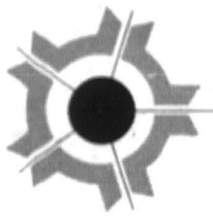

CENTREX
SERVICE

TRAFFIC ENGINEERING NOTES

MAY 1961

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
Operations Department
New York

PRINTED IN U.S.A.

Traffic
Engineering
Notes

CENTREX SERVICE

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May, 1961

TRAFFIC ENGINEERING NOTES

CENTREX SERVICE

GENERAL

Section 1

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
Department of Operations
May, 1961

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CENTREX SERVICE

Centrex is a new private branch exchange development designed to improve the service features available for our business customers. These service features have been divided into two categories—those included in the basic Centrex offering and those provided on an optional basis. A list of the features in each category will follow. Some of them will not be available in all of the equipment arrangements developed to provide this service. Those excluded for a particular equipment arrangement will be defined in the section of these Notes relative to that arrangement.

Service Features Included in Basic Centrex Offering

1. Basic private branch exchange service including—
   a. Attendant facilities individual to each Centrex customer
      1. Consoles
      2. 608A cord switchboards
      3. Existing cord sfitchboards (for some systems)
   b. Three, four, or five digit intercom dialing between stations of the same Centrex customer (variations in systems)
   c. Hunting groups
   d. Restricted stations — incoming, outgoing, or both.
   e. Night closing arrangements for the listed number of the Centrex customer.
2. Direct inward dialing (DID) to the stations of the Centrex customer.
3. Individual station identification on outgoing long distance calls—
   a. Automatic identification on DDD calls.
   b. CAMA operator identification on DDD calls.
   c. Station billing on calls routed to a toll operator.
4. Transfer of a DID call to another station associated with the same Centrex customer.
5. Intercepting arrangements for vacant numbers within the number assignment allocated to a Centrex customer including—
   a. Recorded announcement (non-charge supervision)
   b. Attendant (charge supervision)

Optional Service Features (individual to each Centrex customer)

1. Tie line operation
   a. Dial repeating
   b. Automatic
   c. Ringdown (limited application)
   d. Tandem switching
2. Foreign exchange lines
3. Conference circuits
   a. Attendant controlled
   b. Dial selected (in some systems only)
4. Toll restriction
5. Connection to customer's paging systems
6. Dictation trunks
7. Busy verification by attendant (some systems only)
8. Split connections to announce calls (some systems only)
9. "Camp-on" busy stations on attendant completed calls (some systems only)

Several equipment arrangements have been developed to provide Centrex service. These include both No. 5 crossbar and step-by-step equipment. To a customer, all equipment arrangements provide Centrex service. For Telephone Company clarification, however, the equipment arrangements have been classified into two groups—Centrex CO and Centrex CU.

Centrex CO locates the dial switching equipment on Telephone Company owned or leased premises. Each Centrex station will be served by a direct line on line facilities in this system. Normal station equipment and the attendant facilities will be located on the customer's premises. Floor space and power provided by the customer for a normal dial P.B.X. will not be required with this

arrangement. The dial equipment available for this type can be No. 5 crossbar or step-by-step equipment.

Centrex CU locates both the dial equipment and the attendant facilities on the customer's premises in floor space provided by the customer. This arrangement will usually be provided with 701B P.B.X. step-by-step equipment. It permits the addition of Centrex service to an existing dial P.B.X. and the retention of all the service features now in use by that customer.

No. 5 Crossbar Centrex will, in general, provide Centrex CO service. This system can terminate up to 100 Centrex customers or can combine a fewer number of Centrex customers with regular subscribers. Some of the latest service offerings, such as WATS, can also be terminated. Switching and common control equipment capacities as well as the route screening capabilities of the common control equipment will be controlling in the various types of subscribers included. All subscribers use in common the incoming and outgoing trunking facilities provided for this system. Multi-frequency, dial, and revertive pulsing incoming trunks can be provided. Automatic number identification for all subscribers, including individual Centrex stations, is possible since LAMA facilities will be included.

Step-by-Step Centrex can provide either Centrex CO or CU service. The Centrex CO arrangements can be provided to serve both regular and Centrex customers in the same unit. In effect, a portion of a SXS central office can be assigned for Centrex application, the balance, used for regular service. Incoming traffic to this system can be routed over a common trunk group with distribution occurring at the 4th selectors for Centrex or regular subscriber termination. Outgoing trunks to other local central offices, toll operator, direct distant daling, etc. can be used in common.

The dial equipment, both the DID train and the local train, must be individual to each Centrex customer. Crossconnection flexibility is provided to permit the addition or removal of equipment as required. Outgoing dial "9" trunks must terminate on the regular subscriber line facilities. Outgoing trunks to crossbar tandem can be common to both regular and Centrex customers. If ANI facilities are provided for the regular customers, these can be used by the Centrex customers if No. 1 or 350 type SXS equipment is provided for the switching train.

Centrex CU arrangements are individual to each Centrex customer. Incoming and outgoing traffic can be routed as described above except that it is individual to that customer only. At the present time only CAMA operator identification on DDD calls is available.

The details of the various Centrex systems available are covered in the following sections of these Notes. No attempt has been made to classify any one system specifically for CO or CU application.

TRAFFIC ENGINEERING NOTES

CENTREX SERVICE

NO. 5 CROSSBAR CENTREX

Section 2

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
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NO. 5 CROSSBAR CENTREX

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NO. 5 CROSSBAR CENTREX WITH

622A CONSOLES AS THE ATTENDANT FACILITIES

Section 2-a

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
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CENTREX SERVICE

NO. 5 CROSSBAR CENTREX WITH 622A CONSOLES AS THE ATTENDANT FACILITIES

GENERAL

No. 5 crossbar developments are under way to permit the termination of P.B.X. extensions directly on central office line equipments to operate with 622A consoles as the attendant facilities. The No. 5 crossbar switching equipment can be located on Telephone Company owned or leased premises or on the customer's premises in floor space provided by the customer. The following basic features are included in the Centrex development with consoles as the attendant facilities:

1. Ability to identify 100 different P.B.X. groups or combination of P.B.X. groups and regular subscribers.
2. 622A console attendant facilities individual to each Centrex subscriber.
3. 4 or 5-digit intra-P.B.X. dialing.
4. Direct inward dialing to P.B.X. extensions.
5. Individual extension identification on DDD calls through LAMA, ANI-CAMA, or OI-CAMA.
6. Fully restricted or unrestricted incoming service.
7. Outgoing service can be fully restricted, unrestricted, or semi-restricted.
8. Night closing arrangements.
9. Extension tranfer by the attendant in response to a switchhook flash.
10. Individual intercept arrangements for each P.B.X.
11. Tie line and FX arrangements.
12. Conference circuits.

The following notes describe the method of operation and the necessary traffic engineering considerations for a No. 5 crossbar Centrex office serving a number of P.B.X. groups with 622A consoles as the attendant facilities individual to each P.B.X. These Centrex developments have not as yet been standardized and are subject to change both in method of operation and in traffic engineering requirements.

CENTREX ARRANGEMENTS

Line Link Frames—Line Equipment

Line link frames now being shipped have the standard arrangement for the identification of 100 classes-of-service. Listed number, transfer, conference, attendant, tie line and other miscellaneous Centrex calls may involve more than one switch through the line link and trunk link frames and therefore estimates of the additional CCS involved are required. These estimates will be covered elsewhere in these notes.

Centrex involves the following line link frame items:

1. Line link frame appearances for all incoming trunks with the transfer feature.
2. Line link frame appearances for attendant trunks, tie lines, FX lines, conference circuits, attendant line circuits, two-way attendant access trunks and other miscellaneous Centrex circuits.
3. Sleeve lead requirements for hunting groups and incoming trunks.
4. Ground start line equipments for certain Centrex circuits.
5. Assignment by line link frame and vertical group of those lines requiring access to MF originating registers.

Originating Registers

One combined group of originating registers that can serve both Centrex and individual subscribers will be provided. Centrex features are made operative on a vertical file class-of-service basis. These registers will have the following features for Centrex service:

1. Dial "9" with second dial tone.
2. 4 or 5-digit dialing between extensions of the same P.B.X.
3. "1XX" tie line features.
4. "0" to reach attendant.
5. "1" is reserved for "1XX" code access to tie lines and after dialing "9" for toll access.
6. Digits "2" through "8" may be the thousands digits for extensions. If more than 7000 extensions are required, 5-digit dialing must be provided.

Originating registers have been modified so that Centrex extensions must dial at least 3 digits for tie line codes. After 3 digits, a special digit timer is activated if the initial digit dialed is a "1". This permits dialing codes such as 1XX + 2, 3 or 4 digits, 1XX + "0", 1XX + 1 or 2 digits + 2, 3 or 4 digits, or 1XX + "9" + 7 digits. Ten digits plus the initial "1" is the maximum number of digits that can be dialed.

MF originating registers are required for use by the console attendant and any Touch Tone Calling extensions. The selection of an MF or DP originating register is based upon line link frame and vertical group assignment. Line link frames may or may not be arranged for access to MF originating registers. The frames which are arranged for this feature must use the same vertical group or groups for assignment of attendant lines and Touch Tone Calling extensions. MF originating registers will usually require the same Centrex features as the DP registers. Standard holding times in the T.E.P. may be used for engineering quantities of DP originating registers. MF originating register holding times are covered later in these notes.

Dial Tone Markers

Dial Tone markers have been modified to be able to identify and pass to the originating registers a maximum of 100 classes-of-service and 20 treatments. Dial Tone Markers need also to be arranged for two originating register groups.

Completing Markers

Completing markers will be provided with the following additional features for Centrex:

a. 30, 60, or 100 classes-of-service.
b. Up to 180 service treatment relays and 120 SC points.
c. Ability to handle 4 or 5-digit intra-P.B.X. calls, listed number calls, transfer calls, and "1XX" tie line calls.

In Centrex, the class-of-service feature is used somewhat differently than in the past. Class-of-service identifies the particular P.B.X. involved while treatments determine permissions or denials in terms of charging or routing. The class-of-service and treatment distinction is by vertical file. The class-of-service distinction is used on intra-office calls to match the originating class against the terminating class to keep intra-P.B.X. calls within their P.B.X. On listed number and transfer calls, the class determines the selection of the proper attendant trunk group.

There are a total of 20 treatments available to be shared by all Centrex groups. One treatment might be used to restrict certain extensions from making outside calls. This same treatment relay could be used by extensions of other Centrex customers with the same codes restricted.

A careful review of the equipment capabilities is required when considering a number of special services in one No. 5 crossbar marker group. Sufficient marker screening, routing, and charging capacity may not be available to serve Centrex, other new services, and regular subscribers from the same No. 5 crossbar marker group.

Holding times for completing marker uses on listed number and transfer calls are covered later in these notes.

Incoming and Intra-Office Trunks

All incoming trunks carrying traffic completing to Centrex subscribers will be arranged with transfer and memory features. Controlled ring trunks and trunks carrying traffic to switch through the No. 5 crossbar office on a tandem or intertoll basis can not be arranged for transfer. All incoming trunks arranged for transfer require line link frame appearances and tandem trunk numbers.

A special intra-office trunk arranged to repeat supervision has been designed for intra-P.B.X. Centrex Traffic. These trunks will be used in common by all Centrex subscribers for intra-P.B.X. traffic and also for calls from Centrex and flat rate regular subscribers to regular subscribers who have

an ANC code not shared with Centrex subscribers. This new intra-office trunk is not arranged for transfer. Until such time as an intra-office trunk arranged for transfer is developed, it will be necessary to use an outgoing trunk and incoming trunk arranged for transfer "back-to-back." This trunk group will usually handle:

a. Intra-office inter-P.B.X. traffic.

b. Intra-office calls from regular subscribers to Centrex subscribers.

c. All intra-office calls to regular subscribers that have the same central office code as some of the Centrex subscribers. (Must use common trunk group and calls to Centrex extensions require transfer feature.)

When available, the intra-office trunk with transfer will require a tandem trunk number, an incoming register link appearance, and a line link frame appearance. The transfer feature can be made operative on a 7-digit intra-office call but not on a 4 or 5-digit call.

Incoming Registers

Incoming register usage is computed as covered in Division D, Section 8 of the T.E.P. with the exception that additional uses of MF incoming registers are involved on listed number and transfer calls. MF incoming register holding times for these types of calls are covered later in these notes.

Incoming Register Link Frames

DP or RP incoming trunks arranged for transfer require the ability to have access to MF incoming registers. An MF incoming register is used by the console attendant to complete to the desired extension. It is recommended that non-by-link trunks (RP and DP) have only one appearance in a combined incoming register link group with 7 RP or DP and 3 MF incoming registers. However, it is possible for these non-by-link trunks to have incoming register link appearances in two incoming register link groups. Dial Pulse by-link trunks will have appearances in two incoming register link groups because of the inefficiency of reduced numbers of dial pulse incoming registers serving by-link trunks. MF incoming trunks require an appearance only in the MF incoming register link group.

All incoming trunks with the transfer feature require incoming register link assignments associated with tandem trunk numbers. In the case of two separate incoming register link group assignments, only the MF appearance requires a tandem type vertical and tandem trunk number. This limits the combined or MF incoming register link group to a maximum of 320 trunks arranged for transfer.

Number Groups and Directory Numbers

It probably will be desirable to assign one or more "hundred blocks" of numbers to each Centrex customer to permit more satisfactory intercept arrangements, for easier identification of numbers with Centrex customers, and for easier administration.

Directory numbers will be required for all incoming trunks with transfer (tandem trunk numbers). A maximum of two numbers are required for the listed number of each Centrex customer. As outlined in the paragraph on Typical Centrex Calls, a listed number call is not actually completed to a line link frame termination but is routed to the attendant via the attendant trunk group on the trunk link frame. A second number is provided in order to have a second line link frame appearance for protection purposes.

Provision is made in Centrex to have a maximum of three additional trunk number groups in addition to the two duplicate trunk number groups used for trunks carrying switched traffic. Each incoming trunk with transfer will require a single number group assignment. (No duplication.) Each of these three number groups will serve ten trunk link frames. One for trunk link frames 0-9, one for 10-19 and one for trunk link frames 20-39.

Miscellaneous Centrex Trunks and Circuits

1. **Attendant Line Circuit**

Each console position will normally be provided with one attendant line for the attendant's use in making reports to extension users. This line can not be used to connect two parties. It terminates on the line key on the console and uses one line equipment in an MF vertical group. A number group assignment is not required but an AMA translator assignment will be required if the treatment accorded this line permits toll calling.

When the attendant wishes to use this line, she depresses the line key and her position is made busy to incoming calls. The operation of the STO key

connects an MF originating register into which the attendant can key pulse in the usual manner. Upon completion of the use of the attendant line, the operation of the RLS key will restore the position circuits to normal operation. This circuit requires assignment on line equipment arranged for ground start operation.

2. **2-Way Attendant Access Trunk**

Each console position may be equipped with one or more 2-way attendant access circuits which provide facilities for connecting together two parties on a call originated by the attendant (a delayed call). This trunk has two line link frame appearances. In order to use this trunk, the attendant depresses the associated trunk key. The depressing of the STO key associates an MF originating register and the first desired number is key pulsed (could be an outside number, a tie line or a local extension). After depressing the END key and getting the first party on the line, the depressing of the ADV key will connect the circuit to its second line link frame appearance. When the attendant is no longer required, her position can be released from the circuit but the trunk is held up for the duration of the call. This trunk could be used for handling WATS calls on a delayed basis. The first associated line equipment would have a P.B.X. class-of-service while the second would have a WATS class. Use of this trunk involves two uses of common control equipment, line link frames, trunk link frames, and trunks. Ground start line equipment is required for this circuit.

3. **Conference Circuit**

This circuit provides facilities for connecting together from two to a maximum of five connections of a conference. The conference call may be originated by the attendant because of a previous request or as the result of an incoming call to the conference circuit. This circuit requires five line link appearances and terminates on the CONF key on the console. The first line of the conference circuit will require an extension number. The other four line equipments will not require directory numbers, but if any of the lines are given a treatment that permits outside calls, they will require AMA translator cross-connections. The calling of the conference number will bring the call in on the console CONF key and flash the associated lamp at 120 IPM. The attendant may transfer a call coming in as a listed number call to the conference circuit by keying the conference circuit number in the same manner as when completing to an extension. The attendant may originate a conference call by depressing the CONF key which cuts her position through to the first line link appearance. After key pulsing and getting the first party on the line, the depressing of the ADV key will advance the position circuit to the second LLF appearance. This process can be repeated up to a maximum of five connections. After the conference has been satisfactorily established, the position circuit can be released from the call.

A conference call may use up to a maximum of five intra-office trunks or combination of intra-office trunks, outgoing trunks, and tie lines. Additional uses of common control equipment depends on the type calls necessary to connect the desired members of the conference.

An "add-on" feature is not available at this time, but is scheduled for future development.

4. **Attendant Trunks**

Attendant trunks are used for "0", listed numbers, and transfer calls. A separate group is required for each Centrex customer. These trunks have both a line link and trunk link frame appearance and are terminated on the trunk finder of the call distributor. On an assistance call the attendant trunk will be held up for the duration of the call. However, on listed number and transfer calls completed to extensions, the attendant trunk is released after the connection is established to an extension. The trunk holding time on this type of call will be approximately 45". The line link appearance of this trunk will not require a directory number, but will require an AMA translator cross-connection. Ground start line equipment is required for this circuit.

Ringing Selection Switches

The ringing selection switches have been modified for Centrex service. Ringing combinations have been used to indicate types of Centrex calls. Ringing combinations 4 and 5 are used to indicate listed number calls. RC 9 is for restricted incoming, and RC 14 is used for routing calls to temporary disconnected lines to the customer's group attendant.

Interrupter Circuit

The interrupter circuit has been modified to add 30 IPM which is used to flash an operated hold key on the attendant consoles.

Intercept Arrangements

The following intercept arrangements are available for Centrex subscribers:

1. Calls to spare numbers assigned to a particular P.B.X. are routed to a recorded announcement individual to that P.B.X.
2. Calls to disconnected numbers are routed to the attendant on a charge basis for a limited period and then routed to the recorded announcement.
3. Calls to extensions not permitted incoming service are routed to a recorded announcement common to the marker group.

Night Closing Arrangements

Night closing arrangements have been made to route listed number traffic to night lines by making the night lines a part of the listed number hunting group. A lamp transfer and make busy circuit is provided which, by the operation of a key, causes the listed numbers to be made busy so that the marker will hunt across them to the night lines. The night lines may terminate in regular telephones which have regular P.B.X. extension numbers for use during normal business hours and a second number as part of the listed number hunting group. When the night transfer key is not in the operated position, the night lines are made busy. An additional feature of this circuit is the ability during business hours for number group recognition of an all attendant trunk group busy condition and returning busy back tone rather than switching through the office and then finding all the attendant trunks busy and returning reorder tone.

Tie Lines

An auxiliary outgoing trunk circuit has been designed to provide access from the trunk link frame to a two-way dial pulse P.B.X. tie trunk which requires the use of a DP sender. The two-way dial pulse tie trunk will have a line link frame appearance from which it may act the same as any other extension within the Centrex group. A directory number will not be required, but an AMA translator cross-connection will be needed if the tie line is accorded access to outside points. A line equipment with a sleeve lead is required in order to exchange a busy with the auxiliary circuit used for outgoing access. This type tie line can be reached by the console attendant by the operation of the STO key and dialing of the tie line code. The number and combination of digits that can be used for this type of tie line are covered under Originating Registers.

An auxiliary line circuit has also been designed to connect a Centrex subscriber with a two-way automatic tie line to a distant P.B.X. This line has only a line link frame appearance to which a regular extension number is assigned. By dialing the directory number of this line circuit a subscriber will reach an attendant at a distant P.B.X. On incoming calls the line circuit will be wired for manual P.B.X. treatment and cut through on an automatic basis to the proper attendant trunk group.

Under development is a two-way tie line that can be dial selected on a 1XX basis, give second dial tone and then permit dialing of any number of digits required for switching. This tie line will have a line link frame appearance in addition to a trunk link frame appearance and may also be key terminated on a console but will require converters to convert MF pulses to dial pulse. When key terminated, the console attendant will be able to operate her STO key, key pulse an extension number, then depress the advance key and key pulse out over the tie line in order to connect a distant party with an extension. For incoming service, this tie line may either terminate automatically on a console or appear as a P.B.X. extension on its line link frame appearance.

Also under development is an FX circuit that operates in a similar manner to the above two-way tie line circuit.

Call Distributor

A SxS call distribution circuit provides means for connecting attendant trunks to console positions. A complete description and engineering requirements are covered in Section 5-d. The Laboratories are investigating the possibility of using crossbar switches as a replacement for the SxS call distributor.

Typical Centrex Calls

In order to better understand Centrex traffic engineering considerations, the following is a brief description of transfer, listed number, and attendant "0" calls:

1. **Transfer Calls** (Figure 1)

   As the result of a flash by an extension user, the incoming trunk will seize an MF incoming

register and pass the information to the register that it is a transfer class of call. The TRF class causes the MF incoming register to seize a marker without waiting for pulsing and transmit to the marker the class of call, TLF location, and tandem trunk number. The marker then connects to the incoming trunk and reads out the class of service that has been stored in the memory relays of the incoming trunk. The marker then grounds the TRA code point which after screening provides for the selection of the route relay for the proper attendant trunk group. The marker next selects a number group to obtain the line link location of the line equipment associated with the incoming trunk and connects the LLF appearance of the incoming trunk to the proper attendant trunk group. The call is indicated to the attendant as a transfer call by the source lamp flashing at 120 IPM while the destination lamp is steady. The attendant can transfer the call to another extension by releasing the extension initiating the transfer request, operating the STI key, and key pulsing the extension number into an incoming register. The call can be transferred to a tie line by releasing forward, operating the STO key, and key pulsing into an originating register.

2. **Listed Number Calls** (Figure 2)

   Incoming register receives pulses for directory number and seizes completing marker. Incoming register transmits to marker the called digits and TLF location of incoming trunk. Marker connects to number group frame and receives LLF location of line equipment associated with the directory number and the ringing combination. The ringing combination is the indication that it is a listed number call. The marker then seizes the proper LLF and reads the class-of-service of the selected line which is transmitted to the memory relays in the incoming trunk. The ringing combination sets the incoming trunk ringing switch to operate a DIR relay in the incoming trunk. The operation of this relay sets the incoming trunk to start a transfer call. The marker and incoming register are released from the call. The incoming trunk then seizes an MF incoming register for a transfer call. From this point on, the call is handled as a transfer call except for the setting of a class relay that causes the attendant's source lamp to flash at 60 IPM indicating a listed number call. The attendant can complete the listed number call to an extension by the operation of the STI key and key pulsing the extension number into an incoming register. Calls to tie lines can be completed by the operation of the STO key and key pulsing the proper digits into an originating register.

3. **Attendant "0" Calls** (Figure 3)

   The extension user dials "0" and the call is completed via the trunk link frame attendant trunk group to the call distributor trunk finder, position finder, and position loop. The call is indicated to the attendant as an assistance call by a flashing of the associated source lamp at 120 IPM while the destination lamp remains dark. The attendant may extend the call forward by operation of the STO key and keying the proper digits into an originating register. On an assistance call, the attendant trunk remains in the connection for the duration of the call.

4. Traffic engineering considerations involved in listed number, transfer, and attendant "0" calls include:

   a. Additional completing marker uses.

   b. Additional MF incoming register uses.

   c. Additional originating register and dial tone marker uses when completion to other than an extension.

   d. Additional LLF and TLF CCS. If a call is completed to an extension, a 45" holding time is indicated, but if call is extended forward via an originating register, the attendant trunk will not be released and the additional CCS will be double that of the holding time of the call.

Traffic Registers

New traffic registers have not as yet been developed for No. 5 crossbar Centrex. However, it is recommended that existing registers be utilized to the maximum to obtain peg count, overflow, and usage data for future traffic engineering of Centrex offices.

Airport Dial Service

In some instances it may be desirable to permit 4 or 5-digit dialing between Centrex customers in a No. 5 crossbar marker group. This is possible by omitting the class-of-service match check on intra-office calls.

Present Wire Spring No. 5 Crossbar Offices

Development work is scheduled to permit existing wire spring No. 5 crossbar offices to be modified for Centrex operation with consoles or 608A cord switchboards with release loop operation. These offices will be limited to twenty classes-of-service with twenty treatments. It will be necessary for some items of equipment to be replaced rather than modified.

Holding Times — Centrex Calls

The following holding times for Centrex calls may be used in conjunction with the T.E.P. tables. Standard holding times listed in the T.E.P. may be used for types of calls not listed below.

1. **Completing Markers (wire spring)**

	HT	See Note
Transfer Call	.40	(a)
Listed Number Call	.50	(b)

(a) This HT is only for the portion of a transfer call which routes the call from the first called extension to the attendant. An additional standard holding time for an incoming call or outgoing call is required depending on whether the call is transferred to another extension (incoming), to a tie line or outgoing trunk (outgoing), or to a conference circuit (intra-office).

(b) This HT is for the additional marker uses required to route a listed number call to the attendant. It is assumed that the first marker usage on a listed number call is included in total incoming calls in basic data. Additional marker uses are required dependent on type of attendant completion.

2. **MF Incoming Register (wire spring)**

	HT	See Note
Transfer Call	.90	(c)
Listed Number Call	.90	(d)
From Console Attendant (Includes END key)		
4 digits	4.10	
5 digits	4.70	

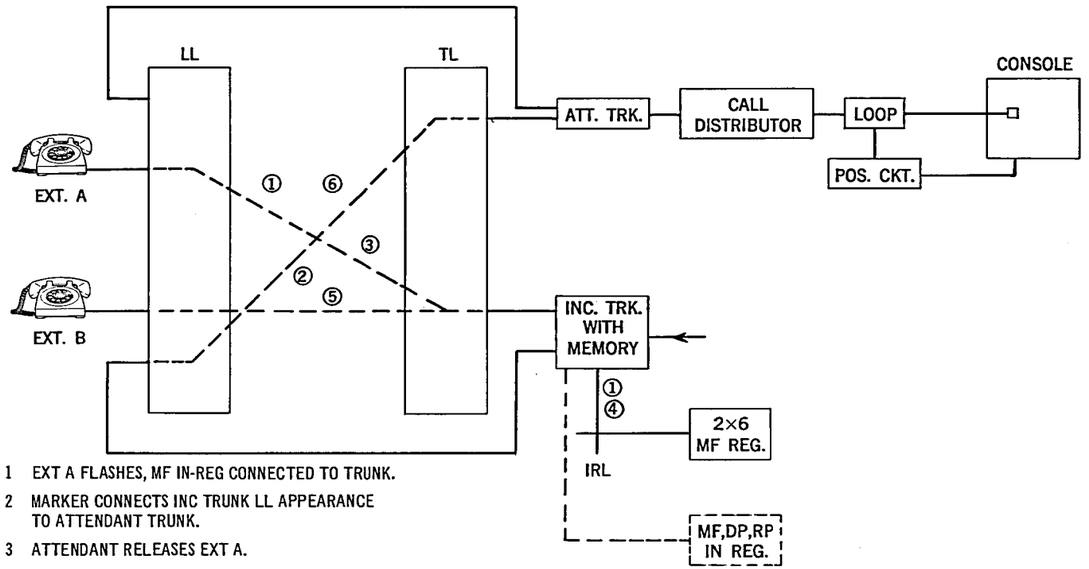
(c) This HT is only for the portion of a transfer call which routes the call from the first calling extension to the attendant. This first use does not involve pulsing. A second use of the MF incoming register is made when the attendant operates the STI key to key pulse 4 or 5 digits to reach a second extension.

