CENTREX SERVICE

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GENERAL

Centrex service for step-by-step P.B.X.'s where consoles are provided for the attendant facilities can be implemented with interim standard arrangements now available. These interim arrangements will be standardized at a later date but the operating features will, in general, remain the same. These arrangements permit direct inward dialing (DID) to the stations of the Centrex by trunking through a crossbar tandem, a No. 5 crossbar office equipped with tandem features, or from the selector levels in step-by-step central offices. It will be possible to route all outgoing traffic from the Centrex directly through a crossbar tandem arranged to handle the traffic, through the local central office as it exists today, or a combination of these two arrangements can be applied.

These interim arrangements use modified 701B P.B.X. facilities for the in-dialing train. They can be used in conjunction with existing 700C, 701A, 701B and 702A type P.B.X. systems to provide DID. These facilities can be used for new Centrex installations located on the customer's premises and for centralized Centrex arrangements located on Telephone Company owned or leased premises. The attendant position used with this system is the 621A console.

CENTREX ARRANGEMENTS

The basic Centrex features of this system will be described briefly to present the over-all picture. The major items of equipment and their functions will be described in detail under "Equipment Elements". The attendant console will be described in Section 5 of these Notes. Figure 1 is a traffic schematic of the overall system.

DID Arrangements (Figure 2)

A one-way incoming trunk group from the tandem or the step-by-step central office must be established to the Centrex for direct inward dialing (DID) to the stations. Both DID and listed number traffic can be routed over this trunk group. It is also possible to restrict this trunk group to DID traffic only.

An incoming switching train must be established at the Centrex. It can be arranged to receive either 3 or 4 digits from the originating office for DID traffic. This train consists of incoming 1st selectors, incoming 2nd selectors (if required) and incoming connectors. Under certain conditions, described in the "Equipment Elements", the incoming and local connectors can be combined into a common connector group. An in-dialing trunk circuit, arranged to return answer supervision to the originating office on called station answer, is associated with each incoming 1st selector.

This switching train is also utilized in completing listed number, DID transfer and other types of attendant completed traffic.

DID Transfer Arrangements (Figure 3)

The in-dialing trunk circuit will recognize a switch-hook flash from the called DID station as a request for transfer and will route the call to the attendant. Attendant access is through a call distributor circuit which connects the in-dialing trunk to a key termination on an idle, occupied attendant console. After the attendant has sufficient information to complete the call to the new station, she releases the switch train connection to the station originating the transfer request. She then proceeds to set up the connection to the new station, re-using the switch train for this purpose. Unless it is required that the attendant remain in the connection after called station answers, the call distributor and the position will automatically release on called station answer. The established connection will be as if the call had been directly in-dialed initially. Subsequent transfers will be handled in a similar manner.

Listed Number Arrangements (Figure 3)

The incoming trunk group from the tandem or the step-by-step central offices can handle both listed number and DID traffic. It is also possible to retain the listed number traffic in the local central office.

When the listed number traffic is combined with the DID traffic (Fig. 3a), the zero level of the incoming 1st selector should be assigned for the listed number calls. The selector will find all terminals busy and step to the 11th rotary position. The incoming trunk will hold the selector off-normal for a short interval to permit any additional digits received to be absorbed. It then sends a request to the incoming trunk to call for the attendant position. Connection of the incoming trunk to the attendant position is through the call distributor. The attendant completes the call to the desired station using the DID switch train for this purpose. Unless it is required that the attendant remain in the connection after the called station has answered, the call distributor and the position will automatically release on called station answer. The established connection will be as if the call had been directly in-dialed initially. Recalls by the called station will be the same as DID transfer requests.

Listed number calls routed from the local central office (Fig. 3-b) will terminate at the Centrex on a new central office trunk associated with an incoming selector. The connection to the attendant position will be through the call distributor. The associated selector will be integrated into the DID train and completion to the called station occurs as described above. Recalls by the called station will be the same as DID transfer requests.

Outgoing Arrangements (Figure 4)

Three arrangements are available to handle outgoing traffic from the Centrex. They are—

1. Route all outgoing traffic through the local central office. Normal central office trunks would apply.
2. Route all local, service code and DSA or toll operator traffic to the local central office. Establish a new outgoing trunk group to crossbar tandem for all DDD traffic.
3. Route all outgoing traffic through a crossbar tandem modified to accept it. An outgoing trunk to tandem is available for this purpose. Joint holding on calls routed to the DSA or toll operator will be possible.

These arrangements can be dial selected by stations from the levels of the local 1st selectors. Attendant access will be from the levels of the attendant outgoing selector associated with the attendant (dial 0) trunk and the levels of the two-way attendant loop used by the attendant to establish a call in both directions. A selecting digit will be required to provide access to the outgoing trunk group or groups from the levels of these selectors.

