

SWITCHING SYSTEM MANAGEMENT
NO. 5 CROSSBAR SYSTEM
EQUIPPED WITH ELECTRONIC TRANSLATION (5 ETS)
GENERAL DESCRIPTIVE INFORMATION

CONTENTS	PAGE	CONTENTS	PAGE
1. GENERAL	3	B. Completing Marker	10
2. SWITCHING PRINCIPLES	5	C. Marker Special Features	10
GENERAL	5	ELECTRONIC TRANSLATION SYSTEM (ETS)	
MAJOR SWITCHING FRAMES	6	11
A. Line Link Frames	6	A. General	11
B. Junctors	7	B. Processor Complex	11
C. Paired Line Link Frames	8	C. Distributing and Scanning (DAS) Equipment	11
D. Trunk Link Frames	8	D. Miscellaneous Interface Equipment	12
E. Trunk Links and Junctors	8	ORIGINATING REGISTERS	12
F. Trunk Switches	9	ORIGINATING REGISTER LINE MEMORY FRAME	13
G. Channels	9	PRETRANSLATORS	13
3. EQUIPMENT ELEMENTS	9	OUTGOING SENDERS	13
LINE LINK FRAMES	9	OUTGOING SENDER LINKS	13
TRUNK LINK FRAMES	9	INCOMING REGISTERS	14
EXTENSION AND AUXILIARY TRUNK LINK FRAMES	9	INCOMING REGISTER LINKS	14
JUNCTOR GROUPING FRAME	10	INTERMARKER GROUP SENDERS	14
MARKERS	10	CONNECTORS	14
A. Dial Tone Marker	10	TRUNKS	15

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SECTION 19a(1)

CONTENTS	PAGE
COIN SUPERVISORY CIRCUITS	16
COIN SUPERVISORY LINKS	17
COIN ZONE TRUNK CONCENTRATOR	17
AMA RECORDING	17
SOFTWARE	18
4. METHOD OF OPERATION	19
A. Dial Tone Connection	20
B. Establishing Dialing Connection	20
C. Pretranslation	22
D. Completing Marker Processing	22
E. Typical Telephone Call	24
F. Intraoffice Calls	27
G. Assistance and Service Code Calls	31
H. Manual Calls	32
J. Direct Distance Dialing	32
K. Various Call Conditions	32
L. Message Charging on Coin and Noncoin Calls	34
M. Operation of No. 5 ETS Office with Operator Switchboard	36
N. No. 5 ETS Office with Tandem Switching Features	38
P. No. 5 ETS Office with Toll Center Switching Features	40
Q. Multioffice Operation	41
R. Direct and Alternate Route Arrangements in No. 5 ETS System	44
S. Selection Preference	44
T. Code Conversion	45

CONTENTS	PAGE
U. Calls Involving Equipment Irregularities	45
V. No. 5 ETS Special Features	47
5. EQUIPMENT ARRANGEMENTS	49
6. MAINTENANCE FEATURES	50
GENERAL	50
ETS MAINTENANCE	52
CENTRAL OFFICE ALARM SYSTEM	54
TEST SET TYPE TESTING ARRANGEMENTS FOR REGISTERS AND SENDERS	55
ARRANGEMENT FOR TESTING CUSTOMER STATION RINGERS	56
AUTOMATIC LINE INSULATION TEST EQUIPMENT	56
AUTOMATIC PROGRESSION TRUNK TEST FRAME (APTT)	56
7. GLOSSARY	57
8. REFERENCES	82

Tables

A. Types of Pulsing	84
B. Connectors	85

Figures

1. No. 5 ETS—Block Diagram	87
2. 200-Point Crossbar Switch for 20 Vertical Units	89
3. Typical Line Link Frame Pattern	90
4. Junctor Distribution—Four Line Link and Two Trunk Link Frames	91

CONTENTS	PAGE
5. Pairing of Trunk Link Frames—40 Line Link and 20 Trunk Link Frames	92
6. Tripling of Trunk Link Frames—60 Line Link and 30 Trunk Link Frames	93
7. Trunk Link Frame	94
8. Trunk Link Distribution	95
9. Switch Arranged for 16 Trunk Appearances on Trunk Link Frame	96
10. Channel Distribution—Line Link to Trunk Link Frames	97
11. Dialing Connection	98
12. Intraoffice Trunk Connection	98
13. Reverting Trunk Connection	98
14. Outgoing Trunk Connection	98
15. Incoming Trunk Connection	99
16. Establishing Dialing Connection	99
17. Initiating the Call	100
18. Dialing and Subsequent Operation in Central Office A	101
19. Address Sent to Intermediate Office	102
20. Operations in the Intermediate Office to Connect Trunks	103
21. The Call Advances to Central Office B and the Called Telephone is Rung	104
22. The Call is Established	105
23. Establishing Intraoffice Trunk Connection	106
24. Establishing Outgoing Trunk Connection	107
25. Establishing Incoming Trunk Connection	108
26. Establishing Reverting Trunk Connection	109

CONTENTS	PAGE
27. Establishing Operator Assistance Service Code, or Manual Trunk Connection	110
28. Coin Junctor Operation	111
29. Traffic at Operator Switchboard Associated with No. 5 ETS Office	112
30. Call from Operator Switchboard Completed to No. 5 ETS Customer	113
31. Call from Operator Switchboard Associated with No. 5 ETS Office to Connecting Office	114
32. Outgoing Call from Operator Switchboard—Pulse Conversion	115
33. Tandem Center Switching Combined with Local Completion to Customers in the Same Marker Group	117
34. Toll Center Switching Combined with Completion to Customers in the Same Marker Group	119
35. Intermarker Group Trunk Connection—Customer-to-Customer	121
36. Intermarker Group Trunk Connection—Customer-to-Trunk	122
37. Intermarker Group Trunk Connection—Trunk-to-Customer	123

1. GENERAL

1.01 This section describes in general terms the No. 5 Crossbar System equipped with an Electronic Translation System (ETS). It includes a description of electromechanical equipment with major emphasis on the electromechanical operation with ETS. All references to the No. 5 ETS in this section will assume a No. 5 crossbar machine that is using stored program control for processing calls.

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

SECTION 19a(1)

1.03 The title for each figure includes a number(s) in parentheses which identifies the paragraph(s) in which the figure is referenced.

1.04 The ETS for No. 5 crossbar is an electronic translation system designed to handle one full size marker group of 12 completing markers and six dial tone markers, and to provide recording of up to 4800 trunks. Its primary function is to perform all line, trunk, and routing translation; however, supplementary features are provided which include full local and centralized automatic message accounting (LAMA and CAMA) with single entry output to a centralized AMA recording center (AMARC), one serving the same time zone in which the No. 5 ETS office is located. The ETS is compatible with all current standard No. 5 crossbar customer services except call waiting and wideband. It is not arranged to work in offices equipped with the following:

- Automatic Trouble Analysis
- International Direct Distance Dialing (IDDD) LAMA feature
- Wideband Data feature
- PICTUREPHONE®
- Office test frames
- Combined markers
- Autovon
- Originating Line Identifiers

1.05 The ETS consists basically of a processor complex with associated scanners and distributors. It bridges onto the No. 5 Crossbar System as illustrated in Fig. 1, receives call details from markers, trunks, and lines via scan leads and returns control information to the markers via distribute leads. The scanning of trunks provides the supervisory indications needed for routing and billing. Trunk scanning is done on outgoing and intraoffice trunks for trunk selection and call recording. Line scanning is done on lines in multiline hunt groups to provide busy/idle status for hunting and on INWATS lines for AMA purposes.

1.06 The processor complex consists of seven 7-foot, ESS-type bays of equipment which

must be located together, preferably in the No. 5 crossbar maintenance center. The distribute and scan (DAS) equipment is provided on standard No. 5 crossbar sheet metal frames (minimum 1, maximum 6) which can be placed in regular No. 5 crossbar lineups.

The ETS eliminates the following within an electromechanical No. 5 crossbar office.

- (1) Line link frame line class of service (C/S) cross-connections.
- (2) Marker routing and screening relays and associated cross-connections.
- (3) Number groups and associated cross-connections.
- (4) All LAMA or automatic number identification (ANI) equipment except transverter connectors.
- (5) All CAMA equipment except CAMA senders, CAMA positions, CAMA position links, and CAMA transverter connectors.
- (6) Foreign area translators.

1.07 The principle features of the No. 5 ETS are as follows:

- (a) **Flexibility:** The flexibility of the No. 5 ETS allows it to be used economically in comparatively small offices as well as large offices. It can handle the basic types of calls, serve as a tandem or toll switching center, and is arranged to serve as a LAMA office or can be arranged to serve other offices as a CAMA office.
- (b) **Common Control:** The switching of traffic in an office is controlled by an auxiliary 3A Processor System which is common to all switching frames through a unit of common control equipment (the marker). This arrangement allows the switching circuits to set up the call, leaving the common circuits available to control the switching of other calls. The common control circuits are also equipped with self-checking and service safeguarding features.
- (c) **Methods of Charging:** ETS performs the AMA function in No. 5 ETS offices. "Initial entry" information is obtained by scanning the completing marker while the call

is being set up. Answer and disconnect indications are obtained by scanning the supervisory relays in the trunk. This approach provides AMA for all outgoing and intraoffice calls in an office. One-second answer and disconnect timing precision is used as is standard single entry output to a centralized AMA Recording Center (No. 1 AMARC). Local recording is not provided. No. 5 ETS offices are arranged for LAMA and/or CAMA with operator (ONI) or automatic identification (ANI) of the calling customer. Message register and coin service, including coin zone dialing, can also be provided.

(d) **Dialing Capacity and Classes of Service:** No. 5 ETS offices are designed to use the nationwide numbering plan (area and office codes), which provides for customer dialing of station calls, special toll calls, and dialing procedures for reaching local and toll information and other special services. Two-thousand classes of service are available.

(e) **Tandem and Toll Considerations:** Tandem and toll center switching features can be provided in a No. 5 ETS office. Such an office serves as a tandem office and toll center as well as a local office.

(f) **Pulsing Considerations:** No. 5 ETS offices can operate with present dial systems with their particular types of pulsing which consist of dial, revertive, panel call indicator, or multifrequency. However, multifrequency pulsing is generally more efficient than other types of pulsing and is used by the No. 5 ETS office whenever practicable. Table A lists the types of pulsing for various combinations on No. 5 ETS and connecting offices.

(g) **Maintenance:** The No. 5 ETS contains a number of self-checking features. The marker and the processor have access to most of the circuits in an office and therefore are able to determine the performance of the various circuits. When a marker encounters a trouble, the marker will identify the problem and cause the trouble recorder to make a permanent record on punched cards. If the processor encounters a trouble, it will provide a permanent record in the form of a printout at a maintenance terminal. The ETS system status panel will also provide a visual indication of the busy/idle state of all DAS equipment and related common control

circuits. The punched cards, maintenance terminal printout or visual display can be used as an aid by the maintenance force.

(h) **Network Measurements:** Network measurements are made by the 5 ETS for Network Administration, Network Maintenance, network design, billing and division of revenue. They include measurements for 5 ETS administration plus certain measurements previously obtained from those electromechanical circuits replaced by the 5 ETS. The latter includes: (a) AMA peg counts, (b) subscriber line overflow for individual lines and hunt groups (associated with the terminating translation feature), and (c) route peg count and overflow and preroute peg count (associated with the route translation feature).

(i) **Network Management Controls:** The No. 5 ETS is arranged to respond to two network management controls; dynamic overload control (DOC) and directional reservation (DRE). DOC permits the automatic cancellation or alteration of automatic alternate intertoll routes in response to control signals from the "home" toll office. DRE is used to preferentially directionalize the flow of traffic on 2-way intertoll trunks.

2. SWITCHING PRINCIPLES

GENERAL

2.01 Part 2 of this section describes how the No. 5 ETS office provides telephone service to the customers. The switching principles are described in terms of the switching frames electromechanical common control circuits, and ETS hardware and software.

2.02 The basic element in any crossbar system is the crossbar switch. Talking connections through switching frames are made by these crossbar switches.

2.03 The crossbar switch is essentially a relay mechanism consisting of 10 horizontal paths and 10 or 20 vertical paths, depending on the size of the switch unit. Any horizontal path can be connected to any vertical path by means of contacts controlled by the operation of relay magnets (select and holding). The points of connection are known as crosspoints. The switch with 10 vertical paths has 100 crosspoints and is called a 100-point switch;

the switch with 20 vertical paths has 200 crosspoints and is called a 200-point switch. A partial perspective view of a crossbar switch is shown in Fig. 2. There are two versions of the crossbar switch, namely large and small. The large switch is available in both 100-point and 200-point sizes. The small switch contains 240 crosspoints (12 horizontals by 20 verticals) but is commonly referred to as a 200-point switch because two levels are normally used only to access the remaining ten.

2.04 Class of Service Translation: Class of service translation is required for screening customer services. Class of service is defined by the combination of line class and rate treatment. With No. 5 ETS, the line class and rate treatment information is stored in the ETS memory on an individual line basis. All No. 5 ETS offices have the capability of providing 100 line classes and 20 rate treatments. Each rate treatment/line class combination can be treated as a unique class of service, hence 2000 classes of service are available.

2.05 Route Translation and Trunk Selection: In a No. 5 ETS office the route translation, screening, trunk selection and 6-digit translations are performed by the ETS processor software. Since the ETS will be providing the trunk block information when distributing the location of the trunk, and since the assignment of trunk block is made only in memory, trunks anywhere in the office can be assigned to any trunk group. Recent changes are made via input messages at an access terminal. Outsender group selection is also performed by the processor. This enables outsender groups to be specified per trunk rather than by route.

2.06 Terminating Translation: Terminating translation in No. 5 ETS includes: (a) translation of telephone numbers (TNs) into line equipment numbers (LENs) on calls to lines, (b) translation of trunk numbers to LENs on tandem (trunk-to-trunk) calls or junctor connections where the LLF appearance of a trunk or junctor is involved, and (c) determining and returning miscellaneous indications (free number, overflow, permanent busy, hunt group, line link pulsing, automatic intercept system (AIS) call, etc) to the completing marker. These functions are performed by the ETS, the direct access pretranslator (DAP), and the AIS sender. The DAP, a circuit which interfaces a 101 ESS control unit, performs the translation on calls to 101 ESS PBXs. AIS senders are provided and perform translation functions on calls to an AIS

when line link pulsing (LLP) is not provided. Number group translations are provided by the ETS in software groups of 100 numbers for a maximum of 60,000 numbers in 600 groups. Any group can be used for telephone numbers or for trunk numbers, but telephone and trunk numbers cannot be mixed in the same group. In addition, the 2-line hunt feature is moved to software and is available in all offices.

MAJOR SWITCHING FRAMES

2.07 All No. 5 ETS office connections in the talking paths are established through line link switching frames and trunk link switching frames. Lines are connected to the switches on the line link frames, and trunks and register circuits are connected to the switches on the trunk link frames. These frames interconnect over junctors that are attached to junctor switches on the line link and trunk link frames. These switching operations are controlled by the common control equipment which includes markers, associated connectors, and processors.

2.08 Fig. 1 is a simplified diagram showing the relationship of the switching frames, crossbar common control equipment, and ETS equipment.

A. Line Link Frames

2.09 The crossbar switches on the LLF (Fig. 3) are divided functionally into line switches and junctor switches. Customer lines, auxiliary line circuits, and some trunk circuits are connected to the line switches and junctor circuits are connected to the junctor switches. Line links are provided for interconnecting the line and junctor switches. The basic LLF is available in two sizes: 190 lines and 290 lines.

Line Switches

2.10 The 290-line frame most commonly used is a 2-bay frame with each bay mounting ten of the large type 200-point crossbar switches. One and one-half switches on each level are used as line switches. Each vertical on a line switch is used for a customer line, an auxiliary line, a tandem trunk, and intercept line, line link pulsing, or a toll trunk, except one which is used for no-test access to the remaining 29. The half switches not used as line switches are used as junctor switches, thus providing ten verticals for terminating the

junctions on each level. The line relays, one for each customer line, are mounted at the top of the LLF.

2.11 The 190-line frame is available with either large or small size crossbar switches. With large switches the equipment is arranged in three bays with each bay mounting ten 200-point switches. The three bays accommodate two 190-line LLFs with each LLF utilizing one complete bay and sharing the third. With small switches the equipment is arranged in two bays. The right bay contains ten 200-point switches for each of two LLFs. The left bay contains ten 200-point junctor switches shared by both LLFs.

2.12 Line links appear on the horizontals of the switches, ten line links on each switch. These ten line links are distributed among the ten junctor switches, one line link to one horizontal on each of the ten junctor switches. This system of line links permits each line on a LLF to reach any one of the 100 junctions serving that frame (Fig. 3).

2.13 Any particular line link can be readily traced because the line switch horizontal number of each line link is the same as the junctor switch number and the junctor switch horizontal number of each line link is the same as the line switch number.

Capacity of Line Link Frames

2.14 Since, in a 290-line frame, each basic line switch is made up of one and one-half 200-point crossbar switches, the basic line link frame has a capacity of 300 line switch verticals (30 on each level) and 100 line links. However, the actual number of customer lines, auxiliary lines, or trunks on this frame is 290 because ten line switch verticals (one on each level) are required for no-test operations, such as obtaining access to busy lines from the local test desk or verification of busy lines by operators.

2.15 Greater line capacity can be obtained by supplementary bays of switches. The number of lines served by 100 line links can be determined by the average incoming plus outgoing usage (calling rate times holding rate) of the lines. To accommodate varying requirements, provision is made for adding supplementary bays to the basic 290-line frame to

serve from 340 to 590 lines in steps of 50, 100, or 200 lines.

2.16 No. 5 ETS offices have no restriction on class of service assignments within a vertical file of a LLF. The line class of service information is stored in the ETS memory on an individual line basis rather than in cross-connections on the LLF.

- TOUCH-TONE® service and line load control are assigned on a vertical group basis.

B. Junctions

2.17 Each LLF has 100 junctor terminations which are used to connect to all trunk link frames (TLFs) in the office. Each TLF has 200 junctor terminals for connecting to all line link frames; therefore the ratio of line link frames to trunk link frames in an office is generally 2:1. There are no half frames. (In an office with 13 line link frames, there are usually seven trunk link frames.) However, conditions peculiar to a particular office may cause some variations in this ratio.

2.18 The 100 junctions from each LLF are divided into approximately equal groups, with one group from each LLF going to each TLF. The number of junctions in a group depends on the number of trunk link frames in the office. The number of junctions per group is determined by dividing the 100 junctions by the number of trunk link frames. However, there is a limiting factor—for efficient service, no group can contain less than ten junctions.

2.19 When there are ten or fewer trunk link frames in an office, each junctor group has ten or more junctions. For example, in an office with eight trunk link frames and 16 line link frames, each junctor group contains either 12 or 13 junctions. Fig. 4 illustrates the junctor distribution for two trunk link frames and four line link frames.

2.20 In an office with 11 to 20 trunk link frames, each junctor is multiplied to two trunk link frames in order to have at least ten junctions per group. For example, in an office with 20 trunk link frames and 40 line link frames, each junctor group contains ten junctions. Fig. 5 illustrates the junctor distribution for 20 trunk link frames and 40 line link frames. In this case, the number of

SECTION 19a(1)

junctions in a group is determined by dividing 100 by the number of pairs of trunk link frames.

2.21 In offices with 21 to 30 trunk link frames, each junctor is multiplied to three trunk link frames. In an office with 60 line link frames, each junctor group contains ten junctions. Fig. 6 illustrates the junctor distribution for 30 trunk link frames and 60 line link frames.

C. Paired Line Link Frames

2.22 Arrangements have been made for paired LLF operation in No. 5 ETS crossbar offices. This arrangement permits a pair of line link frames to make joint use of their junctions, and as a result, increases the load carrying capacity by approximately 20 percent. Paired LLF operation can be used only in offices which have a 20:10 ratio of line link to trunk link frames or a larger number of trunk link frames that are paired or tripled so that there are always ten trunk link frame pairs or triples. These pairs or triples do not have to be fully equipped, but if they are not, the efficiency of the arrangement is reduced.

D. Trunk Link Frames

2.23 The trunk link frame is made up of trunk switches, junctor switches, and various miscellaneous circuits. Trunks and originating registers are connected to the trunk switches (Fig. 7). The junctions from the LLF are connected to the junctor switches. The trunk and junctor switches are interconnected by trunk links which are similar to line links. The trunk links connect the junctor switch verticals to the trunk switch verticals; line links connect line switch horizontals to junctor switch horizontals.

E. Trunk Links and Junctions

2.24 The system of trunk links that permits any outlet or trunk on a trunk link frame to be connected to any one of 200 junctions serving that frame is similar in principle to that used on line link frames. There are 200 trunk links, which are the same as the number of junctions. The junctions are connected to the horizontals of the junctor switches and the trunks to the horizontals of the trunk switches. In order to terminate 20 junctions on the horizontals of one 200-point switch, it is necessary to split the horizontal multiple into left and right half switches. The two half switches

thus formed are treated separately. The numbering of the verticals in each half is similar, but they are identified as left and right. Although the trunk switches are not physically split, the numbering of verticals is also on the left and right basis.

2.25 The trunk link distribution is similar to that provided for line link distribution. The vertical number at one end of a link is always the same as the switch number at the other end of the link. In addition, a vertical on the left half of a switch is always connected to a vertical on the left half of the switch at the other end of the link, and a vertical on the right half of a switch is always connected to a vertical on the right half of the switch at the other end of the link. (See Fig. 8.)

Extension Trunk Link Frame

2.26 When 11 to 20 trunk link frames are involved, each junctor is multiplied to two trunk link frames in order that each junctor group contains a minimum of ten junctions. This requirement reduces the junctor capacity of the basic trunk link frames by 50 percent, and it is necessary to provide additional junctor switches for each trunk link frame. These additional switches are mounted on the extension trunk link frame which, if equipped initially, is placed adjacent to the junctor switch bay of the trunk link frame. The extension frame consists of a framework with ten 200-point, 3-wire switches, the same as the junctor switches on the trunk link frame. These switches have a capacity for 200 junctions and with the 200 junctions on the trunk link frame provide a total of 400 junctions for the combination.

2.27 For those offices with more than 40 line link frames or 20 trunk link frames, a second extension trunk link frame is required to provide additional junctions. The junctor switches of one trunk link frame plus those on two extension frames provide terminations for 600 junctions.

Auxiliary Trunk Link Frame

2.28 An auxiliary trunk link frame is a single-bay framework with twenty 3-wire, 10-level, 20-vertical, small type crossbar switches. The 20 switches are divided into two junctor sets with 10 switches providing 200 junctions per set. The two junctor sets on one auxiliary trunk link frame can be used in place of a first and second extension

trunk link frame for one trunk link frame. They can also be used as the first or the second extension for two trunk link frames.

F. Trunk Switches

2.29 The ten trunk switches on the trunk link frames are 6-wire switches. They furnish locations for either 160 or 200 trunks depending upon the type of switches installed. Each trunk switch has appearances for either 16 or 20 trunks on eight levels on horizontals (Fig. 9). On levels 2 through 9 of the large switch or levels 2 through 11 of the small switch, the 6-wire switches of each level terminate on two 3-wire trunks.

2.30 The trunk link is wired to the first three nonmultiple terminals of level 1 and the last three nonmultiple terminals of level 0. Each operation of the trunk switch requires two selecting magnet operations. Either 0 or 1 selecting magnet must be operated to direct the trunk link to the proper 3-wire connection of the vertical, and the selecting magnet associated with one level of levels 2 through 9 where the trunk appearances must be operated. Levels 0 and 1 are directing levels. The eight appearances on each switch that are selected by horizontal 0 are called A appearances and those selected by horizontal 1 are called B appearances.

G. Channels

2.31 A channel is the combination of a line link, a junctor, and a trunk link formed by crosspoint closures into the transmission path that interconnects a line and a trunk. Each line link junctor, and trunk link consists of the tip, ring, and sleeve leads with a switch appearance at each end.

2.32 The ten or more juncctors in a group connecting LLF with a trunk link frame are distributed over the ten junctor switches of both frames, the junctor switch number being the same on both ends for each junctor. There are ten line links serving each customer line on the LLF distributed over the ten junctor switches.

2.33 There are 20 trunk links serving each trunk on the trunk link frame distributed over the ten junctor switches. Thus, when a line and a trunk for an office consisting of 20 line link and ten trunk link frames are considered, ten channels

are available for a connection. These channels are numbered according to the junctor switches on which they terminate (A of Fig. 10). An idle channel is selected by testing the ten channels at the same time. For office sizes smaller than the above, there are more than ten channels available. For example, in a 10-line link and 5-trunk frame office, 20 channels are provided (B of Fig. 10). Additional tests are required if an idle channel is not found when the first ten channels are tested.

2.34 The channel number also corresponds to the number of the line switch horizontal on the LLF as well as the number of the trunk switch vertical on the trunk link frame.

3. EQUIPMENT ELEMENTS

3.01 The functions and physical appearance of the main equipment elements in a No. 5 ETS office are briefly described in this part.

LINE LINK FRAMES

3.02 Line link frames contain customer line appearances. All calls to or from a customer are connected through the LLF. These frames also contain access leads for tandem trunks, toll trunks, line link pulsing trunks, intercept trunks, and test lines.

3.03 Standard line link frames are 2-bay or 3-bay frames providing termination for 290 lines or 190 lines depending upon the type of switches used. In addition to the basic line link frames, there are single-bay and double-bay supplementary line switch frames containing terminations for 50, 100, 200, 300, or 600 lines. When paired LLF operation is provided, an auxiliary LLF must be provided. Large switch auxiliary LLFs mount ten 200-point switches and serve two LLFs. Small switch auxiliary LLFs mount twenty 200-point switches and serve four LLFs.

TRUNK LINK FRAMES

3.04 Trunk link frames are 2-bay frames which provide terminations for originating registers and trunks on switching frames.

EXTENSION AND AUXILIARY TRUNK LINK FRAMES

3.05 Extension and auxiliary trunk link frames are single-bay junctor switch frames. These

SECTION 19a(1)

frames are required in offices equipped with more than 20 line link frames or 10 trunk link frames. The extensions will be provided as follows:

- (a) One extension per TLF or one auxiliary per two TLFs for offices with more than 20 line link or 10 trunk link frames
- (b) Two extensions per TLF or two auxiliaries per two TLFs for offices with more than 40 line link or 20 trunk link frames.

When extension or auxiliary trunk link frames are added, the verticals are multiplied so that each trunk has three junctor appearances.

JUNCTOR GROUPING FRAME

3.06 The junctor grouping frame is a single-bay frame containing terminal strips, fanning rings, and rings for jumpers. The junctor grouping frame provides means for terminating the juncctors of the line link frames and trunk link frames and for cross-connecting these terminations for equal access to all trunk link frames and all line link frames. One basic junctor grouping frame is provided for each 20 line link frames. Supplementary junctor grouping frames are provided when trunk link frames are paired or tripled and the basic junctor grouping frames are not adjacent.

MARKERS

3.07 The marker (in conjunction with the ETS) provides the intelligence for switching control within a No. 5 ETS office. Marker action is required on all customer service requests. The processor provides the marker with routing information, customer class of service, and other information required by the marker in order to provide a transmission path through the office.

3.08 The quantity of markers in an office depends on the amount of traffic handled by the office.

3.09 ETS is arranged to work with two types of markers, dial tone, and completing.

A. Dial Tone Marker

3.10 The dial tone marker consists of a single-bay frame of equipment functioning together with the ETS to respond to customer requests for dial

tone by establishing a connection between the calling line and an originating register.

3.11 In addition to its normal function of establishing connections between lines and originating registers, the dial tone marker is used to establish connections between incoming trunks and transfer trunks to provide the centrex call transfer feature.

3.12 A supplementary dial tone marker frame is used as a supplement to the dial tone marker frames when 60 line link frames and 30 trunk link frames are provided in a wire-spring-relay type marker group.

B. Completing Marker

3.13 The completing marker consists of several frames functioning together with the ETS equipment to select and establish a path through the switching equipment. The completing marker directs traffic either originating in, completing to, or switching through the No. 5 ETS machine. The common equipment, and translator and code treatment frames are required for all types of service. The code conversion frame, PBX allotter frame, and supplementary and auxiliary service treatment frames are also part of the completing marker but provide marker group capacities and types of service not necessarily required in all No. 5 ETS offices.

C. Marker Special Features

3.14 Two completing markers, 0 and 1, are equipped with special features for handling some test calls. These calls are set up by operators, local test desk personnel, or maintenance personnel, or are automatically controlled by timing devices and consist of the following types:

- (a) Busy verification originated by an operator or no-test calls originated by test desk personnel
- (b) Line insulation test cycles originated locally by maintenance personnel or remotely by test desk personnel
- (c) Special hunt calls originated at the local test desk
- (d) Line verification tests performed by frame personnel.

3.15 Normal ground and continuity line tests performed on marker calls are canceled during the preceding special tests.

ELECTRONIC TRANSLATION SYSTEM (ETS)

A. General

3.16 The ETS provides stored program control of the line, trunk, and routing translation in the No. 5 ETS System. Supplemental features include LAMA and CAMA capabilities. The ETS consists basically of a processor complex with associated scanners and distributors. It bridges onto the No. 5 Crossbar System through the markers as shown in Fig. 1. ETS receives call details from markers, trunks and lines over scan leads, and returns routing information to the marker over distribute leads. The scanning of trunks provides ETS with supervisory status of the trunks for routing and billing. Line scanning is done on lines in multiline hunt groups to provide ETS with busy/idle status for hunting and on INWATS lines for AMA purposes. Busy/idle status is not required for 2-line hunt groups, so these lines are not scanned.

B. Processor Complex

3.17 The major elements of the processor complex are duplicated 3A CC processors, memory units data channel input/output equipment, power converters, and processor maintenance facilities. The processor complex consists of seven 26-inch wide 7-foot ESS type bays. The complex includes two 3A auxiliary processor bays, two memory store bays, one maintenance bay, one ETS auxiliary bay, and one power and data interface bay.

(a) **3A CC Processor:** Duplicated 3A CC processors are contained in the double-bay 3A auxiliary processor frame. In addition to the processors this frame contains up to 256K words (18 bits per word) of random access memory for each processor.

(b) **Additional memory:** Two single-bay store frames may be optionally provided to increase the memory associated with each processor from the 256K words maximum on the processor frame to a total of 764K words. The additional store may not be required in all offices; however, space must be reserved for them.

(c) **Processor Maintenance:** Processor maintenance facilities are provided on a single-bay maintenance frame. Peripheral equipment on the frame includes a system status panel, duplicated tape cartridge units, and associated power and control circuitry. A 35-type TTY may be optionally provided on the maintenance frame.

(d) **ETS Power and Data Interface (PDI) Equipment:** An ETS power and data interface frame containing the system -48 volt and +24 volt power distribution fuse panels, -48 volt filters, +24 volt power converters, data sets, associated data channel interface, and ETS status panel complete the processor complex. One ETS PDI frame is required per office.

(e) **Data Sets and Terminals:** The processors are always served with a minimum of one dial up and one primary dedicated data link to the No. 1 automatic message accounting recording center (AMARC). In addition to the TTY on the ETS maintenance frame, a DATASPEED®-40 must be provided in the maintenance area for 5 ETS control functions. Additional TTYs or DATASPEED-40s may be provided at other locations such as near the main distributing frame (MDF), at a centralized maintenance center, at a Network Administration center, or at a service order center.

C. Distributing and Scanning (DAS) Equipment

3.18 Distributors and scanners serve as the interface between the processors and the No. 5 crossbar electromechanical hardware. Scan points are the signal input channels to the system; they convert the noisy battery ground signals of the electromechanical circuits to the low level noise-free signals required by the processor.

Distribute points are the output control channels for the processors which convert the low level processor signals to the -48V signals required by the electromechanical circuits. In most cases, distribute points are used to operate relays in the electromechanical hardware.

Scan points are grouped into scan matrices of 256 points, each 16 by 16, while distribute points are grouped into distribute matrices of 64 points, each 4 by 16. Two matrices

SECTION 19a(1)

are mounted together to form one unit of apparatus. Ten units mounted together form a DAS group and two DAS groups are mounted on one single-bay (33-9/16 inches wide, by 11-feet 6-inches high) standard sheet metal No. 5 crossbar frame. One DAS group provides the necessary DAS equipment for one dial tone and one completing marker plus a portion of the DAS equipment required for lines, trunks, and miscellaneous functions. One DAS frame is required for each two completing markers. A maximum of 12 DAS groups on six DAS frames may be provided. Functions are spread across DAS groups to minimize the service loss as a result of failure of a DAS group. For example, no more than one completing marker is assigned to a DAS group, and trunks assigned to the same route are distributed across several DAS groups.

D. Miscellaneous Interface Equipment

3.19 Supplemental interface equipment is required for interfacing to completing markers and for the CAMA, ANI, and remote message register features. This equipment consists primarily of wire spring relays and mounts on standard No. 5 crossbar relay racks (23 inches by 11 feet 6 inches). The miscellaneous interface circuits are as follows:

(a) **Marker Distributor Control (MDC):**

This circuit is an interface between the distributor and the completing marker and is provided one per marker. It performs the following functions:

- (1) Converts 2/n information from the distributor into 1/n codes used by the marker
- (2) Permits multiple use of some distribute points by gating to the correct marker leads depending upon the type of call
- (3) Gates information from the distributor to the marker at the correct time
- (4) Checks certain data passed to the marker (data which is not checked by the marker)
- (5) Provides the means to switch back and forth between the ETS and non-ETS modes during transition.

Each MDC requires 18 inches of relay rack space.

(b) **Program Controlled Transverter (PCTV):**

This circuit connects with the ANI and CAMA senders via existing transverter connectors to provide the ANI and CAMA functions. Two circuits for ANI and two for CAMA are provided for reliability. The PCTV requires 6 inches of relay rack space.

(c) **PBX-AIOD Buffer, Control, and Connector (PABCC) Circuit:**

This circuit connects with the AIOD translator for AIOD service. Two circuits are provided for reliability. The PABCC requires 22 inches of relay rack space.

(d) **Remote Message Register Unit (RMR):**

This unit provides the capability of scoring remote message registers at hotel/motel PBX locations via a third wire. It can handle 16 registers. Provision is made for a maximum of 32 units or 512 registers. The RMR unit requires 4 inches of relay rack space.

(e) **Measurement Registration Connector (MRC):**

This circuit connects to existing plant and traffic registers and data collecting devices. It has a capacity of 896 outputs.

(f) **Program Controlled Data Acquisition Interface (PCDAI):**

This circuit connects with the master test frame (MTF) and the trouble recorder and is always provided. It enables the ETS to scan trouble recorder leads for verification of distribute point connections to the markers.

ORIGINATING REGISTERS

3.20 The functions of the originating register are to:

- (a) Transmit dial tone to the customer
- (b) Receive and store the digits of the called number
- (c) Allow preliminary translation of the initial office code dialed by the pretranslator
- (d) Transfer customer location and called number information to the marker after dialing has been completed

- (e) Make 2-party tests to recognize the originating customer for AMA billing information
- (f) Perform customer loop tests designed to detect trouble conditions
- (g) Accept dial pulses and/or TOUCH-TONE frequencies.

Originating register circuits appear on the trunk link frame and connections are established to these circuits by the dial tone marker.

3.21 The originating register frame is a double-bay frame which can be equipped with eight originating registers. The bay is also equipped with register multicontact relays associated with the marker multicontact relays located on the originating register line memory frame. This 2-bay frame is designated OR.

ORIGINATING REGISTER LINE MEMORY FRAME

3.22 The function of the originating register line memory frame is to register the calling customer LLF location and to store this information until required by the completing marker. This frame is a single-bay frame containing multicontact relays and reed-type relays.

PRETRANSLATORS

3.23 The function of the pretranslator is to determine from the second or third digit received by the originating register the number of additional digits that should be received by the register before it attempts to seize a marker. This feature can be applied to all present combinations of office codes or numbering area codes.

3.24 The pretranslator frame is a single-bay frame with space for two pretranslators and two pretranslator connectors which serve up to 144 originating registers. If another frame is necessary, it is provided for one pretranslator and its connector. Two pretranslators are adequate for most marker groups. The arrangements provide for one pretranslator group to serve two marker groups when desired.

OUTGOING SENDERS

3.25 The function of the outgoing sender is to receive the digits from the marker for an

outgoing call and to transmit them to the connecting office.

(a) An outgoing sender is used on all calls requiring pulsing to the connecting office. The completing marker transfers the required digits of the called number to the sender connected to an outgoing trunk. The type of pulses required at the connecting office (step-by-step, panel, manual, ESS, or crossbar) determines the type of sender used to transmit the called number (see Table A). Therefore, five different types of outgoing senders are provided in a No. 5 ETS office as follows:

- (1) Dial Pulse (DP)
- (2) Multifrequency (MF)
- (3) Revertive pulse (RP)
- (4) Panel call indicator (PCI)
- (5) Frequency shift pulsing (FSP).

(b) The wire spring type MF sender circuit can also be equipped for ANI operations. For ANI operation, the MF sender functions to:

- (1) Output the called number
- (2) Connect to a program controlled transverter through a transverter connector and transfer the calling line equipment number to the transverter
- (3) Receive from the ETS the associated directory number
- (4) Output directory number of the calling customer.

(c) The outgoing sender frame is a single-bay frame which contains three or four outgoing senders of the same type. This frame also contains multicontact relays to associate each sender with one of a possible two outgoing sender connectors which may be associated with this frame.

OUTGOING SENDER LINKS

3.26 Outgoing sender links connect outgoing and intermarker group senders to outgoing trunks.

SECTION 19a(1)

Information from a sender to a trunk is transmitted through this sender link.

- (a) One sender link frame is a single-bay frame designated OSL; it mounts ten 200-point crossbar switches. Any or all of the types of outgoing senders (MF, DP, RP, PCI, FSP) and intermarker group senders may have appearances on one sender link frame.

INCOMING REGISTERS

3.27 The function of the incoming register is to receive and record the digits of the called number received over incoming trunks from operators or from a connecting office and transmit them to the completing marker. Since these pulses are incoming from various types of offices, the following incoming registers are provided to record them. (See table A.)

- (a) Dial pulse (DP).
- (b) Multifrequency (MF).
- (c) Revertive pulse (RP). (There are two types of revertive incoming registers.)
 - (1) The local revertive incoming register receives only the four numerals from the originating panel or crossbar office. This register can recognize the "high five" or "low five" incoming group selection to discriminate between the two terminating offices in the marker group.
 - (2) The tandem revertive pulse incoming register receives from the originating panel or crossbar equipment the office brush and group selectors in addition to the four numerals. The office brush and group selectors are translated into an office code from which the marker determines the routing of the call.
- (d) Frequency shift pulsing (FSP).

3.28 The *incoming register frame* is a single-bay frame which contains a maximum of three (DP, RP, or FSP) or four (MF) incoming registers of the same type. This frame also contains multicontact relays for associating each register with one of a maximum of two incoming register marker connectors.

INCOMING REGISTER LINKS

3.29 The function of the incoming register link frame is to select an idle incoming register and connect it to the incoming trunk associated with the connecting office. The connection is established through the crosspoints of a crossbar switch.

- (a) Two types of incoming register link frames are available: bylink frames are used for trunks associated with step-by-step offices and nonbylink frames for all other types.
- (b) The frames are single-bay frames containing general purpose relays, crossbar switches, and a field of cross-connection terminal strips.

INTERMARKER GROUP SENDERS

3.30 The intermarker group sender is used for traffic between two different No. 5 crossbar and/or No. 5 ETS marker groups housed in the same building. It serves in two capacities: as an outgoing sender for calling the marker and as an incoming register for the called marker.

- (a) If AMA billing is not provided, six senders can be mounted on the single-bay frame which is designated intermarker group sender frame (IMGS). If AMA billing is provided, four senders may be mounted on one frame.

CONNECTORS

3.31 A connector is a relay-type switching device for interconnecting two equipment units by a relatively large number of leads.

- (a) A specific method is used to designate connector titles. If a particular type of equipment originates action toward a marker, the connector title includes both the originating and the terminating equipment. For example, the line link marker connector action is originated by the LLF and terminates in the marker. The originating circuit must be mentioned because many circuits can originate action toward a marker.
- (b) When a marker originates action toward another type of equipment, the connector is named according to where the connector action terminates but does not contain the word marker

in the title. Table B lists the principle connectors in a No. 5 ETS office.

(c) Connector frames vary in their marker capacity and connector equipment capacity. When the number of markers or connectors exceeds these frame capacities, additional connector frames must be used. These frames are designated supplementary or auxiliary connector frames; an example is the supplementary trunk link connector frame used in offices equipped with or planned for 12 completing and six dial tone markers.

(d) In general, the wire spring relay type connector frame capacity is greater than that of its flat spring relay type counterpart. This is because the connector control and preference equipment is mounted on separate frames. The equipment mounted on a control frame must be of the same type. For example, the trunk link connector control frame accommodates the equipment for trunk link connectors. The capacities of the control frames vary according to the type connectors they serve.

TRUNKS

3.32 Trunks have switch frame appearances on trunk link frames and carry calls from one office to another and from customer to customer within the office. Various types of trunks are provided to serve the various types of traffic in an office.

(a) Trunks are mounted on relay rack frames.

Those trunks which require ringing, such as intraoffice, incoming, and revertive ringing, usually have ringing selection switches on the same relay rack. Ten trunks can appear on each ringing switch.

(b) Trunks are assigned to the DAS frame for scanning only. Scanning provides ETS with supervisory status of trunks for routing and billing purposes. In most cases trunk scanning is done only on outgoing and intraoffice trunks. The telephone operating company selects the trunks to be scanned and assigns these trunks to DAS units.

(c) The following is a list of principle categories of trunks. Many miscellaneous types are not listed.

(1) **Intraoffice trunks** handle traffic between customers served by the same marker group. Each trunk requires two trunk link frame locations, an A appearance for the calling customer and a B appearance for the called customer. These trunks must be assigned to scan units.

(2) **Outgoing interlocal trunks** are used to transmit calls going from the No. 5 crossbar office to the connecting office. The types of outgoing trunks used depend on the traffic in an individual office. These trunks must be assigned to scan units.

(3) **Incoming interlocal trunks** carry the traffic incoming to a No. 5 ETS office. There are two general types of these trunks, nontandem and tandem. The nontandem-type trunks carry only the calls completing to customers in the office and have only one appearance in the office, the trunk link frame. The tandem-type trunks carry calls completing to customers in the office and also calls which are switched through when the No. 5 ETS office functions as a tandem switching point. Tandem trunks have two frame appearances in the office, one on the line link frame for switching calls through the office and the other on the trunk link frame for calls that terminate in the tandem office.

(4) **Two-way interlocal trunks** are provided on small trunk groups when it is not economical to use one-way trunk groups. These trunks must be assigned to scan units.

(5) **Intermarker group trunks** handle traffic between two No. 5 crossbar or No. 5 ETS marker groups located in the same building. The following three type of trunks are used for this traffic:

- Customer-to-customer
- Customer-to-trunk
- Trunk-to-customer.

These trunks must be assigned to scan units.

(6) **Operator, special service, and recording completing trunks** are used by DSA operators to handle assistance

traffic. There are usually separate groups of trunks for various classes of service. These trunks must be assigned to scan units.

(7) **Tone trunks** are used to give line-busy on intraoffice calls, overflow (paths-busy), partial dial, and vacant code tones. There may be coin and noncoin groups of these trunks. These trunks must be assigned to scan units.

(8) **Common overflow trunks** are provided as a final route when all permanent signal holding or noncoin combination tone trunks are busy. This trunk returns a line-busy signal to the calling party. These trunks must be assigned to scan units.

(9) **Intertoll trunks** are used to switch toll calls between toll centers. These trunks are of three general types as follows:

- **One-Way Incoming Trunks:** These have three frame appearances in an office: two LLF appearances for calls switched through the No. 5 ETS office as a toll center and one trunk link frame appearance for calls terminated in the toll center.
- **One-Way Outgoing Trunks:** These have one trunk link frame appearance for calls outgoing from the No. 5 ETS office as a toll center and one jack appearance at the toll switchboard for operator-handled outgoing calls. These trunks must be assigned to scan units.
- **Two-Way Trunks:** These have all of the appearances mentioned above. Since interlocal and intertoll trunks employ different supervision and impedance characteristics, one type may not be switched directly to the other type without conversion arrangements. These trunks must be assigned to scan units.

(10) **Line link pulsing line circuits** are used to complete calls from the No. 5 ETS office, functioning as a regular or centrex office, directly to PBX extensions. This is accomplished by providing a location for a line link pulsing sender link so that a DP sender can outpulse to the PBX switches. These line circuits have a LLF appearance and must be assigned to scan units.

(11) **Junctor circuits** are accessory circuits which can be attached by switching to trunks to provide additional features which these trunks do not have. Their functions are as follows:

- **Operator Junctor:** This circuit completes calls on a tandem basis from a switchboard located in the same building as the No. 5 ETS crossbar switches, to customers located in other local offices.
- **Operator Toll Junctor:** The functions of this circuit are similar to those of the operator junctor, except that the trunks involved are of the intertoll type.
- **Coin Junctor:** This circuit functions to provide for coin operation (coin collect, coin return, coin test, etc) for local coin calls to be routed over outgoing trunks not arranged for coin service. This circuit must be assigned to a scan unit.
- **Coin Zone Junctor:** In addition to performing the functions of a coin junctor, this circuit is arranged to call in an operator for the initial and overtime charges for coin zone customer-dialed calls. This circuit must be assigned to a scan unit.
- **Off-Net Access Junctor:** This circuit provides common control switching arrangement (CCSA) customers with local off-net access to complete calls to customers in the Bell System network. This circuit must be assigned to a scan unit.

