SWITCHING SYSTEMS MANAGEMENT
NO. 5 CROSSBAR SYSTEM—2-WIRE
OPERATIONAL FEATURES
PHASE III CENTREX SERVICE

CONTENTS PAGE

1. PHASE III CENTREX SERVICE

A. General

1.01 Centrex facilities enable a Private Branch Exchange (PBX) customer to obtain a flexibility

of operation previously unobtainable with normal PBX facilities. Centrex facilities include the following arrangements:

(a) Arrangements for completing incoming calls to an extension without the aid of an attendant (direct inward dialing)

(b) Arrangements for transferring calls from one extension to another without the aid of an attendant (dial transfer)

(c) Arrangements for automatically billing direct distance dialed calls to individual extensions

(d) Arrangements to enable the centrex marker group to act as a main PBX in the 4-wire AUTOVON network (multilevel precedence preemption)

(e) Arrangements which enable a centrex customer to utilize centrally located attendant facilities for handling listed directory number (LDN) and transfer calls for all phase III centrex marker groups which serve the customer (centralized attendant facilities).

1.02 Whenever this section is reissued, the reason for reissue will be listed in this paragraph.

1.03 In the No. 5 Crossbar System, these facilities are divided into two general categories. ***Centrex CO*** enables the PBX customer to use No. 5 crossbar switching equipment located on telephone company premises instead of PBX equipment located on the customer premises. ***Centrex CU*** enables the PBX customer to use PBX equipment in conjunction with a No. 5 crossbar office to provide the centrex services.

1.04 In this section, the extensions associated with one customer which are served by a centrex CO are referred to as ***centrex lines*** and constitute a ***customer group.***

B. Capacity

1.05 The capacity of the No. 5 Crossbar System for centrex operation is essentially the same as for the basic services. When dial transfer is required, however, the marker group may include a maximum of four transfer line link and four transfer trunk link frames, 27 transfer registers, and four transfer register marker connectors.

1.06 Complete marker group and individual frame capacities are covered in Figures 1 and 2, Bell System Practices Section 819-005-150.

C. Method of Operation

General

1.07 The method of operation described in this part covers the dialing arrangements required to initiate and to transfer calls from centrex lines, as well as the No. 5 Crossbar System operation required to handle calls originating from and completing to centrex CO and centrex CU lines.

1.08 In addition to the operation described, a centrex CO can be arranged to transfer incoming calls automatically to an attendant when the call encounters a centrex line which is either busy or does not answer. It also can be arranged to transfer the LDN calls to centrex lines when the attendant position is not occupied.

1.09 A marker group arranged to serve centrex customers may also be used as part of a common control switching arrangement (CCSA) network.

1.10 When a marker is arranged to serve centrex and CCSA customers, access group control facilities are available to control the volume of traffic between the centrex customers and the CCSA network trunks.

2. DIALING ARRANGEMENTS

2.01 This part covers only the dialing arrangements shown in Fig. 1, which are required to initiate a call to gain access to the No. 5 crossbar switching equipment. The arrangements required for transferring calls are covered in Parts 5, 9, and 10. These dialing arrangements are used with both the rotary dial and TOUCH-TONE® sets.

2.02 The centrex line dials "0" when the assistance of a centrex operator is required; "9 plus seven or ten digits" is dialed when a party whose line terminates outside of the customer group is called or when the assistance of a DSA or toll operator is required. The 1XX codes may be used for tie lines and special services. The centrex

station dials four or five digits of the called number when a party whose line terminates in the same customer group is called. (The 4-digit numbers restrict the centrex CO to 7000 [6000 with CCSA] central numbers since digits 0, 1, and 9 cannot be used as the initial digit. In offices where CCSA access is required, initial digit "8" is similarly restricted. The 5-digit numbers enable the centrex CO to use up to the full 40,000 number capacity of a marker group for centrex numbers.)

3. CENTREX CO SYSTEM OPERATION

3.01 In centrex CO operation, centrex lines are assigned line link frame appearances with a class of service and rate treatment identification which enables the dial tone marker to identify them as centrex lines and also to determine their associated customer group.