Intercepting Arrangements

It is recommended that all calls to vacant numbers in the block of numbers assigned to this type of Centrex as well as any vacant levels in the in-dialing train be routed to a recorded announcement on a non-charge basis. 7A record announcement facilities can be provided for this purpose.

Calls to changed numbers may be routed to either the recorded announcement, or, for a limited period, to the attendant for completion. When these calls are routed to the attendant, answer supervision must be returned to the originating office.

Night Closing Arrangements

With DID to the stations of a Centrex, there is no longer a requirement for night service connections to selected stations to provide them with incoming service. There is, however, a requirement on the part of most customers for some night arrangement to provide for the answer of any listed number calls after hours.

When both DID and listed number traffic are combined in the same incoming trunk group, the operation of the night closing key (NITE) at the console does several things. These are—

1. Removes the busy from the terminals of level "0" on the incoming first selector, and allows a listed number call to stop on an idle terminal.
2. Allows the two-way attendant loop terminations on the console to be activated at the key terminations on a key telephone set modified for this purpose. These two-way attendant loops appear on the terminals of level 0 of the incoming 1st selector. During normal operating periods, they are available to attendant originated calls only. The night "attendant"

can extend the incoming call forward to the desired station but cannot be recalled after his receiver is on the switch hook.

3. Disables the transfer feature in the in-dialing trunk.
4. Removes the position available signal in the call distributor and prevents any calls through it.

The operation of the night closing (NITE) key when listed number traffic is routed over a separate trunk group from the local central office results in slightly different arrangements. These are—

1. Disables access to the call distributor for the incoming central office trunk.
2. Connects the incoming central office trunk directly to the keys of a key telephone set provided for this purpose. In this instance, the night "attendant" will be able to answer only. No completion of the call forward is possible.
3. The transfer feature of the in-dialing trunks is disabled.
4. Removes the position available signal in the call distributor and prevents any calls through it.

A combination of these above arrangements are possible when listed number traffic is combined with the DID traffic and incoming FX lines are provided. In this case the listed number traffic can be extended to the desired station and incoming FX calls answered only.

EQUIPMENT ELEMENTS

Incoming DID Train (Figure 2)

The in-dialing train includes the in-dialing trunk, the incoming 1st selector, incoming 2nd selector (if required) and the incoming connector. This train requires 4-wire switches to provide the attendant with visual indications of called station ring, overflow, and called station busy. If these visual supervisory indications can be omitted, 3-wire switches can be used but the attendant will receive tones only.

The **in-dialing trunk** is arranged to return answer supervision to the calling office on called station or attendant answer. It recognizes a switch-hook flash from the called station as a transfer request and routes the call to the attendant. In this case a three-way talking path is established between the calling party, called party and the attendant. It receives a signal from the incoming 1st selector on listed number calls and routes the call to the attendant. It controls the denial of specified levels on the incoming 1st selector to incoming DID traffic but will permit attendant completion to these levels. Audible ring is returned to the calling subscriber while waiting for an attendant answer. The transfer feature is disabled when the night closing arrangements are in effect. The trunk controls the established connection during conversation and will release the train upon calling subscriber disconnect.

The **incoming 1st selector** is controlled in many of its features by the incoming trunk. This selector provides switching access to the balance of the DID train. It can be arranged to deny specified levels to DID traffic. A busy tone will be returned to the calling subscriber when these denied levels are reached. It will signal the incoming trunk when a listed number call is routed to the assigned level (this will generally be level 0). The terminals of this level will be busy to incoming traffic. However, the two-way attendant loops will be terminated on these terminals and will be available to attendant calls only during normal hours. When the night closing features are in effect, the terminals of the listed number level will be used to route listed number calls to night telephones. The selector also has been arranged to absorb the initial digit for attendant completion in 3-digit systems, since a 4-digit station number will generally be supplied to her.

The **incoming 2nd selector** is similar to local 2nd selectors except for the modification to 4-wire operation.

The **incoming connector** is arranged for terminal hunting as required. It will return audible ring to the calling party and a 30 IPM "wink" to the attendant position while the called station is being rung. It will return a busy tone to the calling subscriber on DID calls if the called station is busy. It is also arranged to **"camp-on"** a busy station on attendant completed calls and a 60 IPM flash and busy tone is returned to the attendant. She then operates the CAMP-ON key on her position. If another call is not already camped-on the busy station, the busy tone is removed and the camp-on feature is in effect. The 60 IPM flash is retained on

the attendant position as an indication to the attendant that camp-on is in effect and that subsequent reports are required if the busy condition contines for any duration. The connection will be cut through automatically and called station rung when the station disconnects from the previous call. If another call is already camped-on, the tone will not be removed when the CAMP-ON key is operated, and camp-on is denied. This feature is controlled over the "sleeve" connection and may be provided in 3-wire systems but no visual indication of the busy will be received at the attendant position. Busy tone will be heard however and will be removed when camp-on is allowed.

