SWITCHING SYSTEMS MANAGEMENT

NO. 4A AND 4M TOLL SWITCHING SYSTEMS

INTRODUCTION

CONTENTS PAGE

Figures

NOTICE

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CONTENTS PAGE

1. INTRODUCTION

1.01 The No. 4 Toll Switching System is a 4-wire system that uses one pair of wires for transmitting and one pair for receiving. Its latest electromechanical model is the No. 4A.

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

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 No. 4A and 4M Toll Switching Systems have been designed to serve as a control switching point (CSP) in the switching of intertoll traffic on a nationwide basis. By means of crossbar switches and common control equipment, each system provides 4-wire paths for establishing connections mechanically between intertoll trunks, tandem and intertoll trunks, and intertoll and toll switching or miscellaneous terminating trunks.

1.05 This equipment is in use in major toll centers throughout the United States and Canada. For smaller centers, similar control switching point features will be made available more economically through the use of No. 5 crossbar and crossbar tandem equipment.

1.06 Earlier types of the No. 4 Toll Switching System will need to be modified to No. 4A before nationwide and worldwide direct distance dialing can be fully effective.

2. FEATURES

A. General

2.01 The No. 4A System is able to handle switching between points using either a 3-digit central office code or a 6-digit code including both the numbering plan area (NPA) and the local area office codes. It is able to translate the full 6-digit code for selecting the correct route where more than one route exists to other NPAs. It is able to vary the number of digits sent to the distant office and in some cases substitute other code digits when passing all or part of the full 6-digit code to the distant point. It is able to alternate route traffic when the first choice high usage group is busy. Under certain circumstances, as many as seven different alternate routes from one CSP can be tested in a search for an idle path.

2.02 Crossbar switches arranged on incoming and outgoing link frames, together with the necessary trunks and toll terminal equipment, will care for the switching paths.

2.03 The common control equipment, consisting of senders, connectors, decoders, translators, and markers, will set up the switching paths and receive and send, as necessary, the pulsing and signaling information required for completion of the call.

2.04 The relationship between common control equipment and switching frames is shown in Figure 1.

B. Switching Trains

2.05 The switching trains consist of groups of incoming and outgoing link frames on which incoming and outgoing trunks are terminated, respectively. Paths (links) through these frames are set up and closed to establish trunk-to-trunk connections.

2.06 Two arrangements of equipment are provided for the No. 4A System—one with a single train for smaller offices where the number of incoming or outgoing frames will not exceed forty, and the other with two trains each having this capacity.

2.07 The single train arrangement handles both intertoll and toll completing traffic with a maximum of ten markers and ten decoders. Offices using this arrangement are called ***combined train offices.*** The 2-train offices operate with a maximum of ten markers for each train and eighteen common decoders. This arrangement is called ***separate train offices—combined operation*** to distinguish it from other 2-train offices used in the earlier toll switching systems. In the No. 4A 2-train arrangement, each train handles both intertoll and toll completing traffic with multiple appearances of all incoming trunks on the incoming link frames of both trains.

2.08 The system described in this section is a single-train system, since the basic operations are similar in the two types.

C. Trunk Equipment and Link Frames

2.09 The following trunk circuits are provided:

(a) ***Intertoll—***

- One-way (in or out) and 2-way dial
- 2-way (dial in, automatic out)
- One-way out (ringdown or automatic)

(b) ***Tandem—***Incoming from toll or ***A*** switchboards within the toll centering area

(c) ***Toll Switching—***Outgoing to local offices within the toll centering area

(d) Miscellaneous—Such as outgoing trunks to the toll exchange operator, information desk, rate and route desk, etc.

2.10 These trunks handle the following traffic:

(a) Inward traffic from dial intertoll trunks (MF or DP) to toll switching or miscellaneous trunks

(b) Outward traffic from tandem trunks (MF or DP) to outgoing intertoll trunks (MF, DP, automatic or ringdown)

(c) Through traffic from incoming intertoll trunks (MF or DP) to outgoing intertoll trunks (MF, DP, automatic or ringdown).

2.11 The incoming and outgoing link frames are composed of a primary and a secondary bay of switches, each 10 switches high, with the required extension bays to accommodate the number of trunks necessary to make efficient use of the call-carrying capacity of the frame. Incoming trunks appear on the primary and primary extension bays of the incoming frames, and outgoing trunks appear on secondary and secondary extension bays of outgoing frames. Each bay has a capacity of 100 trunks, with a maximum of 400 trunks and 300 trunks per incoming and outgoing frames, respectively. The links connecting the primary and secondary bays of the incoming frames are called ***A*** links; those connecting the secondary bays of the incoming frames and the primary bays of the outgoing frames are called ***B*** links or junctors; and those connecting the primary and secondary bays of the outgoing frames are called ***C*** links. Each incoming frame has connections to all outgoing frames, but none to other incoming frames. The reverse is true of outgoing frames. Simplified schematic diagrams of the arrangements are shown in Figures 2 and 2a.

2.12 The junctor pattern, or arrangement for connecting all incoming and outgoing frames, should be determined at the very start of the engineering effort for a No. 4A project and adhered to for the life of the office. The importance of this choice cannot be overemphasized, as engineering, manufacture, and installation are each vitally dependent on the pattern chosen and any change in the pattern will result in exceedingly costly rearrangement work.

3. COMMON CONTROL EQUIPMENT

A. General

3.01 Crossbar systems use common control equipment to establish connections for all types of calls. Figure 3 shows in block diagram form the major items of common control equipment, together with the trunks and link frames. The parenthetical numbers in this diagram indicate the relative sequence of the connection indicated.

B. Sender Link Frames

3.02 The sender link frame associates an incoming or outgoing trunk with an incoming or outgoing sender, respectively. Each sender link frame has 40 primary-secondary links which have access to 100 trunks on the horizontals of the primary switches and to 40 senders on the horizontals of the secondary switches. Connections between the trunks and the senders are set up by controllers which are reached by the sender link frame through controller connectors. Duplicate connector equipment is furnished for each sender link frame for access to the controller connectors. Senders of a type are connected to the sender link frames in groups of 80 maximum on a ***key*** frame basis. The key frames are the first four sender link frames of a group. They are interconnected with a slip multiple which is arranged so that when there are 40 or less senders, all senders appear on all link frames. When the number of senders exceeds 40, the additional senders, up to 80, are introduced into the slip multiple in such a way that each sender has appearances on two key frames. Thus, each frame has access to 40 senders, but not always to the same combination of 40.

C. Link Controller and Connector Frames

3.03 The link controller and connector frame connects trunks through the sender link frames to the senders. The controller connector is called in to select an idle controller by the link frame on which the trunk appears. Each link frame has a choice of one of two controller connectors which in turn have access to the same group of controllers, thus providing a duplicate channel to any controller in the group from any link frame.

3.04 The maximum group size is six controllers and six controller connectors. When this limit is exceeded, the sender link frames are subgrouped and each subgroup is provided with separate controllers and connectors.

D. Incoming Sender Frame

3.05 Incoming senders are of two types—dial pulse and multifrequency. They record numerical digits necessary to complete connections through the No. 4A equipment and to control the selection beyond the No. 4A office over the toll completing, intertoll, and miscellaneous trunks. Outpulsing from these senders may be multifrequency or dial pulsing directly to outgoing trunks, or dc keypulsing to outgoing senders. The senders have 11-digit capacity and are arranged for code conversion. Three senders of either type, but not in combination, mount on the incoming sender frame.

E. Multifrequency Receiver Frame

3.06 The multifrequency (MF) pulsing receiver circuit receives and amplifies MF pulsing signals and converts those signals into dc pulses to operate various code combinations of relays in the associated sender. The MF pulsing signals consist of an alternating current of six different frequencies which are combined to provide keypulsing, start signals, and digit codes.

F. Outgoing Sender Frame

3.07 Outgoing senders are required to complete calls to panel offices, crossbar offices not arranged to receive MF, and manual offices arranged for panel call indicator. When an outgoing trunk is selected in the No. 4A office to one of these offices, an outgoing sender is attached, and the trunk passes the necessary class information to the sender. The sender then receives the toll and office code and numerical digits from the incoming sender on a dc keypulsing basis and establishes the connections to the called offices. Three senders mount on one outgoing sender frame.

G. Decoder Connector Frame

3.08 The decoder connector frame mounts three decoder connectors, which provide facilities for connecting incoming senders to the office decoders and markers. Upon receipt of a signal from the sender, a number of leads are cut through to an idle decoder. When the decoder is ready for connection to a marker, the sender is also cut through to the selected marker by this decoder connector. Each connector serves five incoming senders and has access to all the decoders and markers in the office.