3.02 All centrex lines have directory numbers assigned to them and may be listed in the telephone company directory.

3.03 Although the full seven digits of the directory number are required for direct inward dialed calls, only the last four or five digits are dialed for calls between centrex lines in the same customer group (intracustomer group calls).

3.04 In centrex operation, the originating register assumes that the calling line is a centrex line and that only four digits will be dialed unless it receives an initial digit of 0, 1, 8, or 9.

3.05 If the customer group is arranged for 5-digit numbers, the originating register receives an appropriate indication from the dial tone marker.

3.06 If the originating register receives the digits 0, 1, or 9 as the first digit, it realizes that the call is not an intracustomer group call and takes the required action.

3.07 If a regular customer line is connected to the originating register, the originating register receives an indication from the dial tone marker that the calling line is not a centrex line.

4. OUTGOING AND INTERMARKER GROUP CALLS

4.01 Outgoing and intermarker group calls from centrex lines are handled in essentially the same manner as they are handled for basic customer service. However, originating register request and dial tone connection are handled differently.

4.02 The signal generated by the calling centrex line causes the line link frame to ask the dial tone marker for a connection to an originating register. When the connection is established, the originating register sends dial tone to the calling centrex line as a signal to begin dialing.

4.03 The calling centrex line dials "9" into the originating register and waits for a second dial tone.

4.04 The originating register determines from the digit 9 that the call will complete outside of the customer group and sends the second dial tone as a signal to start dialing the number of the called party. The remainder of the operation is the same as for the basic customer services. When these calls require the use of automatic message accounting facilities, they are handled the same as any other call which requires the use of these facilities.

5. DIRECT INWARD DIALED CALLS (INCOMING AND INTRAOFFICE)

5.01 Direct inward dialed calls, both incoming and intraoffice, are handled the same as regular incoming and intraoffice calls.

6. INTRACUSTOMER GROUP CALLS

6.01 Intracustomer group calls are handled essentially the same as intraoffice calls. For intracustomer group calls, however, the calling centrex line dials the 4-, 5-, or 7-digit number of the called centrex line. (Seven digits are required for multizone centralized attendant operator.) When the originating register receives the digits of the called number, it connects to a completing marker and passes the digits to it along with a translation mark which informs the completing marker that it will receive only four or five digits. At the same time, the originating register line memory frame passes the calling centrex line's line link frame termination and class of service to the completing marker. When the completing marker receives the digits, it selects an intraoffice trunk and proceeds to establish the transmission path the same as for an intraoffice call. Before the transmission path connection is established, however, the completing marker matches the class of service

of the called centrex line against the class of service of the calling line. If both classes of service are identical, the completing marker is satisfied that the called line is in the same customer group as the calling line and establishes the transmission path connection.

7. LISTED DIRECTORY NUMBER CALLS

7.01 Listed directory number (LDN) calls originate from a customer outside of the customer group and complete to a centrex attendant.

7.02 The customer places an LDN call when the number of a centrex line is desired, when connection to a centrex line is desired and the 7-digit number required for direct inward dialing is not known, and when any of the various services previously available from a PBX operator except transfer and perhaps conference are desired.

8. LDN CALLS TO AN ATTENDANT

8.01 These calls are handled similarly to direct inward dialed calls. However, the incoming or intraoffice trunk is connected to an attendant trunk instead of to a centrex line.

8.02 The attendant trunk is assigned two line link frame appearances and may connect either to a specific console or through the centrex position link frame to any one of up to 20 consoles. One of the line link frame appearances enables the attendant to receive LDN calls and to initiate the dial transfer operation, and the other appearance enables the attendant to originate calls from the console.

(a) ***Attendant Trunk Connects to a Specific Console:*** When the connection between the attendant trunk and the incoming or intraoffice trunk is established, the attendant trunk signals the attendant by flashing a lamp at the console.

(b) ***Attendant Trunk Connects to a Console Through the Centrex Position Link Frame:*** When the connection between the attendant trunk and the incoming trunk is established, the attendant trunk requests the centrex position link frame to connect it to a console. The centrex position link frame selects an idle console and connects the attendant trunk to it. The attendant trunk then signals the attendant by flashing a lamp at the console.