An overflow in the switching train will return a busy tone to the calling subscriber and on attendant completed calls, a 120 IPM flash to the attendant position. Busy tone only, no flash, will be returned to the attendant if 3-wire systems are used.

Call Distributor

There are two versions of the call distributor available. These are—

1. A call distributor arranged to operate with more than 4 consoles for a single customer. It is also required when more than one customer is included in the same Centrex.
2. A call distributor arranged to operate with a single customer when no more than 4 console positions are required.

The following trunk equipments can be connected to the call distributor—

In-dialing trunk arranged for transfer

Attendant trunk (dial "0")

Incoming central office trunk for listed number traffic only

Incoming central office trunk for FX line application

Incoming automatic tie trunks

Detailed information regarding these call distributors is covered in Section 5-d.

Register Sender and Register Sender Link

The attendant completes calls routed to her by dialing the desired termination. Her position is equipped with a pushbutton dial rather than a rotary dial. This method of operation requires the association of a register sender with the position to receive, store, and outpulse the digits keyed. The position is connected to a register sender through a register sender link circuit.

For normal operation, the attendant operates her start (ST) key to request a register sender. The RL lamp lights to indicate the register sender is attached and that pulsing can start. She then proceeds to key the necessary digits. The attendant must always operate the END key to indicate the end of pulsing.

The **register sender link** can serve a maximum of 10 register senders and 20 positions. It is divided into a preference unit and 4 group and select units. One group and select unit will be required for the first 5 attendant positions, another for the next 5 positions or a portion thereof, and so on. Each group and select unit provides access to a maximum of 10 register senders. The register senders are multipled to other group and select units as required. The group and select unit uses a 100 point 6-wire crossbar switch to connect the position and the register senders. The register senders are on the horizontals of the switch. The positions are on the verticals and require 2 verticals per position. The register sender link connection is held under control of the position circuit. The position circuit releases the link connection when the register sender has completed its functions.

The **register sender** is arranged to receive 2-out-of-5 DC pulsing from the attendant's push button dial. It can store a maximum of 7 digits at one time. It will start outpulsing the digits on a dial pulse basis after the 1st digit has been received. The register sender can outpulse dial pulses on a 10 PPS basis or on a 20 PPS basis. Twenty PPS pulsing is applicable on outgoing "dial 9" calls to the local central office only.

The Attendant will dial "9" as the initial digit on outgoing calls except when DDD calls are routed to crossbar tandem over a separate trunk group.

If the call is routed to a local central office, the RL lamp on her position will flutter as a signal for her to wait until the central office equipment is connected. The RL lamp will be lighted steadily when it is connected (the digit 9 was outpulsed to obtain a central office trunk), the register sender re-cycles and the attendant continues keying the desired termination. If more than 7 digits are required to complete the call, the register

sender will again re-cycle to permit storage of the digits over 7 in those digit locations which have been outpulsed.

If the call is routed directly to crossbar tandem, and "9" has been dialed as the directing code, the attendant will receive the flutter on the RL lamp. She must then release the original register sender by operating the END key. She will hear dial tone when the crossbar tandem sender is attached. She then seizes another register sender to complete her pulsing.

If the call is routed directly to crossbar tandem for DDD traffic only and a digit other than "9" has been dialed as the directing code, the RL lamp will not flutter. After a short interval to allow for trunk connection, the attendant can proceed as described in the previous paragraph.

Register sender equipment can be shared by the attendant teams of more than Centrex customers.

Console Position Circuit and Attendant Release Loops

The **position circuit** provides the attendant with means of completing calls, originating calls, making the position busy, and signalling for supervisor assistance. It also supplies the audible alarm on incoming calls, talking battery for the attendant, and visual indications of position available or busy. It signals the call distributor when the position is available to receive calls.

The **attendant release loops** serve as a connecting link between the position circuit, the call distributor, and the register sender link. A maximum of 6 loops are provided per position. These circuits function to provide most of the operating features at the console. These features are—

1. Flashing source lamp on incoming calls
   a. Directory number and foreign exchange—60 IPM
   b. Transfer request—120 IPM
   c. Dial "0"—120 IPM
2. Station supervision on destination lamp
   a. 30 IPM wink for ring
   b. 60 IPM flash on busy
   c. 120 IPM flash on overflow in switch train
   d. Steady lamp on called station answer
3. Provide holding of loop on position
4. Permit attendant to ring or flash source on an incoming call
5. Permit attendant to receive ring back from toll operator on outgoing calls when call is held on position
6. Permit splitting of connection to announce incoming calls
7. Permit attendant to camp-on a busy station
8. Provide flashing recall from called station when loop is held on position
9. These loops are individual to one position only

Two-Way Attendant Loop (Figure 5c)

This circuit is used by the attendant to originate a call in two directions. Its primary uses are the completion of delayed toll calls and conference calls. It can also be terminated at a telephone set when night closing arrangements are in effect and can in this case be used to extend a listed number call to the desired station.