H. Decoder Frame

3.09 The decoder, in conjunction with the card translator, translates the code received from the sender into the specific information required by the marker and the sender for the completion of a call through a No. 4A toll switching system.

A sender connects to a decoder as soon as it has registered three code digits. The decoder selects a 3-digit card in the home translator; if sufficient information is available on the card to switch the call, the decoder connects to a marker, passes the information for completing the call, and then releases. If the card indicates that more than the three code digits are required (6-digit translation), and if they have not been received by the time the decoder determines this fact from the card, the sender is dismissed with a signal to request a decoder when it has six digits registered. After decoder reseizure, selection of the same 3-digit card is made to determine the translator box location of the desired 6-digit card. The decoder then restores the 3-digit card, selects and reads the 6-digit card containing the required switching instructions, and passes the information to the marker. When the instructions indicate that the decoder will provide no more information for the call, it disconnects, leaving the marker attached to the sender through the decoder connector for completing the call.

3.10 The above information assumes that adequate information is available on the final card dropped for the decoder to complete its function. For calls switching to points with more trunks than can be included on one card (40) or with alternate routes, the decoder has added functions having to do with making the additional trunks and alternate routes available for testing.

I. Card Translator

3.11 The card translator is literally the ***seeing eye*** of the No. 4A common control equipment. It translates the code digits registered in the incoming sender into information which is used by the common control equipment to switch a call. It is called card translator because metal cards are used in the translation process instead of the relay translator used in all other common control systems.

3.12 Card translators are equipped with metal cards, coded, to provide the switching information for all calls arriving at a No. 4A office. As shown in Figure 4, each card has 40 tabs and 118 holes. The tabs are used to code the card to correspond to a called code. This is accomplished by removing some of the tabs so that the remaining tabs are arranged in a definite pattern unique for this card. This tab coding is called the input information. The holes in the card are also coded to correspond to the switching information required for the called code represented by the card. The switching intelligence is applied to the card by enlarging the pertinent holes. It is called the output information.

3.13 The basic elements of the translator consists of a light source modulated at 400 Hz, a bank of light sensitive photo-transistors, and a stack of perforated cards. Each translator can hold about 1100 of the old cards or about 1300 of the new thinner cards. The cards are stacked between the light source and the photo-transistors, of which there is one for each hole in the card. When the cards are in their normal positions, the holes in the cards form 118 continuous tunnels or light channels between the light and the transistors. When the translator is operated, a card is dropped about 1/8 inch; all of the light channels are blocked except for those holes which have been enlarged. Figure 5 shows a schematic of the translator, and Figure 6 indicates the effect of a dropped card on the light channels.

3.14 The selection and dropping of a card is accomplished by means of the card tabs and a group of code bars. The tabs correspond in position to, and rest directly on, 40 rectangular bars located at right angles to the cards. As mentioned previously, a unique group of tabs are left on the card to agree with the code represented. Figure 7 shows a card resting on the code bars when the translator is unoperated. When the decoder connects to the translator, it depresses certain code bars by means of solenoids. The one card, whose tabs correspond to the depressed bars, is thus permitted to drop as shown in Figure 8.

3.15 The card drops a distance slightly greater than the height of an uncoded (nonelongated) hole. Thus, the dropped card produces a shutter effect on all light channels except those for which the card holes were enlarged. The open channels energize their photo-transistors and associated detector amplifiers. These circuits react to the beams of light and transmit the information to the decoder.

J. Electronic Translator System

Introduction

3.16 With the volume of traffic switched through the No. 4A/4M toll machines reaching higher levels each year, two aspects of the route translation—cost and flexibility—have become increasingly important. Continued use of the electromechanical card translator would exact major penalties in both of these aspects. In addition, future network management arrangements would be seriously hampered. Of the choices available for replacement of the card translator, a system using solid state switching devices under stored program control has been chosen and designated the Electronic Translator System (ETS).

3.17 The new system is capable of meeting increased translation requirements resulting from the growth of toll traffic and the introduction of new or changed services, such as overseas transit dialing, private network arrangements, and the new numbering plan. Electronic translation provides a greatly expanded supply of incoming trunk class marks for use in conjunction with address digits and other control inputs. It also allows electrical alterability of route translation to expedite emergency changes and to facilitate network management procedures.

Principles of System Operation

3.18 The basic component of the ETS arrangement is a Common Systems Stored Program Control (SPC) No. 1A. It has been developed concurrently with the Traffic Service Position System (TSPS) No. 1A that will employ the No. 100B TSP with electronic switching to improve operator assistance facilities.

3.19 The solid-state SPC is a fully duplicated, stored program, digital control system, as is the Central Control (CC) with associated program and call stores used in the No. 1 ESS. The SPC differs from the ESS-CC in that it employs a single type of bulk memory using the piggyback twister (PBT) module for both program and data storage.

3.20 The SPC operates under the control of a program of instructions (the software) which is a set of 40 bit words stored in the memory (store). The software for each SPC application will include common programs for operating and maintaining the SPC. The SPC processor recalls instructions sequentially from the store and executes them one at a time. In normal operation, the two processors will operate in parallel to execute identical instructions recalled independently from the duplicated stores. One of the processors assumes active control of input or output and of system activities. High speed matching of information between the two processors will provide the major means of trouble detection within the SPC.

3.21 General input to the SPC is through adapted No. 1 ESS master scanners (MS) which are duplicated. These MSs contain unduplicated ferrod sensors as scan points to monitor the presence of current in connecting circuits and to convert information from electromechanical to electronic form.

3.22 General output of the SPC is through adapted No. 1 ESS signal distributors (SD) and central pulse distributors (CPD) which are duplicated. The SD responds to high-speed signals from the processor to operate or release magnetically latching wire spring relays. The CPD responds by providing pulses to control solid-state flip-flops for its major function of performing address decoding for units such as the MS and SD.

3.23 A master control center provides controls, alarm displays, and associated program tape (PT) and teletypewriter (TTY) units which are necessary to maintain the SPC and peripheral electronic equipment. The TTY is also used by the SPC to supplement alarm and status information for maintenance personnel and may be duplicated at a remote location for extended control purposes.

3.24 The interface between the SPC and the No. 4A/4M crossbar equipment requires several peripheral circuits of both electromechanical and electronic types as shown in Figure 9.

3.25 The decoder channel circuit (DCH), consisting of wire-spring relays, provides sender access from the decoder connectors to the SPC for the dialed code digits and controls selection of the marker through marker connectors by instructions from the SPC. The DCH also verifies the sender-marker connection and the registration of routing information which the marker receives from the SPC through the marker connector and two peripheral electronic circuits—the distributor register (DR) and the peripheral function translator (PFT).

3.26 The peripheral scanner (PSC) uses ferrod sensors to monitor status, to detect bids, and to read input information required by the SPC for call handling. The major circuits scanned by the SPC are the decoder channel, sender link controller, and group busy relays.

K. Marker Connector Frame

3.27 The marker connector cuts through approximately 120 leads between the decoder and an idle marker upon receiving a signal from the decoder. Each connector serves one decoder and has access to all markers.

L. Marker Frame

3.28 Markers locate the calling trunk, select an idle trunk in the group to the called destination, and mark an idle path between the two before setting up the connection from the incoming to the outgoing frame. As soon as the marker is connected to a decoder by means of a marker connector, it receives routing instructions from the decoder and translator regarding the called trunk group. It also receives an MF signal from the incoming trunk from which the marker identifies the particular frame on which the trunk appears. The information received from the decoder concerns the location of the called trunk group and routing information required to complete the call. This information directs the marker to the block relay having the test leads of the called trunk group or subgroup. The marker selects the first idle trunk and receives another MF signal to identify the outgoing frame on which it appears. The marker then associates itself with the incoming and outgoing frames by means of frame connectors, selects the first idle combination of available paths consisting of an incoming link, a junctor, and an outgoing link, and sets up the connection by closing the crosspoints on the switches involved. In the meantime, the marker has sent back to the sender whatever routing information is needed for the further progress of the call.

M. Trunk Block Connector Frame

3.29 A group of outgoing trunks to a particular destination is spread evenly over outgoing frames. To enable the marker to conveniently test the desired group and to select an idle trunk, however, it is necessary to assemble the test leads for all trunks at a central location. The sleeve and select-magnet leads of outgoing trunks are brought to the trunk-block connector for this purpose.