COIN SUPERVISORY CIRCUITS

3.33 Coin supervisory circuits handle all coin operations except those handled by the originating register. In operation, one of these circuits, which are in a common group and are mounted on relay racks, is connected to a trunk that is serving a coin call. The function of this circuit is to collect the coins at the end of a completed call for which a charge is made and to effect coin return as free or noncompleted calls.

- (a) On offices with coin overtime, this circuit makes coin test and collects the coin for the initial and subsequent periods. If a deposit

is not made for an overtime period, the circuit signals an operator to come in on the connection.

COIN SUPERVISORY LINKS

3.34 These links connect coin trunks to coin supervisory circuits. The frame is similar to the incoming register link frame; the circuit arrangements are the same. Because the holding time of coin supervisory circuits with coin trunks is very short, a group of ten supervisory circuits can serve as many as 480 trunks.

COIN ZONE TRUNK CONCENTRATION

3.35 When the coin zone operator is located in a remote building, this concentrator may be used to provide for a more economical trunking plan between buildings. The concentrator uses 200-point crossbar-type switches, with the interbuilding trunks appearing on the horizontals and the trunks to be concentrated appearing on the verticals. The concentrator handles a maximum of 30 outgoing trunks to the switchboards.

AMA RECORDING

A. Call Records

3.36 The following standard single-entry AMA call records are provided by the ETS:

- (a) Toll
- (b) Message rate—bulk
- (c) Message rate—detailed
- (d) WATS (all types)
- (e) INWATS
- (f) CCSA (for example sampling and for charged calls with automatic flexible routing)
- (g) Dial TWX
- (h) Local directory assistance.

B. Recording Formats

3.37 The call record formats used by the ETS conform to the standards for AMA 9-track magnetic tape recording for a single-entry system

as specified by AT&T Comptroller's Spec M-284A, Part 3, Section 4. A forthcoming revision of this specification will describe the statistical labels to be used.

C. Recording Intervals

Call Duration: The ETS records the time of initial recognition of the called party off-hook signal as the answer time. The time of the initial recognition of the associated trunk circuit release is recorded as the call termination time for all outgoing or intraoffice calls. Calls to INWATS lines are recorded as being terminated at the initial recognition of either party disconnecting.

Minimum Recordable Duration: Calls will be recorded only if the off-hook signal persists continuously for a minimum of 0.2 seconds.

Minimum Charge Duration: Calls are identified for charging only when the called party off-hook condition persists continuously for at least two seconds.

D. Statistical Data

3.38 Certain statistics are accumulated hourly and transmitted to the AMARC on the hour. This data, called a *tracer record*, contains time and date information, office identification, and the following:

- Data Link Load
- Toll Message Counts
- Nontoll Message Counts
- Recordable Attempts Count
- Recordable Attempts Lost Count
- Call Records Count
- Call Records Lost Count

In addition to the hourly counts, INWATS overflow counts are accumulated daily and transmitted to the AMARC at midnight.

SECTION 19a(1)

E. AMARC Data Link Security

3.39 Security arrangements are provided which permit only AMARC to receive AMA data over the dial up data link.

SOFTWARE

3.40 ETS software consists of two general categories: **generic** and **office data base**. The generic program for No. 5 ETS is that portion of the software data which is developed by BTL and is the same for all No. 5 ETS offices. The office data base for No. 5 ETS is that portion of the software data which varies with the installation in size, in content, and in address. The general strategy for interfacing the generic program with this variable data base is to provide a table directory (TABDIR) which describes the data for a particular installation. This TABDIR has an entry for every possible table indicating whether the table is provided in that particular installation, the size of the table for that particular installation, and the address where the table is located in that particular installation. All generic programs must index through the TABDIR to access the office data base.

(a) **Generic programs:** The No. 5 ETS generic programs provide the logic and control for all the ETS functions. The programs are divided functionally, either main-store resident or cartridge-tape resident. All call processing programs are main-store resident. Other programs (those not often executed) are cartridge tape resident. The diagnostic programs are an example of tape resident programs. The programs are divided functionally into the following categories:

- (1) **Extended operating system programs:** These provide monitoring and control for all the other programs, and control all the hardware.
- (2) **Call processing programs:** These provide all the functions associated with collecting and distributing call data. They perform various class and routing translations, distribute data to the Switching System required for call switching, billing data translations and formatting, and transmit billing data to the No. 1 AMARC. Included in these programs are capabilities for handling system test calls,

network measurements, and certain administrative functions.

(b) **Data Base:** The discussion of the data base which follows is divided into four areas: (1) generation of the data base, (2) recent changes, (3) reallocation, and (4) paper records produced for data base administration

(1) **Data base generation** begins prior to the start of the ETS installation. In an advance phase of preparation, the network administrator will be required to fill out a number of forms which describe the various office features and parameters. The instructions for completing such forms are contained in the No. 5 ETS Translation Guide. The generation of the data base takes place in three distinct phases: a preoffice interrogation phase, an office interrogation phase, and a data base audit and recent change insertion phase. The preoffice interrogation phase consists of entering the office features and parameter data into the data base from the forms previously filled out. This data is used to allocate memory space for all data base tables. It is also used to build certain tables directly. Upon completion of the first phase, the data base generation software accesses the No. 5 crossbar office. Customer data contained in the cross-connection fields (eg, line class of service, number translations, AMA translations) is automatically extracted from the office and used to build the remaining data base tables. Following the second phase, audit programs are run to determine anomalies. These are printed out, then recent change programs are used to complete the few remaining areas in the data base. A set of records is printed out describing the data base which has been built.

(2) **Recent Change (RC)** programs are used to make all changes to the data base. These include changes to individual customer parameters (eg, charge treatment, telephone number, and the addition or deletion of customers) or changes to office parameters which affect many customers (eg, class of service or trunk group assignments). All recent changes are input via TTY or DATASPEED-40 terminals. Two classes of RC commands exist. The first is high level commands which are expected to satisfy the

majority of recent changes. For example, these commands allow changes to all affected data base tables for a single customer by a single command. The second class is low level commands which change only one table per command. These will be used only rarely, for example to troubleshoot system problems.

Upon receiving an RC command, the RC software will perform a number of validity checks to ensure the reasonableness of the command. Necessary warnings are given to the craftspeople via the DATASPEED-40 terminal. Once warnings are resolved, the RC is put into the data base and also added to the RC file on the backup cartridge tapes.

When about 150 recent changes have been entered on the tape, the RC software will request a tape update. At such time, a craftsman will evoke the RC update procedure described in Section 218-799-202. This procedure includes a run of data base audits and a comparison of the data base in memory with the combined data base and files on tape. Any discrepancies are resolved by craftspeople through the use of additional RC commands.

(3) **Data Base Reallocation** is required when changes must be made which cannot be accommodated within the working data base. Required changes can be due to: (a) office growth, (b) the introduction of new features which can be supported by the existing generic, or (c) the installation of a new generic issue.

(4) **Paper Records** of recent change activity and data base status are generated on the printers associated with the recent change DATASPEED-40 terminal. These outputs are generated after each tape update or whenever requested by a craftsman. The outputs include records of each RC applied to the data base and summaries of table utilization. The outputs are human factored with column headings given in narrative and data outputs presented in decimal or other meaningful forms.

4. METHOD OF OPERATION

4.01 This part describes only the methods of operation used to complete the basic types

of calls. Subsequent sections will describe the methods used to provide the various additional customer services.

4.02 The types of calls included under the basic customer services in a No. 5 ETS marker group are the same as those provided in a full electromechanical office and may be divided into two broad categories:

(a) calls originating in a No. 5 ETS marker group, and

(b) calls originating in a connecting office.

4.03 Calls originating in a No. 5 ETS marker group include intraoffice, reverting, and outgoing calls and those originating in a distant office include incoming and tandem and toll switching. A dialing connection is established in the office for the first three types of calls as shown in Fig. 11.

4.04 An intraoffice call is a call between customers with different customer lines and is served by the same office. The talking connection in the office consists of two channels established between the customer lines through an intraoffice trunk as shown in Fig. 12.

4.05 A reverting call is a call between two customers served by the same customer line (party line service). The talking connection consists of the customer line and a reverting trunk as shown in Fig. 13.

4.06 A customer making an outgoing call to another office is connected through a channel to an outgoing trunk as shown in Fig. 14.

4.07 An incoming call to a No. 5 ETS office is connected to the called customer by a channel between the incoming trunk and the called number as shown in Fig. 15.

4.08 The No. 5 ETS office can also handle calls between two marker groups in the same building through the use of intermarker group senders and trunks which have an originating appearance in one marker group and a terminating appearance in the other. This arrangement is more economical than the use of separate outgoing senders, outgoing trunks, incoming registers, and incoming trunks. Two types of intermarker group

SECTION 19a(1)

calls, customer-to-customer, and customer-to-trunk are included under "calls originating in a No. 5 ETS marker group" and the third type, trunk-to-customer is included under "calls originating in a connecting office."

A. Dial Tone Connection

4.09 The dialing connection is established between the calling station and an originating register in the central office after the calling customer lifts the receiver from the switch hook. Dial tone, which is the signal to start dialing, is returned to the calling customer from the originating register.

B. Establishing Dialing Connection

4.10 When a customer takes the receiver from the switch hook, the line relay on the line link frame is operated to inform the line link marker connector that a dial tone marker is required. The line link marker connector selects an idle dial tone marker, then transmits to this marker the line link frame, vertical group, and horizontal group in which the calling line appears. The only time the line link marker connector seizes a marker is when a dialing connection is to be established. (See Fig. 16, connection 1.)

4.11 In order to establish a dialing connection between the customer line and an idle originating register, the marker must determine the following:

- (a) The trunk link frame location of an idle originating register
- (b) That a channel between the line and the register can be obtained.

The equipment location will be stored in the originating register by the marker for subsequent use on marker intraoffice or outgoing trunk jobs.

4.12 The equipment location of the calling line is identified in terms of the line link frame number, vertical group, horizontal group, and vertical file numbers.

4.13 A vertical group of customer lines is five verticals wide and ten switches high for a total of 50 lines. Thus, the number of vertical groups in a line link frame will vary from four for a 190-line frame to 12 for a 590-line frame. A

horizontal group is one switch high and extends across all the vertical groups on a frame. There are always ten horizontal groups on a frame. A vertical file is one vertical wide and ten switches high for a total of ten lines. The number of vertical files on a frame depends on the number of lines on that frame. The division of the frame into vertical group, horizontal groups, and vertical files is illustrated in Fig. 3.

4.14 The number of the line link frame, vertical group, and horizontal group in which the line appears is transmitted to the marker via the line link marker connector. Therefore, at this point, the calling line location is identified as one of a group of five lines. The other information required by the marker to completely identify the line location within the frame is the vertical file number. This is obtained from the line link frame through the line link connector associated with the frame.

4.15 While the marker is recording the line location information (except the vertical file number), an idle originating register is selected. Originating registers are distributed as equally as possible over all trunk link frames. The marker is notified, by means of test leads from each trunk link frame, which frames have an idle register and are not being held busy by other markers. In a preference sequence, an idle frame having an idle register is selected and the marker connects to that frame through a trunk link connector. (See Fig. 16, connection 2.)

4.16 After a trunk link frame has been selected, additional leads are connected between the marker and line link frame via the line link connector. Each line link frame has a line link connector which provides the leads for vertical file identification and other leads which the line link marker connector does not have for completing connections to the frame (connection 3). The vertical file number is transmitted to the marker which now has all the data for locating the position of the line on the line link frame.

4.17 As the marker is obtaining line link location information, it is passing this information to the ETS processor for processing.

- (a) **Dial tone Marker Processing:** ETS dial tone marker processing consists of performing line translation for the markers and distributing the results to the marker. Processing

for a marker is initiated by the change of state "start" scan point. Marker scan points are divided into two categories: (1) status scan points, and (2) data scan points. Only one status scan point is assigned for a dial tone marker, this is the start point mentioned previously. It is activated when a translation is required and deactivated after the marker has completed the call. Translation is requested (ie, the start scan point activated) immediately after the line link frame has been seized and the calling line identity registered and checked in the marker. When the change of state of the "start" scan point is detected during a periodic scan, an interrogation of the data scan points is initiated.

The data passed by the marker to the processor via scan points includes the call type (regular or transfer), the originating line location (**LLFT**, **LLFU**, **VG**, **HG**, **VF**, **2W/4W**) and any test call indications. The processor, upon receiving the information, checks it for proper codes, and, if correct and not a transfer or test call proceeds with the originating line translation. Originating line translation provides class data for each line equipment location in the office. The result of the translation is distributed to the marker. After the marker has completed the call, the start scan point is deactivated. This is detected by the processor which then releases the distribute points.

(b) **Transfer Calls:** In addition to its normal function of establishing connections between lines and originating registers, the dial tone marker is used to establish connections between incoming trunks and transfer trunks. Operation for dial tone marker transfer calls in phase 1 and 2 centrex offices is essentially as described above except that the centrex customer group number is passed to the processor instead of the originating line equipment number. This translation function is not required for dial tone marker transfer calls in phase 3 centrex offices.

(c) **Trouble Conditions:** Two methods of handling trouble conditions are provided for dial tone marker processing. One method applies when the data received from the marker by the processor fails to pass proper coding checks and processing is stopped. The processor will then distribute a trouble signal to the marker and a trouble report is printed out on the ETS maintenance terminal. The marker times out and also takes

a trouble record. The second method applies when a condition such as "line listed as vacant" occurs. In this case the originating register class is set to "manual" and the call is subsequently routed by the completing marker to a tone trunk or an announcement. In this case a trouble card is not perforated; however, an ETS trouble record is provided.

(d) **Test Calls:** The processing of dial tone marker test calls requires no special ETS processing except when the line class to be translated is provided by the test frame. Scan points associated with the master test frame are interrogated on all test calls and provide the line class to be used by the ETS. The originating line translation program uses this class in conjunction with the line class translation table to provide the data to be distributed to the marker. This operation is essentially the same as that used with phase 1 and 2 centrex dial tone marker transfer calls described above.

A TTY printout may be requested on test calls by the operation of a MTF key. This printout provides call details essentially identical to those provided on a TTY trouble record.

4.18 The marker now must select an idle channel between the customer line and the originating register. A channel consists of a line link, junctor, and trunk link. Channels are arranged in groups of ten so that the marker can check ten channels simultaneously. If the number of channels in an office is not divisible by ten, one group will have nine or fewer channels. When the marker finds an idle channel, it operates the selecting and holding magnets required to close through the channel (Fig. 16, connections 2 and 3). The marker then indicates to the originating register the identity of the line link used in the channel, and the register stores this information for later use.

4.19 Before the marker transfers control of the channel to the originating register, it checks the connector for continuity (connection 4). The marker then releases the associated connectors and itself. The register now furnishes dial tone to the customer and is ready to receive the digits.

4.20 Normally it takes less than 1/2 second to establish the dialing connection and return dial tone to the calling customer.

SECTION 19a(1)

4.21 Upon receipt of dial tone, the customer begins to dial the digits of the called number into the originating register where they are stored until the complete number has been dialed. The originating register seizes a completing marker to which it transmits the stored digits.

C. Pretranslation

4.22 Pretranslation is the process of determining from the first, second, or third digit how many digits the register expects to receive on a particular call. It is called pretranslation because it takes place before marker translation and is required when the total number of digits within the range of customer dialing varies.

4.23 Where the volume of calls is small and the numbering plan is not complex, pretranslation can take place in the originating register. The register can be arranged to determine from the first and second digits the number of digits it should receive.

4.24 For more complex numbering plans, a separate pretranslator circuit is provided. This circuit is called in by the pretranslator connector when the second or third digit has been set in the originating register. The pretranslator determines from these digits how many should be dialed before it calls in a marker.

D. Completing Marker Processing

4.25 In principle, the processing for the completing markers is identical to that already described for the dial tone markers except for the increased complexity arising from the greater variety of translations and sequences. In the interest of simplifying the description which follows, the marker distributor control (MDC) circuit is treated as an integral part of the completing marker. Also, only the major marker call types are considered in detail.

4.26 As in other common control circuits, the scan points for the completing marker are divided into status scan points and data scan points. Any state changes in the status scan points are detected by the processor. When a status point changes from the deactivated state to the activated state, all data scan points are interrogated by the processor before any further work is done.

4.27 One scan point [designated data ready (DR) point] serves the same function as the "start" scan point in the dial tone marker. This is the only one used on regular calls. The other status points are used on special calls and for unusual marker actions. These include such indications as: (a) TLF trunk class data is ready, (b) trunk identification is ready, (c) a recycle is required, (d) a route advance is required, and (e) a trouble record is requested.

4.28 Most of the call processing for the completing marker is performed when the activation of the DR scan point is detected. This occurs shortly after the marker is seized. In some cases, additional processing is required later in the marker sequence, for example, when a recycle occurs. A block of "scratch pad" memory, called a marker buffer, is provided to keep a history of all call processing completed thus far on each call. At the end of each call the contents of the marker buffer are used as the source of data for the AMA initial entry. The marker buffer is also the source for trouble and test call data.

4.29 The following data is supplied by the completing marker to the processor via the data scan points for call processing:

- Type of register (OR, IR, TR) and register translation marks
- Called number (A through M digits)
- Trunk class (from IR)
- Trunk class (from TLF)
- Incoming trunk number (TH, H, T, U, FG)
- Calling line equipment number (LLF, VG, HG, VF)
- Trunk link frame selected (FS-)
- Trunk selected (TB-, TS-)
- TLF busy (FB-)
- Outsider group busy (SIA-, SIB-)
- Customer group number (CTT-, CUT-)

- Miscellaneous data (service observing, 4-wire, party, etc.).

4.30 Different parts of this data are supplied on different calls depending on the type of call.

4.31 The following data is distributed by the processor back to the completing marker (most of it via the MDC):

- Type of call (TER, TOG, LLP, etc.)
- Line class marks (coin, dial transfer, etc.)
- Line location (LLF-, HG-, VG-, VF-)
- Route series (CAMA, ANI, coin, etc.)
- Trunk location (TLF-, TB-, TS-)
- Digits to output (A- to M-; AR- to CR-)
- Outsender group (OSG-)
- Outsender class (CL-)
- Ringing combination (RCT-)
- Customer group (CST-, CSU-)
- Miscellaneous control data for AIS, LLP, and test calls.

4.32 Call processing starts when the processor detects the activation of the DR scan point. This occurs immediately after the marker is seized by a register. The processor then reads all data scan points for the marker and verifies that the software and the marker are in step and that a new call can be processed (ie, the marker has released from a previous call). It then causes a sequence of programs to be executed which result in a route selection.

(a) **Data Check and Conversion:** The processor checks the status points for the type of request and verifies that the request is valid. It then checks the data received from the marker for proper coding and converts the data to the format needed (binary in most cases) for subsequent processing. The data are then stored in the completing marker buffer.

(b) **Originating Line and Incoming Trunk Translations:** After execution of the data check the originating location is translated. The results of these translations are the billing number, class data and line location of tandem incoming trunks. The results of these translations are stored in the completing marker buffer.

(c) **Billing and Routing Translation:** The inputs to the billing and routing translation include the called number, originating class data, and dialing pattern information. The output of the billing translation consists of the call record type and the message billing index or an indication that the call is not to be recorded. The output of the route translation includes the call type, trunk group, outsender group, sender control data, trunk control data, route advance patterns, and terminating office code data. The call type is always translated while the remaining data is only translated if required. The results of these translations are stored in the completing marker buffer.

(d) **Trunk Selection:** Trunk selection is required only on originating calls and calls which are tandem switched. The inputs to the trunk selection program are the trunk group and the TLF busy and outsender group busy data. The results of the trunk selection process include the selected trunk identity, trunk register number and trunk group class data, and the outsender group number which are all stored in the completing marker buffer. If a trunk is not selected a route advance indication is returned.

(e) **Line Selection:** Line selection translations are required only on calls which terminate on the line link frame. The input to the line selection translation is the terminating office (one-out-of-six) and the stations digits or a hunt group number. Individual line translations as well as hunting line selection and translation may be performed. The results of these translations are either line data including line location, terminating class information, line link pulsing outsender control data and trunk register number (INWATS line) or alternate marker control data. The results are stored in the completing marker buffer.

(f) **Data Distribute:** At this point in the call processing all data required by the marker to establish the network connection is

stored in the buffer. The data are next removed from the completing marker buffer, reformatted and stored in the distribute and scan buffer.

(g) **Progress Routed:** The processor then updates the progress to the "routed state." No further processing is required until a status scan point change is detected.

(h) **Trunk Seized:** After the marker has seized the trunk, a status scan point is activated. The processor detects the change by periodic scanning, interrogates the data scan points and then initiates further call processing.

(i) **Trunk Check:** The processor checks the status scan point state and the progress mark in the completing marker buffer to determine subsequent processing. Processing after the scan point is operated is required only on certain incoming calls and calls on which the processor has selected a trunk. The processing for calls on which a trunk has been selected involves comparing the trunk seized by the marker with that specified in the completing marker buffer. On certain 4-digit incoming calls the called office code is specified by trunk class information stored in the TLF. On these calls, abbreviated processing is used through the route translation function. The route data specifies that a terminating call type be distributed to the marker. The marker then seizes the trunk and causes the scan point to operate as in step (h). At this time all data required to perform the call processing is available and processing is restarted at step (a).

(j) **Distribute Enable:** After completion of step (i) the processor enables the marker to set the network connection.

(k) **Progress Enabled:** The processor updates the progress mark to the enabled state and awaits detection of a status scan point change.

(l) **Marker Release:** During marker release all activated status scan points are deactivated. When the status scan point is deactivated, the release processing is initiated.

(m) **Initial Entry:** On all calls in which a trunk register is identified, the processor loads call details required for subsequent call recording from the completing marker buffer into the trunk register. The data stored in the

trunk register is called the initial entry. On calls in which no trunk register is involved this step is omitted.

4.33 Following these operations, the processor releases all distribute points. At this point the ETS is ready to start processing another call.

E. Typical Telephone Call

4.34 This paragraph depicts the equipment used and the sequence of steps involved in establishing a typical telephone call connection in a No. 5 crossbar office equipped with 5 ETS. The scenario for the call is quite simple and typical of calls that are made millions of times every day. The calling customer originates the call and is served by central office A, identified by the number sequence 747 (called an office code). The central office contains the switching and related equipment which provides telephone service for customers in the immediate geographical area. The communication path between the telephone and the central office is called a line or loop. The called customer resides in a nearby town and is served by central office B (No. 5 ETS), identified by the central office code 432. Since central office A and B are relatively close, there are many calls to each from customers served by the other. Therefore, a number of trunks are provided between the two central offices. However, at the time the call is originated, all of the trunks between the two central offices are busy with other calls. The call, therefore, takes an alternate route from central office A to a third switching office (No. 5 ETS), and from there to central office B. The call then reaches the called customer, it is answered, and the two customers conduct their conversation.

(a) **The Telephone Call Sequence:** The weight of the handset holds open the switchhook contact in the telephone set when the set is not in use. When the calling customer removes the handset from its cradle to originate the call, the switchhook contact closes and establishes a path through the loop to a direct current voltage supply in central office A. The resulting current operates a line relay on the line link frame that is permanently associated with that loop in the central office, thus indicating to the office that a connection is desired. A dial tone marker responds as described in 4.17. This marker, in conjunction with the ETS processor selects an idle originating register and connects

it to the line requesting service. Dial tone is then returned to the calling customer, indicating that the register is ready to receive the dialed number. These steps are indicated on Fig. 17. Upon hearing the dial tone, the calling customer dials the telephone address or number of the called customer. The dial tone is removed when the register receives the first digit. When the calling customer has finished dialing, all seven digits will have been stored in the originating register. The next series of steps occurs internally in central office A, as shown in Fig. 18. The register performs one of its functions by recognizing the first three digits as indicating another central office in the immediate area, and therefore expects that only seven digits will be dialed. After the seventh digit is received, the register connects to an available completing marker, and passes to it the seven digit called number and the identification of the calling line. At this point, control of the call has shifted to the completing marker, and the register is disconnected.

The ETS processor recognizes that the marker has call data to be acted upon. ETS obtains the call information from the marker, and translates and stores in a scratch pad memory the information that will be needed later such as accounting data, and call history. ETS also selects a trunk and provides a route on which this call to central office B should be routed. ETS establishes that the direct trunk group to B is the first choice; and all trunks in this group are busy, then selects an alternate trunk and route to the intermediate switching office. This information is distributed back to the marker. At this point several things occur almost simultaneously:

- (1) The available trunk is seized.
- (2) An idle sender is connected to the outgoing trunk and the marker transfers the called number to the sender.
- (3) The marker sets up a connection between the line on which the call was placed and the appropriate outgoing trunk.

The marker is released at this point, leaving the calling customer and the outgoing sender connected to the selected outgoing trunk.

Many trunks, including the alternate-route trunks in this example, are made up (at least in part) of carrier transmission facilities and cannot accommodate direct current signals over the transmission path. A common arrangement for signaling over trunks therefore makes use of tones. When a trunk is idle, a 2600-Hz tone is transmitted continuously in each direction; this is called an "on-hook" signal. When an idle trunk is seized at one end, the 2600-Hz signal is removed in the outgoing direction; this condition is called an "off-hook" signal. After the switching machine at the far end of the trunk detects the absence of the 2600-Hz tone on the incoming side, it takes appropriate action which may lead to its removing the 2600-Hz tone in the opposite direction of transmission.

In the example, central office A has just seized a trunk to the intermediate office. The seizure is recognized at the intermediate office, and an idle register is connected to the trunk which has the incoming call. An **off-hook** signal is sent back to central office A and, after a short interval, an **on-hook** signal is again transmitted by the intermediate office to central office A. Central office A recognizes the removal and replacement of the on-hook signal as an indication that a register has been connected at the far end of the trunk, and proceeds to send address information to the intermediate office. These steps are summarized on Fig. 19.

As mentioned, the trunks in this example cannot accommodate direct current signals over the transmission path; accordingly, the direct current pulsing technique employed on loops cannot be used for signaling from office A to the intermediate office. However, an on-hook/off-hook can be sent, employing the 2600-Hz tone. Signaling could therefore be accomplished by means of trains of on-hook pulses from office A to the intermediate office. However, much faster techniques for signaling have been developed. In one technique, each digit is represented by a pair of tones. By using six tones (frequencies), up to 15 signals, each represented by a pair of tones, can be coded and a single pulse of two tones can transmit any of the signals. Thus, seven 2-tone pulses can transmit a

7-digit telephone number. This multifrequency pulsing technique can be applied to the trunks in the example which use T1 carrier transmission systems. The tones fall in the voiceband.

After the called number has been received in the register at the intermediate office, a completing marker is seized to which the call information is transferred. The ETS processor in that office senses that action is required. This time the ETS equipment in the intermediate office recognizes an incoming register rather than an originating register as the ETS processor in central office A had seen. The ETS recognizes from the call information that the marker requires a trunk and route to central office B which it provides to the marker. As before, an idle trunk is seized, a sender is connected to the outgoing trunk, and a connection between the two trunks is established as shown on Fig. 20. Note that if there had been no idle trunks to central office B, it would have been impossible to complete the call. In that case, an all-paths-busy (or reorder) tone would have been returned to the originator. However, we have assumed that a trunk is available and the call will progress.

Now the trunk seizure is recognized at central office B. A register is connected and the called number is transferred from the intermediate office. Note that only the last four digits of the called number need be transferred. The completing marker and ETS in central office B recognizes this as a terminating call. ETS provides the marker with a translation and a route to the called line and the marker tests the called line to determine if it is busy and, finding it idle, it sets up a connection between the incoming trunk and the line and applies a ringing signal. The ringing signal rings the bell on the called customer's telephone and an audible ringing signal is transmitted back over the connecting trunks and is heard by the calling customer. These steps are shown on Fig. 21. The ringing signal consists of an alternate current voltage superimposed on a direct current voltage. When the called customer lifts the handset to answer the call, the switchhook contact in the set closes, permitting

a direct current to flow in the loop. This operates a relay in central office B that disconnects ("trips") the ringing voltage supply, thus permitting voice communication over the telephone connection. Also, an off-hook signal is placed on the trunk to the intermediate office and then on the trunk to the originating office. Detection of the off-hook signal at central office A is recognized as an indication that the called party has answered. The ETS in central office A recognizes this and makes a second entry for accounting in the same scratch pad memory used previously. These steps are shown on Fig. 22. The telephone connection is now complete. The two parties can carry on their conversation for as long as they desire. The elapsed time to complete the call is only about 15 to 20 seconds, most of which is required to dial the 7-digit number and to answer the telephone after it starts to ring. The time required for signaling and for the switching machines to respond is small by comparison. At the conclusion of the telephone call, both parties hang up their handsets. This opens the direct current paths to both central offices, which in turn causes the trunks involved in the call to be restored to an idle condition and the connections within the switching machines to be released. Completion of the call is recorded in ETS memory for accounting purposes at central office A. The records include the number of both the calling and called customers, the time the call was answered, and the time the call ended. Thus, all information needed to compute the toll charge for the call is available.

(b) **AMA Call Processing:** In general, the AMA call processing function involves the following steps:

- (1) Placing the initial entry in a portion of ETS memory called a trunk register at the beginning of the call
- (2) Placing the answer entry in the same trunk register when answer supervision is detected
- (3) Removing the call data from the trunk register and storing it in a call buffer when disconnect supervision is detected

(4) Removing several calls from the call buffer, formatting the calls into standard single-entry records, combining the records into a data block, and storing them in the data block buffer

(5) Transmitting the data block to AMARC.

(c) **Initial Entry:** The initial-entry data consists of the called number, the calling number, and data relating to the type of recording required for the call. Called party supervision is used to determine the answer time, such time being determined and placed in the trunk register when the called party supervision is first detected. When the removal of the called party supervision is detected, the processor determines the elapsed time since answer. If duration of answer is less than 0.2 seconds, the answer record is erased; if greater than 0.2 seconds but less than 2.0 seconds, an "answer-no-charge" entry is made in the trunk register; if greater than 2.0 seconds, an answer-charge entry is made in the trunk register. Until an "answer-charge" entry is made in the trunk register, each change in called-party supervision is processed. Once an answer-charge entry is made, further changes in called-party supervision are ignored. Initial entries are made on all calls involving scanned trunks with trunk registers even if the call is not to be recorded or the trunk is not arranged for AMA. The "type of recording" information stored in the trunk register denotes whether or not a call will be recorded. When recording is denoted, the type of record and the message billing index (when required) are included.

The release of calling party supervision indicates a "disconnect." When disconnect is detected, the processor determines: (1) whether a record should or should not be made depending, respectively, on the presence or absence of an answer entry in the trunk register and (2) the type of record to be made as specified by flags in the trunk register. If the call is not to be processed, the trunk register is cleared except for certain call history data. If the call is to be recorded, the call data is removed from the register, combined with the disconnect time and trunk register number, then stored in the call buffer. The trunk register is then cleared except for certain call history data.

(d) **AMA Call Record Format:** Call records associated with calls to be recorded are temporarily stored in a call buffer to await formatting. The call buffer has a minimum capacity of 1000 call records. Any otherwise unassigned memory can also be used for this purpose such that the capacity of the buffer is normally much greater than the minimum. After removing the call records from the call buffer, the processor assembles the data in standard single-entry format, groups the records into a block, and adds control and check characters. After the calls in a block have been formatted, the processor adds a block control character and computes a cyclic redundancy check (CRC) character for the block. The data is then placed in the data block buffer which has a capacity of ten data blocks. Formatting is a background task which is executed as time permits whenever calls are waiting to be formatted and the data link buffer is not full.

(e) **AMA Data Link Processing:** The AMARC data links operate using a polling arrangement. When the AMARC is ready to accept new data over a data link, a polling message is sent to the ETS equipment. If AMARC had detected an error in the previous data block, a retransmit message is sent.

F. Intraoffice Calls

4.35 The typical telephone call presented in 4.34 is an interface call and shows an overall view of the interaction of three No. 5 crossbar switching machines. The following paragraph will describe the switching and features within an individual class five No. 5 ETS office.

4.36 When the calling customer removes the receiver from the switchhook, the dialing connection is established as shown in Fig. 16. After the number is dialed, the originating register engages a marker through an originating register marker connector. (See Fig. 23, connection 1.) The register then transmits the line equipment location of the calling line and the digits of the called number to the marker. The ETS processor translates the office code and determines that the called number is assigned to the same marker group as the calling line.

4.37 The processor then provides the marker with information which will allow it to proceed

SECTION 19a(1)

to perform an intraoffice trunk job which consists of two parts, the establishment of a terminating and an originating connection. The terminating connection is set up between the called line and the B appearance of the intraoffice trunk; the originating connection is set up between the calling line and the A appearance of the intraoffice trunk.

Establishing Terminating Connection

4.38 The terminating connection is established first, so that if the called line is busy, the marker can immediately connect the calling line to a tone trunk and thus save holding time on equipment. Before the terminating connection can be set up, the marker must obtain the following information from the processor:

- (a) The equipment location of the called number
- (b) The setting of the ringing selection switch
- (c) Determine if terminal hunting is necessary.

4.39 After the marker has obtained the necessary information from the processor it proceeds to select an intraoffice trunk on an idle trunk link frame (connection 2). Through the line link connector, the marker gains access to the line link frame on which the called customer line is located (connection 3). If it is not busy, the terminating channel is set up between the B appearance of the intraoffice trunk on the trunk link frame and the called line (connection 4).

- (a) If there is no idle channel available, the marker recycles by releasing the intraoffice trunk it is holding and selecting another one (usually on another frame). If there is no idle channel on this recycle, the marker reroutes the call to a tone trunk.

Terminal Hunting

4.40 A customer who has more than one terminating line is assigned one directory number per line, with usually only the lowest number listed in the directory. These lines form a terminal hunting group and are usually numbered consecutively. The terminal hunting feature is performed entirely within the ETS, with the completing marker operating essentially the same as for nonhunt lines. The hunt lines must be scanned and are assigned to

the ETS scanners. The line-to-scan-point association is provided by MDF cross-connections.

(a) **Operation:** The ETS scans the hunt lines and stores the condition in memory. Each change from a previous condition (idle to busy or busy to idle) is posted for each line. When a request for a hunt line translation occurs, ETS consults the appropriate hunt group and selects the first idle line. It then obtains the line equipment number and ringing combination for the selected line and returns this information to the completing marker. From this translation the marker also receives a hunt group indication so that it will re seize ETS and obtain a different line selection should a line busy or failure-to-match be encountered on the first attempt. Three hunting sequences are provided with ETS:

- (1) **Hunt to End:** Hunt starts with dialed number and terminates with last line in group
- (2) **Circular:** Hunt starts with dialed number, proceeds to last line in group, continues with first line in group, and terminates with the dialed number
- (3) **Uniform:** Same as circular, except hunt does not start with dialed number. It starts where the previous call to the group stopped.

2-Line Terminal Hunt

4.41 The ETS provides 2-line hunt features on a per-line basis in the software by adding flags in the line translation memory.

(a) **Operation:** The marker serves 2-line hunt groups in the same manner as ordinary lines, except a hunt group indication is returned by the processor to the completing marker. This is the same indication used with multiline hunt groups and causes the marker to re seize the processor to obtain the second line number should a line busy or failure-to-match be encountered in attempting to complete to the first number. In the case of recycle, the processor uses the second number in the line translation.

Establishing Originating Connection

4.42 After the terminating channel is established, the marker proceeds to set up an originating channel between the calling line link frame and the A appearance of the intraoffice trunk on the trunk link frame over an idle channel (Fig. 23, connection 6). The marker seizes the line link frame of the calling customer (connection 5). Before it releases the dialing connection, the marker determines if there is an idle channel between the calling customer and the A appearance of the intraoffice trunk. If there is an idle channel, the dialing connection is released immediately, enabling the marker to use the dialing connection line link as part of the originating connection, if necessary. However, if there is no idle channel available, the marker recycles. In the event no idle channel is found on the recycle, overflow tone is returned from the originating register through the dialing connection.

- (a) After the marker sets up the ringing selection switch in the terminating connection in accordance with the information obtained from the processor, it releases itself and the originating register from the intraoffice connection. The dialing connection is disengaged and the customers are interconnected. The trunk now controls the ringing and supervision of the call. The ringing is tripped when the called party answers and the ringing selection switch releases. When the call is completed, the originating and terminating connections are released and the intraoffice trunk is released.

Timed-Release Feature

4.43 A timed-release feature is provided in order to prevent the calling party from holding the called line out of service indefinitely by failing to hang up the receiver. In this case, the timed-release feature disconnects the calling line 13 to 35 seconds after the called customer hangs up. If the calling customer disconnects first and the called customer fails to disconnect, the timed-release feature disconnects the called party after 13 to 35 seconds.

Interoffice Calls—Outgoing

4.44 Outgoing calls are established to customers in a connecting office or to operators (toll, assistance, and service code calls). Calls to

connecting offices require the services of an outgoing sender but assistance calls and service code calls usually do not.

Establishing Outgoing Trunk Connection

4.45 When the customer has dialed the called number, the originating register engages a marker via an originating register marker connector. (See Fig. 24, connection 1.) The register transmits the following information to the ETS processor through the marker: the equipment location and class of service of calling customer, the number of the line link frame used in the dialing connection, and the called number.

4.46 From the office code, the processor determines the following:

- (1) That the call is to be completed to a connecting office and requires an outgoing trunk
- (2) Type of pulsing the office requires (multifrequency, dial, revertive, or panel call indicator).

4.47 The processor performs a route translation and trunk selection and distributes to the marker a trunk and a route to be used to connect to the trunk. The marker proceeds to set up the call as follows:

- (1) By means of the outgoing sender connector, the marker gains access to an outgoing sender that generates the type of pulses the connecting office requires (connection 2).
- (2) When the outgoing sender connector is engaged, the marker, by means of the trunk link connector, gains access to ETS selected idle outgoing trunk on an idle trunk link frame (connection 3). The sender is connected to the marker through the outgoing sender connector and receives the called number from the marker. The marker also sets up a connection between the outgoing trunk and the outgoing sender through the sender link.
- (3) As soon as the trunk link frame is seized, the marker connects to the line link frame of the calling customer (connection 4) and establishes a channel between the customer and the outgoing trunk (connection 5). The dialing

SECTION 19a(1)

connection is released if the marker finds an idle channel. The line link used in the dialing connection may be reused in the outgoing connection. If there is no idle channel available, the marker recycles the call by releasing the outgoing trunk and reconsults with the ETS processor.

(4) The outgoing sender then makes a trunk test. If the trunk test fails, overflow tone is returned to the customer from the trunk. As in an intraoffice call, the marker releases upon completion of its functions. The sender transmits the called number to the connecting office, then disconnects itself and the sender link. The outgoing trunk maintains supervision of the call.

Interoffice Calls—Incoming

4.48 An incoming call is the continuation and completion in a called office of an outgoing call from a connecting office. In the called office, the trunk from the originating office is an incoming trunk. The incoming connection consists of a channel between an incoming trunk and the called customer.

Establishing Incoming Trunk Connection

4.49 As soon as the incoming trunk is activated by a call originating in a connecting office, it seizes an incoming register through an incoming register link. (See Fig. 25, connection 1.) Separate groups of incoming registers are provided for each type of pulsing that the office is equipped to receive (multifrequency, dial, frequency shift, or revertive pulsing).

4.50 After the trunk is seized in the called office, the incoming register is connected to the incoming trunk and receives the numerals of the called number. (In this example, it is assumed that the trunk is used for completing calls to only one of several offices which may be served by a marker group.) The register records the number of the trunk link frame on which the incoming trunk appears so the marker will later be able to reach that incoming trunk. After the numerals of the called number have been registered, the register gains access to a marker through an incoming register marker connector (connection 2) to which it transmits the called digits and the trunk link frame number.

4.51 The ETS processor recognizes the frame, the marker status, the need for a terminating number translation and distributes to the marker the line location for the called number.

4.52 The marker first seizes the trunk link frame (connection 3), and, as soon as the marker has the called line location from the processor, it seizes the proper line link frame and performs the line-busy test on the called line (connection 4).

4.53 If the called line is idle, the marker sets up a channel between the trunk and the called line (connection 5). Utilizing the ringing code information it has obtained from the processor, the marker sets the ringing selection switch. If the marker cannot find an idle channel, it sets the ringing selection switch to return a reorder signal and releases itself from the connection.

4.54 As soon as the marker has finished these functions, it disconnects the incoming register, the register link, and itself from the connection. The trunk now controls the ringing and further supervision of the call. The ringing selection switch vertical releases when the called party answers or the call is abandoned.

4.55 If the called line is busy, the marker sets up a busy signal on the ringing selection switch. The marker then releases the incoming register, the register link, and itself from the connection.

Reverting Calls

4.56 A reverting call takes place between customers who share the same party line. The talking connection is set up between the customer line and a reverting trunk when reverting trunks are provided in the office. If reverting trunks are not provided in the office it is necessary to connect the calling customer to an operator over an outgoing trunk to a switchboard. The operator obtains the called customer and supervises the connection.

Establishing Reverting Trunk Connection

4.57 The calling customer receives dial tone and dials in the usual manner. The originating register transmits the calling customer line location and class of service and also the called number to the marker and processor which recognizes that number as belonging to the same office. (See

Fig. 26, connection 1.) The marker recognizes that the called line location is the same as that of the calling line and route advances. This route advance causes the processor to execute a revertive call route advance. If revertive calls are permitted for the calling line a revertive route is selected.

4.58 The marker then seizes a trunk link frame on which an idle reverting trunk appears (connection 2) and sets up a channel between the customer line and that trunk (connections 3 and 4). After the marker sets up the proper ringing codes in the reverting trunk, it releases from the connection. The reverting trunk is now left in control of the call.

4.59 The following are two types of reverting trunks:

- (1) Trunks used for 2-party selective, 4-party semiselective, and 10-party divided code ringing
- (2) Trunks used for 2-party selective, 4-party full selective, and 8-party semiselective ringing.

Depending on office requirements, one or both types of reverting trunks may be used.

Reverting Trunks for 2-Party Selective Lines

4.60 In the case of one customer calling the second customer on a 2-party line, the trunk returns a busy signal to the calling customer who hangs up. The trunk then applies regular ringing to the called party and reverting ringing signal (1/2 second on, 2-1/2 seconds off) to the calling customer. When the called customer answers, the ringing is tripped, which notifies the calling party to lift the receiver and start talking.

Reverting Trunks for 4-Party Semiselective and 10-Party Divided Ringing Lines

4.61 The method of operation on these lines is the same as that used on 2-party lines, except that the trunk rings all parties on one side of the line. Since each customer on the same side of the line has a separate ringing code, only one of the parties will answer.

Reverting Trunks for 2-Party Selective, 4-Party Full-Selective, and 8-Party Semiselective Lines

4.62 When a customer on a 4-party full selective or an 8-party semiselective line wishes to call another party on the same line, the customer dials the called number. The originating register engages a marker and processor which connects to a reverting trunk in the same manner just described and sets the ringing switch for the called station. The trunk then supplies a steady high tone to the calling customer; this tone notifies the customer to dial an additional digit which is associated with his station for use on reverting calls. From this digit, the trunk selects the individual ringing position for the calling station. After the extra digit is dialed, the trunk supplies busy signal to the calling station. The calling customer hangs up, and the trunk proceeds to alternately ring the called and calling station.

4.63 When the called station answers, the ringing is tripped. This notifies the calling customer to remove the receiver and start talking. When both parties hang up, the equipment returns to normal.

G. Assistance and Service Code Calls

4.64 Calls for which a customer dials 0- or a service code are completed over channels between the calling customer and an appropriate outgoing trunk. (See Fig. 27.) When there are direct trunks to the operator positions, no outpulsing is necessary, and therefore, outgoing senders are not required in the connection. However, service code calls and zero operator calls may sometimes be handled through a centralized point such as a TSPS location, and in that case, an outgoing sender is required to outpulse the dialed digits.

- (a) Pretranslation is not necessary because the originating register is equipped to recognize the zero and service codes directly.

Zero Operator Calls

4.65 When the originating register records a first digit of "0", it will wait approximately four seconds for an additional digit to be dialed. If, at the end of that time, no additional digits have been received, the register will engage a marker (Fig. 27, connection 1). ETS then recognizes the zero digit and directs the marker to establish a

SECTION 19a(1)

channel between the calling line and an outgoing trunk to an operator and releases (connections 2, 3, and 4). The customer hears an audible ringing signal until the operator answers. After the operator has connected to the trunk, the circuit is so arranged that if the customer hangs up, the operator can hold the connection. This prevents any accidental manipulation of the switchhook from destroying the connection.

Service Code Calls

4.66 For service code calls (business office, repair service, etc), the originating register receives the service code digits, engages a marker, and transmits the digits to the marker. The marker then sets up a channel between the calling customer and an outgoing trunk to the proper operator or desk and releases. The customer hears an audible ringing signal until the operator answers. When the customer hangs up, the connection is released.

H. Manual Calls

4.67 A No. 5 ETS office may also serve some customers who require the assistance of an operator on all originating calls.

- (a) When a customer with manual class of service lifts the receiver from the switchhook, the line link marker connector engages a marker. At the same time that it is receiving the line link frame location of the calling line from the connector, the marker selects an idle originating register as though the call were from a dial station and transmits the line location to the processor. The processor in turn translates the information and informs the marker that the call is to be manual. The marker transmits this information to the register and releases. No dial tone is returned to the customer because the register recognizes the class of service of the calling line as manual. The originating register then seizes a marker and indicates that a connection to an operator is required. The marker establishes a channel between the calling customer and an outgoing trunk to an operator. The operator then completes the call at the request of the customer.

