SWITCHING SYSTEMS MANAGEMENT

STEP-BY-STEP

SYSTEM DESCRIPTION

CENTREX

NOTICE

1. CENTRAL OFFICE ARRANGEMENTS FOR CENTREX SERVICES

A. General

1.01 Step-by-step central offices, in conjunction with a step-by-step private branch exchange (SXS-PBX), may be arranged to provide many features, such as direct inward dialing (DID), automatic identified outward dialing (AIOD), station-to-station transfer without attendant assistance, and automatic number identification (ANI) of both the station number as well as the trunk number of the trunk used. ANI equipment is required at the centrex customer location to provide AIOD services. The PBX arrangement for ANI provides the means for identifying stations, attendant originated central office (CO), and common control switching arrangement (CCSA) calls from a PBX which provides centrex customer services.

1.02 Whenever this practice is reissued, the reason will be listed in this paragraph.

1.03 Prior to PBX-AIOD (or PBX-ANI), station identification for any centrex PBX outward charge call required operator identification at a centralized automatic message accounting (CAMA) office.

1.04 The PBX-ANI method used to identify a PBX station or attendant originating a call into a local CO is to identify, at the PBX, both the station making the call and the trunk being used. This identification information is in the form of a 4-digit station number and a 4-digit trunk number. The station and trunk numbers are forwarded to the CO where they are stored until required for charging purposes (refer to Figure 1, block diagram of PBX and CO/AIOD arrangement).

1.05 Identification and storage of the station number is performed for every CO call whether or not the call is a charge call. The station number remains in storage in the CO until requested by the automatic message accounting (AMA) or ANI [local automatic message accounting (LAMA) or CAMA] equipment. Should the AMA or ANI facility not request the station number, it will remain in storage until it is updated by new information identifying another call on this trunk.

1.06 Figure 1 shows a block diagram of PBX-AIOD facilities for both conventional centrex PBXs and the No. 101 ESS-PBX.

1.07 The 701B SXS and the 757A crossbar centrex PBXs use PBX-ANI equipment for station identification (SI) on calls to a CO. The No. 101 Electronic Switching System (ESS) is designed to provide SI when handling this type of call. For further details on No. 101 ESS-PBX, refer to Bell System Practices Section 966-300-100.

B. Operation

1.08 With PBX-AIOD, a centrex PBX customer dialing a CO access code is identified by the last four digits of his in-dial directory number and the 4-digit number assigned to identify the PBX trunk seized for the call. These two numbers are temporarily stored in the PBX-ANI station and trunk number memories to await transmission over a data trunk to the PBX-AIOD station identification (SI) frame in the connecting CO.

1.09 The SI frame is the receiving, processing, and storage system designed to handle a maximum of 60 data trunks. This system is capable of handling identifications for a maximum of 1800 PBX trunks distributed over a maximum of 60 PBXs.

1.10 Upon the completion of the identification process and temporary storage by a PBX-ANI installation, a bid signal is sent by the PBX-ANI equipment over its data trunk to the SI frame which returns a transmit signal to indicate its readiness to receive, process, and store the identification information. PBX-ANI then transmits its stored identification information over the data trunk. All data trunk transmission is in 2-out-of-5 code using frequency shift pulsing (FSP).

1.11 The PBX trunk numbers are assigned by the CO to the PBX trunks used by the PBX for the outgoing call. The 4-digit numbers are determined by the trunk CO equipment location when the serving CO is a No. 1 LAMA or No. 5 crossbar (transverter) office. Also, the 4-digit number may be derived from a special AIOD number network when the serving CO is a SXS, panel or No. 1 crossbar office equipped with ANI-B. SXS offices equipped with ANI-C use the number assigned to the connector that is used for the

PBX trunk. Only the SXS office equipped with ANI and outpulsers will be covered in this practice.

1.12 The 4-digit trunk number is used by the SI frame to address a specific memory location within the SI store into which 4-digit station numbers are stored. The memory location also stores the number of the data trunk used in transmitting the information from the PBX-ANI equipment. The 4-digit station number remains in storage until called for by the AMA or ANI equipment via the AIOD translator and translator connector. This request is initiated only if the stored SI number is needed by the AMA or CAMA facilities for billing purposes.

C. Capacity

1.13 The station identification store (SIS) provides storage for SI for 1800 PBX trunks.

1.14 One PBX-AIOD SI frame with an associated AIOD translator and translator connector can provide service to a maximum of two separate switching facilities as follows:

(a) A maximum of two ANI-B identifier groups with a maximum of ten ANI-B outpulsers per group.

(b) A maximum of two AMA transverter groups with a maximum of ten transverters per group.

(c) A maximum of two ANI transverter groups with a maximum of two transverters per group.

(d) A combination of one AMA or ANI transverter group and one ANI outpulser group.

(e) One outpulser ANI-C group.

1.15 The PBX-AIOD SI frame can accept data from 60 PBXs with each PBX identified by the same or different office indexes up to a maximum of (a) 30 office indexes per No. 5 crossbar transverter group, (b) nine office indexes per ANI-B outpulser group, or (c) one office index per ANI-C outpulser group. The last two items are associated with SXS-PBXs.

2. FEATURES OF PBX-AIOD FACILITIES

GENERAL

2.01 The SI frame used in PBX-AIOD utilizes solid state units such as transistors, diodes, and magnetic devices.

2.02 For the most part, solid state and magnetic devices are mounted on plugable circuit boards and modules (refer to Figure 2, PBX-AIOD SI Frame—Block Diagram).

2.03 The SI frame uses a central control (CC) circuit with a wired program. (Refer to Figure 4 for SI frame layout.)

2.04 When a PBX trunk is reassigned at the CO and the number has not been changed at the PBX, the PBX-AIOD SI frame can be programmed to substitute the old number for the new to properly identify the station.

2.05 Failure to provide a station number by the PBX-AIOD results in alternate billing. In an outpulser SXS office, a CAMA operator is called in to identify the calling PBX station.

2.06 The PBX-AIOD SI frame has an automatic error detecting and encoding facility which continuously monitors its operation. An error will cause circuit status information to be collected and printed by a tape printer in the form of an error message. The error message information is used in association with a trouble location manual to determine the trouble area and the necessary corrective action.

2.07 The PBX trunk numbers are 4-digit numbers which are assigned to them at the CO to associate each call over a PBX trunk with the PBX-ANI information received from a PBX over the data trunk.

2.08 In SXS-COs using the ANI-B system, the four digits assigned to a PBX trunk are derived from the special AIOD number network; in the ANI-C system the four digits are determined from the regular number network.

2.09 All PBX trunk number assignments at the CO must be in a one or two thousand number series.

2.10 Since the SIS in the SI frame has 1800 trunk-addressed storage locations arranged in two blocks of 900 numbers each (A000-A899 and B000-B899), the assignment of the thousands digit permits each of two identifier groups to have 900 PBX trunks.

2.11 If an identifier office requires more than 900 storage locations, the second block of 900 numbers may be used.

2.12 Where one of this identifier type of SXS office shares the SIS with a transverter office, trunk number assignment must be coordinated to prevent conflicts.

SYSTEM ELEMENTS

2.13 Figure 2 shows a simplified block diagram of the PBX-AIOD SI frame and interface equipment. The PBX-AIOD frame is capable of receiving SI information over data trunks. The output of the SI frame is interfaced to the CO equipment by AIOD interface equipment which performs the preference and control of data to and from the CO equipment and number translation when required. Figure 4 shows the physical layout of equipment elements on the SI frame.

2.14 The SI is composed of five major circuits with a sixth circuit providing the alarms and miscellaneous functions. The five major circuits are as follows:

(a) Digit register connector circuit

(b) Digit register circuit

(c) Station identification store circuit

(d) Station identification store control circuit

(e) Station identification test circuit.

2.15 The combination of these six circuits provides the facilities for storing the station identification numbers received from the PBXs. The SI frame is a sequential, clock-timed system performing both a write-in and a readout function. The station number digits when received over a data trunk are written into memory. Following a CO request for the data, the stored station number digits are read out of memory and sent to the CO equipment along with the 2-digit office index.

A. Digit Register Connector

2.16 The digit register connector circuit provides the means of automatically connecting a data trunk from a PBX to one of two digit registers. The digit register connector provides a metallic switched path for a maximum of 60 data trunks. This circuit scans all of the data trunks for PBX service requests and, in the absence of a request, completes the scan in less than 1 millisecond.. When a request is recognized, the digit register connector circuit connects the data trunk to one of the two digit registers and returns a transmit signal to the PBX-ANI equipment over the trunk. The scan stop and transmit signal takes approximately 65 milliseconds, after which the scan is continued. A similar scan stop occurs on a second request. If a third request is detected while both digit registers are busy handling PBX data, the scan stops and waits for the release of one of the two digit registers. This release occurs when all of the PBX data has been received by one of the digit receivers which requires a maximum of 190 milliseconds.

2.17 The digit register connector circuit is made up of four subcircuits:

(a) Trunk scanner circuit

(b) Digit register preference and selection circuit

(c) Connector switch selection circuit

(d) Connector switch network.

These circuits in performance of their duties select, under a preference circuit, an idle digit register and connect it to the data trunk requesting the connection. Also, these circuits alternate the selection of digit registers on successive calls to even the wear and load.

B. Digit Register Circuit

2.18 The two digit registers within the digit register circuit can be simultaneously connected to serve data trunks, thus providing for operation under heavy load conditions.

2.19 The frequency shift (FS) signals that are transmitted over the data trunk from the PBX-ANI equipment must be converted from the FS form to a form usable by the data processing SI frame. This is accomplished by the selected digit register.

2.20 The selected digit register converts the received FS signals into DC logical "1" marks and "0" spaces and then transforms each digit from serial to parallel form. Each digit is then checked for a valid 2-out-of-5 code.

2.21 A bit format of 13 bits for the PBX-AIOD trunk number and 16 bits for the station number is transferred a digit at a time to the SIS control circuit.