These two-way loops will generally be terminated in only one position of the team. A minimum of 5 would be required if a conference circuit is provided with the installation since one loop is used in establishing each leg of the conference connection. A call may be extended to these loop terminations from other positions from the levels of the incoming 1st selectors and the attendant out selectors. They can be selected by the attendant occupying the position in which they terminate by operating the associated loop key.

Two selectors, a FRONT and a REAR selector, are associated with each two-way loop. The selectors should be mounted on the same shelf. Stations, C.O. trunks, crossbar tandem trunks, foreign exchange trunks, tie lines, conference circuits, and the busy verification train (if provided) are available from the bank multiple. To prevent improper tandem application of these facilities, the FRONT selector should be arranged to deny selected levels (C.O. trunks, FX trunks, and trunks to crossbar tandem).

Attendant Trunk (Figure 5a)

This circuit is provided to permit the routing of dial "0" calls to the attendant console from the local selector train. Access to the attendant release

loops is through the call distributor. A selector is associated with this trunk to permit forward completion of the call and provide access to the 2-way attendant loops. Stations, central office trunks, foreign exchange trunks and tie lines are available from the levels of this selector. Audible ring is returned to the calling station until the attendant answers. This trunk and the established switching path is held under control of the calling subscriber.

If the attendant position is released from the connection after it is established forward, a switchhook flash by the calling party will **not** re-connect the attendant position.

FX or Central Office Trunk (Figure 5b)

This circuit is arranged for incoming or two-way operation. It can be used for foreign exchange trunks or can be used for listed number trunks terminated in the local central office. A selector is associated with each trunk to provide access to the stations and tie trunks. Access to the attendant can be provided through the call distributor. Audible ring is returned to the calling subscriber until the attendant answers on incoming calls and answer supervision is returned to the originating office on attendant answer. Calling party control is also provided. If this trunk is used for outgoing access, a toll denial feature can be operated when the toll operator is connected and busy tone will be returned to a restricted station. On incoming calls, the called station can originate a transfer request and the attendant can be re-connected through the call distributor.

This trunk can also be terminated directly on a key on the attendant position and not connected to the call distributor. An application of this in the Centrex installation is Foreign Exchange trunk terminations where attendant control and attendant barge-in is required. The incoming call would terminate directly on the assigned key and the attendant would complete forward over the associated selector. The call would remain on her position for duration of conversation and automatically release on calling party disconnect. Splitting, camp-on, etc. would be possible on this connection.

The attendant completes calls over these trunks in two-way—(1) extends the call on a dial selection basis through the switch train, or (2) she selects the trunk by operating the key and completes the call on a call-back basis. When the latter method is used, she operates the KPR key, and when the register sender is attached, key pulses the distant termination. To reach the station to be connected, she proceeds in the normal manner, using the associated selector, to establish the connection.

Outgoing Trunks to Local Central Office or Crossbar Tandem

Standard central office trunks, presently available, can be used for station dial selected outgoing calls (dial "9"). However, if these trunks are used in common for both stations and attendants when the 621A console is provided, they must be modified to return a "stop pulsing" signal to the register sender for attendant completed calls until the central office is ready to receive dial pulses. At that time a signal is received to indicate that pulsing can continue. If a separate trunk group is provided for attendant access only, trunks in this group will require modification and no change is required in those available to the stations.

It is possible to provide outgoing service through a crossbar tandem instead of the local central office if the necessary tandem modifications have been provided. A new **outgoing trunk to crossbar tandem** is available. These can be substituted for the standard central office trunks if this arrangement is desirable. Dial tone will be returned when the crossbar tandem is ready to receive dial pulses. On attendant calls over these trunks, no "stop pulsing" signal will be received. She will have to key "9," release the register sender, receive dial tone and reseize a register sender to continue pulsing.

Tie Trunks

Dial repeating tie trunks applicable with this system are the standard facilities available today. They can be used for one-way or two-way operation as required. When associated with this Centrex System, the incoming selector levels will be multipled to corresponding levels of the local first selector. Outgoing access to these tie trunks is on a dial selected basis from both stations and the attendant consoles.

Automatic tie trunks (Figure 5d) can be used for one- or two-way operation as required. An incoming selector is associated with each trunk for the completion of incoming calls by the attendant. They can be arranged to gain access to the attendant through the call distributor or they can be terminated directly on a key on the console. When connected to the call distributor, they are arranged to route a transfer

request to the attendant. All other normal operating features also apply. When connected directly to a key, the call remains on the position for duration of conversation. Supervisory signals will be received and the camp-on feature can apply. Outgoing attendant calls on these trunks can be extended on a dial selected basis through the switch train. Outgoing calls from the attendant when the direct key selection is used must be handled on a call-back basis. The call is started by operating the key. The station is connected through the associated selector. Stations can gain access to these trunks on a dial selected basis if desirable.