3.30 A single connector accommodates 400 trunks, in ten ***blocks*** of 40 each, with duplicate appearances, and gives all markers access to them. A block consisting of 40 trunks may be (a) a complete trunk group insofar as destination is concerned, (b) only part of a group, or (c) several groups.

3.31 The select magnet lead which is brought through the trunk-block connector carries information to the marker identifying the location of the trunk on the outgoing frame. Since it is frequently necessary to make temporary reassignments of toll lines, the trunk-block connector is supplemented by assignment patching bays (APB) through which the sleeve and select magnet leads of many toll lines are carried and where, with patch cords and plugs, trunk groups may be conveniently enlarged or reduced. A trunk-block connector frame accommodates two connectors.

4. TYPICAL CALLS

A. Call Through A No. 4A/4M System

4.01 All calls described are theoretical.

4.02 The call through a No. 4A/4M System is a single call requiring 3-digit translation and is switched to a system requiring MF pulsing.

4.03 The call arrives at the No. 4 office over an incoming trunk and leaves over an outgoing intertoll (IT) trunk. The incoming trunk may be selected by an outward operator, or it may be seized at a distant automatic toll office. (The procedure in this No. 4 office is the same in either case.)

4.04 As shown in Figure 3, each incoming trunk has two major appearances in a No. 4 office—one on the incoming frame, used for the talking connection, and one on the sender link frame, used for passing information to the common control equipment.

4.05 As soon as the incoming trunk is seized, it signals a sender link (connection 1) to connect it to an incoming sender for registering the incoming pulses. To make this connection, the sender link frame through its connector signals a controller connector to seize an idle link controller (connection 2). The link controller then tests for and seizes an idle incoming sender and closes the crosspoints between this sender and the incoming trunk at the sender link frame (connection 3). This completes the function of the link controller and controller connector, and they release from the connection to serve other calls.

4.06 As soon as the incoming sender is attached, it signals either for the outward operator to begin pulsing or, if the call is from a distant automatic toll office using senders, for the sender in that office to begin pulsing. When the incoming sender in this office has received and registered three digits, it signals the decoder connector to seize an idle decoder (connection 4). This decoder immediately connects to its home translator (connection 5). Now the three code digits in the sender are transmitted through the decoder to the home translator and a card coded to correspond to these digits drops. This card contains information for switching the call with 3-digit translation.

4.07 The decoder reads the card and signals a marker connector to seize an idle marker (connection 6). When a marker is seized, the marker connector signals the decoder connector to connect the incoming sender to this marker (connections 7 and 7a). These connections are necessary because the marker must give certain information to the sender after the decoder may have been released.

4.08 The marker obtains the locations of the outgoing trunks suitable for this call from the decoder and the dropped card. Guided by this information, the marker selects an appropriate outgoing trunk through a trunk block connector (connection 8). This trunk then registers its outgoing frame appearance in the marker.

4.09 The decoder and the card also tell the marker (a) that the incoming sender should outpulse on an MF basis for this call and (b) whether the digits should be outpulsed as received, skipped, or converted. When the marker has received all of this information, it signals the decoder to release.

4.10 Now the marker proceeds to set up the talking path from the incoming trunk to the selected outgoing trunk. Through the outgoing frame connector, the marker gains access to the incoming links through the incoming frame connector (connection 9a). (The incoming trunk has already registered its incoming appearance to the marker over connections 1, 3, 4, and 7a.) The marker then tests the incoming and outgoing links and the junctors to find an idle channel between the incoming trunk and the outgoing trunk. It then closes the crosspoints to establish this channel (connection 10).

4.11 Now the marker passes the outpulsing information to the sender and releases from the connection. The sender outpulses the digits through the sender link frame over the transmission path to the outgoing trunk and through to the called office; then the incoming sender and sender link frame release.

4.12 The connections in the transmission path remain until a disconnect signal is received. Then all the connections are released and the equipment returns to normal.

4.13 The time the common control equipment takes to switch a call through a No. 4A office is so short that the operating time of each piece of apparatus is measured in milliseconds and Bell Telephone Laboratories works constantly trying to reduce the operating time of each type of apparatus.

B. Three- and 6-Digit Translation

4.14 Figure 10 shows two calls from an Oakland, California, customer to customers in Cleveland and Canton, Ohio. For the call to customer ***B,*** the Oakland customer must dial 216-622-1234 (area code 216 for Cleveland, 622 for the central office code serving the called customer, and 1234 to complete the called customer's telephone number).

4.15 Dialing for the call to customer ***C*** is like that for the call to ***B*** except that the central office code is 623.

4.16 These calls illustrate 3-digit translation in the Oakland, Cleveland, and Canton offices. In all three offices, the calls are switched from information provided by the first three digits received. Because it has two groups of trunks to the 216 area, the Chicago office must look at six digits: (1) the first group of three to determine the area where the call will terminate and (2) the second group of three to determine the central office code to know whether to send the call to Cleveland or Canton, both of which are in the 216 area.

4.17 Figure 11 illustrates automatic alternate routing. The preferred route from Oakland to Cleveland is via Chicago. On this particular call, Oakland finds all the Chicago trunks busy, so it automatically selects trunks to St. Louis and completes the call through St. Louis to Cleveland.

C. Coding Conversion and Variable Spill

4.18 Figure 12 shows that the Sacramento office knows from the card used on this call that San Jose has no need of the 415 area code because the call will complete in that area; therefore, the Sacramento office omits the 415 when spilling forward to San Jose. This illustrates the variable spill feature. At San Jose, the card used indicates that Palo Alto requires only 2-1234 for switching this call. Therefore, the card indicates that the 962 for the central office code should be ***code converted*** to a 2.

5. TOLL TERMINAL EQUIPMENT

5.01 The toll terminal equipment is an important part of the overall layout of a No. 4 system. In fact, it is somewhat difficult to separate the two, as distributing frames are provided as part of the No. 4 installation to which a large amount of the toll terminal equipment is cabled for direct cross-connection to No. 4 circuits.

5.02 Major items of toll terminal equipment cabled in this manner include the No. 17C toll testboard, circuit patch bays, and assignment patch bays. Figure 13 provides a diagram showing the interconnections of these units with the switching equipment.

6. MAINTENANCE FEATURES

6.01 With its relatively small quantity of vital common control equipment, the No. 4A System requires accurate and speedy locating and clearing of troubles. To facilitate these functions, the following frames are located in a portion of the switchroom called the maintenance center.

6.02 ***Trouble recorder frame:*** This frame indicates by a perforated card where, in the course of handling a call, the switch equipment runs into trouble. This frame also provides means for testing decoders, markers, translators, and link controllers and makes it possible to manually operate the card translator for maintenance purposes.

6.03 ***Sender test frame:*** This frame is used for making routine and trouble location tests on senders both automatically and manually.

6.04 ***Sender make busy frame:*** This frame provides a ready means for removing senders from service.

6.05 ***Automatic outgoing toll connecting trunk test frame:*** This frame makes it possible to test toll connecting trunks on an automatic or manual basis.

6.06 ***Manual outgoing toll connecting trunk test and test and make busy frame:*** This apparatus makes it possible to manually test circuits, including cable pairs, into local offices. Connections are made to these circuits in a manner which bypasses the No. 4A trunk circuits. It also provides a convenient means for busying toll connecting trunk circuits.

6.07 The chief switchman's desk, card files, and other items vital to efficient maintenance are also located in the maintenance center.

6.08 In addition to the frames mentioned in 6.02 through 6.07, a number of smaller units and portable test sets, such as the No. 35F relay test set, the No. 2B signaling test set, the No. 40B transmission test set, etc, are provided to aid in the maintenance force's duties.

6.09 Under toll terminal equipment in Part 5, mention was made of the close connection between the switching equipment and the toll terminal equipment. This arrangement necessitates close coordination between the switching equipment maintenance force and those people maintaining the toll terminal equipment who make extensive use of the No. 17C toll testboard and the automatic outgoing intertoll trunk test frame in conjunction with No. 4A maintenance. Adequate intercommunication facilities must be provided to meet the frequent need for communication between the two groups.

7. Summary of Overall Features

7.01 Because of its features, the No. 4 system has the ability to complete calls on a destination basis using the called telephone number and to perform the translation and routing functions necessary. It has the ability to handle calls in a variety of ways, including the following:

(a) Three-digit translation for calls to points within the same area as the CSP receiving the call.

(b) Three-digit translation for calls to foreign areas where it is desirable to handle all calls to that area over one trunk group.

(c) Six-digit translation for calls to foreign areas where there are more than one entry to that area, and where the CSP in the calling area must look at the full telephone number.