C. Station Identification Store Circuit

2.22 The SIS circuit uses the No. 6A memory which contains electrically alterable ferrite sheets. The memory uses coincident current work selection, with the access, read, and write circuitry provided by circuits in the SIS circuit. This memory has a capacity of 2048 word locations of 24 bits each; but only 1920 word locations of the memory are connected to access circuitry since the address bits are in 2-out-of-5 code and will not perfectly map into all 2048 memory locations.

2.23 Out of the 1920 word locations that are connected to access circuits, 1800 word locations can be addressed using the PBX trunk numbers. The trunk number addresses are divided into A000 through A899 and B000 through B899, where A and B are any two thousands digits as determined by the cross-connection arrangement. Since the SIS circuit is arranged in two 900-word groups, each group being addressed by the thousands digit of the PBX-AIOD trunk number, the thousands digit is converted by a cross-connecting arrangement to a logical "1" or "0", depending upon in which of two thousands groups the trunk number lies. The logical "1" or "0" arrangement for the thousands digit determines which one of the two areas of the SIS the remaining hundreds, tens, and units digits of the trunk number will be steered. These remaining digits then determine the actual storage location within the specific 900-word group.

D. Station Identification Store Control Circuit

2.24 The SIS control circuit provides the logic to control the SI frame in assembling and transferring its data and writing in and reading out data from the SIS circuit.

2.25 A clock circuit is used to develop twelve 1-microsecond timing pulse outputs which sequence and synchronize the various operations throughout the system. The twelfth timing pulse is used to generate a 96-microsecond scan cycle that provides eight 12-microsecond scanning intervals for the following functions:

(a) Scans 1 and 2 assemble the data from digit register A.

(b) Scans 3 and 4 assemble the data from digit register B.

(c) Scans 5 and 6 perform SIS and SIS control circuit check.

(d) Scan 7 serves test circuit requests.

(e) Scan 8 serves CO requests.

2.26 Scan 8 handles requests for SI by the CO through the AIOD translator and connector. During this scan, the "0" bits in each digit of the station number are reconstructed to again form a true 2-out-of-5 code. The station numbers, including the office index, is transferred to buffer registers that control the multilead data sent to the CO equipment. The office index is derived from the six binary bits of the data trunk number stored in the No. 6A memory with the station number by translating the six bits to 1-out-of-64 octal code and cross-connecting these to assign an office index in 1-out-of-3 tens digit and 2-out-of-5 units digit.

2.27 PBX trunk number reassignment provisions have been incorporated to permit reassigning a PBX trunk number at the CO without immediately changing the trunk number at the PBX. To do this, the old trunk location address is written into the new trunk location in the No. 6A memory which is then tagged to indicate that the station number should be obtained from this old trunk location.

2.28 If there is a data trunk failure, the data trunk number is restored and used to deny SI to all calls on PBX trunks associated with this data trunk. This denial is continued for a 25-second period after the data trunk trouble has been cleared. This prevents the use of any PBX-ANI information by the CO that might be in error due to the data trunk failure until the information can be updated. If two or more data trunks fail, the SI frame is taken out of service automatically for the duration of the trouble plus the 25-second denial period.

2.29 For reliability purposes, all timing circuits within the SIS control circuit are duplicated. Parity checks, 2-out-of-5 checks, and data comparisons are made periodically during the processes of assembly and transfer of data with the SI frame. Failure-to-check alarms are given and error indications are handled by the SI test circuit for printout on its tape printer.

E. Station Identification Test Circuit

2.30 The SI test circuit provides the means for performing operational on-line and off-line tests and routine maintenance on the PBX-AIOD SI frame. The test circuit performs three basic functions:

(a) Detects information errors and circuit failures and prints out an error code and status information with its tape printer.

(b) Acts as an input/output buffer to check the SIS through the SIS control circuit.

(c) Acts as a PBX simulator.

2.31 When trouble occurs with a data trunk, patching arrangements are provided to substituted PBX talking trunk conductors for the data trunk conductors. When this substitution is performed, it requires a corresponding conductor transfer at the PBX.

2.32 When E and M type signaling is used for carrier transmission between the PBX-NI and CO, a conversion is required at the PBX-ANI, and again at the CO. A simplex to E and M signaling conversion is provided at the PBX-ANI CO by using the PBX-AIOD signaling converter unit.

F. PBX-ANI Capacities and Features

2.33 The capacity of the PBX-ANI circuit is as follows:

	MIN.	MAX.
701B station line identification (SI)	20	9000
701B CO trunk identification (TI)	6	210
Normal data trunk connections	4	4
Alternate data trunk connections	1	1
Distinct listed numbers for operator billing	4	4

The number of equipment units required by the ANI circuit is determined by the number of station lines and CO trunks in the associated PBX. Each ANI installation requires *one* basic ANI circuit. Supplementary station identification units and supplementary trunk identification units must be provided when required by the associated PBX station and line size.

2.34 The basic ANI unit is equipped with one SI subunit which has the capacity for identifying 100 PBX station lines or tie trunk incoming selectors. A station identification unit also has the capacity for identifying a maximum of 36 attendant circuits.

2.35 The basic ANI circuit is equipped with one trunk identification unit which has the capacity for identifying 30 CO trunk circuits.

2.36 When more than 100 station lines or 30 CO trunk circuits need to be identified, supplementary units should be provided up to the maximum as shown in Table A. For more detailed information on PBX-ANI, refer to Bell System Practices Section 981-601-100.

3. INTERFACE EQUIPMENT BETWEEN CENTRAL OFFICE AND PBX-AIOD

A. General

3.01 The AIOD translator and translator connector, as shown in Figure 3, form a preference and control circuit in the central office. This furnishes the interface between existing CO equipment and the PBX-AIOD SI frame. The CO connecting equipment can be various types of equipment, such as ANI outpulsers in SXS, etc.

The AIOD translator and translator connector function according to the type of CO used.

3.02 It should be noted that all word transmission to and from the AIOD system, whether an SI frame or a No. 101 ESS, is based on the 2-out-of-5 code. When interfacing between an outpulser type office (SXS) and SI frame, a number code conversion on the 2-out-of-5 coded station number by the AIOD translator and translator connector is not necessary because the outpulser uses the 2-out-of-5 code. The only conversion required is the office index from the 2-out-of-5 code to the 1-out-of-9 code.

3.03 In addition to number code conversion, when required, the AIOD translator connector, acting as a preference and control circuit, functions to permit only one outpulser (or transverter) access to the SI frame at a time and in a predetermined order. Since one AIOD translator and translator connector can serve a maximum of two separate CO number identification systems, each with a definite combination of identifiers and transverters, preference and control are required. The AIOD translator, in processing its input and output information, checks for word errors to assure proper word structure during its control, conversion, and transfer of information.

3.04 Upon receipt of the PBX station number from the AIOD translator and translator connector, the outpulser (or transverter) follows the normal routine in forwarding the information to the AMA facility.

3.05 Should the AIOD translator and translator connector detect a failure or error within its own circuit or within other equipment required in the identification process, the CO equipment is notified to perform an alternate billing routine. In the ANI outpulser type of offices, CAMA operator identification is used as the alternate billing routine.

B. AIOD Translator Connector

3.06 The translator connector consists of a preference circuit and multicontact relay connectors. The preference circuit allows only one outpulser (or transverter) access to PBX-AIOD translator at one time and in a predetermined order, thus guarding against a double connection. The multicontact relays provide the leads necessary between the CO switching system equipment and the PBX-AIOD translator.

C. AIOD Translator

3.07 The AIOD translator is composed of nine basic functional circuits.

(a) Five of these circuits (Fig. 4) perform the trunk number registration, translation, checking, and transmission of the PBX trunk number to the PBX-AIOD SI frame. They are as follows:

(1) Trunk number thousands, tens, and units digit register circuit.

(2) Trunk number hundreds digit register circuit.

(3) Trunk number hundreds, tens digit translator circuit.

(4) Trunk number 2-out-of-5 check circuit.

(5) Trunk number sending circuit.

(b) The four remaining circuits (Fig. 3) perform the station number registration, translation, checking, and transmission to the CO switching system via the translator connector. They are as follows:

(1) Station number register circuit.

(2) Station number and office index 2/5 check circuit.

(3) Office index sending circuit.

(4) Station number sending circuit.

D. Operation With Outpulsers

3.08 In a SXS outpulser office the calling number request on PBX-AIOD calls is steered to the AIOD translator connector by assigning all PBX trunks to special number networks in the ANI-B system or by using one of the special treatment marks in the ANI-C number networks. When an outpulser receives preference in the translator connector, it is connected through to the translator.

3.09 The PBX trunk number thousands, tens, and units digits are received and registered directly in 2/5 code in the trunk number thousands, tens, and units digit register circuit. The PBX trunk number hundreds digit is received and registered directly in 2/5 code in the trunk number hundreds digit register circuit. No PBX trunk number word translation is required on PBX-AIOD translator inputs when associated with outpulser offices, since outpulsers use the 2/5 code.

3.10 Transfer and checking of data through the PBX-AIOD translator, for both the PBX trunk number and station number and the office index, is identical to the process for a transverter office.

3.11 Again, no number code conversion is required for PBX-AIOD translator station number outputs as the outpulser uses the 2/5 code.

3.12 Since the maximum office index handling capacity of any outpulser is nine office index codes, the office index is handled on a 1/9 multilead basis to the outpulser.

4. FEATURES OF CENTREX OFFICES

GENERAL

4.01 Among the many features of the modern centrexes are the following:

(a) Direct Inward Dialing (DID)

(b) Automatic Identified Outward Dialing (AIOD)

(c) Night Service and Service Packages—Centrex I

(d) Service Package—Centrex II

(e) Night Attendant Service

(f) Station-to-Station Calling

(g) Station Transferring

A. Direct Inward Dialing

4.02 Direct inward dialing (DID) is a centrex feature which provides for the assignment of 7-digit numbers to stations within the PBX, so that incoming calls may be directly dialed to any station without the assistance of an attendant. Refer to Figure 5 for a typical arrangement.

4.03 On an incoming call to the PBX listed directory number, the DID trunk is connected to the attendant facilities. The attendant then handles the call as a regular incoming CO call.