(d) This HT represents only the MF incoming register use required to route a listed number call to the attendant. The first use in which the listed number is pulsed into an incoming register is included in the basic data by type pulsing. An additional use of the MF incoming register is involved if the listed number call is completed to an extension.

3. **Originating Registers (wire spring)**

Calls For	MF Console Attendant	MF Touch Tone Subscriber	DP	MF 608A Attendant
4-Digit Numbers	3.3	5.9	8.7	5.4
5-Digit Numbers	3.9	6.7	10.2	6.0
7-Digit Numbers	5.1	8.3	13.2	7.2
"0" Operator — Non-Coin	2.1	2.7	4.2	2.5
— Coin	—	4.2	5.7	—
3-Digit Operator Codes				
Non-Coin	2.7	3.5	5.7	3.3
Coin	—	5.0	7.2	—
3-Digit "1XX" Codes (Note e)	2.7	3.5	5.7	3.3
Manual Originating	—	—	.9	—
To the above, add the following for the condition listed —				
Stations Delay (Note e)	3.5	3.5	3.5	3.5
Directing Codes:				
1-Digit ("1", "9")	.6	.8	1.5	.6
3-Digit (X0X, X1X)	1.8	2.4	4.5	1.8
Each Additional Digit Following "1XX" Codes (Note e)	.6	.8	1.5	.6

(e) Station delay required for all "1XX" codes when timing for variable number of digits. Also add indicated HT for each digit dialed after the "1XX" code.



1 EXT A FLASHES, MF IN-REG CONNECTED TO TRUNK.

2 MARKER CONNECTS INC TRUNK LL APPEARANCE TO ATTENDANT TRUNK.

3 ATTENDANT RELEASES EXT A.

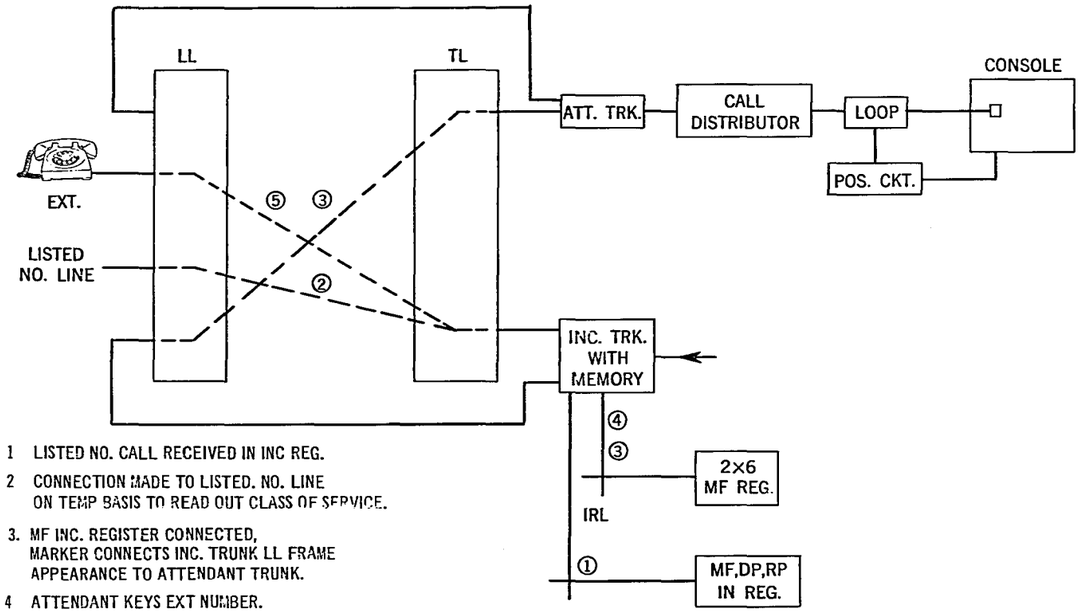
4 ATTENDANT KEYS EXT B.

5 MARKER CONNECTS INC TRUNK TO EXT B.

6 CONNECTION TO ATTENDANT RELEASED ON EXT B ANSWER.

FINAL CONNECTION IS SIMILAR TO DID CALL.

FIG. 1
No. 5 CROSSBAR CENTREX - CONSOLE OPERATION
TRANSFER CALL TO ANOTHER EXTENSION



1 LISTED NO. CALL RECEIVED IN INC REG.

2 CONNECTION MADE TO LISTED. NO. LINE ON TEMP BASIS TO READ OUT CLASS OF SERVICE.

3. MF INC. REGISTER CONNECTED, MARKER CONNECTS INC. TRUNK LL FRAME APPEARANCE TO ATTENDANT TRUNK.

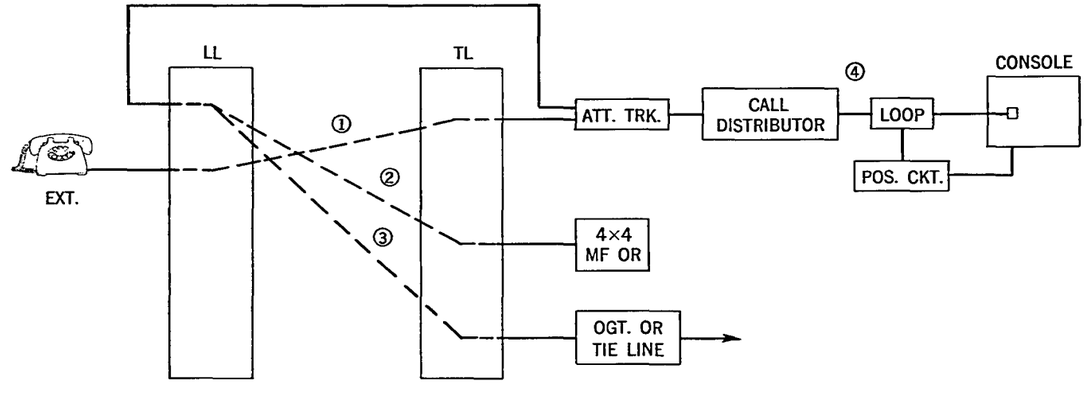
4 ATTENDANT KEYS EXT NUMBER.

5 MARKER CONNECTS INC TRUNK TO EXTENSION.

6 CONNECTION TO ATTENDANT RELEASES ON EXTENSION ANSWER.

FINAL CONNECTION IS SIMILAR TO DID CALL.

FIG. 2
No. 5 CROSSBAR CENTREX - CONSOLE OPERATION
LISTED NUMBER CALL COMPLETED TO EXTENSION



1 EXT. DIALS "0" FOR ATTENDANT.

2 ATTENDANT ANSWERS AND KEY PULSES DESIRED TERMINATION VIA LL APPEARANCE OF ATTENDANT TRUNK.

3 MARKER CONNECTS LL APPEARANCE OF ATTENDANT TRUNK TO OGT OR TIE LINE.

4 ATTENDANT CONSOLE RELEASED FROM CONNECTION.

ATTENDANT TRUNK RETAINED IN CONNECTION FOR DURATION OF CALL.

FIG. 3
No. 5 CROSSBAR CENTREX - CONSOLE OPERATION
DIAL "O" CALL

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TRAFFIC ENGINEERING NOTES

CENTREX SERVICE

NO. 5 CROSSBAR CENTREX WITH 608A CORD SWITCHBOARDS AS THE ATTENDANT FACILITIES

Section 2-b

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
Department of Operations
May, 1961

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TRAFFIC ENGINEERING NOTES

CENTREX SERVICE

NO. 5 CROSSBAR CENTREX WITH 608A CORD SWITCHBOARDS WITH SINGLE AND NORMAL CORD OPERATION FOR THE ATTENDANT FACILITIES

Section 2-b (1)

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
Department of Operations
May, 1961

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CENTREX SERVICE

NO. 5 CROSSBAR CENTREX WITH 608A CORD SWITCHBOARDS WITH SINGLE AND NORMAL CORD OPERATION FOR THE ATTENDANT FACILITIES

GENERAL

Planning is in progress for the necessary development effort to modify 608A cord switchboards for use as the attendant facilities with a No. 5 crossbar Centrex office of the type described in Section 2-a. This section will discuss the traffic engineering considerations of the anticipated differences in the No. 5 crossbar equipment required for operation with 608A cord switchboards with release loop operation from those required for operation with 622A consoles.

Proposed Method of Operation

The basic difference between 622A consoles and 608A cord switchboards as the attendant facilities is the ability in the latter to complete calls with single or normal cord pair operation. Listed number and transfer calls to be completed to extensions within the No. 5 crossbar office can be completed with single cord operation. The attendant can answer with a back cord and then key pulse the extension number back over the back cord. Upon extension answer, the cord can be taken down. Calls to be completed to other than extensions in the No. 5 crossbar can be handled with normal cord pair operation.

Attendant Trunks

As in console operation, these trunks will route listed number, transfer, and "0" assistance calls to the attendant. However, these trunks will not require a line link frame appearance. The attendant will normally complete listed number and transfer calls on a single cord basis. Assistance calls will be completed with normal cord pair operation. If necessary, listed number and transfer calls can be completed with normal cord pair operation. Dial "0" and transfer calls will flash the trunk lamp at 120 IPM. Listed number calls will light the trunk lamp with a steady signal.

OGT to CO Lines

A group of dial originating lines will be required at the 608A cord switchboard for the attendant's use in completing assistance calls. These lines will appear on line link frame locations which are arranged for access to the MF originating register group. Some of these lines may be given a WATS class-of-service.

Attendant Local Completion Lines

Four or five-digit completing trunks will be required to enable attendants to complete incoming calls from FX and tie lines to extensions in the No. 5 crossbar local office. These same trunks are also required to set up conference calls. These trunks will originate at the 608A cord switchboard and terminate on incoming locations on trunk link frames.

Tie Lines — FX Lines

Tie lines and FX lines may be terminated on jacks on the 608A cord switchboard. If the attendant is to use these lines for outgoing service, MF to DP converters will be required. These lines may have line link frame appearances for incoming service and trunk link frame appearances for dial selection. Ringdown tie lines are also possible.

Call Distributor

A call distributor is not required when 608A cord switchboards are used for the attendant facilities. Attendant trunks are multipled throughout the cord switchboard.

Other No. 5 Crossbar Items of Equipment

Development planning for No. 5 crossbar Centrex with 608A cord switchboards for attendant facilities is still in progress. However, traffic engineering considerations for line link frames, trunk link frames, incoming trunks, and other items of common control equipment will probably be the same as those required for operation with 622A attendant consoles.

TRAFFIC ENGINEERING NOTES

CENTREX SERVICE

NO. 5 CROSSBAR CENTREX WITH 608A CORD SWITCHBOARDS WITH NORMAL CORD PAIR OPERATION FOR THE ATTENDANT FACILITIES

Section 2-b (2)

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CENTREX SERVICE

NO. 5 CROSSBAR CENTREX WITH 608A CORD SWITCHBOARDS WITH NORMAL CORD PAIR OPERATION FOR THE ATTENDANT FACILITIES

GENERAL

A form of No. 5 crossbar Centrex has been developed by the New Jersey people to serve one large P.B.X. It offers the advantages of being able to be added to an existing wire spring No. 5 crossbar office without modifying the line link frames and completing markers for the new method of class-of-service and treatment identification and the transfer feature can be added to standard No. 5 crossbar "B" type non-tandem incoming trunks. The following is a description of the No. 5 crossbar Centrex office that serves the Bell Telephone Laboratories at Murray Hill, New Jersey:

Equipment and Features

1. Wire-spring No. 5 crossbar office with maximum of sixty classes-of-service (no treatments).
2. 608A cord switchboard with MF keysets.
3. Separate designations for the P.B.X. and regular subscribers.
4. High usage incoming trunks to each designation overflowing to combined groups serving both designations.
5. Modification of standard No. 5 crossbar incoming trunks for transfer. (No memory.)
6. Foreign exchange trunks.
7. Tie lines.
8. Tandem switching of tie line calls.
9. Dial dictation trunks.
10. 4-digit intra-P.B.X. dialing.
11. One digit and 3-digit tie line codes.
12. Numbering and Dialing Procedures
    - "0" — Attendant
    - "1" — First digit for "1XX" tie line codes
    - "2, 3, 4, 6" — Thousands digits for extensions
    - "5, 7, 8" — One-digit tie line codes
    - "9" — Access to regular trunking network

Method of Operation

1. **Transfer Calls**

   A transfer request from a Centrex extension is activated by a switchhook flash. The switchhook flash causes the line link appearance of the incoming trunk to set up a demand for dial tone. The transfer request is then routed to a special group of transfer trunks on a manual class-of-service basis. The transfer trunks appear at the 608A cord switchboard on a double-jack basis. The attendant answers the transfer request with a back cord, and after receiving the transfer request, plugs the front cord of the pair into the associated jack. The new extension number will be key pulsed, and upon start of ring, the front cord is released. When the cord signal indicates that the second extension has answered, the back cord is taken down.

   A circuit difficulty is encountered if the second extension is busy and the incoming trunk returns a busy tone to the calling party. In order to remove the busy back condition from the incoming trunk, the attendant must release the front cord, re-insert, and transfer the call to a listed number which she can answer. This has not created an operating problem.

2. **Listed Number Calls**

   Listed number calls are routed in the normal manner to a hunting group with line equipments that terminate on jacks in the multiple of the 608A cord switchboard. Attendant

completion to local extensions is with normal cord pair operation via a 5-digit local completing group which originates in the multiple of the 608A switchboard and terminates on incoming trunk link frame appearances. Listed number calls for completion to tie lines are completed by the attendant via the tandem completing group to the local No. 5 crossbar office. The dial originating lines can not be used to complete listed number calls to tie lines because of different signalling conditions between the listed number trunks and the dial originating lines.

3. **Attendant "0" Calls**

Assistance calls and calls from restricted extensions are completed by the attendant on a normal cord pair basis. The attendant answers these calls with a back cord and completes with a front cord via the dial originating lines for calls to the DDD network and to tie lines.

4. **Tie Line Calls**

Local extensions dial both 1-digit and 3-digit tie line access codes. As additional thousands digits are required for extensions, all tie line codes will be of the "1XX" type. All the digits required for selection of the tie line group, switching, and reaching the terminating line are dialed into an originating register. Outgoing senders are used to outpulse over the tie lines. Extensive use is made of code conversion to permit a wide variety of switching capabilities. Some examples are:

a. Extension dials 162. The 162 is converted to 580. The 580 is outpulsed to the first SXS P.B.X. where a fifth level trunk is selected. The 80 is continued to the second SXS P.B.X. where an eighth level trunk is selected to the third SXS P.B.X. where the call is routed to the attendant trunk group.

b. Extension dials 143 + XXX + 4 digits. The 143 is code converted to a "9" and 9 + XXX + 4 digits is outpulsed. A ninth level trunk is selected at the distant SXS P.B.X. and the original extension user reaches a local central office where he can complete calls to its 7-digit area.

The Murray Hill No. 5 crossbar office has also been arranged as a tandem switching point for tie lines. Two-digit tie line codes are pulsed into an incoming register. These two digits plus any additional required digits are used either to complete locally or to switch through the No. 5 crossbar office to select outgoing tie lines. Some examples are:

a. Incoming register receives XX-XXXX. Call is completed to local extension.

b. Incoming register receives XX (two digits only). Call is completed to local 608A attendant or an outgoing tie line is selected and the code is converted to a "0" to reach distant attendant.

c. Incoming register receives XX + XXX + XXXX. Call is completed to a tie line group and the XX is code-converted to a "9". 9 + XXX + XXXX is outpulsed to select a ninth level trunk at a distant SXS P.B.X. to have access to the distant central office 7-digit area.

d. Incoming register receives XX + XXX + XXXX. Call is completed to an FX line on trunk link frame. This FX line is terminated on a local line link frame where after code conversion of the XX to a "9", the 9 + XXX + XXXX is outpulsed to an originating register to permit access to the 7-digit dialing area of the local No. 5 crossbar office on an AMA basis.

Miscellaneous Centrex Trunks and Circuits

1. **Transfer Trunks**

The transfer trunks are used for transfer requests only. They have trunk link frame appearances (type G108 auxiliaries) and terminate on locally developed relay equipments at the 608A switchboard. Double-jack appearances are required.

Traffic engineering considerations for transfer calls will include:

a. A dial tone marker attempt, an originating register use (.9″ HT), and completing marker use (HT .33″) to route call to the attendant.

b. Completion of transfer requests to a second extension involves additional CCS on line link and trunk link frames (45″) while call is being routed from the first extension to the attendant and back to the second extension. A completing marker use (HT .34″) for an incoming call and a 5-digit MFKP incoming register holding time of 6.2″ are required. Transfer trunks require 5-digit pulsing by the attendant because the original incoming trunk may have been common to both designations.

c. The number of transfer trunks required will be the result of the holding time times the estimated number of transfer calls with the resulting CCS read into a P = .001 table. Until actual operational data is available, it is suggested that the estimates of calls affected by transfer be sufficient to provide reasonable assurance of no postcutover transfer trunk shortage.

If a transfer trunk group overflow is incurred, the reorder tone returned to the calling party can be released only by the hang up of the calling party.

2. **Listed Number Trunks**

These trunks originate as line equipments on line link frames and terminate on SD-66719 type relay equipments at the 608A switchboard. These calls are included in the count of incoming calls in the basic data. However, the method of attendant completion of these calls involves additional switching path and common control usage not in the original count of calls. Traffic engineering considerations for listed number calls will include the following:

a. Listed number calls completed to local extensions will be completed via the local completing group and will add additional CCS to the line link frames and trunk link frames to the extent of the duration of the calls for these are not completed on a release loop basis. A 5-digit MFKP incoming register holding time of 6.2″, and a completing marker holding time of .34″ for an incoming call are required.

b. Listed number calls to be completed to tie lines are completed by the attendant via the tandem completing trunk group incoming to the local No. 5 office. The MFKP incoming register holding time is dependent upon the number of digits. A tandem switch completing marker HT of .40″ is required in addition to the outgoing sender usage. Additional CCS is added to link and trunk link frames for the second switch through these frames. Listed number lines are retained in the connection for the duration of the call. The number of listed number lines can be estimated by multiplying the number of calls times the holding time and reading the resulting CCS into a P = .01 table. It is suggested that adequate spare be provided.

3. **Attendant Trunks**

Attendant trunks are provided on the trunk link frames to route assistance calls from local extensions and attendant calls from tie lines to the 608A attendant. The No. 5 crossbar trunk (type 2D76) is coupled with SD-66716 type relay equipments at the 608A switchboard. Traffic engineering considerations will include the following:

a. It is assumed that all attendant calls from local extensions are included in the basic data of total originating calls. However, attendant completion is on a fixed loop basis via the dial originating lines and involves a second switch through the line link and trunk link frames, an MF originating register use (HT dependent upon the number of digits), a completing marker use for an outgoing call (.33″) and an outgoing sender use.

b. An estimate is required of the number of incoming tie line calls directed to

the 608A attendant. Completion of these calls may be to local extensions via the local completing trunk group which requires an MFKP incoming register use for five digits (6.2″), a completing marker use (.34″) for an incoming call and additional CCS for the second switch through the trunk link and line link frames. Completion to tie lines and the local office DDD network will involve the same traffic engineering considerations as in (a) above. The number of attendant trunks is estimated by multiplying the number of calls times the holding time and reading the resulting CCS into a P = .01 table and providing adequate reserve.

4. **Two-way Tie Lines**

Incoming tandem trunks are tied to outgoing "C" type trunks (1C36) with tandem—completing features by means of an auxiliary trunk (G88) to provide two-way service. Incoming and outgoing trunk link appearances are required. Tandem trunk numbers and line link frame appearances are provided for the incoming trunks. Incoming tie line trunks are not arranged for transfer. Traffic engineering considerations will include the switched CCS, incoming register uses, completing marker uses for switched calls, and outgoing sender uses.

In order for an incoming tie line call to be able to have access to the local No. 5 crossbar DDD network on an AMA basis, it is necessary to switch through the No. 5 office to an FX line (1C36) on the trunk link frame which terminates on a local line link frame. After switching through the office, a DP outgoing sender spills its digits to an originating register. Traffic engineering considerations for this type of call will include the considerations for switched traffic plus a dial tone marker attempt, DP originating register use, completing marker use for an outgoing call, and an outgoing sender use. CCS for a second switch through the office is added to the line link and trunk link frames.

5. **Incoming and Intra-Office Trunks**

a. **Incoming Trunks**

High usage incoming trunks individual to each designation overflowing to trunk groups common to the two designations have been provided. Incoming trunk groups individual to the P.B.X. designation and trunk groups serving both the regular subscribers and P.B.X. extensions have been modified locally to provide for transfer as the result of a switchhook flash. This transfer feature has no memory and can route transfer calls to only one attendant facility. As the result of a switchhook flash, the line link frame appearance of the incoming trunk sets up a demand for dial tone and the transfer request is routed on a manual class-of-service basis to the transfer trunk group. Activation of the transfer feature is controlled by the ringing combination assigned to the terminating line. The Centrex extensions have been assigned ringing combinations 05 for non-hunting lines and 08 for hunting groups. Regular subscribers have the normal ringing combination regularly assigned for their class-of-service which will not activate the transfer feature.

b. **Intra-office Trunks**

Since the regular subscribers have a different ANC code from the Centrex extensions, it was possible to provide a flat-rate intra-office trunk group to carry the following intra-marker group calls:

a. Calls from flat-rate regular subscribers to regular subscribers

b. Calls from extensions to extentions

c. Calls from extensions to regular subscribers

An AMA coin overtime group was provided on a 'back-to-back" basis (C17 and B60M) for calls from regular subscribers to the P.B.X. designation. The

incoming portion of the "back-to-back" intra-office trunk has been modified for transfer. This intra-office trunk arrangement requires in addition to outgoing and incoming completing marker uses, the use of an MF outgoing sender and MF incoming register.

6. **Dial Originating Lines**

Dial originating lines have been provided in the OGT multiple of the 608A switchboard (SD-66719) to be used to complete attendant "O" calls to the local office DDD network and to tie lines. These lines require assignment to MF vertical groups on the line link frames. MF originating register holding times to be used with calls from 608A switchboard attendants are included in the holding time tables in Section 2-a.

7. **Tandem Completing Trunks**

Tandem completing trunks have been provided in the OGT multiple of the 608A switchboard which terminate on B74M type trunks on the No. 5 crossbar trunk link frames. This trunk group is used to complete listed number calls to tie lines.

8. **Local Completing Trunks**

Local completing trunks have been provided in the OGT multiple of the 608A cord switchboard which terminate on B60M type trunks on the No. 5 crossbar trunk link frames. This trunk group is used to complete listed number calls to local extensions. These trunks have not been arranged for transfer because the attendant has cord supervision.

Markers

Dial Tone and completing markers need minor modifications to operate with this type of Centrex.

Incoming Register Link Frames

The incoming trunks arranged for transfer can be terminated in two incoming register link frame groups (DP or RP and MF) or can be terminated in a single incoming register link group equipped with both RP or DP and MF incoming registers. MF incoming trunks require a single appearance in the MF incoming register link group. The incoming register links need to be modified for separate or combined operation.

Originating Registers

The originating registers in this office were modified by local development. However, the new standard PBX combined originating registers have all the options necessary for operation with this system.

Dial Dictation Circuits

Dial dictation trunks were provided and operate on a dial selection basis off the trunk link frames (G108). Control of dictation machine is by dial operation after cut-through on a "1XX" code basis. Attendants and extensions with Touch-Tone calling can not operate the dictation machine.

Tie Line Group Busy Indication

Since attendants have access to tie lines on a dial selection basis only, a special group of lamps have been provided at the 608A cord switchboard to indicate to the attendant a tie line group busy condition. One lamp has been provided for each tie line group.

Night Closing Arrangements

P.B.X. make busy and transfer circuits have been provided which transfer certain of the listed number lines to a call director at a night location and make busy the remaining listed number lines.

Intercept Arrangements

Non-working numbers in number groups provided for the P.B.X. designation are routed to a 7A announcement system with a special announcement for the P.B.X. Blank thousands are routed to regular telephone company intercept. Calls for changed extension numbers can be routed to the attendant on a charge basis.

Holding Times and Capacity Tables

MF originating register holding times for calls originated by 608A cord switchboard attendants are included in Section 2-a. Standard holding times as published in the T.E.P. may be used for engineering all other items of equipment.

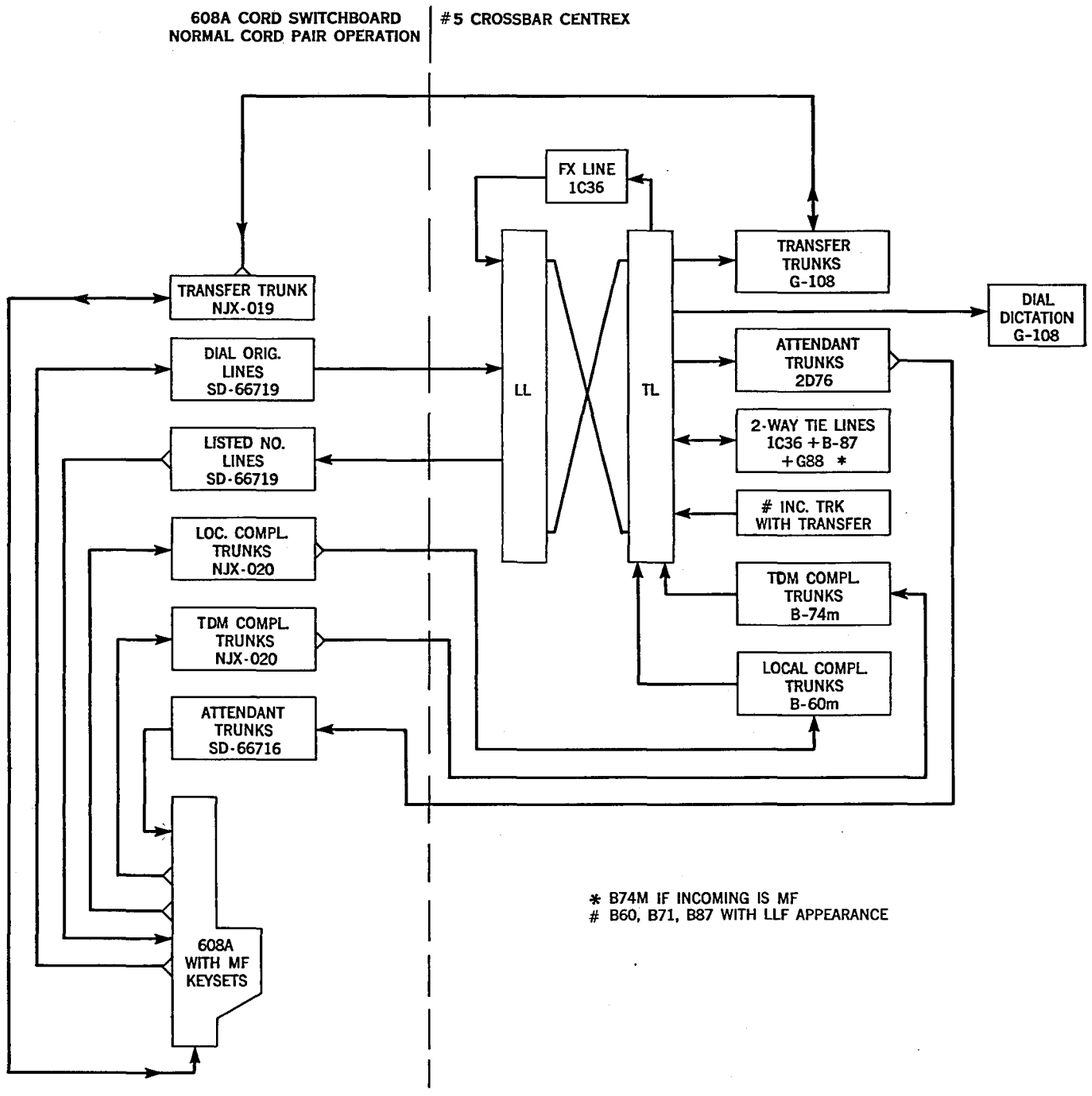

FIG. 1
#5 CROSSBAR CENTREX WITH 608A CORD SWITCHBOARDS
WITH NORMAL CORD PAIR OPERATION FOR THE ATTENDANT FACILITIES

TRAFFIC ENGINEERING NOTES

CENTREX SERVICE

STEP-BY-STEP CENTREX

Section 3

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
Department of Operations
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CENTREX SERVICE

STEP-BY-STEP CENTREX

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CENTREX SERVICE

STEP-BY-STEP CENTREX

GENERAL

The step-by-step Centrex arrangements described in this Section fall into three classifications—

Those which use any PBX type cord switchboard as the attendant position and retain the switchboard in the connection for the duration of the call. (Section 3-b)

Those which require the 608A cord switchboard as the attendant facility. Listed number and transfer request calls can be released from the switchboard by the attendant upon called station answer. All other switchboard calls are retained for the duration of the call. (Section 3-c)

Those providing the 621A console as the attendant facility. In general, calls handled at the console can be released automatically on call station answer. (Section 3-d)

The equipment and operating features described in Section 3-b will, in general, apply to many Centrex CU installations. The existing PBX would be modified for Centrex operation and the present cord switchboards retained as the attendant facilities. It can also apply for new installations if this method of operation is desirable.

