

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 transfer 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. "IXX" tie line features.
4. "O" to reach attendant.
5. "1" is reserved for "IXX" 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 "IXX" 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 associ-

ated 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 "O", 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.

Ringling Selection Switches

The ringling selection switches have been modified for Centrex service. Ringling combinations have been used to indicate types of Centrex calls. Ringling 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)

	<u>HT</u>	<u>See Note</u>
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)

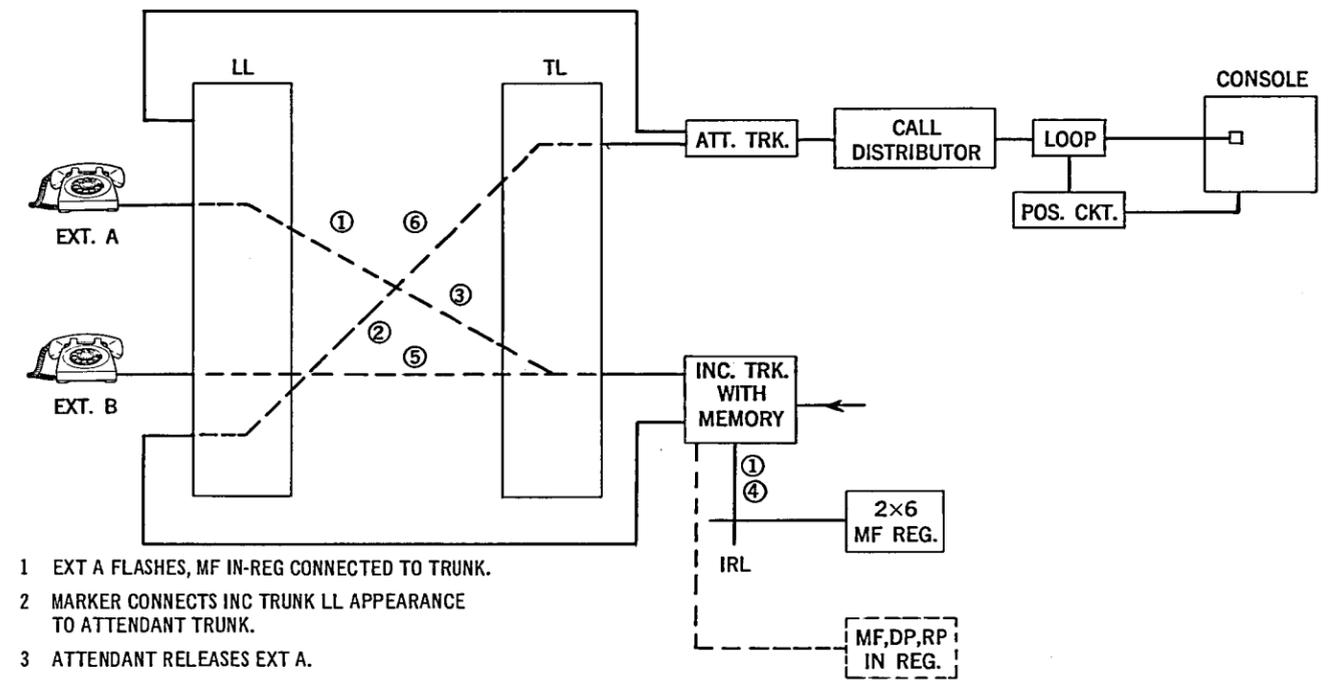
	<u>HT</u>	<u>See Note</u>
Transfer Call	.90	(c)
Listed Number Call	.90	(d)
From Console Attendant (Includes END key)		
4 digits	4.10	
5 digits	4.70	

- (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)

<u>Calls For</u>	<u>MF Console Attendant</u>	<u>MF Touch Tone Subscriber</u>	<u>DP</u>	<u>MF 608A Attendant</u>
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