Two-way ringdown tie trunks (Figure 5e) are also available. These circuits terminate on a key at the console only. Every outgoing call on these circuits is handled on a "call back" basis, i.e., the attendant must recall the station originating the request for connection. Access to the stations is through an associated selector. The camp-on feature can be provided with this circuit. Selector level access is not provided for these trunks.

Conference Circuit

This is a dial conference circuit for use by the attendant when the 621A console is provided. It provides for a conference connection between a maximum of 5 stations; 4 stations and one central office or tie trunk; or 3 stations and 2 central office or tie trunks. The circuit is equipped with a voice repeater to increase the volume level in the talking circuit. Access to this conference circuit is from a level of the attendant two-way loops only (Fig. 5-c). One two-way attendant loop is required to set up each leg of the circuit.

Presently available dial selected conference circuits can also be provided in the local switching train. These will not be available to the attendant.

Busy Verification (Special order only)

Busy verification features may be provided for attendant use if required. A no-test switching train must be provided with no-test connectors installed in each connector group. Operator access is provided from one position only—the special position with the two-way attendant loops. Access to the no-test train is from a terminal on the level of the selector of the two-way loops. It is recommended that this be the 1st terminal on the level assigned to the conference circuit. It will be busy until a Busy Verification (BV) key, located in this special position only, is operated. This removes the busy and opens the no-test train for use.

Traffic Registers

All traffic registers available with standard 701B PBX equipment are applicable with these facilities. In addition, Peg Count registers may be associated with the indialing trunks arranged for tranfer to score individually (1) total DID calls, (2) total listed number calls, and (3) total transfer calls. Peg count and ATB registers can be associated with the 2-way central office trunks (with selectors). ATB registers can be provided for the attendant trunks (with selectors.)

ENGINEERING RECOMMENDATIONS

Engineering recommendations for this Centrex systems are covered below for all items of equipment involved.

	Item	Recommendation
1.	Incoming trunk group—Did and Listed Number	Table 20
2.	" " " —DID only	Table 20
3.	" " " —Listed Number only	Table 20
4.	Incoming second selectors (if required)	Table 10
5.	Incoming connectors	Table 10
6.	Combined group of local and incoming connectors	Table 10
7.	Register Sender Link—(10 register senders and 20 pos. max.) Group and select unts	1/5 pos.
8.	Register Senders	
	1 pos (BH requirement)	1 reg. sender
	2 pos " "	2 " "
	3 pos " "	2 " "
	4 pos " "	3 " "
	5 pos " "	4 " "
	6 pos " "	5 " "
	7 pos " "	5 " "
	8 pos " "	6 " "
	9 pos " "	7 " "
	10 pos " "	8 " "
9.	Attendant trunks	Table 20
10.	Foreign Exchange Trunks	as req'd.
11.	Tie trunks—all types	" "
12.	Outgoing trunks to central office	Table 20
13.	Outgoing trunks to crossbar tandem	Table 20
14.	Local train equipment will be engineered as specified in the T.E.P. for 701 type P.B.X.'s.	

Attendant console and loop requirements will be covered in Section 5 of these Notes.