The equipment and operating features described in Section 3-c providing the 608A switchboard as the attendant facility can apply for either Centrex CO or CU installations. This arrangement would be recommended for those customers with a relatively large private line network requiring attendant control. With listed number and transfer requests calls being released from the position, the switchboard can be remote from the dial switching gear.

The equipment and operating features described in Section 3-d provide for console operation. These arrangements can be either Centrex CO or CU and would be recommended for those customers with little or no tie trunk requirements. The consoles can be installed at a location remote from the switching equipment.

TRAFFIC ENGINEERING NOTES

CENTREX SERVICE

STEP-BY-STEP CENTREX

USING

CORD SWITCHBOARDS WITH NORMAL CORD

OPERATION AS THE ATTENDANT FACILITIES

Section 3-b

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
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CENTREX SERVICE

STEP-BY-STEP CENTREX

USING

CORD SWITCHBOARDS WITH NORMAL CORD OPERATION AS THE ATTENDANT FACILITIES

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CENTREX SERVICE

STEP-BY-STEP CENTREX

USING

CORD SWITCHBOARDS WITH NORMAL CORD OPERATION AS THE ATTENDANT FACILITIES

GENERAL

Centrex service for step-by-step P.B.X.'s where cord switchboards with normal card operation are provided for the attendant facilities can be implemented with standard arrangements now available. 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 is also possible to route all outgoing traffic from the Centrex directly through a crossbar tandem rather than the local central office.

Several new circuits are now available which permit the provision of Centrex service at a step-by-step P.B.X. where cord switchboards with normal cord operation are used at the attendant positions. These new circuits are:

a. In-dialing trunks arranged for transfer.
b. Transfer trunk finder.
c. Attendant transfer trunk.
d. Outgoing trunk to crossbar tandem.
e. Listed number trunks.

These circuits and the various Centrex arrangements described in the following sections have been designed for use with 700C, 701A, 701B and 702A type P.B.X.'s using 552, 605, 607 and 608 cord switchboards as attendant facilities. Figure 1 is a traffic schematic of the overall plan.

CENTREX ARRANGEMENTS

DID Arrangements

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). Both DID and listed number traffic can be routed over this trunk group or it can be restricted 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 can be a separate incoming train consisting of incoming 1st selectors, incoming 2nd selectors (if required), and incoming connectors. The incoming and local connectors can be combined into a common connector group if desirable.

Associated with each incoming 1st selector is a new in-dialing trunk circuit which is arranged to return answer supervision to the originating office on called station answer. The connection will be held under control of the calling party. An option is provided in the trunk for establishing charge or non-charge supervision to permit the use of this trunk for "free service" calls to official Telephone Company Centrex installations.

DID Transfer Arrangements

The in-dialing circuit is also designed to recognize a switchhook flash from the called DID station as a request for transfer and will signal the attendant. Each circuit can be terminated directly on a jack and lamp at the cord switchboard, or all in-dialing circuits can be concentrated and a fewer number of transfer trunks terminated on the switchboard. Figure 2 illustrates the transfer arrangements possible.

A transfer trunk finder is used to concentrate the incoming trunks to reduce the number of transfer trunk terminations at the switchboard. A maximum of 200 incoming trunks can be terminated on the levels of the trunk finder. The number of trunk finders required depends on the estimated volume of transfer traffic. Associated with each trunk finder

is a new attendant transfer trunk which is terminated on a jack and lamp at the switchboard.

The attendant completes the transfer call in the normal manner with the cord pair remaining in the connection for the duration of conversation. Normal supervision will be received on this connection. The attendant will be able to recall a distant operator, if necessary, over this transfer connection by repeatedly removing and re-inserting her cord in the transfer jack. Any additional transfer request received on this connection will be received as a cord supervisory signal.

The initially called station can remain in the connection after the second station has been added. He can disconnect at any time, however, and his line will be free to receive or originate other calls. No indication of his disconnection is recived by the attendant when it occurs.

Listed Number Arrangements

This traffic can be routed to the P.B.X. in several ways. These include:

1. Combined with the DID traffic from the originating office and routing to the switchboard from a level of the incoming 1st selector (Figure 3a).
2. A separate trunk group from a crossbar tandem modified for P.B.X. translation (Figure 3b).
3. Retention of the listed number in the local central office with no change in the existing arrangements in effect today (Figure 3c).

In the first category (Fig. 3a), the remaining digits not used for routing at the originating office would be pulsed forward to the P.B.X. The first digit received would select the level of the incoming 1st selector assigned to listed number traffic. The new listed number trunks would be assigned to the terminals of that level. The listed number trunks are arranged to absorb none, one, two or three digits as required before signaling the attendant. Completion of the call is via operator first selectors. Should the calling party disconnect before the attendant has released, the circuit will remain busy to prevent re-seizure. Any possible flash by the attendant toward the listed number trunk will not activate the transfer feature in the in-dialing trunk and bring in a transfer signal to the switchboard.

Another possibility in this first category applies to completion from crossbar tandem only. If the tandem has been modified for P.B.X. translation, the listed number is converted to "0" (the listed number must have zero as the last digit) and the "0" is pulsed forward. This restricts the assignment of the listed number trunks to level 0 of the incoming 1st selectors. All other features are as described above.

For the second category (Fig. 3b), a separate trunk group is used for the listed number traffic at the crossbar tandem. The tandem must have the P.B.X. translation features. It recognizes the call as a listed number call and completes the connection on a straightforward basis directly to the switchboard.

The third condition (Fig. 3c), retaining the listed number in the local central office, is no change from existing arrangements in effect today. These trunks can be used for 2-way operation if desirable.

Outgoing Arrangements

Three outgoing arrangements are possible. They are —

1. Route all outgoing traffic through the local central office as it exists today (Figure 4a).
2. Route all local, service code, and operator traffic through the local central office. Establish a new outgoing trunk group to crossbar tandem for all DDD traffic (Figure 4c).
3. Route all outgoing traffic through a crossbar tandem modified to accept it. A new trunk circuit is now available for this purpose. It is arranged for both selector level and switchboard jack termination (Figure 4b). Joint holding features are available on calls to the DSA or toll operators.

In general, the outgoing arrangements described above will require one-way trunk groups. A two-way group could be provided, however, when the listed number traffic is retained in the local office and all outgoing traffic is routed to the local central office.

Intercepting Arrangements

It is recommended that all calls to vacant numbers in the blocks of numbers assigned to this type of Centrex as well as those to any vacant levels in the in-dialing train be routed to a recorded an-

nouncement on a non-charge basis. This arrangement can be provided with 7A recorded announcement facilities.

Calls to changed numbers may be routed to either the recorded announcement or to the attendant for completion. If these calls are routed to the attendant, answer supervision must be returned to the originating office. It is expected that these would be routed to the recorded announcements as soon as the call volume decreases to an acceptable level.

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 these stations 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.

The listed number traffic, with this Centrex System, can be extended to special night telephones when the attendant positions are unattended. These night telephones should be terminated on a separate strip of jacks in the board and will be used for incoming calls only. No switching of the call is contemplated.

Listed number traffic incoming from the local central office (Fig. 3-c) can be extended to the night telephones by patching the regular incoming trunk jacks to the night telephone jacks. The position cords are used and the Night-Thru Dial keys are operated.

When the listed number traffic is routed to the switchboard from a level of the incoming 1st selector (Fig. 3-a) or over a separate trunk group from crossbar tandem (Fig. 3-b) special night jacks must be provided to extend this traffic. The listed number trunk circuit used with these arrangements recognizes a "loop closure" rather than "generator" as a signal to call in the attendant and cannot be patched to the night telephones. An auxiliary line circuit normally used for single digit dialing in Hotel-Motel service for completion from a selector level to a station line must be bridged to each listed number trunk. The auxiliary line circuits would be terminated on night trunk jacks and would be patched to the night telephone jacks with switchboard cords as described above. The auxiliary line circuits would provide ringing current toward the night telephones on incoming calls.

ENGINEERING RECOMMENDATIONS

Engineering recommendations for the Centrex arrangements are covered below for all equipment involved.

	Item	Engineering Recommendation
1.	Incoming trunk group — DID and/or listed number	Table 20
2.	Incoming second selectors (if required)	Table 10
3.	Incoming connectors	Table 10
4.	Combined local and incoming connectors	Table 10
5.	Transfer trunk — terminated directly on switchboard	One jack/trunk
6.	Transfer trunk finders	Table 10
7.	Transfer Attendant trunk	One/trunk finder
8.	Listed number trunks — from incoming selector levels	Table 10
9.	Operator dialing selectors (Note)	Table 10
10.	Outgoing trunks to crossbar tandem	Table 20
11.	Outgoing trunks to the central office	Table 20
12.	Local train equipment will be engineered as specified in the T.E.P. for 701 type PBX's.	

Note — Dial completion of incoming attendant traffic is recommended in all Centrex installations. However, station multiple can be retained for those installations already equipped if the conditions warrant this action.

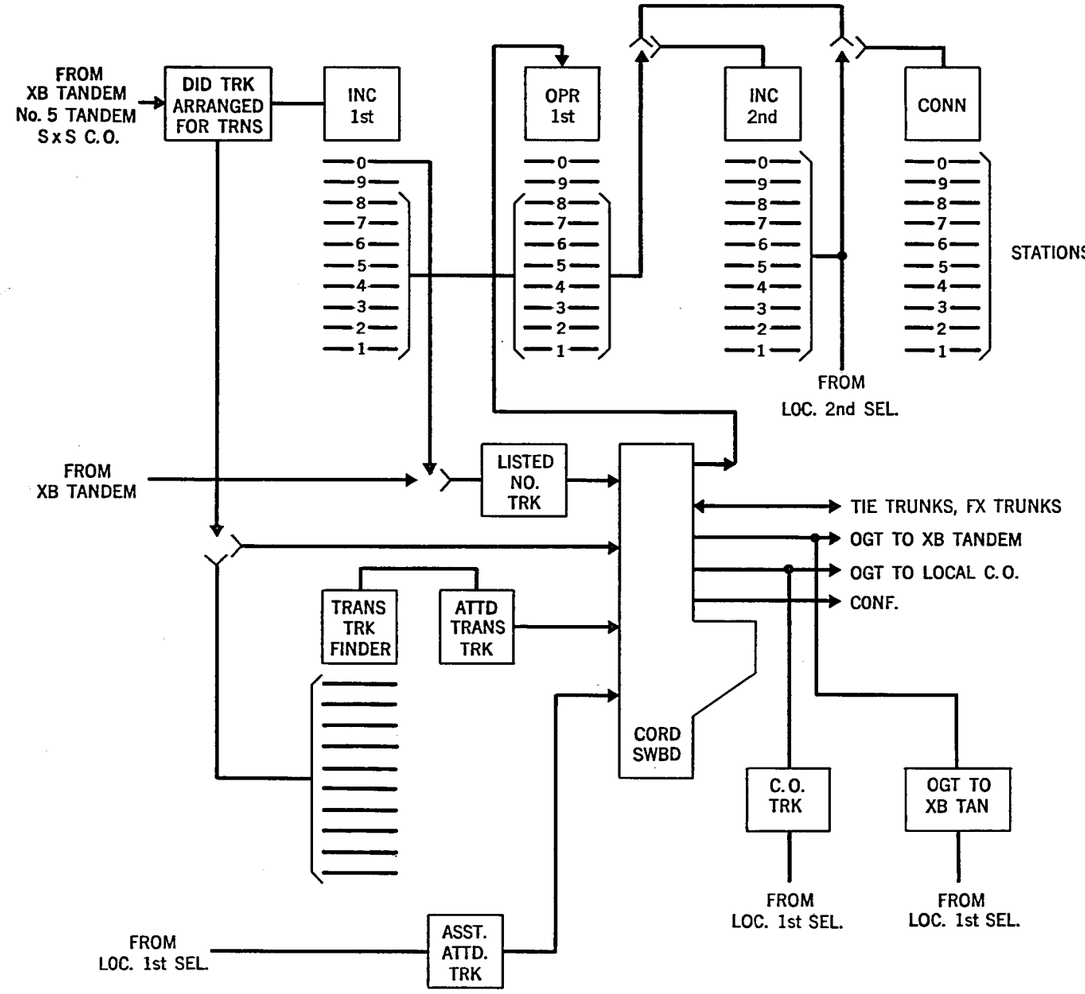
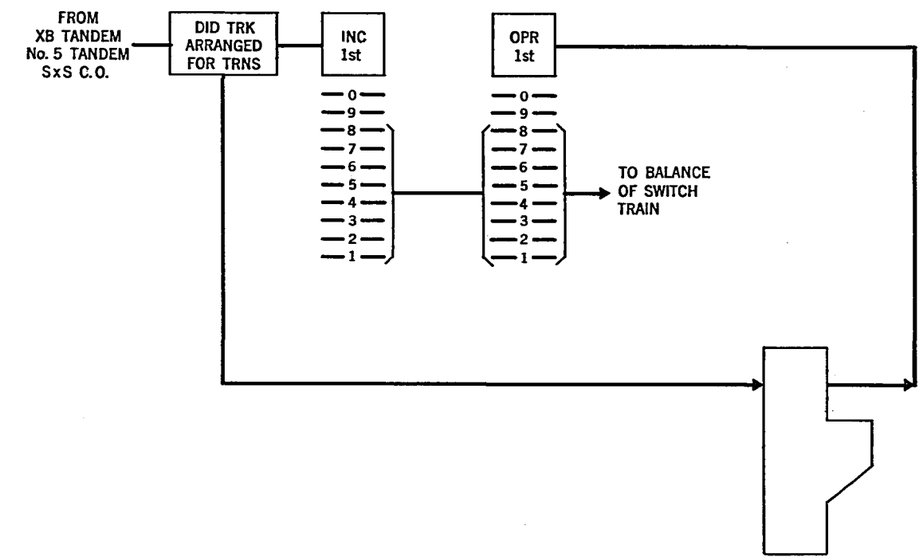


FIG. 1
STEP - BY - STEP PBX ARRANGED FOR CENTREX SERVICE
CORD SWITCHBOARD WITH NORMAL CORD OPERATION FOR ATTENDANT POSITION.

A) DIRECT TERMINATION



B) CONCENTRATION

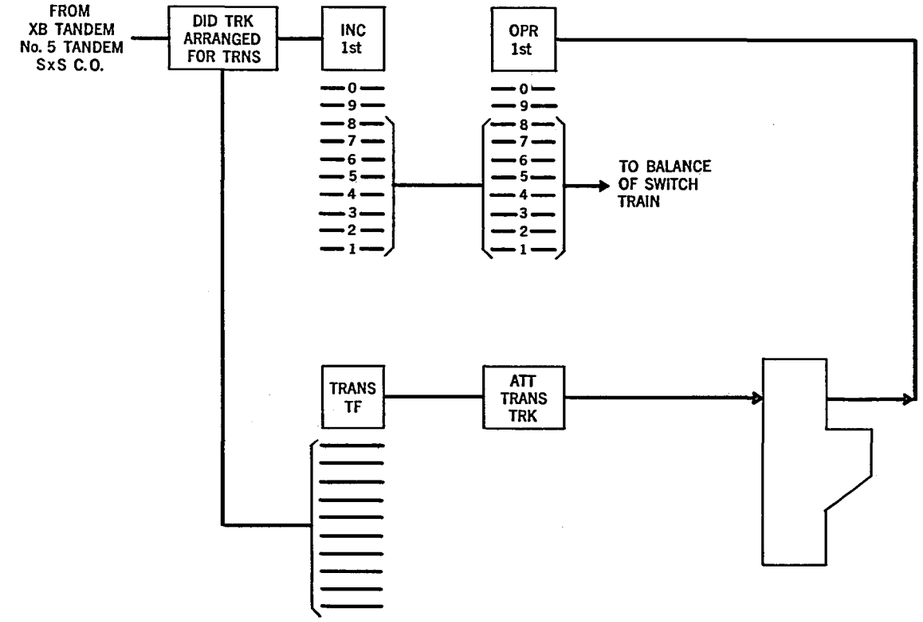
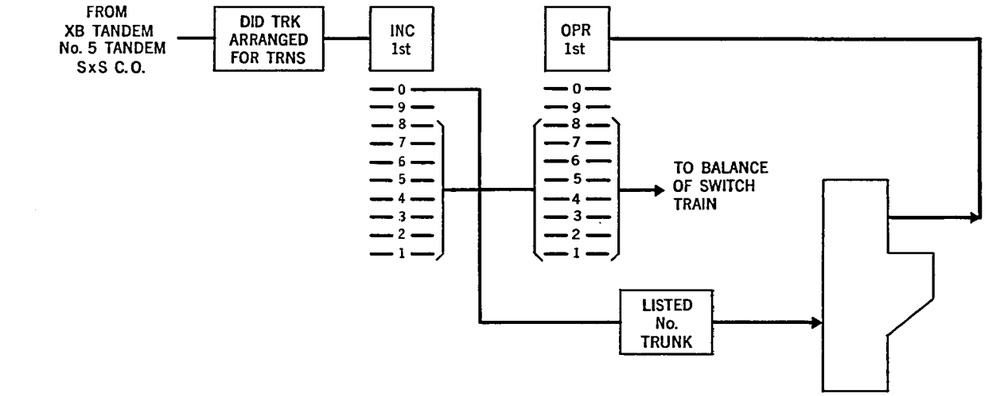
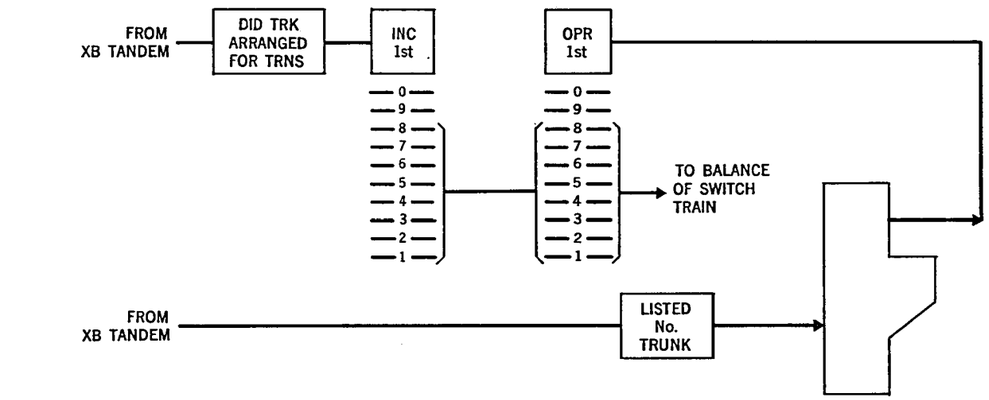


FIG. 2
TRANSFER ARRANGEMENTS

A) COMBINED WITH DID



B) SEPARATE GROUP FROM CROSSBAR TANDEM



C) SEPARATE GROUP FROM LOCAL CENTRAL OFFICE

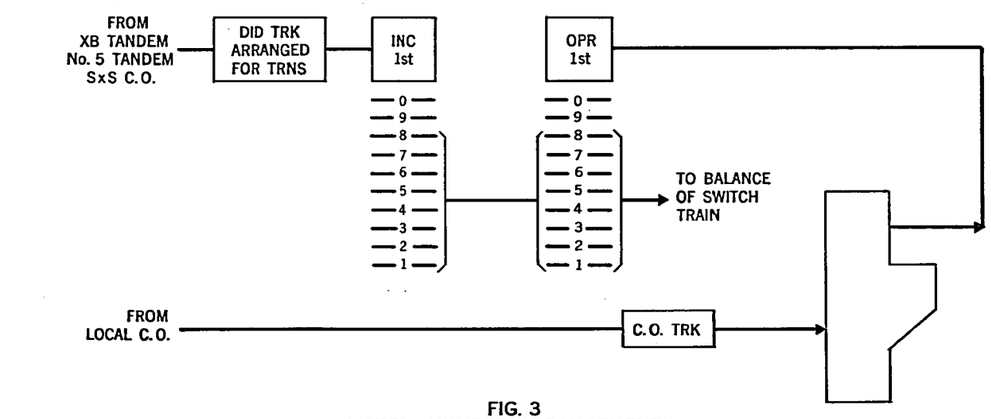
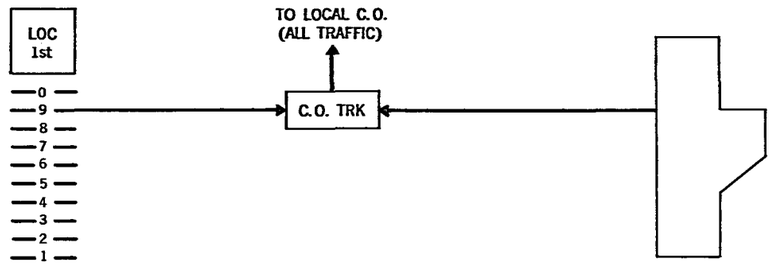
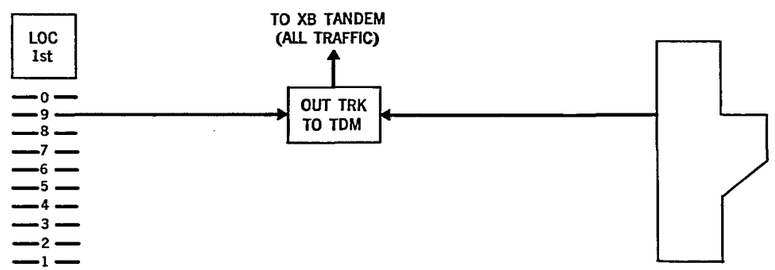


FIG. 3
LISTED NUMBER ARRANGEMENTS

A) ALL TO LOCAL C.O.



B) ALL TO CROSSBAR TANDEM



C) SPLIT

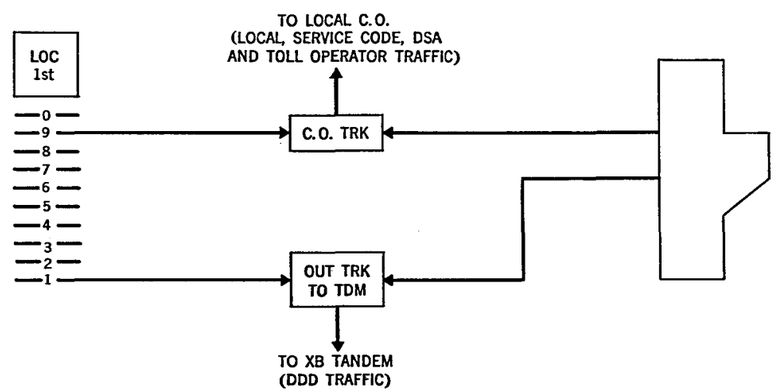


FIG. 4
OUTGOING ARRANGEMENTS

TRAFFIC ENGINEERING NOTES

CENTREX SERVICE

STEP-BY-STEP CENTREX

USING

608A CORD SWITCHBOARDS WITH SINGLE AND

NORMAL CORD OPERATION AS THE ATTENDANT FACILITIES

Section 3-c

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
Department of Operations
May, 1961

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CENTREX SERVICE

STEP-BY-STEP CENTREX

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608A CORD SWITCHBOARDS WITH SINGLE AND NORMAL CORD OPERATION AS THE ATTENDANT FACILITIES

INDEX

CENTREX SERVICE

STEP-BY-STEP CENTREX

USING

608A CORD SWITCHBOARDS WITH SINGLE AND NORMAL CORD OPERATION AS THE ATTENDANT FACILITIES

GENERAL

Centrex service for step-by-step P.B.X.'s where 608A cord switchboards arranged for single and normal cord operation 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 608A cord switchboard.

CENTREX ARRANGEMENTS

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

DID Arrangements (Fig. 2)

A one-way incoming trunk group from the tandem or the step-by-step central office must be established in 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 indialing 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 (Fig. 3)

The indialing 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 indialing trunk to a jack termination on the switchboard. After the attendant has answered and obtained 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, reusing the switch train for this purpose. Upon called station

answer, the attendant can release her position from the connection by removign the cord from the jack. The call distributor will also be released. The established connection will then be as if the call had been directly indialed initially. Subsequent transfers will be handled in a similar manner.

Listed Number Arrangements (Fig. 3)

The incoming trunk group from the tandem or the step-by-step central offices can handle both listed number and DID traffic. A separate listed number group directly from crossbar tandem can also be established. 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, a level of the incoming 1st selector will 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. The operation and final result is similar to the DID transfer call described above. Recalls by the station are the same as transfer requests.

The listed number calls can be routed over a separate trunk group from a crossbar tandem modified for P.B.X. translation (Fig. 3-b). Termination will be in a standard circuit available for this purpose arranged for jack termination on the switchboard. Completion is over the operator selector integrated in the DID train. The connection is retained on the switchboard for duration of conversation. Recalls will be a cord signal.

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

This traffic can also be routed from the local central office for direct termination on the cord switchboard (Fig. 3-b). Standard central office trunk circuits are used for this arrangement. Completion is over the operator selector and the connection is retained on the switchboard for duration of conversation. Recalls will be a cord signal.

Outgoing Arrangements (Fig. 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 features are available on calls to the DSA or toll operators.

These arrangements can be dial selected by stations from the levels of the local 1st selectors. Attendant access will be from jack terminations of these trunks at the switchboard.