4.04 After a DID call is established, the called party can recall the attendant by flashing the switchhook. The DID call is then directed to the attendant with a distinctive recall signal (120 ipm) supplied at the attendant console (or switchboard) *unless station dial transfer* is provided. When call transfer individual is provided, the called party receives dial tone by flashing the switchhook, then dials the desired station number. When the dialed station answers, the transferee may stay on the connection for a 3-way conversion or hang up, leaving the transferred station and the incoming call conversing.

B. Direct Outward Dialing—Automatically Identified Outward Dialing (DOD-AIOD)

4.05 DOD-AIOD allows the PBX or centrex station user to gain access to the CO exchange network without the assistance of an attendant.

4.06 By dialing a prefix digit (usually an 8 or a 9) before a 7-digit number (local calls) or a 10-digit number (for DDD calls to a foreign NPA), a centrex or PBX subscriber may reach other subscribers. Refer to Part 2 for more detail on PBX-AIOD.

C. Night Service and Service Packages—Centrex I

4.07 The night service feature is provided in the Centrex I package by use of the night service circuit (Fig. 6). This circuit provides for ringing, transmission, and supervision from an incoming trunk to a station, so that incoming calls will be routed to a station when an attendant is not servicing calls. This circuit is connected to the *in-dial first selector bank multiple,* so that it may be seized on an incoming call to the trunk. The other end of the circuit is connected to a station line circuit or in multiple with the usual bank connection. Thus, it provides a *shortcut* access to the station without other effect on the use of the station.

4.08 The night closing and alarm circuit is required to condition the in-dial first selector to cut through the connection from the incoming trunk to night service during the night mode of operation.

D. Service Package—Centrex II

4.09 The *trunk answer from any station* feature is provided by the night service circuit (Fig. 7). On the outgoing side of the circuit, connection is made to the bank multiple of one of the local selectors. This circuit can be answered from any centrex station by dialing the assigned code. Remote visual or audible signaling (or both) can be provided.

E. Night Attendant Service Option

4.10 One additional night feature, not a part of any service package, is the night attendant feature. This feature is provided by use of the 2-way position trunk circuit (Fig. 8). This circuit, used with attendant consoles where the attendant completes by keypulsing or dialing, provides a means for originating calls in two directions. It is intended primarily for use in connection with delayed long distance calls and conference calls. It further provides for a 6-button key telephone set or a CALL DIRECTOR* telephone to be used as a night station for receiving and completing calls after regular business hours.

*Registered trademark of AT&T

4.11 In general, PBX installations using attendant consoles have only one position equipped with 2-way position trunks. This is known as the *special* position. Positions not equipped in this manner are known as regular positions.

4.12 After hours, when the night closing circuit has been activated, incoming calls to the attendant are routed through the 2-way position trunk to the night attendant. The night attendant completes to the stations by dialing, using the front selector. Trunk supervision and a holding feature are also provided.

F. Station-To-Station Calling

4.13 The station-to-station calling feature allows a station user to dial another station within the same PBX or centrex without the assistance of the attendant.

4.14 The call to another station may be placed through the attendant, if desired, by dialing "0" and giving the attendant the desired station number.

4.15 The number of digits to be dialed in a station-to-station call depends upon the dial system used in the centrex—ie, the 2-digit, 3-digit, or 4-digit system. In the 2-digit system, the line finder is directly connected to the selector-connector (Fig. 9). The selector-connector functions as a connector on calls assigned to station lines. On a station-to-station call, the first digit dialed steps the selector-connector vertically to the desired level, and the second digit dialed rotates it horizontally to the connector terminals of the desired line.

4.16 When a 3-digit dial system is used (Fig. 10), the line finder extends the call to a first selector. Upon receiving the first digit dialed, the first selector steps vertically to the level dialed; it then rotates horizontally until an idle trunk to a connector is found. The connector responds to the last two digits dialed, the second digit dialed steps the connector vertically to the dialed level, and the third digit rotates the switch to the desired connector terminal.

4.17 In a combined 3- and 4-digit system, the routing of 3-digit station-to-station calls is the same as previously described. When a 4-digit call is dialed, the first selector extends the call to a second selector, which extends the call to a connector. Therefore, as shown in Figure 11, in a PBX or centrex using a 4-digit numbering plan, station-to-station calls are routed through the switch train in the same manner as the 4-digit calls in the combined systems.

G. Station-To-Central Office Calls

4.18 CO calls may be completed by dialing a digit corresponding to the selector level to which the CO trunks have been assigned (usually an "8" or a "9"). The local selector or selector-connector (Figures 9, 10 and 11) then extends the call through a direct dial CO trunk to the dial central office. From there a second dial tone is received, and the station user then dials the desired number in the usual manner.

H. Station To Dial-Repeating Tie Trunk Calls

4.19 Calls over dial-repeating tie trunks may be completed directly by dialing the tie trunk code and the extension, or via the distant attendant by dialing "0" after the tie trunk has been seized.

4.20 When the tie trunk code is dialed, the switches (either first selector or selector connector) step up to the level dialed and rotate in the level until an idle trunk is found.

4.21 The call is extended to an incoming selector or selector-connector at the distant end, and the desired extension can be reached directly by dialing the appropriate code without waiting for second dial tone (Figures 9, 10,and 11).

I. Transfer On Calls Originated Over Inward Dialing Trunks

4.22 An incoming call previously dialed directly to an extension from a CO or distant PBX over an in-dialing trunk may be transferred to another extension within the PBX by the *called party* (Fig. 12). This feature permits a PBX station user to transfer an established incoming trunk to the PBX attendant or to another station by flashing the switchhook and dialing the desired extension.

4.23 When DID trunks or 2-way CO trunks are provided at the PBX or centrex, this feature requires a dial transfer circuit (Fig. 12), an associated selector per trunk, and a connector applique unit per connector switch arranged for dial transfer.

4.24 When one-way CO trunks equipped for dial transfer are provided, the dial transfer circuit is not required. However, the dial transfer selectors and the connector appliques must be provided. Depending upon the traffic requirements and the percentage of call transfers, a trunk finder switch may be used to reduce the number of dial transfer selectors required at the centrex or PBX.

J. Call Waiting

4.25 The call waiting feature provides an indication to an attendant and, if provided, to a network supervisor on the approximate number of calls waiting for connection to all attendant positions. When no network supervisory cabinet is provided, the attendant positions receive two indications: (a) one indication for one or two calls waiting and (b) one for three or more calls waiting. When a supervisory cabinet is provided, three indications are given to the supervisory cabinet:

(1) One indication for one or two calls waiting.

(2) One indication for three to five calls waiting.

(3) One indication for six or more calls waiting.

Also, an audible call waiting signal for one or more calls waiting is available as an option.

K. Conference calling

4.26 Station controlled conferencing arrangement will permit any centrex or PBX station user to originate and dial-select as many as five conferees. These arrangements are provided by interconnecting a station controlled conference circuit with a solid-state conference bridge comprised of six conference ports (Fig. 13). Five selector switches provide for station access to the centrex or PBX from the conference circuit. The conference originator is attached to the sixth port.

4.27 The associated selector switches are arranged so that dial selection is limited to the first port and outgoing facilities are restricted from the ninth level. Therefore, CO trunk connections must be established by the attendant.

4.28 A station user desiring to originate a conference call will dial the conference code. Assuming that the conference circuit is idle, second dial tone is returned. The originator then dials the extension number of the first conferee and, when the called station answers, both the originator and the conferee are automatically connected to the conference buss. The originator flashes the switchhook, obtains dial tone, and dials the next conferee. At this time previously summoned conferees are placed on hold. When the second conferee answers, the originator may add the second conferee to the conference bridge by a switchhook flash. This procedure is repeated until the desired number of conferees (maximum—5 plus the originator) have been added to the conference buss.

4.29 If for any reason the originator wishes to abandon a call to a potential conferee before completion or if the number dialed is busy, a switchhook flash will release the forward end of the connection and reconnect him to the conference buss. A subsequent switchhook flash will result in reconnecting dial tone and the procedures in 4.28 will be repeated.

4.30 Any of the conferees may disconnect from the conference without disturbing any of the other conference connections. That port then becomes available to the originator for additional conferees, if desired.

4.31 The originating station maintains control of the circuit until the conference is terminated, even though he may have disconnected in the interim, and a potential originator seeking access to the conference circuit will receive a busy signal.

L. Lockout and Secrecy

4.32 *Lockout* is an optional feature of the attendant loop circuit that prohibits the attendant from reentering any call unless recalled by the controlling station. The recall is executed by the following:

(a) Switchhook flash with Centrex I service.

(b) Switchhook flash plus dial "0" with Centrex II service.

The controlling station is the called station for incoming calls and the calling station for calls via attendant trunks.

4.33 *Lockout* may be provided as an independent feature; but if *secrecy* is provided, *lockout* must also be provided. *Secrecy (and lockout)* is an optional feature of the attendant loop circuit and direct terminated trunks which automatically exclude the calling party from the attendant to permit an announcement of an incoming call. This feature (automatic exclude source condition) is activated when the attendant at the telephone console depesses the START key to keypulse the number of the desired station. After announcing the incoming call to the called station, the attendant completes the connection by releasing in the normal manner. The attendant is locked out from the connection after the called station answers.

4.34 If the called station is busy or fails to answer, the attendant may remove the exclude source condition to make a progress report by depressing the associated pickup key. If the called station answers while the attendant is making a progress report, the exclude source condition is restored.

4.35 If the attendant wishes to exclude the called station after the called station has answered, the attendant operates the EXCLUDE DESTINATION key and is reconnected exclusively to the calling station. If the attendant removes the exclude destination condition, the exclude source condition is automatically restored. Thus, the attendant may alternate between the exclude source and exclude designation conditions as required.

ATTENDANT FACILITIES

4.36 Depending upon the type of console used, the attendant features will provide the basic trunk and loop pickup circuits, besides CO trunks, trunks to the attendant, and dial-selected tie trunks. Manually selected tie trunks are also usually provided.