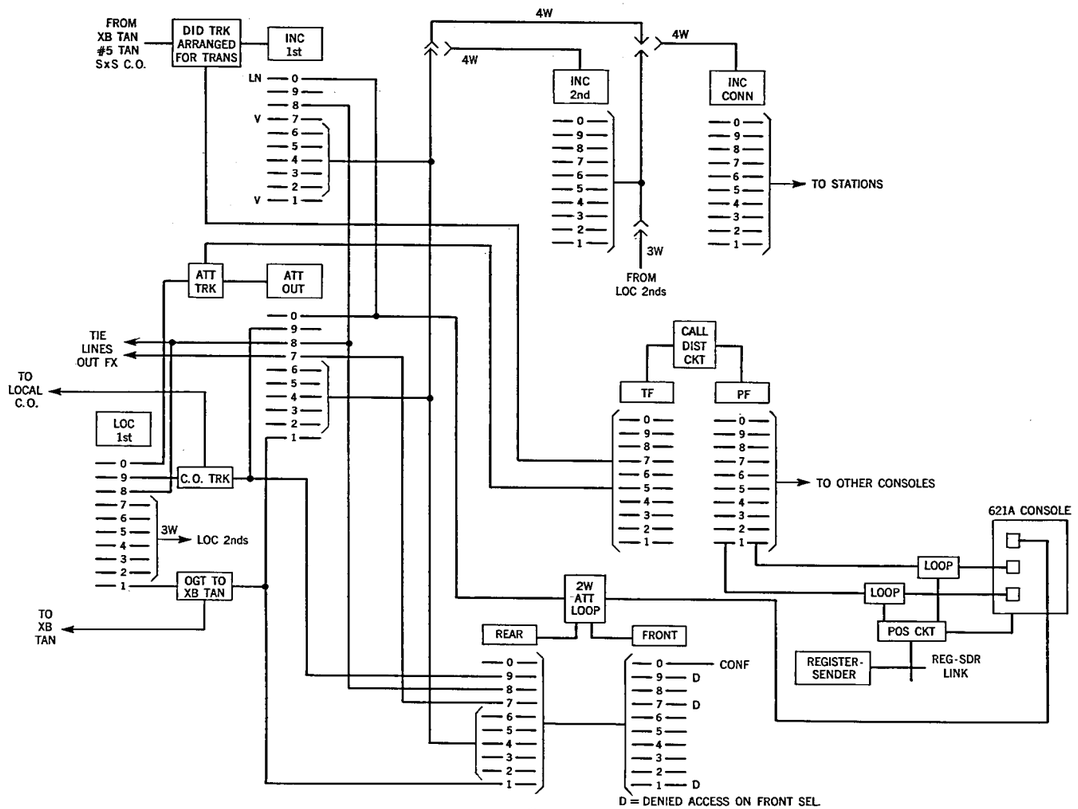


FIG. 1
STEP-BY-STEP CENTREX
CONSOLES FOR ATTENDANT FACILITIES
(TYPICAL)

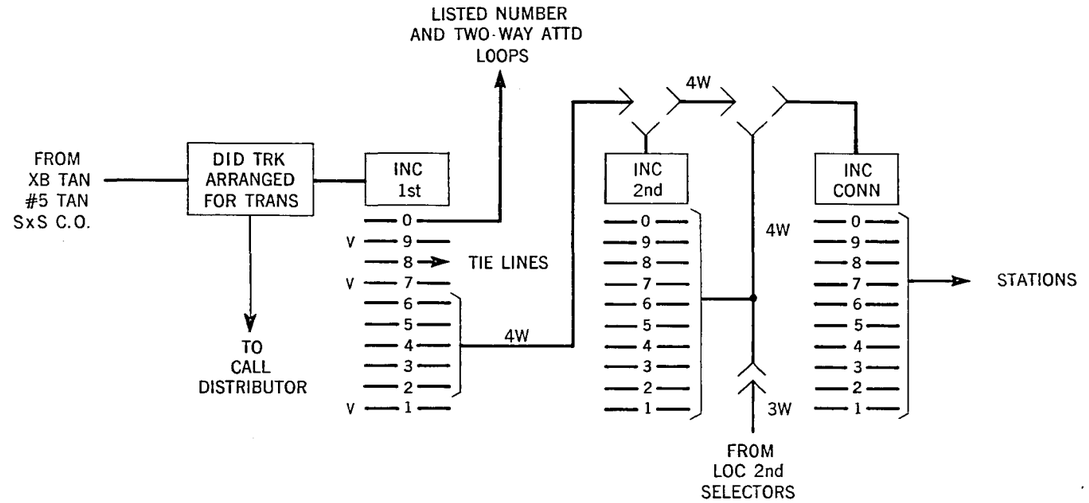
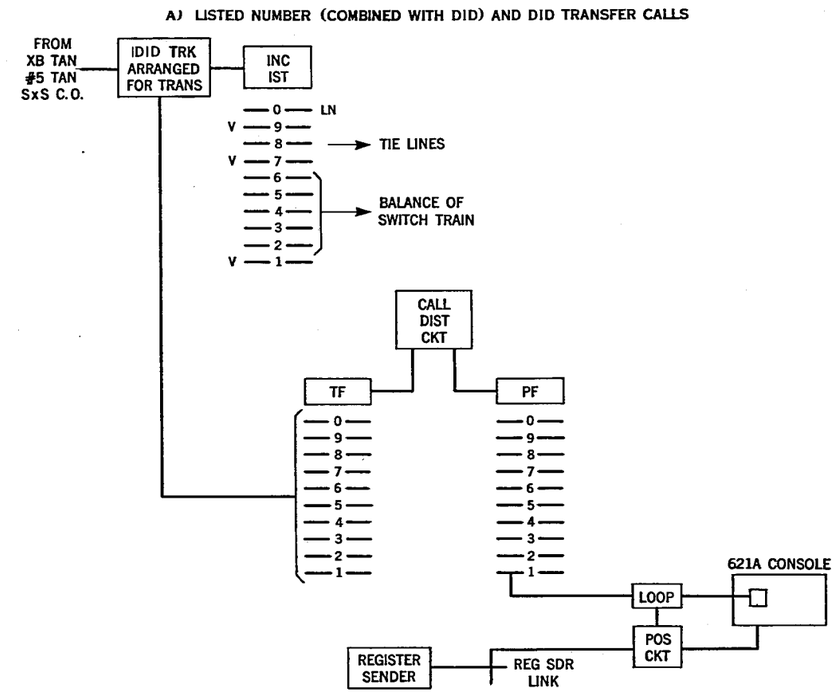