(d) Variable spilling with ***no skip, skip 3,*** or ***skip 6*** for calls where the office selected as the next switching point may not require the complete code.

(e) Prefixing for calls where the next office requires more code information than that registered in the sender handling the call.

(f) Code conversion for calls that require a change in the numerals for the first, second, or third digit to be outpulsed.

(g) Code matching, which is a means whereby the decoder matches the first three registered digits with the first three required at the next CSP to determine the need for prefixing. (This is used when alternate route trunk groups have been selected.)

(h) Alternate routing over a succession of trunk groups to various CSPs. (This routing follows a predetermined pattern in accordance with the toll switching plan and always progresses toward the ***home*** group for the calling CSP.)

(i) Principal city routing, which is utilized on calls to foreign areas where more than one entry exists, but where calls to certain points may be completed via the principal city.

(j) Route advance, which is the ability to scan the 40 trunk subgroups of large outgoing trunk groups successively up to 160 trunks.

8. SUPPLEMENTARY INFORMATION

Bell System Practices

SECTION	TITLE
212-000-000	Numerical Index—Division 212—No. 4A and 4M Toll Switching Systems.
818-000-000	Numerical Index—Division 818—No. 4 Type Toll Switching System.
818-005-170	No. 4 Type Toll Switching Systems—Engineering Information—No. 4M Office
818-005-171	No. 4 Type Toll Switching Systems—Engineering Information—No. 4A Office
964-110-100	No. 4A and 4M Toll Switching Systems—General Description

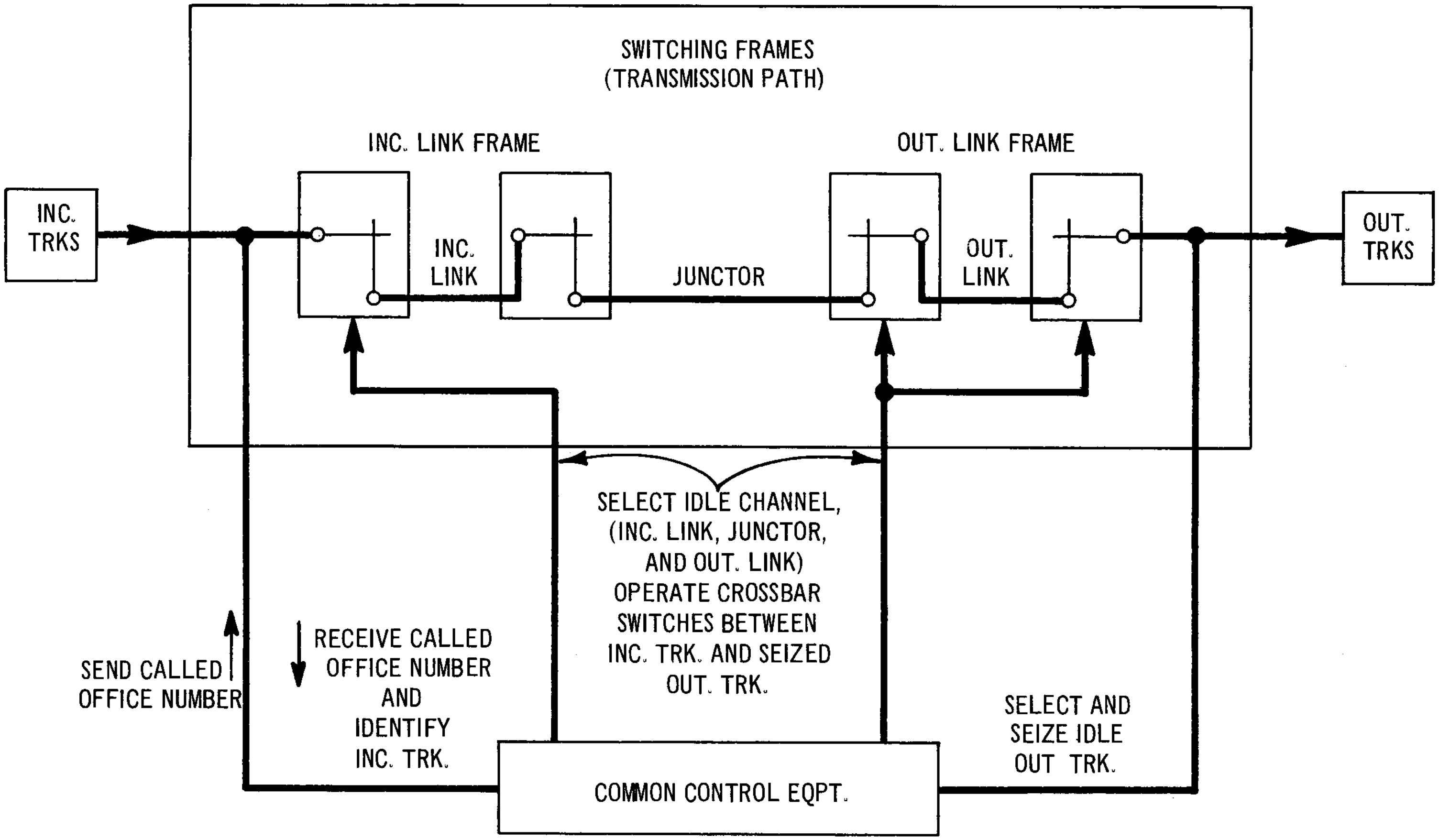


Fig. 1—Relationship Between Common Control Equipment and Switching Frames (2.04)

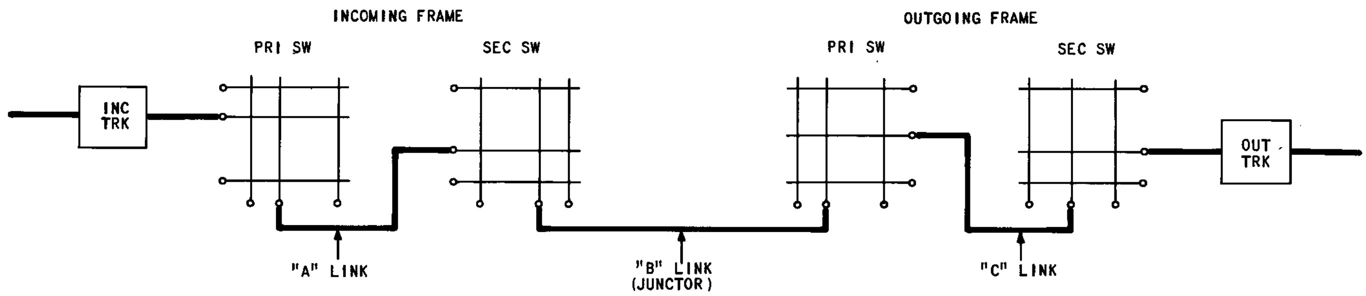


Fig. 2—Channel Between Incoming and Outgoing Trunks (2.11)

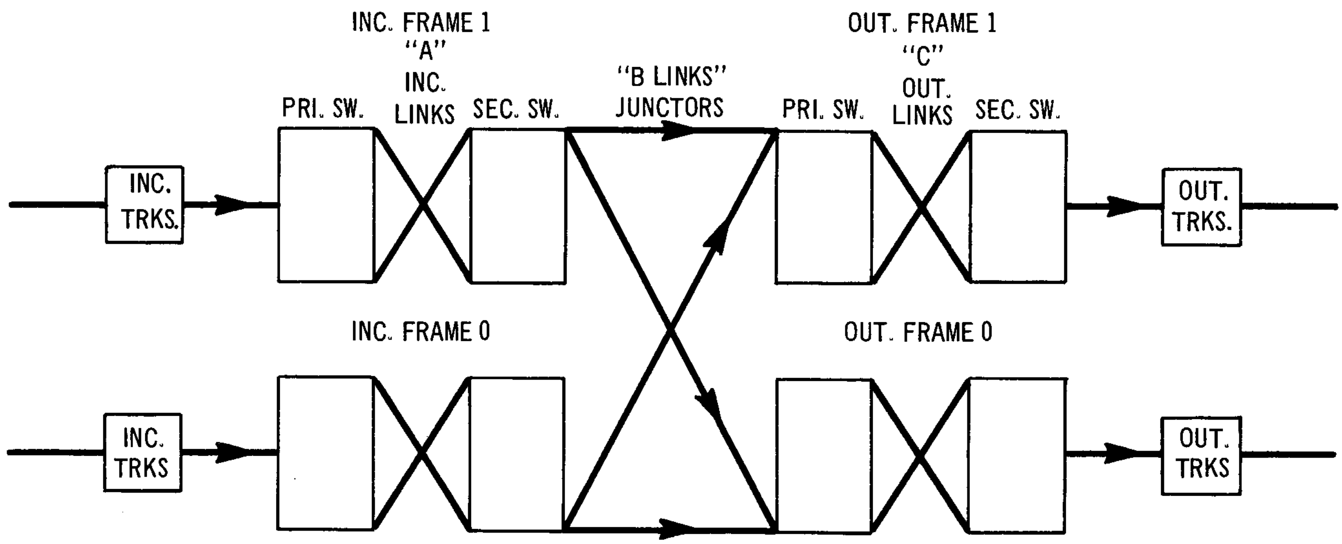


Fig. 2a—Path of Call Through Incoming and Outgoing Frames (2.11)