J. Direct Distance Dialing

4.68 The No. 5 ETS office is designed so that the customers may dial into all the numbering

plan areas in use in the United States and Canada. The calling customer dials the 3-digit numbering plan area code of the called customer, then the 7-digit directory number. Depending on local options, the calling customer may dial a 0 or 1 access digit before dialing the 3-digit numbering plan area code and the 7-digit directory number. The 0 is used for calls which require assistance, such as person-to-person. The 1 is used as a toll access digit to prevent incorrectly dialed calls from completing to toll points. The processor, in translating the area code, provides a connecting path to a direct trunk to the switching center in the area dialed or to an intermediate toll switching point which will select a route to the area dialed. Where more than one route is available from the No. 5 ETS office to a particular area, the marker determines from its ETS processor which route to use to the particular office. The processor has the ability to recognize certain unauthorized code combinations dialed by customers. On these incorrectly dialed calls the processor will prevent the call from completing and will route the call to a tone trunk.

K. Various Call Conditions

Permanent Signal

4.69 A permanent signal may result from faulty handling of the station equipment or from trouble conditions in the telephone plant. After dial tone has been sent to the calling line, the originating register waits for dialing to start. The register allows 20 to 37 seconds, under normal traffic conditions, for the receipt of the first digit. If it does not receive the first digit in time, the register refers the call to a marker as a permanent signal. The marker then connects the calling line to a permanent signal trunk. Before releasing, the marker indicates to the trunk whether the calling line is coin, PBX, or a noncoin, non-PBX class.

Partial Dial

4.70 Having recorded the first digit, the register waits 20 to 37 seconds under normal traffic conditions for each succeeding digit.

- (a) If the customer fails to dial a digit within this specified time interval, the register refers the call to a marker as a partial dial. The processor may handle the situation in one

of two ways: it may connect the calling line to a tone trunk or connect the calling line to an outgoing trunk which terminates before an announcement or an operator. The method that is used depends on the procedure followed in the individual office.

the vacant code; therefore, it waits for the full directory number or partial dial timeout before it engages a marker. The processor then recognizes the vacant code and routes the call to an operator or to a tone or announcement trunk.

Local Overload Announcement

4.71 During periods of severe weather, widespread commercial power failure, or other emergencies, abnormal load conditions may be placed on the No. 5 ETS office. The local overload announcement feature can be provided to prevent long dial tone delays which would result from an all-registers-busy condition during these periods of heavy emergency traffic. The feature can be activated manually so that customer call attempts will be routed to an announcement when an all-registers-busy condition exists. The announcement will inform the customer of the overload condition, and as a result, prevent his repeated attempts for service so that the overload condition will be reduced.

- (a) Some customers are not routed to the local overload announcement, thus allowing them to wait for dial tone. This arrangement is provided for lines such as data customers, coin lines, police, fire, etc.

Dialing Before Receipt of Dial Tone

4.72 If a customer starts dialing before receiving dial tone, one of the following situations will occur:

- (a) The first digit may be distorted so that the originating register will record an incorrect code.
- (b) The register will record an insufficient number of digits.
 - (1) If the code which the register records is a working one, the calling customer may get a wrong number. However, if the digits recorded by the originating register constitute a vacant code (a code not in current use), the calling party will be connected either to an operator or to a tone or announcement trunk.
 - (2) If pretranslation is not provided, the originating register does not recognize

Intercepting

4.73 A line may be placed on intercept with a recent change procedure. A call is intercepted if it is made to any of the following:

- (a) Temporarily disconnected number
- (b) Changed number
- (c) Out of order number and arrangements have been made to intercept incoming calls
- (d) Permanently disconnected number
- (e) Unassigned number
- (f) Blank number
- (g) Vacant code
- (h) Denied code.

4.74 When a number which is on intercept is called, the calling party may be routed to a recorded announcement and/or an intercept operator over an intercept trunk. Each intercept trunk has a line link appearance and is assigned a number in a terminal hunting group. Therefore, on an intraoffice or incoming call, when the ETS processor finds that the called number is on intercept, it directs the marker to an intercept trunk (which may be on the same or a different frame). Through a line link connector, the marker seizes the line link frame on which the trunk appears and establishes a channel between the calling line and the intercept trunk. Unassigned numbers and blank numbers are also treated in this manner. Vacant codes and denied codes may be routed to either machine announcements or operators over trunks appearing on the trunk link frame. The routing for each of these conditions is determined by the processor.

L. Message Charging on Coin and Noncoin Calls

Prepayment Coin Service

4.75 There are two types of prepayment coin service: coin first and dial tone first. With coin first service, a coin must be deposited before dial tone is returned to the calling party. With dial tone first service, dial tone is returned when the receiver is removed from the switchhook; a check for coin deposit is made after dialing is completed. Only coin first ground-start service is described.

- (a) With ground-start operation, the customer is connected to an originating register after a coin is deposited. When dialing is completed, the originating register engages a marker and transmits the usual information to it, including the coin class of service of the calling party. The ETS processor and the marker then establish a connection between the calling party and a trunk arranged for coin operation.
- (b) The answer of the called customer sets the charge condition in the trunk. If the office has no provision for overtime charging, the collection of the coin is made when the calling customer disconnects at the end of the call. When the called customer takes the receiver off-hook, for an interval of 2 to 5 seconds, the charge condition, which determines that the calling party will be charged for the call, is set in the trunk. This charge delay is used to prevent an intermittent short creating a false charge condition. On an intraoffice call, the 2- to 5-second charge delay is the same, but the charge condition is set locally in the trunk.
- (c) When the calling party disconnects, the trunk used in the talking channel associates itself with a coin supervisory circuit through a coin supervisory link. The coin supervisory circuit then tests for and collects the coin if the charge condition has been set; if it has not, the coin is returned.
- (d) After coin collect or return is made, the coin supervisory circuit again tests for the presence of coin ground. If the coin ground is found, indicating that the coin is still in the box, the circuit signals a stuck-coin condition to an operator. From the signal, the operator knows whether the coin should be collected or

returned and tries to dispose of the coin. If this is unsuccessful, the line is considered out of order because of the stuck-coin condition and is referred to the maintenance department.

(e) When the circuits are arranged for coin overtime, an additional charge is made for each overtime period beyond the initial timing period. The trunks are equipped with interval timers and collect the coin 1/2 minute before the end of initial charging period. At this time, a tone is put on the connection for 1/2 second to remind the calling party that another coin must be deposited if the conversation is to continue beyond the next 1/2 minute without interruption. At the end of the initial period, if the connection has not been released, the coin supervisory circuit is again connected to the trunk to test whether a coin has been deposited. If a coin has been deposited, the coin control circuit releases itself from the connection and the conversation continues uninterrupted. If a coin has not been deposited, an operator is signaled to interrupt the conversation and to request the additional coin. The coins deposited for overtime service are collected 1/2 minute before the end of the overtime charge interval. If another coin is collected and the connection is released before the full charge interval has elapsed, the coin is returned by the coin supervisory circuit.

(f) On 0+ and service order calls, the trunk may be arranged to retain or return the initial deposit when the operator answers. If the customer hangs up before the operator answers, the initial deposit is returned.

Coin Junctor

4.76 Separate groups of trunks may or may not be provided for handling outgoing interoffice calls dialed from coin lines. With the coin junctor arrangement, outgoing trunks that handle coin and noncoin traffic do not need coin features.

(a) The coin junctor is composed of two trunk circuits. One is an outgoing trunk arranged for coin service and the second is an incoming trunk arranged with tandem or toll features. The junctor therefore has two frame appearances: one on a trunk link frame and the second on a line link frame.

(b) With coin junctor operation, the calling customer is connected to an outgoing trunk the same as a regular outgoing call. (See Fig. 28, connections 1 through 5.) The marker instructs the outsender to outpulse the called directory number and releases. The call proceeds in the same manner as an incoming tandem or toll call. The called number and trunk number are placed in the incoming register (connection 6). The register seizes a marker through a connector and transmits the called number and trunk number to the marker (connection 7). The ETS processor determines and provides the marker with the line link frame location of the incoming trunk. The marker then proceeds to establish a connection between this location and an outgoing trunk (connections 9 through 12). It is not necessary for the outgoing trunk to be equipped for coin service, since the junctor is equipped for it.

Coin Zone Dialing

4.77 Coin zone dialing is a form of prepayment coin service; however, it differs from the coin service described. Coin zone dialing, in addition to providing for local calls, also has provision for coin customer dialing outside of the local area or for multiunit initial charge calls. A second difference is that local calls may be fully automatic, whereas the coin zone dialed calls require the use of an operator to verify that the customer makes the proper deposit for the initial period and later, if the call extends into an overtime period, to time and collect for the overtime.

(a) Upon completion of dialing by the coin customer, the completing marker is seized by the originating register and functions to connect the customer to an outgoing coin zone trunk. This trunk has an appearance before a coin operator (either locally or remotely located from the No. 5 ETS office), and informs the operator of the required initial charge for the call by lighting one of eight initial charge lamps associated with that group of outgoing trunks. The operator requests the customer to make the initial deposit. When the operator has verified that the proper deposit has been made, the call is completed. The initial deposit is collected automatically if the call terminates before the end of the initial charge period. If the call progresses beyond this period, the coin zone trunk again calls in an operator by flashing the

proper overtime charge lamp. From this point, the coins are collected manually by the operator as the call is timed until it is completed.

ANI Processing

4.78 Automatic number identification (ANI) provides for identifying a calling customer number and for transmitting this number to a traffic service position system (TSPS). ANI, however, is limited to calls originated by PBX, individual, and 2-party customers. Calls from 4-party and rural lines require that the TSPS operator identify the calling customer. The ANI function involves the translation of the calling line number to a billing number. This function is performed by the processor in No. 5 ETS offices.

(a) After the calling customer has completed dialing, the originating register transfers the calling customer class of service, line location, and called number to the processor through the completing marker. The processor then establishes an outgoing connection to a TSPS trunk as indicated in 4.44.

(b) The requirement for ANI on a call is determined during marker processing. When ANI is indicated, the marker sets the sender for ANI operation and passes the line equipment marker (LEN) as well as the called number to the sender. After marker release, the sender receives a start signal from the TSPS office and begins outpulsing the called number and simultaneously bids for a transverter connector and one of two ANI program controlled transverters (PCTVs). When these connections have been established, the sender passes the calling LEN to the ANI PCTV which is periodically scanned by the ETS. The ANI PCTV scan points are divided into status scan points and data scan points. Distribute points are provided for returning control and data signals to the PCTV. If a change of state of a status point is noted by the processor during one of its periodic scans, it reads the data scan points and does the required processing. When a processing function is completed, and distribute points are to be operated or released, the processor operates the distribute points.

SECTION 19a(1)

(c) The processor, in conjunction with the ANI PCTVs, performs the following functions in sequence:

- (1) Detect a PCTV seizure
- (2) Check, then store the calling LEN
- (3) Perform the originating line translation and pass the billing number to the ANI and DAS buffers and then to the sender
- (4) Check that the billing number is stored in the sender correctly by comparing it with that in the ANI buffer and advance the sender
- (5) Detect release of the sender; clear ANI and DAS buffers; restore PCTV to idle condition.

The major ANI processing function is the translation of the LEN into a billing number.

- (d) When the equipment in the distant office is ready to receive the calling number, it indicates this by transmitting an off-hook signal. The outgoing sender recognizes this as a start signal and outpulses the calling directory number prefixed by an information digit.
- (e) The information digit is used to inform the distant TSPS equipment of the type of call being handled. Translation of this information digit by the TSPS is as follows:

DIGIT	TRANSLATION
0	AI—Service nonobserved (automatic identification)
1	OI—Service nonobserved (operator identification)
2	IF—Service nonobserved (identification failure)
3	AI—Service observed (automatic identification)
4	OI—Service observed (operator identification)
5	IF—Service observed (identification failure)
6	HM—Service nonobserved (hotel-motel)
7	HM—Service observed (hotel-motel)

AIOD ANI Call

4.79 If an ANI call is from an AIOD line (determined by originating line translation),

the processor determines the station number. The AIOD processing sequence is identical to that described for AMA calls in 4.34(b). When the AIOD processing sequence is completed, the billing number is distributed as described above.

Trouble Conditions

4.80 Any trouble condition detected by the ETS equipment will result in a trouble report on the maintenance TTY containing the call details and the trouble identification.

M. Operation of No. 5 ETS Office with Operator Switchboard

4.81 The switchboard considered for this discussion is a switchboard located in the same building with the No. 5 ETS office. The difference between having the switchboard in the same building as the No. 5 ETS office or in another building is the type of trunks used. The method of operation is the same for both arrangements.

- (a) The types of calls which may be handled by switchboard operators are shown in Fig. 29. Some service code calls are answered by an information operator, repair clerk, etc, instead of the operator. Permanent signal, partial dial, and vacant code calls may appear at the switchboard according to the practice in individual offices.
- (b) Each incoming trunk to the switchboard has a lamp appearance before an operator which indicates that a call should be answered and appropriate action taken. This operator has access to various types of outgoing trunks for calls extended from the switchboard.
- (c) When traffic is heavy, direct or tandem trunks are provided between the switchboard and some connecting offices. The operator can key or dial the called number directly into these outgoing trunks to reach the connecting office without going through the No. 5 ETS office.
- (d) There are also operator junctors and trunks arranged for pulse conversion outgoing from the switchboard. The operator can handle operator assistance completing traffic by means of these circuits.

Assistance and Long Distance Calls

4.82 A dial customer who desires the service of an operator to make a long distance call or to complete a local call, dials 0 and is routed to an operator. Some of the duties of an operator are as follows:

- (a) To complete calls for customers who require assistance to complete coin or person-to-person calls or calls requiring a ticket
- (b) To check complaints about called numbers which are continuously busy or unanswered.

Calls From Switchboard Completed to No. 5 ETS Customer

4.83 The operator can complete calls to customers in the No. 5 ETS office over toll switching trunks. These trunks have two appearances, one at the switchboard and the other on a trunk link frame. (See Fig. 30.)

- (a) The operator plugs into a toll switching trunk (connection 1). The trunk is connected to an incoming register through an incoming register link (connection 2). The operator keys the numerals. (A directing digit is prefixed if the trunk serves more than one office code.) The call then proceeds in the same manner as a regular incoming call (connections 3 through 6).

Calls From Switchboard to Connecting Office

4.84 By means of an operator junctor or operator toll junctor, an operator located in the same building as the No. 5 ETS office can gain access to the outgoing trunks in that office.

- (a) Operator juncctors and operator toll juncctors are trunks that have appearances at the switchboard on a line link frame, and on a trunk link frame in a No. 5 ETS office. (The trunk link location is used for returning overflow signal.) Operators use these juncctors to gain access to the outgoing trunks in the office to switch a call to a connecting office. Since the operator junctor is a type of tandem trunk, the No. 5 ETS office must be equipped for tandem operation and since the operator toll junctor is a type of intertoll trunk, the No. 5 ETS office must be equipped for toll switching.

(b) In Fig. 31, a calling customer reaches an operator and gives the operator the called number. From this number, the operator determines the route for the call and plugs into an operator junctor. The operator keys the called number into the junctor (connection 1) when the junctor has been connected to an incoming register through an incoming register link (connection 2). After the called number, the trunk number, and the trunk link location of the operator are set in the incoming register, the register seizes a marker and transfers this information to the marker via an incoming register marker connector (connection 3). Directed by the trunk number, the marker obtains the line link frame location of the trunk from the ETS processor.

(c) The marker seizes and transmits the called number to an outgoing sender through an outgoing sender connector (connection 5). By means of a trunk link connector, the ETS processor determines and directs the marker to seize an idle trunk link frame with an idle outgoing trunk on that frame (connection 5), then connects the outgoing sender to the outgoing trunk through the sender link. Through a line link connector, the marker seizes the line link frame on which the junctor appears (connection 6). At this point, the marker sets up a channel between the junctor and the outgoing trunk. The sender transmits the required digits to the connecting office through the sender link and the outgoing trunk, releases, and then releases the sender link. The marker releases upon completion of its functions, and the operator has supervision of the call (connection 7).

Pulse Conversion Outgoing Calls

4.85 A switchboard located in the same building as the No. 5 ETS office which it serves, may have, if traffic warrants it, direct trunks to a connecting office which receives only dial or revertive pulsing. These trunks are provided for calls that require the assistance of an operator. By means of a process known as pulse conversion, the operator can complete a call from the No. 5 ETS office to such a connecting office.

- (a) Pulse conversion is the action of converting MF pulsing, received from a switchboard position, to the type of pulsing required by the office to which the call is completed. This type

of pulse conversion requires that these pulses be converted to either dial or revertive pulses, whichever are required by the connecting office. This method of completing calls to a connecting office from a switchboard is economical and efficient for three reasons:

- (1) No junctors are used in the connection
 - (2) The operator keys the numerals of the called number into the trunk when completing to a local office. (Directing digits are prefixed if the trunk serves more than one office code.)
 - (3) The switchboard sender for converting pulses to the proper type is eliminated.
- (b) A pulse conversion trunk first operates as an incoming trunk by seizing an MF incoming register and passing pulses to it. Later, it acts as an outgoing trunk by connecting to a dial or revertive pulse outgoing sender and transmitting the required type of pulses to the called office.
- (c) The calling customer reaches the operator in the usual manner and gives the operator the called number. From this information, the operator plugs into a trunk arranged for pulse conversion outgoing to the called office. (See Fig. 32, connection 1.) Through an incoming register link, the trunk is connected to an MF incoming register (connection 2) and transmits the trunk class mark indication to it. The operator then keys the number after receiving a start dialing signal.
- (d) The incoming register seizes and transmits the trunk class and called number information to a marker through an incoming register marker connector (connection 3). From the trunk class mark, the processor determines that this is a pulse conversion job and directs the marker to seize and transmit the called numerals to the proper sender through an outgoing sender connector (connection 4). The marker causes the outgoing sender (connection 5) to be connected through a sender link to the trunk, and after the sender makes a trunk test, it outpulses the digits to the connecting office. The talking connection is established over the trunk (connection 6). The control equipment is released and the operator supervises the call.

N. No. 5 ETS Office with Tandem Switching Features

4.86 Since it is not economical to have direct trunks between all central offices, intermediate switching points are provided to handle traffic between offices that have no direct connections. This type of operation is known as tandem switching. In the typical telephone call depicted in 4.34, the intermediate office is this type of office.

- (a) A No. 5 ETS office can be used to provide this tandem switching service in addition to its regular functions. An incoming trunk arranged for handling tandem traffic at a No. 5 ETS office with tandem switching features can also handle traffic for completion to this office, since it is generally economical to combine these two types of traffic over the same trunk group. To permit this dual use, it is necessary to provide such trunks with both trunk link and line link frame appearances in the No. 5 ETS office with tandem switching features. The trunk link frame appearance is used when an incoming call on a tandem trunk terminates in the No. 5 ETS office. When the incoming call is to be switched to a connecting office through the No. 5 ETS office, the line link frame appearance is used.

Establishing a Tandem Connection to a Connecting Office Through a No. 5 ETS Office

4.87 A calling customer served by office X (Fig. 33) originates a call to a customer served by office Z. In this case, there are no direct trunks connecting offices X and Z, and the call is routed from office X over a tandem trunk to a No. 5 ETS office Y, which has completing trunks to office Z. These completing trunks can be used for handling calls from several offices.

- (a) In a No. 5 ETS office, a tandem trunk incoming from another office is connected to an incoming register through an incoming register link (connection 1). The following information is then transferred to the incoming register: the called directory number, the trunk link frame number (not used on tandem calls), the trunk number, and the class mark of the incoming tandem trunk. The trunk number is an arbitrary 4-digit number (0000 through 3999) assigned to each trunk for the purpose of obtaining the line link equipment location of the trunk. These trunk numbers are stored in the ETS memory. The called number may consist of

five, six, seven, or ten digits: a single-digit office code and four numerals, a single-digit directing code and four numerals, a 2-digit office code and four numerals, a 3-digit office code and four numerals, or 3-digit area code and a 3-digit office code with four numerals. If the pulses are transmitted on a revertive pulse basis, the office code is designated by office brush and office group pulses which are always sent. They are translated by the incoming register into a 2- or 3-digit office code as required for presentation to the marker and processor. The register also determines from its translator the number of selections it may expect and whether the code received is a working or vacant code. This register will handle calls terminated in the local office as well as those terminating in a distant office.

(b) The incoming register seizes a marker and transmits the information in the register to the marker through an incoming register marker connector (connection 2). From the called office code, the processor determines that a tandem job is necessary because the call is to be switched through to a connecting office. The processor directs the marker to seize an outgoing sender through an outgoing sender connector (connection 3), the marker proceeds to engage an outgoing trunk on an idle trunk link frame (connection 4), and connects the outgoing sender and the outgoing trunk by means of the sender link. The processor translates the trunk number and provides the marker with the line link frame location of the tandem trunk. The marker then seizes the line link frame on which the incoming tandem trunk appears via a line link connector (connection 5).

(c) A channel is established between the incoming tandem trunk and the outgoing trunk by the marker (connection 6). The marker then releases the incoming register and itself from the connection, and the incoming tandem trunk is left in control of the supervision of the call.

(d) A feature known as tandem screening is available to permit denial of service from special incoming trunk groups to selected office codes available to other customers. For example, with this feature, customers in noncommon control offices, such as step-by-step, can be given unlimited access to the No. 5 ETS office and be denied service by the No. 5 ETS office to

those office codes not allowed on a free basis by their tariff. The incoming trunks used for this purpose are given tandem class of service treatment within the ETS processor.

Establishing a Terminating Connection in a No. 5 ETS Office via an Incoming Tandem Trunk

4.88 A call coming over an incoming tandem trunk and terminating in the No. 5 ETS office is treated in the same manner as a call coming in on a nontandem trunk.

(a) In Fig. 33, the incoming tandem trunk connects to an incoming register through an incoming register link (connection 1) and transmits the called number and the trunk link frame number to the register. (This called number ranges from five to seven digits.)

(b) The register seizes and transmits the information to a marker by means of an incoming register marker connector (connection 2). The marker seizes the trunk link frame (connection 4). From the processor, the marker determines the line link location of the called number and seizes the proper line link frame (connection 5). The marker establishes a channel between the incoming tandem trunk and the called line (connection 7). The marker then sets the proper ringing in the ringing selection switch, releases its associated linkage and itself, and leaves the incoming tandem trunk in control of the call.

(c) A screening feature is also provided on dial pulse incoming nontandem trunks whereby either six or seven digits can be received. This feature is useful when it is not desired to absorb the excess digits in the originating office, such as step-by-step. Under this condition, the marker and the processor are given both the incoming class mark, indicating that this particular trunk is capable of being used in tandem connections, and a signal indicating the proper 6- or 7-digit translation to be used. Then, if the marker receives a code not usable over this trunk, it sets up reorder. This feature is applicable whether or not other trunks in the office, or in the same register link, are equipped for tandem operation. The registers must be equipped to record the total number of digits.

SECTION 19a(1)

P. No. 5 ETS Office with Toll Center Switching Features

4.89 A local No. 5 ETS office may be arranged to serve as a toll center for surrounding offices and handles the following types of traffic:

- (a) Regular local traffic
- (b) Toll calls originated by local customer or terminated to local customers
- (c) Toll calls switched through the No. 5 ETS office (calls which originate or terminate in other offices)
- (d) Calls to callback operators serving the No. 5 ETS office

(1) Traffic between toll offices is carried over intertoll trunks. The three general types of intertoll trunks are one-way outgoing, one-way incoming, and 2-way. These trunks have the following frame appearance in a No. 5 ETS office:

- **One-Way Outgoing Trunk:** Trunk link frame
- **One-Way Incoming Trunk:** Two on line link frame and one on trunk link frame. The line link appearances are used on switched-through calls. The trunk link frame appearance is used on incoming calls terminating in the No. 5 ETS office.
- **Two-Way Trunk:** Two on line link frame and one on trunk link frame. The line link frame appearances are used on switched-through calls. The trunk link frame appearance is used for calls outgoing from the No. 5 ETS office or for incoming calls terminating in the No. 5 ETS office.

(2) The two line link frame appearances for trunks are provided in order to increase the number of channels between the intertoll trunks and the trunks to connecting offices. In addition to the two line link frame appearances, the one-way outgoing and 2-way intertoll trunks may have outgoing appearances in a switchboard located in the same building.

Establishing a Connection for a Toll Call to a Connecting Office Through a No. 5 ETS Office

4.90 A calling customer served by local office X originates a toll call to a customer served by office Z. The customer dials and is connected by the originating office as appropriate per the digits dialed. 0- calls are routed to an operator at a TSPS or switchboard location. 0+ calls are routed to the No. 5 ETS office via a TSPS trunk. 1+ calls are routed directly to the No. 5 ETS office.

- (a) In Fig. 34 the switchboard operator receives the request of the customer and plugs into a toll switching trunk or an intertoll switching trunk (connection 2). The toll switching trunk is used for direct access to office Z if the switchboard has the correct type of outpulsing to work into that office (connection 3). The intertoll trunk is used if the call is routed through an intermediate point before reaching office Z due to traffic considerations or if the call must be routed through an intermediate point due to an incorrect type of outpulsing to work directly into office Z (connection 4).
- (b) After selecting the proper trunk (connection 3 or 4) the intermediate or terminating office returns a start-pulsing signal to the toll operator. The operator then keys the called number to the intermediate or terminating office.
- (c) Calls to call back operators are established in a similar manner. In Fig. 34, the operator is shown on one of the terminating points. The operator keys the appropriate call back code or connects to the appropriate toll switching trunk and the call is established without outpulsing to the call back operator.
- (d) Calls dialed direct by the customer (0+ or 1+) and calls dialed by the TSPS operator (0-) are completed the same way as those described for a No. 5 ETS office with tandem features except an intertoll trunk is used on 0- calls.
- (e) A feature known as toll screening is available to permit denial of service to certain incoming trunk groups to select office or area codes available to other incoming trunk groups. This screening may be used in much the same way as tandem screening.

Establishing a Connection for a Toll Call Terminating in a No. 5 ETS Office

4.91 In Fig. 34, a calling customer served by local office X originates a toll call to a customer served by a No. 5 ETS office Y. This call arrives at office Y on a 0 trunk (connection 1) or on incoming intertoll trunk (connection 1A). When the call uses a 0 trunk, the operator listens to the customer request and connects to an appropriate toll switching trunk (connection 2). This trunk is connected to an incoming register through an incoming register link (connection 3A). The operator keys the called number into the register and the number of the trunk link frame on which the toll trunk appears is also registered in the incoming register. The register seizes and transmits the information to a marker by means of an incoming register marker connector (connection 4A). The marker seizes the proper trunk link frame (connection 5).

- (a) From the processor, the marker obtains the line equipment location of the called number and a route. The marker then connects to the proper line link frame (connection 6). The marker then establishes a channel between the toll switching trunk and the called customer. After setting the proper ringing in the ringing selection switch, the marker releases, leaving the switchboard in control of the call.
- (b) If an idle channel is not available between the trunk link frame and the line link frame, the marker sets the toll trunk to return reorder to the toll operator.
- (c) If the toll call is dialed directly by the customer in office X (0+ or 1+), or by the TSPS operator (0-) (connection 1A), the call is handled in the same manner as the tandem call except an intertoll trunk is used.

Q. Multioffice Operation

4.92 A No. 5 ETS marker group can be arranged to handle a maximum of 40,000 numbers (directory and trunk). When an office is equipped for more than 10,000 numbers, at least one office code must be assigned for each number series (0000 through 9999). A particular marker group may have as many as six number series. The

major reasons for using additional office codes in a marker group are as follows:

- (a) To obtain discrimination between the number subdivisions for rate purposes
- (b) To have ample line numbers for the lines required to load the marker group.
 - (1) More than one office code may be needed whenever the customers served by one marker group are located in more than one subdivision with different tariffs. Assignment of a distinct office code to the customers in each subdivision enables the ETS equipment to provide distinctive charging and routing treatments. In this situation, incoming calls from distant wire centers are given a different charge treatment to the several offices in the marker group. This feature prevents completion of calls on which distant customers dial the office code of the lowest charge in the No. 5 ETS marker group, followed by the numerals of the line desired. When such a dialing condition occurs, the call is routed to an intercepting operator or a machine announcement.
 - (2) Where one No. 5 ETS marker group installation replaces more than one central office, the names or numbers associated with these offices may be retained to eliminate wholesale number changes. The No. 5 ETS equipment cannot handle directory numbers with party letters.
 - (3) Early marker groups equipped for a maximum of 20,000 numbers (directory and trunk) can accommodate three office codes in each number series (0000 through 9999) as follows:

OFFICE A

OFFICE B

Physical office A

Physical office B

Theoretical office A

Theoretical office B

Extra-theoretical office A

Extra-theoretical office B

This is known as physical-theoretical office operation.

- (4) Marker groups equipped for a maximum of 40,000 directory and trunk numbers are arranged for six number series as follows:

SECTION 19a(1)

NO. SERIES GROUP A	NO. SERIES GROUP B
0	1
2	3
4	5

This is known as number-series operation.

(5) In assigning blocks of numbers to a particular office code, the same principles apply to both physical-theoretical office operation and to number-series operation.

(6) When discrimination is used, the customer numbers associated with a particular office code are assigned in increments of 100 numbers and in any ratio desired. The blocks assigned to any one of these subdivisions need not be consecutive. There is a restriction that an increment of 100 numbers cannot contain numbers of two or more subdivisions.

(7) Usually, where discrimination is used, one or more blocks of 100 numbers are arranged for nondiscrimination. These are called common numbers and are assigned to official lines, business office lines, test lines, etc.

(8) When discrimination is not used, any of the hundreds blocks may be arranged to complete the connection when the numerals are preceded by any one of the several office codes in the group of 10,000 numbers associated with a physical-theoretical office A or B, or with any one of the six number series.

Intermarker Group Operation

4.93 Intermarker group operation is an efficient method of handling the traffic between No. 5 ETS marker groups located in the same building. The three types of intermarker group trunks for carrying this traffic are as follows:

- (a) Customer-to-customer
- (b) Customer-to-trunk
- (c) Trunk-to-customer.

(1) These trunks have appearances in both marker groups. Customer-to-customer

and trunk-to-customer trunks have trunk link appearances in each marker group. Customer-to-trunk trunk has a trunk link frame appearance in the nontandem marker group and line link frame and trunk link frame appearance in the tandem marker group. This method is more efficient and economical than handling such traffic as regular interoffice traffic because the traffic between these marker groups is carried over intermarker group trunks and senders, using customer-to-customer type trunks. This avoids using the conventional outgoing senders, incoming registers, and interoffice trunks.

(2) The intermarker group sender serves both as an incoming register and as an outgoing sender. It acts as an outgoing sender when connected to a calling marker and as an incoming register when connected to a called marker.

Customer-to-Customer

4.94 For calls that originate in marker group 0 and terminate in marker group 1, and vice versa, the trunks used are called customer-to-customer type. These calls are routed over an intermarker group trunk which requires the use of an intermarker group sender. From the called code, the processor in the originating office determines that an intermarker group connection is necessary and proceeds to direct the marker to set up a connection to an intermarker group trunk. (See Fig. 35, connections 1, 2, and 4.) The marker also connects to an intermarker group sender and transmits the called directory number to it (connection 3). The calling marker interconnects the trunk and sender via a sender link (connection 5) and releases.

(a) Now the intermarker group sender acts as an incoming register and connects to a marker in the called office via an incoming register marker connector (connection 6). The sender transmits the called number and the trunk link frame number of the intermarker group trunk in marker group 1 to the called marker and releases. The processor and the marker, using this information, proceeds to set up a regular incoming call connection to the called customer (connections 7, 8, and 9).

Customer-to-Trunk

4.95 For calls that originate in marker group 0 and require the use of marker group 1 as a tandem office to a connecting office, the trunks used are called customer-to-trunk type. When no direct trunks are provided from marker group 0 to the desired destination, or when the direct trunks are all busy and an alternate route is to be used, a call from marker group 0 to a connecting office is tandemed through marker group 1 in order to obtain an outgoing trunk.

(a) Fig. 36 shows a call to a connecting office from a customer in marker group 0. After receiving the called number, the processor recognizes that the required trunk is a customer-to-trunk type. This trunk has trunk link and line link frame appearances in marker group 1. The processor directs the marker to set up a connection to the proper trunk (connections 1, 2, and 4), and to seize an intermarker group sender (connection 3), and to connect them to each other through a sender link (connection 5). The marker transmits the called number to the sender and releases.

(b) Since the line link appearance of this trunk in marker group 1 is used on the call, the trunk number (0000 through 3999) is obtained from the processor in marker group 0 and stored in the sender. The sender then passes this trunk number to the called marker through the incoming register marker connector (connection 6). The trunk also passes the trunk frame number to the sender, which in turn passes it to the called marker.

(c) The marker goes to the processor and from the trunk number, obtains the line link frame location of the trunk. The processor directs the marker to seize both the line link frame on which the trunk appears (connection 7) and an idle trunk link frame which has an outgoing trunk (connection 8), then to set up a channel between the frames (connection 10). At the same time, the marker connects to an outgoing sender (connection 9). The marker passes the called number to the sender, connects the sender and the outgoing trunk through the sender link (connection 11), and releases. The call proceeds as a regular outgoing call.

(d) If the processor cannot provide the marker with an idle outgoing trunk, it directs the marker to seize the trunk link frame appearance of the intermarker group trunks (from the trunk link frame number) and to set the trunk to return overflow signal to the calling office.

Trunk-to-Customer

4.96 Calls that originate in connecting offices and require the use of marker group 1 as a tandem or toll center switching point for reaching customers in marker group 0 have to be tandemed through on an intermarker group basis. The incoming trunks, which are regular incoming tandem equipment, have two appearances in marker group 1, one on the line link frame and one on the trunk link frame. Just as for regular tandem calls, the line link appearance is used for calls going through the office, and the trunk link appearance for calls terminating in the office.

(a) As shown in Fig. 37, the call starts out as a regular incoming call, going through the incoming register to the marker (connection 1). Through this linkage, the following information is transmitted to the marker: the called directory number, the trunk number (0000 through 3999), and the number of the trunk link frame on which the trunk appears.

(b) From the called office code, the processor recognizes that this call is to be tandemed through to marker group 0. The processor selects a trunk link frame (connection 2) with an idle intermarker group trunk (trunk-to-customer), and then directs the marker to seize an intermarker group sender (connection 3). From the processor, the marker obtains and then seizes (connection 4) the line link frame appearance of the incoming trunk. The marker then connects the intermarker group trunk and the intermarker group sender using a sender link (connection 5). The marker transmits the called directory number and the trunk link frame number to the sender, establishes a channel between the incoming trunk and the intermarker group trunk (connection 6), and releases.

(c) The intermarker group sender seizes a marker in marker group 0 and via a connector, passes the called number and trunk link frame number (connection 7) before releasing. The marker seizes the trunk link frame on which

SECTION 19a(1)

the trunk appears (connection 8). The processor determines from the called number the line link location of the called line to which it directs the marker. After seizing this appearance, the marker sets up a channel between the intermarker group trunk and the called customer (connection 11). The call proceeds from the incoming trunk through the intermarker group trunk to the called customer.

R. Direct and Alternate Route Arrangements in No. 5 ETS System

Direct Routes

4.97 In a small or moderately sized exchange area, each central office may have direct trunks to all other center offices in that area. The trunks are usually provided on a one-way basis with traffic in each direction handled over a separate group of trunks. Such an arrangement permits the interconnection of any two customers in the exchange area.

(a) When setting up an interoffice call, the processor determines whether a trunk link frame has idle trunks before allowing the marker to seize the frame. Since each frame is limited to a maximum of 20 trunks per trunk group, the total number of trunks per trunk group in the marker group is limited to 20 times the number of trunk link frames.

(b) If the number of trunks in an office are not adequate to handle the amount of traffic to a connecting office, then more trunks may be provided. The trunks are divided into subgroups. These subgroups are then spread over the trunk link frames, a maximum of 20 trunks of each subgroup on a frame.

Alternate Routes

4.98 The alternate route principle is a combination of direct and tandem routing. Direct trunk groups are supplied from office X to office Y, but these groups will not carry all of the traffic during heavy loads. Office X will always attempt to route calls over the direct group to office Y first, and therefore, the high load on that group keeps it working efficiently. When all of the trunks of the direct group are in use and another call is originated to the same destination, the marker and the processor in office X will attempt to

complete the call over the direct group, but in this case, will find all trunks busy. The processor then attempts to complete the call over the alternate (tandem) route as a tandem call.

(a) In large exchange areas where trunking becomes more involved, more than one alternate route may be available for a call. For example, office X can reach office Y over the direct route trunks and also through tandem offices 1 and 2.

(b) The processor and marker in office X route calls for office Y over the direct route trunks as long as any of them are idle. Additional calls are then routed to office Y through tandem office 1. The route through tandem office 1 is called the first alternate route. If both the direct route and the first alternate route trunks all test busy, the markers in office X attempt to route additional calls for office Y through tandem office 2 (second alternate route).

(c) The No. 5 ETS system can handle ten alternate routes in addition to the direct route. If a call cannot be completed over any of these routes, overflow tone is returned to the calling customer.

S. Selection Preference

Selection Preference for Vertical Groups, Horizontal Groups, and Vertical Files

4.99 To distribute service among the lines on a line link frame, a circuit arrangement is provided which rotates the order of the marker preference for serving calling lines, one step for each call or connection. The preference chain is fixed, but the point of entry is different each time.

(a) When a line link frame is seized to set up a dial tone connection, the marker follows a fixed selection preference for serving vertical groups, horizontal groups, and vertical files. The only exception to this chain of preference is vertical group 02, which is always served first. Coin, police, fire, and emergency lines appear on this vertical group. The selection preference feature solves the problem of giving an equal grade of service to all lines when simultaneous demands for dial tone occur. The marker serves one call at a time in accordance

with the selection preference sequence, and any other call has to wait its turn.

(b) When a marker serves a dial tone job on a line link frame, it immediately looks at vertical group 02. If there is a call on one of the lines in that group, the marker serves it; if not, the marker attempts to serve calls in other vertical groups. The marker proceeds to do this by identifying which vertical groups have lines awaiting service. Of those groups, a preference circuit will decide which one is to be served on this marker use. Similarly, the horizontal groups and vertical files will be examined, and the same preference circuit will select one of each in order to identify the line to be served on this marker use.

(c) The preference circuit is advanced after each marker use.

Selection Preference for Originating Registers

4.100 When selecting an originating register circuit, the marker seizes a trunk link frame on which there is at least one idle circuit. If there are several idle circuits on the frame, the marker must select one for service. In order to distribute the traffic uniformly, a method of rotating the selection preference is used. The preference circuit is the same one used for selecting vertical groups, horizontal groups, and vertical files. Originating registers associated with a trunk link frame are grouped on one trunk block relay, trunk block 0. The maximum number of originating registers per trunk link frame is ten, the maximum number of trunks is 160 or 200 depending upon the type of switches installed.

(a) The marker selects the trunk link frames in numerical order. However, the marker does not have a means of rotating the selection of frames. A frame memory circuit records the number of the frame used on the last marker usage. On the next marker use, the marker will select a higher numbered frame.

Selection Preference for Trunks

4.101 Trunk selection starts with the identity of the outgoing or intraoffice (IAO) trunk group obtained from the routing translation. The trunk selection program then uses three busy/idle status indications to determine and select the

preferred idle trunk in the group: (1) the trunk busy/idle status, (2) the TLF busy/idle status scanned from the completing marker, and (3) the outsender group busy/idle status also scanned from the completing marker. The preferred trunk is the one that has been idle the longest.

(a) Up to five trunk/TLF combinations may be tried in the search for an idle combination. If an idle TLF cannot be found, the trunk involved in the fifth attempt is selected. The marker then waits for that TLF to become idle.

(b) If all trunks are busy in the route or if the outsender group is found busy, the processor will initiate a route advance and repeat the five combination search procedure in an alternate route. A maximum of ten route advances are permitted. If a trunk is not selected after trying all possible routes, the processor gives a marker return reorder indication. The originating register provides the reorder signal.

(c) If the marker encounters a failure to match (all channels busy) in attempting to connect to the selected trunk or if the trunk is a 2-way trunk that has been seized from the far end, then the marker will recycle and request another trunk selection from the ETS processor.

T. Code Conversion

4.102 When calls from a No. 5 ETS office are routed through an intermediate step-by-step office, it may be necessary to outpulse from the No. 5 ETS office to the intermediate office digits which do not correspond to those dialed by a customer or operator. This conversion of codes is required where the trunking arrangements of the step-by-step selectors are on an arbitrary code basis. Dial pulse and multifrequency outgoing senders are arranged (optionally) for a maximum of three arbitrary digits, from which full flexibility in single-digit, and 3-digit arbitrary codes can be obtained. The arbitrary codes can be substituted for the directory codes (code conversion) or they can be prefixed ahead of directory codes.

U. Calls Involving Equipment Irregularities

Stuck Originating Registers

4.103 An originating register may be stuck in such a way that after dialing is completed,

SECTION 19a(1)

it cannot obtain a marker. In this case, the register times out and releases itself and the dialing connection after 20 to 37 seconds. The originating customer is then given another dial tone connection. During periods of heavy traffic, the timeout period may be reduced to 10 to 18 seconds, depending on whether or not any digits are dialed.

- (a) If the originating register is stuck in such a way that it cannot register any of the dialed digits, the call is treated as a permanent signal.
- (b) If the originating register is stuck in such a way that it registers part of the dialed digits, the call is treated as a partial dial.

Stuck Outgoing Senders

4.104 An outgoing sender which is being used in an outgoing connection may not be able to outpulse or complete pulsing because of an equipment irregularity. In this case, a DP or RP sender times out after 19 to 37 seconds on non-AMA calls, 7 to 13 seconds on AMA calls; an MF sender times out after 13 to 24 seconds on non-AMA calls, 7 to 13 seconds on AMA calls; an FSP sender times out after 12 to 24 seconds on non-AMA calls, 7 to 12 seconds on AMA calls. After timing out, the sender sets the outgoing trunk to give a reorder signal to the calling customer and releases itself from the connection.

- (a) The timing features of the PCI sender also depend on the type of call involved. On AMA calls, it allows 7 to 13 seconds for the initial entry. When handling calls to switchboards, it allows 19 to 37 seconds while awaiting assignment by an operator. After timeout, the sender sets the outgoing trunk to give a reorder signal to the calling customer and releases from the connection.
- (b) An outgoing sender may not be able to outpulse because of a shortage of incoming registers or senders in the connecting office. To prevent overloads in connecting offices from affecting the equipment in the No. 5 ETS office, all senders are provided with an intersender timing feature. This feature allows for a delay of 4 to 8 seconds for the receipt of the start-dial signal. If the signal is not received by this time, the sender records this fact and continues to time. However, if a completing marker

discovers that all senders in a desired group are busy, it will initiate a sender group-release signal to release all senders whose intersender timers have timed out. Before releasing, these senders will set their associated trunks to return a reorder signal.

- (c) If the trunk test which the sender performs fails, the sender times out to release after first setting the outgoing trunk to return reorder signal.

Stuck Incoming Registers

4.105 An equipment irregularity may prevent an incoming register from calling in a marker or from transmitting all of the necessary information to a completing marker after the register has seized the marker. In the first case and under normal conditions, a DP, RP, MF, or FSP register times out after 19 to 37 seconds and the register releases from the incoming trunk. In the second case, the marker, having been seized and lacking receipt of the call information, will time for 0.45 to 0.61 or 2.6 to 4.3 seconds, depending on which information is missing, and then signal the incoming register to make a second attempt. If this attempt fails, the second marker signals the incoming register to release and, if conditions permit, sets the incoming trunk to return a reorder signal to the originating end.

- (a) The timeout period for the DP incoming register is reduced to 4 to 8 seconds during heavy traffic; the timeout period for MF and FSP registers remains the same.
- (b) A stuck revertive pulse incoming register does not go to the marker, but signals the outgoing sender in the originating office to set up the reorder signal in the trunk. This register has the same timeout periods as the DP register.

Marker Irregularities

4.106 If for any reason, while handling a call, a dial tone marker encounters a trouble condition, it signals its associated marker connector to select another marker. If the second marker encounters trouble, the process is repeated. In this way, as long as there is an off-hook condition on the calling customer line, the line link marker connector continues to select a marker until the customer hangs up or the call is completed.

(a) Before it releases, each marker which encounters trouble causes the trouble recorder to make a trouble record.

ETS Processor Irregularities

4.107 The processor system employs a combination of hardware and software techniques to achieve a highly reliable system configuration. The basic reliability techniques applied are as follows:

- Duplicated processors with a multiplicity of I/O channels
- Self-checking hardware throughout the entire system
- System software which employs initialization strategies, software audits, and hardware diagnostics.

(a) The self-checking capability permits the processors to operate asynchronously, one active and the other standby. Self-detection of an error generates a signal which causes one of the following actions:

- (1) **Interrupt:** Least severe action; usually due to trouble in an I/O facility or maintenance channel (MCH). The on-line processor maintains complete control.
- (2) **Switch to Standby Processor:** Control exchanged due to fault in active processor.
- (3) **Initialization—Five Levels:** Restart of the processor in a particular state.

First Level: (elapsed time 3 seconds)
Calls being established are slightly delayed.

Second Level: (elapsed time 3 seconds)
Revenue is lost on established calls and calls being established are delayed.

Third Level: (elapsed time 2 minutes)
The data base, including recent changes, is reloaded using check sums. Revenue is lost on established calls and calls being established are delayed, most are abandoned.

Fourth Level: (elapsed time 3 minutes)
The data base, including recent changes is

reloaded using the complete tape. Revenue is lost on established calls; calls being established are delayed.

Fifth Level: (elapsed time 2 minutes 30 seconds) The data base, without recent changes, is reloaded using the complete tape. Revenue is lost on established calls; calls being established are delayed.

(b) Memory reliability is achieved with both error detecting and error correcting schemes.

(c) The cartridge tape system automatically reads after a write and checks the validity of the data which has been written on the tape. The switch to the duplicate tape unit is made under control of the processor. Integrity of the ETS is maintained following a cartridge tape fault since the information is still present in main memory.

