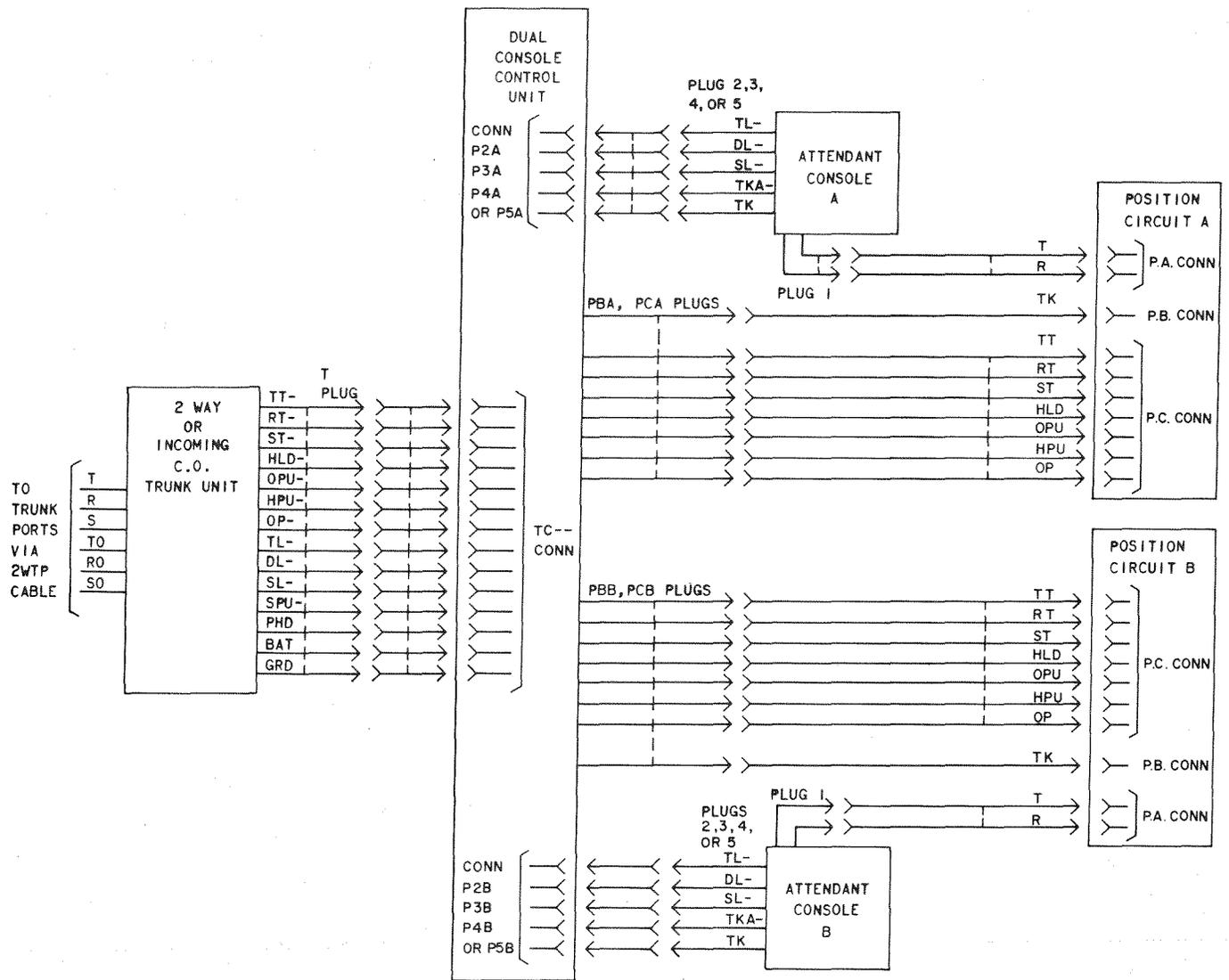