9. TRANSFER CALLS

9.01 In centrex CO operation, several types of transfer calls can be handled. These types of calls include dial transfer by a centrex line to another centrex line, dial transfer by a centrex line to an attendant, and attendant-controlled transfer.

10. DIAL TRANSFER CALLS BY A CENTREX LINE TO ANOTHER CENTREX LINE

10.01 This type of transfer enables a called centrex line (station B) to transfer a call from the calling customer (station A) to another centrex line (station C) without the aid of an attendant.

10.02 This section divides the method of operation of dial transfer calls into the following segments:

(1) Transfer Request Connection

(2) Transfer Register Request

(3) Line Identification

(4) Transfer Dial Tone Connection

(5) Transfer Transmission Path Connection.

10.03 Incoming and intraoffice calls can be transferred, but intermarker group operation cannot be used for calls to centrex offices. Since the method of operation is the same for transferring both incoming and intraoffice calls, only incoming calls are covered in this section.

11. TRANSFER REQUEST CONNECTION

11.01 The transfer request connection includes both the original transmission path connection between the incoming trunk and station B and a connection between the incoming trunk and a transfer trunk through the transfer line link and transfer trunk link frames. When station B desires to transfer a call to station C, the switchhook is flashed as a signal to the incoming trunk that the call is to be transferred. (The incoming trunk has both a trunk link frame appearance and a transfer line link frame appearance.)

11.02 Upon receipt of the signal, the incoming trunk causes the transfer line link frame to connect to a dial tone marker through a transfer line link marker connector. The transfer line link frame, through this connection, asks the dial tone marker for a connection to a transfer trunk.

11.03 The dial tone marker connects to the transfer trunk link frame through the transfer trunk link connector and selects an idle transfer trunk. (The transfer trunk also has a regular trunk link frame appearance.) The dial tone marker then connects the transfer trunk to the incoming trunk through the transfer trunk link and transfer line link frames. (Junctor grouping frames are not used with transfer line link and transfer trunk link frames.)

11.04 The transfer line link frame also passes the trunk link frame number of the incoming trunk to the dial tone marker which in turn passes it to the transfer trunk where it is stored for subsequent use.

12. TRANSFER REGISTER REQUEST

12.01 The transfer trunk requests its associated transfer register link frame to connect it to a transfer register. When the connection is established, the transfer trunk passes both its own trunk link frame number and the trunk link frame number of the incoming trunk to the transfer register where they are stored for subsequent use.

13. LINE IDENTIFICATION CONNECTION

13.01 The line identification connection includes the original transmission path connection between the incoming trunk and station B, a connection between the line identification power supply and the incoming trunk, and a connection between the line link frame which contains station B line termination and the transfer line identification frame.

13.02 The transfer register connects to the transfer line identifier frame through the transfer register identifier connector and requests an identification of station B line termination on the line link frame. At the same time, the transfer register causes the transfer register identifier connector to signal the transfer trunk that a line identification is to be made.

13.03 The transfer trunk signals the incoming trunk, through the transfer trunk link and transfer line link frames, to connect the line identification power supply to the station B line link frame termination through the original transmission path connection.

13.04 The line identifier power supply then supplies an identifying signal to the line link frame termination of station B. The line link frame uses this signal to connect to the transfer line identifier frame.

13.05 The transfer line identifier frame scans the terminations on this line link frame. When it detects the signal through a termination, it passes the location of it to the transfer register frame.

13.06 When the line identification connection is established, the transfer trunk causes the incoming trunk to remove station A from the transmission path and place it on hold.

14. TRANSFER DIAL TONE CONNECTION

14.01 When the transfer register receives the location of the station B line link frame termination, it connects to a completing marker through the transfer register marker connector and passes both this information and the trunk link frame number of the transfer trunk to it.

14.02 The completing marker now releases the original transmission path connection between the incoming trunk and station B and establishes the transfer dial tone connection between the transfer trunk and station B through the trunk link, line link, and junctor grouping frames. When the completing marker establishes this connection, it receives the class of service of station B line link frame termination and passes it to both the transfer trunk and transfer register where it is stored for subsequent use. The completing marker then releases from the call and prepares to handle other calls.