V. No. 5 ETS Special Features

Centrex Service

4.108 The addition of centrex service to the No. 5 ETS office provides the means for PBX extensions to be switched directly by central office common control equipment. All extensions terminate on the central office line equipment, eliminating the need for switching equipment at the customer location.

(a) Centrex service effectively provides the equivalent of individual line service for each PBX extension. All incoming calls can be dialed directly to the extensions (DID). Automatic identification of outward dialed calls by centrex stations can be provided for automatic billing if the customer desires. A station within a centrex group can dial another station within that group on a 4- or 5-digit basis. Centrex can also provide attendant or dial transfer of calls, do not answer transfer, and busy line transfer.

(b) No. 5 ETS wire spring relay type offices can serve a maximum of 100 PBX customer groups or a lesser number of PBX customer groups combined with regular customers. For a more complete description of No. 5 ETS centrex, refer to the general descriptive section for No. 5 crossbar centrex service, DFMP, Division H, Section 5d(2).

SECTION 19a(1)

Line Link Pulsing (LLP)

4.109 In some cases, it is not practical to serve all PBX extensions with central office switching equipment and as a result, PBX switching equipment outside the central office is used. LLP provides a means for giving these customers direct-inward-dialing (DID). LLP, as the name implies, allows outward pulsing from the line link frame without requiring a tandem switching function.

(a) With ETS, the recognition of an LLP call and the associated line hunt functions is done by the processor. After the translation, the following information is passed to the completing marker: (1) LLP indication, (2) the LEN of the selected hunt line, and (3) all sender information.

(b) A main PBX location and one or more secondary locations can be served over a common PBX trunk group. When calls are directed to PBX extensions, a sender associated with the LLP circuit transmits the digits of the called extension to select that extension using PBX switching equipment. If the extension is served by a secondary PBX, the called number will be preceded by a directing digit which will be used by the main PBX to select a tie trunk to the secondary PBX and then the called number will select the extension within the secondary PBX.

(c) In another LLP arrangement, extensions in the main PBX can be served directly by the No. 5 ETS office and the extensions in a secondary PBX served by LLP. With this arrangement, only the called extension number needs to be outpulsed since the PBX trunk used is incoming directly to the secondary PBX switching equipment.

(d) Calls to PBX consoles may be handled directly by the No. 5 ETS office or over the same trunk group which handles PBX extensions. When the same trunk group is used, the sender outpulses a single digit (usually 0) which is determined by the marker. This extends the call through the incoming switch at the PBX to the attendant console.

(e) Provision has been made to route LLP calls directed to unassigned, unequipped, changed, disconnected, or temporarily out of service

directory numbers to an automatic intercept center (AIC) when the No. 5 ETS office is arranged for automatic intercept service.

(f) When the marker attempts to complete an intercept call, the ETS processor provides a blank or unassigned indication to the marker if the called number has been changed or disconnected. These indications cause the marker to generate the appropriate information digit plus the line number for the group of intercept lines.

(g) The marker consults the processor a second time for the equipment location of the intercept lines. Upon finding an idle intercept line with an idle sender, the marker connects the incoming trunk circuit to the intercept line circuit, transfers the called number and the information digit to the associated MF sender, and releases.

(h) The information digit and the called number are pulsed to the AIC which connects an appropriate recorded announcement based on the information digit or routes the call to an operator.

Common Control Switching Arrangements (CCSA)

4.110 CCSA, also referred to as switched services networks, provides for the interconnection of several customer PBX locations by means of private line facilities or telpak voice channels. These networks are intended primarily for use by large industrial customers and government agencies who have extensive requirements for voice, telegraph, and data communications between a number of geographical locations. Each customer network has its own private or dedicated access lines and network trunks and will share No. 5 ETS switching centers with other private networks as well as regular No. 5 ETS switching functions. The services provided by CCSA will depend on the individual customer requirements.

Direct Access Dialing from No. 5 ETS System to No. 101 Electronic Switching System

4.111 Arrangements have been provided in No. 101 ESS for direct access dialing from No. 5 ETS offices. This direct access arrangement eliminates the need for LLP from the No. 5 ETS office.

(a) When a call is established from a customer served by a No. 5 ETS office to a customer served by a No. 101 ESS office, the marker in the No. 5 ETS office connects to the No. 101 ESS office and passes a 4-digit called number. The No. 101 ESS office translates the four digits to determine the called customer and trunk to be used and passes the line link frame appearance of this trunk to the marker. The marker proceeds to connect the call to the trunk identified.

(b) The No. 101 ESS times for seizure on the trunk and when a seizure signal is received the call is cut through to audible ringing or busy tone. When the called customer answers, the No. 101 ESS returns answer supervision to the No. 5 ETS office and establishes a talking connection to the called customer.

Range Extension and Unigaugage

4.112 Outside plant cabling may be converted to a uniform gauge. Customer loops which do not exceed 30,000 feet in length are using 26-gauge cable. As a result, this cable contains approximately half the copper which was required for the 22-gauge cable previously used and provides a considerable savings in copper cost.

(a) The use of smaller gauge wire increases the customer loop resistance and results in greater losses in the customer loop. To compensate for these greater losses, it is necessary to increase voltage levels for signaling and talking purposes and provide amplification for voice frequencies.

(b) To provide an economical arrangement for serving customers with high loop resistance, a circuit called a range extender has been added. The range extender is inserted in the line link frame between the line link primary and the line link secondary. Physically, this equipment is mounted externally to the line link frame and connected by cabling.

(c) In addition to the range extender, higher battery voltage is used and circuits are modified to apply the higher battery for customer long loops.

5. EQUIPMENT ARRANGEMENTS

ETS EQUIPMENT

5.01 The ETS processor complex (all 7 feet high frames) should be in a single lineup. If this is not possible, then it can be in two adjacent lineups in such a way that at least one bay of each lineup overlaps. This overlap is necessary to permit interconnection of the separated segments with a standard cross-aisle cable rack. The supplementary main store frames are located one at each side of the processor frame. In small offices where the supplementary main store frames are not initially required, they will be provided but left empty.

(a) All frames in the processor complex have an 18-inch deep base, whereas the regular No. 5 crossbar frames have a 10-1/2 inch deep base.

(b) The ETS DAS frames are 2 feet 9-9/16 inches wide, No. 5 crossbar type frames and can be located wherever space is available in existing lineups. The only restriction is that they must be located within 100 cable feet of the processor measured from the center of the processor frame to the bottom of the DAS frame.

(c) The processor complex utilizes man-machine interfaces to maintain the system. It is therefore very desirable to locate the processor complex in the existing maintenance center with a work area between the existing No. 5 crossbar test frames and the processor complex.

(d) Where the alternate two lineup arrangement must be used for the processor complex, the maintenance frame and the PDI frame should be in the lineup closest to and facing the existing test frames. The processor and main store frames, in this case, should also face the existing test frames to provide convenient access to the processor panel even though this is contrary to the normal front-to-front and rear-to-rear frame arrangements.

(e) In cases where it is not possible to locate the processor complex in the existing maintenance center, a remote DATASPEED-40 terminal should be located in the maintenance area for the convenience of the maintenance force.

ELECTROMECHANICAL EQUIPMENT ARRANGEMENT

5.02 The line link and trunk link frame lineups are usually placed close together to reduce the length of the cabling between these frames and a junctor grouping frame which is common to both. For the same reason, the trunk link connectors are next to each trunk link frame. The testing and maintenance frames are located in a central spot for easy access.

- (a) The basic framework is the same throughout the No. 5 ETS office. The frames are 11-1/2 feet high and 10-1/2 inches deep and their widths vary from 20-1/2 to 45 inches. Generally, they are arranged with the apparatus sides of two frames facing each other, with a 2-foot 6-inch aisle between them. The wiring aisles between the backs of the frames are approximately 23 inches wide.
- (b) Since the contacts of wire spring type relays are protected from dust by a cover and equipment using these relays is wired with fire-resistant wire, front and rear frame covers are not furnished on frames where such equipment is mounted. Frames on which flat spring type relay equipment is mounted are furnished with enclosures. There are metal covers for some equipment units and transparent plastic covers for others. When the equipment units are enclosed with front covers, front horizontal baffles are provided to prevent the distribution of dust and the spread of fire. Rear baffles are provided with rear covers.
- (c) An end guard, which is a metal panel, is on the side of the frame at the end of a frame lineup. The aisle pilot lamps for the alarm systems are mounted on these end guards at the main aisle end of the lineup. There is also space for mounting the frame distributing fuses at the top end of the guard panel.
- (d) The front of each frame is stamped with the frame name and number. In addition, each lineup has designation cards to identify each frame and its position in the lineup.
- (e) In order to trace the interconnections between the circuits mounted on these frames, designation cards which contain this information are provided for various frames.

6. MAINTENANCE FEATURES

GENERAL

- 6.01** The basic provisions for maintenance of No. 5 ETS offices consist of the following:
- (a) Testing equipment for the various circuits and associated apparatus
 - (b) Arrangements for providing notice of, and information about, failures occurring on service and test calls
 - (c) Means for removing equipment from service.

In addition, testing equipment is provided for use in the maintenance of the customer line plant and of trunks terminating in other buildings. Maintenance of the No. 5 ETS processor complex and the DAS interface to the crossbar equipment utilizes methods and equipment similar to those used in ESS. In general, this maintenance is independent of the crossbar maintenance equipment and is provided as part of the processor complex. However, test access may be via the master test frame as is the case for testing interface to marker, trunks, etc. It is desirable to locate the ETS test and maintenance facilities in the No. 5 crossbar maintenance center because of the close interaction of the two systems.

- 6.02** The majority of the equipment required for the maintenance features is mounted on bays which collectively are called the master test frame. The remaining apparatus is mounted on other equipment bays or frames, or in portable test boxes.
- 6.03** The master test frame bays are required in all No. 5 ETS offices. They are located in the maintenance center, since most of the apparatus required for operating and administering the testing and the other maintenance features associated with the master test frame are mounted on these frames. This apparatus includes recording devices which automatically provides, in the form of punched cards or TTY printout, information concerning both failures on service calls and the results of certain test calls.
- 6.04** A basic 2-bay connector frame is provided as part of the master test frame in every office for the purpose of connecting to a maximum of eight completing markers. An auxiliary bay is

provided for each marker group equipped for AMA. A separate connector bay is provided for connecting to dial tone markers. These connector bays are placed in some convenient location, but not necessarily in or close to the maintenance center.

6.05 From one to four additional frames may be required, depending on the type of testing equipment desired for the senders and registers and on the type of senders and registers to be tested. These bays are also located in some convenient location on the maintenance center floor.

6.06 The following choice of testing equipment for the senders and registers is available.

(a) Permanently located apparatus arranged to provide extensive tests of the circuits. This equipment will automatically produce or select digits, using pulses which are precise in speed (ratio of open to closed intervals), and it includes registering devices for receiving the output of senders.

(b) Test set type testing equipment employs portable test sets which perform marginal tests only. It is used where a small expense in test apparatus is desired and requires that digit and selection pulses be produced by manually operating a dial or keys. Some auxiliary apparatus is required and is located on the master test frame. With such an arrangement, a pulse generator, capable of producing pulses which are accurate in speed and length of pulse and which can be varied over a considerable range, will be required for occasional conditioning purposes. Such a generator is available in portable form.

6.07 The choice of testing arrangements can be made for each type of sender or incoming register, except for tandem revertive incoming registers. For these registers, only the test set type of testing equipment is available. It should be noted that although a No. 5 ETS office may be furnished with both testing facilities (the automatic monitor, register and sender test circuit and the test set type facilities), both cannot be used for testing the same type of registers or senders. Each testing facility requires a different circuit arrangement in the type of register or sender to be tested. This prohibits the use of both facilities for testing the same type of registers or senders.

6.08 The more complete type of testing equipment is a dual-purpose arrangement which permits its use as a means for automatically monitoring the senders and registers while they are being used on service calls. Failures indicated during this monitoring process cause the trouble recorder to make a record of the conditions and of the circuit units used on the call.

6.09 In addition to the trouble recorder, the following apparatus is mounted on the four basic bays located at the maintenance center.

(a) Keys, lamps, and other apparatus for directing test calls to the circuit or combination of circuits to be tested, for controlling the actual testing functions and indicating the progress of the test call, and for monitoring on senders and registers. Certain testing functions are also included in the control circuit.

(b) The apparatus required for making tests of trunk circuits.

(c) Lamps for indicating certain trouble conditions which do not cause an automatic record to be made and other lamps which indicate the duration of use of certain of the circuits.

(d) Lamps and jacks associated with permanent signal holding trunks, common overflow trunks, and plugging-up lines.

(e) Jacks for taking units of the common control equipment out of service.

(f) Test and make-busy jacks for outgoing trunks.

(g) A voltmeter circuit for use in testing customer lines and outgoing trunk circuits.

(h) Communication trunks, including a telephone circuit and a dial.

(i) Plant peg count registers.

6.10 Some of the other testing equipment used in No. 5 ETS offices is as follows:

(a) A manually operated outgoing trunk test frame for use where there are a large number of outgoing trunks.

SECTION 19a(1)

- (b) A 17-type toll testboard for use in maintaining intertoll trunks. For smaller installations, a 4-type toll test unit or the 18-type toll testboard may be used in maintaining intertoll trunks.
- (c) Test lines for use in making tests of the operating and signaling features of local and intertoll trunk circuits.
- (d) Test lines for making 1000-Hz one-way transmission tests of local and intertoll trunks.
- (e) Test line for making loss and noise transmission tests of local and intertoll trunks.
- (f) A test line for making a balance test of intertoll trunk circuits.
- (g) A test circuit for checking foreign area translator code cross-connections.
- (h) A test circuit for checking the cross-connections in the number group frames and AMA translator frames.
- (i) Equipment for automatically testing intraoffice-type trunks, customer-to-customer intermarker group type trunks, and outgoing interoffice-type trunks.
- (j) Several portable test sets.
- (k) Testing arrangements required for use in the maintenance of customer lines consisting of the following:
 - (1) An automatic line insulation test circuit
 - (2) Station ringer test arrangements
 - (3) Test and no-test trunks, which can be used to reach customer lines from the local test desk
 - (4) Trunks to local test desk
 - (5) A circuit under control of test desk for providing access to permanent signal holding trunks and plugging-up lines.

ETS MAINTENANCE

- 6.11 The ETS maintenance objective, with regard to the crossbar equipment, is to retain the

existing trouble detection and testing capabilities. ETS maintenance does, however, impact on crossbar maintenance in two ways. First, it enhances trunk maintenance through audits of trunk scan point status. Analysis of such audits reveals malfunctions in trunk supervision thus augmenting existing trunk testing routines. Secondly, it eliminates the need for certain existing crossbar maintenance tasks and the administration required for these tasks. These include:

- (a) Maintenance of class of service cross-connections and the associated logic circuitry
- (b) Maintenance of route translation and trunk selection equipment and associated cross-connection field
- (c) Maintenance of the number group equipment and associated cross-connect field
- (d) Maintenance of the electromechanical AMA equipment and the AMA features of trunks and trunk test circuits.

Processor Complex

6.12 Although the processor will automatically recover under trouble conditions, certain software or hardware faults or combinations of the two may occur in which the system is unable to configure into a working mode (eg, continuously switching processors). In these cases, manual recovery must be performed via hardware which allows maintenance personnel the capability of forcing the system into a fixed configuration and then locking it into that mode.

6.13 Under trouble conditions, the on-line processor can control diagnosis of the off-line unit on a step-by-step basis via the maintenance channel. Diagnostics are normally initiated only on manual request via a maintenance TTY. The diagnostics are stored on the tape data cartridge and are paged into the main memory for execution. An extensive trouble locating manual (TLM) (Section 218-799-101) supports the diagnostics.

6.14 Each processor includes a control and display panel which is one of the means (in addition to TTY and status panel) for communication between maintenance personnel and the processor for testing and manual operations.

(a) **Peripherals:** Peripheral units which are part of the processor complex are:

- Tape Data Controller (TDC)
- TTY 33/35 Controller (TTYC)
- RS232C Serial Interface (RSI)

6.15 These devices incorporate self-check and diagnostic features which enable rapid detection of circuit failure and permit diagnostics to be performed by the processor. Redundancy is employed throughout the peripheral units to ensure availability.

Status and Control Panels

6.16 Two status panels provide a vital part of the ETS man-machine interface. One panel, called the system status panel (SSTP), is located on the maintenance frame and provides indications and manual controls associated with the maintenance of the processor complex. The other, called the ETS status panel (ETSSP), is located on the PDI frame and is used in maintenance of the DAS and crossbar equipment. In their respective areas of application, these panels provide indications of: (a) normal operating conditions, (b) trouble conditions, (c) manually initiated tests, and (d) equipment taken out of service. They provide manual controls for initiating tests, taking equipment out of service, and retiring alarms. The SSTP includes controls for initializing and reconfiguring the processors. Both panels function in conjunction with TTY I/O messages.

Distribute and Scan (DAS)

6.17 The rapid detection and location of DAS hardware faults is facilitated by the following: (1) self-checking and diagnostic circuitry, (2) operational software checks, (3) test/diagnostic programs invoked either automatically or manually, and (4) a trouble locating manual (Section 218-799-101).

(a) Distribute and scan points and associated bus and matrix controllers are not duplicated. However, functional assignments of DAS points are such that on removal of a DAS unit or group from service the effect on the switching capacity of the office is minimized (ie, loss of one dial tone marker, one completing marker, a proportionate number of trunks, etc.).

(b) DAS units may be removed from service by the processor either in response to TTY input commands or automatically as a result of software detection of trouble. Simultaneously, associated crossbar common control equipment such as a marker or program controlled transverter will be automatically made busy. Associated trunks and PBX hunt group lines will be effectively made busy to subsequent selection in software although calls in progress will be undisturbed and incoming calls on 2-way trunks and outward calls on PBX lines will be unaffected.

(c) Inasmuch as these make-busy functions are program controlled and the common control hardware make busy is activated via distribute points, neither of which is visible to craftspeople, the following indicators are provided:

- (1) The PDI lamp is lighted in the MTF jack bay.
- (2) A light emitting diode (LED) indicating the DAS equipment out of service is illuminated on the ETSSP.
- (3) The following common control equipment which may be made busy is identified on the ETSSP.
 - Completing marker
 - Dial tone marker
 - RMR unit
 - PCTV—ANI
 - PCTV—CAMA
 - PCDAI unit
- (4) The effected DAS and common control equipment is listed in a MTC TTY error message.

(d) Total failure of processor access to a DAS group precludes the common control make-busy function as described above since the controlling distribute points are ineffective. In this case the associated DAS watchdog timer performs the hardware make-busy function and lights the visual indicators while the processor generates

SECTION 19a(1)

the TTY error message and provides the software busy status.

- (e) Appropriate central office alarms are activated along with each of the above operations.
- (f) Certain trouble conditions at the DAS crossbar interface (eg, faulty distribute point) may result in dual reports of the same trouble via both a crossbar trouble record card and a TTY error message.

Miscellaneous Interface Circuits

6.18 The AIOD, PCTV, MRC, PCDAI, RMR and MDC circuits interface the DAS and crossbar equipment and consist of electromechanical hardware. A degree of operational checking, testing and diagnosis is incorporated in software; otherwise, maintenance of these circuits is similar to conventional electromechanical equipment in the No. 5 crossbar environment. Alarm indicators and make-busy controls for the AIOD equipment are provided in the ETSSP. PCTVs utilize make-busy jacks in the MTF jack bay formerly assigned to paper tape AMA transverters. The AIOD, PCTV and PCDAI circuits include time alarm features.

CENTRAL OFFICE ALARM SYSTEM

6.19 The central office alarm system provides audible and visual signals to notify the

maintenance force of trouble conditions and the location of the equipment in trouble.

- (a) Each aisle is equipped with a red aisle pilot lamp for indicating major alarms involving that aisle and with a green aisle pilot lamp for indicating minor alarms.
- (b) The same general arrangement of cross-aisle, main-aisle, and other floor and exit pilots, are provided. Similarly, an individual lamp indicating the equipment causing the alarm is provided.
- (c) The audible signals are those which are standard for other systems, they include:
 - (1) tone bar for major alarms
 - (2) customer sets for minor alarms
 - (3) customer sets for alarm battery fuse alarms
 - (4) Loud ringing bell for indicating power failures affecting a portion of the office.
- (d) Arrangements are available for transferring alarm indications to some other point in the same or another building when the office is to be unattended.

6.20 Alarms associated with the ETS include the following:

HARDWARE-DETECTED FAILURES

CIRCUIT	CONDITION	ALARM
Processor	Panel Time-Out*	Critical
All ETS Circuits	Blown Fuse	Major
All Power Converters	Failure	Major
DAS Group	Out of Service**	Major
PCTV, PBX-AIOD	Failure	Major
PCDAI	Failure	Minor
Power Converters	Voltage Out of Limits	Minor

SOFTWARE-DETECTED FAILURES

Processor	First Maintenance Reset Function (MRF)***	Major
Processor	Second MRF within Timed Interval	Critical
RSI/SPI	I/O Failure	Major
DAS	Matrix Failure	Major
TTYC: TDC	Circuit Failure	Major

Visual indications are given of hardware-generated alarms on fuse panels or on one of the two status panels (SSTP or ETSSP) as appropriate. Software-detected failures are reported by a TTY message and an associated status panel lamp.

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- * Hardware sanity timer functions when deterioration of processing capability falls below a prescribed minimum level.
 - ** Major DAS group connecting circuits (markers, PCTVs, and RMRs) are made busy by DAS watchdog timer or processor or operation of DAS group make-busy key.
 - *** System initialized due to hardware or software failure.

(a) Hardware-generated alarms may be accompanied by related software alarms. In some cases, a crossbar alarm may also be initiated as a result of a trouble record card being generated by the same trouble condition.

(b) When alarms are transferred during unattended periods, the ETS fuse and power converter alarms (hardware generated) are combined with the common crossbar office alarms. The PCTV and AIOD failure alarms are also combined with the common crossbar major alarms when the alarm-sending circuit is employed, but are assigned as specific circuit alarms when telecommunications alarm and surveillance control (TASC) is provided.

TEST SET TYPE TESTING ARRANGEMENTS FOR REGISTERS AND SENDERS

6.21 A portable test set is provided for use in testing both originating and incoming registers. This test set is provided with two standard dials, one in the 8- to 11-pps (pulse per second) range and one in the 16- to 19-pps range. A keyset is also provided for use in testing MF incoming registers. The dials are used for testing both originating and dial pulse incoming registers. Some additional control keys and lamps are also provided.

- (a) Access to originating registers is obtained by the master test frame in the same manner as when the more complete test equipment is

SECTION 19a(1)

provided. The portable test set is then connected to the registers by way of the master test frame. The dials on the test set are used to send the test code and number into the register. The results of the test are shown on a trouble recorder card.

(b) Access to incoming registers is obtained by a control circuit provided when the portable test set is to be used. This control circuit is mounted on the master test frame. The results of the tests are shown on a trouble recorder card.

(c) A separate portable test set is provided for testing outgoing senders, and a separate auxiliary relay circuit is required for each type of outgoing sender, DP, MF, RP, PCI, and FSP. Access to the sender is obtained by way of the master test frame.

(d) Test connections are made in the same manner as described for registers, except two patching cords are used for this test set.

(e) The test set is provided with lamps which light when DP, MF, FSP, or PCI pulses are transmitted by the sender. In the case of revertive pulse senders, the pulses are transmitted by the auxiliary relay circuit, and the lamps record the number of pulses required to cause the sender to open its fundamental circuit on each selection. In the case of MF senders, the pulses are transmitted by the sender into an MF receiver, from which the test set gets its information. This receiver can be one which is normally associated with an MF incoming register or a receiver provided for testing purposes.

(f) The portable test sets can be used at the master test frame or, by means of a tie line arrangement, at the location of the circuit being tested.

(g) The electronic pulse generator is a portable device arranged so that pulses (opening and closing of a circuit path) at any desired speed and ratio of closed to open periods over a reasonably large range can be obtained. The purpose of this generator is to provide the means for making an occasional marginal test of senders and registers without necessitating the provision of pulse generating equipment (used to make

these tests) in the master test frame in every office.

ARRANGEMENT FOR TESTING CUSTOMER STATION RINGERS

6.22 A station ringer test circuit is reached by dialing a special code and replacing the receiver on-hook. The ringing is stopped by again taking the receiver off-hook.

(a) For the No. 5 ETS system, a special code is dialed, followed by the number assigned to the station under test. The code causes a connection to be established between the line and a ringer test circuit.

(b) The number which is dialed causes the marker to set the ringing selection switch associated with the selected circuit for the kind of ringing which the station should receive.

AUTOMATIC LINE INSULATION TEST EQUIPMENT

6.23 The primary function of this equipment is to automatically scan customer lines for defects which show up as low insulation resistance. A secondary function (optional) is used for making some traffic measurements. In regard to the latter, it is arranged to automatically scan line links and trunk links at regular intervals and to record the number of links found busy.

(a) When used for testing customer line insulation, about 12,000 lines per hour are tested and the trouble recorder records the line link equipment number of the lines failing to meet the test conditions or transmits the data to a teletypewriter page printer at the local test center.

AUTOMATIC PROGRESSION TRUNK TEST FRAME (APTT)

6.24 With the automatic progression trunk test frame the following trunks may be tested automatically or manually.

- Outgoing intertoll
- Outgoing interoffice
- Intraoffice
- Customer-to-customer intermarker group

- Customer-to-trunk intermarker group
- Line link pulsing
- Centrex
- Data.

(a) These tests may be transmission tests or operational tests. In addition, CAMA incoming trunks, CAMA intermarker group trunks, CAMA junctors, and outgoing junctors may be tested operationally on a manual or automatic basis. When these tests are done automatically, the test frame is under control of a tape fed into teletypewriter equipment. This tape is prepunched to identify the trunks to be tested and the tests to be made. The results of the tests are displayed at the test frame by progress lamps and/or printed on teletypewriter page copy. Any test failure, when the frame is used for automatic testing, will cause the frame to stop its tests and sound an alarm or produce a teletypewriter page printout to indicate the trouble.

7. GLOSSARY

7.01 The following is a general glossary of terms used by the network administrators when discussing telephone systems in general and No. 5 crossbar and No. 5 ETS in particular. The terms listed do not necessarily appear in this section. No. 5 ETS is a crossbreed of ESS type functions and electromechanical type functions. Because of the divergent history of the two types of systems, many terms are ambiguous when used in the crossbreed office.

A and B Appearances for Trunks on Trunk Link Frame: These are the two possible trunk switching connections on a trunk link frame. Trunks are assigned to these appearances according to the traffic engineering practices of an office. Originating registers are always assigned to the A appearances.

Actual Work Time (AWT): The average time an operator takes to handle a call. This corresponds to the expected value (mean value) of the holding time distribution used in the Erlang C model.

Address: (1) A sequence of numbers that identifies the telephone to which a call is directed. The

address is usually a 7- or 10-digit number, depending on whether the destination is inside or outside the numbering plan area where the call originated. (2) Digital information (a combination of bits) that identifies a location in a storage device or equipment unit.

Address Signals: Signals used to convey call destination information such as telephone station number, central office code, and area code.

Administration: In operating companies, Dial or Network Administration is a number of related functions with the objective of ensuring the overall provision of service by a switching system. It includes assignment of lines and trunks to switching system terminals, collection of traffic data, analysis of troubles and customer complaints, and requests for additions and modifications to switching systems.

Alerting (Alerting Signal): A signal sent to a subscriber, PBX, or switching system to indicate an incoming call. The most common form is the signal that rings a bell in the telephone set that is being called.

All Number Calling (ANC): The system of telephone numbering that uses all numbers and replaces the two letter—five number, numbering plan. ANC offers more usable combinations of numbers than the 2L + 5N numbering plan and is becoming the nationwide standard.

All Paths Busy Tone (also called Fast Busy, or Reorder Tone): An audible signal indicating that a call cannot be completed because of trunk or switching system blocking. The signal has 120 impulses per minute.

Alternate Route: A route which may be selected to provide a connection in a complex network when more direct or first-choice routes are not available.

AMARC: AMA Recording Center

American Standard Code for Information Interchange (ASCII): A 7-bit code for providing as many as 128 different characters. An eighth bit can be added as a parity check for error detection purposes.

Analog Signal: A continuously varying signal such as a voice telephone signal or AM radio program. This may be contrasted with a digital

SECTION 19a(1)

signal which has only discrete states. The signal put out by a data set has both analog and discrete characteristics.

Answer Delay: The time from the beginning of ringing until the called station answers.

Apparatus: A unit of hardware, such as a relay, a capacitor, a telephone set, or a data set, which is handled without the keeping of certain kinds of records of installation and changes. (Contrasts with equipment.)

Area Transfer: The process of assigning a group of customers to a new wire center.

ASR: Automatic send and receive (TTY)

Assistance Call: A call which the customer could or could not dial directly, but on which he dials zero to contact the operator for assistance.

Asynchronous Data Transmission: Data transmission where there is no predetermined time spacing between successive symbols. With this technique, either a particular symbol is used to separate message symbols or else coding is used to ensure that no two successive symbols will run into one another so as to obscure the transition.

Attempts Per Circuit Per Hour (ACH): Indication of calling pressure. (See also **Connection Per Circuit Per Hour.**)

ATA: Automatic Trouble Analysis

Attestation: A tariff provision allowing for the direct electrical connection of certain relatively simple, nonpowered devices to the message network.

Audits: These are programs or sections of programs that test for consistency or reasonableness of data stored in memory. Thus, the number of consecutive unanswered calls, whether a line is never idle and whether the recorded directory number (TN) for a specific line equipment is unique, are all typical audits.

Automatic Call Distributor (ACD): A system for automatically providing even distribution of incoming calls to operator or attendant positions; calls are served in the approximate order of arrival and routed to positions in the order of their availability for handling a call.

Automatic Intercept Center (AIC): A centrally located set of equipment that is a part of an automatic intercept system and provides arrangements, having stored program control, whereby the calling customer is automatically advised, by means of either recorded or electronically assembled announcements, of the prevailing situation that prevents completion of connection to the called number.

Automatic Intercept System (AIS): That type of traffic service system consisting of one or more automatic intercept centers and a centralized intercept bureau for handling intercept calls.

Automatic Message Accounting (AMA): An arrangement for automatically collecting, recording, and processing information relating to calls for billing purposes.

Automatic Message Accounting—Operator Number Identification (CAMA-ONI) Operator: An operator located at a position which is connected temporarily on a customer-dialed station-to-station call. The operator secures the calling number from the customer and keys the number into the centralized automatic message accounting equipment.

Automatic Monitor: A unit of equipment which attaches itself to registers and senders on a progressive basis. It records the signaling input without distortion and compares this with the output. The unit causes the trouble recorder to record any incorrect operation and may be used under manual control for testing senders and registers.

Automatic Number Identification (ANI): The automatic identification of a calling station, usually for automatic message accounting.

AIOD: Automatic Identification Outward Dial—same as ANI (but used for PBX only).

Automatic Ringdown: A technique for supervision alerting on a nondial tie trunk where the application of a loop closure at the originating PBX end results in a ringing signal at the terminating PBX end.

AUXLNT: Auxiliary Line Translation

Average Business Day (ABD): Denotes the average over the business days during the period considered of the parameter in question, for example, busy-hour traffic. Business days

include Mondays through Fridays but exclude holidays. See **Peak Load**.

Baud: Unit of digital signaling rate. It is equal to the reciprocal of the length in seconds of the shortest digital code element or symbol. The rate in bits per second may be greater than the baud rate because one symbol can carry more than one bit.

BCD: Binary Coded Decimal

BD: Back Dated

Bell System Repair Specification (BSRS): A Bell System document which specifies detailed repair procedures for apparatus and equipment-coded units. These documents are not for standard field maintenance purposes, but rather for detailed major repairs usually performed at a Western Electric service center.

Binder Groups: A group of cable pairs within a cable sheath which are twisted and bound together during cable construction.

Bit: (1) An abbreviation for **Binary Digit**. A bit can be one of the two binary characters, 1 or 0. (2) A unit of information. One bit of information is sufficient to specify one of two equally likely possibilities.

Bits Per Second (b/s): Digital information rate expressed as the nominal number of equivalent binary information units per second.

Blank Number: A number outside the assigned capacity for a particular office.

Blocking: Inability for the calling party to be connected to the called party because either (a) all trunk paths are busy, or (b) a path between a given inlet and any suitable free outlet of the switching network of a switching system is unavailable.

Bridged Tap: A cable pair which is connected in parallel with a customer loop. The connection (tap) is ordinarily made somewhere along a cable route.

Business Communications Systems (BCS): Customer Switching Systems. Includes small systems

such as key telephone systems as well as larger systems, such as PBXs.

Business Communications Terminal: A device which provides a human interface into a data channel and thus to another terminal or a computer system.

Business Customer Services (BCS): Refers to a class of services generally used by business customers, including private branch exchange service, key telephone service, automatic call distributor service, and telephone answering service.

Business Information Systems (BIS): A series of computer-based systems for performing voluminous business and administrative operations associated with the provision of telephone service by operating companies.

Business Information Systems—Customer Services (BISCUS): Part of the overall Business Information System being developed at Bell Laboratories. The first portion of BISCUS, BISCUS/FACS, is used to assign cable facilities, cable terminations, and central office line equipment to service orders.

Business Office: The part of the telephone company that a customer contacts regarding initial requests for service and subsequent changes in service.

Business Service: Telecommunications service used in a business environment.

Business Terminal Equipment (BTE): Refers to the terminal equipment used by business customers including teletypewriter machines, data sets, key telephone systems, PBXs, etc.

Busy Hour: That hour during which the portion of the telephone network in question carries the most traffic. Traffic peaks caused by holidays or special events are not considered. Switching systems and trunk groups are normally sized for the busy hour. (See also **Peak Load**.)

Busy Hour, Bouncing: See Busy Hour. The highest load may not occur at the same hour on all days. If the highest load is selected for each day without regard to the hour in which it occurs, the average of these loads is said to occur in the bouncing busy hour. Traffic measurements are

SECTION 19a(1)

usually made over the five working days of each week.

Busy Hour, Fixed: See Busy Hour. When the hourly loads are averaged across days for each hour of the day, the maximum of these averages defines the fixed busy hour. Traffic measurements are usually made over the five working days of each week.

Busy Tone: An audible signal indicating that a call cannot be completed because the called line is busy. The signal has 60 impulses per minute.

Cable Fill: The percentage of pairs in a cable sheath actually assigned and used.

Cable Vault: An area, generally on the lower level of a wire center building, where cables enter the building.

Call: The word call is used only if the function is inclusive of all equipment. (See **Job**.)

CP: Call Processing

CAMA-ONI: Centralized Automatic Message Accounting—Operator Number Identification.

Carried Load: The average number of calls in progress. The unit, one call, is an Erlang.

CC: Central Control

Carrier System: A system for transmitting electrical information by modulating it onto a carrier wave (generally higher in frequency), then recovering the original information at the receiving end by the reverse process of demodulation. Many channels of intelligence can be modulated on one carrier wave and carried on a single transmission channel.

CCH: Connections Per Circuit Per Hour

CCS: Hundred Call Seconds

Central Office (CO): Also called a wire center. An operating office of a telephone company where a switching system makes interconnections between telephone lines. A Class 5 switching office. One or more switching systems may be located in a central office. Central offices also provide a connection point and maintenance access point for private lines.

Central Office Code: Also called NNX code. A 3-digit identification within which up to 10,000 station numbers are subgrouped. Exchange area boundaries are associated with the central office code which accordingly has billing significance. Note that several central office codes may be served by a central office.

Central Office Work Order: An order for work to be done in the operating company to add, remove, or change central office line equipment in the inventory.

Centralized Automatic Message Accounting (CAMA): Centrally located equipment, including a switchboard or a traffic service position associated with a tandem or toll switching office, for automatically recording billing data for customer-dialed extra-charge calls originating from several local central offices. The tape is processed at an electronic data processing center.

Centralized Intercept Bureau (CIB): That type of bureau that is part of an automatic intercept system and is associated with one or more automatic intercept centers; it provides facilities whereby operators situated at auxiliary service positions furnish assistance to calling customers whose calls have been intercepted and who require help beyond that furnished by an automatic intercept center.

Centrex: Service providing direct inward and outward dialing for BCS extensions. The customer is assigned a set of telephone numbers and made a part of the numbering plan. A main listed number will give access to the BCS operator. The switching function may be provided by a PBX machine or by a Class 5 office.

Centrex—CO: A serving arrangement providing centrex service where the switching functions are done directly in the central office and a minimum of equipment is on the customer's premises.

Centrex—CU: Same as Centrex—CO except most of the switching equipment is located on customer premises. The choice depends primarily on the distance to the wire center and the availability of the proper switching system in the central office.

Channel: The smallest subdivision of a transmission system by means of which a single type of communication service is provided, ie, a voice channel, teletypewriter channel, or data channel.

Channel Number: A composite number identifying the line switch horizontal number of the line link, the trunk switch vertical number of the trunk link, and the junctor switch number in a channel.

Charge-Delay Interval: An extended interval of time (2 to 5 seconds), maintained in the control of message charging, to ensure against possibilities of false charging due to transients or other conditions of short duration.

Circuit: (1) Communication path between two or more points. (2) A network of circuit elements such as resistors, inductors, capacitors, semiconductors, etc, which performs a specific function. (3) A closed path through which current can flow.

Circuit Order: The document used to transmit engineering design of a public telephone network trunk or special service trunk. This is received by the plant department, which then implements the design.

Class 5 Office: A local exchange area central office which serves as the network entry point for station lines and certain special service lines. Other offices, Class 1, 2, 3, and 4, are toll offices in the telephone network.

Class of Service (C/S): The commercial term applying to the subgrouping of customers for the sake of rate distinctions. This subgrouping may, for example, distinguish between individual and party, between business, residence, and coin, between flat rate and message rate, and between restricted and extended scope. In equipment and traffic engineering, it is used to refer to the subgrouping of lines for originating service for the sake of equipment operation distinction, whether or not rate distinctions are involved. For example, in dial operation, lines may be subdivided into PBX and non-PBX classes to permit proper use of the howler on permanent signal conditions.

CLR Operator: A toll operator who performs the following duties: (a) Answering the call when the customer dials long distance, (b) Writing the toll ticket, using the information furnished by the customer, (c) Making attempts to reach the called party while holding the calling party, (d) Timing the call if connection is established, (e) Passing the ticket to the designated call back operator if the initial attempts fail and the operator dismisses the customer.

Code Conversion: Converting a directory or toll directing code into an arbitrary code for controlling the selection of a trunk route at a distant switching point.

Coded Ringing: A form of semiselective ringing. The customer is required to identify his own code.

Coin-First: Coin telephone service where an initial rate deposit is required to obtain dial tone.

Coin Relay: A relay in a coin telephone that collects or returns the coins under the control of the central office.

Coin Service: A public, semipublic, or customer class of service which has a coin collecting device as part of the station equipment.

Coin Supervisory Link: A switching arrangement for connecting originating dial equipment to coin supervisory circuits.

Coin Test: A test made by either the originating register or coin supervisory circuit to establish the presence of a coin in the trap of a coin station subset.

Combined Toll and Dial System A Switchboard or Toll and DSA Switchboard: A local dial office switchboard which handles toll assistance calls, intercepted calls, and calls from miscellaneous lines and trunks.

Common Channel Interoffice Signaling (CCIS): A signaling system, for use between stored program switching systems, in which all of the signaling information for a group of trunks is transmitted over a dedicated high-speed data link, rather than on a per-trunk basis. CCIS can reduce call set-up time and save money compared to individual trunk signaling.

Common Control: An automatic switching arrangement in which the control equipment necessary for the establishment of connections within an office is shared, being associated with a given call only during the period required to accomplish the control function. (All ESS and crossbar switching systems have common control.)

Common Control Switching Arrangement (CCSA): An arrangement in which switching for a private network is provided by one or more

SECTION 19a(1)

common control switching systems. The switching systems may be shared by several private networks and may also be shared with the public telephone network.

Common Language Code: Codes used to ensure uniform abbreviation of equipment and facility names, place names, etc.

Compandor: An abbreviation for *compressor expander*. A device used to compress the range of talker volume levels at the input to a carrier system (in particular, to increase low-level talker volumes), and to expand the received signal levels at the output of the carrier system (to provide the complementary function and make the transmission system transparent). This technique improves the signal-to-noise ratio for low-level talkers, and provides a substantially reduced received-noise level during the so-called quiet interval.

Concentration: (1) Applies to a switching network (or portion of one) which has more inputs than outputs. (2) In a traffic network, combining calls arriving on many lines or trunks to transmit them more efficiently in a trunk group. (3) Locating as much equipment as possible at a given place to achieve economies in such things as building costs, power arrangements, and maintenance.

Connecting Arrangement Service: A service arrangement which provides for the interconnection of customer-provided equipment to the public telephone network through an interconnecting unit.

Connection: (1) A point where a junction of two or more conductors is made. (2) A telephone connection is a 2-way voiceband channel completed between two points by means of one or more switching systems. It will contain two loops and may contain one or more trunks. It is capable of transmitting control, ringing, and supervisory signals in addition to the voiceband signal.

Connections Per Circuit Per Hour (CCH): Indication of holding time of calls. Under normal circumstances $ACH=CCH=6$ for toll trunk groups excluding high-usage groups.

Connector: A relay-type switching device for interconnecting two equipment elements over a relatively large number of leads.

Construction Program: A detailed plan of placement, removal, and rearrangement of facilities to expand the capacity of the facilities network.

Continuous Malfunction: A malfunction which after detection can be repeatedly detected on each successive use of that hardware or software—ie, does not seem to disappear when analysis is attempted. This is similar to what ESS has called a fault.

Conversion (Converting): The substitution of one, two, or three digits for received digits for the purpose of directing the call through the next office.

Conversion Failure: A failure where data does not conform to its standard format (ie, 2-out-of-5) and hence cannot be converted to a value.

CORNET Network: A private telephone network serving Western Electric and Bell Laboratories; *CORNET* is a contraction of corporate network. This network uses common control switching arrangements (CCSA).

Country Code: The one-, two-, or three-digit number that, in the world numbering plan, identifies each country or integrated numbering plan in the world. The initial digit is always the world-zone number. Any subsequent digits in the code further define the designated geographical area normally identifying a specific country. On an international call, this code is dialed ahead of the national number.

Crossbar Switch: A selective, multiunit, 2-stage switch, configured with 10 or 20 horizontal paths and 10 or 20 vertical contact paths. A 2-stage operation is used to close any crosspoint. First, a selecting magnet shifts a vertical actuating card to close the selected contacts.

Crosspoint Array: An arrangement of switching elements used in some switching networks, characterized by incoming and outgoing talking paths arranged at right angles to each other, with switching elements at intersections.

Crosstalk: Undesired power coupled into a communications circuit from other communications circuits. Telephone crosstalk may be intelligible or unintelligible.

CSACS: Centralized Status, Alarm and Control System

Custom Calling Services: A group of four services provided to business and residence customers: 3-way calling, speed calling, call forwarding, and call waiting.

Customer Premises Equipment: Equipment normally installed on the customer's premises, such as telephone sets, key telephones, PBXs.

Customer Radio Services: A class of services which utilize radio channels to provide telephone service. Customer Radio Services include: (a) Land Mobile Telephone Service, (b) BELLBOY® Service, (c) VMF-Maritime Service, (d) Coastal Harbor Service, (e) High Seas Maritime Radiotelephone Service, (f) High-Speed Train Service.

Customer Switching System: A switching system which provides service for a subscriber, typically a business subscriber. Systems in this category include key telephone systems, PBXs, automatic call distributors, and telephone answering systems.

Customer Trouble Report Analysis Plan (CTRAP): A plan that provides manual and mechanized procedures for recording troubles reported by customers and analyzing the reports to obtain statistical data on customer service.

DAP: Direct Access Pretranslator

DAS: Distribute and Scan

Data Communications: In telephone company terminology, data communications refers to end-to-end transmission of any kind of information other than sound (including voice) or visual. Data sources may be either digital, such as a computer, or analog, such as an electrocardiogram transmitter. Data transmission should not be confused with digital transmission. Data transmission refers to transmission of information from a data source, whereas digital transmission refers to a particular kind of transmission facility implementation.

DATA-PHONE® Service: A service in which calls are placed over the public telephone network in the normal manner or automatically, and, after a connection is established, data terminals are

connected at both ends for exchange of data. Now used to apply to private-line service as well.

Data Set: Equipment for performing the conversion between signals from data processors or terminals (usually digital) and signals suitable for transmission over telephone lines, and for control of the connection. Data sets can be either transmitters, receivers, or both. A data set which is both a transmitter and a receiver is also called a modem, a contraction for modulator/demodulator. In common usage, the terms data set and modem are often used interchangeably, although strictly speaking a data set has functions beyond modulation.

Data Terminal: A device which provides a remote interface into computer systems for data input and output. For example, a teletypewriter is a data terminal and so is a remote magnetic tape reader. Also applies to devices for terminal-to-terminal communications.

Data Under Voice (DUV): A system for transmitting data streams in the bandwidth available underneath the portion of the base band used for voice channels on existing microwave routes. DUV will be the primary long-haul transmission facility used in the early years of the digital data system.

DBG: Data Base Generator

dB: decibel, a logarithmic measure of the ratio between two powers.

DC Signaling: Refers to a variety of techniques for transmitting signaling information using direct current over metallic circuits. Examples are: loop reverse battery, loop-start and duplex (DX). DC signaling is a subset of out-of-band signaling.

Diagnostic (DIAG): A sequence of commands to localize a malfunction once the fault has been detected.

Dial: A device which is part of a customer's telephone set and is used to generate a coded signal to control the central office switching equipment in accordance with the digits dialed. It may be either a rotary device or a pushbutton (TOUCH-TONE) device. Sometimes used as an adjective as in "Dial Administration", the process of short-term rearrangements and monitoring of performance in a central office switching system.