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 those to any vacant levels in the in-dialing train be routed to a recorded announcement with non-charge supervision provided. 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 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 battery cut-off key at the switchboard does several things. These are —

Removes the busy from the terminals of listed number level on the incoming first selector, and allows a listed number call to stop on an idle terminal (Fig. 2). Each terminal, as required, is connected to a two-way attendant access loop normally associated with the 621A console. Each loop terminates on the keys of a telephone set modified for this purpose. The night "attendant" can answer the incoming call and extend it to any station since the levels of the associated loop selectors would be connected into the DID train. No recall of the night attendant would be possible after attendant hang-up has occurred.

The transfer feature of the in-dialing trunk is also disabled.

Operation of the battery cut-off key, when listed number traffic is routed over a separate trunk group from the local central office and the C.O. trunk with the associated selector is provided, results in another arrangement. It is—

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. The transfer feature of the in-dialing trunk is disabled.

Direct completion from the local central office or crossbar tandem to jacks on the switchboard requires other arrangements. These are—

The central office trunks can be patched to special night telephones terminating on jacks at the switchboard. Regular cords are used and the Night-Thru Dial key is operated. No switching of incoming calls is contemplated.

The listed number trunks directly from crossbar tandem cannot be patched directly to the night telephones because the trunk circuits recognize a "loop closure" rather than "generator" as a signal to call in the attendant. An auxiliary line circuit normally used in Hotel-Motel service for completion from a selector level to a station line circuit must be bridged to each listed number trunk. These auxiliary line circuits are then connected to special night trunk jacks which are patched to the night telephones as described above. The auxiliary line circuit would provide ringing current toward the night telephone on an incoming listed number call.

The transfer feature of the in-dialing trunk is also disabled.

EQUIPMENT ELEMENTS

Incoming DID Train (Fig. 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 are not required, 3-wire switches can be used. The attendant will receive tones only.

The **in-dial 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 of 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, two-way attendant loops, normally associated with the 621A console, connected to a key telephone modified for this purpose may be terminated on these terminals. When the night closing features

are in effect, the terminals of the listed number level will be used to route the listed number calls to the 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 an indication to the attendant that camp-on is in effect and that subsequent reports are required if the busy condition continues for any duration. The connection will be cut through 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. However, the operation is not as satisfactory since 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

Two call distributors are available with this system — (1) a distributor which applies when more than one Centrex customer is to be served and (2) a distributor which applies when only one customer is to be served.

The following trunk equipments can be connected to these call distributors:

In-dialing trunk arranged for transfer

Incoming central office trunk (with associated selector) used for listed number calls only

Incoming central office trunk (with associated selector) used as FX lines

These call distributors are described in detail in Section 5-d.

Register Sender and Register Sender Link

The attendant completes calls routed to her by dialing the desired termination. Her position can be equipped with a pushbutton dial instead of a rotary dial. Pushbutton dial 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. The attendant operates her start (ST) key to request a register sender. A register sender attached indication (lighting of START lamp) is received to indicate the register sender is attached and that pulsing can start. The attendant always operates 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 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 pushbutton 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. 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. 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 calls to the central office only.

The register sender equipment can be shared by the attendant teams of more than one Centrex customer.

Attendant Loops

This circuit is used as a connecting link between the 608A cord switchboard and incoming trunks associated with the call distributor for DID transfer requests and listed number traffic. The attendant loop, when seized, will alert the attendant by sounding an audible alarm and by lighting the trunk lamp. The trunk lamp will be steady on listed number calls and flashing at 120 IPM on transfer requests.

The attendant loop is arranged for operation with the back cord only (single cord operation). The incoming signal and the audible alarm are retired by inserting the back cord of an idle pair (with TALK key operated) into the associated jack. The attendant associates the position rotary or pushbutton dial with the cord by operating her DIAL BACK key. The camp-on feature applicable to busy stations is included with these arrangements. The supervisory signals received on the back cord are—

a. Station ring—30 IPM wink
b. Station busy—60 IPM flash and busy tone
c. Camp-on in effect—60 IPM flash and no tone
d. Camp-on denied—60 IPM flash and busy tone
e. Switchtrain overflow—120 IPM flash
f. Called station answer—dark
g. Station recall (cord in jack)—120 IPM flash

To disconnect from the cord circuit, the attendant can operate the RLS key or a TALK key associated with another cord. To release the connection from her position after called station answer, the attendant removes the cord from the jack. This releases the call distributor and the attendant loop. The established connection to the called station will then be similar to a DID call. The attendant is recalled by a switch-hook flash from the called station and the connection is re-established as if it were a transfer request.

Splitting for announce calls is achieved by the operation of the SPLIT key with the TALK key operated. The condition is released and the connection bridged through by re-operation of the SPLIT key, operation of the RLS key, or another TALK key. Splitting is an optional feature.

The Release Forward (RLS FWD) key is used to restore to normal any established switch train connection associated with the attendant loop. The cord cannot be removed and re-inserted as with normal cord operation since removal of the cord releases the loop from the position.

Recall of a toll operator connected to an attendant loop on an incoming call can be accomplished with the RING BACK key.

Only single cord operation is possible with these attendant loops. Completion from these loops to FX or tie lines, even though these lines appear in the station multiple, must be on a dial selection basis through the incoming DID 1st or the incoming FX or central office trunk selectors. The connection can then be released from the position on called station answer.

Completion of an incoming listed number call or transfer request on the attendant loop for a conference connection can be accomplished in the following manner (Fig. 1)—

1. Assign an attendant (dial 0) trunk to a terminal of the listed number level of the DID 1st selector with a multiple appearance on the zero level of the incoming FX or central office trunk selector. This level on both selectors would be available on attendant originated calls only.
2. Terminate this attendant trunk on the switchboard multiple.
3. The attendant who answers the loop initially can extend the call to the conference attendant by dialing "0". She releases her cord and position on conference attendant answer. The incoming trunk is now connected directly to the conference attendant.
4. The conference attendant can establish the desired connections using normal cord operation.

Connections to RD tie lines are accomplished in a similiar manner from another level. These tie lines are not arranged for selector level termination.

Incoming FX or Central Office Trunk with Selectors (Fig. 1)

This circuit is arranged for incoming operation in its application within this system. It can be used for foreign exchange trunks or for listed number trunks from the local central office. A selector is associated with each trunk to provide access to the stations and tie trunks. Access to the attendant is provided through the call distributor. Completion is through the associated selector into the DID train. Audible ring is returned to the calling subscriber until the attendant answers on incoming calls. Answer supervision is returned to the originating office on attendant answer. Calling party control is also provided. The called station can originate a transfer request and the attendant can be re-connected through the call distributor.

Operator Selector and Out-Dial Trunk (Fig. 1)

An operator selector is associated with an out-dial trunk circuit terminated on a jack at the switchboard. The selector is intergrated into the in-dialing train. All incoming calls, except those on the attendant loops, can be extended to stations within the Centrex on a dial completion basis over these trunks. Conference connections to stations are completed over these circuits. Splitting, camp-on, and cord supervisory signals similar to those on attendant loop calls will be received. Normal two-cord operation is provided with these arrangements and the connections will remain on the switchboard for duration of conversation.

Other Trunk Circuits

Standard **central office trunks** can be used for outgoing central office calls. These can be both dial selected from stations and jack terminated on the switchboard. Two-way or one-way operation can be provided when these circuits are used to terminate incoming listed number trunks or foreign exchange trunks directly on the switchboard.

Standard **attendant trunks** can be provided for dial "0" attendant access. They can also be used for conference operator and RD tie trunk access (See Attendant Loops).

All standard **tie line trunks** available for step-by-step P.B.X. application can be terminated on this board. Dial access to the attendant should be provided from levels of the DID first selector and the incoming FX or C.O. trunk selector (See Attendant Loops).

Standard **outgoing trunk to crossbar tandem** can be used for all outgoing traffic, or can be used for DDD traffic only if desired. Dial selection by stations and jacks terminations for the attendant can be provided.

Standard jack terminated **conference circuits** are available. For access to conference operator on incoming calls on attendant loops see "Attendant Loops".

Access to a **busy verification** train can be jack terminated on the switchboard if required by the customer.

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 transfer 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)

ENGINEERING RECOMMENDATIONS

Engineering recommendations for this Centrex system 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 units	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 (jack terminated)	as req'd.
11.	Tie trunks—all types	as req'd.
12.	Outgoing trunks to central office	Table 20
13.	Outgoing trunks to crossbar tandem	Table 20
14.	Operator selectors and out trunks	Table 10
15.	Attendant loops	
	(a) associated with single customer call disrtibutor	one/TF
	(b) associated with multi-customer call distributor (see Sec. 5-d for loop HT)	Table 10
16.	Local train equipment will be engineered as specified in the T.E.P. for 701 type P.B.X.'s	

Attendant position requirements will be covered in Section 5 of these Notes

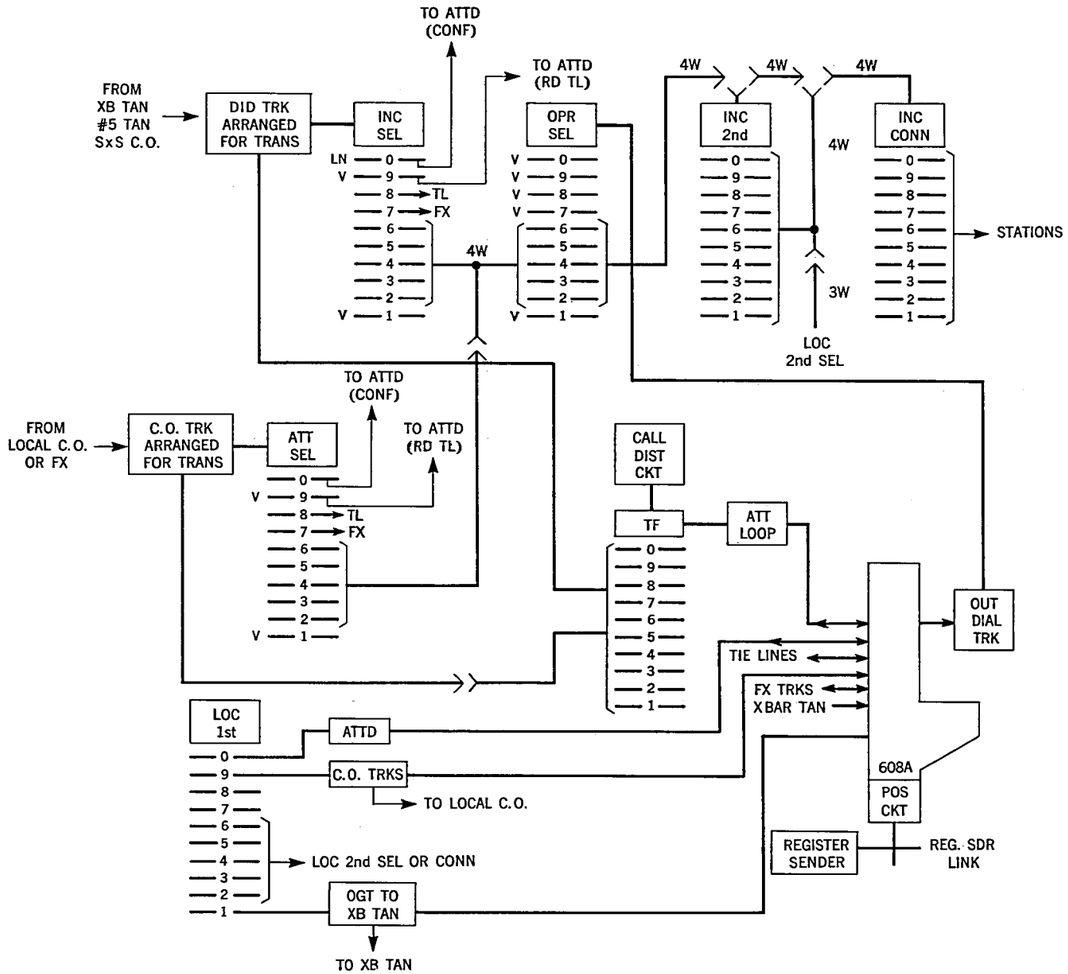


FIG. 1
STEP-BY-STEP CENTREX
608A CORD SWITCHBOARD WITH SINGLE & NORMAL
CORD OPERATION FOR ATTENDANT FACILITIES

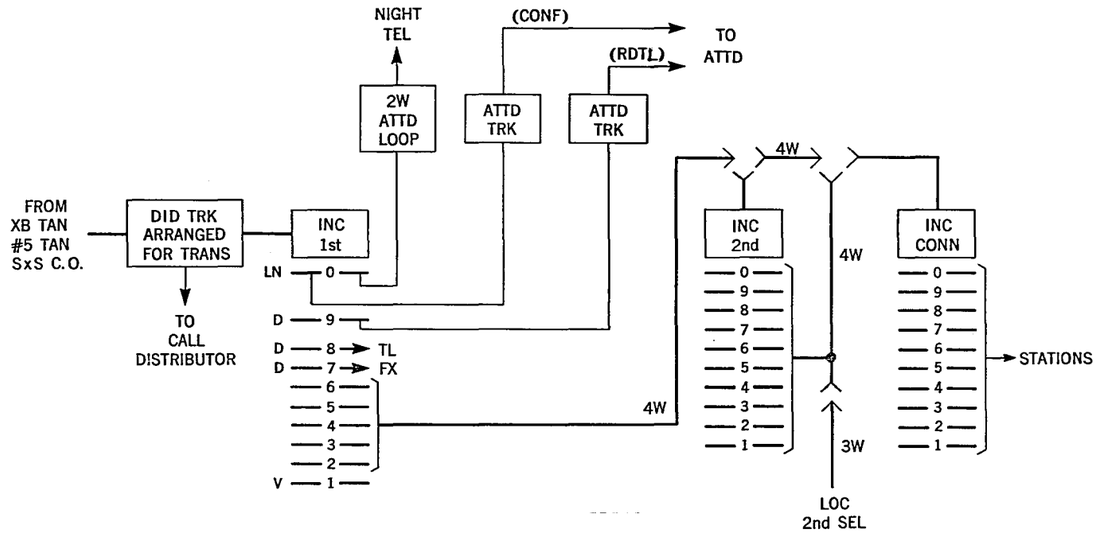
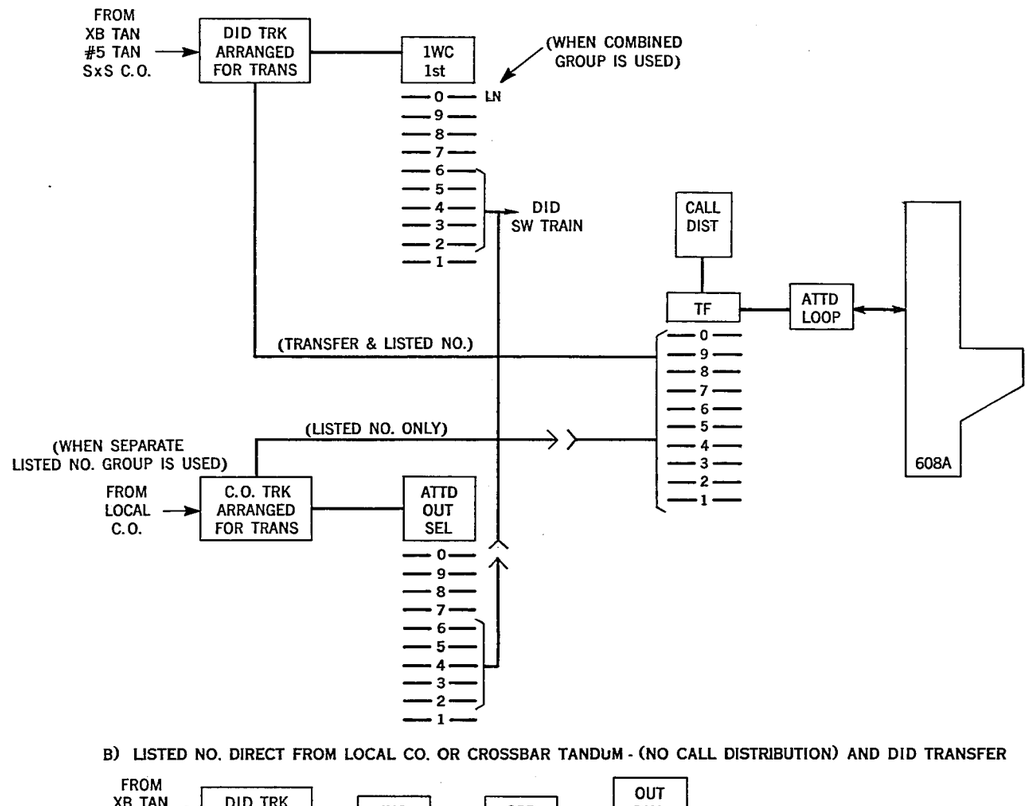


FIG. 2
DIRECT INDIALING TRAIN

A) LISTED NO. AND DID TRANSFER - CALL DISTRIBUTOR ACCESS



B) LISTED NO. DIRECT FROM LOCAL CO. OR CROSSBAR TANDUM - (NO CALL DISTRIBUTION) AND DID TRANSFER

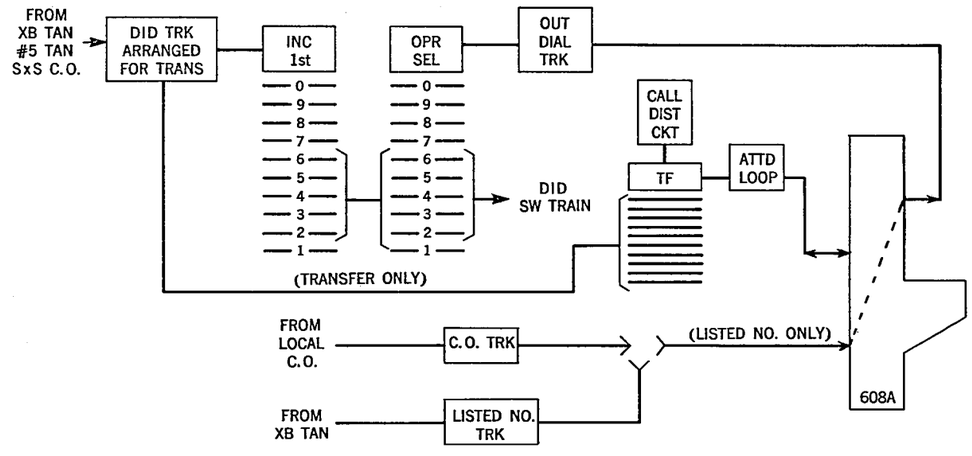
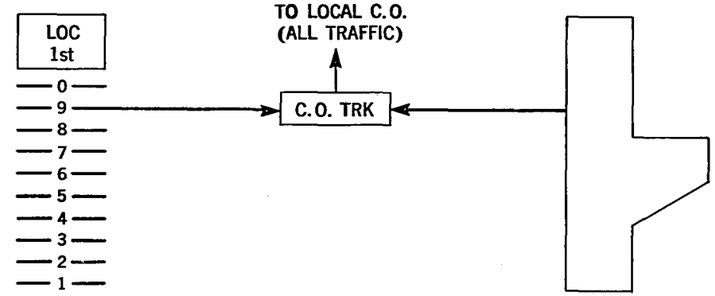
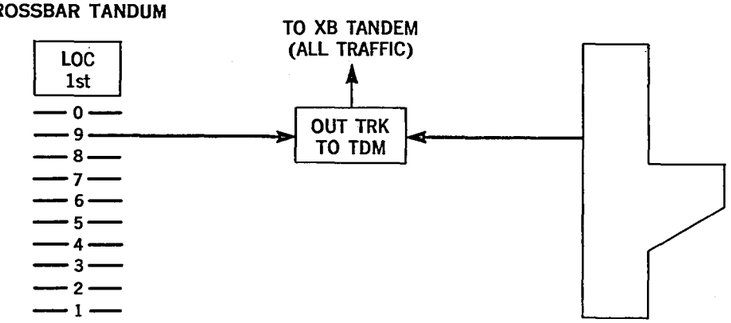


FIG. 3
CONNECTIONS TO ATTENDANT POSITION FOR LISTED NUMBER AND DID TRANSFER CALLS

A) ALL TO LOCAL C.O.



B) ALL TO CROSSBAR TANDUM



C) SPLIT

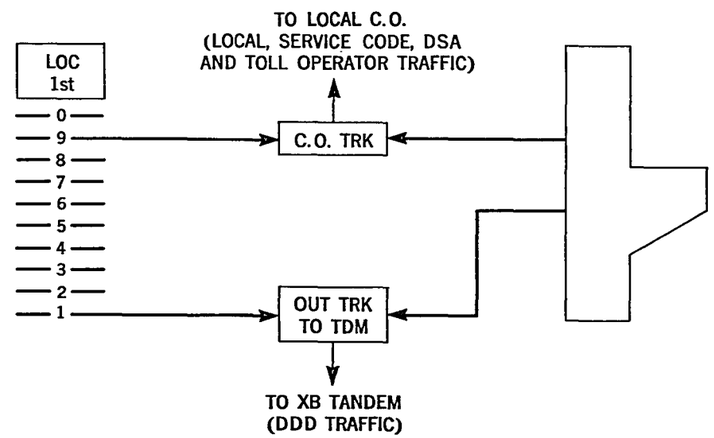


FIG. 4
OUTGOING ARRANGEMENTS

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May, 1961

TRAFFIC ENGINEERING NOTES

CENTREX SERVICE

STEP-BY-STEP CENTREX

USING

CONSOLES FOR ATTENDANT FACILITIES

Section 3-d

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
Department of Operations
May, 1961

Printed in U. S. A.

CENTREX SERVICE

STEP-BY-STEP CENTREX

USING

CONSOLES FOR ATTENDANT FACILITIES

INDEX

CENTREX SERVICE

STEP-BY-STEP CENTREX

USING

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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

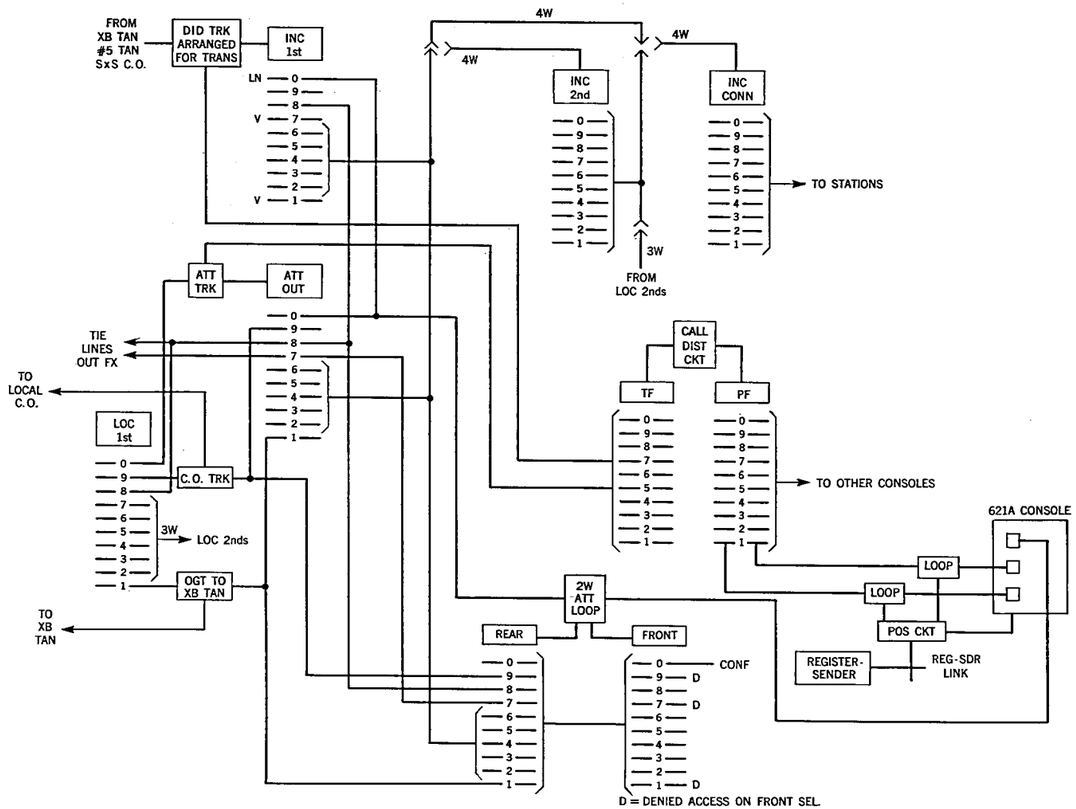
All traffic registers available with standard 701B PBX equipment are applicable with these facilities. In addition, Peg Count registers may be associated with the indialing trunks arranged for tranfer to score individually (1) total DID calls, (2) total listed number calls, and (3) total transfer calls.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



D = DENIED ACCESS ON FRONT SEL.