14.03 The transfer register, having previously been connected to the transfer trunk through the transfer register link frame, sends dial tone over the transfer trunk to station B as a signal to begin dialing the number of station C.

15. TRANSFER TRANSMISSION PATH CONNECTION

15.01 The transfer transmission path connection is between the incoming trunk and station C through the trunk link, line link, and junctor grouping frames.

15.02 This connection, along with the portion of the ***transfer request connection*** between the incoming trunk and the transfer trunk and the portion of the ***transfer dial tone connection*** between the transfer trunk and station B, will permit ***private consultation*** between stations B and C.

15.03 When the transfer register receives all the digits of the number, it again connects to a completing marker through the transfer register marker connector. The transfer register then passes the station C number, the station B class of service, and the trunk link frame number of the incoming trunk to the completing marker. The completing marker obtains the line link frame termination of station C from the number group frame and establishes the transfer transmission path connection. The completing marker then causes ringing to be applied to station C and releases from the call. Although the transfer transmission path has been established, station A is retained on hold by the incoming trunk and is unable to talk to station C. Private consultation, however, is possible between stations B and C.

15.04 Station B informs station C that station A wishes to talk. If station C agrees to talk to station A, either station B or C flashes the switchhook as an indication to the incoming trunk to remove station A from hold and to add it to the transmission path (add-on).

15.05 Station B now either releases from the call or remains in the path and engages in a 3-way conversation with stations A and C. If station C does not answer or the line is busy, station B flashes the switchhook as an indication to the incoming trunk to remove station A from hold and reconnect it to station B. This connection is established through the path used by station B for private consultation with station C. The transfer transmission path connection between the incoming trunk and station C, however, is released.

15.06 If either station B or station C disconnects from the call during conversation, the associated portion of the transmission path is released. If station C wishes to transfer station A to another centrex line, the switchhook is flashed, and the complete dial transfer operation is repeated.

15.07 If station B wishes to ***retransfer*** station A to another centrex line when station C disconnects from the call, the switchhook is flashed as a signal to the transfer trunk to originate the retransfer. Since the identification of the line termination of station B has already been accomplished during the first request, that portion of the operation is not repeated.

16. CALLS TRANSFERRED TO AN ATTENDANT

16.01 This type of transfer enables station B to transfer a call to an attendant.

16.02 Station B initiates a transfer to the attendant in the same manner as a transfer to station C. However, when the transfer dial tone connection is established and dial tone is returned to station B by the transfer register, station B dials the digit "0" instead of the last four or five digits of the listed directory number.

16.03 The completing marker, when it receives the digit "0," generates the last four or five digits of the attendant listed directory number and obtains from the number group frame both the line link frame termination and an indication that this termination is a listed directory number. The completing marker signals the incoming trunk to remove station A from ***hold*** and establishes the transfer transmission path between the incoming trunk and the attendant trunk.

16.04 Station B informs the attendant that station A wishes to be transferred and disconnects from the call.

16.05 The attendant depresses a start key and completes the transfer the same way a regular centrex line (station C) completes a second transfer.

17. ATTENDANT CONTROLLED TRANSFER CALLS

17.01 A centrex CO office may serve customer groups which permit calls to be transferred only by an attendant. Although centrex lines in these customer groups cannot use the dial transfer method to transfer a call to an attendant or other

centrex lines, they can transfer a call to an attendant by merely flashing the switchhook.

17.02 When station A requests to be transferred, station B flashes the switchhook as an indication to the incoming trunk that a transfer is desired. The transfer request, line identification, and transfer dial tone connections are established the same as for a regular dial transfer call.

17.03 When the completing marker establishes the transfer dial tone connection, it determines from the station B class of service that the transfer cannot be completed by dialing and signals the transfer register that the call will be transferred by an attendant. The completing marker then releases from the call.

17.04 When the transfer register receives the signal from the completing marker, it withholds dial tone from station B and again connects to a completing marker through the transfer register marker connector.

17.05 The transfer register then generates a digit "0" and passes it to the completing marker along with the trunk link frame number of the incoming trunk and station B class of service.

17.06 When the completing marker receives the digit "0," it establishes the transfer transmission path in the same way it establishes the path when station B initiates the transfer by dialing "0." The remainder of the call and the subsequent transfer by the attendant also are handled the same as when station B initiates the transfer by dialing "0."