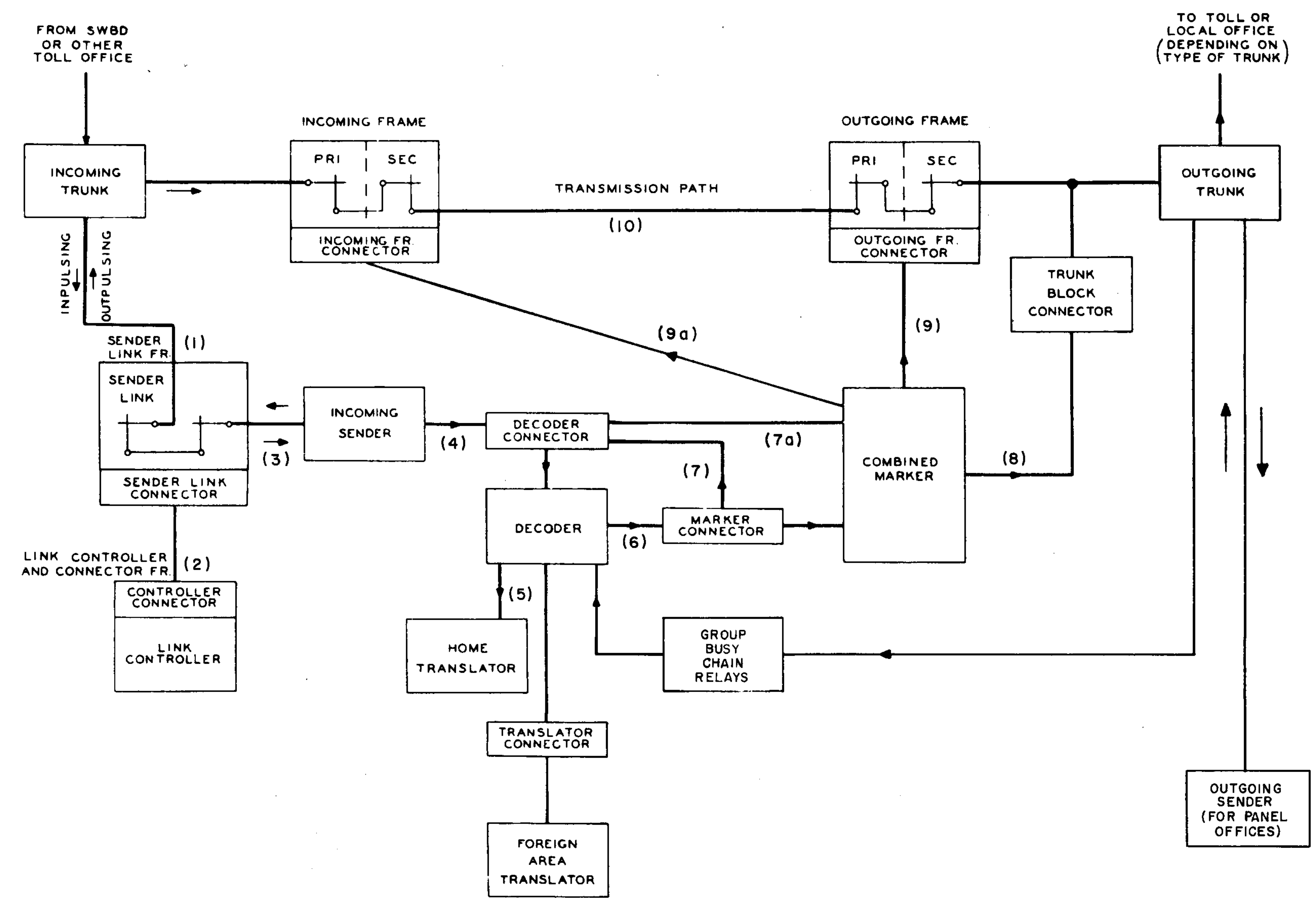


Fig. 3—Call Through a Combined Train CT Office (3.01, 4.04)

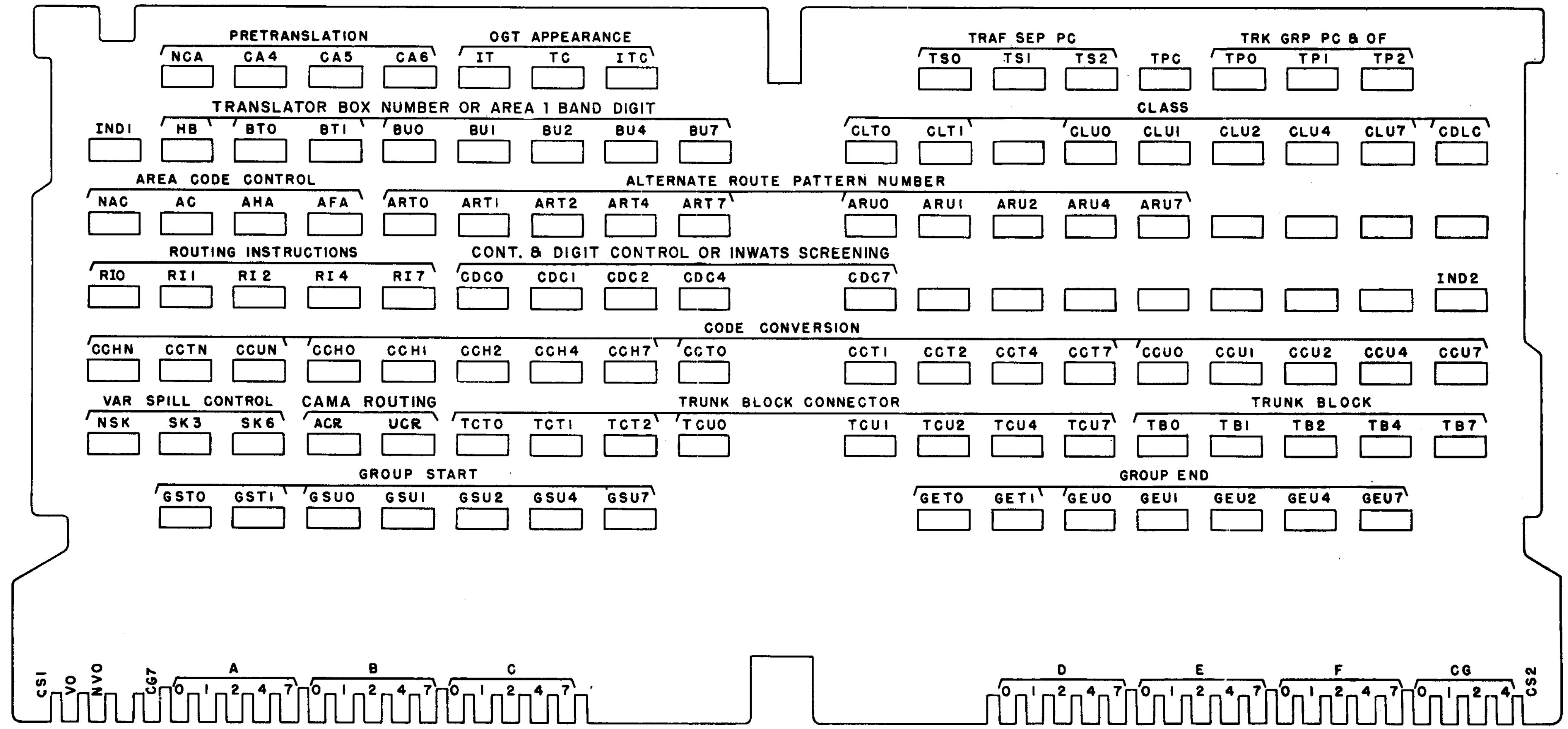


Fig. 4—Translator Card (3.12)