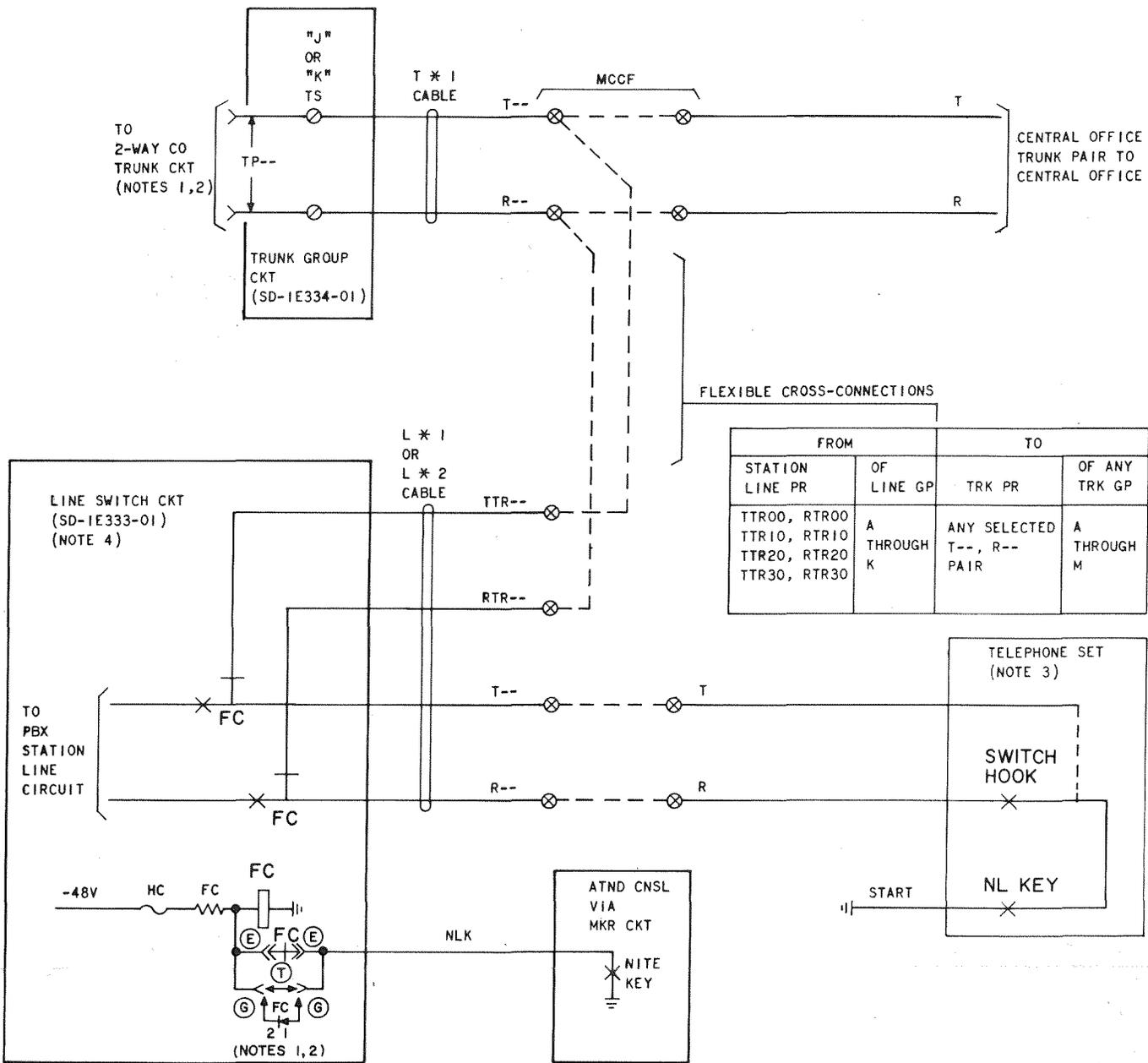