Dial Long Line Circuit: A repeating circuit, usually located in a central office, for extending the dialing, supervision, and other signaling range of subscriber loops.

Dial Pulsing (DP): A means of pulsing, consisting of regular momentary interruptions of a direct or alternating current path at the sending end in which the number of interruptions corresponds to the value of the digit or character. The interruptions are usually produced by a rotary telephone dial, but may be produced by a sender in a switching system.

Dial Repeating Trunks: PBX tie trunks used with terminating PBX equipment capable of handling PBX station signaling information without attendant assistance.

Dial System B (DSB) Switchboard: A switchboard of a dial system for completing incoming calls received from operators over straightforward or call circuit trunks.

Dial Tone (DT): An audible signal sent from an automatic switching system to a subscriber to indicate that the equipment is ready to receive dial signals.

DID: Direct Inward Dialing

Dial Tone Delay: A measure of time required to provide dial tone to customers. This measures one aspect of performance of switching systems.

Dial Tone First Coin Service: A coin service that allows customers to obtain dial tone before money is deposited into the coin telephone. Some service codes, such as 911, may be dialed without a coin at all. Contrasts with "postpay" operation, which is a limited feature service.

Dial Transfer: A service available with some PBXs and centres where a station receiving an incoming call can transfer it to any other station in the same group without the assistance of an operator.

Dialing Time: The time it takes for a customer to dial, beginning from the time he lifts the receiver until the last digit is sent.

Digital Data System (DDS): A private line synchronous data communications network formed

by interconnecting digital transmission facilities. Customers are offered transmission rates of 2.4, 4.8, 9.6, and 56 kilobits per second.

Digital Facility: A switching or transmission facility designed to handle digital signals.

Digital Facility Terminal (DFT): A voice frequency facility terminal which includes digital banks and interfaces between a digital carrier system and a switching system.

Digital Transmission: A mode of transmission in which all information to be transmitted is first converted into digital form and transmitted as a stream of pulses (implies a serial stream of pulses but parallel forms are also possible). Any signal-voice, data, television—can be converted into digital form.

Digroup: A digitally multiplexed group of 24 channels.

Direct Distance Dialing (DDD): The automatic establishing of toll calls in response to signals from the dialing device of the originating customer.

Direct Distance Dialing (DDD) Network: Strictly, the telephone network over which a customer can dial all calls to which toll charges are applicable. Because of the ubiquitousness of DDD service and the fact that exchange area calls can be dialed directly using the same facilities, the name DDD is sometimes applied to the whole traffic network that provides public telephone service.

Direct Progressive Control: Mode of operation of an automatic telephone switching system in which the dial pulses from the calling telephone directly control the switches that establish the desired connection.

Direct Trunk: A trunk between two Class 5 offices.

Directed Distribute/Scan: The specifying of the state of distribute points (or requesting state of scan points) by means of an address.

Directing Code: Digits, such as 11, 0X, and X1X, dialed ahead of the directory number of the called station. These will enable a customer or operator to dial a number in an area out of the basic numbering plan area of the customer or operator.

Directory Assistance (DA): A service available to the general public whereby anyone, by dialing the proper service code or number, will be connected to an operator at a directory assistance bureau and will be told the directory number of the customer whom he desires to call, provided that the customer's number is, or will be, published (listed) in the telephone directory. (Formerly called information service.)

Directory Assistance Bureau: A bureau where directory assistance service is rendered to customers. The operators in attendance obtain the desired telephone numbers from telephone directories or similar media. (Formerly called information bureau.)

Directory Assistance Operator: A person who handles directory assistance calls.

Directory Number (DN): The full complement of digits required to designate a customer in the directory. In a 5-, 6-, or 7-digit exchange area, the directory number consists of the office code followed by four numerals. In some areas, a station letter to control selected ringing follows the four numerals and is considered part of the number.

Dispatch: The process of sending a craftperson to an outside plant location or to a customer's premises for maintenance or trouble diagnostic purposes.

Distribute Sequencer: A sequence of directed distributes and scans used to sequentially activate each distribute point in a marker and verify by means of scans that appropriate circuit action ensues.

Distribution: Applies to a switching network (or portion of one) which has an equal number of inputs and outputs. In a traffic network, refers to separating calls on incoming trunk groups at a toll or tandem office and recombining them on other outgoing trunk groups.

Distribution Frame: A main distribution frame is a connection system which interfaces between lines and switching equipment. Other distribution frames are used to interconnect other equipments within an office.

Divided Ringing: A method of obtaining partial ringing selectivity by connecting one-half of the

ringers from one side of the line to ground and the other half from the other side of the line to ground. This term is not ordinarily applied to selective and semiselective ringing systems.

DOC: Dynamic Overload Control

DRE: Directional Reservation

EADAS: Engineering and Administrations Data Acquisition System

EBAC: Error Billing Accuracy Control Center

Echo: An attenuated signal derived from a primary signal by reflection at one or more impedance discontinuities and delayed relative to the primary signal.

Echo Suppressor: A device which detects speech signals transmitted in either direction on a 4-wire circuit and introduces loss in the direction opposite to the direction of speech transmission for the purpose of suppressing echoes. Long circuits may use one such device.

Echo, Talker: An echo of a talker's voice which is returned to the talker. When there is delay between the original signal and the echo, the effect is disturbing unless the echo is attenuated to a tolerable level.

Economy of Scale: As the need for increased capacity in switching and transmission facilities develops, either due to growth or concentration, the cost per unit of capacity may decrease due to two factors: (a) The unit cost decreases due to fixed getting started costs which are spread over an increasing number of units. (b) The unit cost decreases due to technological advantages that can be achieved when designing for large capacity.

EADAS/NM: EADAS/Network Management.

Electronic Translator: In a No. 5 and 4A switching system, the equipment that, by means of electronic circuitry and stored program control information, translates the called codes into information required by the system to select an available route to the central office of the called customer.

E&M Signaling: A specific format of interface between a switching system and a trunk where

the signaling information is transferred across the interface via 2-state voltage conditions on two leads, each with ground return, separate from the leads used for message information. The message and signaling information are combined (and separated) by a signaling system appropriate for application to the transmission facility. Used also in some special service applications.

End-to-End Signaling: A mode of network operation in which the originating central office (or station) retains control and signals directly to each successive central office (or PBX) as trunks are added to the connection. Contrasts with operation where each office takes control in turn, called link-by-link signaling.

Engineering, Communications or Telephone: An activity that applies the principles of electrical communications to the solution of practical communication problems. A common use of the term refers to operating company functions, such as the final planning and sizing of trunk groups, central office equipment, and transmission facilities, or the end-to-end transmission design of loops and trunks. In Bell Laboratories, planning and coordinating work may go by this name.

Engineering and Administration Data Acquisition System (EADAS): A computer-based system which will be the Bell System standard traffic measurement system.

Engineered Capacity: The highest load level for a trunk group or a switching system at which service objectives are met. In general, for a switching system, carried load is equal to offered load below engineered capacity, but is less than offered load above engineered capacity.

Engineering Work Order: An order for work to be done in an operating company to add, remove, or change outside plant facilities in the inventory.

Entity: A single, complete unit. Commonly used to indicate a single switching system. A central office may have one or more entities.

Equipment: A unit of hardware, typically including apparatus units as components, for which certain standard records of the equipment itself, installation, and changes are kept.

Equipment Charge: Monthly nonusage sensitive charges, based on the amount and type of installed telephone equipment or apparatus.

Erlang: A dimensionless *unit of traffic* used to express the average number of calls in process or the average number of devices in use. Traffic in erlangs is the sum of the holding times, expressed in fractions of an hour, for the number of calls handled in a one-hour period.

1 erlang = 3600 call seconds per hour

1 erlang = 36 CCS per hour

The term erlang can also be used to express the capacity of a system; for example, a trunk group of 30 trunks, which in an absolute peak sense might carry 30 erlangs of traffic, would have a real capacity of perhaps 25 erlangs averaged over an hour.

Erlang B: One of the basic traffic models and related formulas used in the Bell System. The assumptions are Poisson input, negative exponential holding time, and blocked calls cleared. Used for trunk engineering.

Erlang C: One of the basic traffic models and related formulas used in the Bell System. This is the queueing model with assumptions of Poisson input, negative exponential holding times, and blocked calls delayed. The queueing discipline may be arbitrary but is usually approximately first come, first served. Used for common control engineering.

Error: Intermittent Malfunction

Error Rate: A measure of the performance of a digital transmission system. It can be specified as a bit error rate (the probability of error per bit transmitted) or a block error rate (the probability of one or more errors in a specified-length block of bits), or in other forms such as percent error-free seconds.

ETDC: EADAS Traffic Data Converter

ETS: Electronic Translation System

ETSSP: ETS Status Panel

Exchange: A unit of a telephone company used for the administration of service in a specified area which usually encompasses a city, town, or village and its suburbs. It consists of one or more central offices together with the associated plant used in furnishing communication service in that area. Ordinarily an individual local tariff is filed for each exchange.

Exchange Area: An area within which there is a single uniform set of charges for telephone service. An exchange area may be served by a number of central offices. A call between any two points within an exchange area is a local call.

Exchange Area Facilities: Transmission facilities within an exchange area. Also commonly used to refer to relatively short transmission facilities up to a few hundred miles.

Expansion: The term applied to a switching network (or portion of one), which has more outputs than inputs.

Extended Area Service: Telephone service that allows subscribers in one exchange to call subscribers in another nearby exchange without a toll charge.

Facilities Network: A network made up of interconnectable facilities including transmission systems, switching systems, and terminal equipment. A facilities network can be a vehicle for a plurality of traffic networks.

Facility: Any one of the elements of a physical telephone plant which are needed to provide service. Thus, switching systems, cables, and microwave radio transmission systems are examples of facilities. Sometimes used in a more restricted sense to mean transmission facilities.

Facility Management: A concept of overall efficient transmission system (facility) utilization—including concepts such as the use of protection channels, temporary set-ups for television specials, etc. These uses are in addition to normal utilization for maintenance and restoration purposes.

Facility Work Order: An order to rearrange facilities on working services, or those for which service order work is in progress.

Failure Analysis: Localization of a malfunction primarily by software means.

Failure Detection: Malfunction detection primarily by software means—usually results in a failure message.

Failure Message: A message on one or more TTYs reporting a detected system malfunction, ie, a TTY message reporting a failure which may be intermittent (error) or continuous. Thus, the term error message is only used for a message reporting a condition known to be intermittent.

Fault: Continuous Malfunction

Final Group: A trunk group which acts as a final route for traffic. Traffic can overflow to a final group from high-usage groups that are busy. Traffic cannot overflow from a final group.

FIT: A unit for expressing reliability in terms of failure rate.

$$1 \text{ FIT} = 1 \text{ failure in } 10^9 \text{ operating hours}$$

Flat Rate Service (FR): A customer classification of local service in connection with which a stipulated monthly charge is made covering all message use to stations within a specified area.

Flip-Flop: A 2-state device that assumes one state or the other, depending upon the polarity of the pulse used to drive it, or upon the terminal to which the drive is applied.

FM: Failure to match or frequency modulation

Focused Overload: Abnormal calling from many points to one particular point. Examples: After an earthquake, or in response to a radio station give-away offer.

Force Administration Data System (FADS): A system which provides basic telephone traffic data from which additional derived data may be obtained to assist in arranging the most effective manning of attendant or operator positions and in calculating work force performance.

Forcing: The managerial function of providing the proper number of operators (half-hourly) to serve demand. The goal is to satisfy the service objectives while controlling expense. The functions

SECTION 19a(1)

are forecasting demand, scheduling tours to cover this demand, allocating the tours to offices in multioffice systems, assigning individual operators to specific tours, and making corrections in real time as required.

Foreign Area Translation (FAT): The translation of the office codes of a foreign area for routing purposes when there is more than one trunk route available for entry into the foreign area, or for other selective treatment.

Foreign Exchange (FX) Service: A service providing a circuit connecting a subscriber's main station or private branch exchange with a central office of an exchange other than that which regularly serves the exchange area in which the subscriber is located.

Foreign Numbering Plan Area (FNPA): Any NPA outside the boundaries of the home NPA.

Four-Wire Circuit: A circuit using two 1-way transmission paths, one for each direction of transmission. It may be two pairs (four wires) of metallic conductors or two circuits in a carrier system.

Free Code Call: A call which the terminating equipment recognizes from the code dialed as one to be handled on a free-service basis.

Frequency Shift Pulsing (FSP): A method of pulsing in which the 0 through 9 digits and the start and end signals are represented by a frequency shifted above or below a reference frequency to represent these digits in a 2-out-of-6 code.

Full Group: A trunk group which would ordinarily be a high usage group, except that instead of an alternate route enough trunks are provided to give an acceptable blocking probability. For large groups, this may be more economical than using an alternate routing strategy.

Grade of Service: (1) A measure of customer satisfaction with a particular aspect of service (such as noise or echo). It combines the distribution of subjective opinion with the distribution of performance for the particular aspect being graded. For example, with a specified distribution of noise, 95 percent of the people using a circuit may judge it to be good or better; the grade of service is

said to be 95 percent good or better. (2) The proportion of calls, usually during the busy hour, that cannot be completed due to limits in the call-handling capability of a network. See **Service Objectives**.

Ground Start: A supervisory signal given at certain coin telephones and PBXs by connecting one side of the loop to ground.

Hardware Tariffs: Tariffs filed on the basis of providing service with an explicit type of serving equipment.

Held Order: (1) A service order which is not completed within a specified period of time. (2) A service order requiring rearrangement or reinforcement of outside plant.

High-Usage Group: A trunk group which is the primary direct route between two switching systems. The group is designed for high average occupancy. To provide an overall acceptable probability of blocking, an alternate route must be provided for overflow traffic.

Home Numbering Plan Area (HNPA): The NPA within which the calling line appears at a local (Class 5) switching office.

Horizontal Group: All of the lines served by the same ten line links.

HTR: Heavy Traffic

Hub Layout: A multipoint network configuration where each leg of the network serving a particular station is routed to a common central location for appropriate bridging and test access. The central location is generally known as a serving test center (STC). More specifically, a hub is the point where telegraph channels of a multipoint circuit are connected.

IAO: Intraoffice

Inband Signaling: Signaling that uses the same path as a message and in which the signaling frequencies are in the same band used for the message.

Incoming Register: The register which receives the pulsing (dial, multifrequency, or revertive) from

the incoming trunk and transmits it to the marker through an incoming register marker connector.

Incoming Register Link: A switching arrangement for connecting incoming trunks to incoming registers.

Incoming Trunk: A trunk incoming to a local central office switching unit for use in terminating calls on the customer lines of the unit. Also, a trunk incoming to a local toll, tandem, or PBX switchboard or switching unit.

Index Plan: A method used in the Bell System to calculate an index of performance. There are a number of index plans in use each of which takes into account statistical data for a particular parameter or combination of parameters of plant performance or service. Examples are connection appraisal index plan, trunk transmission maintenance index plan, and local dial line index plan.

Individual Line Service: Refers to the provision of a nonshared access line to the central office as part of either business or residence telephone service.

Information Signals: Audible tones or recorded announcements which are used to convey call progress or call failure information to customers or operators.

Input/Output (I/O): (1) The information entering or leaving a system across a system boundary (alternatively, information entering or leaving a subsystem within the system boundary). (2) The process of transmitting information from an external source to a system or from a system to an external source.

Installation Charge: One-time charge due upon installation of customer premises equipment, used to help recover the actual expenditures.

Intercept Operator: A person who provides intercept service at an intercept position of a switchboard or at an auxiliary services position of a centralized intercept bureau.

Interface: A common boundary between two systems or pieces of equipment where they are joined together.

Interface Device: A device which meets the interface specifications on one side of an interface. The term is usually applied to a device through which a system must work to meet interface specifications.

International Direct Distance Dialing (IDDD): The automatic establishing of international calls by means of signals from the calling device of either a customer or a regular toll operator.

Intermittent Malfunction: A malfunction which is only detected on some uses of the same hardware or software. This is similar to what ESS has called an error.

Intertoll Trunk: A channel between two offices (Class 1, 2, 3, and 4 offices).

Intraoffice Trunk (IAO Trunk): A trunk between two points in the same central office or switching unit.

Intrastate Toll: Traffic within state boundaries which is charged at toll rather than local rates.

Inward Wide Area Telephone Service (INWATS): A reverse charge direct distance dialing service to a specific directory number, (see **WATS**). Bulk rates based on measured time are charged.

ITCTT: Incoming Trunk Class Translation Table

ITE: Installation Test Equipment

Job: A specific function attributed to the marker. (See **Marker Job**.)

Junctor: A circuit used to connect two stages of a switching network in a switching system. An intraoffice trunk.

Junctor Group: The junctors which extend from a particular line link frame to a trunk link frame. The size of the junctor group depends on the number of trunk link frames or pairs of trunk link frames.

Junctor Grouping Frame: A frame which functions to facilitate the distribution of the 100 junctors from each line link frame to all of the trunk link frames so that each line link frame will have equal access to all trunk link frames.

SECTION 19a(1)

KSR: Keyboard Send and Receive (TTY)

Key Pulsing Signal: A multifrequency signaling, a signal, keyed by the operator, used to prepare the distant equipment for receiving digits.

LCTT: Line Class Translation Table

LDN: Listed Directory Number

LEN: Line Equipment Number

Line: (1) A communication channel between a customer station or other terminal and a switching system. Synonymous with loop. (2) In carrier systems, the portion of a transmission system that extends between two terminal locations. The line includes the transmission media and associated line repeaters. (3) Also used to indicate the side of a piece of central office equipment that connects to or toward the outside plant; the other side of the equipment is called the drop side.

Line Link: A switching arrangement for connecting customer lines to junctors on originating calls and junctors to customer lines or trunks on terminating or through calls.

Line Link Frame (LLF): A frame containing line links with associated equipment and customer line relays.

Line Link Pulsing (LLP): Arrangement to enable PBXs which are served by a No. 5 crossbar marker group to receive direct-inward-dialed calls to the individual PBX extensions.

Line Number: See **Station Number**. In the past, a line number and a party letter were often combined to provide station identification. With party letters discontinued, the four numerics have assumed the role of station identification.

Link-by-Link Signaling: A mode of network operation in which each office along the route of a call acts autonomously, forwarding all of the information required to complete the call to the next office in the chain. Contrasts with end-to-end signaling.

LINT: Line Translation

LIS: Line Scanner

LIT: Line Insulation Test

LNTEXP: Line Translation Expansion

Load Balancing: The process of assigning customers to line equipment so as to maintain a proper distribution of traffic in a switching system.

Local Automatic Message Accounting (LAMA): Facilities located in a local central office for automatically recording billing data for message rate call (bulk billing) and for customer-dialed station-to-station toll calls.

Local Exchange Service: Public telephone service within designated local service areas, for which no toll charges are levied.

Local Switching Facilities: Switching systems that perform central office functions; switching systems to which loops are connected (Class 5 switching systems).

Loop: (1) A channel connecting a subscriber's terminal equipment to a central office. A loop is usually a pair of wires and associated circuit elements. Also called a line. (2) Loop is also used to mean a 2-wire ungrounded connection between pieces of equipment (as distinguished from a one-wire and ground connection).

LSTAT: Logical Status Table

LVT: Line Verification Test

MASC: Main Store Controller

MASM: Main Store Memory Unit

MASMO: Main Store Module

Main Distribution Frame (MDF): A distribution frame used to interconnect loop cable pairs and line equipment terminals on a switching system.

Make-Busy (Busy-Out): Conditioning a circuit, a terminal, or a termination to be unavailable for service. When unavailable, it is generally necessary that it appear busy to circuits that seek to connect to it.

Malfunction: Anything wrong in the system.

Malfunction Analysis: The process of localizing a malfunction.

Malfunction Detection: The process of finding that a malfunction exists.

Malfunction Report: Either a trouble record or a failure message.

Marker: Equipment which establishes communication paths between calling customers and trunks, between trunks and called customers, and between trunks.

Marker, Completing: A marker which performs all marker operations except the dial tone job.

Marker, Dial Tone: A marker which performs marker dial tone job only.

Marker Group: A common group of markers which serve one or more central offices. A marker group is arranged to handle a maximum of six office code groups spread over six number series with a maximum of 40,000 numbers. The term marker group is also used to refer to the equipment served by a marker group.

Marker Job: The single marker usage (from seizure to release) involved in completing any one of its designated functions. Marker jobs are indicated accordingly as follows:

- (a) Dial tone job
- (b) Intraoffice trunk job
- (c) Outgoing trunk job
- (d) Incoming trunk job
- (e) Reverting trunk job
- (f) Toll trunk job
- (g) Tandem trunk job.

Master Test Frame (MTF): A unit of equipment which provides for the testing of the equipment units of a marker group.

Master Test Frame Connector (MTC): A connector by which markers and other equipment obtain access to the master test frame.

MCH: Maintenance Channel

MDC: Marker Distributive Control

Measured (or Message Rate) Service (MR): Telephone service for which a charge is made in accordance with a measured amount of usage, referred to as message units.

Message: A successful call attempt which is answered by the called party and which (for a toll call) may be billed to the calling party.

Message Rate Service: A customer classification of local service which is measured in terms of messages or message units for the purpose of charging for the service.

Message Register: A counting device which records message units on originating traffic for calls to points within the one message unit charge area.

Message Telecommunication Service (MTS): Services that use in whole or in part the public telephone network. Examples include mobile radio-telephone service, interstate toll, air-to-ground service, etc. Private line services are not included.

Message Unit: The unit of measurement for charging for message use by the translation into equivalent message units of ticket or AMA charges for calls within a specified area.

Modular Telephone: A concept in station set design where the handset and line cord connect into their mating parts by plug and jack rather than permanent wiring. The plug-in design was in part motivated to cut down maintenance costs.

MUD: Message Unit Detailed

Multifrequency Signaling (MF): An inband interoffice address signaling method in which ten decimal digits and five auxiliary signals are each represented by selecting two frequencies out of the following group: 700, 900, 1100, 1300, 1500, and 1700 Hz.

Multiparty Service: Service where more than one station set is served by the same station line or loop.

SECTION 19a(1)

Multiple: Terminals or jacks grouped in a manner which makes a circuit available at a number of points, eg, a switchboard multiple.

Network: (1) An arrangement of transmission facilities (and, in certain cases, switching facilities) to provide one or more multipoint communications services, such as a multipoint, private-line data service or public telephone service. This is known as a facilities network. (2) An arrangement of channels, such as loops and trunks, and associated switching arrangements designed to handle a specific type of traffic. This is known as a Traffic Network. The public telephone network, private data networks, and television program distribution networks are examples of traffic networks. (3) An electrical/electronic circuit, usually packaged as a single piece of apparatus or on a printed circuit pack. Examples are a transformer network and an equalization network. (4) The switching elements and associated connecting wiring of a switching system are collectively called the switching network.

Network Access Pricing (NAP): A tariffing concept whereby the rate for a service would be influenced by the cost of network elements (eg, stations, loops, etc,) used to provide that service. Contrasts with tariffing concept based on value of service.

Network Management: A set of procedures, equipment, and operations designed to keep the network operating near maximum efficiency when unusual loads or equipment failures would otherwise force the network into a congested inefficient state.

Noise: Unwanted disturbances superimposed upon a useful signal that tend to obscure its information content.

Nondial Trunks: PBX tie trunks that require attendant assistance for verbal transmission of address information.

Nondiscriminating Number: A number associated with two office codes. Such a number is reached regardless of which of the two codes is dialed.

No-Test Call: A call from an operator or a test desk which will connect to the dialed customer line regardless of whether or not it is busy. If the line is idle, the connection is established through a regular channel, and if the line is busy, the

connection is established through the no-test connector and a no-test vertical on the line link frame.

No-Test File: The ten vertical units which are used for no-test operation and are located one above another on a line switch bay of the basic line link frame.

No-Test Vertical: Vertical file 0 in vertical group 02 of each line link frame contains ten no-test verticals. These no-test verticals are used when a connection is established between a busy line and a no-test trunk through the no-test connector. No-test verticals 0 through 4 are multipled, and also no-test verticals 5 through 9, so that only two no-test calls may be simultaneously established through the no-test connector between no-test trunks and busy lines of one line link frame.

Number Group: An arrangement for associating equipment numbers with main-station codes. Also called translator.

Number Group (NG) Frame: A frame containing 1000 consecutive numbers that can be associated with one, two, or three office code groups.

Number Series: Ten thousand or less nonconflicting numbers between 0000 and 9999. They may be associated with one, two, or three office code groups.

Number Series Group: Thirty thousand or less numbers that are associated with three or less office code groups. There is a maximum of two number series groups, designated group A and group B, each consisting of a maximum of three number series with a maximum of three office code groups. Number series groups A and B have the same significance as offices A and B (in past terminology) when each number series group consists of a single number series.

Number Service: Service to provide (to people) information necessary for call completion; includes information provided by directory assistance, intercept, and rate and route bureaus.

Number Service Operator: A person who provides any of several services relating to telephone numbers, such as directory assistance both for customers and toll service operators, and intercept of calls to unassigned or changed numbers.

Numbering Plan Area (NPA): A geographical division within which telephone directory numbers are subgrouped. In North America, a 3-digit, N0/1X code is assigned to each NPA, where

N = any digit 2 through 9

0/1 = 0 or 1

X = any digit 0 through 9

Off-Hook: Station loop closed or whatever supervisory condition is indicative of the in-use or request for service state.

Office A—Office B: The terms which refer to each of the two number series groups in a marker group.

Office Code Group: One or more local office codes associated with 10,000 or less directory numbers, given the same rate or number treatment (office code or codes grouped together to operate the same local completion relay in the marker).

Offered Load in Erlangs: The average number of calls that would have been in progress if there had been no delay or blocking.

One-Way Trunk: A trunk where call origination can occur at only one end.

On-Hook: Station loop open or whatever supervisory condition is indicative of the equipment idle state.

Operating Force: Those employees primarily engaged in service relating to telephone operators and their associated clerical and supervisory personnel. This includes personnel in operator training but does not include personnel engaged in the observation of the handling of operator traffic or personnel at attended pay stations.

Operating Company: A regulated telephone company whose primary business is providing telephone service to customers. There are 24 operating companies in the Bell System and about 1800 non-Bell operating companies in the United States. These together provide service to the entire country.

Operator Person-to-Person: The service where the person originating the call specifies to the operator a particular person to be reached or

a particular station, department, or office to be reached through a PBX attendant.

Operator Services: A variety of services normally performed by operators. These include completing or helping customers complete toll calls and assistance calls, preparing billing inputs on those calls, providing directory assistance, intercepting and helping customers with calls to changed or nonworking numbers, providing special services such as person-to-person, coin, credit card, collect, PICTUREPHONE®, mobile, and conference calls, and giving on-the-job consultation to business customers.

ONI: Operator Number Identification

Operator Station-to-Station: A call placed by an operator without specifying the party answering the called telephone. Operator station-to-station includes station-to-station service originating at a public or semipublic coin telephone.

Operator Trunk: A type of toll connecting trunk which provides access from Class 5 offices to toll assistance operators.

OPT: Office Parameter Table

Origination Delay: The time between customer service request (transition from idle state to off-hook) and seizure of the central office equipment.

Originating Register: A register connected to a customer line via line and trunk links for giving dial tone and for recording the customer-dialed or keyed pulses.

Originating Stage: That portion of the switching process involved in extending the connection from the selected intraoffice trunk to the originating line. The originating stage is a subdivision of the marker intraoffice trunk job.

Outgoing Trunk: A trunk used for calls terminated outside a switching unit.

Outward Toll Position: An outward toll position is arranged to complete, time, and ticket toll calls received from customers. These positions may also handle DSA traffic.

Outside Plant: Any part of the telephone system which is located physically outside of telephone

SECTION 19a(1)

company buildings. Includes cables, supporting structures, and certain equipment items such as load coils. Microwave towers and antennas are not usually considered outside plant.

Overflow: A count of all calls offered to a trunk group which are not carried (see **Peg Count**). Usually measured for an hour.

Overflow Tone: A tone returned to the calling customer to indicate the call could not be completed because the marker was unable to find an idle channel, outgoing sender, or trunk to use in the connection. Overflow tone is usually interrupted 120 times per minute.

Parity Bit: A bit attached to a word to make the total ones, including the parity bit, odd (or even). Used to detect single bit errors.

Parity Check: A check on the validity of a binary word by determining whether the number of ones in the word is odd (or even).

Partial Dial or Partial Digits: A failure of the originating register to receive sufficient digits to complete the call. It may result from a customer dialing before dial tone or failing to dial or key sufficient digits after receiving dial tone.

Party Line Service: Refers to the provision of a shared access line to the central office as part of either business or residence telephone service. Two, four, eight, or more customers may share a party line.

PBX Attendant: A person situated at a position of a switchboard, desk, or console on a customer's premises who handles switching and signaling operations needed to establish telephone connections between stations or who performs various auxiliary functions associated therewith. Not an employee of the telephone company.

PBX Tie Trunks: A trunk which connects two PBXs.

PBX Trunks: A trunk which connects a PBX and a central office. Sometimes called PBX line, but this can be confused with a station line on a PBX.

PCDAI: Program Controlled Data Acquisition Interface

PCTV: Program Control Transverter

PDI: Power and Data Interface

Peak Load: A measure of traffic which is higher than average and is defined in terms of its frequency of occurrence. Note that significantly higher peak loads do occur infrequently as a result of catastrophes, also on Mother's Day and Christmas.

Peg Count: A count of all calls offered to a trunk group, usually measured for an hour.

Per-Trunk Signaling: A method of signaling in which the signals pertaining to a particular call are transmitted over the same trunk which carries the call. Interoffice signaling other than CCIS falls into this category.

Permanent Signal: A sustained off-hook supervisory signal, originating outside a switching system and not related to a call in progress. Permanent signals can occupy a substantial part of the capacity of a switching system.

Personnel Subsystem: The people and their supporting methods and procedures, training aids, etc, working in conjunction with a hardware (and software) configuration to achieve system objectives.

PhoneCenter: A store where a customer may select telephones to be brought home and plugged into prewired connectors.

Physical Number: An arbitrary designation for the numbers associated with only one of three office codes using the same number series. The numbers associated with the other office code only are designated as theoretical or exteoo numbers.

Physical-Theoretical Discriminating Feature: The feature which indicates to the marker whether the physical or the theoretical office is wanted and whether the number is a physical or a theoretical number.

Polar Binary: A form of bipolar signal in which positive and negative amplitudes represent the two binary states.

Positions: Units of manual work (usually multitask) that must be assigned and performed as a whole; ie, that will not be fragmented among several

workers. A common example is a switchboard position.

Post-Dialing Delay: The elapsed time from the end of dialing to the start of ringing at the called end.

Postpay: Coin telephone service where coins are deposited after the called party answers. The simplest form of coin service, this always requires attention from the operator and lacks features such as coin return.

Prefix: Any dialed signal input prior to the address. Prefixes are used to place an address in proper context, to indicate service options, or both. Examples: prefix 1, to indicate a toll call; prefix 0, to call in the services of an operator.

Prepay: Coin telephone service where an initial rate deposit is required before the connection is made on chargeable calls. Being replaced by dial tone first, an improved service requiring additional functions in the station and in the switching system.

Pretranslation: This operation takes place after a fixed number of digits (usually the office code) has been recorded to determine how many additional digits, if any, are required for the complete translation of the directory number. This feature is designed to reduce time delay in transmitting the call from the register to the marker where the total number of digits which can be dialed or keyed is variable.

Primary Center: A Class 3 switching office in the hierarchy of toll offices.

Principal City: The principal city for an NPA is the toll office farthest down the routing ladder to which *all* codes for that area *can* be routed by destination type codes. It need not be physically located within the NPA served.

Private Branch Exchange (PBX): A private switching system, either manual or dial, usually serving an organization such as a business company or a government agency and usually located on the customer's premises. Telephones served by the PBX are called stations. Calls from one station to another may be handled manually or automatically depending on the type of PBX. Calls between stations and an external network, for example, the public telephone network, are normally handled

manually by the PBX attendant. Centrex service can be provided by a PBX; it includes direct inward dialing and automatic identified outward dialing. Tie trunks between PBX systems of a single customer are commonly used.

Private Line: (1) A circuit leased by a customer for his exclusive use. PBX tie trunks and FX lines are private lines. (2) A channel connecting two or more terminal equipments only to each other, and working independently of any central office switched interconnections; it may be used for voice, data, television, etc.

Private Line Service: A service in which the customer leases a circuit for his exclusive use. The private line may be used for transmission of voice, teletypewriter, data, television, etc.

Private Voiceband Network: A network made up of voiceband circuits, and sometimes switching arrangements, for the exclusive use of one customer. These networks can be nationwide in scope and typically serve large corporations or government agencies.

Protection Channel: The broadband channel of a carrier system which is utilized as a spare, and which can be switched into service in the event of failure of a normal working channel.

Protection Span: A section of a carrier transmission system, embodying either terminal equipment or a number of repeatered line sections, within which standby equipment can be substituted for the regular equipment to provide service continuity in the event of failure of the working channel.

Protector Frame: A frame, separate from the main distribution frame, which serves as termination for loop cables and contains electrical protection devices.

PSTAT: Physical Status Table

Public Coin Telephone Service: Coin telephone service provided where a public need exists, such as at an airport lobby, at the option of the telephone company with the agreement of the owner of the premises or space. There is no directory listing.

Public Telephone Network (PTN): The network that provides public telephone service.

SECTION 19a(1)

Public Telephone Service (PTS): Ordinary telephone service in which a customer has a connection to a central office and can be connected to any other customer to the service. Sometimes called plain old telephone service (POTS).

Pulse Conversion: The operation of changing, when necessary, the type of pulsing between connecting offices in order to meet their particular transmission requirements.

Pulsing: The act of transmitting digit information over a circuit to a switching unit for the purpose of reaching a called customer or operator. The various kinds of pulsing used in the No. 5 ETS office with interconnecting offices include the following:

- (a) Dial (DP)
- (b) Multifrequency (MF)
- (c) Panel call indicator (PCI)
- (d) Revertive (RP)
- (e) Frequency shift pulsing (FSP).

Range Failure: After or during conversion the data is found to conform to its standard format but to be out of the range of acceptable values.

Rate Center: A geographically specified point used for determining mileage-dependent rates. The rate center of an exchange is generally a point centrally located within the exchange area.

Rate or Number Discrimination: Discrimination is a means of differentiating, where necessary, between numbers in different code groups but within the same number series group. Numbers in two different number series groups are differentiated by a number series group A or B indication. Where required, rate discrimination is provided for giving separate rate treatment to the three or less office code groups within a number series group. Where rate discrimination is not provided, it may be necessary to provide number discrimination to identify the particular number series so that a connection to the correct number group can be made. For example, if no rate discrimination is necessary for two office code groups that are associated with different number series, number discrimination must be provided.

Rate and Route Operator: An operator who provides information to the toll operator, such as special operator routing codes, rate information, and lists of numbers which are coin lines.

RC: Recent Change

Ready-Access Terminal: A class of unsealed terminals that are used to make connections of customer drop wires to wire paths in a distribution cable.

Recycle: The action which releases the initially selected trunk, and permits an attempt to establish the connection to another trunk of the same route but using a different group of junctors and trunk links.

Regional Center: A Class 1 switching office in the hierarchy of toll offices; the highest level toll office.

Register: A part of an automatic switching system that receives and stores signals from a calling device or other source for interpretation and action.

Remote Switching Unit: A small, usually unattended, switching system.

RMR: Remote Message Register

Reorder Tone: A low-frequency tone interrupted 120 times per minute that indicates all switching paths are busy, all toll trunks are busy, equipment blockages, unassigned code dialed, or incomplete registration of digits.

Residence Service: Telecommunications service used for predominately social (as opposed to business communications).

Reverting Call: A customer-dialed call between two customers served by the same customer line.

Revertive Pulsing: Pulsing over a trunk in the reverse direction. The office being signaled sends pulses to the originating office, which counts the pulses and signals when the correct numbers have been received. Not used in present-day designs.

Ring Conductor: One conductor of the subscriber loop (tip and ring). Use of the names tip and ring has extended throughout the plant.

Ringdown: A technique for supervision alerting on a nondial trunk by the application of a ringing signal at the originating PBX.

Ringer: A device installed in a station set which responds to a 20-Hz signal to produce an audible ringing sound.

Ringling: The process of alerting a station through the application of a 20-Hz ringing signal to the station line; this produces an audible ringing sound at the station. There has been extensive experimentation with use of a low-power tone instead of 20 Hz to activate a special ringer.

ROTL: Remote Office Test Line

SCC: Switching Control Center

Sectional Center: A Class 2 switching office in the hierarchy of toll offices. See **Toll Office**.

Seize, Seizure: The action of a switching system in selecting and reserving an outgoing trunk or other component for a particular call which is being set up.

Selective Ringing: A means of ringing only the desired party on a multiparty line.

Semipublic Coin Telephone Service: Coin telephone service provided where there is a combination of general public and specific customer need for the service, such as at a gasoline station. A directory listing is provided with this service.

Semiselective Ringing: A means of providing a coded ringing, eg, one short or one long, to alert the proper party on a multiparty line.

Sender: A device in a common-control type of office used to transmit and/or receive the called number to or from a distant office; usually arranged for transmitting on a multifrequency or dial-pulse basis.

Sender Attachment Delay: A source and a measure of delays between switching systems. Since this is the mechanism by which congestion

spreads in an overloaded network, it is of importance to network management.

Sender Link: A switching arrangement for connecting outgoing senders and trunks.

Series Packages: A type of service tariff for PBXs. Series packages provide for defined groups of service features which must be provided to customers as groups and are not offered individually. The packaging makes choice and administration simple, but could force subscribers to purchase service features they do not desire.

Service Attitude Measurement (SAM): A program in which attitudes of telephone customers toward various services are solicited. A questionnaire relating to a specific type of service is mailed to a selected sample of customers. Similar to TELSAM, in which the sample of customers is contacted by telephone rather than mail.

Service Circuit: An auxiliary circuit connected through the switching network to lines or trunks as required. It performs a specialized function such as dial pulse detection.

Service Code: A code typically of the N11 series, such as 411 (directory assistance) and 911 (emergency) which defines a connection for a service rather than a connection to a customer.

Service Objectives: Statements of the quality of service which are to be provided to the customer; for example, no more than 1.5 percent of customers should have to wait more than 3 seconds for dial tone during the average busy hour, and the busy hour blocking should not exceed one percent.

Service Observing: A direct measurement of service provided to the customer, obtained by sampling actual calls.

Service Order: (1) An order prepared in the commercial department of an operating company at the request of a customer to establish a service, to change an existing service, or to terminate a service. (2) The document which results from a customer contact with the operating company for the purpose of initiating, removing, or changing service. This document will contain all the information required to meet the customer needs.

SECTION 19a(1)

Service Representative: The individual in the business office who typically deals with the customer.

Service Tariffs: Tariffs filed on the basis of providing service independent of the actual type of serving vehicle used to provide the service. For example, local exchange rates are not based on the type of switching system used.

Serving Area: A geographic region including all customers served by a given wire center.

Serving Test Center (STC): A major office which serves as a testing point for multipoint special-service circuits, which are routed through the STC for this purpose. The circuits are usually configured in a hub arrangement, with individual circuit legs of a multipoint circuit emanating from the STC.

Signaling: The transmission of address, status, or other switching information between stations and switching systems and between switching systems, including any information required for billing.

Six-Digit Translation: The specific operation of converting six digits, most commonly comprising a 3-digit numbering plan area code followed by a 3-digit central office code, into routing control signals for the switching of calls.

Skewed Overloads: Abnormal loads which greatly exceed average business day demands and are usually distributed quite differently geographically; for example, snowstorm calling between city and suburbs.

Special Operator Service Traffic (SOST): Special traffic handled by operators primarily because of their unique accessibility by all customers at all times; examples include providing emergency manual service, opening doors, discharging plant alarms.

Special Service: Any of a variety of private line services or special rate services that make use of private lines. Examples are PBX tie lines, PBX trunks, WATS, foreign exchange service, and private line services, such as data and teletypewriter.

Speed of Answer Index: One of the service indexes for operator services, the speed of answer index gives an indication of the delay an arriving

call will experience before being served by an operator. This is the expected delay under the Erlang C model.

SPI: Serial Peripheral Interface

SSCH: Serial Subchannel

SSTP: ETS System Status Panel

Start (ST) Signal: In multifrequency and keypulsing, a signal used to indicate that all digits have been transmitted.

Station Number: The final four digits of a standard 7- or 10-digit address. These digits define a connection to a specific customer's telephone(s) within the larger context of an NPA and central office code. The term "main station code" is an equivalent expression.

Subscriber Sender: A device in a common-control switching system which receives address information from a customer in the form of dial pulses. Same function as register.

Supervision: The function of monitoring and controlling by means of supervisory signals. See **Supervisory Signals**.

Supervisory Signals: Signals used to indicate or control the states of circuits involved in a particular connection; for example, signals to initiate a request for service, hold or release an established connection, recall an operator on an established connection, alert a customer, initiate custom calling, etc. In general, call processing signals which cannot be classified as information signals or address signals would fall in the supervisory category.

Switching: (1) Designates a field of work such as system development, planning, or engineering involving the application of switching technology in telephone networks. (2) Refers to the process of connecting together appropriate lines and trunks to form a desired communication path between two telephone sets. Included are all kinds of related functions, such as sending and receiving signals, monitoring the status of circuits, translating addresses to routing instructions, alternate routing, testing circuits for busy condition, and detecting and recording troubles. (3) In a more restricted sense, switching is the technology of making and breaking electrical contacts. Sometimes used to

describe any circuit that operates discretely, particularly logic and memory.

Switching Equipment Irregularities:

Malfunctions in switching equipment and associated signaling that result in wrong numbers or absence of appropriate call progress indications to the call originator. Sometimes loosely called equipment irregularities.

Switching System: Electromechanical or electronic system for switching. One or more switching systems are located in a central office. A single switching system may handle several central office codes. The term includes PBX switching systems and toll switching systems.

Switching Network: Switching stages and their interconnections within a switching system.

Synchronous Data Transmission: Data transmission where the nominal signal element spacing is fixed. This is called synchronous transmission, since the receiver must be in synchronism with the time pattern of the incoming symbols. Contrasts with asynchronous data transmission.

System Code: A 3-digit code of the form 0/1XX available to operators or automatically associated with certain toll calls to modify routing or call handling logic. Customers are prevented from using system codes by constraints in the format of signals accepted by switching systems.

TABDIR: ETS Table Directory

Tandem Central Office or Tandem Office:

A central office used primarily as an intermediate switching point for traffic between other central offices. Unless qualified by a prefix or other explanation, this term is restricted by usage to an office used primarily for the interconnection of local central offices.

Tariff: The published rates, regulations, and descriptions governing the provision of communications services.

Task Oriented Plant Practice (TOPP): A Bell System Practice (BSP) concept where the complete step-by-step procedures necessary to perform a complete task are available in one unified (and often flow-charted) document.

TB: Trunk Block

TBS: Tens Block Screening

TDC: Tape Data Controller

Technical Reference: Publication that gives additional description and technical details to supplement a tariff. One use is to provide interface guidelines for non-Western Electric manufactured telephone equipment.

Telephone Answering Service (TAS): A service provided by firms who specialize in answering, at central locations called bureaus, the telephones of their clients. The Bell System provides telephone answering systems to these bureaus.

Telephone Service Attitude Measurement (TELSAM): A program in which attitudes of telephone customers relating to various services are solicited. A selected sample of customers are called by telephone and asked to reply to a questionnaire. There are questionnaires for installation services, repair services, business office services, operator services, and dial calling services. Similar to SAM, in which the questionnaires are mailed to customers.

Telephone Set: The terminal equipment on the customer's premises for voice telephone service. Includes handset, switchhook, dial, ringer, and associated circuits.

Teletraffic Theory: A mathematical description of message flow in a communications network; a part of congestion theory.

Teletypewriter (TTY): An electromechanical typewriter device which generates from a keyboard a coded signal corresponding to the typed character. This electrical signal may be passed over appropriate transmission facilities and used to control a similar teletypewriter at a distance.

Teletypewriter Exchange Service (TWX): A service in which a subscriber's teletypewriter is connected to a TWX switching system and can be connected to any other subscriber to the same service. This service was formerly offered by the Bell System, but was sold to the Western Union Telegraph Company in 1971.

Terminal: (1) Equipment at the end of a communication circuit. User terminals include

SECTION 19a(1)

telephone sets, data sets, teletypewriters, key systems, PBXs, etc. (2) Carrier terminals are the multiplex equipments used to combine and/or separate a number of individual channels at the ends of a transmission system.

Termination Charge: Charge due if and when certain types of telephone service (eg, large PBX service) are prematurely discontinued. The termination charge is typically a decreasing function of time that reduces to zero in 2 to 4 years.

Termination Delay: Time between calling party going on-hook and release of the central office equipment.

Terminations: The points on a switching network at which trunks or lines may be attached.

Tie Line: A private line connecting two private branch exchanges or equivalent switching systems.

Time Sharing: The use of a facility for more than one purpose or function within the same overall time period. This is accomplished by interspersing or interleaving the required actions in time.

Tip Conductor: One conductor of the subscriber loop (tip and ring).

Tip and Ring Conductors: The two conductors associated with a 2-wire cable pair. The terms tip and ring derive their names from the physical characteristics of an operator's cordboard plug, in which these two conductors terminated in the days of manual switchboards. Use of the names tip and ring has extended throughout the plant.

Tip, Ring, Ground: The conductive paths between a central office and a station. The tip and ring leads constitute the metallic pair of wires which carry a balanced speech or data signal. The ground path is used occasionally for signaling.

TKS: ETS Trunk Scanner

TLF: Trunk Link Frame

TLM: Trouble Locating Manual

Toll: A term describing a type of telephone service, or components of the telephone plant, which are used principally for providing toll service.