18. PBX ASSIGNED A SEPARATE OFFICE CODE

18.01 A centrex CO assigned a separate code can be reached either by using the No. 5 crossbar marker group as a tandem switching center or by line link pulsing (LLP) operation.

18.02 Tandem operation requires tandem incoming trunks and tandem marker features and tandem marker relays in the outgoing trunks. These connections are either local originated outgoing calls or tandem calls. There are no ***intraoffice*** connections. Except for the excessive use of NNX codes, any number of separate PBXs may be reached, each on its separate code.

18.03 A centrex CO assigned a separate code can be reached using LLP in an office without tandem features.

18.04 This code need not remain separate if there are numbers in the number series 0000 to 9999 that are not required for the centrex. Any such numbers could be used for regular customers (POTS). When codes are so shared with POTS, each code uses a portion of one of the six terminating entities of a No. 5 crossbar marker group. Assuming one code for number series, the number of codes that can be so served by a No. 5 crossbar marker group with this type of operation would be limited to six, and no other customer could be served.

19. PBX ASSIGNED GROUPS OF NUMBERS WITHIN A SHARED OFFICE CODE

19.01 The number of PBXs which can be served by a No. 5 crossbar marker group is limited by the marker group capacity of 40,000 numbers, 6 terminating entities, CCS, and marker call volume capacity.

20. CENTREX CU OPERATION WITH NO. 5 CROSSBAR

20.01 In centrex CU operation, a PBX is located on the customer premises and functions with a marker group to provide the centrex facilities.

20.02 The PBX, however, must be arranged to accept direct inward dialing before it can realize the full capabilities of these facilities.

20.03 Calls from centrex lines that are assigned to a centrex CU are handled in the No. 5 crossbar marker group the same as calls from PBX extensions assigned to a PBX which does not have access to the centrex facilities except that they must have station identification on charge calls.

20.04 The PBX may be assigned either a separate office code or groups of 4- or 5-digit numbers within an office code which is shared with other PBX or regular customers.

20.05 At the present time, only the PBX attendant can transfer calls.

21. CENTRALIZED ATTENDANT FACILITIES

21.01 These facilities enable a centrex customer to use a centrally located attendant in a primary marker group for handling LDN and transfer calls for all phase III centrex marker groups which serve the customer.

21.02 These facilities also enable intracustomer group calls to be handled between marker groups, as well as within the same marker group.

21.03 Either telephone consoles or 608-type switchboards may be used by the attendant.

22. EQUIPMENT REQUIRED ON PBX CUSTOMER PREMISES

22.01 This part covers the equipment required on the PBX customer premises when served by the centrex facilities.

22.02 Although the bulk of the equipment used for phase III centrex is located on the telephone company premises, certain equipment must be located on the customer premises. This equipment furnishes operation with the attendant facilities and the key telephone sets associated with the individual extensions.

A. Equipment Associated With the Attendant Facilities

22.03 The following equipment is associated with the attendant facilities:

(a) Telephone console

(b) Traffic supervisory cabinet

(c) 10V dc power supply

(d) Lamp repeating units

(e) -48V dc power supply.

B. Telephone Console

22.04 The telephone console enables the customer attendant to handle listed directory number (LDN) calls, to manually transfer calls, and to provide other assistance as required.

22.05 Two types of consoles are available. The 1B-type console has a capacity of 12 trunk loop and pickup keys, and the 2B-type console has a capacity of 30 trunk loop and pickup keys.

22.06 Each console is associated with a position and position loop circuit, SD-27695-01, located in the No. 5 crossbar marker group. Six loops of a console are required for association with a position circuit, and the remainder may be used for tie trunks, conference circuits, and other similar types of circuits.

C. Traffic Supervisory Cabinet

22.07 The traffic supervisory cabinet, J58837BN, enables the PBX customer to obtain supervision of the traffic handled by a maximum of ten consoles.

22.08 This cabinet is a desk-top unit containing the lamps and other apparatus for observing call-waiting signals, night-closing conditions, and the availability of positions.