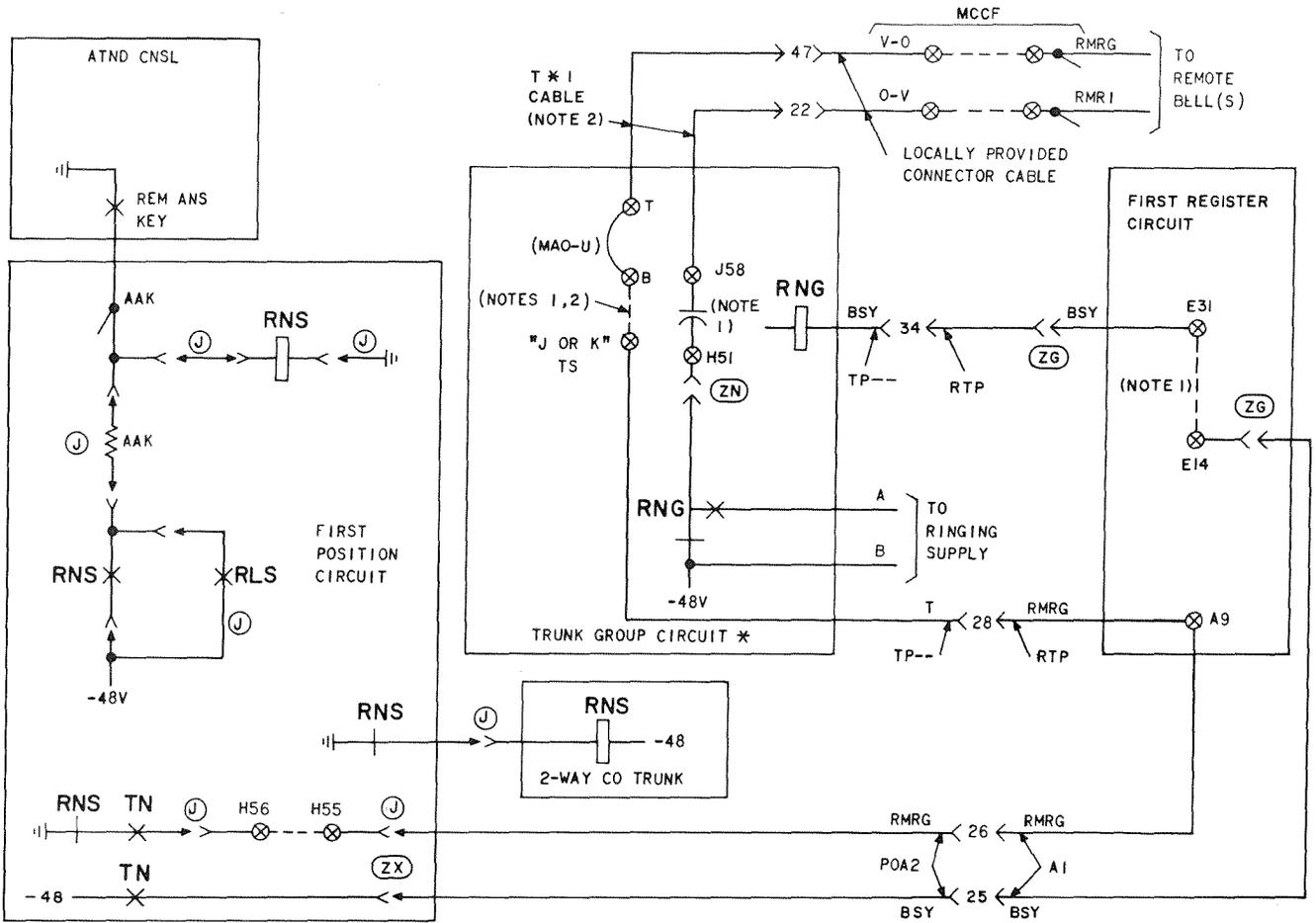