4.37 The No. 1 and 2 telephone consoles are provided with the modernized 701B PBX (SXS) and are arranged for cordless operation. These are separate and complete operating units capable of handling their share of the total attendant traffic. The No. 1 console has a maximum capacity of 12 trunk and loop pickup keys, while the No. 2 console has a maximum of 30 trunk and loop pickup keys.

4.38 Some of the attendant telephone console features are as follows (refer to Fig. 14):

(a) Call Transfer-attendant

(b) Call Waiting

(c) Secrecy and Lockout—Loop Circuit

(d) Night Closing Arrangements

(e) Two-way Splitting

(f) Supervisory Console—Network Supervisor's Cabinet

(g) Attendant Camp-On

(h) Attendant Conference

(i) Attendant Direct Station Selection

(j) Busy Verification

(k) Call Forwarding—Busy Line

(l) Call Forwarding—Don't Answer

(m) Call Transfer—Individual, Consultation, Hold, and Add-On

(n) Conferencing.

Most of these features may be provided, in addition to switched-loop console operation, in the current PBX or centrex packages. For a more detailed description of the telephone console operation with a 701B PBX (SXS), refer to Bell System Practices Section 981-610-101.

5. SUPPLEMENTARY REFERENCES

Bell System Practices

SECTION	TITLE
801-801-153	Station Identification Frame—PBX Automatic Identified Outward Dialing—Type A1—Equipment Design Requirements—Common Systems
814-100-151	General Outline—CAMA—Intertoll Dialing Office—Equipment Design Requirements — Step-By-Step Systems
814-106-151	PBX-AIOD Translator and Connector Equipment—AMA or ANI Equipment Design Requirements
951-331-100	AIOD—CO Arrangements for PBX
955-135-100	ANI System—Type C—Step-By-Step Systems
955-136-100	ANI System—Type D—Step-By-Step Systems
955-210-100	AMA—No. 1 Step-By-Step Offices
966-300-100	No. 101 ESS—PBX—Centrex
981-601-100	AIOD—PBX—Centrex

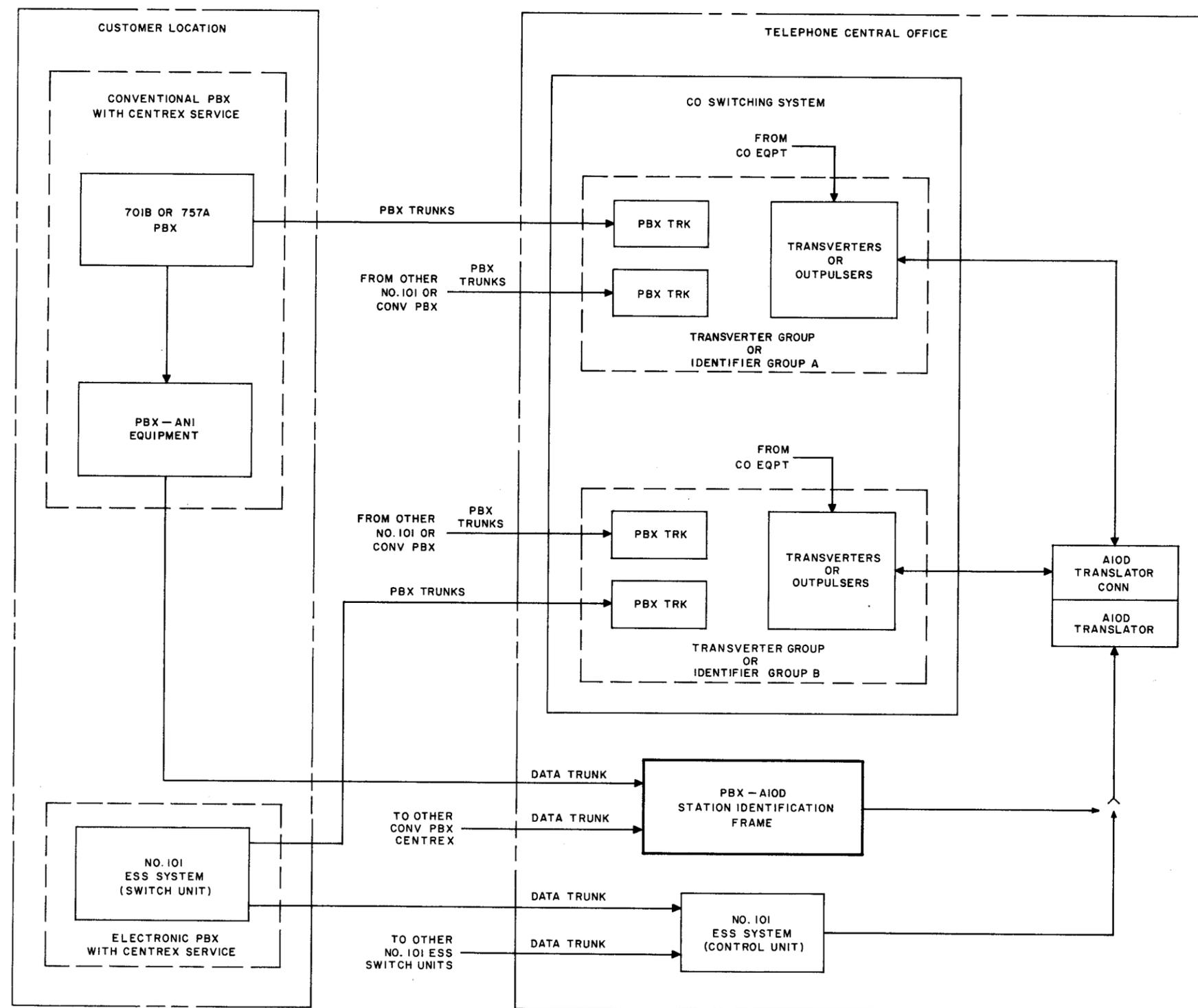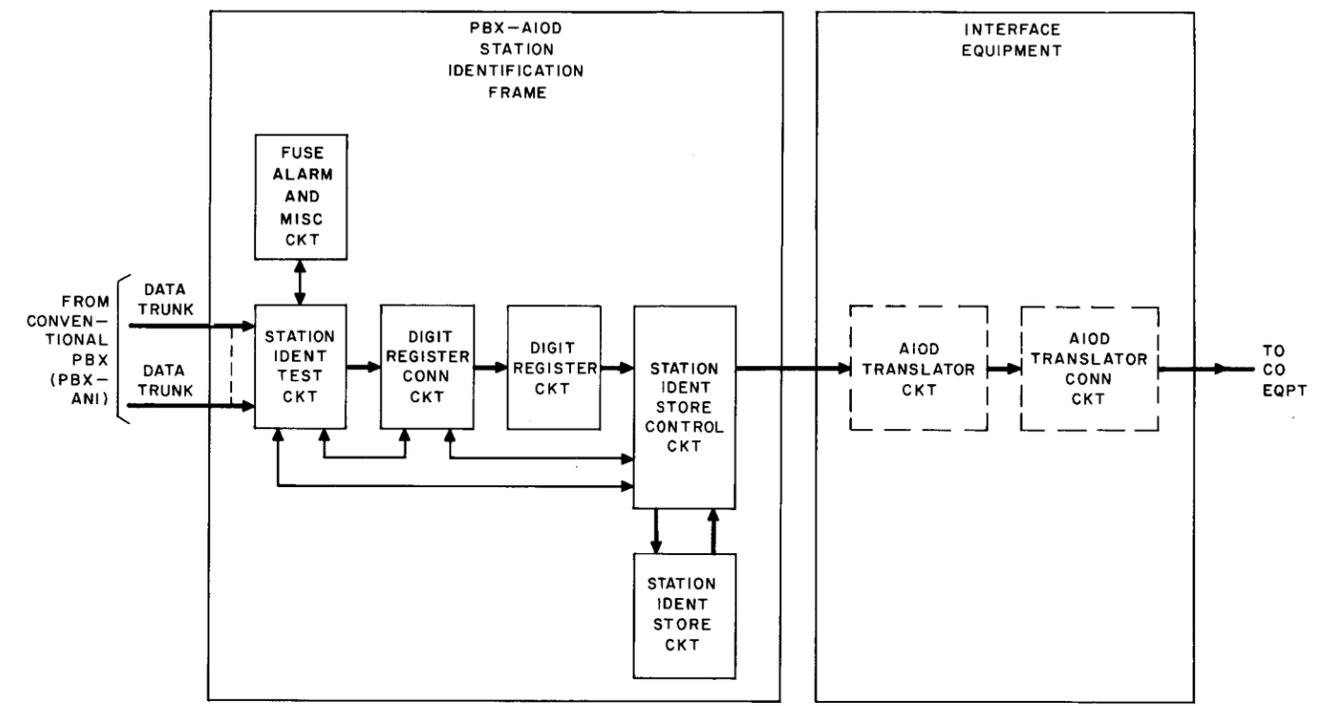| SECTION	TITLE	SECTION	TITLE
981-610-100	No. 701B PBX—General Descriptive Information	**Schematic Drawing**	
981-610-101	No. 701B PBX Arranged for Operation With Telephone Consoles	SD-32320-01	Keysheet—Step-By-Step Systems