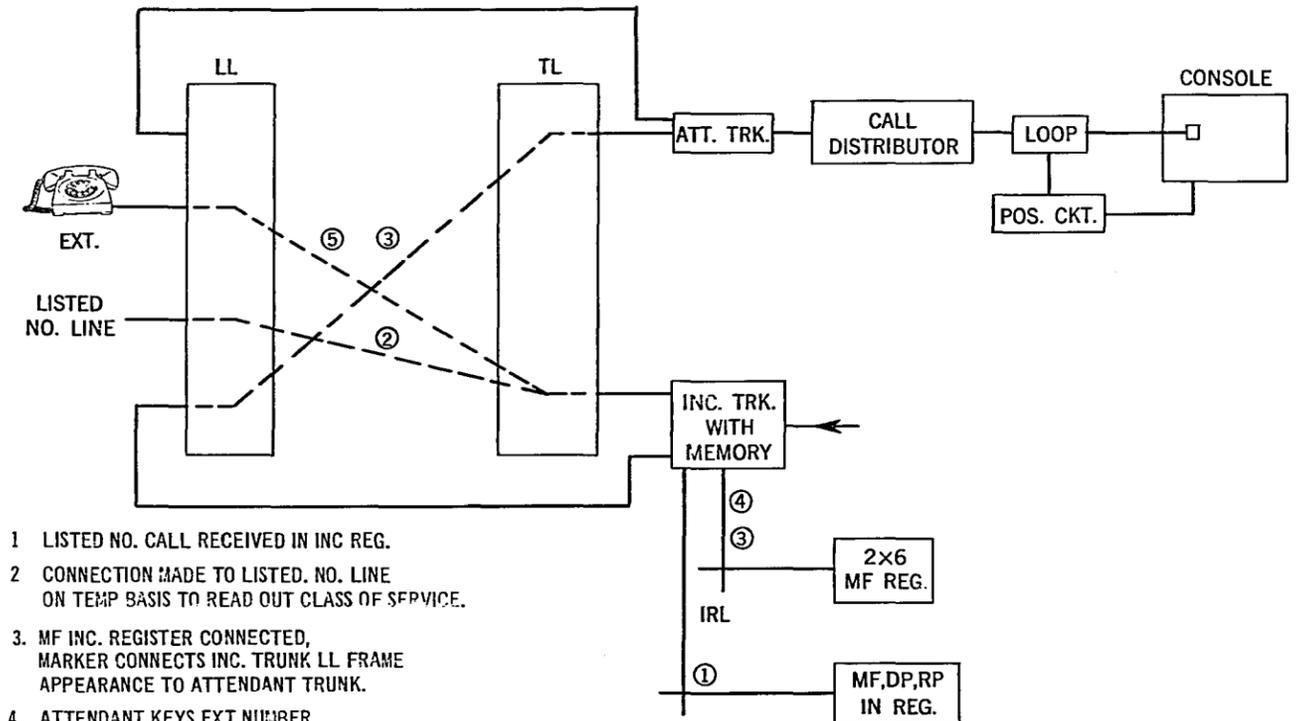
(e) Station delay required for all "1XX" codes when timing for variable number of digits. Also add indicated HT for each digit dialed after the "1XX" code.



- 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.

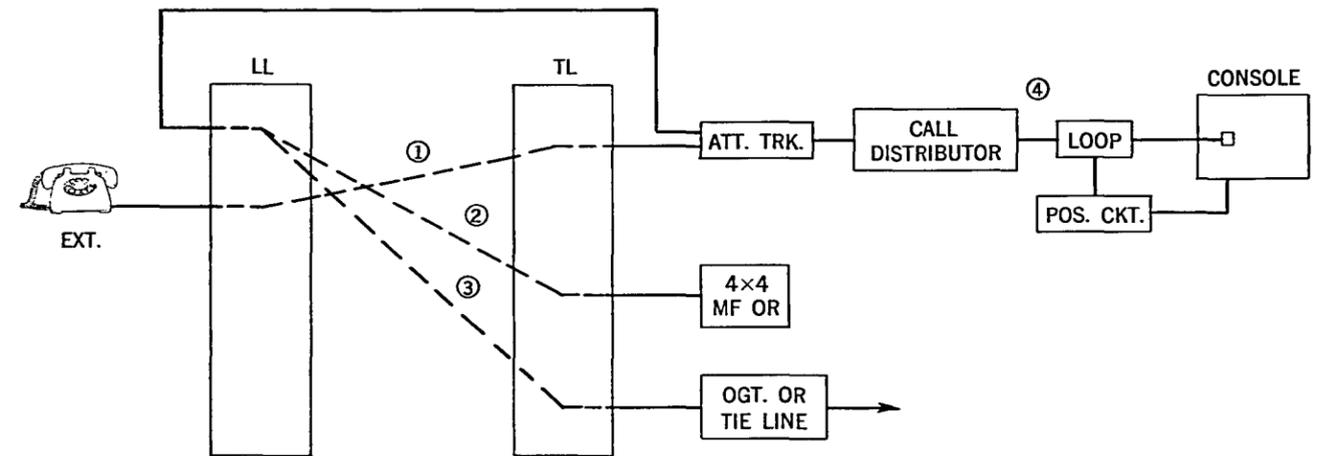
FINAL CONNECTION IS SIMILAR TO DID CALL.

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 "0" CALL