Fig. 37—Direct Trunk Termination—Dual Console Operation



- NOTES:
- SEE SECTION 551-770-201 FOR EQUIPMENT SERVICE OPTION CROSS CONNECTIONS.
  - WHEN FIXED NIGHT CONNECTIONS ARE PROVIDED, THE FOLLOWING OPTIONS MUST BE INSTALLED:
    - (A) SD-1E333-01 — OPTION G (OPTION T AND E ARE RATED MD AT ISSUES 11AC AND 13B RESPECTIVELY)
    - (B) SD-1E340-01 — OPTIONS M, ZG.
  - TELEPHONE SETS ASSOCIATED WITH STATION LINE PORTS ARRANGED FOR FIXED NIGHT SERVICE MUST BE EQUIPPED WITH A NONLOCKING START KEY.
  - FOR FIXED NIGHT SERVICE, UP TO FOUR (4) STATION LINE PORTS (00, 10, 20, 30) OF EACH LINE GROUP MAY BE CROSS-CONNECTED TO ANY SELECTED TRUNK PAIR (T--, R--) OF ANY TRUNK GROUP. (MAX 5 PER TRUNK GROUP)
  - LINES FOR FIXED NIGHT AND POWER FAILURE TRANSFER CANNOT APPEAR ON THE SAME LINE SWITCH.
- \*=(A, B, C--)

Fig. 38—Fixed Night Station Connection Arrangement



- 1. SEE SECTION 551-770-201 FOR EQUIPMENT SERVICE OPTION CROSS CONNECTIONS.
- 2. TRUNK GROUP CIRCUIT ASSOCIATED WITH FIRST REGISTER CIRCUIT.
- \* = A, B, C,---