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

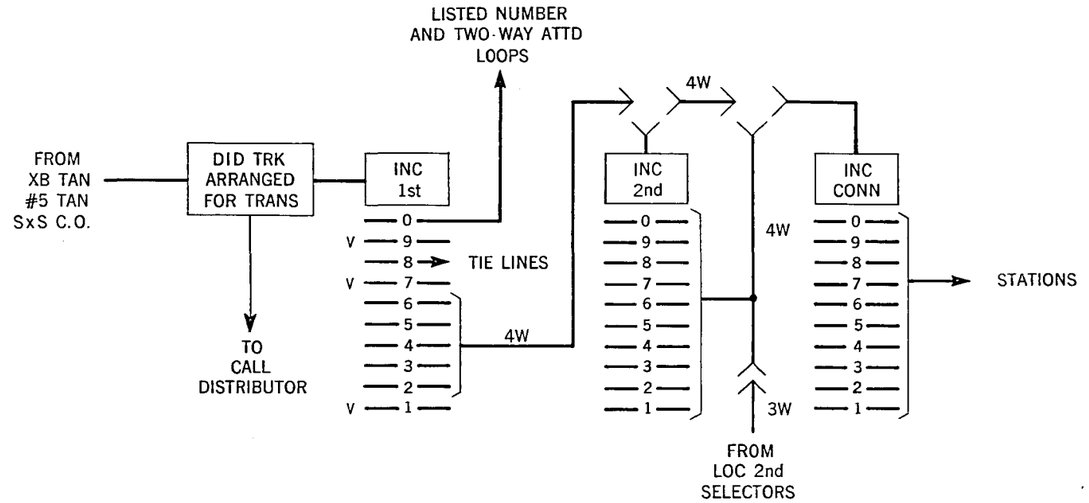
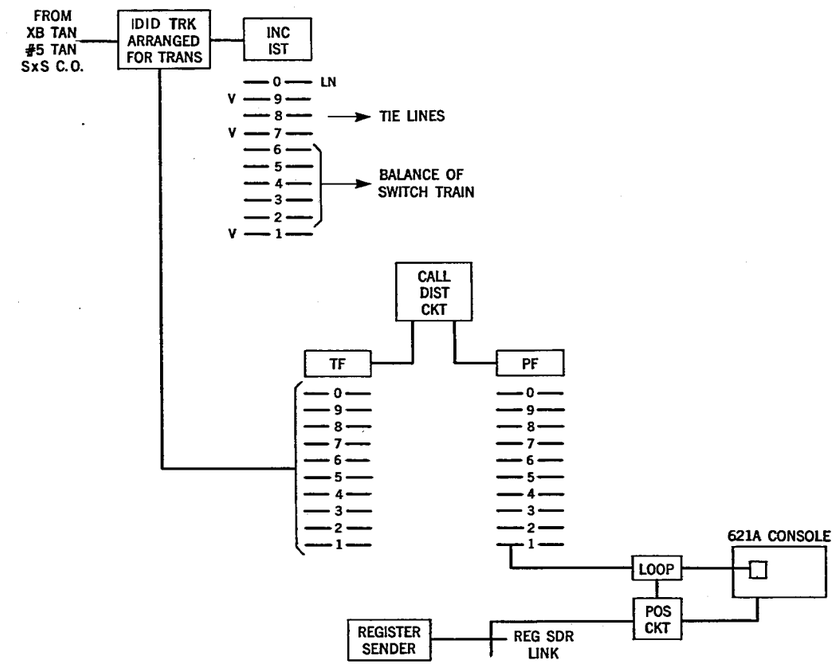


FIG. 2
DIRECT INDIALING TRAIN
(TYPICAL)

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



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

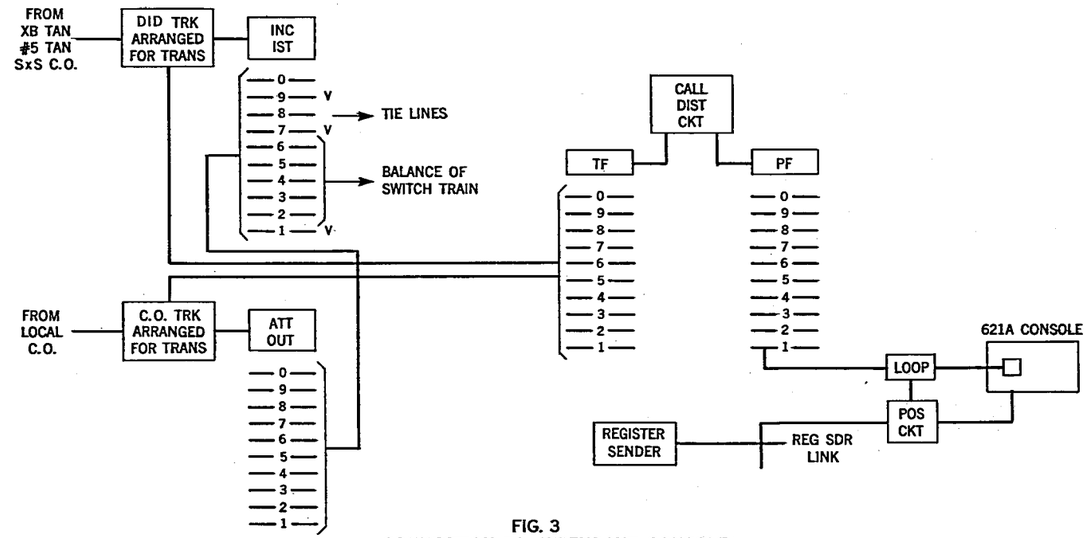
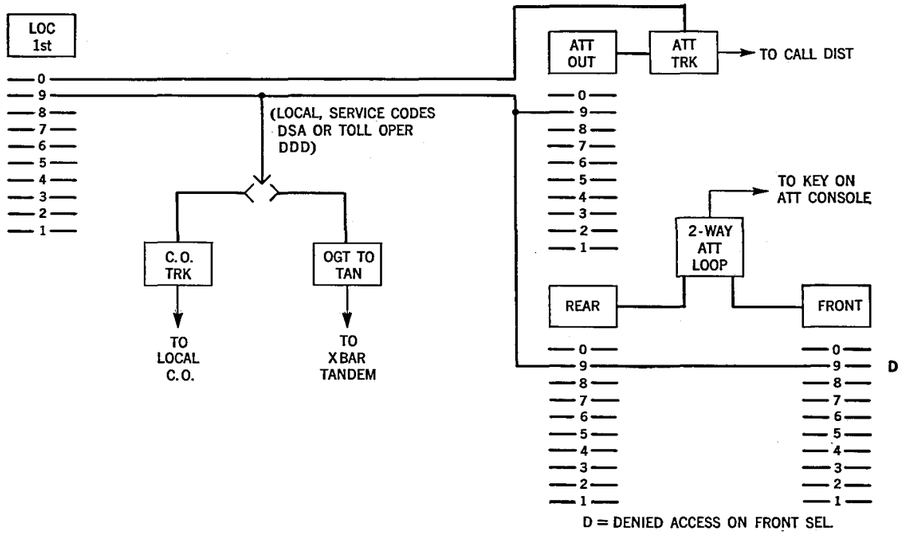


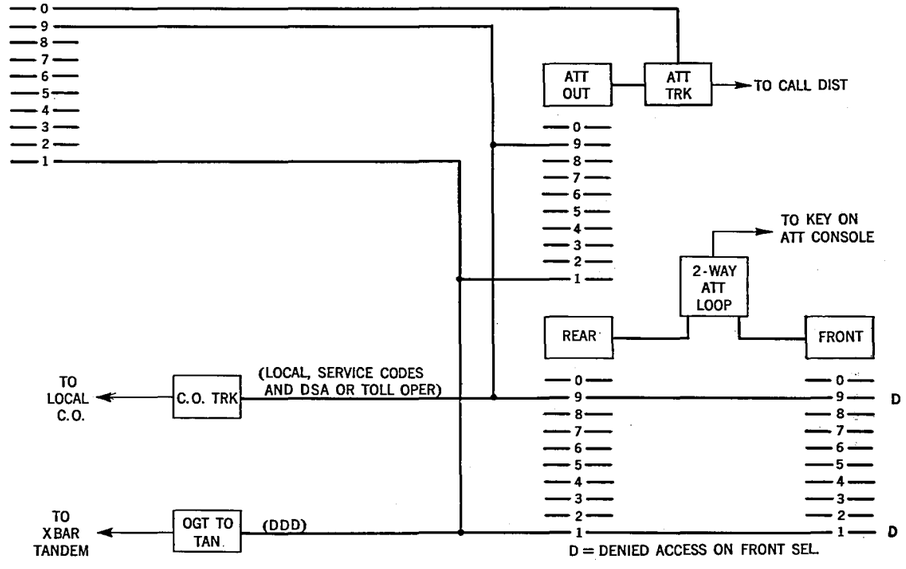
FIG. 3
CONNECTION TO ATTENDANT CONSOLE
(TYPICAL)

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)

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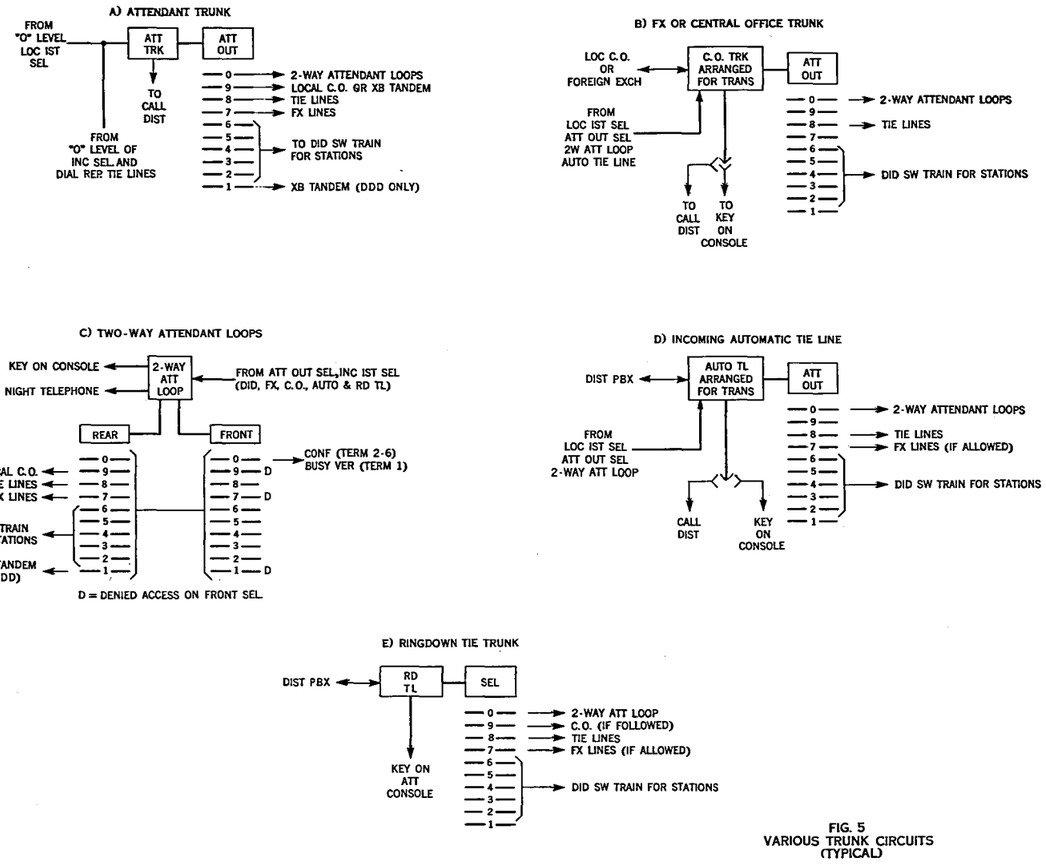

FIG. 5
VARIOUS TRUNK CIRCUITS
(TYPICAL)

TRAFFIC ENGINEERING NOTES

CENTREX SERVICE

STEP-BY-STEP CENTREX

CENTREX C.O. ARRANGEMENTS

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CENTREX SERVICE

STEP-BY-STEP CENTREX

CENTREX C.O. ARRANGEMENTS

Centrex C.O. service can be made available for customers using step-by-step equipment instead of No. 5 crossbar equipment. Basically, two arrangements are possible—(1) combining the Centrex customers with regular subscribers in a partially equipped step-by-step central office, or (2) providing a centralized location for the dial P.B.X. equipment required to serve both Centrex and regular P.B.X. customers occupying a large office buliding or a group of nearby office buildings. Both arrangements locate only the attendant positions for each customer on his premises.

Central Office Location

To illustrate the first arrangement, the vacant thousand blocks of numbers in a partially equipped step-by-step central office which are not assigned to regular subscribers can be used for Centrex customers. All incoming traffic to both regular and Centrex customers would be over common trunks. Distribution would occur at the 4th selectors to the regular subscribers and each Centrex customer. Each Centrex customer would have an in-dialing train and a local train which would be available for his use only. Outgoing traffic to local subscribers, service codes, and DSA or toll operators could be handled on a standard P.B.X. basis, i.e., central office trunks to line equipment in the central office with dial "9" and/or attendant access. Common trunks to the CAMA office can be used for both Centrex and regular customers. Automatic number identification could also be possible for the Centrex customers if this feature is available for regular subscribers. Details of this arrangement are covered in Section 8 of these Notes for the step-by-step central office. The in-dialing trains for these Centrex customers are covered in Sections 3-b, 3-c, and 3-d.

Centralized Location

The dial equipment required to serve both Centrex and regular P.B.X. customers occupying a large office building or a group of nearby buildings can be installed in a centralized location either leased or owned by the Telephone Company. Several advantages are achieved with this plan—

1. Floor space and power for the dial equipment, normally provided by the customer on his premises, will no longer be required. Space for his attendant positions will still be a requirement, however.

2. The centralized equipment will be engineered to provide the flexibility to add or remove dial equipment as necessary.

3. Service to new customers can be handled promptly. Vacated or spare facilities can be assembled to meet this customer's needs.

4. Common maintenance coverage for all customers will be supplied.

Engineering of these installations must be liberal to provide the facilities to meet the fluctuating demands possible with this arrangement.

701B P.B.X. equipment is provided for these centralized locations. Each customer's facilities are individual to him only. No interconnection between customers on an intercom basis (except over private tie line groups) will be possible. The Centrex customers are provided an in-dialing train operating as described in Section 3-b, 3-c, or 3-d of these Notes. Incoming traffic to them could be handled over a common trunk group with distribution provided (4th selectors) to reach each Centrex customer. Individual incoming trunk groups to each Centrex customer can also be provided if necessary. Regularly P.B.X. customers would be served from a local central office as they are today. Outgoing traffic from Centrex customers would be handled as described in Section 3-b, 3-c, or 3-d of these Notes. A possible exception would be a combined group of trunks to the CAMA office to handle the DDD traffic for all Centrex customers. Regular P.B.X. customers would be routed to the local central office as they are today.

In general, only CAMA operator identification of outgoing DDD calls from these Centrex customers will be available at this time.

The basic modifications in the 701B equipment required for this plan are—

1. Flexibility is required to add or remove equipment. This is provided for all switches, trunks of all types, call distributors, attendant loops, console position circuits, and access to the register senders through the position link when DC pushbutton dials are provided at the attendant positions.

2. Dial rather than station multiple completion to stations on attendant handled calls will be required.

3. The line groups can be arranged to serve 200 lines or two groups of 100 lines.

4. The line finders are modified to permit their use with either 100 or 200 line groups.

Figure 1 illustrates a typical installation for Centrex customers.

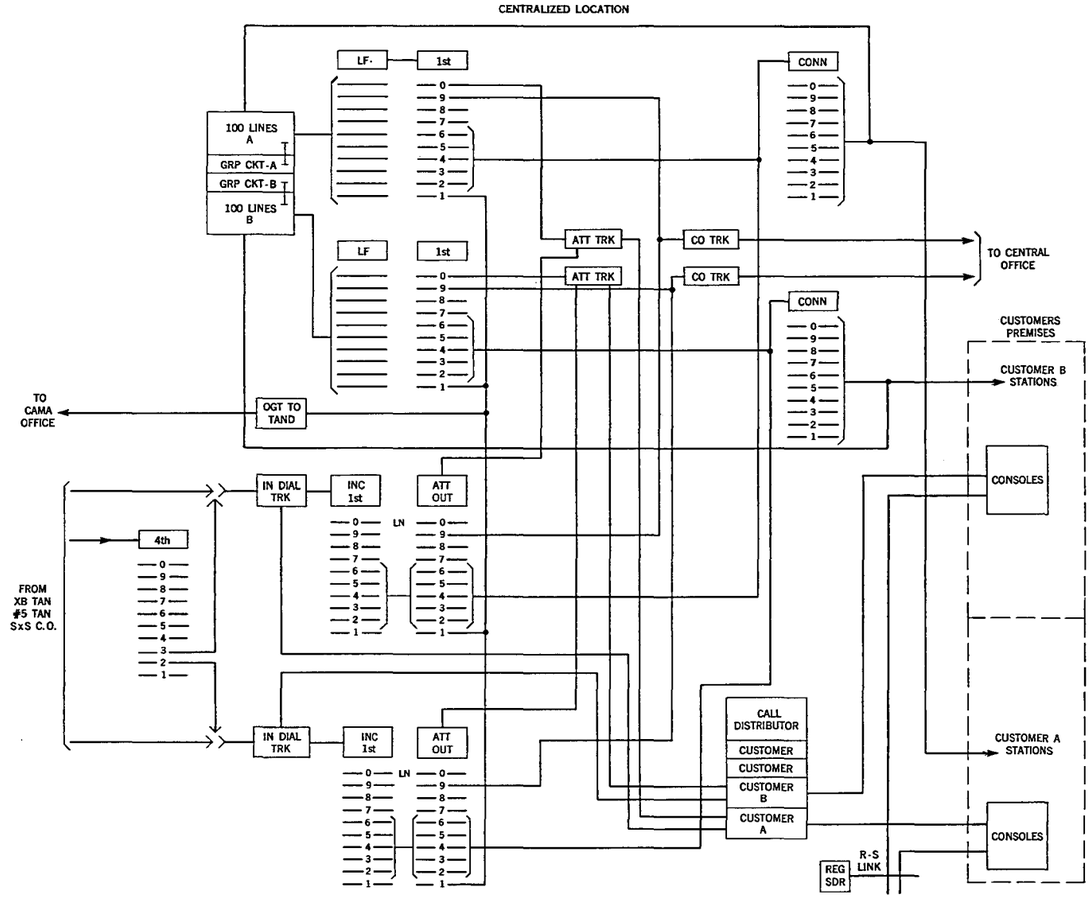

FIG. 1
CENTREX CO ARRANGEMENTS WITH S x S FACILITIES

TRAFFIC ENGINEERING NOTES

CENTREX SERVICE

STEP-BY-STEP CENTREX

AUTOMATIC NUMBER IDENTIFICATION

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CENTREX SERVICE

STEP-BY-STEP CENTREX

ANI FACILITIES

Automatic number identification can be provided for step-by-step Centrex CO customers under the following conditions—

1. The dial equipment associated with the Centrex customers is located in a step-by-step central office building.
2. Standard ANI equipment has been provided for the regular subscribers in that central office building.
3. The local switching train for each Centrex customer is No. 1 or 350 type step-by-step equipment.
4. Direct access to the CAMA office is provided in the local switching train for each Centrex customer for DDD traffic. This direct trunk group can be common for all Centrex customers and can be included in the trunking arrangements serving the regular customer if feasible.
5. The central office code associated with the Centrex customers must be included in the recorder group at the CAMA office in which the trunks terminate.

Automatic number identification facilities applicable with step-by-step Centrex CU installations and those centralized installations of 701B PBX equipment located in leased space in large office buildings is not available at the present time. Studies are under way at the Bell Laboratories to determine a practical solution to the problem. Requirements have been established by representatives of the Operations Department of the American Company. It has been estimated that the ANI facilities designed to meet these requirements will be available in 1964 at the latest. Every effort is being made to secure them at an earlier date.

TRAFFIC ENGINEERING NOTES

CENTREX SERVICE

SATELLITE OPERATION WITH CENTREX SYSTEMS

Section 4

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CENTREX SERVICE

SATELLITE OPERATION WITH CENTREX SYSTEMS

Many of our P.B.X. customers who are potential candidates for Centrex service have their employees at more than one location. They either have satellite P.B.X. installations or have provided separate P.B.X.'s with attendants at these locations. When one of these customers is interested in Centrex service, he will, in most cases, require this service for all his stations and the provision of the attendant facilities at one location only. Each customer with these requirements must be given individual consideration. We do not intend to present in these Notes a solution to every possible combination which can exist. We do, however, intend to offer some broad ground rules which can be applied in these cases.

No. 5 Crossbar Centrex Installations

The No. 5 crossbar Centrex development, as it is today, **can not** include the satellite stations in the overall numbering plan for a Centrex customer **if the 711 type dial equipment is retained at the satellite location.** All incoming calls to these stations must be routed through the customer's attendants for completion. This completion will be over tie lines between the two systems. Intercommunication on a two-way basis between the Centrex and the satellite stations can also be completed over these tie lines. Future development will make it possible to include these satellite stations in the Centrex customer's overall numbering plan.

It is possible to **include** these satellite stations in the No. 5 crossbar Centrex **if these stations are terminated directly in the Centrex installation.** In this case, they would be equivalent to regular Centrex stations and loose their identity as satellite stations. The same attendant team would serve all stations and no tie lines would be required for intercommunication between stations. The distance of these stations from the No. 5 Centrex will require consideration in this case.

This satellite location can also be served from another No. 5 Centrex different from that serving other stations of the same customer. In this case, this location must be treated as a separate Centrex customer with its own attendant facilities to provide all the features available with Centrex service. Intercommunication between the customer's stations in each Centrex can be over tie lines if desirable, or can be over the regular telephone network combined with regular subscriber traffic.

Step-by-Step Centrex Installations

All the customer's stations can generally be provided Centrex service when step-by-step facilities are used. The dial facilities can be retained at the various locations and one attendant location can be provided. This requires the introduction of a universal numbering plan for all stations. This could require some rearrangements at some locations, and in some cases, complicate the intercommunicating trunk pattern. Any of the equipment arrangements described in Section 3 of these Notes can apply.

Those described in Section 3-b (cord switchboards, with normal cord operation as the attendant facilities) are very similar to normal P.B.X. operation. The controlling factor in routing incoming DID traffic to each location is the transfer feature. If separate trunk groups to each location are provided, each group of indialing trunks can be concentrated and only a relatively small number of transfer trunks returned to the switchboard. Since the transfer connection is retained on the position for the duration of the call, the transmission of the established connection can be affected if too much back haul results from this arrangement.

The equipment arrangements described in Sections 3-c and 3-d (608A switchboards with single and normal cord operation or 621A consoles as the attendant facilities) will generally require tandem routing through the dial equipment nearest the attendant location for all DID traffic to the satellite stations. This is necessary because of the method of operation employed for transfer and listed number calls (release loop operation). It is possible to route from the serving office directly to each location if this is required. In this case, the transfer traffic must be handled at a console position at that satellite. Again back haul problems resulting in

transmission difficulties must be considered. Another possibility, when the 608A switchboard is used, is to provide separate indial trunk groups to each location, as required, with the equipment for the satellite location arranged as described in Section 3-b. Transfer trunks would be terminated at the cord switchboard and normal cord operation used to handle this traffic. Again, the same problems of back haul exist.

Outgoing traffic from each location presents a problem also. Local and service code traffic can be routed to the serving central office nearest each location. Toll operator traffic should be routed to the same serving office for all locations since they all now have the same central office code. This can be over separate trunk groups or through the main location. DDD traffic from each location can be over individual trunk groups but these trunks should be terminated in the same recorder group at the CAMA office. This traffic can also be routed through the main location.

If Centrex-CO operation is provided for the stations of the main location, ANI can be available for these stations only. The identification for the satellite stations (when the dial eqiupment is retained at that location) must be on a CAMA operator basis until ANI equipment is developed for use with 701 P.B.X. facilities.

TRAFFIC ENGINEERING NOTES

CENTREX SERVICE

ATTENDANT FACILITIES

Section 5

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CENTREX SERVICE

ATTENDANT FACILITIES

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ATTENDANT FACILITIES

GENERAL

Section 5-a

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CENTREX SERVICE

ATTENDANT FACILITIES

GENERAL

The service features offered with Centrex should permit a good portion of the incoming traffic to a customer to be completed directly to the desired station without attendant assistance. These features will also permit a good portion of the outgoing traffic to be dialed from the individual station. The remainder of the traffic, both incoming and outgoing, will require routing to the customer's attendant for completion. Several types of attendant facilities are available for this purpose.

These attendant facilities include both console and cord switchboard positions. Pushbutton dialing has been included as an operating feature in both the consoles and the cord switchboards. However, the 608A cord switchboard is the only one being modified, for System application, to include this feature. The various facilities and their application within the different Centrex arrangements available will be described briefly below.

The **621A console** will function with a SxS system incorporating modified 701B type facilities as the in-dialing train. In general, the listed number, DID transfer, dial "0" and certain tie line calls reaching the attendant will be released automatically from the position on called station answer, releasing the attendant console from the established connection.

The **622A console** will function with a No. 5 crossbar Centrex system arranged for multi-Centrex customer application. Its functions are very similar to those of the 621A console.

The **552, 605, 607 and 608 type cord switchboards,** arranged for **normal cord operation,** are applicable to a SxS Centrex where the connection through the position for any attendant traffic is retained for duration of conversation. The 608A switchboard can be equipped for DC pushbutton dialing. All types can be equipped for rotary dial operation. Station multiple can be used in some instances if desirable.

The **608A cord switchboard** can be equipped with MF pushbutton dials when associated with one version of the No. 5 crossbar Centrex. **Normal cord operation** will apply and any connection through the switchboard will be retained for duration of conversation.

The **608A cord switchboard arranged for normal and single cord** operation can be applied to both SxS and No. 5 crossbar Centrexes. With both systems, the equipment arrangements permit listed number and transfer calls to be handled on a single cord basis. The attendant can release the cord on called station answer. This releases the switchboard from the established connection. All other connections will be on a normal basis and will be retained for duration of conversation. The SxS Centrex application will provide 2-out-of 5 DC pushbutton dials or rotary dials for the position. The No. 5 Centrex application will provide MF pushbutton dials only. The 608A application for the No. 5 crossbar Centrex is still under development at this time.

Details of these above attendant facilities will be covered in the following sections. The 552, 605 and 607 type cord switchboards will be omitted, however, because sufficient information is already available in existing T.E.P.'s.

TRAFFIC ENGINEERING NOTES

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ATTENDANT FACILITIES

CONSOLES

Section 5-b

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CENTREX SERVICE

ATTENDANT FACILITIES

621A CONSOLE

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CENTREX SERVICE

ATTENDANT FACILITIES

621A CONSOLE

The 621A console (Figure 1) is applicable with a step-by-step Centrex system incorporating modified 701B step-by-step equipment as the in-dialing train. The associated 701B facilities are described in Section 3-d of these notes.

The console can be located on top of a desk or table. It is encased in a sloping plastic case approximately 15" wide, 12" deep and 6" high. The case is available in four colors — ivory, moss green, light gray and light beige. The connecting cord is available in the same colors and is arranged for plug-in termination. Two pairs of head set jacks are provided in the left side panel of the console.

The console may be equipped for 10 trunk or loop terminations (621A-1 console) or for 20 trunk or loop terminations (621A-2 console). All apparatus mounted in the front surface is arranged to be plugged in and all keys are of the non-locking type. Figure 2 illustrates the key panel layout. Details of the functions of the keys and lamps included in the key panel are described below.

Trunk or Attendant Loop Terminations

Each trunk or attendant loop termination consists of a key and the associated source and destination supervisory lamps. This apparatus is used to terminate attendant loops (release type), two-way attendant loops (non-release type), and any foreign exchange lines, automatic or ringdown tie lines requiring direct key terminations.

The **key** is non-locking and, when operated, will connect the attendant to the trunk or loop. Operation of this key lights it to indicate to the attendant that she is now connected. Attendant release from the trunk or loop will extinguish the key lamp. If a call is held on a trunk or loop while other calls are handled, the key will "wink" while the trunk or loop is in this condition.

The **source supervisory lamp** will flash at 60 or 120 IPM to indicate an incoming call. It becomes steady when the key is operated. Supervisory signals from the source of the call are received on this lamp. The lamp is darkened when the trunk or loop is released from the position.

The **destination supervisory lamp** displays the supervisory signals for the destination of the call. Called station being rung (30 wink), called station busy (60 IPM flash), called station answer (steady), overflow in switching train (120 IPM flash), outgoing central office trunk connected (steady) are some of the supervisory indications displayed.

Figure 3 illustrates the signals for some of the basic conditions occurring in handling calls at this console.

Control Keys

There are two groups of control keys provided with this console. The group to the immediate right of the trunk or loop terminations are used more often than the group located at the extreme right side of the console. The function of each of these control keys is described below.

a. **Release Key (RLS)**
This key releases the attendant's position circuit from the trunk or loop. Its operation makes the position available to receive another call. It will be lighted to indicate the position available condition.

b. **Hold Key (HOLD)**
The operation of this key places the call on the trunk or loop to which the attendant is connected in a "hold" condition and locks it on the position. The trunk or loop key will "wink" when this occurs.

c. **Release Forward Key (RLS FWD)**
The operation of this key releases any established connection toward the destination of the call. It is used to release the station originating a transfer request to permit re-use of the switching train for the new connection.

d. **Camp-on Key (CAMP-ON)**
This key is used to control the camp-on feature available with this SxS Centrex. This

feature permits an attendant handled call to camp-on a busy station for automatic connection when that station releases from the call in progress.

e. **Position Busy (POS BSY)**
The operation of this key removes the position from the operating team even though the position is still occupied. The key will be lighted until the position busy condition is removed by reoperation of the key.

f. **Supervisor Key (SUPV.)**
This key is used to call a supervisor. It will flash at a 60 IPM until the supervisor has plugged into the position. Incoming calls are not blocked out of the position when this key is operated.

g. **Trunk Release Key (TRK RLS)**
This key will release any attendant loop from the position when that loop has become a permanent signal.

h. **Flash Key (FL)**
This key is used to flash toward the central office on an attendant established LD call to a toll operator. The loop or trunk must still be on her position to perform this function.

i. **Ring Key (RING)**
This key is used to recall an extension held on an attendant trunk, or to recall a toll operator on an incoming call held on the attendant position.

j. **Split Key (SPLIT)**
This key is used to split the trunk from the connection, for example, on an announce call. Reoperation of the loop or trunk key removes the split. The key is illuminated when the connection is split.

k. **Night Connection Key (NITE)**
This key will appear in only one position of the team. Its operation will transfer listed number calls to the night termination and the key will be lighted. Reoperation of the key releases the night connection arrangements.

l. **Key Pulse Rear Key (KPR)**
This key will appear in the positions equipped with two-way attendant loops and FX key ended trunks. It is used to transfer the loop or trunk from one direction of operation to the other.

m. **Busy Verification Key (BV)**
Busy verification features are optional and are provided only upon customer request. This key is located in one position only—the position with the two-way attendant loops. It permits the attendant access to the no-test train for verification of busy extensions.

n. **Line Key (LINE)**
This is the attendant's extension line for use on outgoing calls only. The use of the line does not make the position busy to incoming calls.