Tone Trunk: A trunk which supplies tone to the calling customer. The marker attempts to route a customer to a tone trunk for conditions of overflow, partial dial, vacant code, or line busy on an intraoffice call.

TOUCH-TONE®: The Bell System's designation for a station set address signaling technique which encodes digits as multifrequency tone pairs. The frequencies are chosen to make unlikely the simulation of any pair by a human voice.

TOUCH-TONE® Dial: A pushbutton pad and associated oscillator circuitry which is used to transmit address (or end-to-end data) signals from customer stations by means of inband tones. Each decimal digit, plus a maximum of six additional signals, is uniquely represented by selecting one frequency from each of two mutually exclusive groups of four. The dial is ordinarily powered from the central office.

Traffic Network: A network that carries a particular type of traffic (voice, data, picture, etc.) between a number (possibly a large number) of terminal sets that can be interconnected. It consists of terminal sets, transmission channels, and switching systems that provide the capability for interconnection.

Traffic Service Position: A two-position, cordless, console-type structural unit which is associated with either a crossbar tandem office or a traffic service position system, equipped so that operators can provide assistance if needed on station-to-station calls, special toll calls, coin distance dialing calls, and all local and toll dialing assistance traffic. The operators provide assistance to aid in completing these calls and to ensure recording correct data in the centralized automatic message accounting equipment or in the traffic service position system equipment. The operators also supervise coin deposits for calls originating at coin stations. The position is arranged for automatic display of both the calling and called numbers, as well as certain other information.

Traffic Service Position System (TSPS): That type of traffic system that provides for the processing and recording of special toll calls, coin station toll calls, and other types of calls requiring operator assistance. The system employs stored program control. It includes traffic service positions arranged in groups called traffic offices where operators are automatically connected in on calls

to perform the functions necessary to process and record the calls correctly.

Traffic Usage Recorder (TUR): A device which scans trunks every 100 seconds and counts the number busy. At the end of an hour, the TUR provides an approximate measure of usage directly in CCS (approximate due to the scan interval).

Translator: A device that converts information from one form to another. In crossbar switching systems, a translator converts address digits to an identification of the appropriate trunk group to use. The term decoder is associated with devices that perform a similar function in panel switching systems.

Translation: The operation of converting information from one form to a different form.

Transmission: (1) Designates a field of work such as equipment development, system design, planning, or engineering, where electrical communication technology is used to carry information over a distance. (2) Refers to the process of sending information from one point to another. (3) Used with a modifier to describe the quality of a telephone connection: good, fair, or poor transmission. (4) Refers to the transfer characteristic of a channel or network in general, or, more specifically, the amplitude transfer characteristic. One sometimes hears the phrase "transmission as a function of frequency."

Transmission Facility: An element of physical telephone plant that performs the function of transmission; for example, a multipair cable, a coaxial cable system, and a microwave radio system.

Traveling Class Mark: A unique "label" which accompanies a call as it is routed through the network; eg, an indication that the call originated from a coin telephone. Traveling class marks are not presently used, but will be possible with CCIS. It will then become possible to use the same transmission facility in several different traffic networks, each identified by a traveling class mark.

Trouble Analysis: Localization of a malfunction primarily by hardware means.

Trouble Card: A card perforated at the trouble recorder reporting a detected system malfunction.

Trouble Data Report: A TTY message issued by ETS on a call ETS considers good but on which a trouble card is perforated. The message contains ETS data to supplement the trouble card information.

Trouble Detection: Malfunction detection primarily by use of hardware circuits - usually results in a trouble record.

Trunk: A communication channel between two switching systems. The term "switching system" includes central office types, toll switching systems, PBXs, key telephone systems, manual and automatic switchboards, concentrators, etc.

Trunk Circuit: A circuit, part of a switching system, associated with the connection of a trunk to the switching system. It serves to convert between the signal formats used internally in the switching system and those used in the transmission circuit, and it performs the logic and sometimes memory functions associated with supervision.

Trunk Group: A group of several trunks interconnecting two switching systems. The trunks in a trunk group can be used interchangeably.

Trunk Link: A switching arrangement for connecting originating registers and trunks to junctors.

Trunk Order: The traffic department request to engineering and/or plant that results in change to a trunk group.

Trunks Integrated Record Keeping Systems (TIRKS): Part of the overall Business Information System being developed at Bell Laboratories. A computer is used to maintain the inventory and assignment of the facilities and equipment used to establish trunks of all kinds.

TS: Trunk Sleeve

TSPS: Traffic Service Position System

TTYC: Teletypewriter Controller

Two-Tier Tariffs: A tariff structure providing for a decrease in monthly equipment charges after a contracted period. The initial and decreased monthly charges are functions of capital costs and administration and maintenance charges incurred for the customer.

SECTION 19a(1)

Two-Way Trunk: A trunk where call origination can occur at either end.

Call Back Operator: An outward toll operator or team of operators who performs three specialized jobs.

- (a) Initiating subsequent attempts on toll calls which are delays for the following reasons:
- (1) The called party does not answer.
 - (2) The called line is busy.
 - (3) An all-circuits-busy condition was encountered on the initial attempts by the CLR operator.
 - (4) The specific person was not available on a person-to-person call.

Unassigned Number: A number within the assigned capacity for a particular office, but unassigned to a customer.

Unigauged Design: A design method for customer loops which provides for the exclusive use of 26-gauge cable on all loops within 30 kilofeet of the central office. Requires range extension developed specifically for the unigauged system.

Usage: A measure of trunk or equipment occupancy. One trunk busy for an hour would carry one erlang of traffic. In the Bell System, usage is measured in CCS (hundred call seconds) where 36 CCS per hour = 1 erlang.

USP: Usage Sensitive Pricing

Vacant Code: A digit or a combination of digits that is unassigned. Upon recognition, a call placed with a vacant code is normally directed to a vacant code announcement.

Vertical File: The ten vertical units of a crossbar switch, located one above another on a line link frame.

Vertical Group: The five vertical files making up the left or right half of a column of lines.

Note: One of the vertical groups of each line link frame contains the no-test file. Consequently, this vertical group has only 40 instead of 50 lines.

Vertical Services: Service over and above what is required for basic communications capability; eg, deluxe telephone station sets or custom calling services.

Wide Area Telecommunications Service (WATS): WATS permits customers to make (OUTWATS), or receive (INWATS), long distance voice or DATA-PHONE® calls, and have them billed on a bulk rather than individual call basis. The service is provided within selected service areas, or bands, by means of special private access lines connected to the public telephone network via WATS-equipped central offices. A single access line permits inward or outward service, but not both. For interstate WATS, a customer may elect either full business day service (WATS 240) providing for up to 240 hours of service a month, or measured time service (WATS 10) providing for up to 10 hours of service a month. In either case, additional usage is charged by the hour.

Wire Center: The location of one or more local switching systems. A point at which customer loops converge. Also called a central office.

Word: A set of characters associated to express information. (The term "word" may be prefixed by an adjective describing the nature of the characters, such as binary words.)

8. REFERENCES

The following is a list of Bell System Practices which contain additional information pertaining to this section.

Section	Coverage or Title
958-313-100	ETS, General Descriptive Information, No. 5 Crossbar
958-313-101	3A Central Control - Theory & Functional Description
958-313-102	Main Store - Theory & Functional Description
958-313-103	TTY & TTY Controller - Theory & Functional Description
958-313-104	System Status Panel & Controller - Theory & Functional Description

958-314-105	Tape Data Facility - Theory & Functional Description	218-799-312	AIOD Tests
218-799-000	Alphabetical Index	218-799-313	CAMA Tests
218-799-101	5 ETS Trouble Locating Manual - Description & Usage	218-799-314	Miscellaneous Tests (under operating system)
218-798-102	Call Record, Trunk Register, and Maintenance Printout Formats	218-799-315	Diagnostics
218-799-103	Cutover Procedures	218-799-316	Audits (Manual & Automatic)
218-799-104	Acceptance Procedures	218-799-317	Cartridge Tapes, Generating, Storage, etc.
218-799-201	Input/Output Descriptive, Subsystem Documents	218-799-318	Line Link Pulsing Tests
218-799-202	Recent Changes, Verification Descriptive, Subsystem Documents	218-799-501	Completing Marker Tests (Software)
218-799-203	Maintenance, Descriptive, Subsystem Documents	218-799-502	Program Controlled Transverter Tests, ANI (TVT)
218-799-204	Diagnostics, Descriptive, Subsystem Documents	218-799-503	ANI Sender Tests Using PCTV - (AMRST)
218-799-205	Call Processing, Descriptive, Subsystem Documents	218-799-504	ANI Sender Tests Using PCTV - (Sender Test Set)
218-799-301	Processor Control, Loading, Recovery	218-799-505	Program Controlled Transverter Tests, CAMA (TVT)
218-799-302	System Operations, Miscellaneous Procedures (traps, etc)	218-799-506	CAMA Sender Tests Using PCTV (AMRST)
218-799-303	Input Manual - Description & Usage	218-799-507	CAMA Sender Tests Using PCTV (Sender Test Set)
218-799-304	Output Manual - Description & Usage	218-799-508	Interfaces not Covered by Diagnostics
218-799-305 through 218-799-311	Recent Changes, Verification Tests, Reallocation Procedures, as required	218-120-502	Dial Tone Marker Tests (5 ETS)
		218-122-503	Completing Marker Tests (5 ETS)

TABLE A
TYPES OF PULSING

PULSING FROM NO. 5 ETS OFFICE	INTERCONNECTING OFFICE	PULSING TO NO. 5 ETS OFFICE
Multifrequency (MF) Dial (DP) Revertive (RP) Frequency Shift (FSP)	No. 5 Crossbar or No. 5 ETS	Multifrequency (MF) Dial (DP) Revertive (RP) Frequency Shift (FSP)
Multifrequency (MF) Revertive (RP) Dial (DP)	No. 1 Crossbar	Multifrequency (MF) Revertive (RP) (Predominant)
Revertive (RP)	Panel	Multifrequency (MF) Revertive (RP) (Predominant)
Dial (DP)	Step-by-Step	Dial (DP)
Panel Call Indicator (PCI) Straightforward (Nonpulsing) Step-by-Step Call Indicator (DP)	Manual	Multifrequency (MF) Dial (DP) Straightforward (via DSB Switchboard)
Panel Call Indicator (PCI)	Panel Sender Tandem	Revertive (RP) Dial (DP)
Multifrequency (MF) Dial (DP) Revertive (RP)	Crossbar Tandem	Multifrequency (MF) Dial (DP) Revertive (RP)
Multifrequency (MF) Dial (DP)	No. 4-Type Toll (Crossbar)	Multifrequency (MF) Dial (DP) Revertive (RP)
No Provision	Panel Distant Office Tandem (2-Wire Office)	Revertive (RP)
Multifrequency (MF)	Electronic Switching	Multifrequency (MF)

TABLE B
CONNECTORS

CONNECTOR	CONNECTS FROM	CONNECTS TO
Line Link Marker Connector	Line Link Frame	Dial Tone Marker
Originating Register Marker Connector	Originating Register	Completing Marker
Incoming Register Marker Connector	Incoming Register	Completing Marker
Transfer Line Link Marker Connector	Transfer Line Link Frame	Dial Tone Marker
Transfer Register Marker Connector	Transfer Register	Completing Marker
Line Link Connector	Dial Tone or Completing Marker	Line Link Frame
Trunk Link Connector	Dial Tone or Completing Marker	Trunk Link Frame
Transfer Line Link Connector	Dial Tone Marker	Transfer Line Link Frame
Transfer Trunk Link Connector	Dial Tone Marker	Transfer Trunk Line Frame
Outgoing Sender Connector	Completing Marker	Outgoing Sender
Direct Access Pretranslator Connector	Completing Marker	Direct Access Pretranslator
Pretranslator Connector	Originating Register	Pretranslator
Transfer Register Identifier Connector	Line Identifier	Transfer Register
ANI Transverter Connector	Outgoing Sender	Program Controlled Transverter

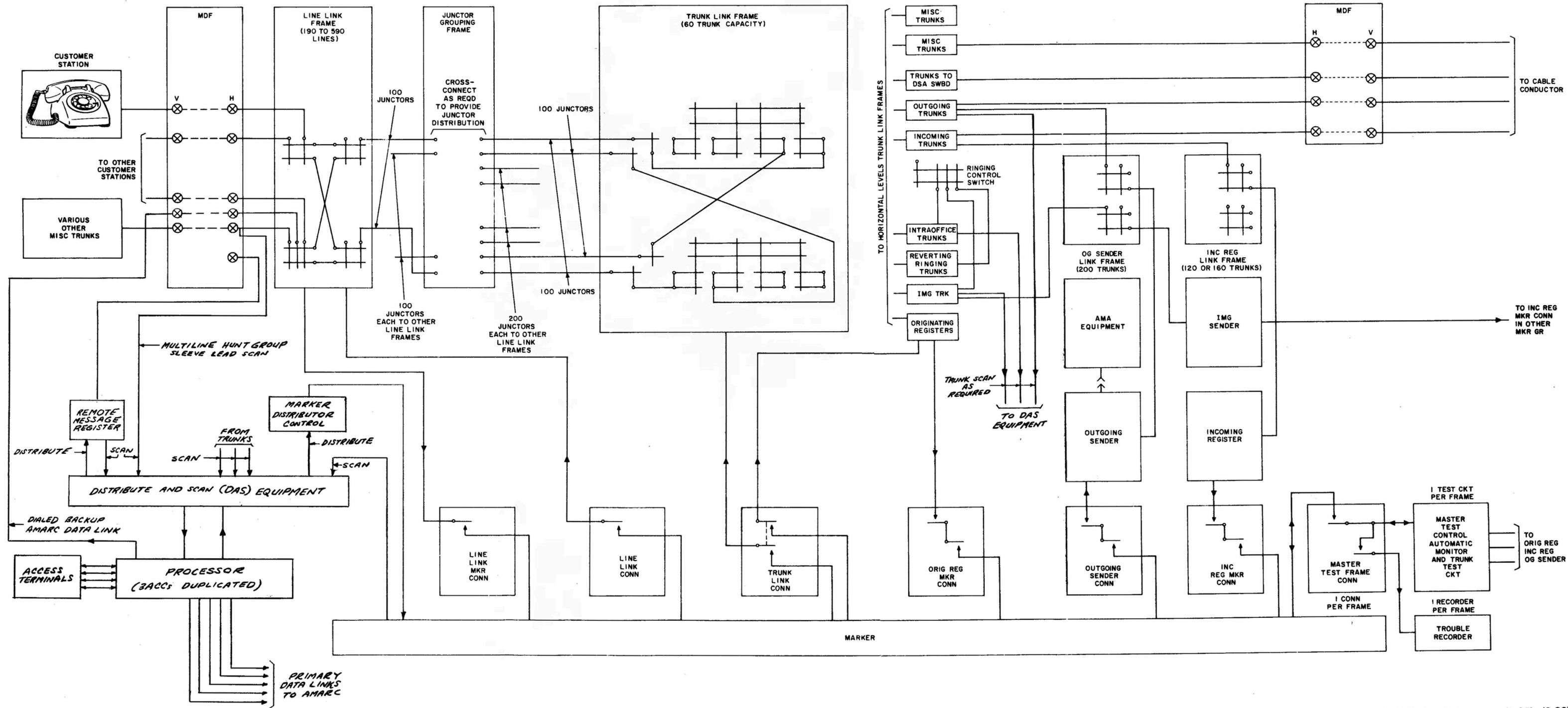


Fig. 1—No. 5 ETS—Block Diagram (1.05) (2.08)

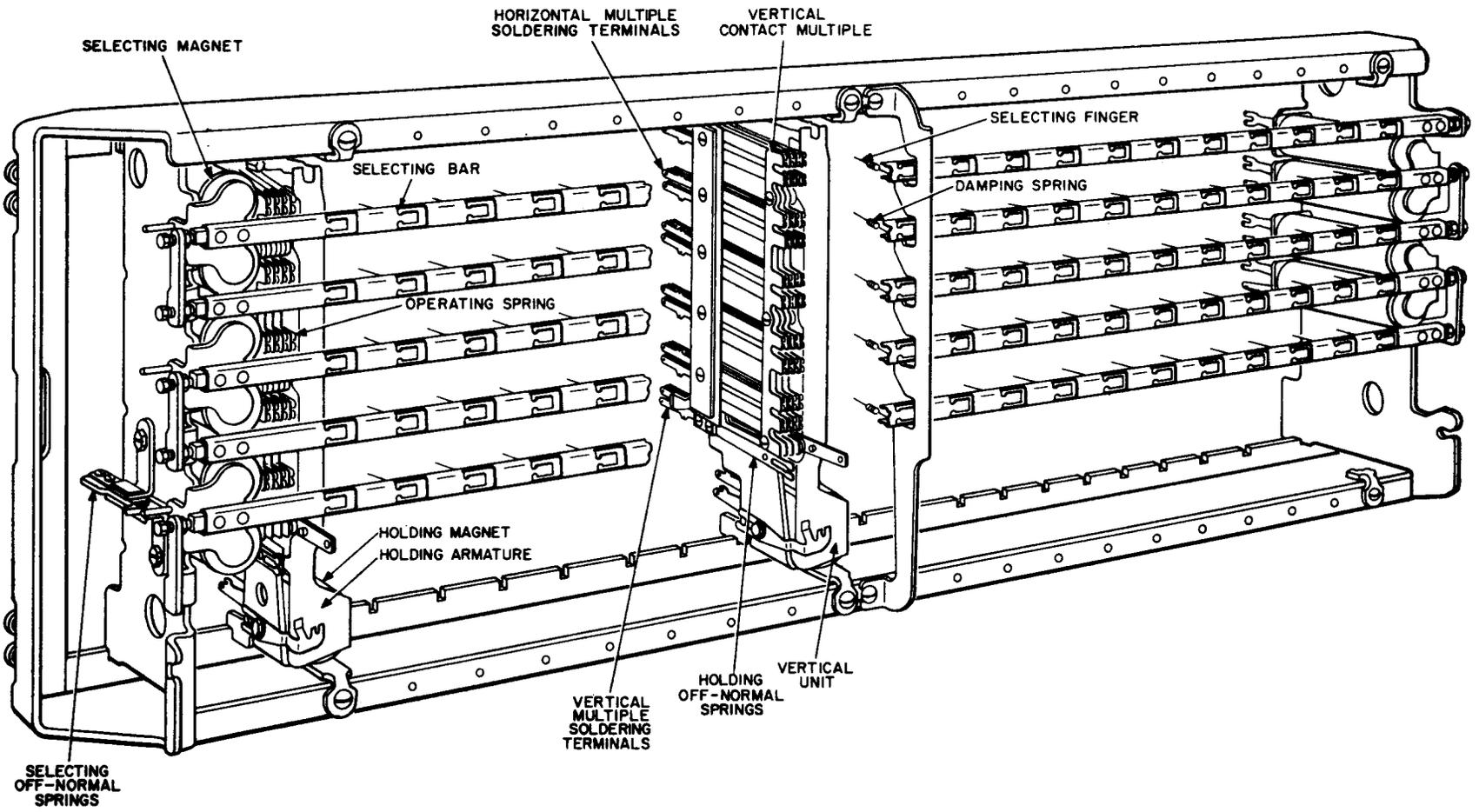


Fig. 2—200-Point Crossbar Switch for 20 Vertical Units (2.03)

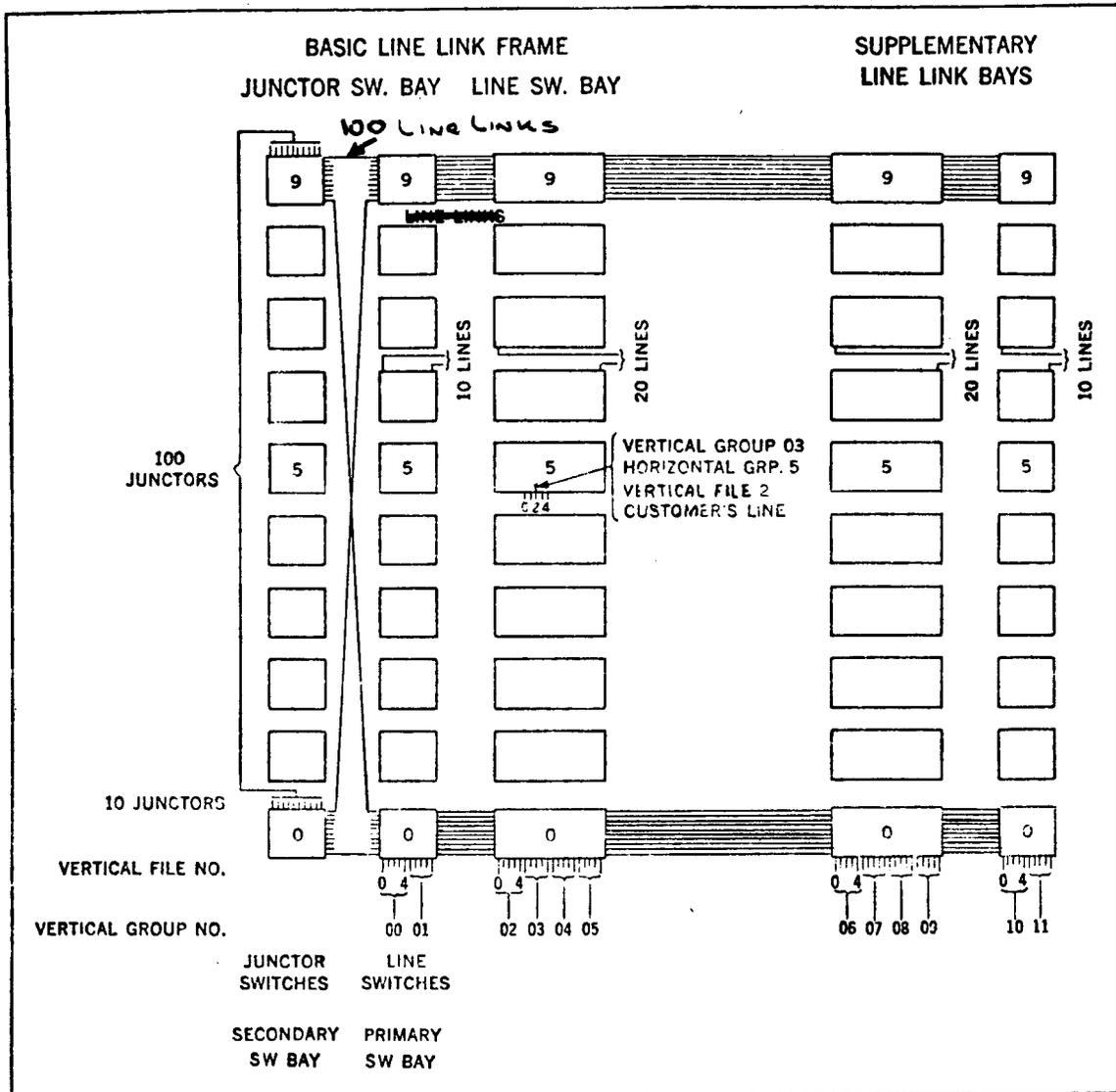


Fig. 3—Typical Line Link Frame Pattern (2.09) (2.12) (4.13)

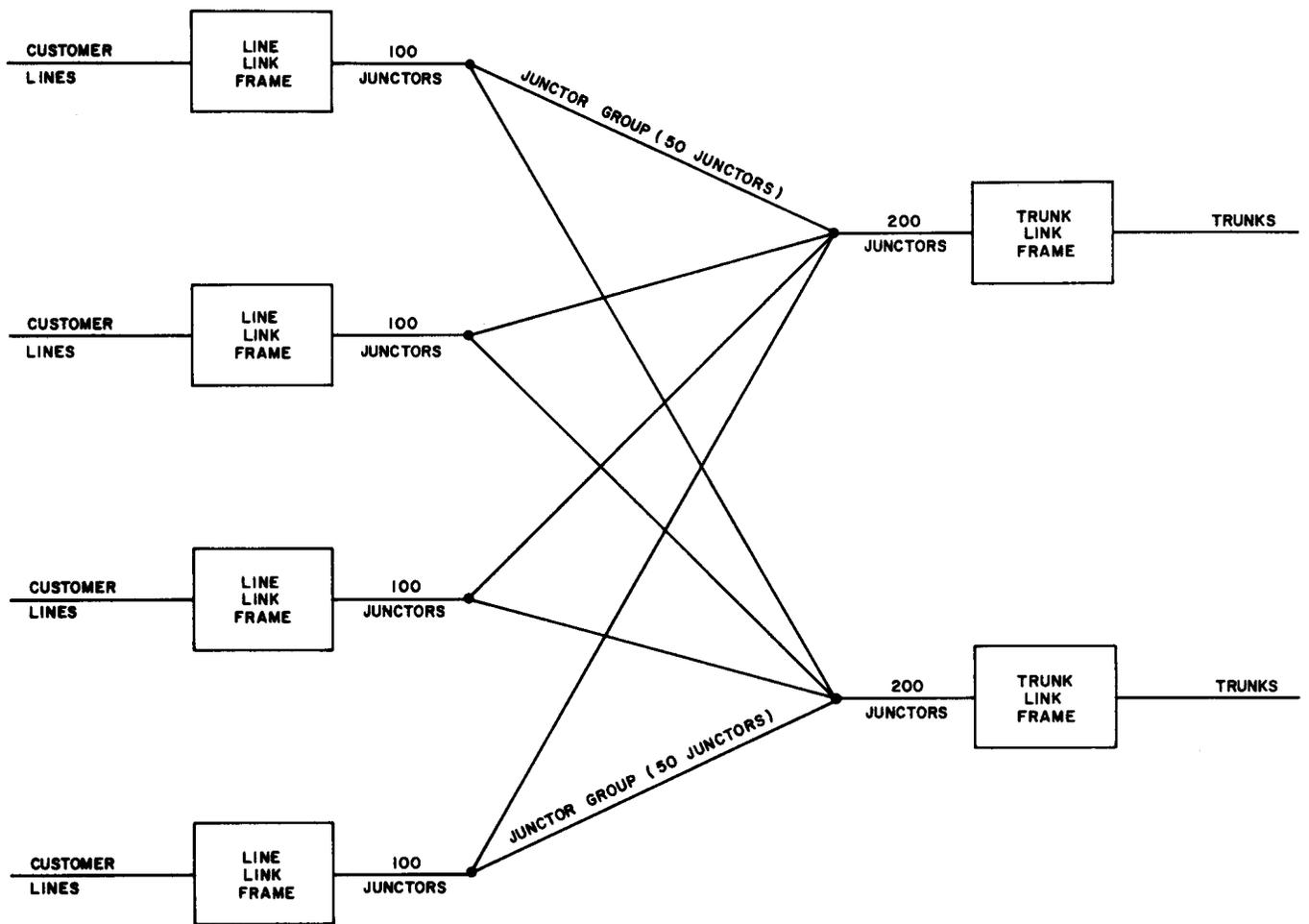


Fig. 4—Junctor Distribution—Four Line Link and Two Trunk Link Frames (2.19)

SECTION 19a(1)

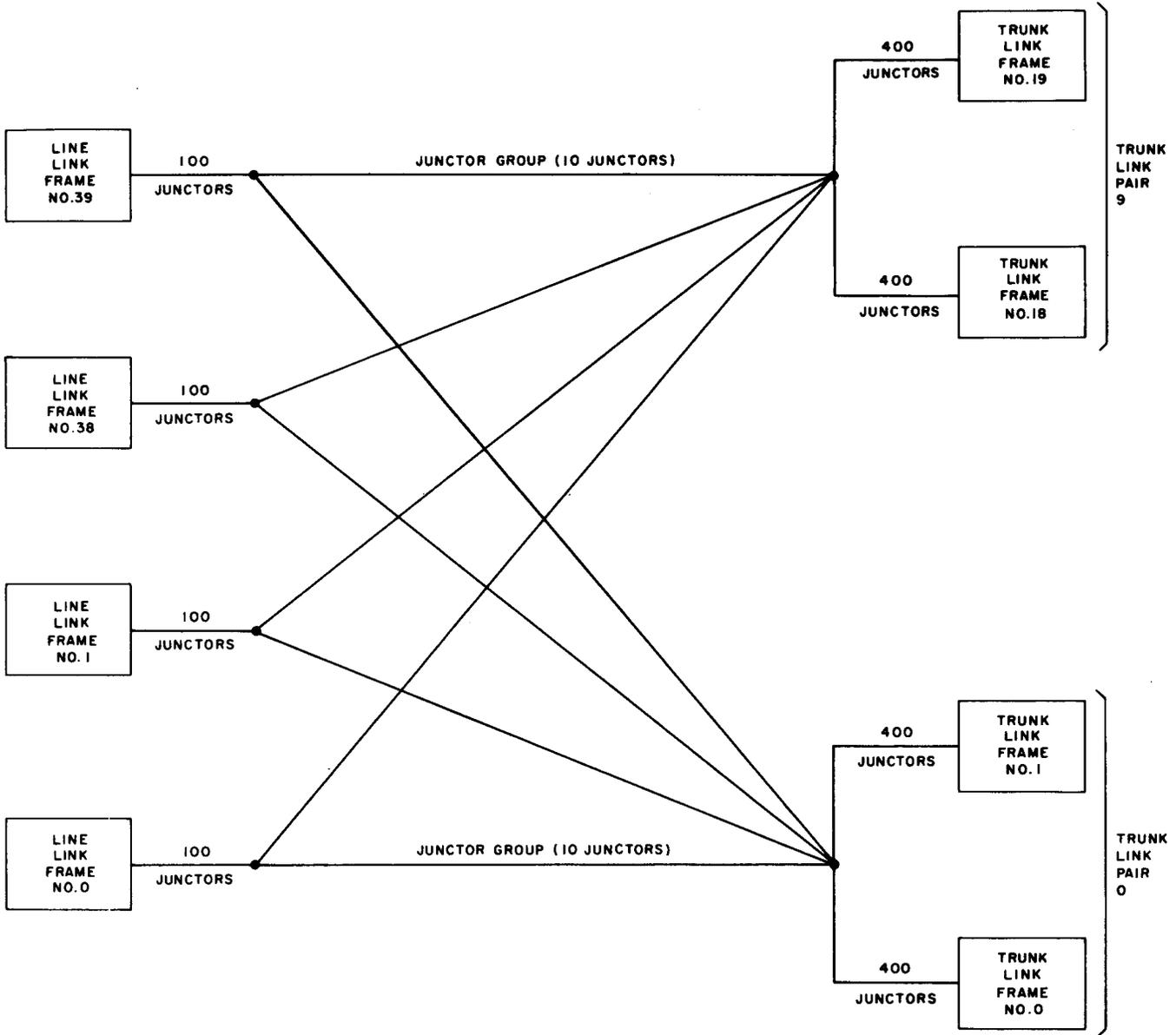


Fig. 5—Pairing of Trunk Link Frames—40 Line Link and 20 Trunk Link Frames (2.20)

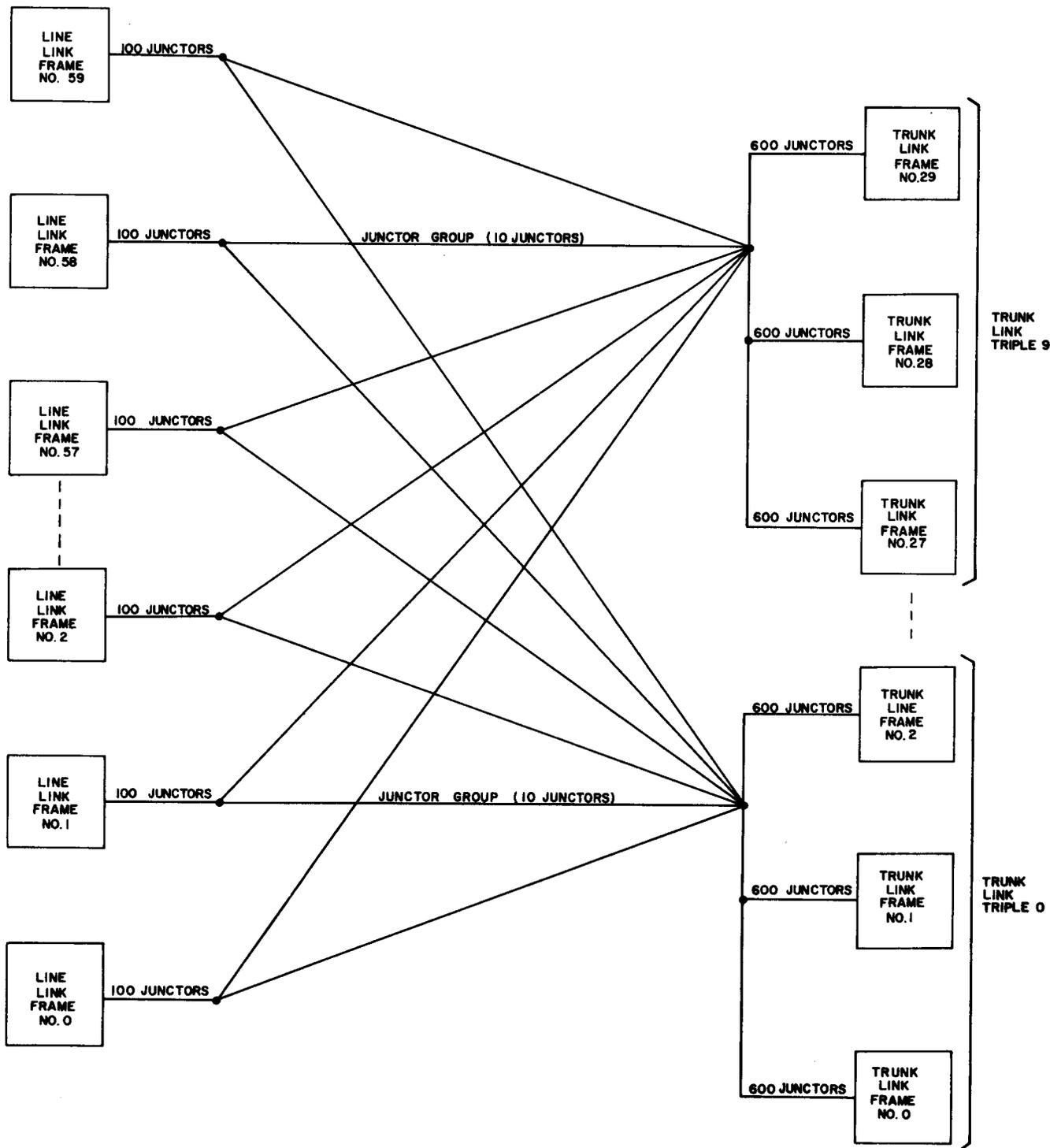


Fig. 6—Tripling of Trunk Link Frames—60 Line Link and 30 Trunk Link Frames (2.21)

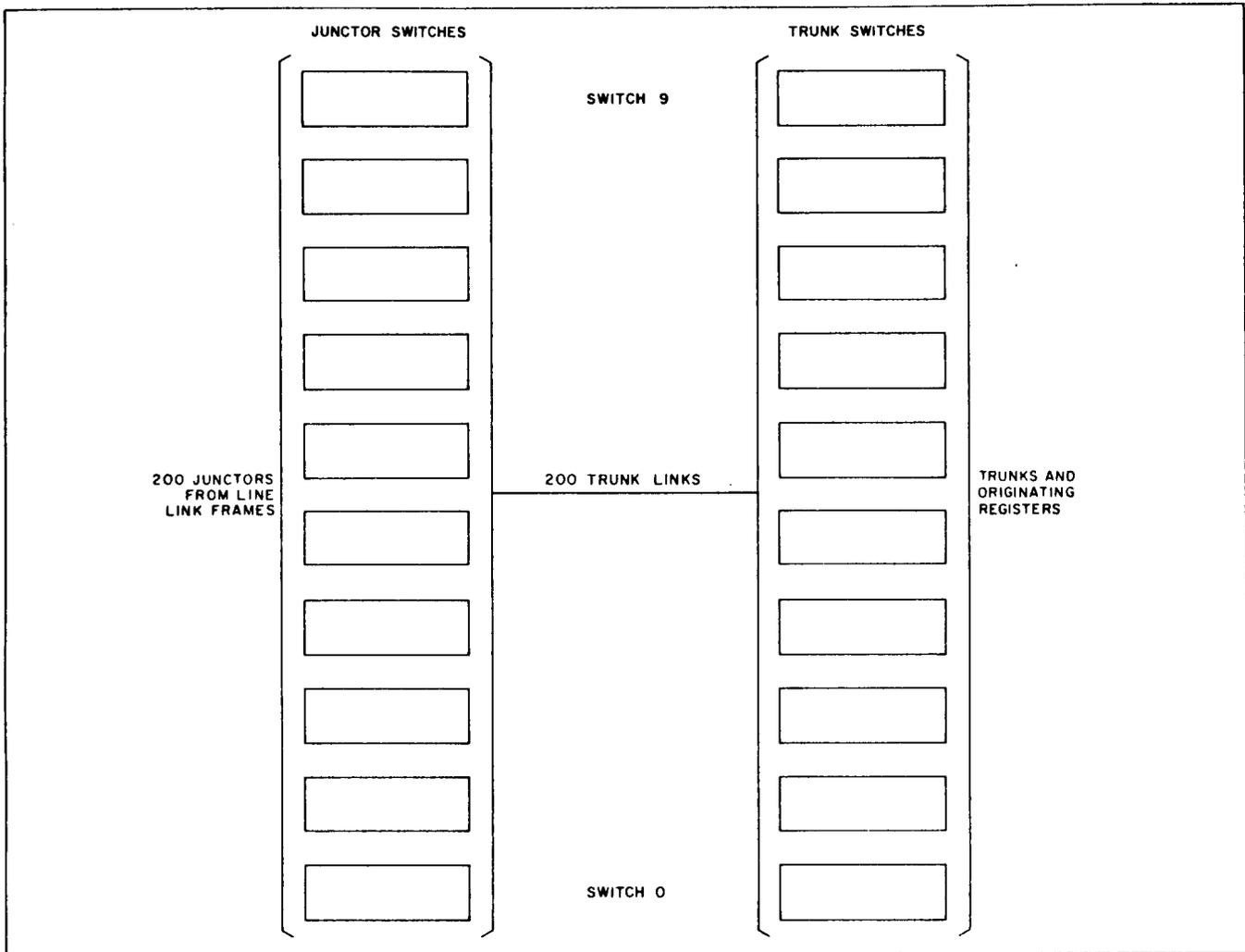


Fig. 7—Trunk Link Frame (2.23)

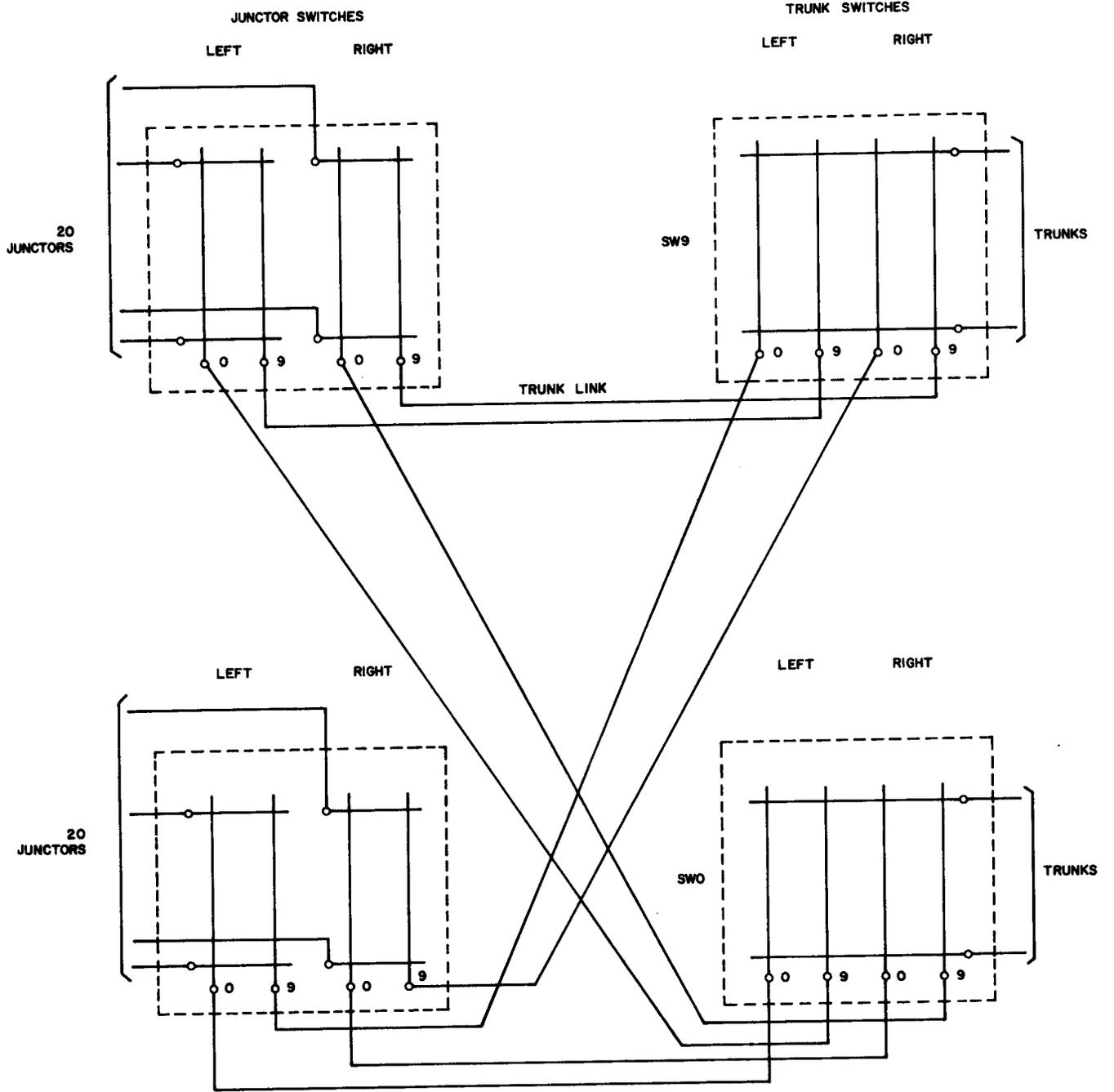


Fig. 8—Trunk Link Distribution (2.25)

SECTION 19a(1)

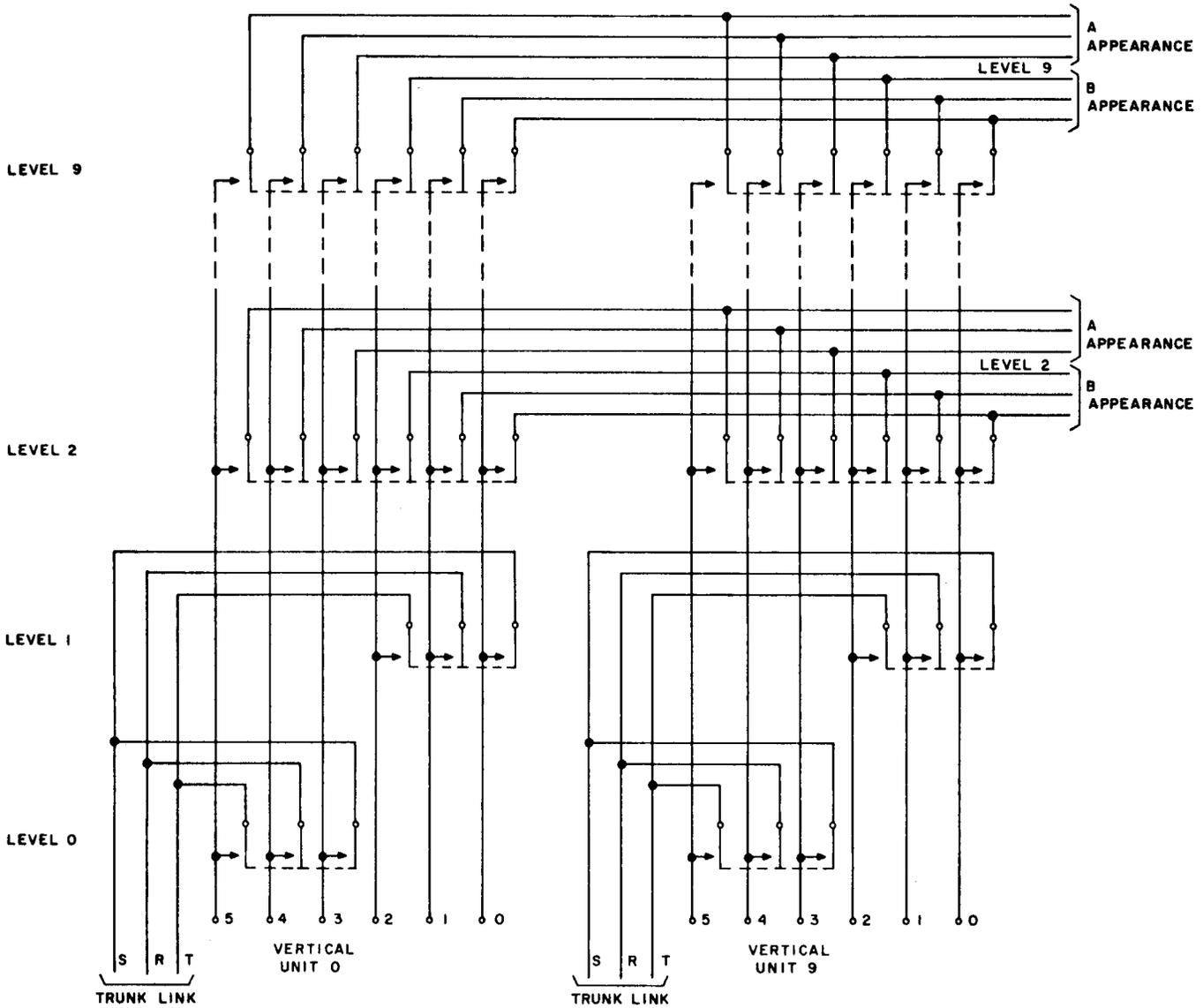


Fig. 9—Switch Arranged for 16 Trunk Appearances on Trunk Link Frame (2.29)

NOTE:

THE CHANNEL NUMBER ALWAYS CORRESPONDS TO THE LINE SWITCH HORIZONTAL NUMBER OF THE LINE LINK, THE TRUNK SWITCH VERTICAL NUMBER OF THE TRUNK LINK, AND THE JUNCTOR SWITCH NUMBER. ALL OTHER ELEMENTS ARE NUMBERED INDEPENDENTLY OF CHANNEL NUMBER CONSIDERATIONS.