Fig. 39—Trunk-Answer-From-Any-Station Arrangement

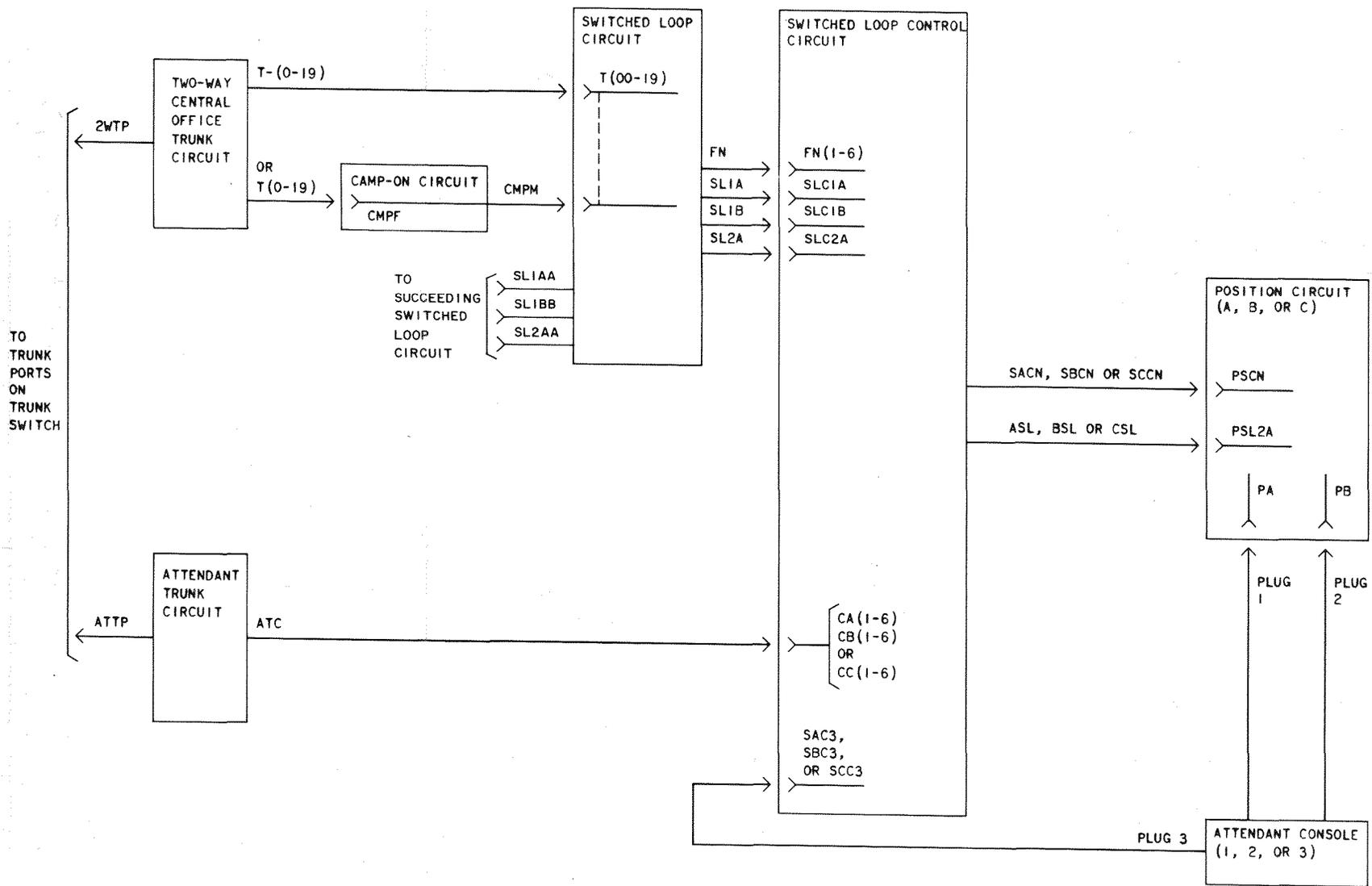


Fig. 40—Switched Loop Termination

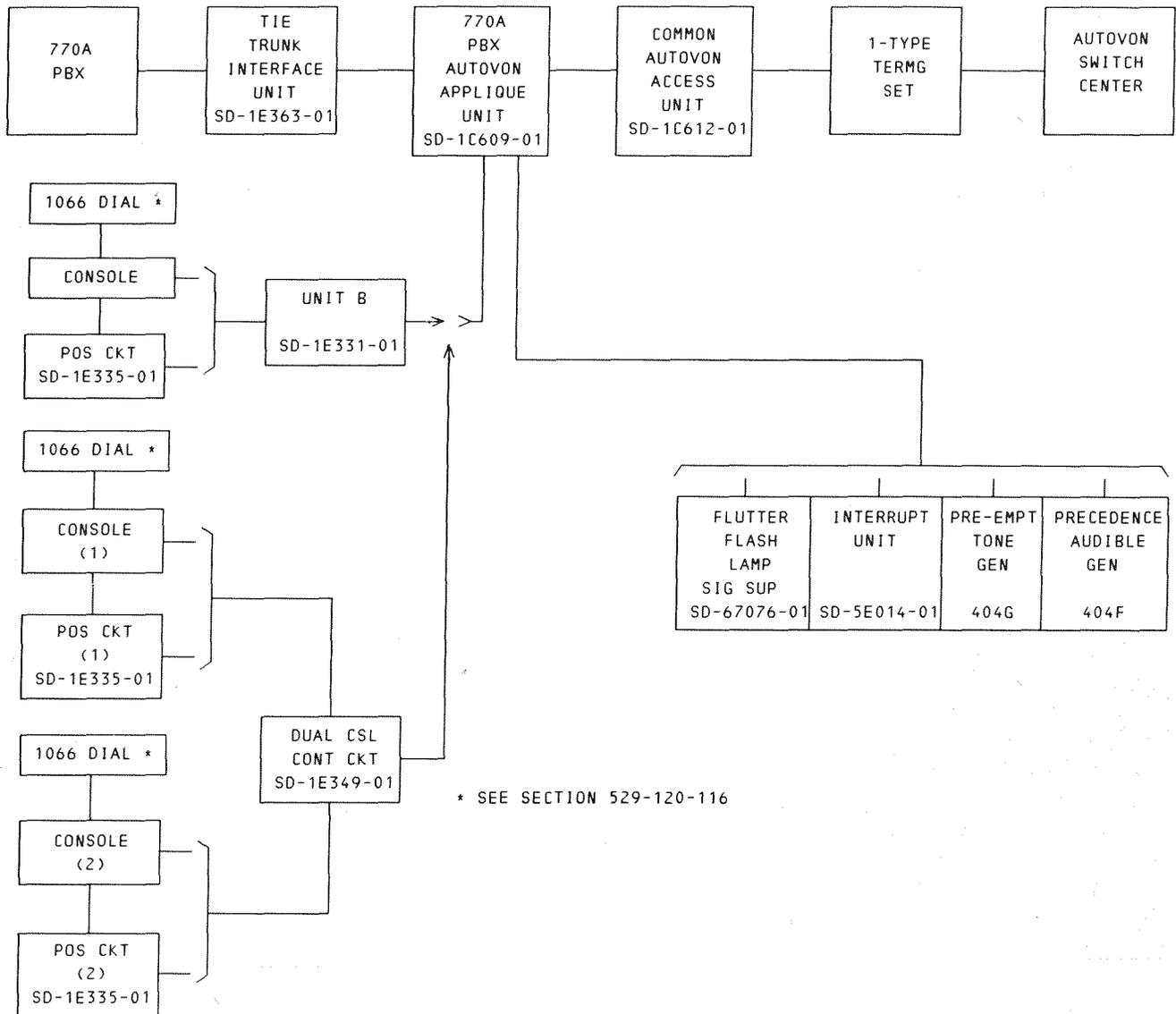


Fig. 41—AUTOVON System Connection—770A PBX

SECTION 981-680-100

7. REFERENCES

7.01 This issue of this section is based on the following drawings:

SD	TITLE	SD	TITLE
1E331-01, Iss 24B	770A Interface Circuit	1E353-01, Iss 1	Trunk Junctor Circuit
1E332-01, Iss 63D	Marker Circuit	1E355-01, Iss 5B	AC Distribution Circuit for 770A PBX—J58876PA
1E333-01, Iss 26D	Line Switch Circuit	1E356-01, Iss 13B	Power, Interrupter, and Tone Supply Circuit for 770A PBX—J58876PB
1E334-01, Iss 40D	Trunk Group Circuit	1E357-01, Iss 8B	Power and Ringing Supply Circuit for 770A PBX—J58876PC
1E335-01, Iss 48B	Position Circuit	1E358-01, Iss 7D	Power Supply and Message Waiting Circuit for 770A PBX—J58876PD
1E336-01, Iss 10D	Switched Loop Circuit	1E359-01, Iss 6B	Traffic Register Circuit
1E337-01, Iss 44B	Register Circuit	1E360-01, Iss 4D	Power and Fuse Circuit for 770A PBX—J58876PE
1E338-01, Iss 27AC	Attendant Trunk Circuit	1E361-01, Iss 6B	Battery Reversal Toll Control Circuit
1E339-01, Iss 11AC	Intercom and Busy Tone Trunk Circuit	1E362-01, Iss 6B	Universal Interface Circuit