FIG. 2
DIRECT INDIALING TRAIN
(TYPICAL)

A) LISTED NUMBER (COMBINED WITH DID) AND DID TRANSFER CALLS



B) LISTED NUMBER (FROM LOCAL C.O.) AND DID TRANSFER CALLS

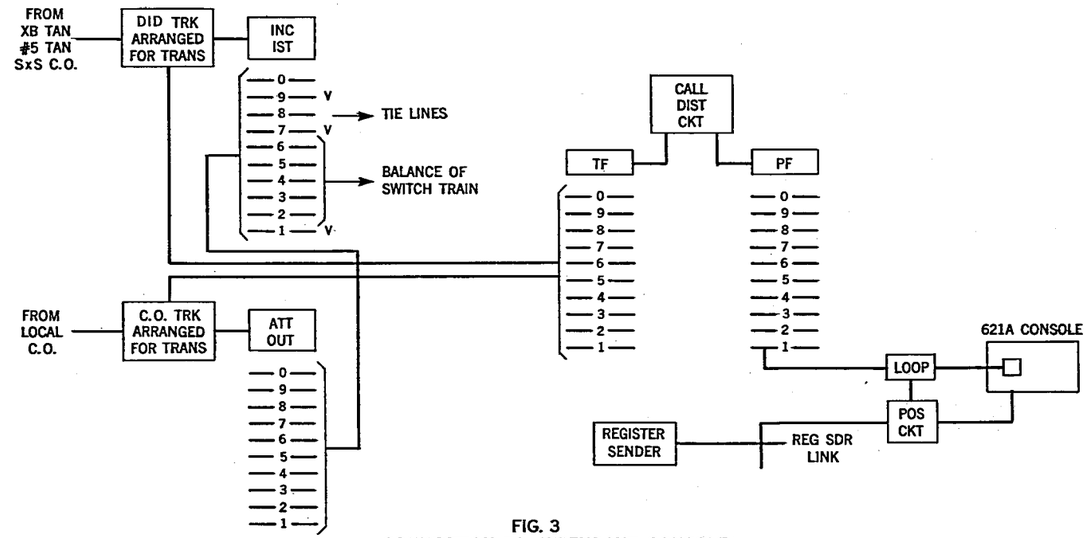
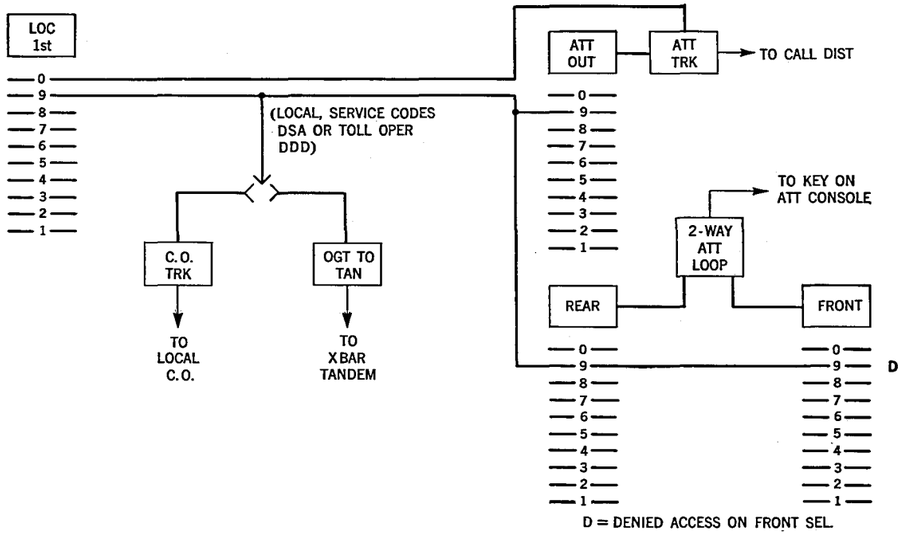