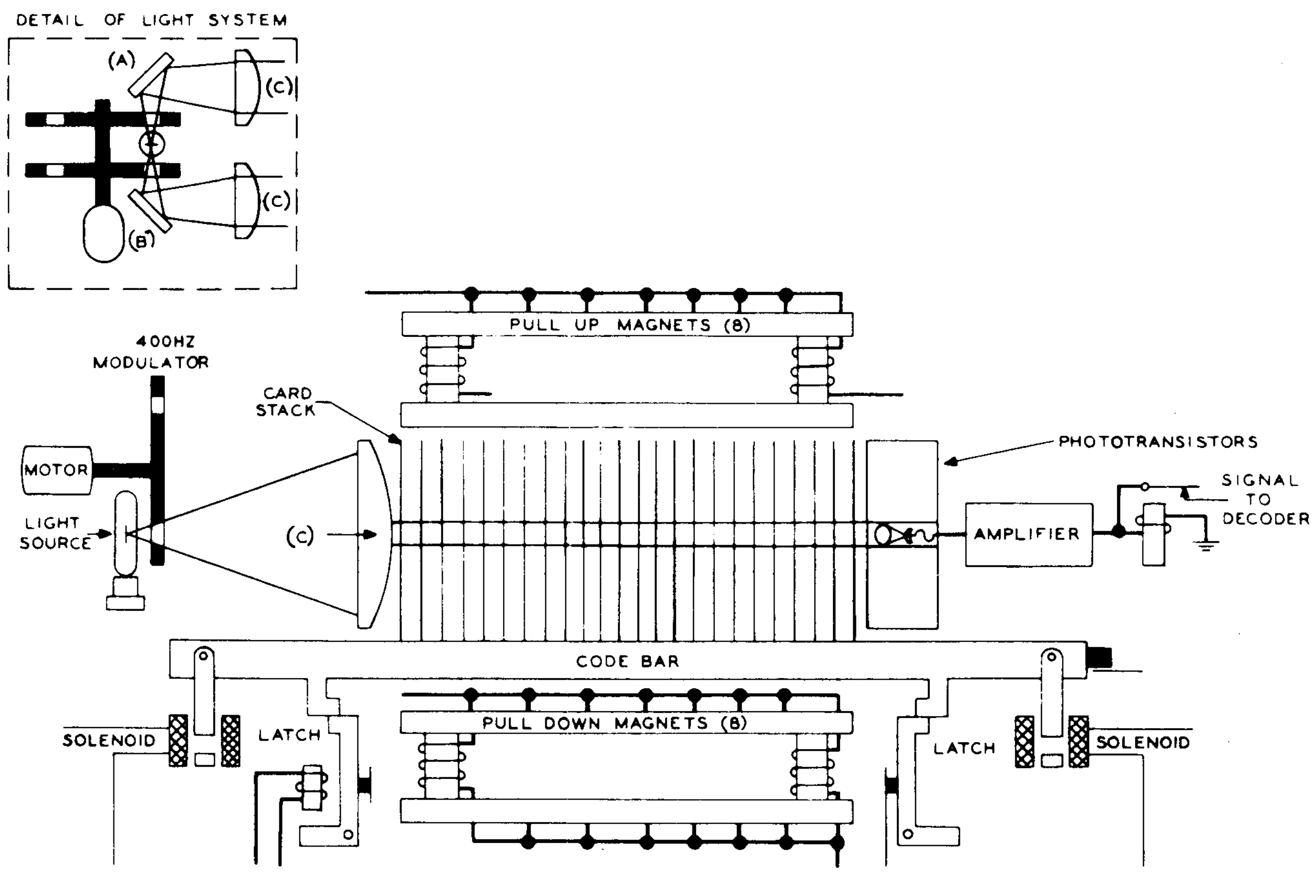


Fig. 5—Elements of Card Translator (3.13)

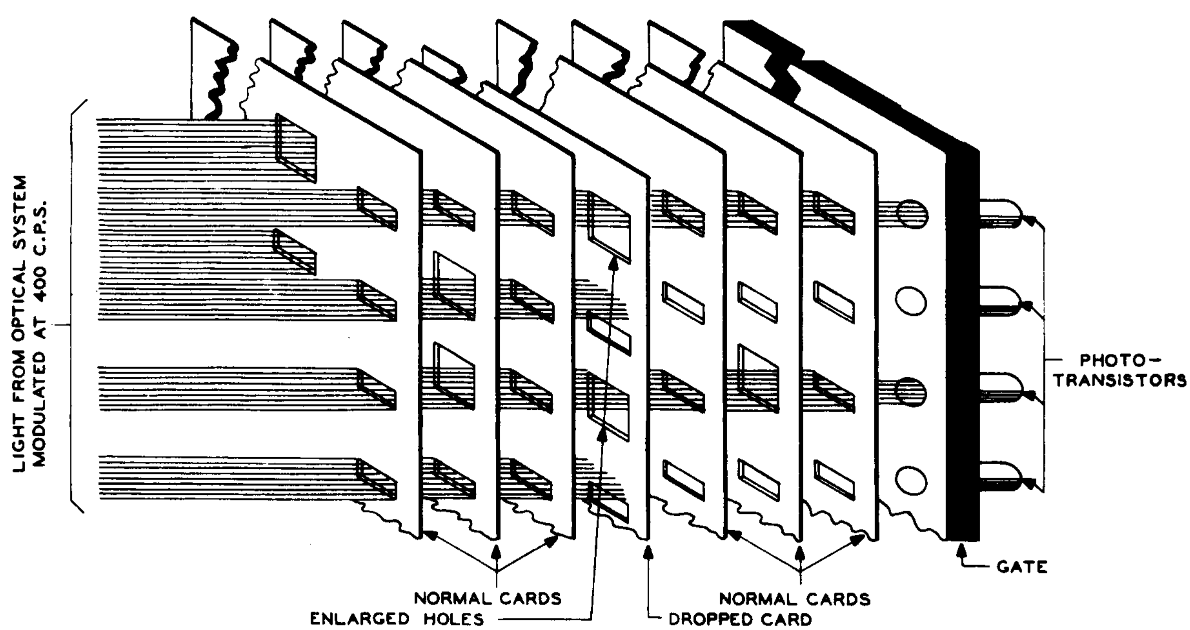


Fig. 6—Effect of Dropped Card on Light Channels (3.13)

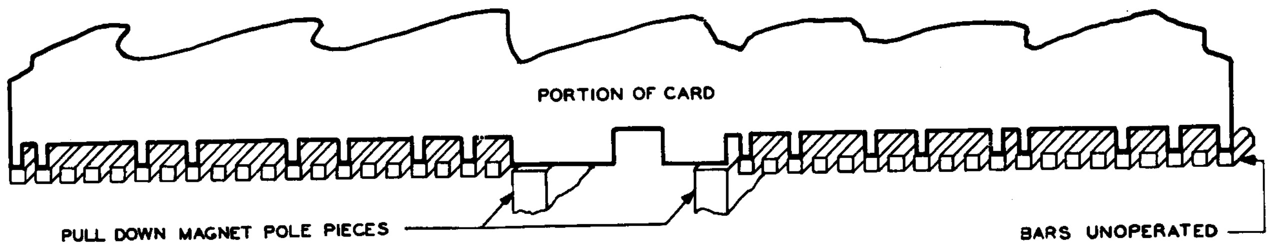


Fig. 7—Card Support and Code Bars Normal (3.14)

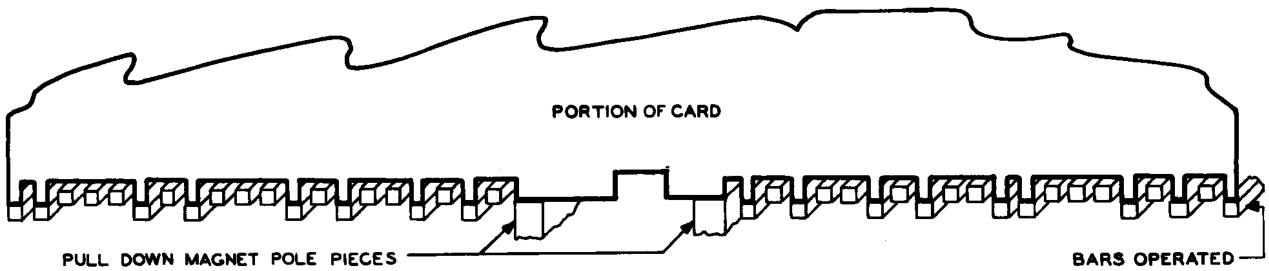


Fig. 8—Card Support and Code Bards Operated (Corresponding Card Drops) (3.14)