1E340-01, Iss 47AC	2-Way Central Office Trunk Circuit	1E363-01, Iss 6B	Tie Trunk Interface Circuit
1E341-01, Iss 10AC	One-Way Outgoing Central Office Trunk Circuit	1E364-01, Iss 3B	Power, Ringing, Interrupter, and Tone Circuit for Battery Operation
1E344-01, Iss 19B	Dial Transfer Circuit	1E368-01, Iss 3D	Executive Ringback or Executive Override Trunk Circuit
1E345-01, Iss 1	Message Registration Circuit	1E369-01, Iss 7B	DID Central Office Trunk Circuit
1E346-01, Iss 15AC	Camp-On Circuit	1E370-01, Iss 7B	Incoming Register Circuit
1E347-01, Iss 8B	Digit "0-1" Monitor Toll Control Circuit	1E371-01, Iss 6B	Incoming Register Network Circuit
1E348-01, Iss 11D	Attendant-Controlled Conference Circuit	1E372-01, Iss 5B	ANI Interface Circuit for 770A PBX
1E349-01, Iss 8B	Dual Console Control Circuit	1E373-01, Iss 6B	Applique and Release Link Trunk Circuit for Centralized Attendant Service
1E350-01, Iss 4D	Tie Trunk Applique Circuit (MD)	1E375-01, Iss 2D	Trunk Selector Circuit
1E351-01, Iss 5D	Tie Trunk Interface Circuit (MD)	1E376-01, Iss 2B	Timed Reminder Circuit
1E352-01, Iss 6AC	Two-Way CCSA Trunk Circuit		

1E377-01, Iss 1	Maintenance Control Circuit	1E379-01, Iss 1	Switched Loop and Trunk Maintenance Circuit
1E378-01, Iss 1	Marker Display Circuit	1E505-01, Iss 1	ANI Circuit (Universal)