Fig. 1—PBX-AIOD Facility—Block Diagram

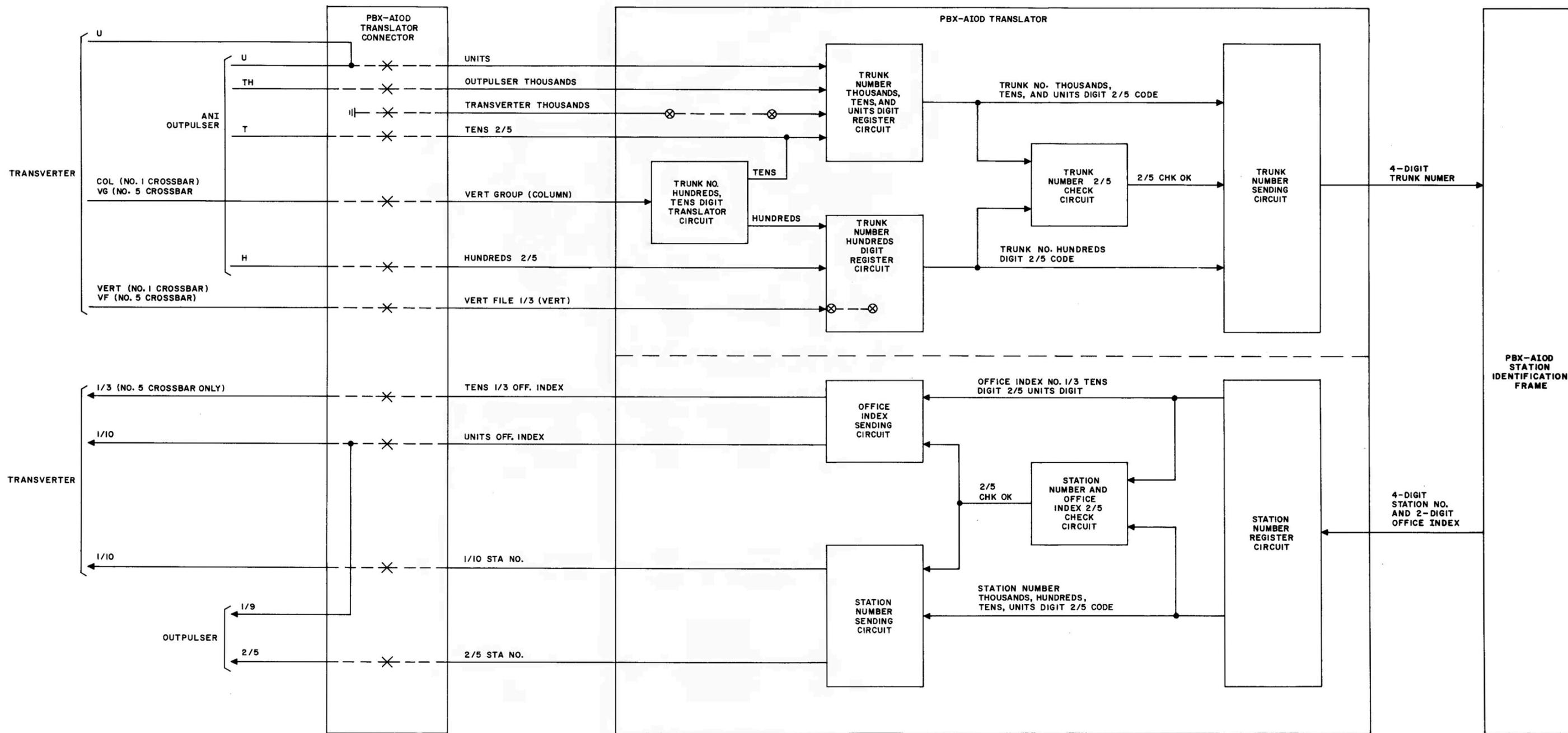**Fig. 2—PBX-AIOD Station Identification Frame—Block Diagram**

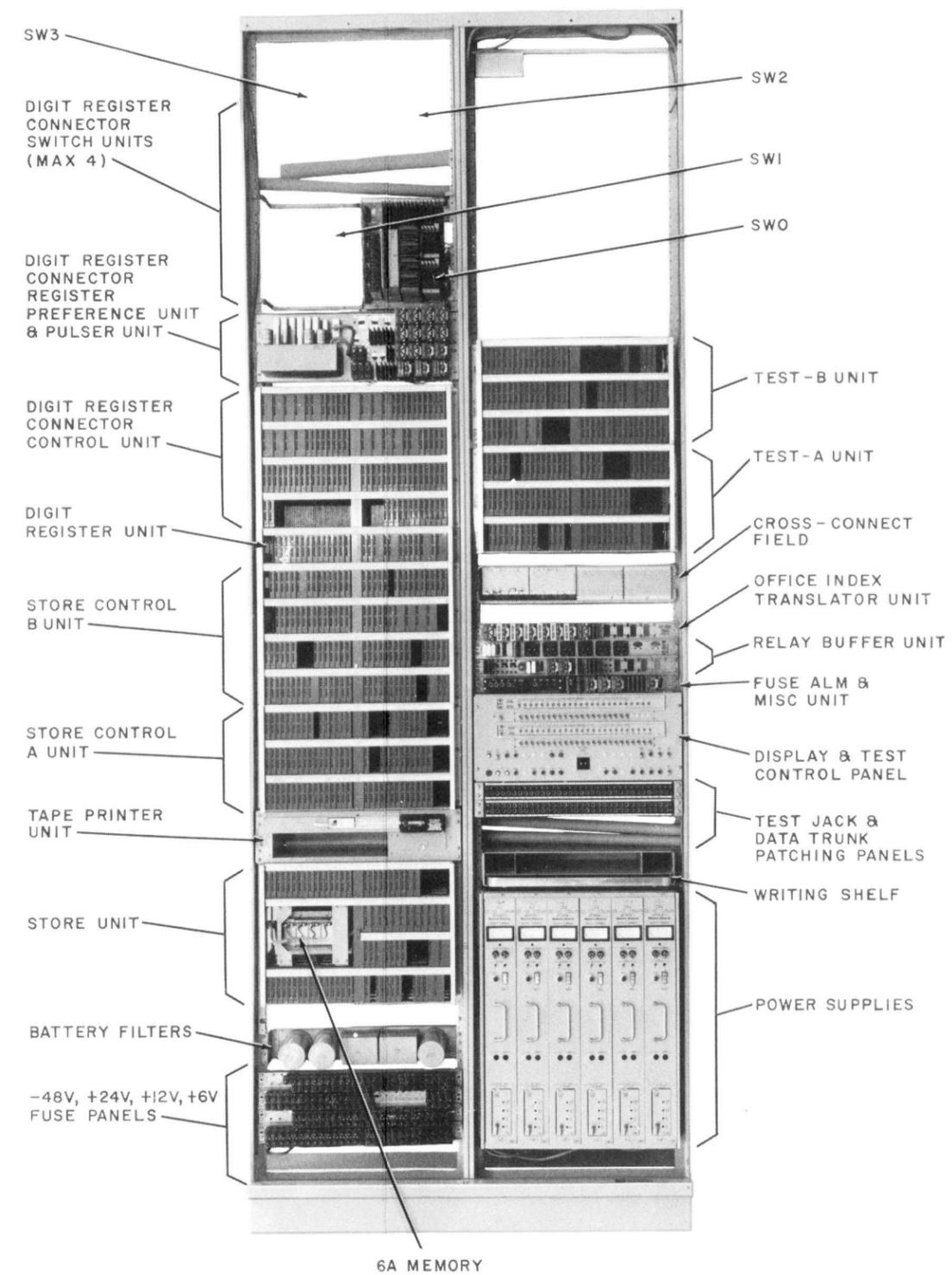Fig. 3—PBX-AIOD Translator and Connector—Block Diagram—SXS-Outpulser and ANI-Outpulser

SW3

DIGIT REGISTER
CONNECTOR
SWITCH UNITS
(MAX 4)

DIGIT REGISTER
CONNECTOR
REGISTER
PREFERENCE UNIT
& PULSER UNIT

DIGIT REGISTER
CONNECTOR
CONTROL UNIT

DIGIT
REGISTER UNIT

STORE CONTROL
B UNIT

STORE CONTROL
A UNIT

TAPE PRINTER
UNIT

STORE UNIT

BATTERY FILTERS

-48V, +24V, +12V, +6V
FUSE PANELS

SW2

SWI

SWO

TEST-B UNIT

TEST-A UNIT

CROSS-CONNECT
FIELD

OFFICE INDEX
TRANSLATOR UNIT

RELAY BUFFER UNIT

FUSE ALM &
MISC UNIT

DISPLAY & TEST
CONTROL PANEL

TEST JACK &
DATA TRUNK
PATCHING PANELS

WRITING SHELF

POWER SUPPLIES

6A MEMORY

Fig. 4—Station Identification Frame Equipment Layout
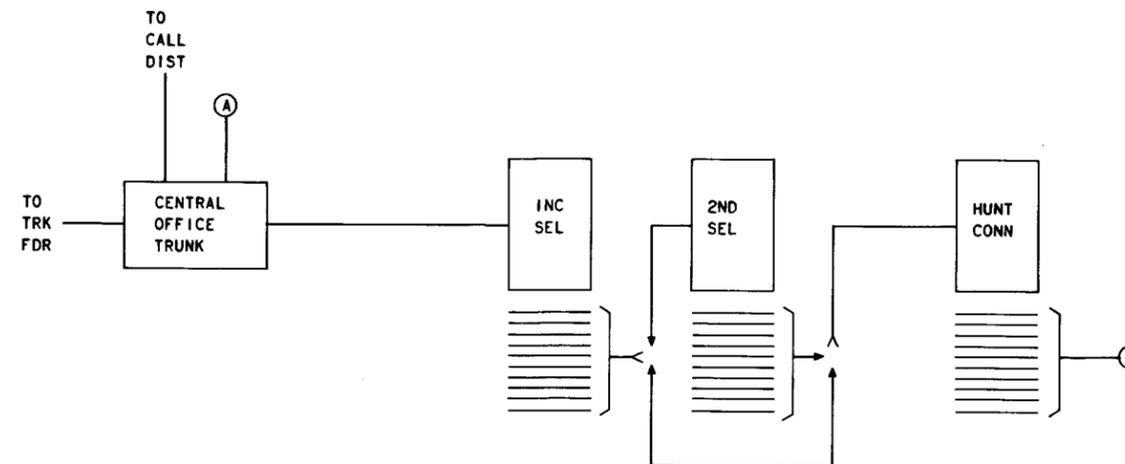
Fig. 5—Typical Direct Inward Dialing Arrangement
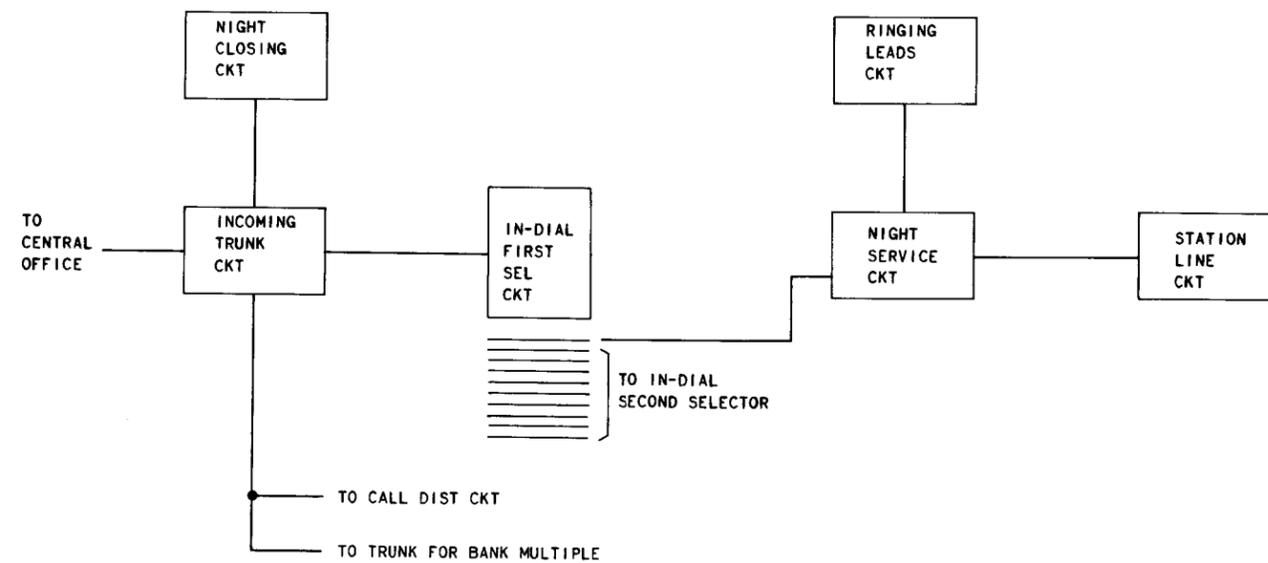
Fig. 6—Night Service—Centrex I Service