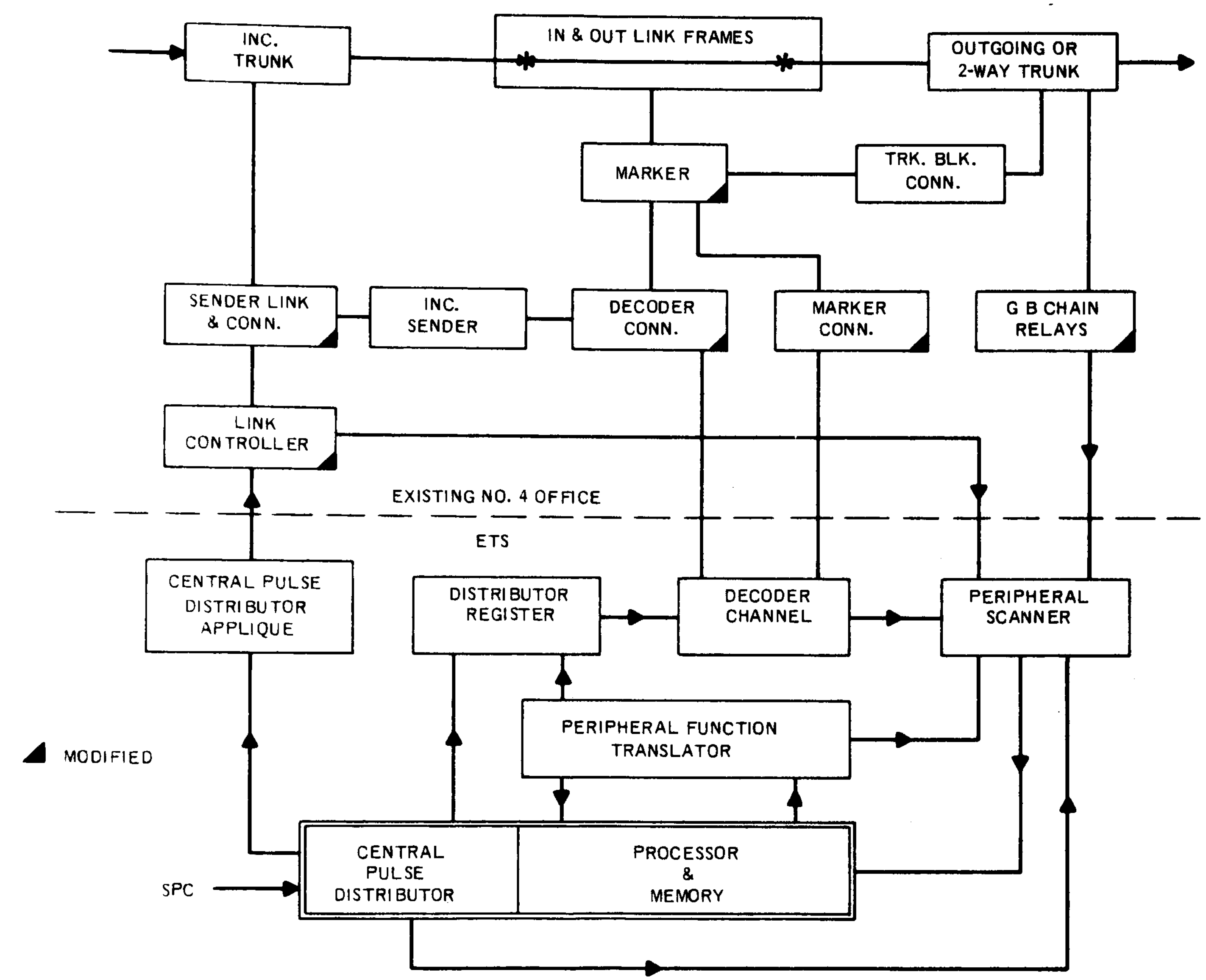


Fig. 9—Electronic Translator System (ETS) Schematic (3.24)

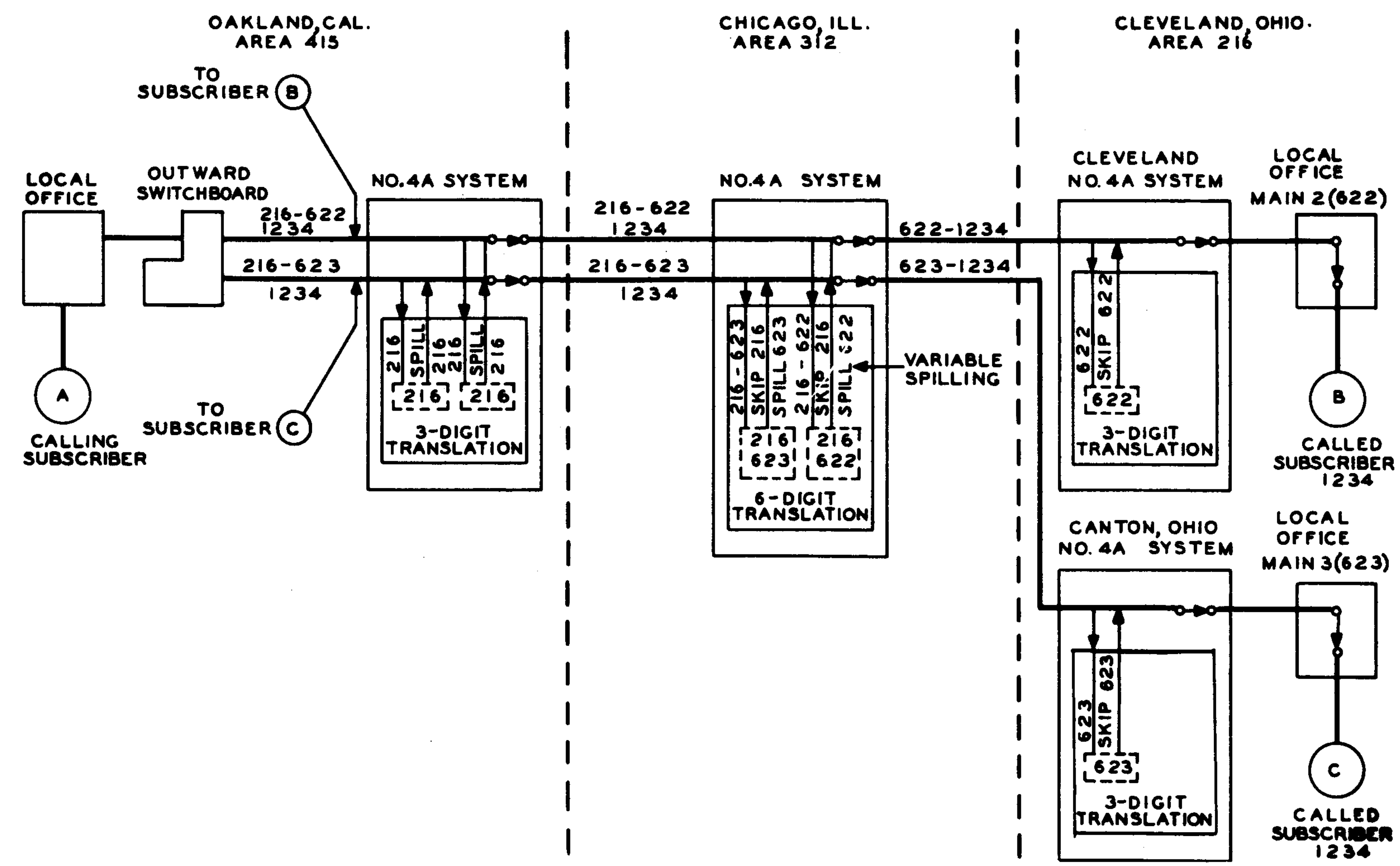


Fig. 10—Three- and 6-Digit Translation (4.14)