Pushbutton Dial Unit

This unit contains the pusbutton dial with its associated START and END keys and register sender connected (RL) lamp.

Other Items

The audible signal control keys, (OFF-ON and VOLUME) and a calls waiting (CW) lamp are mounted above the dial unit.

Operating Room Arrangements

It is not necessary to arrange the consoles in a line-up similar to that provided for cord switchboards. All positions included in the operating team should be within the confines of the allocated operating room space but can be located according to the customer's desires.

Position Arrangements

It is recommended that one position in the team contain the two-way attendant loops, the busy verification feature (if provided), and the night closing key. Key terminated trunks — foreign exchange, and automatic or ringdown tie lines — can be assigned as desired. However, it is **not** recommended that these direct key terminated trunks be multiplied between position because the supervisory signals received would be duplicated at each termination.

The release type attendant loops will be individual to each position. A maximum of 6 per position can be provided. Handling high volumes of T&C traffic, which is retained on the position for the duration of the call, increases the loop requirements. Preliminary information indicates the loop requirements as follows:

4 loops	up to 10%	T&C of total attendant traffic
5 loops	up to 25%	" " " " "
6 loops	over 25%	" " " " "

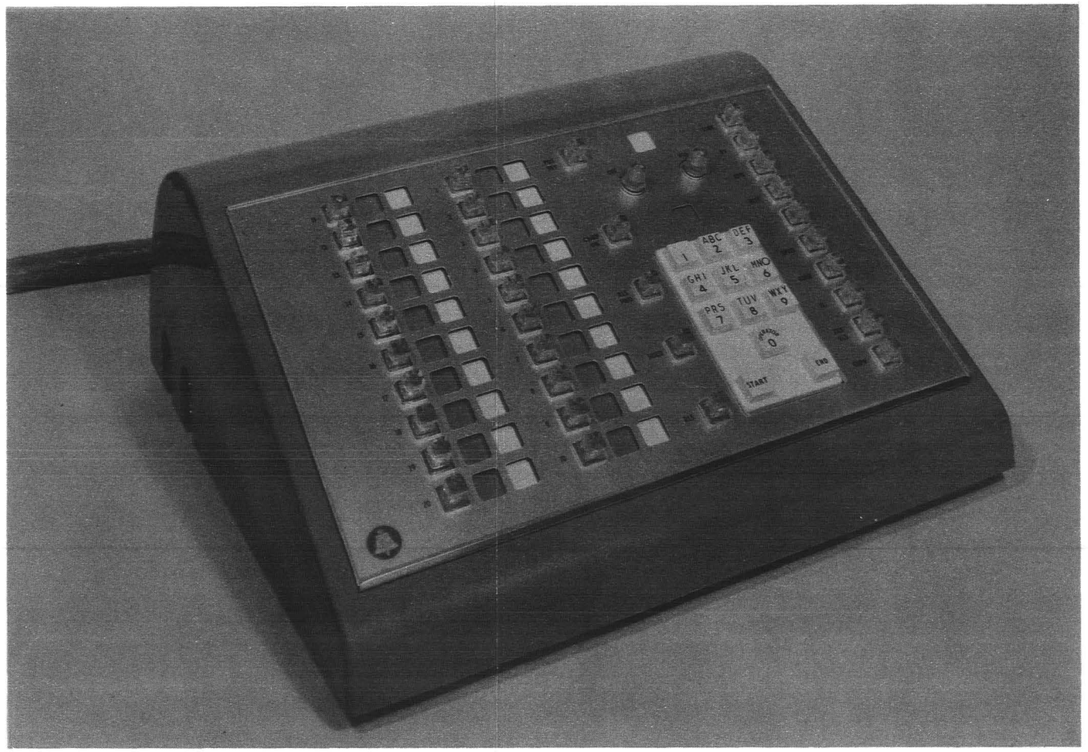

FIG. 1
621A CONSOLE

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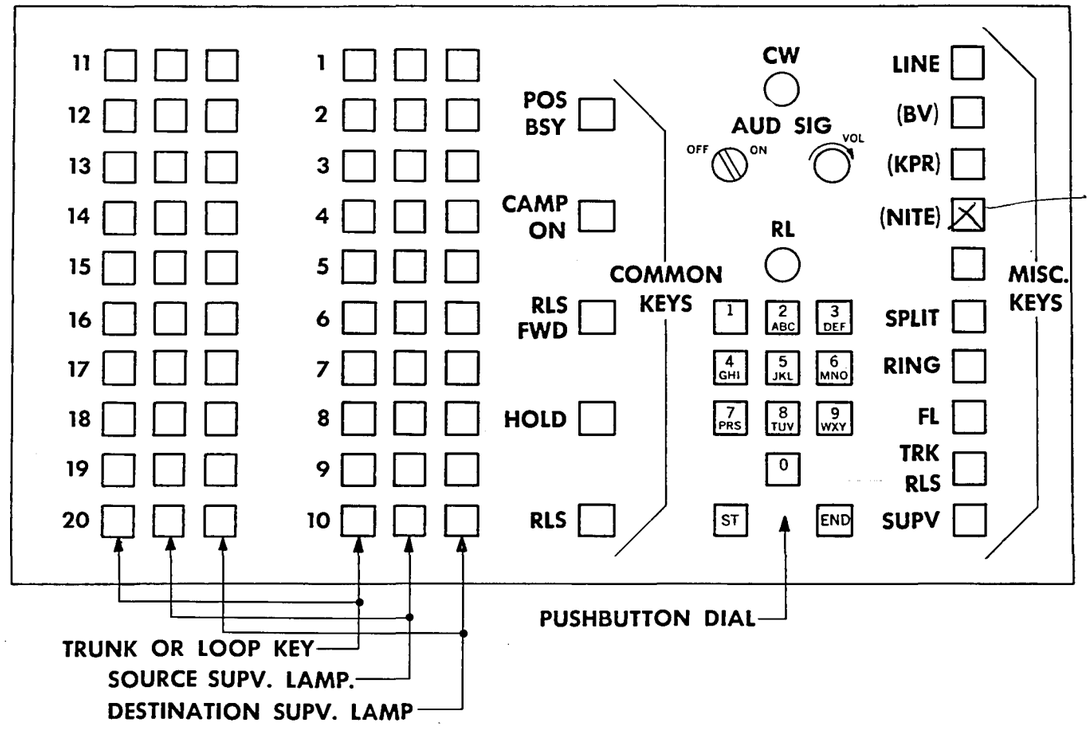
Key panel layout - 621A attendant console . . . .



TYPICAL SIGNALS RECEIVED ON 621A CONSOLE

Condition	Trunk or Loop Key	Supervisory Lamp Source	Supervisory Lamp Destination	Remarks
1. Incoming Signal				
(a) Listed No. & FX	D	60	D	
(b) Attendant	D	120	D	
(c) Tie	D	120	D	
(d) In-dial Transfer	D	120	D	
(e) Station Recall (Loop off position)	D	120	D	
2. Attendant Answer				
(a) Listed No. or FX	S	S	D	
(b) Att'd. Trk. or Tie	S	S	D	
(c) Transfer and Recall	S	S	S	
3. Station Ring	S*	S	W	Audible ring heard
4. Station Busy				
(a) No camp on feature	S*	S	60	Busy tone heard
(b) With camp on feature				
(1) Station busy	S	S	60	Busy tone heard
(2) Camp on in Effect	S*	S	60	Busy tone removed when CAMP ON key operated
(3) Camp on denied	S	S	60	Busy tone continues
5. Station Answer				
(a) Auto. Release	D	D	D	
(b) Loop or Trnuk retained on pos.	**	S	S	
6. Station Recall (Loop or trunk retained on position)				
(a) Incoming trunk call	**	S	120	
(b) Attendant call	**	120	S	
7. Trunk Hold (clg. pty. waiting for completion)				
(a) Listed No. or FX	W	S	D	
(b) Attendant or Tie	W	S	D	
8. Toll Rering	**	S or D	120	

* Lighted steady if att'd. is still in connection, dark otherwise.

** Lighted steady if att'd. is still in connection, wink otherwise.

(key) D — Dark Lamp
S — Steadily lighted lamp
W — Winking lamp (1.7" lighted, .3" dark)
60, 120 — flashing lamp at frequency indicated

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ATTENDANT FACILITIES

622A CONSOLE

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ATTENDANT FACILITIES

622A CONSOLE

The 622A console (Fig. 1) is applicable with a No. 5 Crossbar Centrex system. The associated No. 5 crossbar facilities are described in Section 2a of these Notes.

The console can be located on top of a desk or table. It is encased in a sloping plastic case approximately 15" wide, 12" deep and 6" high. The case is available in four colors — ivory, moss green, light gray and light beige. The connecting cord is available in the same colors and is arranged for plug-in termination. Two pairs of head set jacks are provided in the left side panel of the console.

The console may be equipped for 10 trunk or loop terminations (622A-1 console). All apparatus mounted in the front surface is arranged to be plugged in and all keys are of the non-locking type. Figure 2 illustrates the key panel layout. Details of the functions of the keys and lamps included in the key panel are described below.

Trunk or Attendant Loop Terminations

Each trunk or attendant loop termination consists of a key and the associated source and destination supervisory lamps. This apparatus is used to terminate attendant loops (release type), attendant access trunks and any foreign exchange lines, or tie lines requiring direct key terminations.

The **key** is non-locking, and, when operated, will connect the attendant to the trunk or loop. Operation of this key lights it to indicate to the attendant that she is now connected. Attendant release from the trunk or loop will extinguish the key lamp. If a call is held on a trunk or loop while other calls are handled, the key will "wink" while the trunk or loop is in this condition.

The **source supervisory lamp** will flash at 60 or 120 IPM to indicate an incoming call. It becomes steady when the key is operated. Supervisory signals from the source of the call are received on this lamp. The lamp is darkended when the trunk or loop is released from the position.

The **destination supervisory** lamp displays the supervisory signals for the destination of the call. Called station being rung (30 wink), called station busy (60 IPM flash), called station answer (steady), overflow in switching train (120 IPM flash), outgoing central office trunk connected (steady) are some of the supervisory indications displayed.

Figure 3 illustrates the signals for some of the basic conditions occurring in handling calls at this console.

Control Keys

There are two groups of control keys provided with this console. The group to the immediate right of the trunk or loop terminations are more commonly used than the group located at the extreme right side of the console. (Exception — the END key.) The function of each of these control keys is described below.

a. **Release — Position Available Key (RLS-PA)**
This key releases the attendant's position from the trunk or loop. Its operation makes the position available to receive another call. It will be lighted to indicate the position available condition.

b. **Hold Key (Hold)**
The operation of this key places the call on the trunk or loop to which the attendant is connected in a "hold" condition and locks it on the position. The trunk or loop key will "wink" when this occurs.

c. **Release Forward Key (RLS FWD)**
The operation of this key releases any established connection toward the destination of the call. It is also used to release the station originating a transfer request to permit reuse of the switching train for the new connection.

d. **Advance Key (ADV.)**
This is associated with the attendant access trunk, the conference circuit and any direct

key terminated foreign exchange or tie line trunks. Its function is to indicate to the trunk that all operations in one direction are now completed and that a shift is required to permit operations in another direction.

e. **Position Busy (POS BSY)**
The operation of this key removes the position from the operating team even though the position is still occupied. The key will be lighted until the position busy condition is removed by reoperation of the key.

f. **End Key (END)**
This key is associated with the pushbutton dial and signals the register that pulsing is completed. It must be operated at the end of each pulsing sequence.

g. **Supervisor Key (SUPV.)**
This key is used to call a supervisor. It will be illuminated until the supervisor has plugged into the position. It will not block out incoming calls when this key is operated.

h. **Trunk Release Key (TRK RLS)**
This key will release any attendant loop from the position when held by a trouble condition.

i. **Flash Key (FL)**
This key is used to flash toward the central office on an attendant established LD call to a toll operator. The loop or trunk must still be on her position to perform this function.

j. **Ring Key (RING)**
This key is used to recall an extension held on an attendant trunk, or to recall a toll operator on an incoming call held on the attendant position.

k. **Night Connection Key (NITE)**
This key will appear in only one position of the team. Its operation will transfer listed number calls to the night terminations. Reoperation of the key releases the night connection arrangements.

l. **Conference Key (CONF)**
This key termination provides access to the conference circuit. Incoming calls to the conference circuit will flash this key at 120 IPM. It will become steady when the attendant answers and remains lighted for the duration of the conference connection.

m. **Line Key (LINE)**
This is the attendant's extension line for use on outgoing calls only. The operation of this key makes the position busy to incoming calls.

Pushbutton Dial Units

This unit contains the pushbutton dial with its associated START IN (ST-I) and START OUT (ST-0) keys and register connected (RL) lamp. The ST-I key is used to obtain a register when extending an incoming call on the attendant loops to a local Centrex station. The ST-0 key is used to obtain a register on all other operations. Connections on the conference circuit, the attendant access trunk, and key ended trunks require the use of the ST-0 key.

Other Items

The audible signal control keys, (OFF-ON and VOLUME) and a calls waiting (CW) lamp are mounted above the pushbutton dial.

Operating Room Arrangements

It is not necessary to arrange the consoles in a line-up similar to that provided for cord switchboards. All positions included in the operating team should be within the confines of the allocated operating room space but can be located according to the customer's desires.

Position Arrangements

The release type attendant loops will be individual to each position. A maximum of 6 per position can be provided. Handling high volumes of T&C traffic, which is retained on the position for the duration of the call, increases loop requirements. Preliminary information indicates the loop requirements as follows:

4 loops	Up to 10% T&C of total attendant traffic
5 loops	Up to 25% " " " " "
6 loops	Over 25% " " " " "

At least one attendant access trunk should be terminated on each position. This trunk can be used by the attendant to originate calls in both directions.

Key terminated trunks — foreign exchange and tie lines — can be assigned as desired. However, these key terminated trunks can not be multipled between consoles because of circuit operating conditions and the undesirability of the supervisory signal being duplicated at each termination.

Busy verification and **splitting** are **not** available with the 622A console.

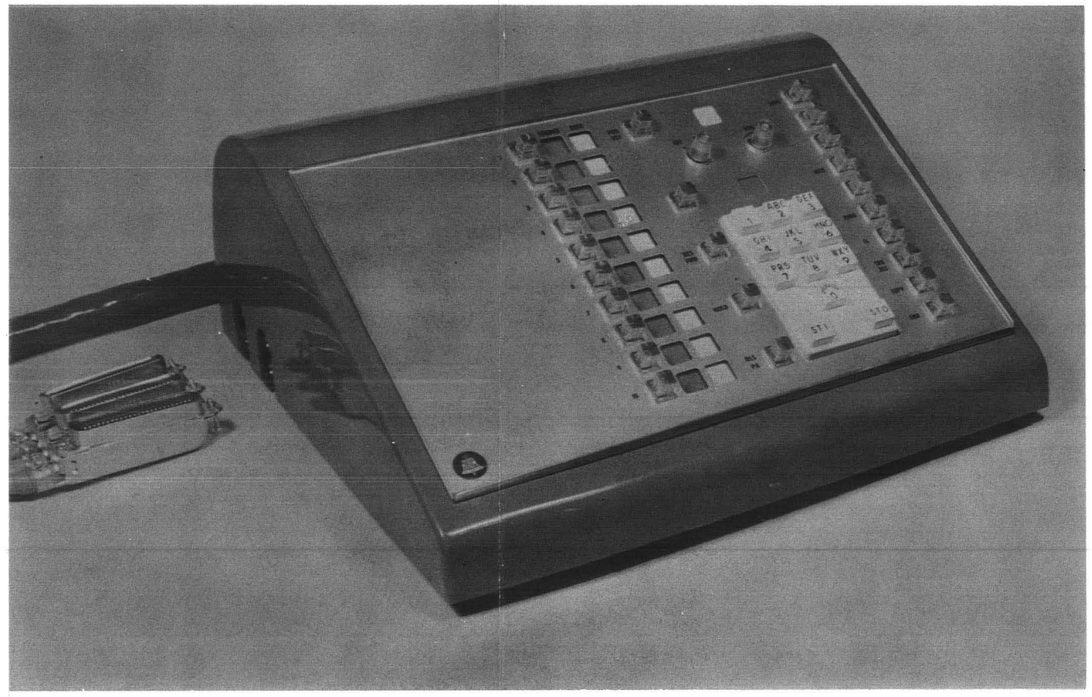

FIG. 1
622A CONSOLE

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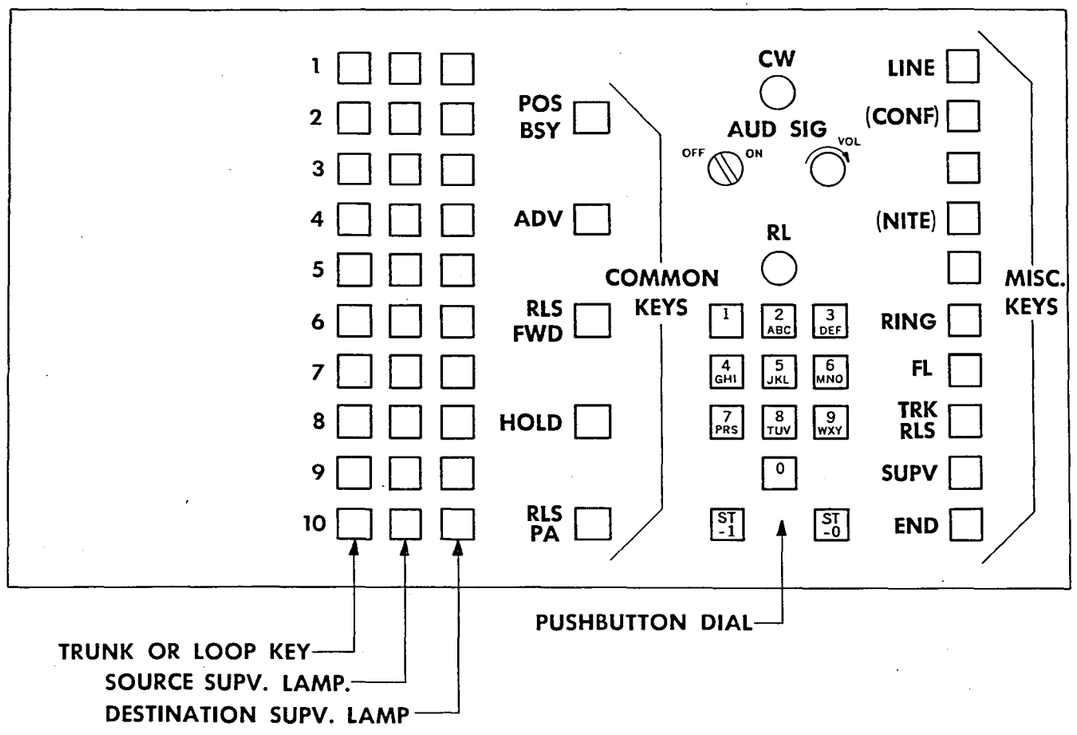
Key panel layout - 622A attendant console . . . .



TYPICAL SIGNALS RECEIVED ON 622A CONSOLE

Condition	Trunk or Loop Key	Supervisory Lamp Source	Supervisory Lamp Destination	Remarks
1. Incoming Signal				
(a) Listed No. & FX	D	60	D	
(b) Attendant	D	120	D	
(c) Tie	D	120	D	
(d) In-dial Transfer (station)	D	120	S	
(e) In-dial Transfer (Tie line station)	D	120	120	
(f) Station Recall (Loop off position)	D	120	S	
2. Attendant Answer				
(a) Listed No. or FX	S	S	D	
(b) Att'd. Trk. or Tie	S	S	D	
(c) Transfer & Recall	S	S	S	
3. Station Ring	S*	S	W	Audible ring heard (compl. to tie line station — audible only)
4. Station Busy				
(a) No camp on feature	S*	S	60	Busy tone heard
5. Station Answer				
(a) Auto. Release	D	D	D	
(b) Loop or trunk retained in pos.	**	S	S	
6. Station Recall (Loop retained on position)	**	S	flash	Follows switch-hook
7. Loop or trunk hold (clg. pty waiting for completion)				
(a) Listed No. or FX	W	S	D	
(b) Attendant or Tie	W	S	D	
8. Toll Rering	**	S or D	120	

* Lighted steady if att'd. is still in connection, dark otherwise.

** Lighted steady if att'd. is still in connection, wink otherwise.

(Key) D — Dark lamp
S — Steady lighted lamp
W — Winking lamp (1.7" lighted, .3" dark)
60, 120 — flashing lamp at frequency indicated.

TRAFFIC ENGINEERING NOTES

CENTREX SERVICE

ATTENDANT FACILITIES

TRAFFIC SUPERVISOR'S TURRET

Section 5-b-(3)

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CENTREX SERVICE

ATTENDANT FACILITIES

TRAFFIC SUPERVISOR'S TURRET

A Traffic supervisor's turret will generally be provided with each multi-position Centrex installation when the attendant facilities are console positions. It will be located in the operating room on the chief operator's or the supervisor's desk. The turret is encased in modular apparatus case units used with 101 type key equipment. It is approximately 9" long, 9" deep, and 6" high. The turret has a beige grey wrinkle enamel finish. It provides various lamp indications to show the availability of positions, major and minor alarms in the dial equipment, and calls waiting signals. An audible signal is also provided with the alarm and calls waiting indications. This signal can be silenced by the operation of a cut-off key. A key is provided to put into effect the night closing feature for out-of-hour operation.

When a supervisors turret is not provided, the dial equipment alarms are located in the dial control center. The calls waiting indications will appear on externally mounted lamps in the operating room or on the consoles only. The night closing feature will be controlled at one of the console positions.

The faceplate for the Traffic supervisor's turret is illustrated in Figure 1. The various keys and lamps provided with this turret, along with their functions, are covered in the following chart.

TRAFFIC SUPERVISOR'S TURRET—FACE EQUIPMENT

Lamp	Key	Note	Function
MA (red)		1	**Major alarm** in dial equipment. Audible signal also received.
AL (white)		1	**Minor alarm** in dial equipment. No audible alarm received.
	ACO		**Alarm cut-off** key. It is a non-locking pushbutton key. Its operation silences the audible alarm.
PA (white)			**Position available** indication that position can receive calls. One per position provided.
PB (red)			**Position busy** indication that occupied position can not receive calls. Will also flash at 60 IPM to indicate a request for a supervisor. One per position provided.
CW1 (white)		2	**Calls waiting** indication of 1 call waiting for more than 3-5 seconds to be served. Audible signal also received.
CW2 (green)		2	**Calls waiting** indication of 3 to 5 calls waiting to be served. Audible signal also received.

TRAFFIC SUPERVISOR'S TURRET—FACE EQUIPMENT (Cont'd.)

Lamp	Key	Note	Function
CW3 (red)		2	**Calls waiting** indication of 6 or more calls waiting to be served. Audible signal also received.
	NC	3	**Night closing** key. It is a turn key and, when operated, will put into effect the night closing feature.
NC (white)			**Night closing** lamp. This lamp lights when night closing key is operated and remains lit until the key is restored to normal.

Note 1—These signals will be provided with step-by-step Centrex installations only.

Note 2—The CW lamp on the console will be lighted steadily when these lamps are lighted. When the turret or externally mounted lamps are not provided, the calls waiting indications will appear at the console positions. The CW lamp will be steady for 1 call waiting longer than 3-5 seconds, flashing at 30 IPM for 3 or more calls waiting.

Note 3—This will be a non-locking pushbutton key when used with the 622A console. Operate to put night closing into effect, re-operate to restore to normal.

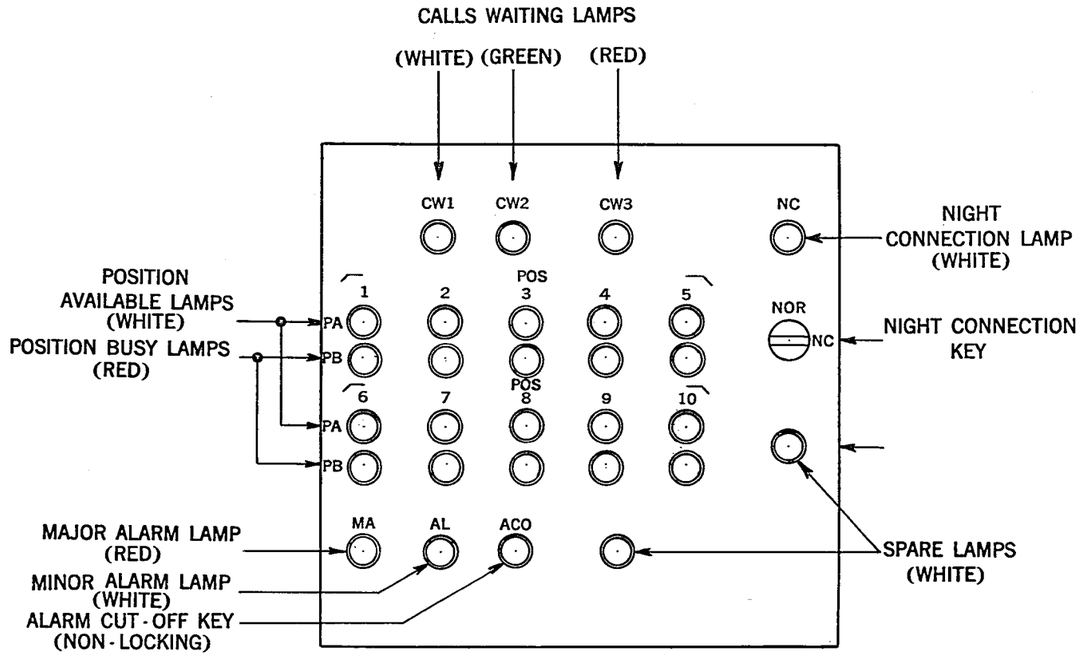

FIG. 1
FACEPLATE FOR TRAFFIC SUPERVISOR'S TURRET

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TRAFFIC ENGINEERING NOTES

CENTREX SERVICE

ATTENDANT FACILITIES

608A CORD SWITCHBOARD

Section 5-c

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CENTREX SERVICE

ATTENDANT FACILITIES

608A CORD SWITCHBOARD

The 608A Cord Switchboard can be used as the attendant facility for both step-by-step and No. 5 Crossbar Centrex systems. The system under consideration will determine the operating features provided for the switchboard.