Fig. 5 and 6

Page 19
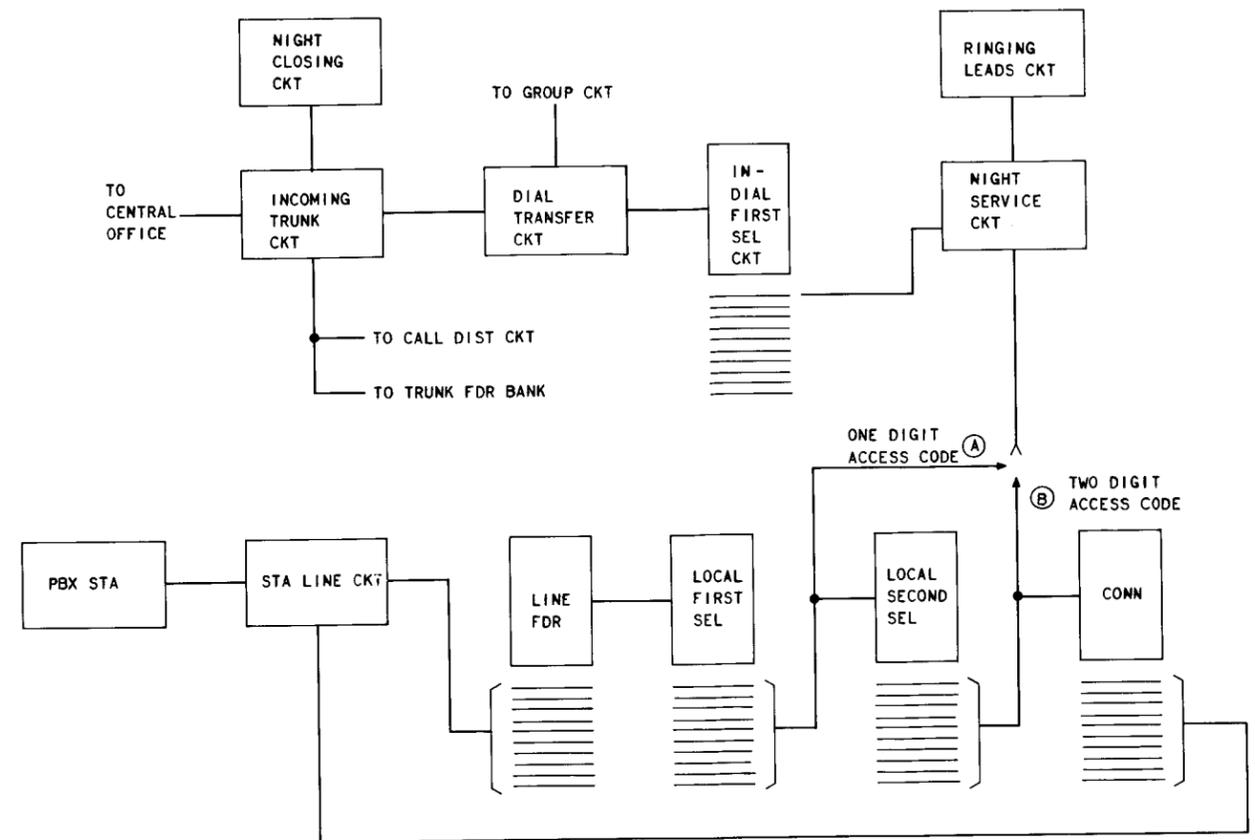
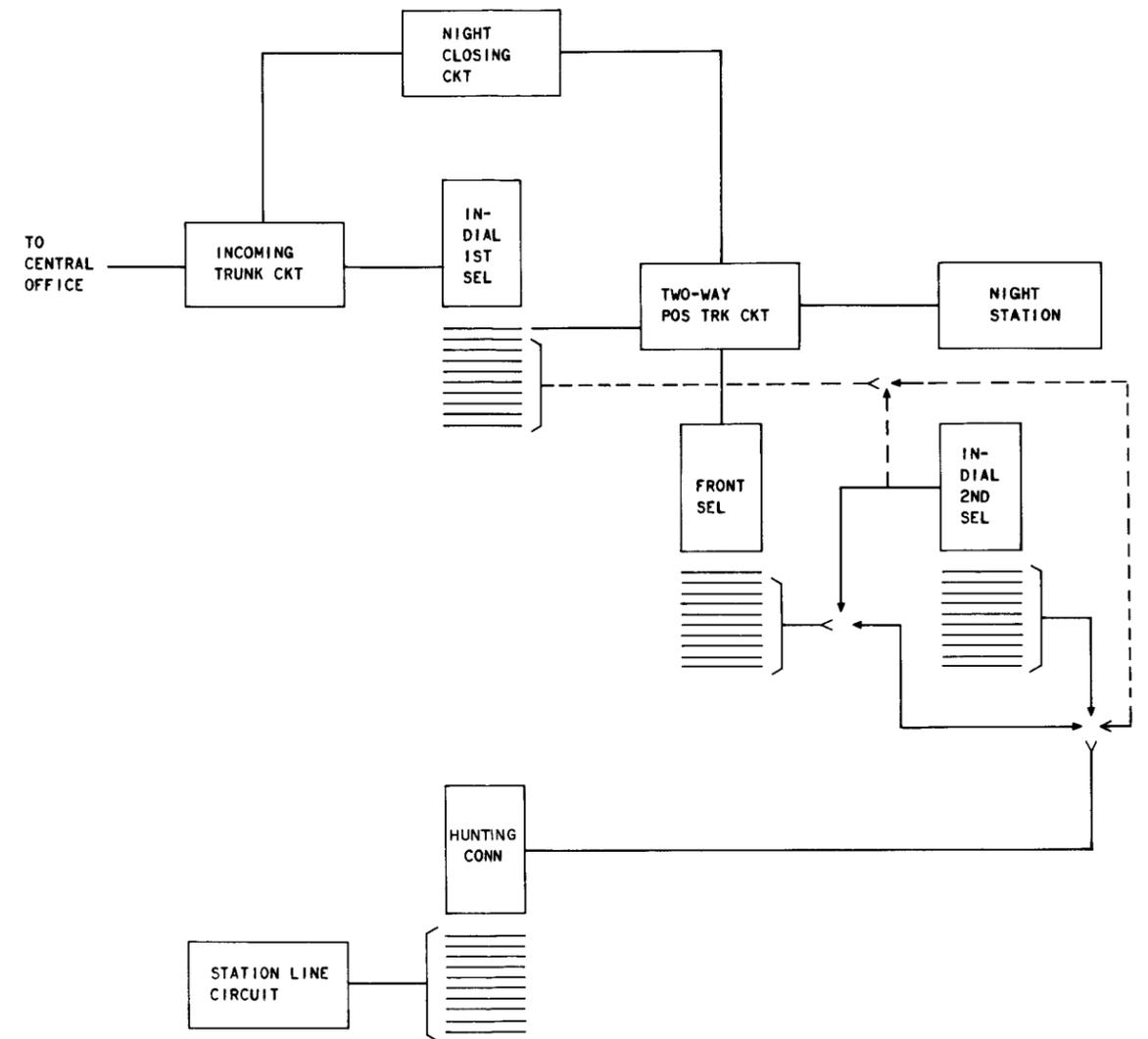**Fig. 7—Trunk Answer From Any Station—Centrex II Service**