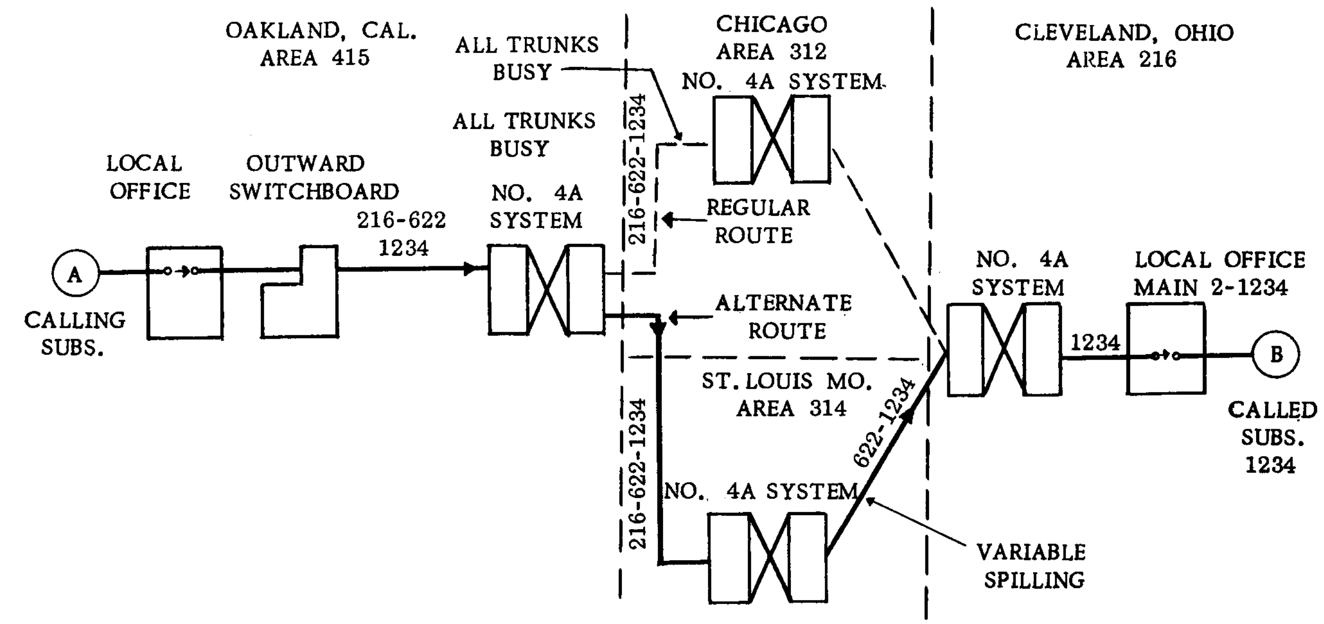


Fig. 11—Automatic Alternate Routing (4.17)

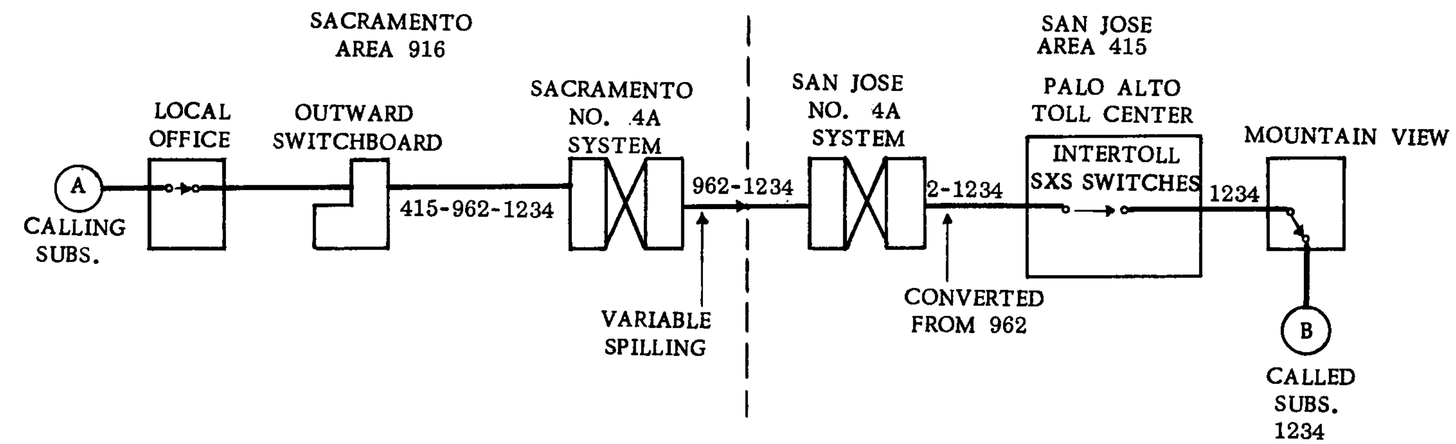
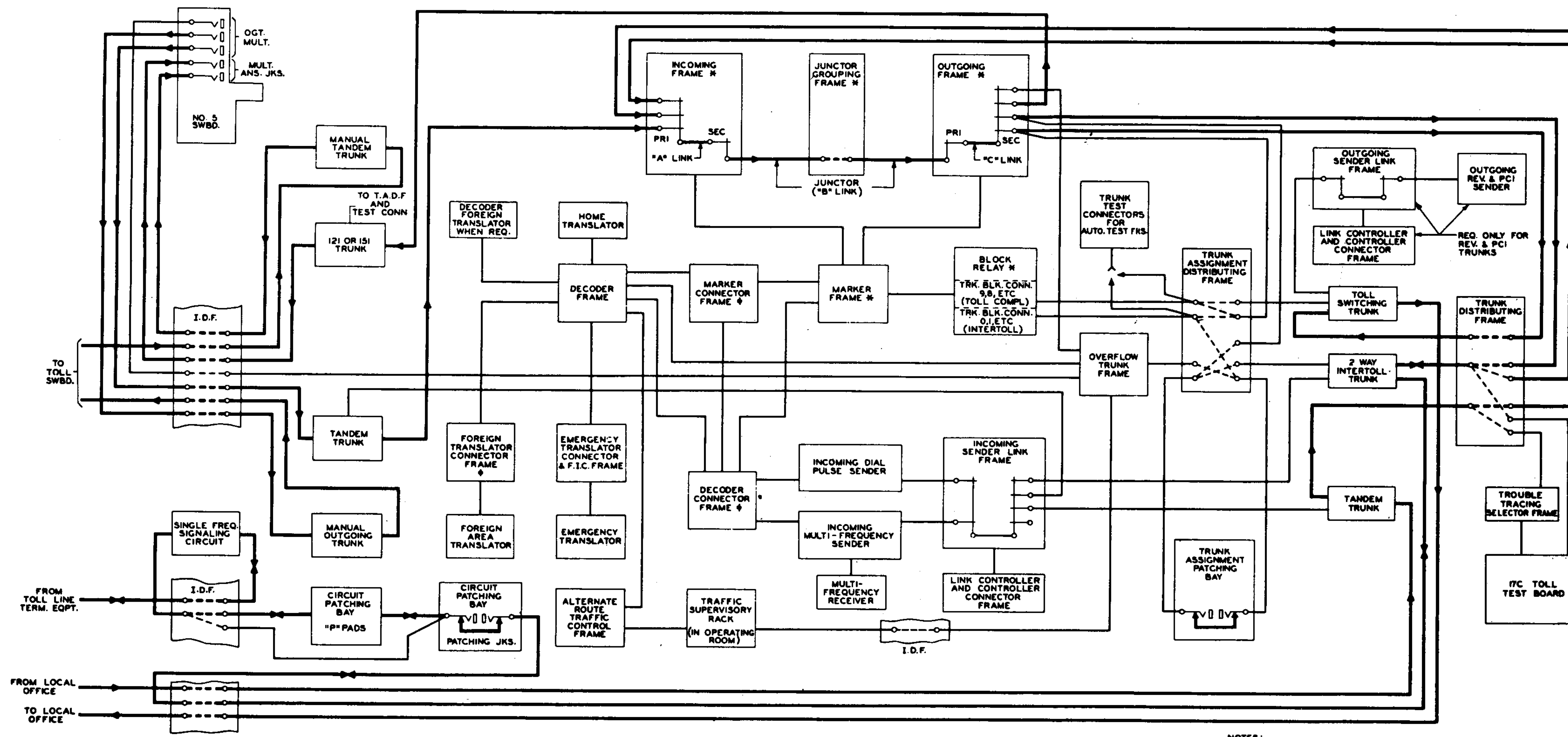


Fig. 12—Code Conversion and Variable Spilling (4.18)



NOTES:
1. FRAMES MARKED WITH AN ASTERISK (*) INDICATE THOSE FOR WHICH SEPARATE INTERTOLL AND TOLL COMPLETING FRAMES ARE FURNISHED IN A TWO TRAIN OFFICE.
2. FRAMES MARKED ♦ INDICATE THOSE WHICH ARE FURNISHED IN DIFFERENT CAPACITIES IN COMBINED AND TWO TRAIN OFFICES.

Fig. 13—No. 4A Equipment Schematic (5.02)