23. REFERENCES

Bell System Practices

Section 819-005-150

Section 958-120-100

Dial Facilities Management Practices

Division H, Section 5a

NO. 5 CROSSBAR OFFICE ARRANGED FOR CENTREX SERVICE

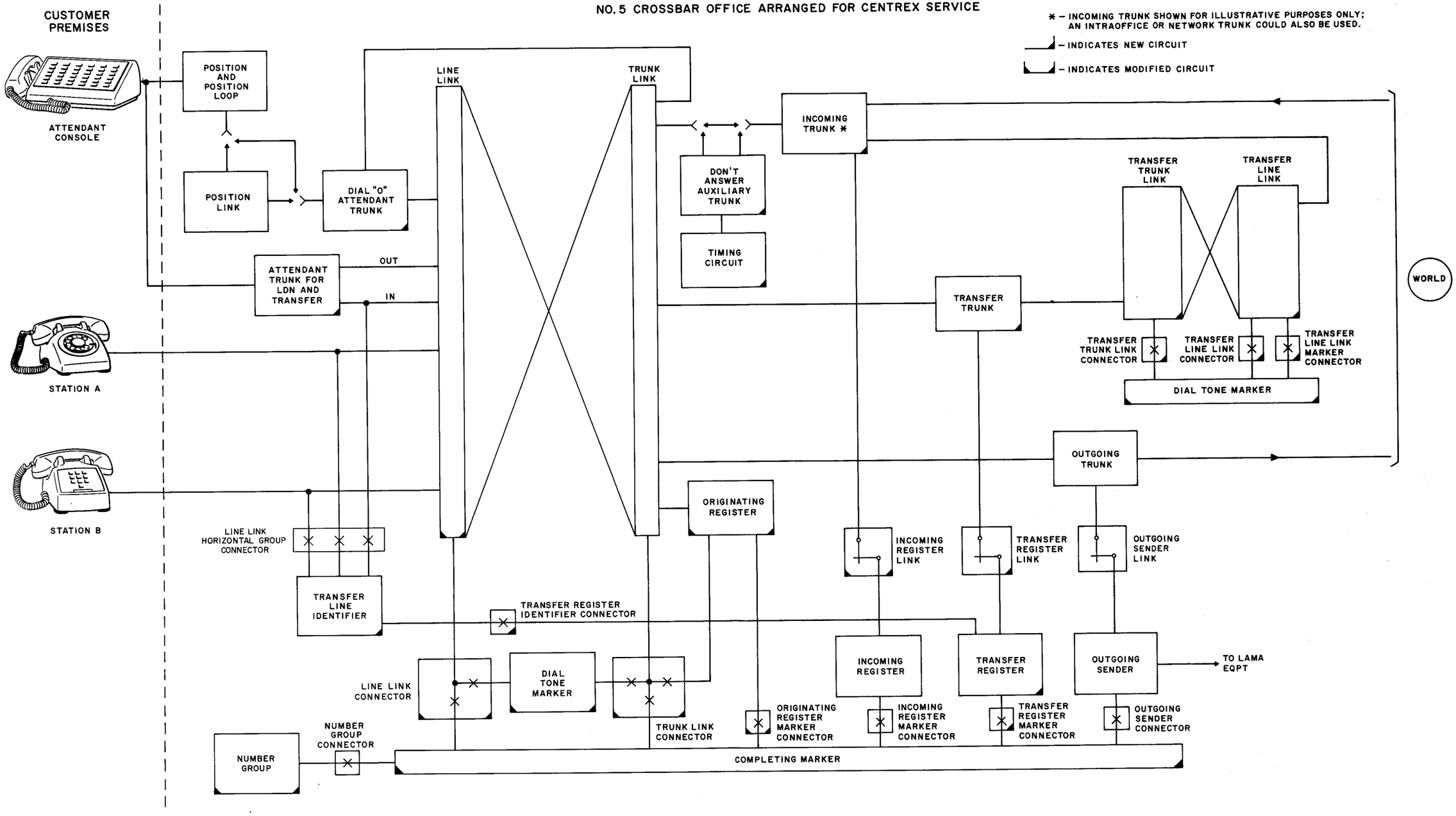

Fig. 1—Phase III Centrex Office