Fig. 8—Night Attendant—PBX or Centrex Optional Service
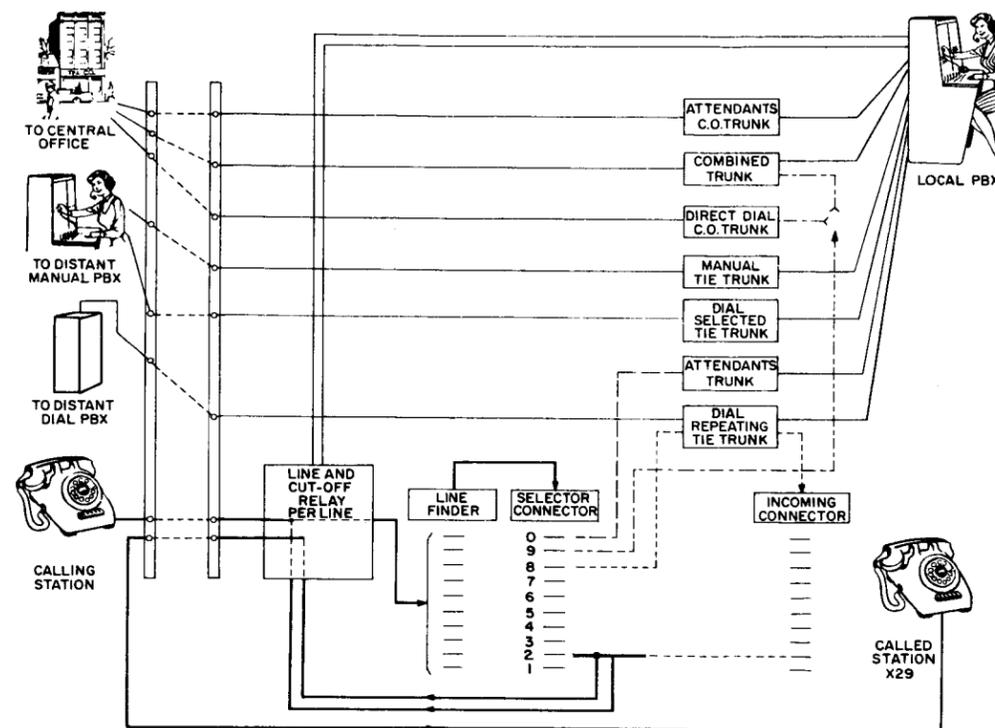
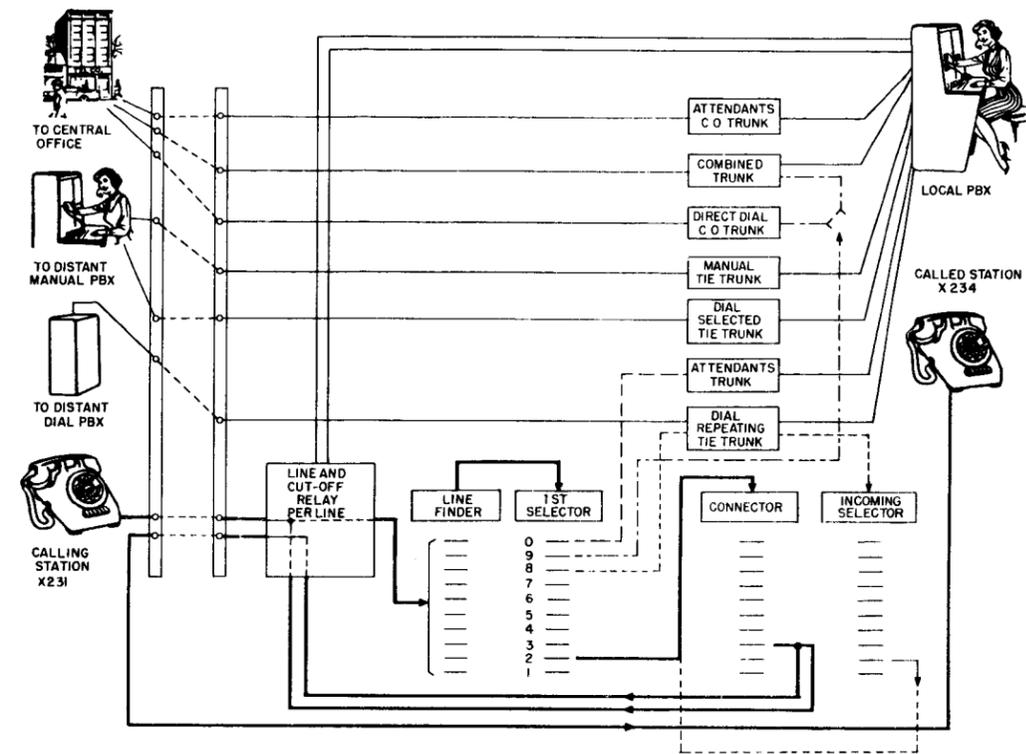Fig. 9—Trunking Arrangements for 2-Digit Systems

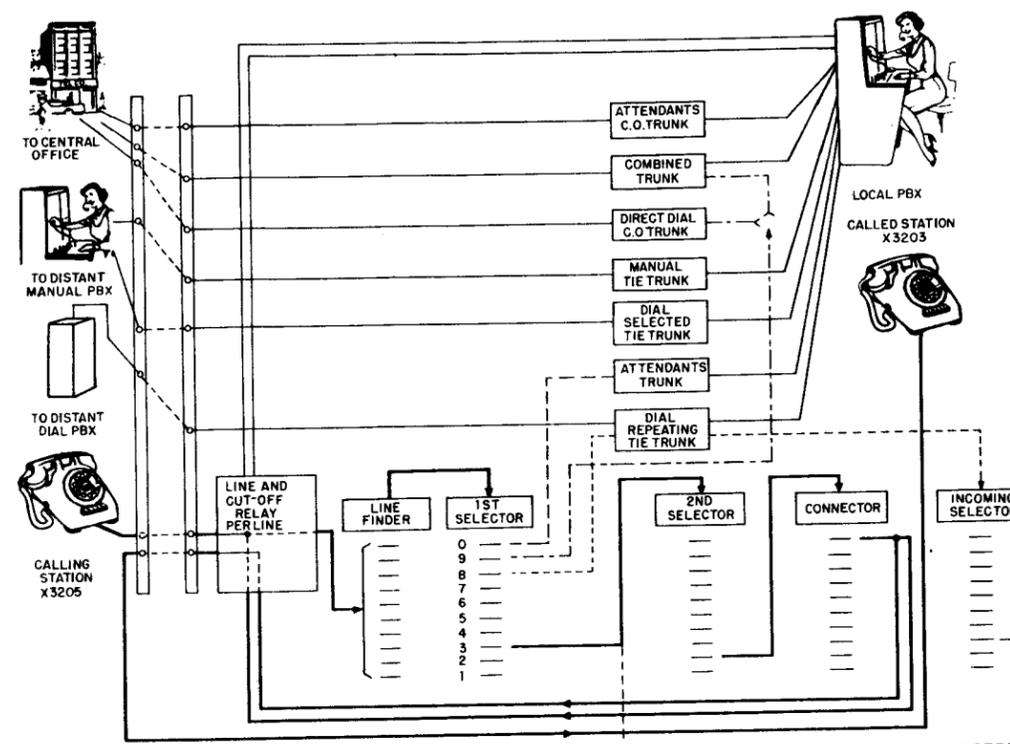**Fig. 10—Trunking Arrangements for 3-Digit Systems**

ATTENDANTS
C.O. TRUNK

COMBINED
TRUNK

DIRECT DIAL
C.O. TRUNK

MANUAL
TIE TRUNK

DIAL
SELECTED
TIE TRUNK

ATTENDANTS
TRUNK

DIAL
REPEATING
TIE TRUNK

TO CENTRAL
OFFICE

TO DISTANT
MANUAL PBX

TO DISTANT
DIAL PBX

LOCAL PBX

CALLED STATION
X3203

CALLING
STATION
X3205

LINE AND
CUT-OFF
RELAY
PER LINE

LINE
FINDER

1ST
SELECTOR

2ND
SELECTOR

CONNECTOR

INCOMING
SELECTOR

0
9
8
7
6
5
4
3
2
1

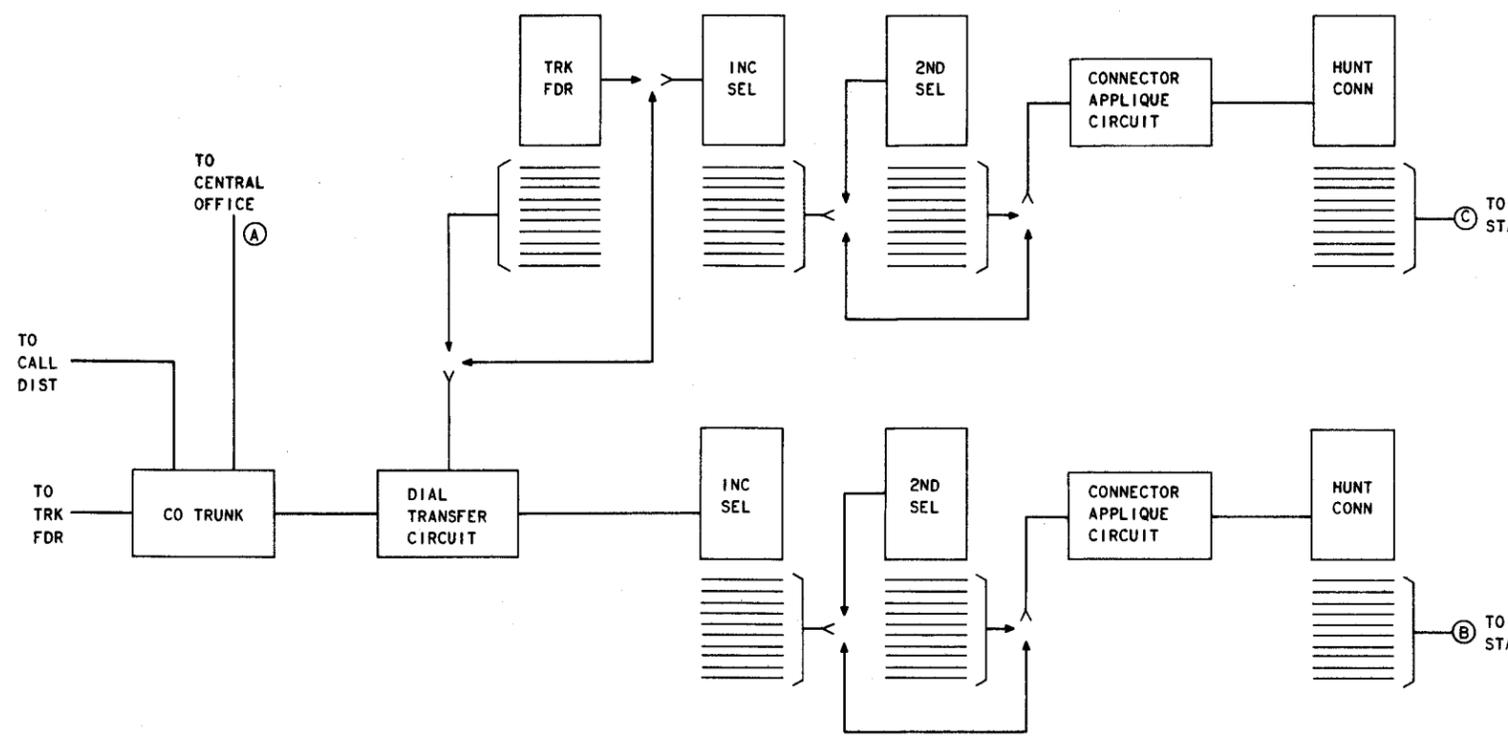**Fig. 11—Trunking Arrangements for 4-Digit Systems**