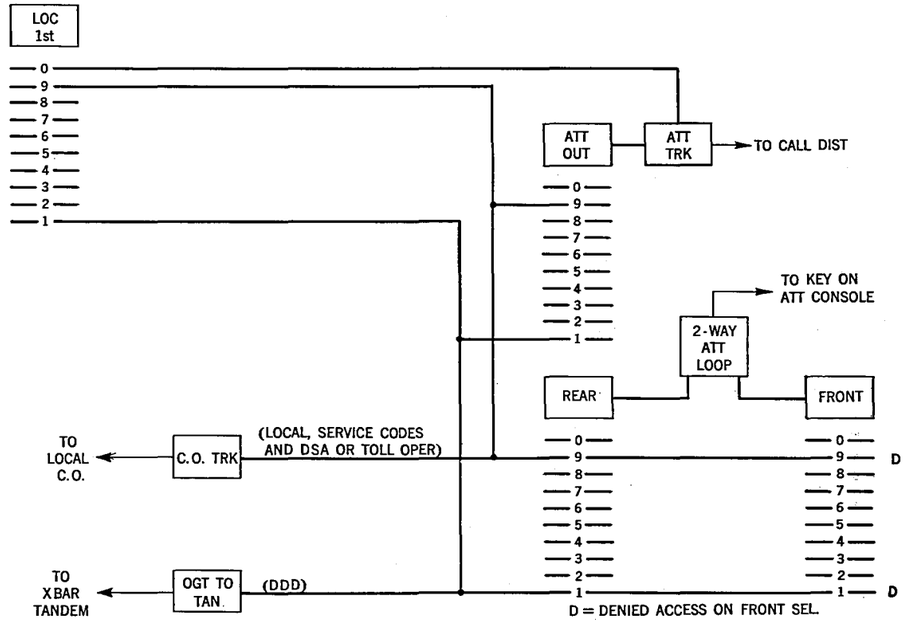
FIG. 3
CONNECTION TO ATTENDANT CONSOLE
(TYPICAL)

A) OUTGOING THROUGH LOCAL CENTRAL OFFICE OR CROSSBAR TANDEM



D = DENIED ACCESS ON FRONT SEL.

B) OUTGOING THROUGH LOCAL CENTRAL OFFICE AND CROSSBAR TANDEM



D = DENIED ACCESS ON FRONT SEL.

FIG. 4
OUTGOING ARRANGEMENTS
(TYPICAL)

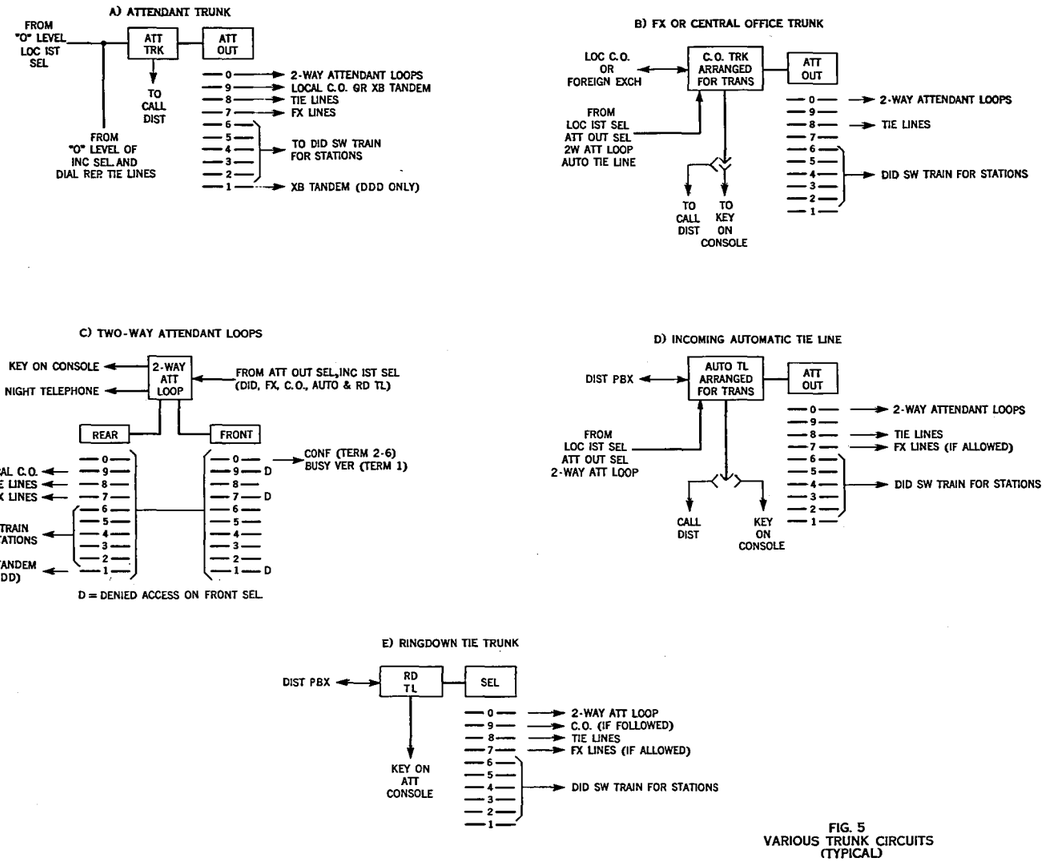


FIG. 5
VARIOUS TRUNK CIRCUITS
(TYPICAL)