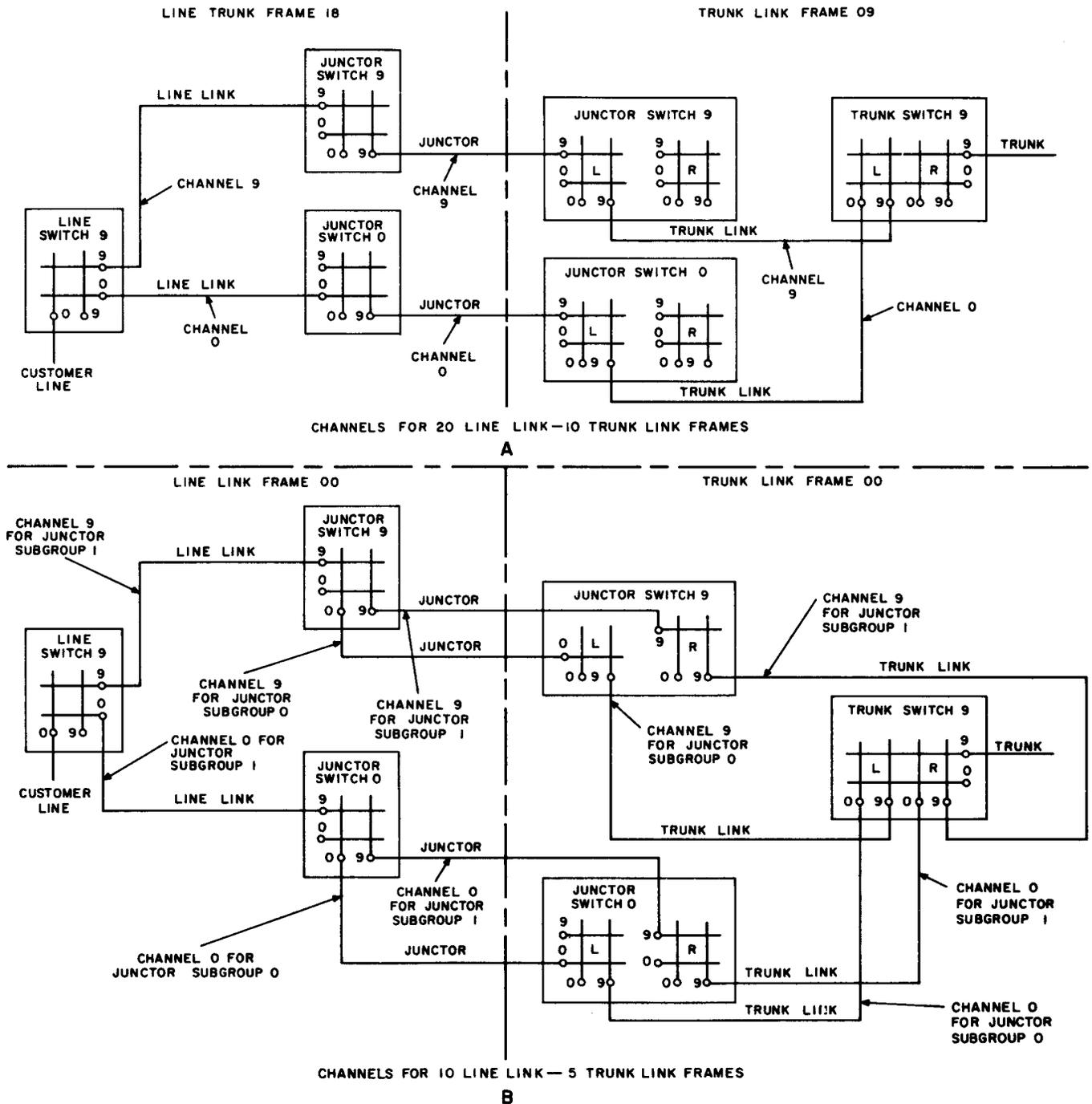


Fig. 10—Channel Distribution—Line Link to Trunk Link Frames (2.33)

SECTION 19a(1)

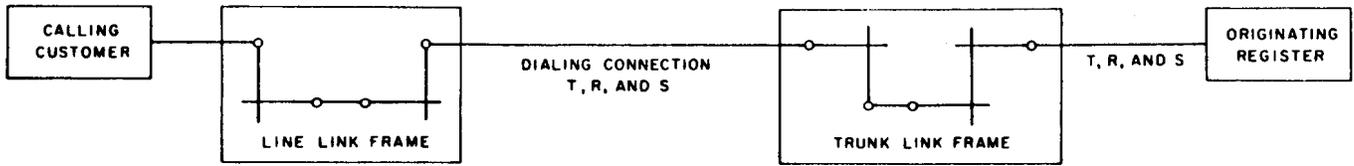


Fig. 11—Dialing Connection (4.03)

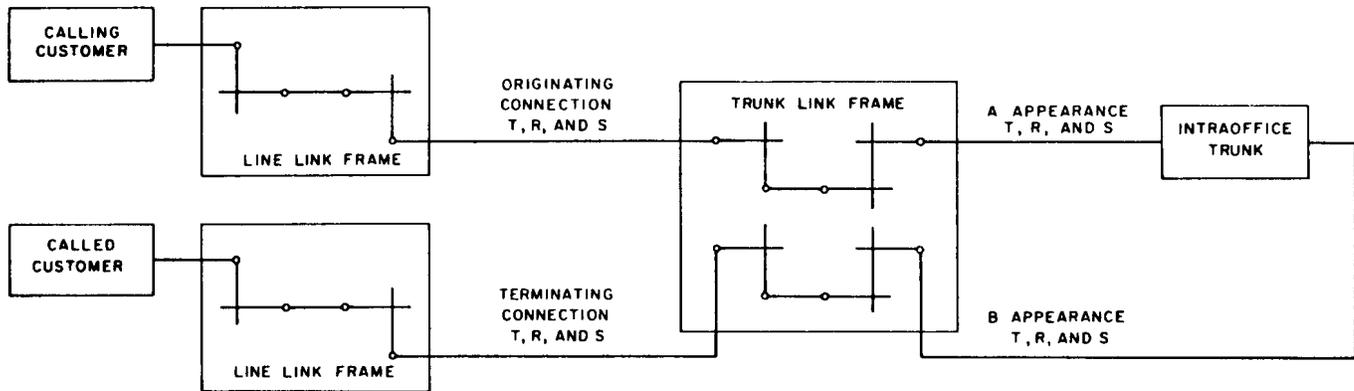


Fig. 12—Intraoffice Trunk Connection (4.04)



Fig. 13—Reverting Trunk Connection (4.05)

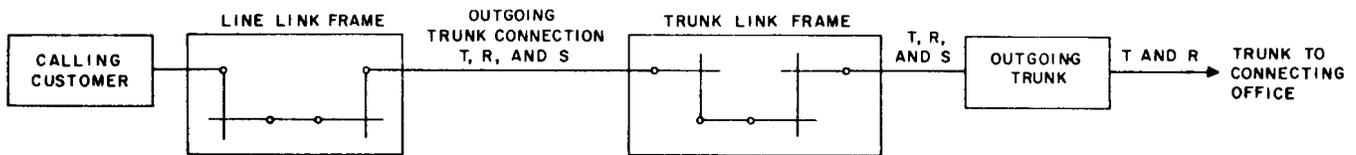


Fig. 14—Outgoing Trunk Connection (4.06)

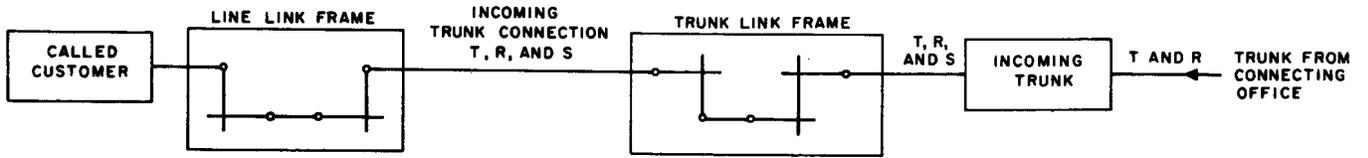


Fig. 15—Incoming Trunk Connection (4.07)

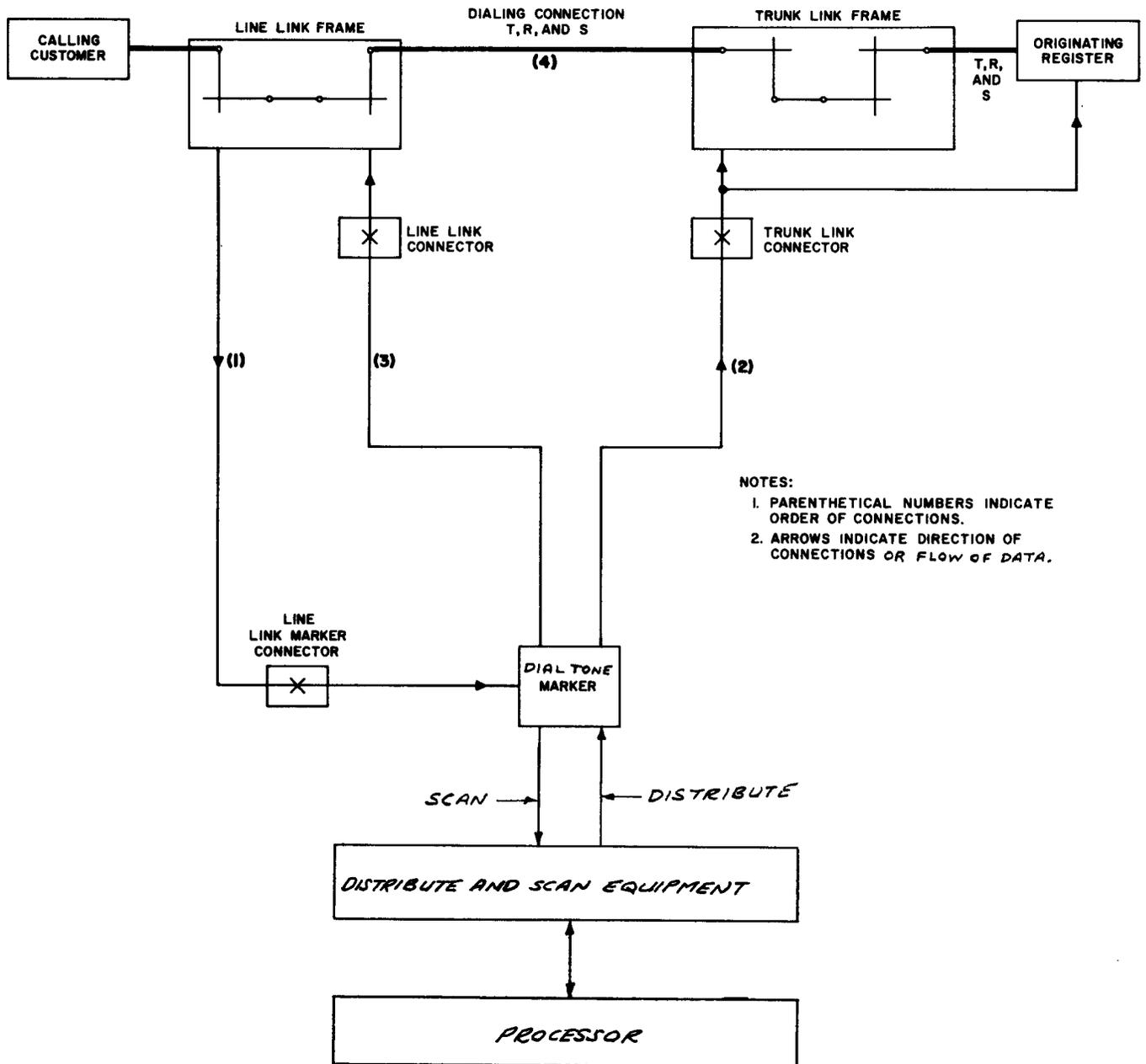


Fig. 16—Establishing Dialing Connection (4.10) (4.15) (4.18) (4.36)

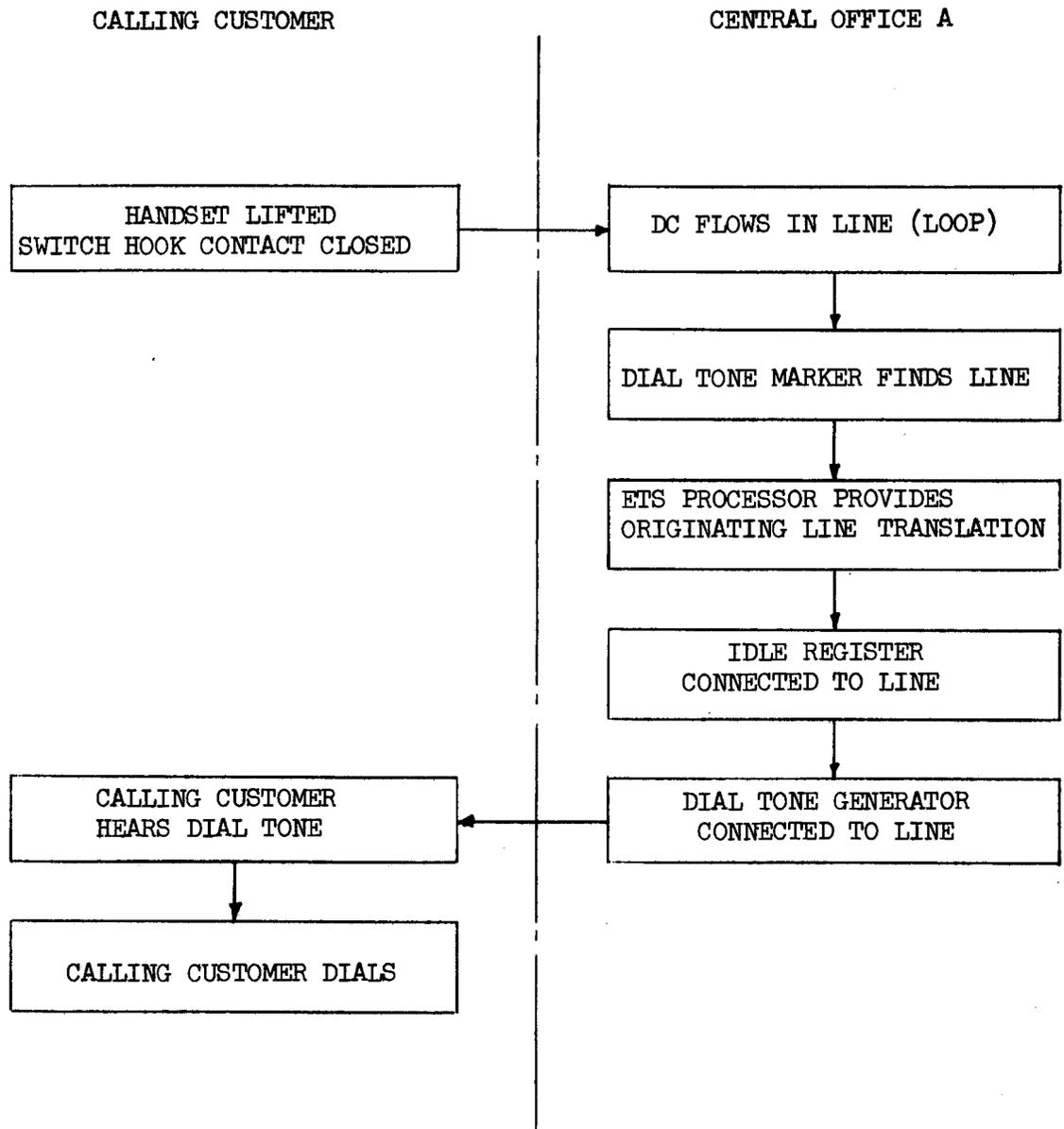


Fig. 17—Initiating the Call (4.34)

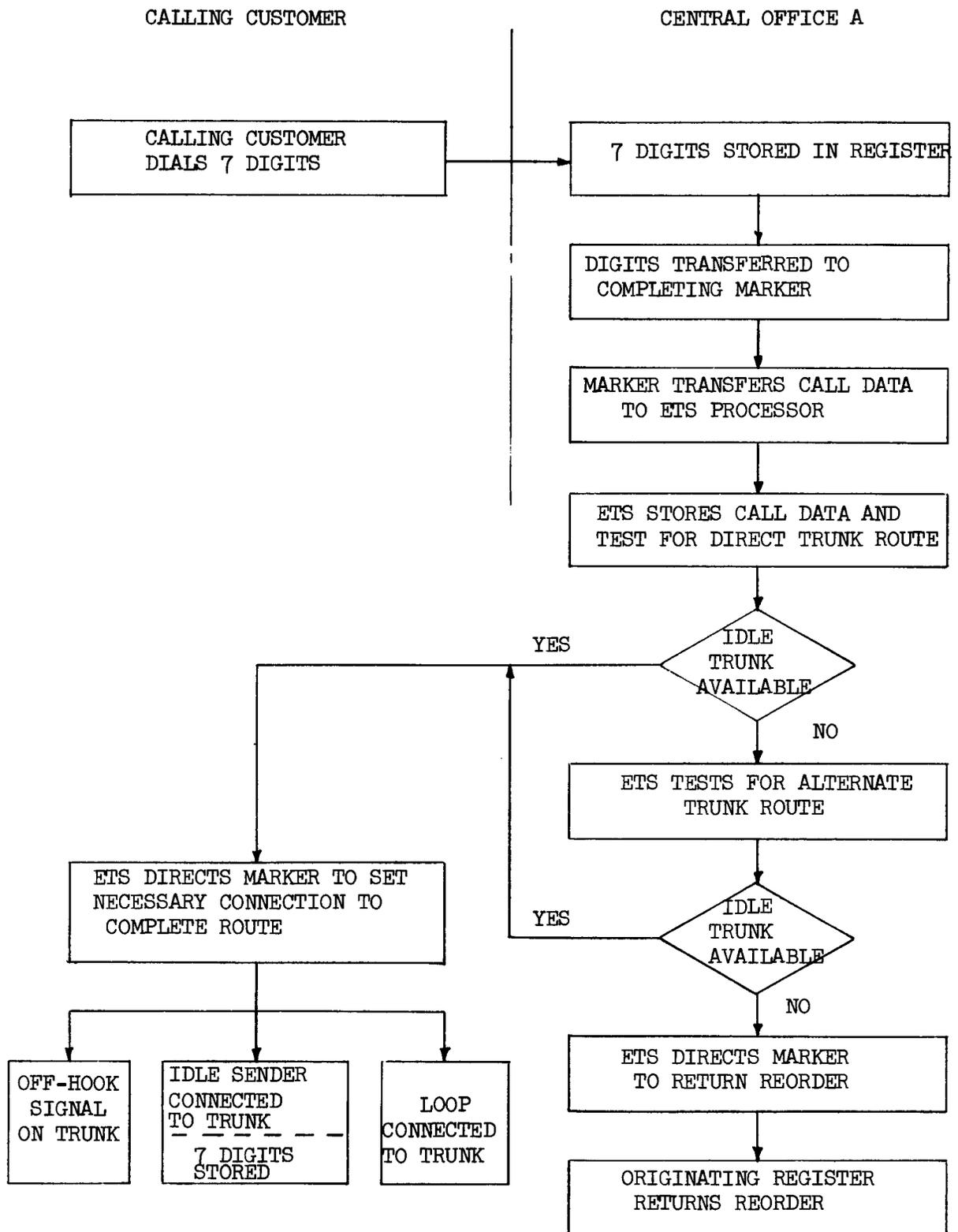


Fig. 18—Dialing and Subsequent Operation in Central Office A (4.34)

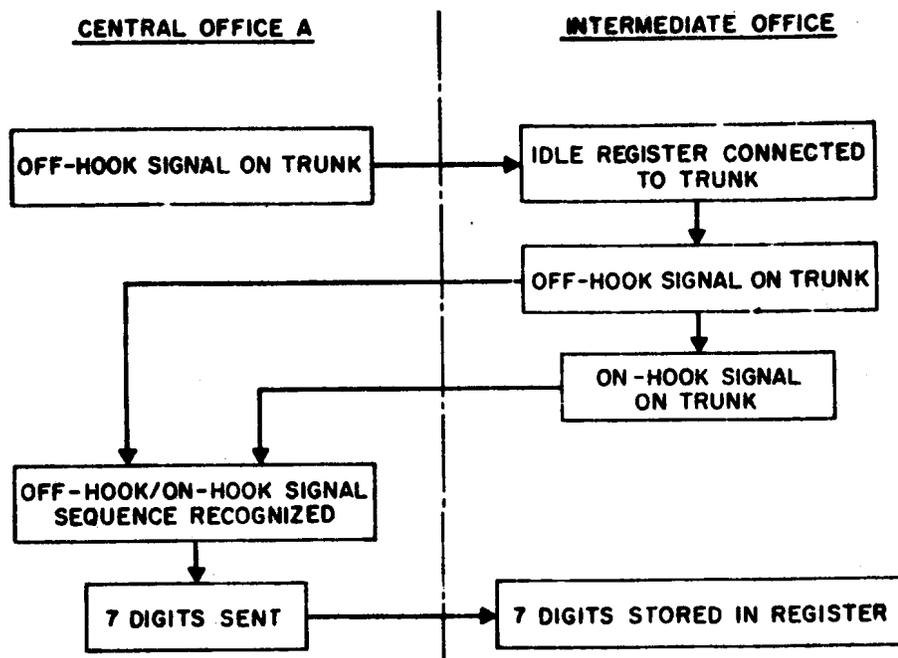


Fig. 19—Address Sent to Intermediate Office (4.34)

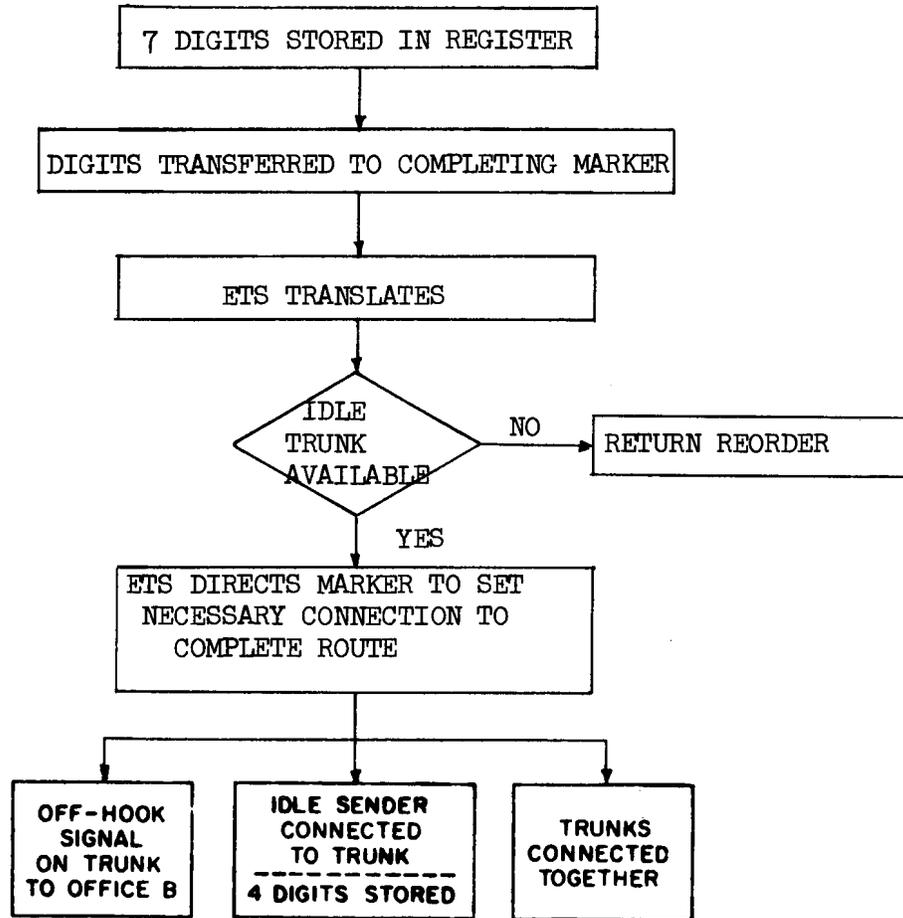


Fig. 20—Operations in the Intermediate Office to Connect Trunks (4.34)

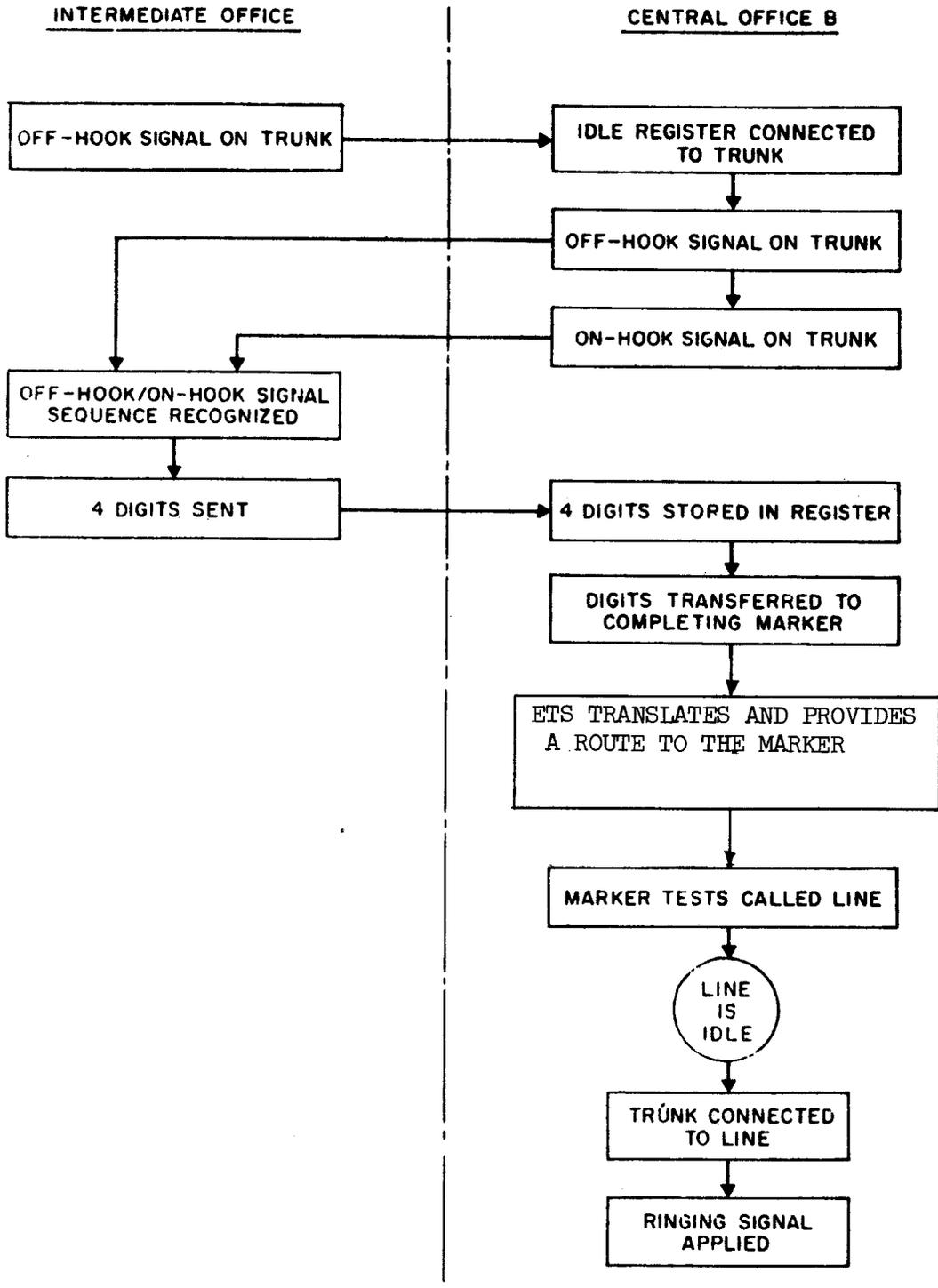


Fig. 21—The Call Advances to Central Office B and the Called Telephone is Rung (4.34)

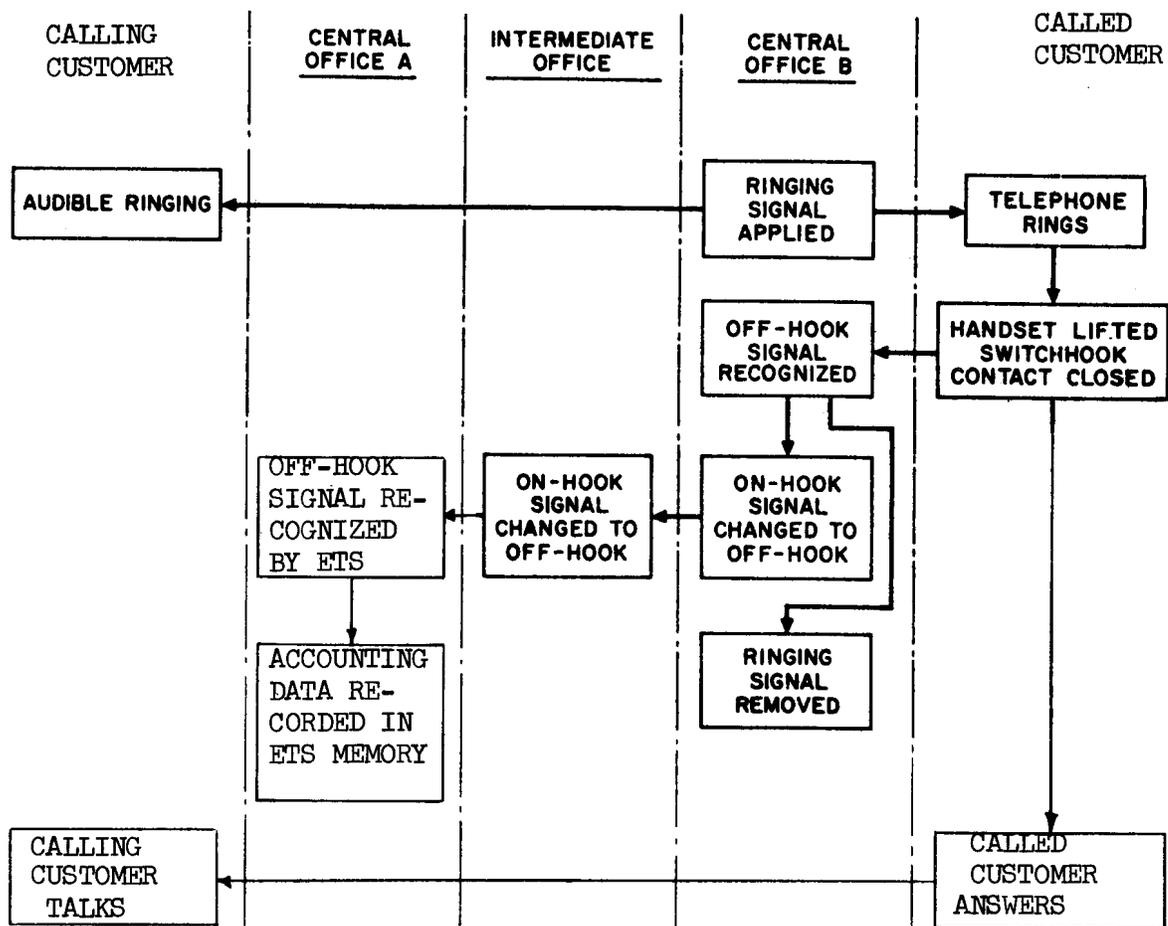


Fig. 22—The Call is Established (4.34)

SECTION 19a(1)

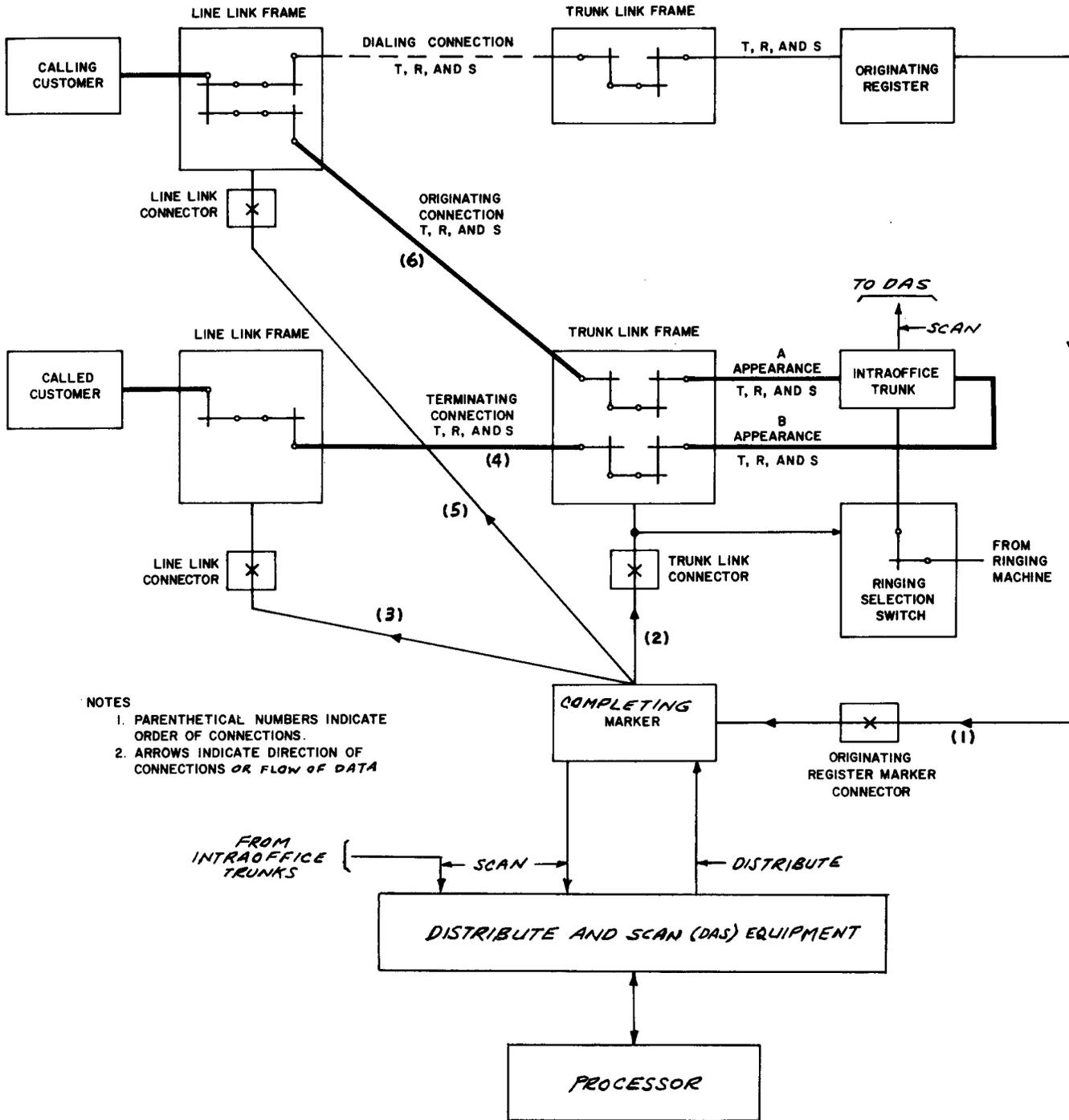
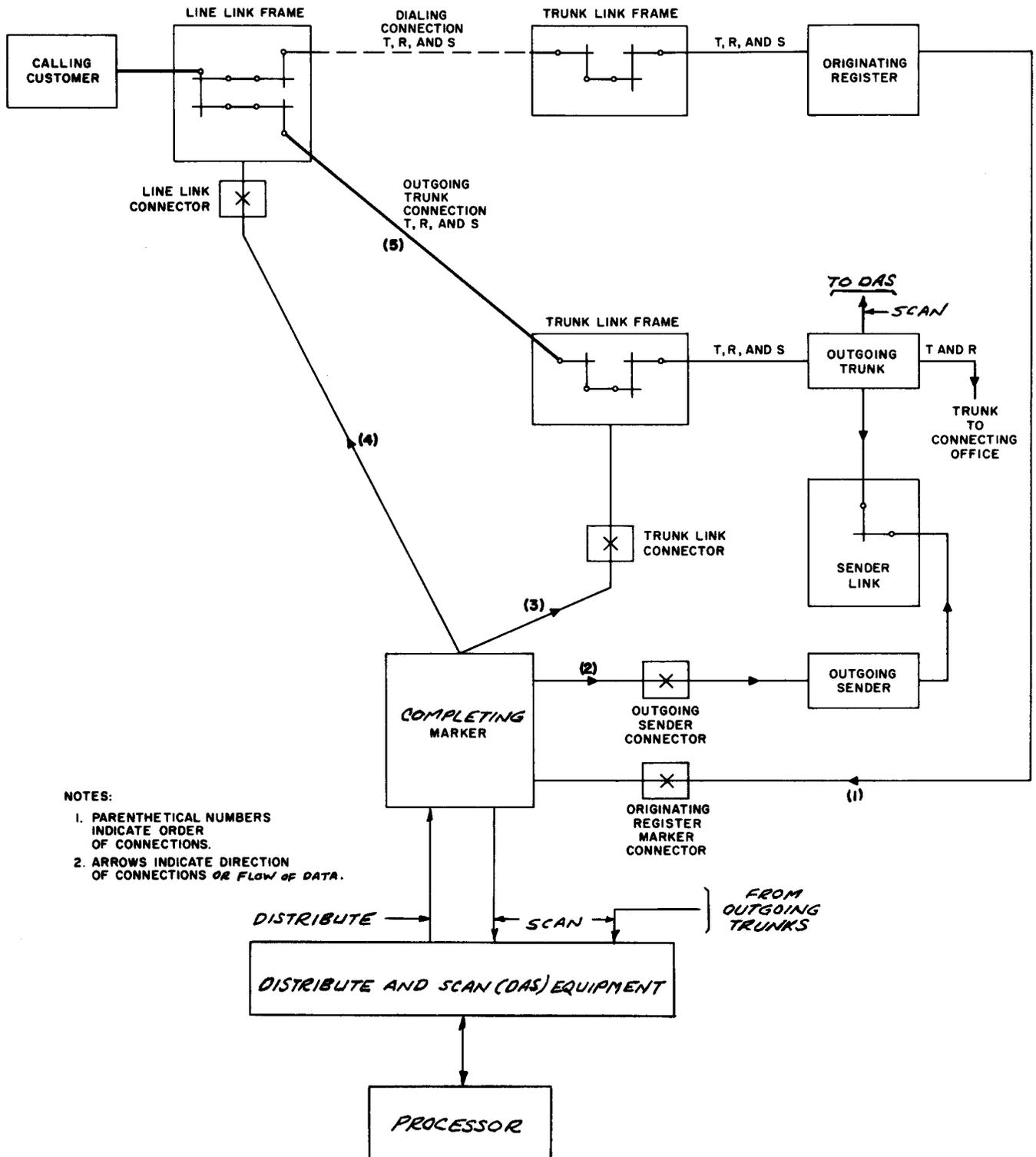


Fig. 23—Establishing Intraoffice Trunk Connection (4.36) (4.42)



- NOTES:
1. PARENTHETICAL NUMBERS INDICATE ORDER OF CONNECTIONS.
 2. ARROWS INDICATE DIRECTION OF CONNECTIONS OR FLOW OF DATA.