The operating features fall into two general categories:

1. Normal cord operations where the switchboard is retained in the connection for the duration of the call.
2. Combined normal cord and single cord operation. Normal cord operation will retain the connection through the board for the duration of the call. Single cord operation (release loop) will permit the release of the switchboard from the connection when the colled station answers.

Details of these operating arrangements are covered below for their application with both step-by-step and No. 5 Crossbar Centrex systems.

APPLICATION WITH STEP-BY-STEP CENTREX

(a) Normal Cord Pair Operation

The step-by-step Centrex system using this arrangement of the 608A switchboard is described in Section 3-b of these Notes. Incoming calls are answered with the back cord and are completed with the front cord of a pair. Completion to stations can be on a dialing basis or through the station multiple if it is provided. For dial completion, rotary or DC pushbutton dials can be provided.

The 608A P.B.X. switchboard must operate on a normal basis when the positions are equipped with station multiple or rotary dials.

Dialing completion requires the addition of operator dial trunks. Station access is through the switch train. In general, the only visual cord supervisory indications received will be station answer, recalls from toll operators and station flash. Audible supervisory signals will be heard by the attendant while she is still in the connection. When rotary dials are used, no modification in the cords or the position circuit is required. Standard arrangements presently available, apply. Figures 1 and 2-a illustrate the keyshelf equipment arrangements.

The 608A position circuit must be modified when equipped with a DC pushbutton dial. A new dial unit is provided, the PEG key is replaced by a release forward (RLS FWD) key, and the position circuit must be arranged to provide access to register sender circuits (incoming DC—outgoing DP). Details of the register sender and the associated linkage are described in Section 3-c of these Notes. Operation with the DC pushbutton dial is described under (b) "Normal Cord Pair and Single Cord Operation" below. Figures 1 and 2-b illustrate the keyshelf equipment layout for this method of operation.

(b) Normal Cord Pair and Single Cord Operation

The step-by-step Centrex arrangements described in Section 3-c of these Notes are designed to function with the 608A switchboard modified to provide single cord and normal cord pair operation. Dial completion to stations rather than station multiple completion should be provided since listed number and transfer request calls can be released from the position upon called station answer. The position can be equipped with either a rotary or a DC pushbutton dial. Figures 1, 2-c and 2-d illustrate the keyshelf equipment layouts available for this application.

The **cord circuits** have been modified to permit both single and normal cord pair operation. **Single cord operation** is usd to complete listed number and transfer request calls routed to the switchboard over the attendant loops. The trunk lamp will be lighted steadily on incoming listed number calls, flashing at 120 IPM on transfer requests. An audible alarm is also activated. The attendant answers and completes the call using the back cord only. Visual supervisory signals of station ring, station busy,

station answer and switch train overflows can be received. Audible signals for the same conditions are also received if the attendant is still in the connection. All calls received on the attendant loops must be handled on a single cord basis. Completion to trunks which appear in the multiple must be on a dial selection basis as described under "Attendant Loops" in Section 3-c. The call cannot be extended by plugging the other cord of the pair into the trunk jack in the face equipment. The single cord connection can, however, be retained on the board as long as the attendant deems it necessary to complete the call satisfactorily. Splitting is possible with single cord operation. The release of the switch train for re-establishment of a connection to a different destination is controlled by the RLS FWD key when rotary dials are provided. The release of the switch train and the register sender equipment is controlled by this same key when DC pushbutton dials are provided.

Normal cord operation retains the connection through the switchboard for the duration of the call. All incoming calls on trunks other than the attendant loops are completed in a manner similar to normal 608A P.B.X. operation. Completion to stations will be over out-dial trunks. These trunks use the switch train for completion. Calls completed over these trunks will receive all the visual and audible supervisory signals obtained with single cord operation. Splitting is possible with normal cord pair operation. The release of the switchtrain for re-establishment of a connection to a different destination can be accomplished by the removal of the cord from the outgoing trunk jack when rotary dials are provided. The release of the dial equipment and the register sender is controlled by the RLS FWD key when DC pushbutton dials are provided.

The **position circuit** has been modified to permit the activation of the camp-on feature in the incoming connectors on calls encountering busy stations. Other modifications include the removal of PAGE and PEG features, the transfer of the attendant telephone set to **either** the right or the left position only, and the connection of a register sender when a DC pushbutton dial is provided.

With **DC pushbutton dialing,** the attendant requests a register sender by the operation of the START key. The position is connected to the register sender through a register sender link frame (See Sec. 3-c). The START lamp will light when this occurs. Digits are keyed into the register sender which outpulses them through the cord circuit to advance the dial equipment. The END key must always be operated to indicate end of pulsing. The attendant must stay in the connection until the register sender has completed outpulsing before she can be available to handle other calls. The completion of the register sender functions and its release are indicated by the START lamp going dark. If a mistake in pulsing occurs, the attendant restores the dial equipment and releases the register sender by the operator of the RLS FWD key.

APPLICATION WITH NO. 5 CROSSBAR CENTREX

(a) Normal Cord Pair Operation Only

This arrangement is provided with the No. 5 crossbar Centrex systems described in Section 2-b of these Notes. Incoming calls are answered on the back cord and are completed on the front cord of a pair. The position has been modified to use an MF pushbutton dial. Plugging a cord into a trunk jack calls for a register. The START lamp will light when the register is connected and will remain lighted until the register releases. The END key must always be operated when pulsing is completed. Both 4 x 4 and 2 x 6 MF pulsing are included. Selection of the required pulsing will be automatically controlled by the sleeve of the trunk used. Two types of completing trunks are available—(1) an Operator Local Completion trunk used to complete to stations, and (2) an OGT to Central Office trunk used to complete all other calls. Figures 1and 3-a illustrate the keyshelf equipment layout used with these arrangements.

Tie lines, conference circuits, etc., can be terminated in the multiple. Outward completion on dial type tie trunks is possible by extending the call through the switching system on a dial selection basis. Completion forward on foreign exchange lines terminated on distant central office line facilities is not possible unless—(1) the distant CO is arranged to receive 4 x 4 MF pulsing, or (2) a position in the operating team is equipped with a rotary dial.

Some Telephone Companies have provided the 608A with normal cord operation and have also included a transfer feature. The equipment details of the No. 5 crossbar office arrangement are described in Section 2-b of these Notes. The termination of the transfer attendant trunk at the switchboard requires an answering and a

completing jack for each trunk. The attendant answers a transfer call by plugging the back cord into the answering jack. She releases the transferring station and establishes a connection to the new station over the front cord plugged into the completing jack. She releases the front cord when the new station is rung. She releases the back cord when the station answers. This releases the transfer connection from the switchboard.

The transfer arrangement described above and in Section 2-b is non-standard at this time, and, as of now, is not expected to be a standard offering.

(b) **Normal Cord Pair and Single Cord Operation**

The development of the circuitry required for this arrangement is still in progress. The information contained herein is subject to change as the design progresses but minor variations only are expected. The associated No. 5 crossbar Centrex is described in Section 2-b of these notes.

Both single cord and normal cord pair operation will be provided. All cords are arranged to operate in either manner. The MF pushbutton dial will be provided in the position. Selection of the required MF pulsing will be controlled by the sleeve of the trunk. A release forward key (RLS FWD) will replace the PEG button in the dial unit. No change will be made in the transfer key operation now available with non-Centrex 608A switchboards. No camp-on feature will be available when the switchboard is used with this system. Figures 1 and 3-b illustrate the keyshelf layout for this method of operation.

Single cord operation will be associated with the attendant loops only. The back cord is used with this method of operation. While the attendant is in the connection, audible supervisory indications of station busy, or switchtrain overflow will be received. With the attendant cut out of the connection, visual supervisory signals for these conditions plus called station answer supervision will be received. A single cord connection can be released from the switchboard on called station answer by removing the cord from the jack. The RLS FWD key must be used to release any connection toward the destination of the call if a change is required while processing that call. Splitting of the connection on single cord operation is not possible.

Single cord operation will apply on listed number calls and DID transfer requests to stations within the Centrex. Incoming signals on listed number calls will light the trunk lamp with a steady signal; the transfer request will flash the lamp at 120 IPM. In both cases, an audible alarm will also be provided. The lamp and the alarm are retired by attendant answer.

Dial "O" traffic is also handled on the attendant loop. The incoming signal will be a 120 IPM flash on the trunk lamp plus the audible alarm. Completion of this call will require normal cord pair operation. The completion of listed number calls and DID transfer requests to a tie trunk termination in the multiple is also possible with normal cord pair operation.

Normal cord pair operation is similar to that of a normal cord switchboard. In general, the only visual cord supervisory indications will be station answer, recalls from toll operators and station flash. Audible signals can be heard by the attendant while she is still in the connection. Splitting is possible with normal cord pair operation.

The foreign exchange, dial repeating and automatic tie trunks terminated on this board are arranged for MF pushbutton dial operation. They are the trunk circuits described in the No. 5 Centrex system using consoles as the attendant facilities.—Section 2-a of these Notes. When terminated on the switchboard, separate IN and OUT jacks are required. Ringdown tie trunks are those available today.

Normal cord operation also requires the provision of Operator Local Completion trunks and OGT to Central Office trunks with this arrangement.

FACE EQUIPMENT ARRANGEMENTS

Recommended face equipment arrangements have been described in T.E.P., Division I, Section 2-n. A copy of the suggested face equipment is included with these notes as Figure 4.

OPERATING ROOM ARRANGEMENTS

The operating room arrangements will be similar to that provided for a normal P.B.X. when cord switchboards are provided as the attendant facilities.

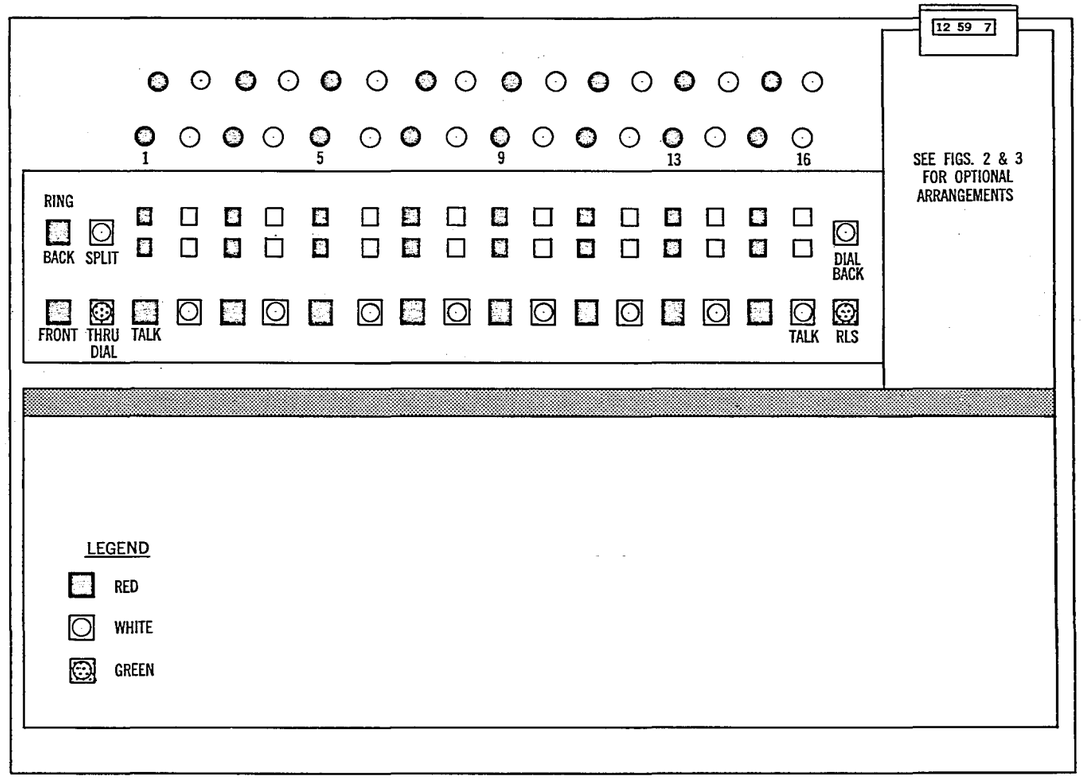

FIG. 1
608A KEY SHELF EQUIPMENT

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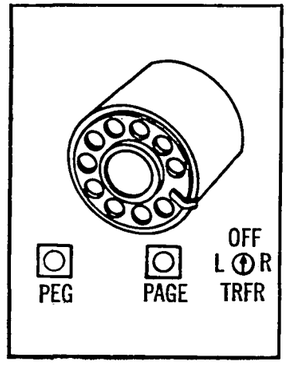
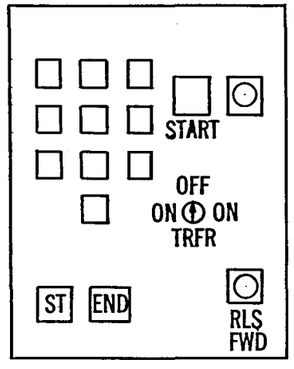
S x S CENTREX APPLICATION - NORMAL CORD PAIR OPERATION

A) ROTARY DIAL UNIT

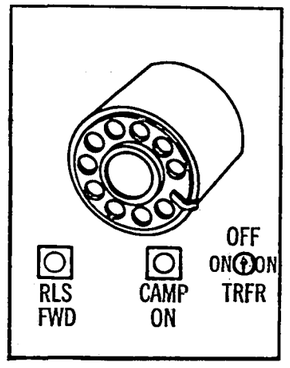


B) DC PUSHBUTTON DIAL UNIT



S x S CENTREX APPLICATION - SINGLE CORD AND NORMAL CORD PAIR OPERATION

C) ROTARY DIAL UNIT



D) DC PUSHBUTTON DIAL UNIT

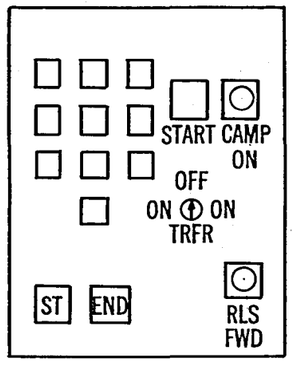


FIG. 2
OPTIONAL KEY SHELF EQUIPMENT ARRANGEMENTS
608A SWITCHBOARD

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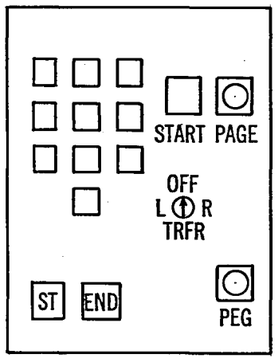
No. 5 CROSSBAR CENTREX APPLICATION - NORMAL CORD PAIR OPERATION

A) MF PUSHBUTTON DIAL UNIT



No. 5 CROSSBAR CENTREX APPLICATION - SINGLE CORD AND NORMAL CORD PAIR OPERATION

B) MF PUSHBUTTON DIAL UNIT

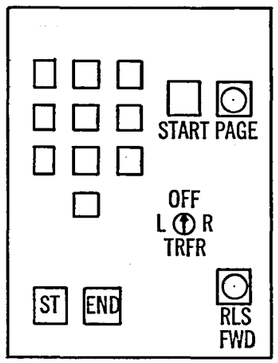


FIG. 3
OPTIONAL KEY SHELF EQUIPMENT ARRANGEMENTS
608A SWITCHBOARD

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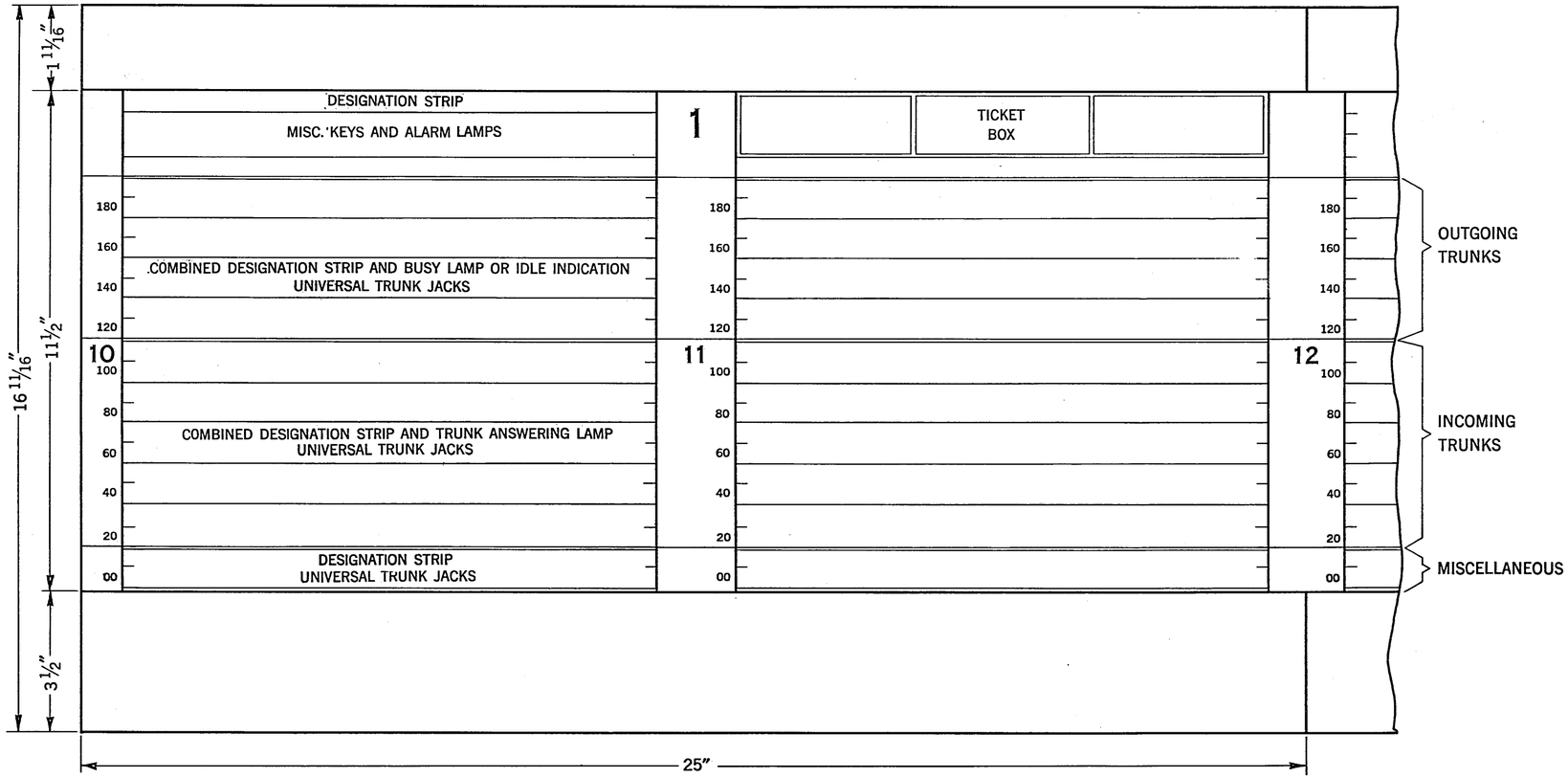

FIG. 4

TYPICAL IN - DIALING FRONT EQUIPMENT DRAWING
3 PANEL MULTIPLE - LOWER UNIT

TRAFFIC ENGINEERING NOTES

CENTREX SERVICE

ATTENDANT FACILITIES

CALL DISTRIBUTORS

Section 5-d

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
Department of Operations
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CENTREX SERVICE

ATTENDANT FACILITIES

CALL DISTRIBUTORS

Attendant seeking traffic, such as listed number, DID transfer request, and dial "O" calls, are allotted to the Centrex customers' attendant positions through a call distributor when these positions are arranged for release loop operation. There are three types of distributors available—(1) for single or multi-customer operation in both the No. 5 crossbar and the step-by-step Centrex systems, (2) for single customer operation in step-by-step Contrexes when up to a maximum of 4 console positions are required, and (3) for single customer operation in step-by-step Centrexes when the 608A cord switchboard is provided. The details of these call distributors are covered below.

Single or Multi-Customer Call Distributor (Fig. 1)

This call distributor consists of a call distribution circuit and the associated trunk and position finders. It can be used for single customer operation or can serve a maximum of 4 customers. Up to 99 trunks, and 10 console positions or 99 attendant loops to switchboards can be served. Its application with the various Centrex systems is as follows:

No. 5 Crossbar Centrex requires this distributor when multi-customer operation is provided. It is also required for single customer operation when consoles, arranged for release loop, are provided. When the console loops are connected directly to the customer's attendant trunks (single console position operation, for example), a distributor will not be required. A distributor is also not required when the 608A switchboard is provided as the attendant facility.

Step-by-Step Centrex requires this distributor when multi-customer operation is provided and the attendant positions are either consoles or 608A cord switchboards. It is also required when more than 4 consoles are provided for a single customer.

The call distributor is designed with an A and a B group to permit a call in each group to be switched simultaneously. A maximum of 12 trunk and position finders can be associated with each group. When multi-customer operation is required, two customers can be assigned to each group. The specific levels assigned to a particular customer must be the same on both the trunk and position finders. The trunks terminated on the trunk finder levels 1-5 in the A group will have matching appearances on similar terminals on levels 6-0 in the B group. Similarly, trunks on levels 1-5 in the B group appear on levels 6-0 in the A group. The lower levels have preference in each of the respective groups. Cord switchboard or console attendant loops are terminated on levels 1-5 with matching appearances on levels 6-0 of the position finder levels in a similar manner to the trunk arrangements described above.

Trunks appearing on a particular level of the trunk finders in either group will seek connection to the corresponding level on the associated position finders. This arrangement provides each incoming trunk with a first preference for a particular console or group of switchboard attendant loops thus offering a more even distribution of traffic to the console team. However, this has no effect as far as the switchboard attendant loops are concerned, since these loops are terminated in switchboard multiple common to all positions. The trunks should be evenly assigned to all allocated levels to maintain the preference pattern with console operation, i.e., an equal number of trunks should be assigned to each level allocated to a customer. Moreover; first, second,—etc., choice trunks should be equitably distributed over all these levels to avoid overloading certain positions. This assignment procedure is not necessary when the 608A switchboard is provided.

The calls routed through this distributor will not be lost if all finders in both the A and B groups are busy, all console positions are busy, or all switchboard loops are busy. Audible ring will be returned to the calling subscriber for the duration of the delay and the connection will be established as soon as the busy condition is removed.

Single Customer Distributor—Step-byStep Centrex with Consoles (Fig. 2)

This call distributor is only applicable with step-by-step Centrexes arranged for release loop console operation. It contains a call distribution circuit and the associated trunk finders. Each trunk finder is connected directly to a specific attendant loop. The distributor is arranged for single customer operation only and a maximum of 24 trunk finders can be provided. Up to 99 incoming trunks and 4 console positions can be associated with it. The incoming trunks appear on the levels of the trunk finders. Up to six trunk finders are directly associated with the loops terminated on each of the console positions.

This distributor does **not** provide subgroup operation. A preference arrangement is provided in the selection of the trunk finder to distribute calls evenly to the console positions. No special assignment procedures for trunks are required.

If all positions or trunk finders are busy, the call is not lost. Audible ring will be returned to the calling subscriber for the duration of the delay, and the connection will be established as soon as the busy condition is removed.

Single Customer Call Distributor—Step-by-Step Centrex with 608A Cord Switchboards (Fig. 3)

This call distributor is only applicable with step-by-step Centrexes arranged for 608A cord switchboard single cord operation. It consists of a simplified call distribution circuit with associated trunk finders. Each attendant loop is directly connected to a trunk finder as well as the switchboard jacks. Only one group is provided. Preference arrangements are not provided since they are not needed to distribute the calls to the positions. Two sizes are available—(1) a call distribution circuit arranged to function with a maximum of 12 trunk finders with up to 49 incoming trunks terminated on the TF levels, and (2) a call distribution circuit arranged to function with a maximum of 24 trunk finders with up to 99 trunks terminated on the levels of the TF selectors. In either case, no special trunk assignment procedures are required.

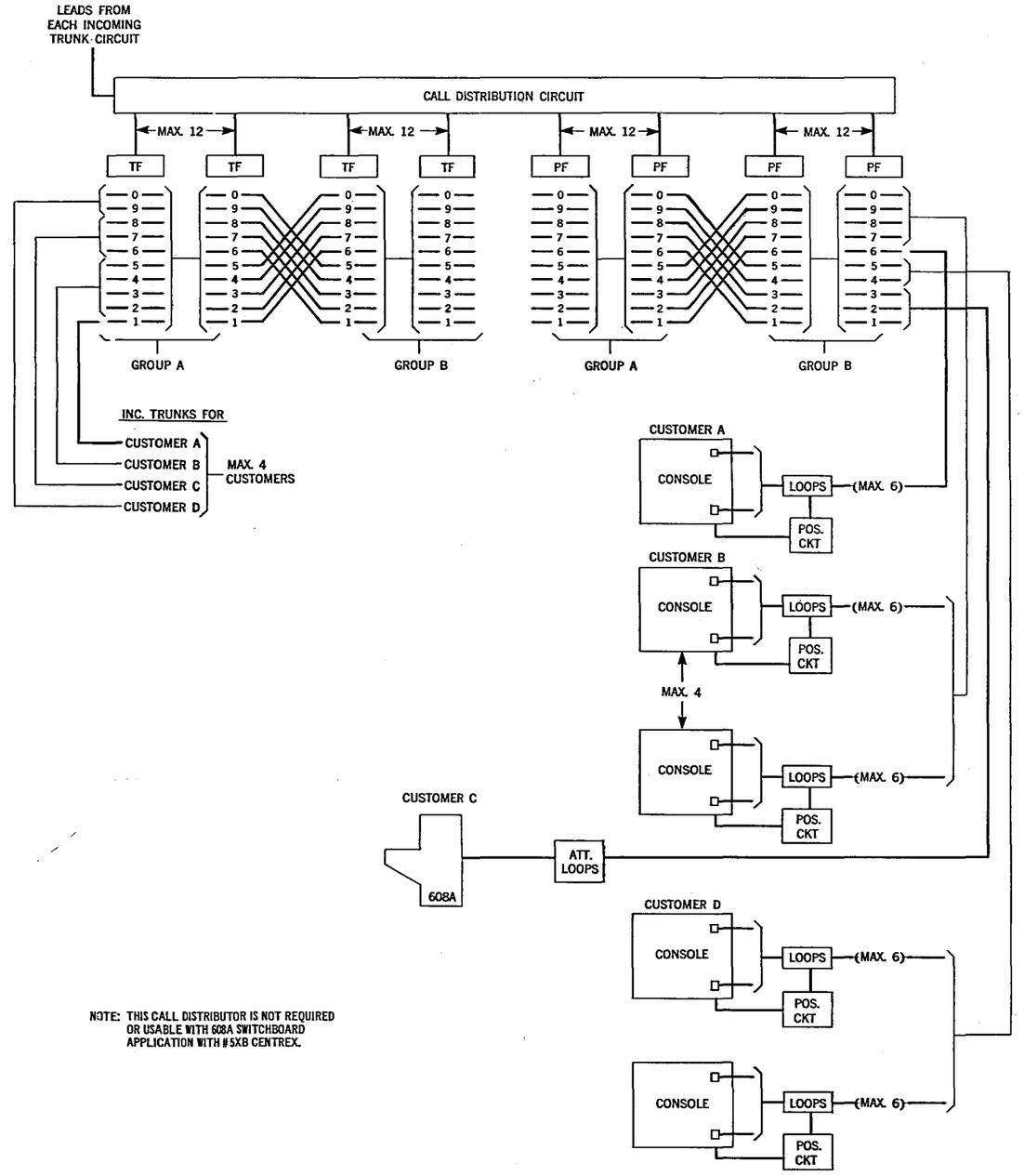
If all trunk finders are busy, the call is not lost. Audible ring is returned to the calling subscriber for the duration of the delay, and the connection will be established as soon as the busy condition is removed.