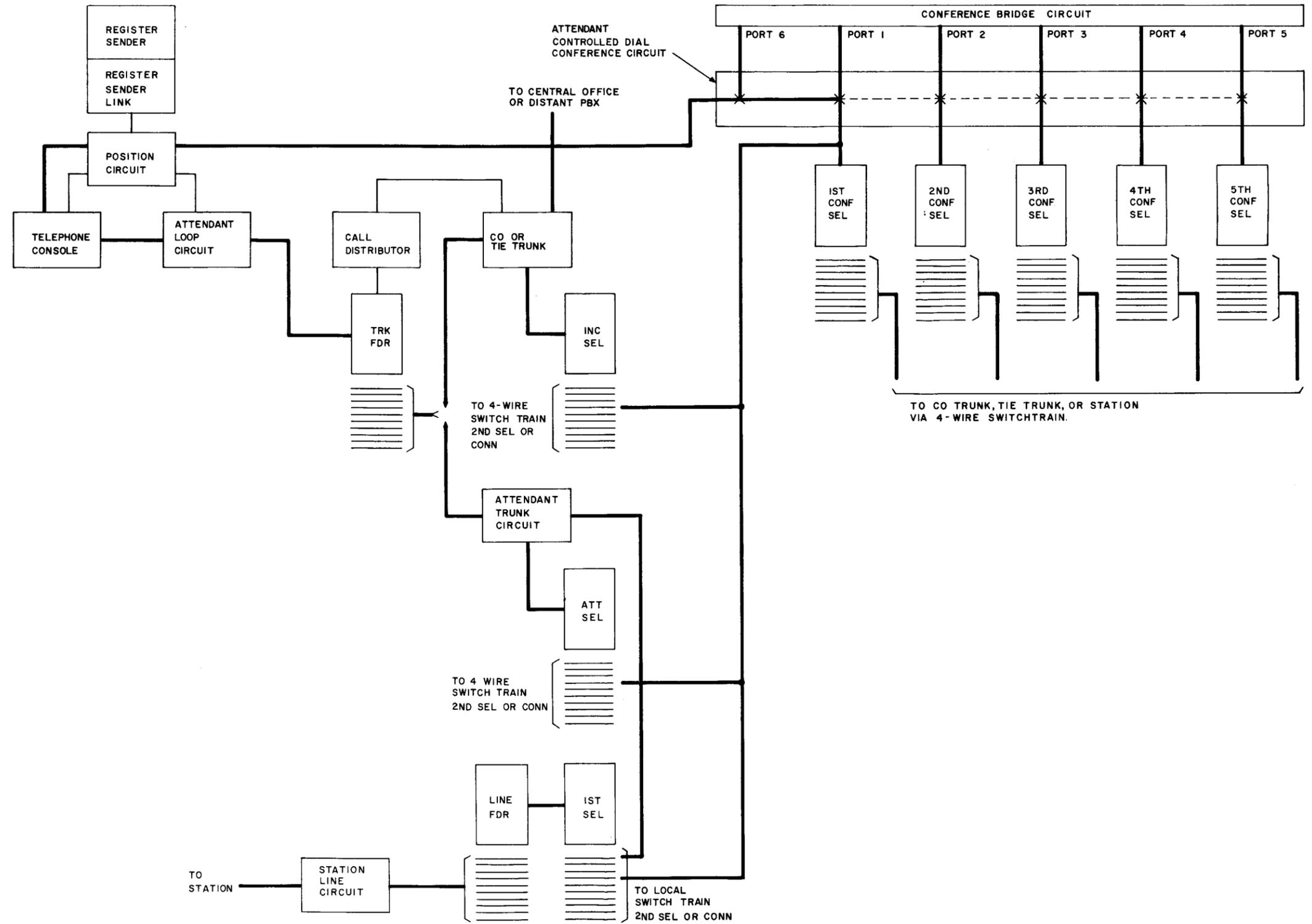**Fig. 12—Typical Call Transfer—Individual Arrangement**

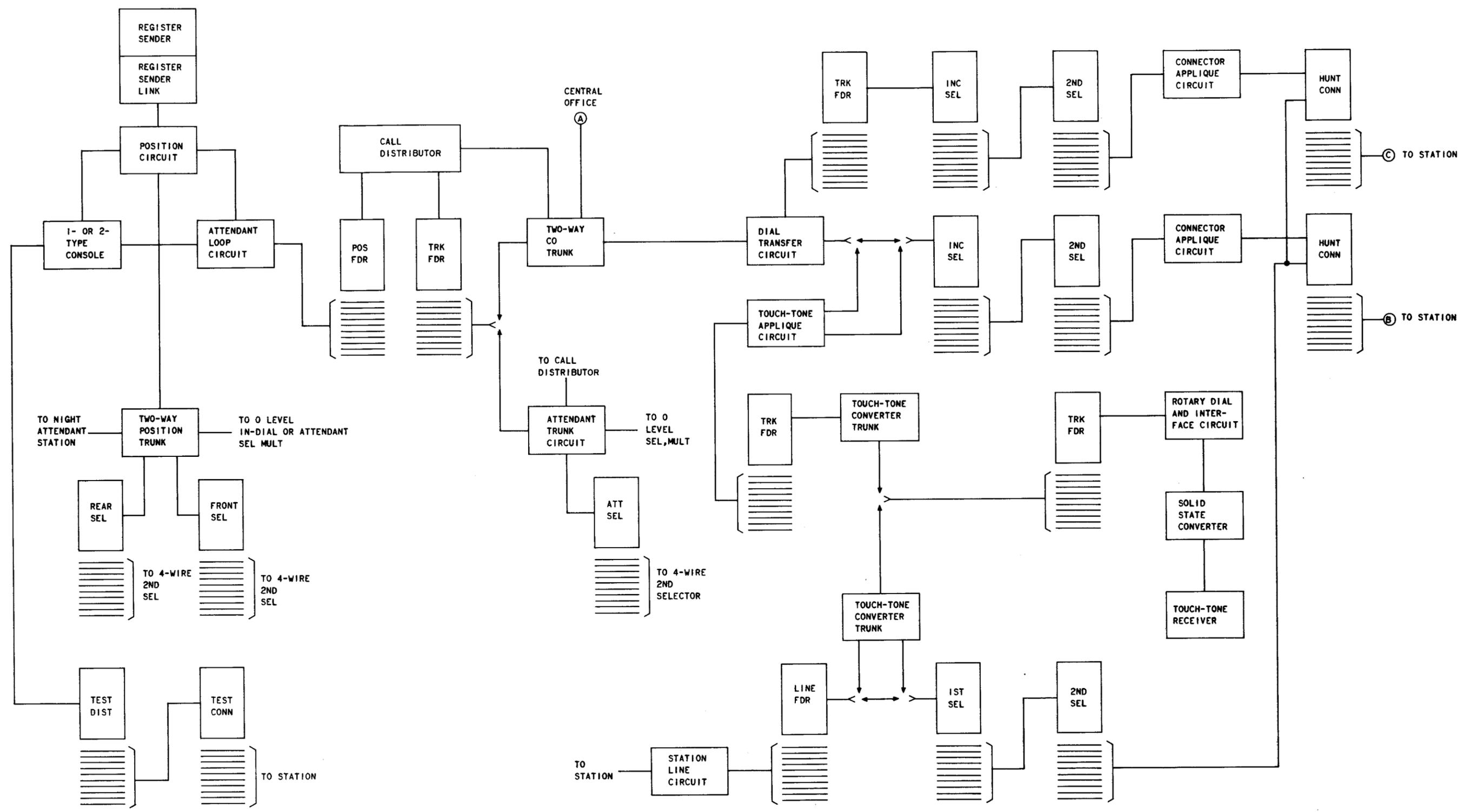Fig. 13—Typical Conference Calling Arrangement

Fig. 14—Typical Switch-Loop Arrangement for Large 701B PBX With Special Attendant Position, Night Attendant, Busy Verification, TOUCH-TONE® Calling and Call Transfer— Individual

TABLE A
CAPACITY OF PBX ANI UNITS

	UNIT	QUANTITY	REQUIRED	MAX CAPACITY OF EACH UNIT
PBX ANI BASIC UNITS	Basic station identification unit	1	For each installation	Identification of 100 station lines or tie trunk incoming selectors and 36 attendant circuits or attendant controlled dialed conference connecting circuits.
	Alarm panel	1		
	Common control panel	1		
	Basic trunk identification unit	1		Identification of 30 central office trunk circuits.
PBX ANI SUPPLEMENTARY UNITS	Supplementary station identification unit	1 to 89	When more than 100 PBX lines	Identification of 100 station lines or tie trunk incoming selectors and 36 attendant circuits or attendant controlled dialed conference connecting circuits.
	Supplementary trunk identification unit	1 to 5	When more than 30 PBX CO trunks	Identification of 36 CO trunk circuits.
GROUP SELECTION UNITS	Group relay driver unit	1	When more than 15 station identification units are provided.	16 group relay drivers
	Group selector relay unit	1 to 6		3 group select relays

Table A—Capacity of PBX ANI Units