Fig. 24—Establishing Outgoing Trunk Connection (4.45)

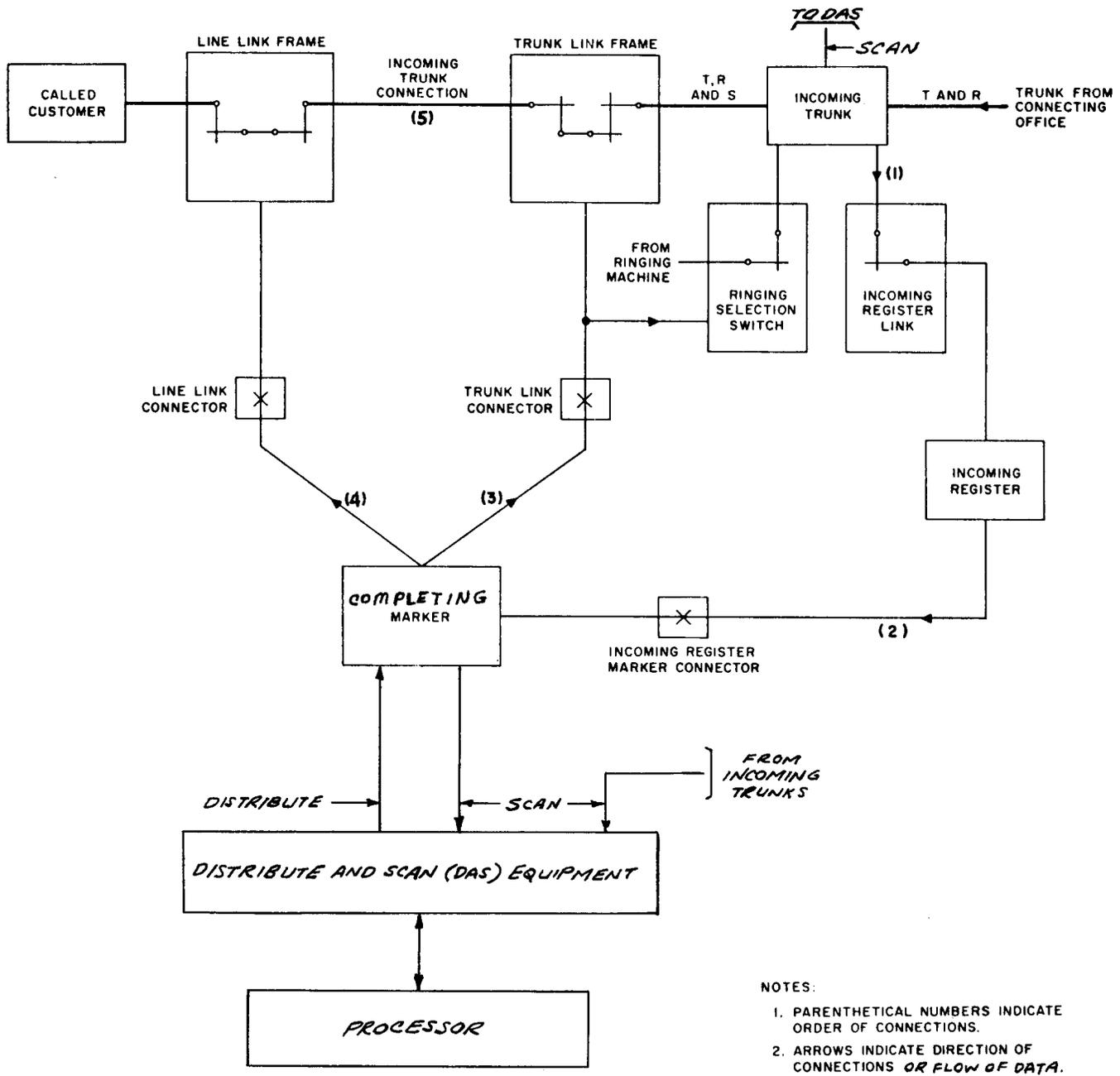


Fig. 25—Establishing Incoming Trunk Connection (4.49)

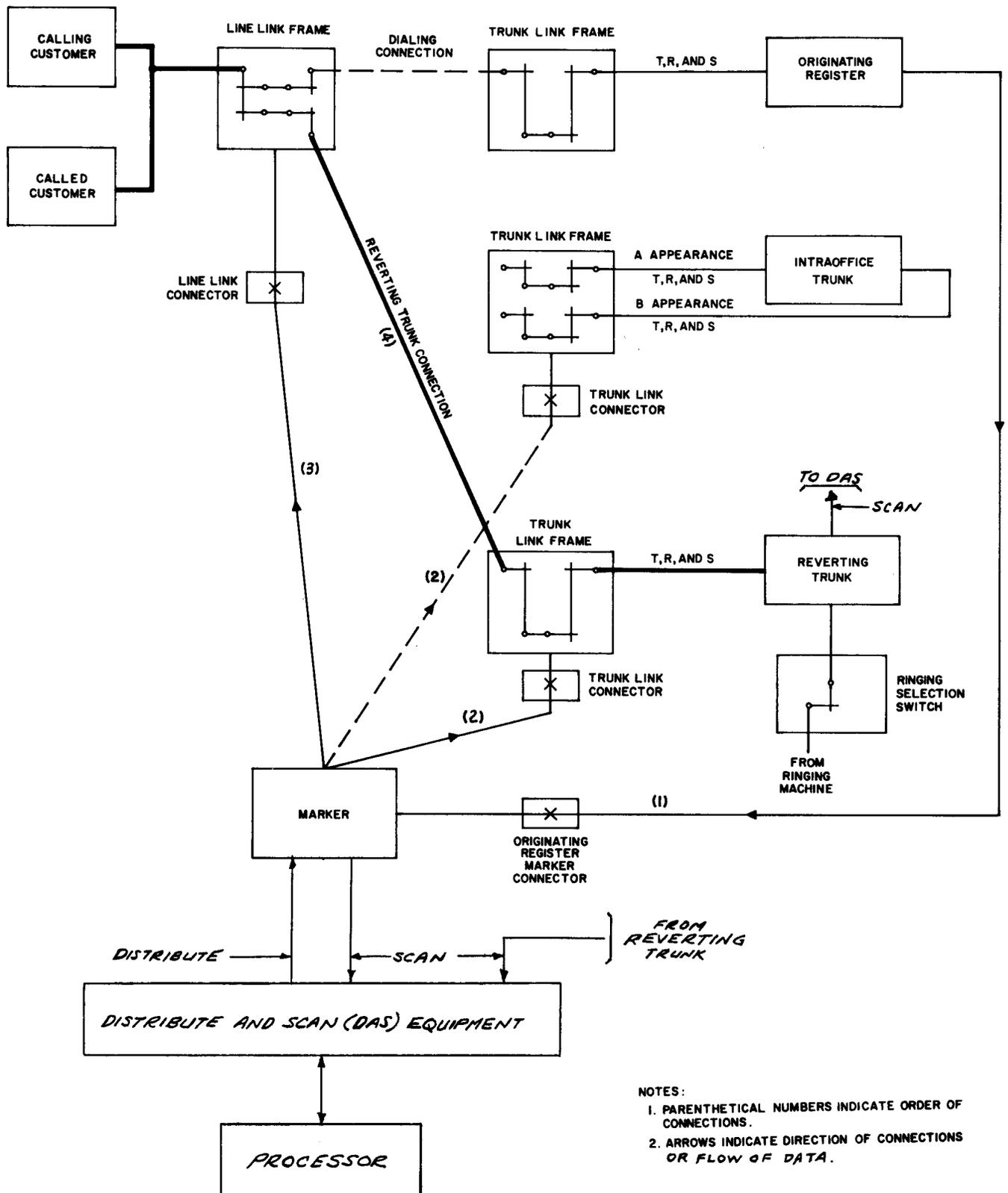


Fig. 26—Establishing Reverting Trunk Connection (4.57)

SECTION 19a(1)

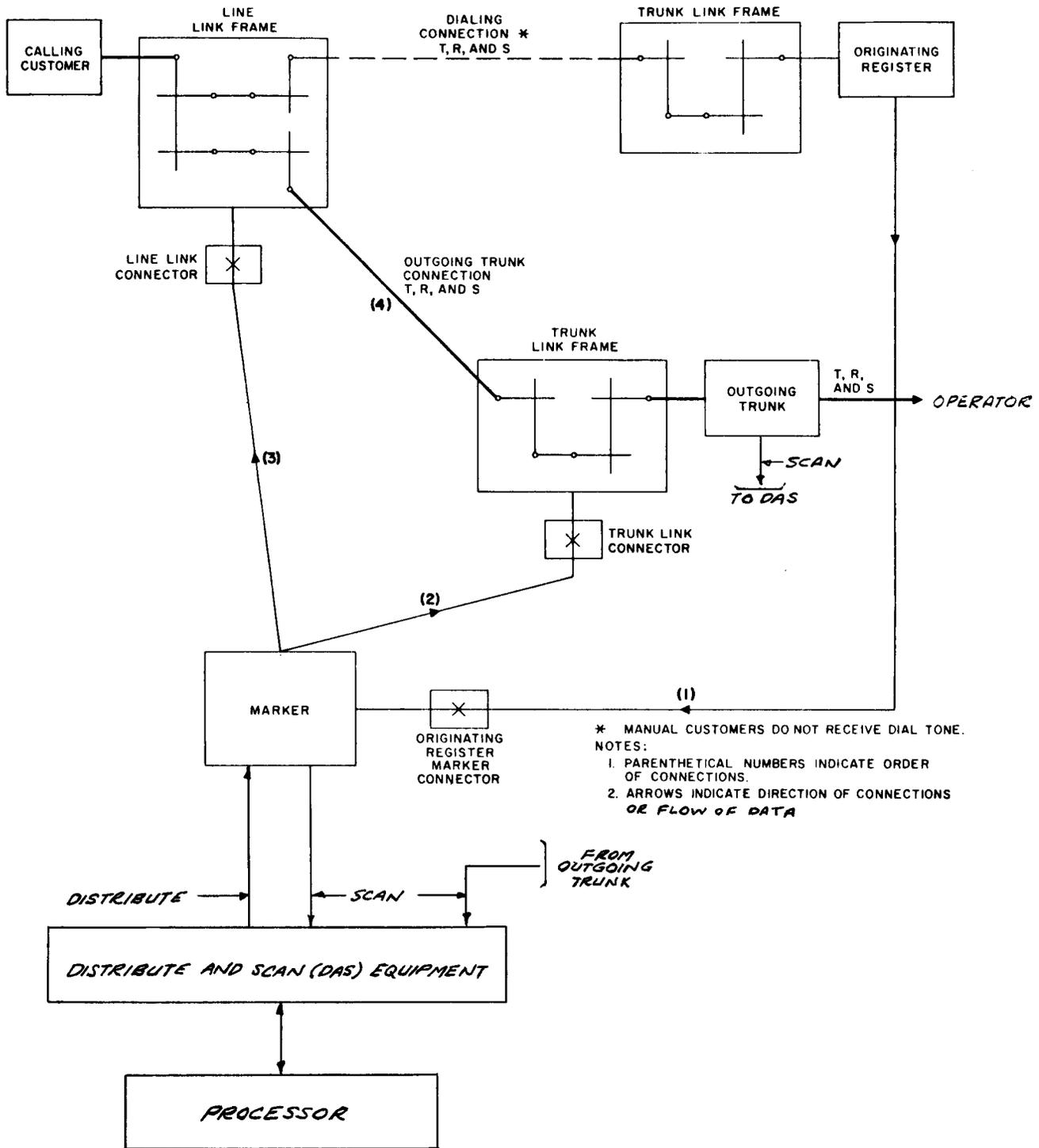


Fig. 27—Establishing Operator Assistance, Service Code, or Manual Trunk Connection (4.64) (4.65)

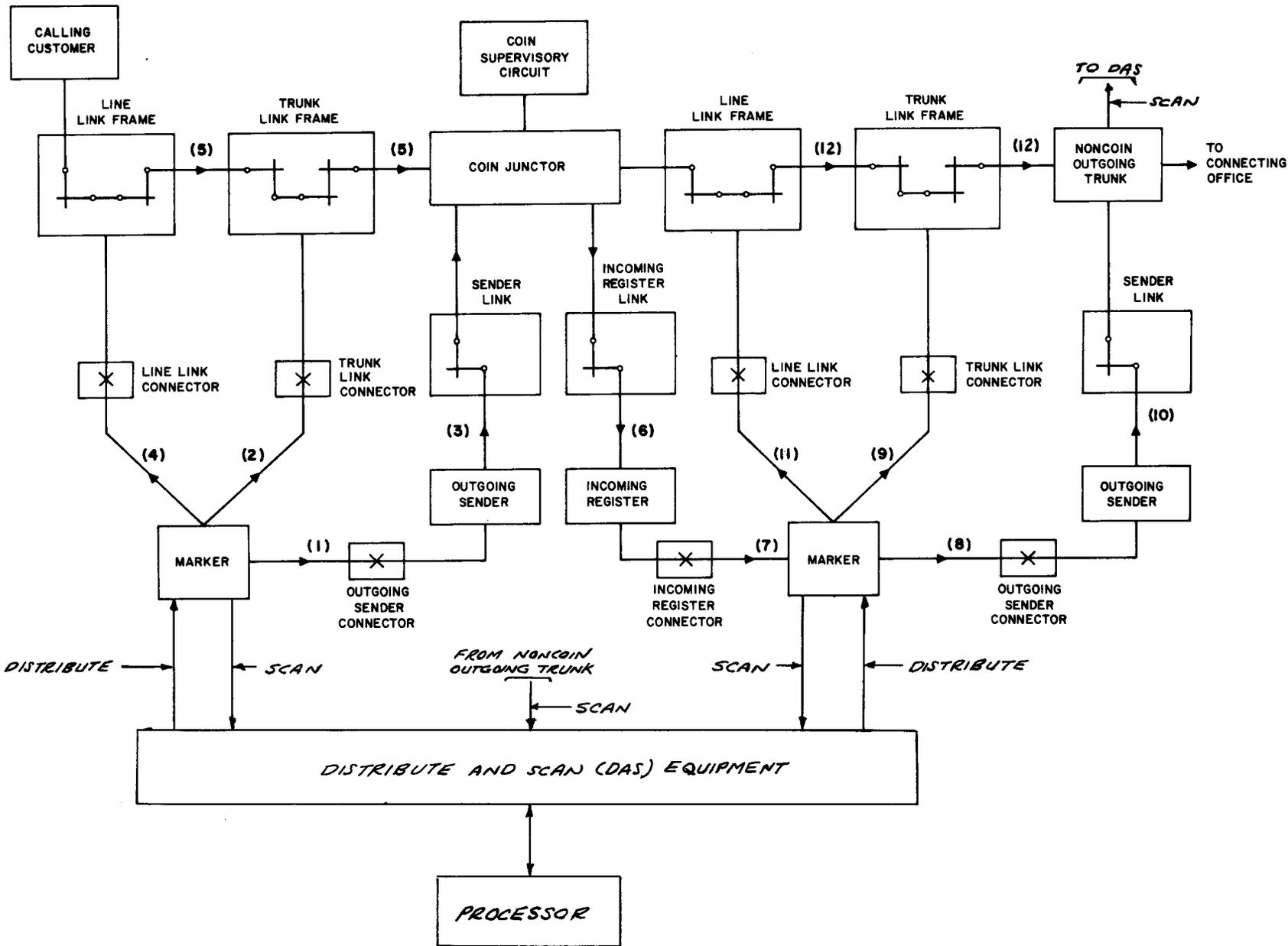


Fig. 28—Coin Juncture Operation (4.76)

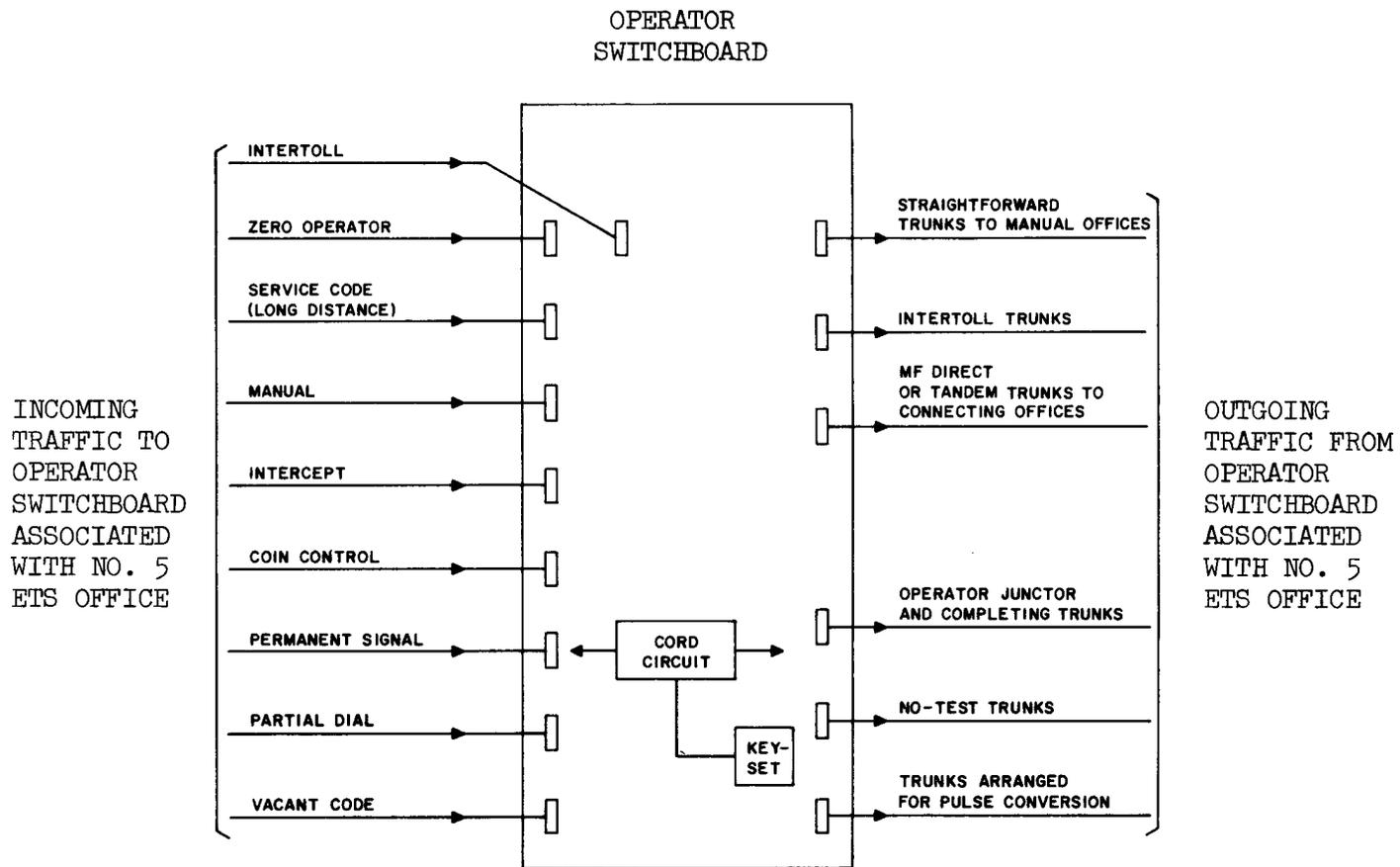
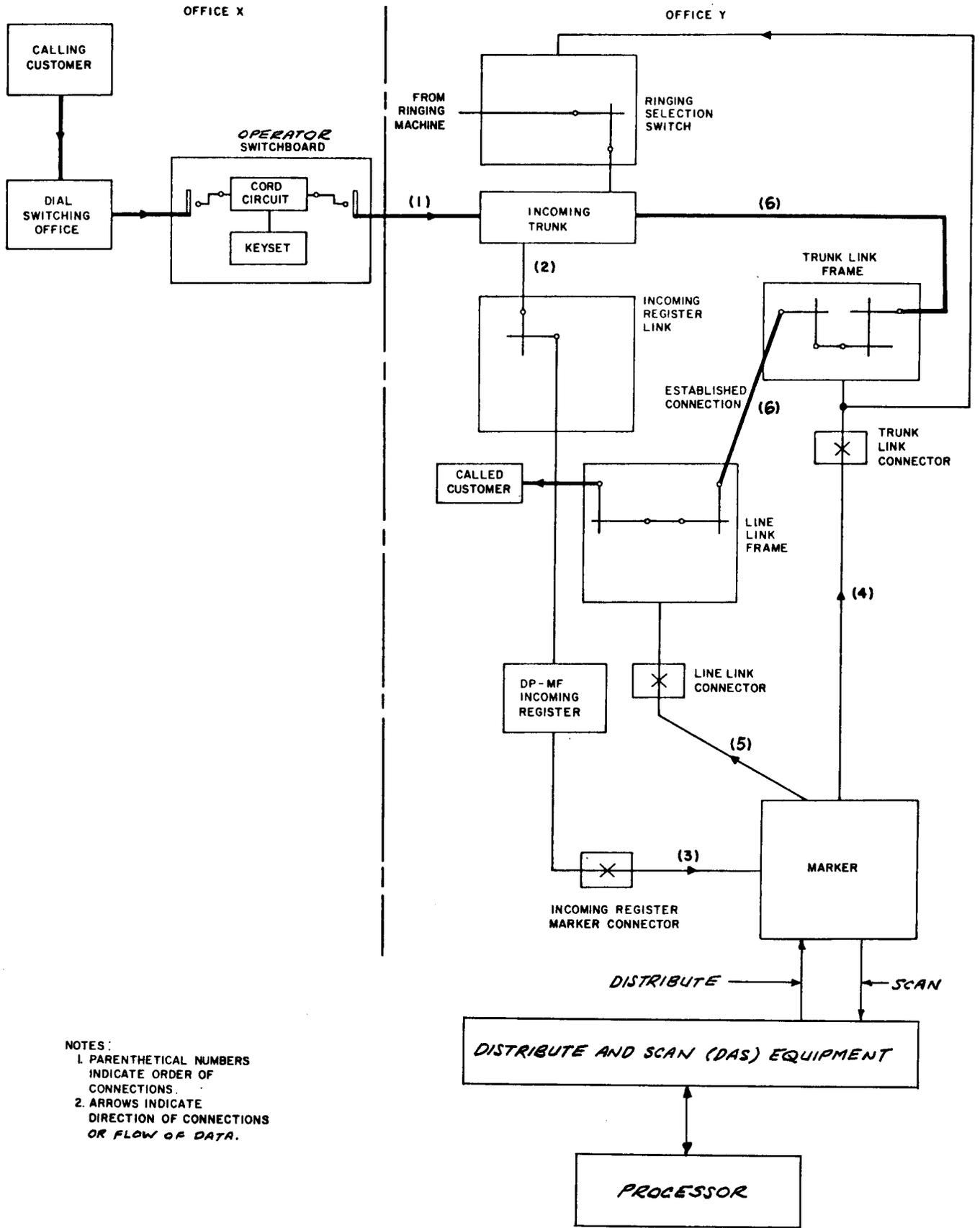


Fig. 29—Traffic at Operator Switchboard Associated with No. 5 ETS Office (4.81)

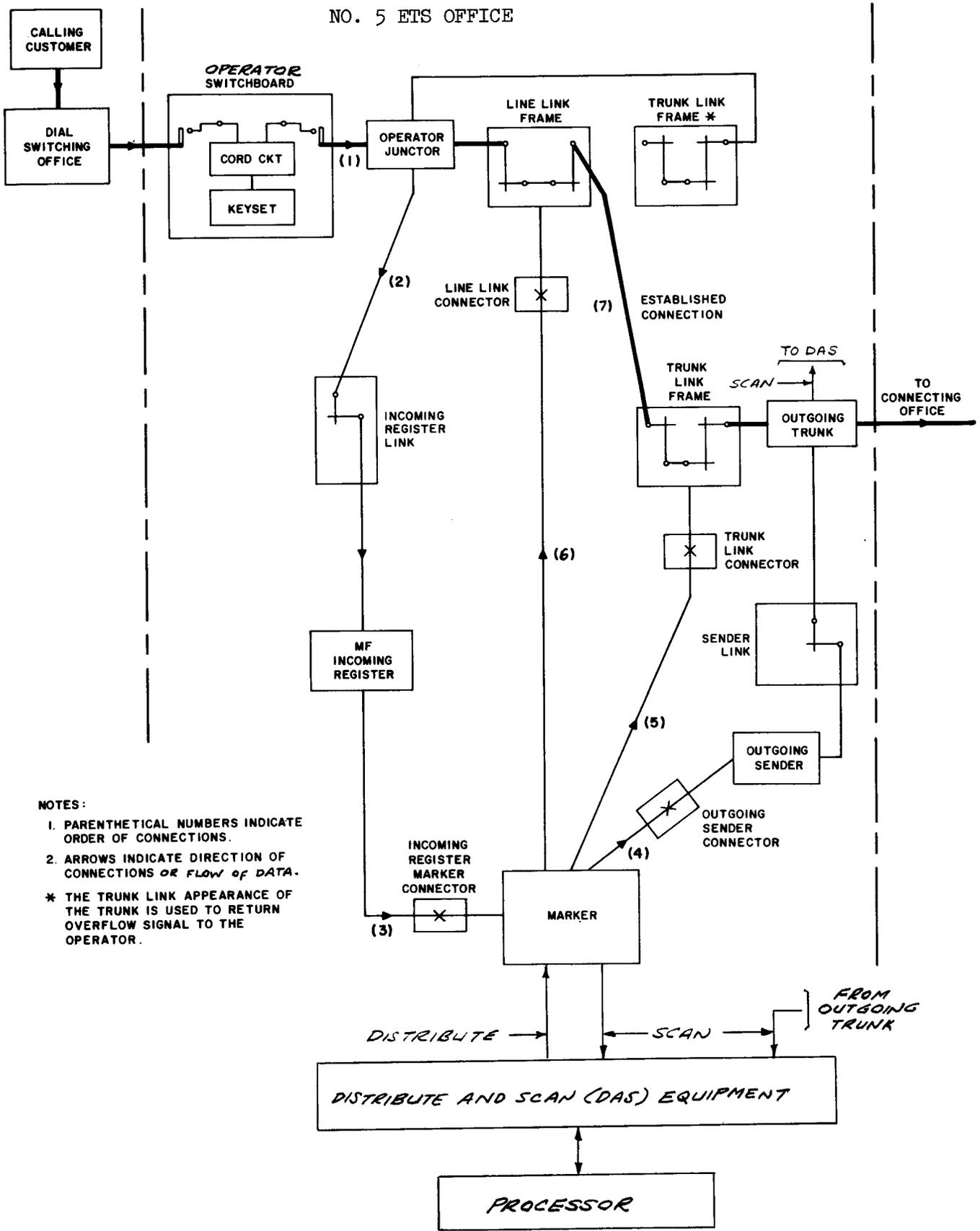


- NOTES:
1. PARENTHETICAL NUMBERS INDICATE ORDER OF CONNECTIONS.
 2. ARROWS INDICATE DIRECTION OF CONNECTIONS OR FLOW OF DATA.

Fig. 30—Call From Operator Switchboard Completed to No. 5 ETS Customer (4.83)

SECTION 19a(1)

NO. 5 ETS OFFICE



NOTES:

1. PARENTHETICAL NUMBERS INDICATE ORDER OF CONNECTIONS.
2. ARROWS INDICATE DIRECTION OF CONNECTIONS OR FLOW OF DATA.
- * THE TRUNK LINK APPEARANCE OF THE TRUNK IS USED TO RETURN OVERFLOW SIGNAL TO THE OPERATOR.

Fig. 31—Call From Operator Switchboard Associated with No. 5 ETS Office to Connecting Office (4.84)

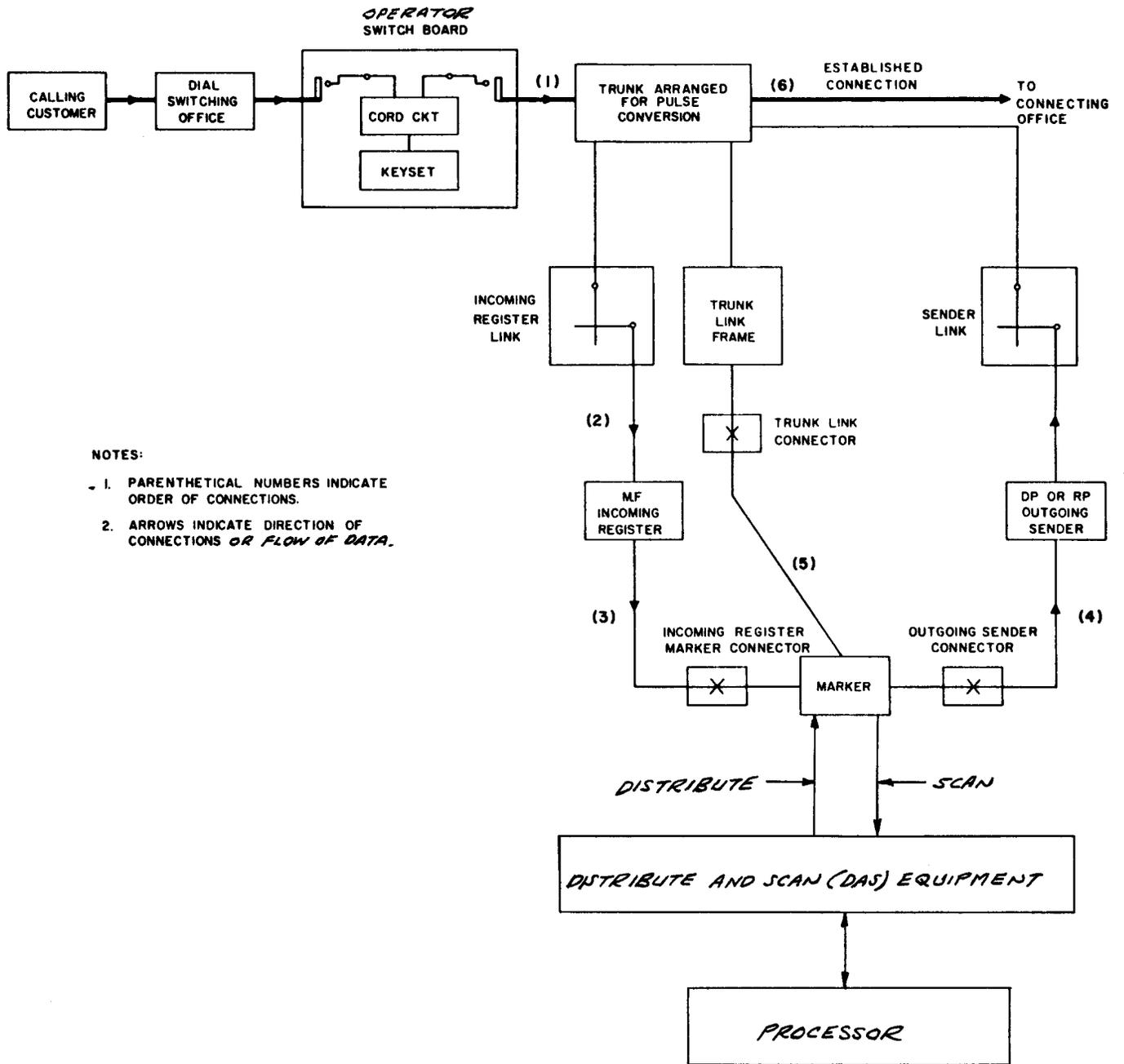
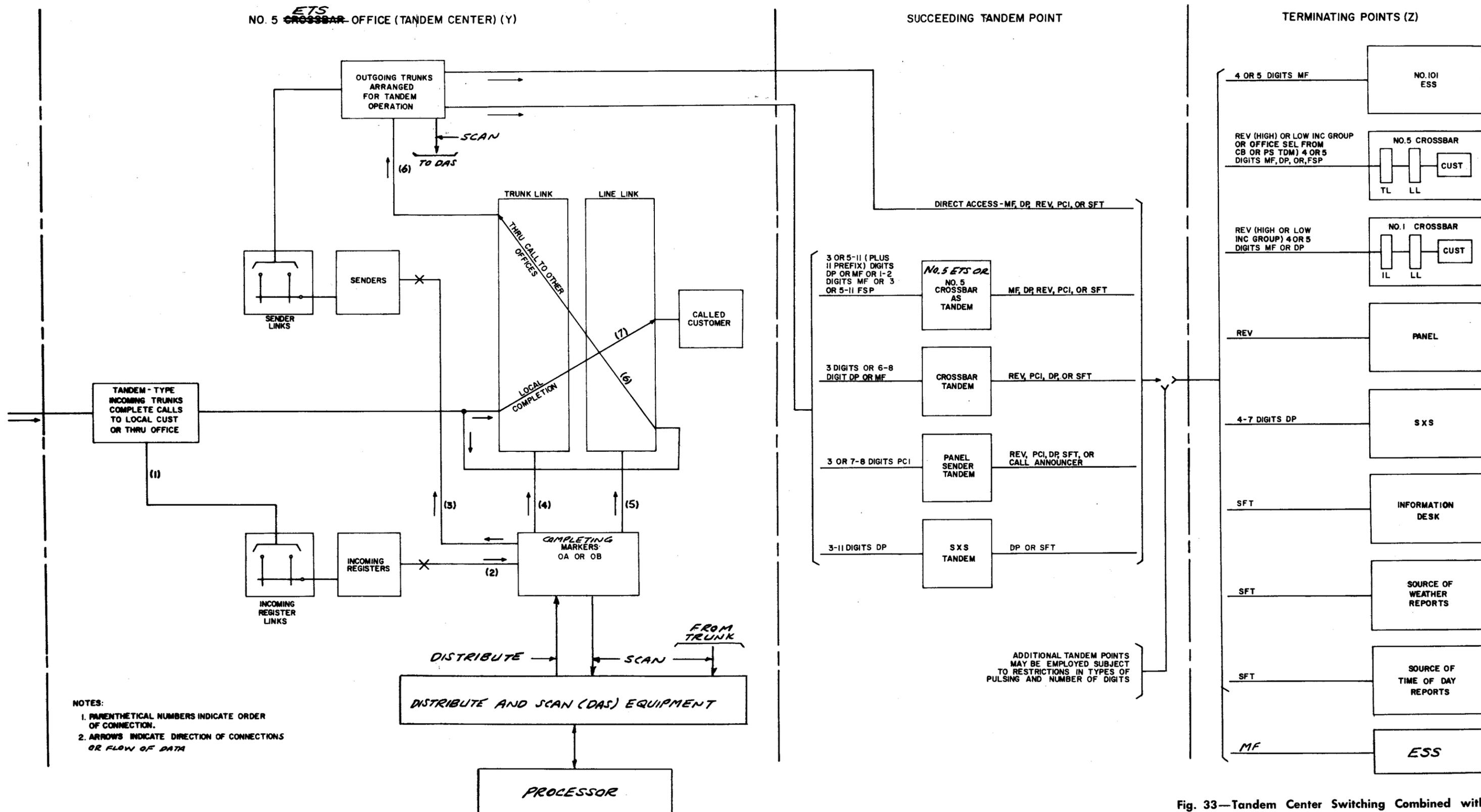


Fig. 32—Outgoing Call From Operator Switchboard—Pulse Conversion (4.85)



NOTES:
 1. PARENTHETICAL NUMBERS INDICATE ORDER OF CONNECTION.
 2. ARROWS INDICATE DIRECTION OF CONNECTIONS OR FLOW OF DATA

ADDITIONAL TANDEM POINTS MAY BE EMPLOYED SUBJECT TO RESTRICTIONS IN TYPES OF PULSING AND NUMBER OF DIGITS

Fig. 33—Tandem Center Switching Combined with Local Completion to Customers in the Same Marker Group (4.87) (4.88)

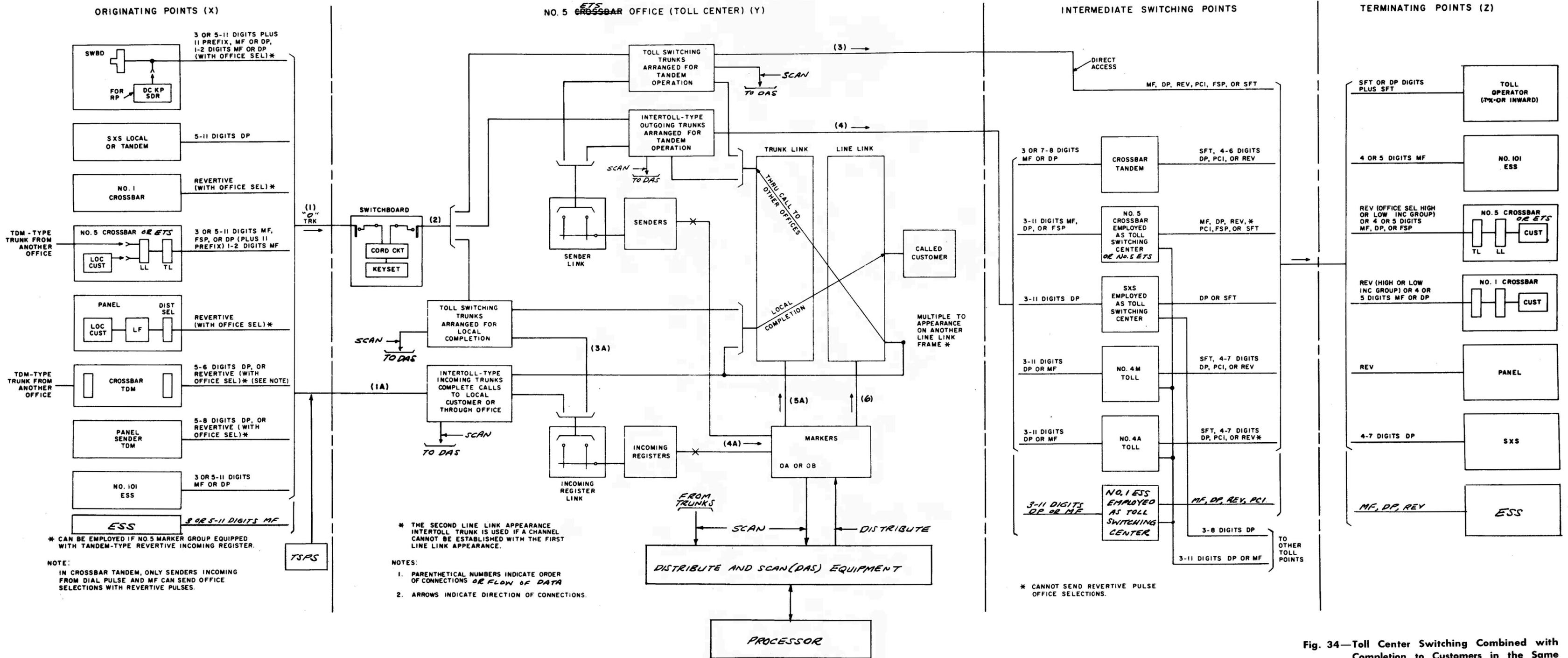
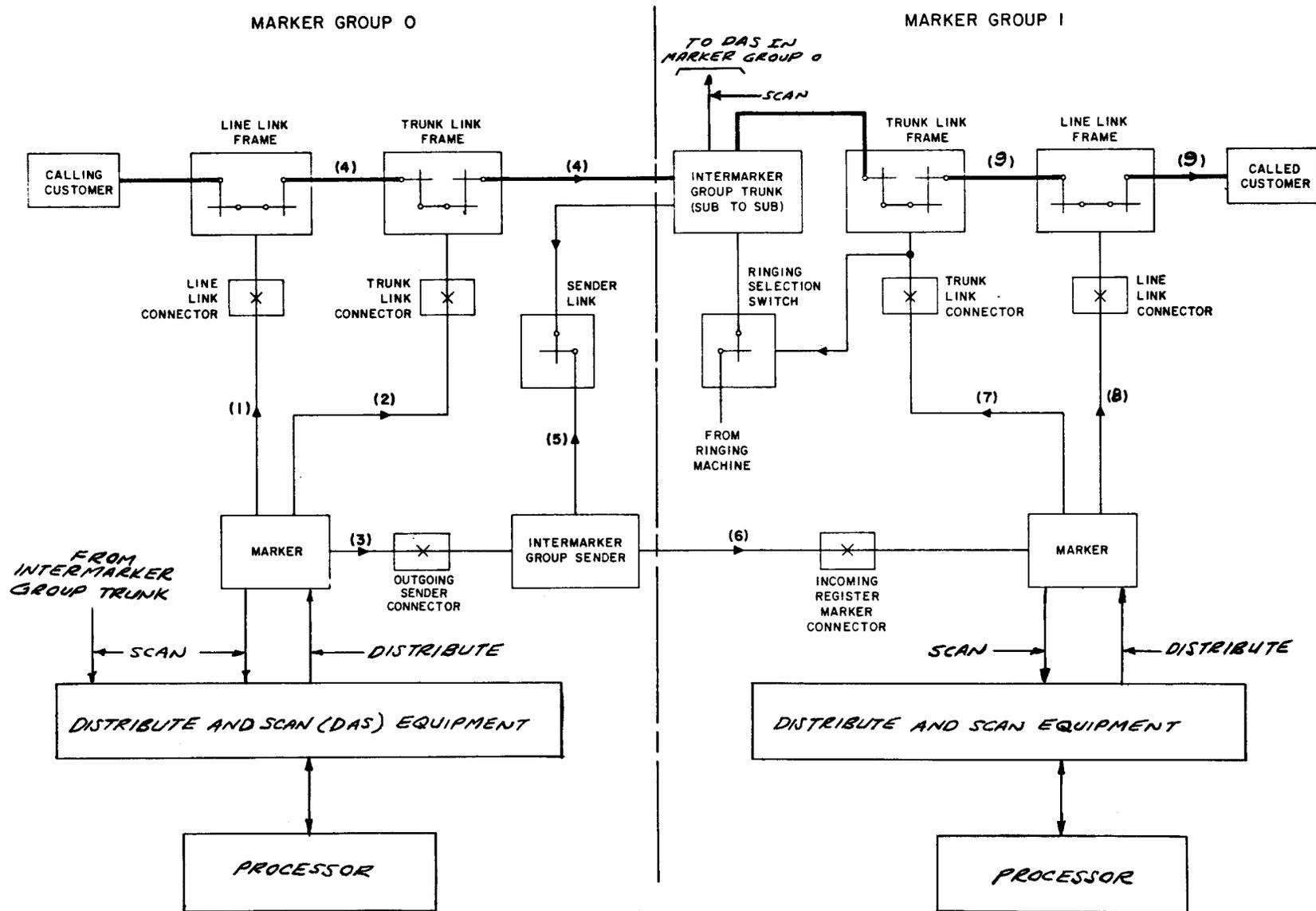
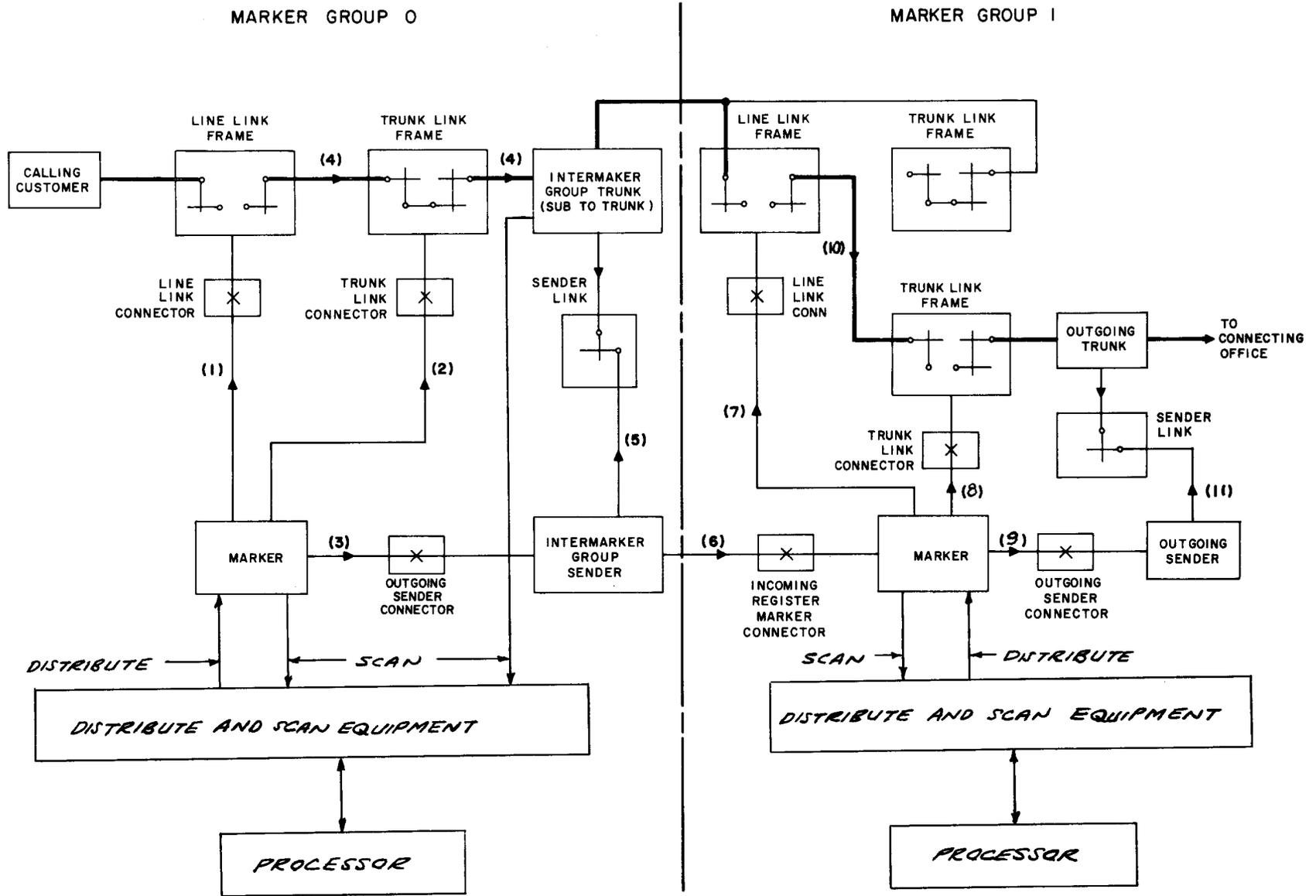


Fig. 34—Toll Center Switching Combined with Completion to Customers in the Same Marker Group (4.90) (4.91)



- NOTES:
1. PARENTHEetical NUMBERS INDICATE ORDER OF CONNECTIONS.
 2. ARROWS INDICATE DIRECTION OF CONNECTIONS OR FLOW OF DATA.
 3. THE DIALING CONNECTION IS NOT SHOWN.

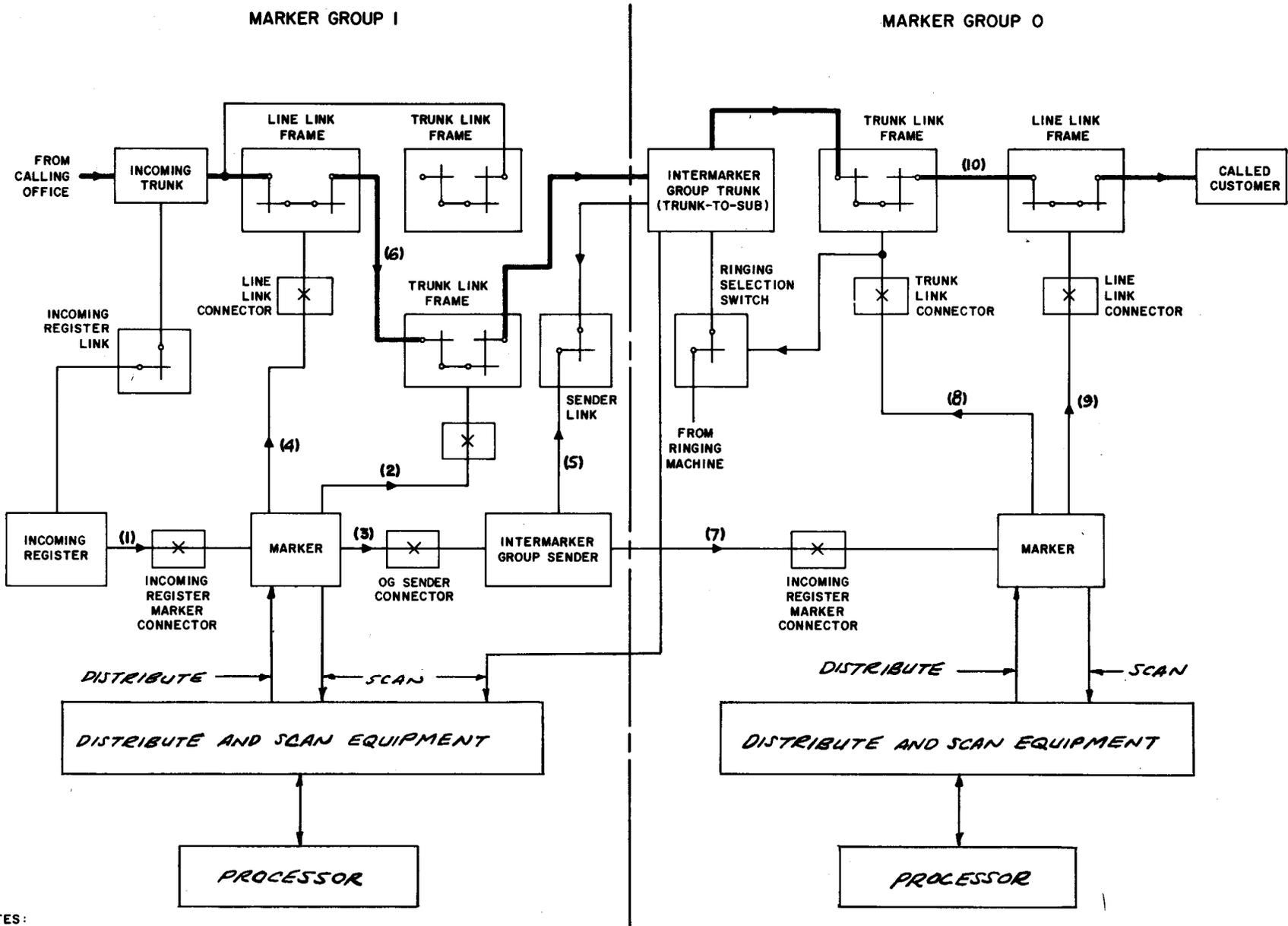
Fig. 35—Intermarker Group Trunk Connection—Customer-to-Customer (4.94)



NOTES:

1. PARENTHETICAL NUMBERS INDICATE ORDER OF CONNECTIONS.
2. ARROWS INDICATE DIRECTION OF CONNECTIONS OR FLOW OF DATA
3. THE DIALING CONNECTION IS NOT SHOWN.

Fig. 36—Intermarker Group Trunk Connection—Customer-to-Trunk (4.95)



- NOTES:
1. PARENTHETICAL NUMBERS INDICATE ORDER OF CONNECTIONS.
 2. ARROWS INDICATE DIRECTION OF CONNECTIONS OR FLOW OF DATA.
 3. THE DIALING CONNECTION IS NOT SHOWN.

Fig. 37—Intermarker Group Trunk Connection—Trunk-to-Customer (4.96)