ENGINEERING RECOMMENDATIONS

Item	Recommendation
1. Multi or Single Customer Distributor Trunk finders and Position finders	Table 10
2. Single Customer Distributor—SxS Centrex for Consoles	Table 10
for 608A Switchboard	Table 10

Attendant Handled Calls	Estimated HT (Sec.)
Listed number—extension unknown	50
" " " known	35
Transfer and Recall	40
Incoming FX—extension unknown	50
" " " known	35
*Incoming automatic tie line	35
*Outgoing—local	35
* " —LD—station	55
* " —LD—person	75
* " —LD—T&C	410 (held on console for duration of call)

*Console operation only.



NOTE: THIS CALL DISTRIBUTOR IS NOT REQUIRED OR USABLE WITH 608A SWITCHBOARD APPLICATION WITH #5XB CENTREX.

FIG. 1
MULTI- OR SINGLE CUSTOMER CALL DISTRIBUTOR

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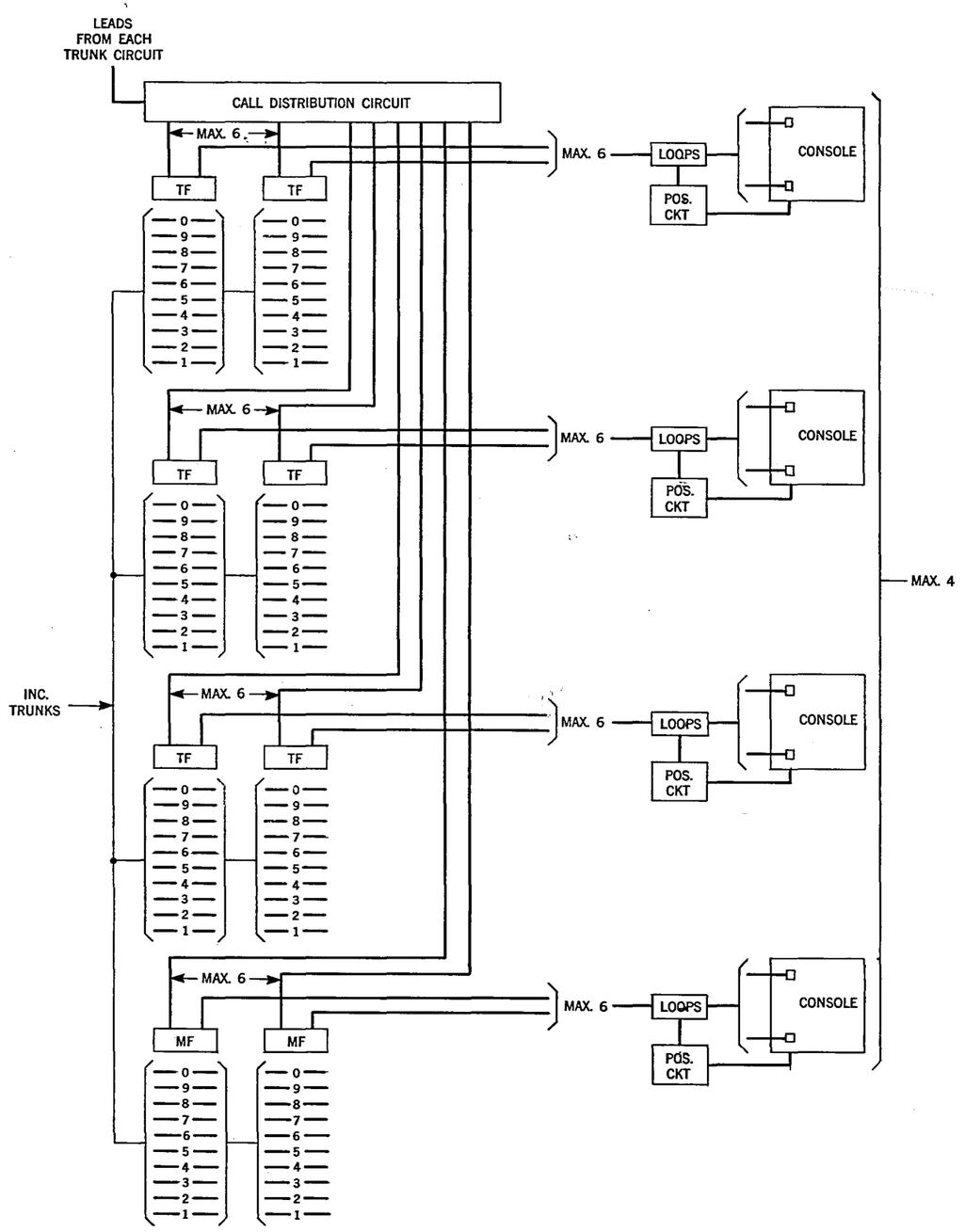
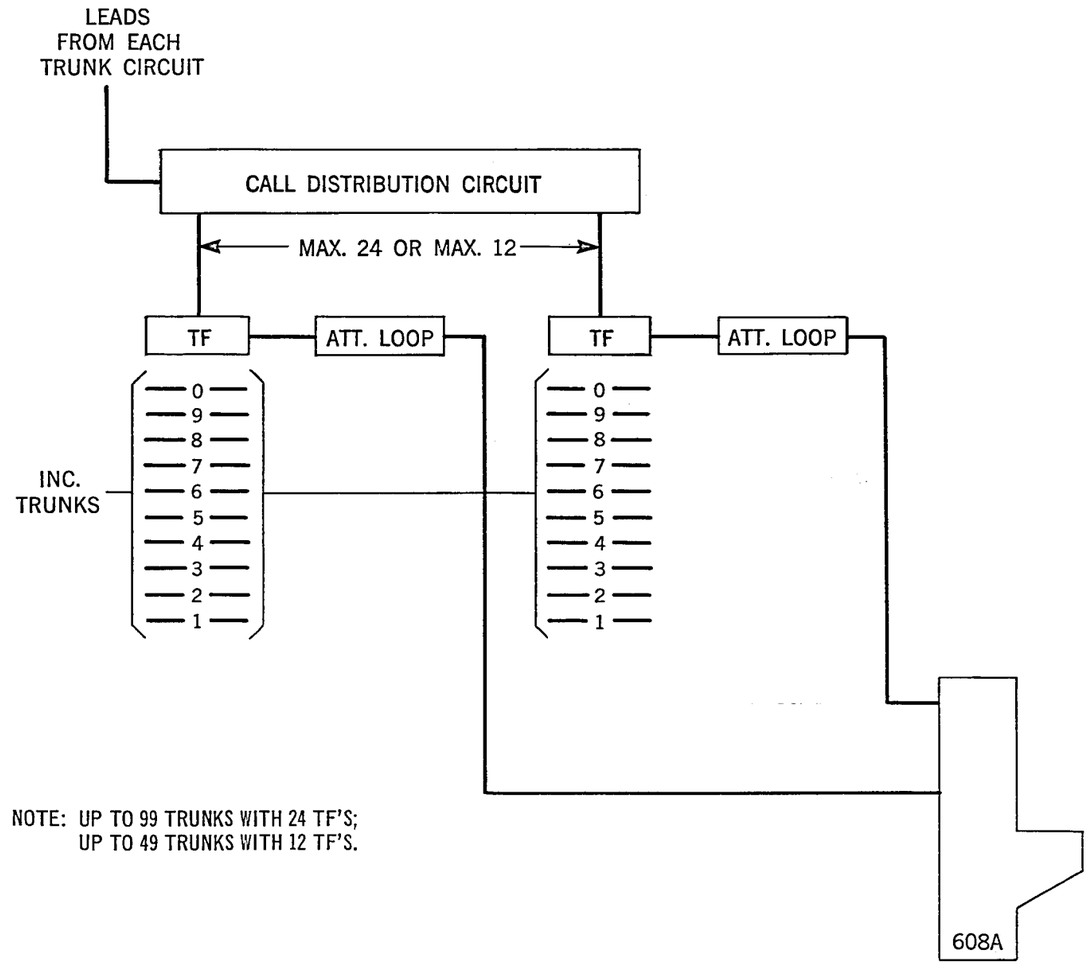


FIG. 2
SINGLE CUSTOMER CALL DISTRIBUTOR
STEP-BY-STEP CENTREX WITH CONSOLES



NOTE: UP TO 99 TRUNKS WITH 24 TF'S;
UP TO 49 TRUNKS WITH 12 TF'S.

FIG. 3
SINGLE CUSTOMER CALL DISTRIBUTOR
STEP-BY-STEP CENTREX WITH 608A CORD SWITCHBOARDS

TRAFFIC ENGINEERING NOTES

ATTENDANT FACILITIES

COEFFICIENTS AND BOARD LOADS

Section 5-e

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
Department of Operations
May, 1961

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CENTREX SERVICE

ATTENDANT FACILITIES

COEFFICIENTS AND BOARD LOADS

Coefficients and engineering board loads have been developed for application with these attendant facilities. They are based on several broad assumptions and are interim recommendations only. Factual data based on actual installations will be obtained as soon as feasible. New coefficients and loads will be developed at that time and will be published as soon as they are available.

No attempt has been made to develop coefficients for each type of call possible at these positions. Only those applicable to the primary calls expected have been developed. Existing P.B.X. coefficients can, in general, apply for other types of calls. These may be found in Peg Counts and Traffic Summaries—Div. B, Sect. 12, Table A.

Coefficients

Type Call	Consoles and 608A (Release Loop Oper.)	608A (Normal Oper.)
*Listed No.—extension unknown	2.4	2.6
— " known	1.2	1.4
*Transfer and Recalls	1.6	1.8
Outgoing—local	2.3	2.3
—long distance—station	4.4	4.4
—person	6.4	6.4
—T & C	8.4	8.4

*Coefficients have been weighted for 10% BY and 5% DA.

Transfer coefficient also include a factor for information look-up on some of the calls.

Board Loads

Pos. in Team	Total BH Load
1	150
2	340
3	540
4	760
5	975
6	1,230
7	1,470
8	1,760
9	2,025
10	2,300

TRAFFIC ENGINEERING NOTES

CENTREX SERVICE

CROSSBAR TANDEM

APPLICATION WITH STEP-BY-STEP CENTREX

Section 6

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
Department of Operations
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CENTREX SERVICE

CROSSBAR TANDEM

APPLICATION WITH STEP-BY-STEP CENTREX

GENERAL

Crossbar tandem can be modified to serve step-by-step Centrex installations with various combinations of originating and terminating treatments.

The originating arrangements permit the handling of "O" operator calls, single message unit local calls, service code calls and operator identified CAMA calls.

On these direct outward dialed calls, the tandem provides dial tone via the Centrex trunks to the extension user or Centrex attendant. The message unit and CAMA calls are billed to the listed or trunk number. Extension identification is available on CAMA calls, but only on an operator identified basis. While the tandem can handle single message unit non-timed calls and service code calls, it is suggested that considerable thought be given to the costs of line haul and back haul, and the relative costs of switching through tandem vs. switching through a local dial office.

The terminating arrangements provide the ability to route direct from tandem to a Centrex customer having his own office code, or to route direct to as many as sixty customers on each of ten shared codes. On shared codes, the routing can be direct to the extension user or to the listed number. These arrangements are covered in more detail in the equipment section.

EQUIPMENT

Direct Outward Dialing from Step-by-Step Centrex Customers

Arrangements for step-by-step Centrex customers to dial out to the world require direct access trunks to the crossbar tandem. After dialing an access code (such as "9"), the subscriber receives second dial tone. He then dials the desired number. He cannot dial the one-prefix plus seven or ten digits as the tandem is not arranged for this.

The billing process varies. If the call is to a point which is a single message unit without overtime charging, a message register associated with the trunk scores when a completed call is disconnected. All other chargeable calls are billed by operator identification of the Centrex extension number or the directory number.

The DP Sender SD-25999 can be arranged to:

(1) Upon receipt of a Centrex class of service mark, send second dial tone to the Centrex extension or attendant.

(2) Handle single digit ("O" operator) and three-digit (X11 and 11X) service codes.

(3) Permit either CAMA service observing or local dial service observing on incoming trunks from Centrex customers.

The markers can be arranged to:

(1) Discriminate between Centrex and non-Centrex originated traffic.

(2) Determine from the route relay whether the call is AMA-charge, message register charge or non-charge.

(3) Send the proper routing and charging signals to the sender.

The message registers are located on a message register frame in the tandem office.

Direct Inward Dialing to Step-by-Step Centrex Customers

It is possible to employ crossbar tandem to dial direct to Centrex extensions where a central office type code is unique to a Centrex customer or is shared by more than one Centrex customer. The sharing is accomplished by assigning to the Centrex a number series within a central office code used for Centrex purposes at the crossbar tandem, with each extension assigned a standard seven-digit number. As many as sixty Centrex customers can share one central office code. The marker can be arranged

to recognize the shared office code and arrange for six-digit translation, using the office code and the first three digits of the extension number. This permits reservation of numbers in groups of ten, so that the entire number series is used most efficiently.

The call is routed over a direct trunk group to the Centrex, where the outpulsing of the digits directs the equipment to the attendant or to the proper extension.

Six-digit translation is required where:

(1) An office code is shared by more than one Centrex. This is the normal condition—non-sharing the abnormal condition.

(2) The number of digits outpulsed to a Centrex extension is different from the number outpulsed on calls to the Centrex attendant.

(3) Separate trunk groups are provided for the attendant and for extension users.

The Translator Frame handles a maximum of five Centrex central office codes and/or foreign area codes per pair of translator frames. The crossbar tandem is limited to two pairs of translator frames or ten codes. For each code, the equipment can arrange for sixty different routings. One routing is required per Centrex per quantity of digits to be outpulsed. Also, one routing is needed per code for calls to unassigned numbers.

On a call to a Centrex central office code, the marker signals the sender to try again after receipt of six digits. On calls of this type which are preceded by the home area code, the marker sets up a "loop back" connection. This loops the call through the office link frame back to the trunk link frame, coming in with the home area code deleted. Three marker seizures are required to complete this call.

For calls to an official Centrex the marker can discriminate among:

(1) Local calls to extensions to be handled free.

(3) Toll calls to extensions. These require answer supervision in order to charge for the call.

(3) Local calls to the attendant to be handled free.

(4) Toll calls to the attendant. These require answer supervision in order to charge for the call.

The MF Sender SD-27024, DP Sender SD-25999, and PCI Sender SD-25961 can be arranged to recognize the marker signal requesting release and reseizure when six digits are registered. Also, they can send the thousands, hundreds and tens digits to the marker, can outpulse (as received) one to seven digits to reach an extension, and can reach an attendant on a straightforward basis.

When all trunks to a Centrex are busy, 60 I.P.M. tone is returned. The No Circuit Signal Trunk has been modified to permit its use for this function.

Equipment Quantities

The provision of equipment for Centrex at the tandem will be determined in accordance with the T.E.P., Division D, Section 6, and with the various letters relating to that section.

TRAFFIC ENGINEERING NOTES

CENTREX SERVICE

NO. 5 CROSSBAR TANDEM — APPLICATION WITH

STEP-BY-STEP CENTREX

Section 7

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
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CENTREX SERVICE

NO. 5 CROSSBAR TANDEM — APPLICATION WITH STEP-BY-STEP CENTREX

DIRECT INWARD DIALING ARRANGEMENTS

A No. 5 crossbar tandem can switch traffic to DID extensions of a P.B.X. that have been assigned 7-digit numbers with a separate central office designation for each P.B.X. For routing purposes, the P.B.X. is treated as a tributary of the No. 5 crossbar tandem. The use of this plan can be wasteful of central office codes.

It is possible on a non-standard basis to provide one code in a No. 5 crossbar tandem to serve a maximum of ten P.B.X.'s by using the "1XX" translator in the completing marker. Each P.B.X. would be assigned a different thousands digit. Listed number traffic can be routed over the in-dialing group or to the line link frame appearances of the ninth level trunks.

DIRECT OUTWARD DIALING

Two methods are available for handling outgoing calls from step-by-step Centrex installations.

a. Route all outgoing traffic over ninth level trunks that terminate on line link frames. AMA can be provided for trunk identification. However, extension identification can be done only on an operator identified CAMA basis.

b. Split the outgoing trunk groups from the step-by-step Centrex offices. Provide one trunk group with an access code direct to the No. 5 crossbar CAMA tandem. This will permit extension identification on an operator identified basis and will require only one switch through the No. 5 crossbar office. Provide a second group to terminate on No. 5 crossbar line link frames to reach local service area points and service codes.

TRAFFIC ENGINEERING NOTES

CENTREX SERVICE

STEP-BY-STEP OFFICES

APPLICATION WITH STEP-BY-STEP CENTREX

Section 8

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CENTREX SERVICE

STEP-BY-STEP OFFICES

APPLICATION WITH STEP-BY-STEP CENTREX

CENTREX CO OPERATION

No. 1 and 350 type step-by-step offices may be used as the Centrex switching facility. Each Centrex customer is provided a separate Line Finder Group. This makes possible 3, 4, and 5-digit "intercom" dialing and special trunking arrangements to toll switchboards, tie lines, and to "dial 0" attendant trunks. Access to other customers in the local calling area is provided by "dial 9" trunks to a regular central office Line Finder Group. Each Centrex customer thus has exclusive use of his intra-P.B.X. dial train, and shares the central office local dial train with the regular customers.

Centrex customer numbers must be segregated by connector groups. It is necessary in order to provide the transfer feature. These segregated numbers are also desirable with operator identification of the calling extension.

A special train is provided between the Centrex line finder and connector groups for use on intra-P.B.X. traffic. The regular central office train is also provided access to these Centrex connector groups for the completion of calls from other customers.

If future demand warrants it, development will be requested for the provision of an in-dialing extension transfer arrangement and the "camp-on" feature.

TRUNKING FROM STEP-BY-STEP CENTRAL OFFICES TO CENTREX OFFICES

The Centrex customer may be served by a dial P.B.X. or by a No. 5 crossbar office which does not serve regular customers.

In such cases, trunks must be provided from the step-by-step central office from the appropriate selector stage to the P.B.X. Where a toll train is installed in the central office, separate trunks to the P.B.X. may be required for the local and toll trains.

Since available trunks will not work in all cases, development has been requested to obtain the required new trunks. This development also will permit the combining of the local and toll trains into one trunk group for the central office to the Centrex Installation where it is required.

TRAFFIC ENGINEERING NOTES

CENTREX SERVICE

SERVICE OBSERVING FACILITIES

Section 9

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CENTREX SERVICE

SERVICE OBSERVING FACILITIES

GENERAL

Basically, observing requirements for calls originating or terminating at CTX stations do not differ from those in existence for traffic to and from other stations and PBX's. However, the newness of this service offering and of the equipment arrangements necessary to provide it, appears to warrant an expansion of observing objectives for administrative purposes to be continued as determined by the PBX servicing people. This Section, therefore, describes means for implementing these expanded objectives.

OBSERVING ON ORIGINATING TRAFFIC

From No. 5 Crossbar Centrex

Local dial observations will be obtained using standard local dial observing circuits for No. 5 crossbar. In addition to the usual inter or intra central office traffic normally observed, observations of intra CTX customer calls will be obtained. These cannot be mechanically excluded and will have to be treated appropriately by the Service Observing people.

Observations of DDD traffic will be obtained in the normal manner using standard AMA service observing circuits applicable to No. 5 crossbar.

From SxS Centrex to a Local Office

These calls will reach the local office over 9th level trunks as is customary with normal PBX operation. Standard local dial observing circuits applicable to the serving central office will be used for observing this traffic. In this case, intra customer traffic will not be included.

DDD traffic will be observed as today at the AMA recording center.

From SxS Centrex to a Crossbar Tandem

The facilities for observing on these calls is under development and is expected to be available late 1962.

The local dial observing circuit for crossbar tandem will permit observing on calls incoming over the 9th level trunks from the SxS CTX in the normal manner.

The CAMA service observing circuit may be used either with the 9th level trunks or with a separate DDD group from the CTX when provided. When used with 9th level trunks, it will screen out all non-CAMA calls thus offering only DDD calls for observation.

OBSERVING ON TERMINATING TRAFFIC

A portion of the calls originated from various central offices terminate at PBX's and these are now observed in their true proportion with regular local dial observing done at these originating offices. Similarly, a portion of originating calls from any office will terminate at CTX stations, and it is proposed that local dial observing will adequately fill this need in a like manner. Hence, no special arrangements are needed to fulfill normal observing requirements.

However, since this is a new service offering implemented by new circuitry and experience is to date very limited, it seems prudent to arrange to obtain fairly large volumes of observations on calls into CTX stations for administrative purposes. These data would continue to be obtained so long as they appeared to serve a useful purpose as determined by the PBX administrative people. The following methods may be used depending on the CTX equipment involved.

No. 5 Crossbar CTX Using Consoles or 608A Switchboard with Single and Normal Cord Operation

Connect a No. 6 service observing set to the attendant trunk at its trunk link frame appearance. Calls which will be offered for observation include listed number, dial "O" (by CTX station), and requests for transfer of DID calls. Because of the release loop feature on listed number and transfer calls, these calls cannot be followed

beyond CTX station answer. However, if a wrong CTX station were reached, the subsequent transfer request could be observed.

No. 5 Crossbar CTX Using 608A Swictchboard with Normal Cord Operation

Connect a No. 6 service observing set at the line link appearance of the listed number central office trunk. Listed number calls only are available for observation but the entire call can be observed.

Transfer of DID calls could be observed, if desired, by connecting a No. 4 set to the Transfer Trunk at the trunk link appearance.

SxS CTX with Trunks from Crossbar Tandem

A PBX service observing circuit now under development will permit observing on trunks from crossbar tandem either listed number only or combined listed number and DID—availability, late 1962. Entire call may be observed.

SxS CTX with Trunks from No. 5 Crossbar with Tandem Features

Combined listed number and DID groups can be observed using No. 4 service observing set. Connect at the line link frame appearance of the trunks.

SxS CTX with Trunks from Selector Level Trunks of a SxS Office

Combined listed number and DID trunk group can be observed using a No. 4 service observing set. Connect at the M.D.F. or I.D.F.

SxS CTX with Final Terminal Trunks from Any Local Office

Use same facilities and methods as today for observing on PBX incoming traffic; i.e., a No. 6 observing set connected at the central office.

RECOMMENDATIONS

In view of the newness and importance of Centrex service it is urged that at least in the early installations, maximum use be made of any observing facilities that can be provided. Experience with this service should later permit a better judgment of permanent observing requirements.

TRAFFIC ENGINEERING NOTES

CENTREX SERVICE

INTERCEPTING ARRANGEMENTS

FOR OLD LISTED NUMBER

Section 10

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
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CENTREX SERVICE

INTERCEPTING ARRANGEMENTS

FOR OLD LISTED NUMBER

The majority of the applicants for Centrex service will be those customers now served by normal PBX's. The inauguration of Centrex service for a customer will, in most instances, require a change in the customer's listed number. The treatment of traffic to the old number must be given careful consideration from both the customer's and the Company's viewpoint. We have engineered the Centrex to complete a major portion of the customer's incoming traffic directly to his stations and have reduced his attendant requirements accordingly. Can this changed number traffic be routed to the new Centrex attendant team without affecting the customer's service or should some other treatment of this traffic be considered? We have investigated three treatments for traffic to the old number. These which briefly are:

a. **Intercept by the Telephone Company** with reference to the new listed number provided.
b. **Intercept by the customer** (no charge supervision) with reference to the new Centrex station number. The calling subscriber would be requested to place the call to the new number.
c. **Answer and complete** to the desired station without intercepting.

The effect of each treatment on the customer's service and the additional equipment required during the post-cutover period to handle this traffic will be described in detail in the following divisions.

Intercept by the Telephone Company

The traffic to the old listed number could be intercepted by the Telephone Company. Either regular intercepting or special recorded announcement arrangements can be provided. The calling subscriber would be referred to the new listed number for completion.

This traffic must be attendant handled at the Centrex. Combined with other attendant seeking traffic, the resulting effect could require more positions than those actually available and the customer's service would be degraded.

If this treatment is provided and additional positions are required in the Centrex attendant team for this post-cutover period, these requirements must be included in the engineering estimates. One exception to this applies to Centrex CU installations which have retained the existing PBX positions for the attendant facilities. The removal of the excess positions can be delayed for as long as required.

Intercept by the Customer

As a part of the educational program introduced with every Centrex customer, the customer's attendants are instructed to inform all subscribers reaching the firm via the new listed number, the number of the desired station and how to reach this station on a direct dialing basis on future calls. The effect of this operation is twofold—it benefits the customer in keeping the attendant handled traffic at a low level and helps to increase the proportion of traffic indialed to the stations.

This same approach can be applied, with the customer's agreement, for traffic to the old listed number. The old listed number trunks can be retained in service for as long as required and the traffic terminated on the customer's old switchboard positions. If this is not feasible some temporary attendant facilities can be provided. Attendant facilities would be modified to provide a non-charge condition when the incoming call was answered. With the customer's attendants manning these positions, the calling subscriber will be provided with all the information he needs to complete his call on a direct indialing basis. He will be asked to hang up and dial his call again. This would also occur if the call had been routed to the Telephone Company intercept but the calling subscriber would not have obtained as much information in reaching his destination. As a result of this operation, the traffic to the Centrex attendant team will not be affected, the indialing traffic will be high, the Telephone Company will have had no increased volume of intercepting traffic, and the calling subscriber

will have received a better and more complete service than if he had reached Telephone Company intercept.

Answer and Complete

Another possible treatment, with agreement from the customer, is to terminate the old listed number trunks on attendant facilities manned by the customer's attendants and complete to the desired station. The customer will usually desire to have all traffic routed to his concern handled by his people. This arrangement can provide this feature for him.

There are some equipment complications, however, with this plan. If this traffic is routed to his new Centrex attendant team, the same problem exists as described under "Intercept by Telephone Company." He may have insufficient positions to maintain a reasonable grade of service. For No. 5 crossbar Centrex installations with consoles provided as the attendant positions, the termination of the old listed number trunks is not possible with existing circuit designs.

As a solution to these problems, the old PBX positions can be manned. The old listed number trunks can be retained here, the instructions given to the calling subscriber, and completing trunks provided for extending the call to the desired station on a charge supervision basis. These completing trunks must be included in the engineering estimates for the new service. If manning the old positions is not feasible, temporary attendant facilities can be provided with the same arrangements as described above.

Recommendations

Traffic to the old listed number will be high for some Centrex customers, for others it will be insignificant. We have tried to point out the problems which can exist in treating this traffic and the physical arrangements possible to obtain the desired solution. However, there are other problems involving rates for temporary facilities, retaining old trunks in service, etc., as well as the connection of these temporary facilities. Customer agreement to the treatment accorded his installation is also an important factor.

We recommend that the situation for each Centrex customer be considered separately. All interested departments should be advised of that situation and a joint decision should be reached as to the desired treatment applicable. Concurrence of this or an alternate treatment should then be obtained from the customer. This answer should be obtained early enough in the negotiations for Centrex service to permit the inclusion of any additional equipment needed for this purpose in the engineering estimates.