NO.1 CROSSBAR SYSTEM

Condensed Description
of
A Crossbar to Crossbar Call

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P.T.S. 901.4

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The Plant Training Schools

For Training Purposes Only

PREFACE

This outline has been prepared as a guide for the instructor to enable him to make full use of the apparatus and materials provided for use in this class. The teaching sequence as outlined is largely the result of experience and should be closely followed in order to obtain uniform results.

Reference to Bell System Practices are to latest issues at the time this outline is published. It will be necessary for the instructor, therefore, to check subsequent issues of practices, making corrections as necessary in this outline. When such corrections are necessary, they should be made in all existing copies of the outline.

If after considerable experience in teaching the class from this outline the instructor feels that changes should be made or if he wishes to introduce new ideas and materials, such changes should be discussed with Plant School Supervision. Should the discussion result in a decision to make such changes, appropriate steps will be taken to have this outline republished.

PREFACE

This text book has been prepared to describe briefly the general features of the Crossbar System, the No. 1 Crossbar System and a condensed description of a No. 1 Crossbar to Crossbar call. The information contained herein is to be used for training purposes only.

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THE CROSSBAR SYSTEM

General

The two outstanding features of the crossbar systems are the "crossbar switch" which is used in all major switching operations, and the "marker" system of control which is used in the establishment of all connections throughout the crossbar office.

The crossbar system is essentially a relay system employing simple forms of relay and relay type structures for all switching operations. The apparatus consists almost wholly of crossbar switches, multi-contact relays, U and Y type relays and other relays similar to those generally employed in all telephone systems. The switching circuits are wired to the contacting springs of the switches and the connections thru the switches are made by pressing contacts together by means of simple electromagnetic structures instead of the moving brushes and associated fixed bank terminals of other dial systems.

The use of relay type apparatus with its small, pressure type contact surfaces economically permits the use of twin or double contacts with thin layers of precious metal for all contact points. These double precious metal contacts make for reliable operation, especially with low speech and signalling currents inherent to a telephone system.

The short mechanical movements and short operating time intervals of the relay like crossbar switch permit the use of common circuits or markers to control the operation of the switches. This has permitted the use of large assemblies of switches and associated relays on unit frames which can be wired and completely tested for operation in the factory before the units are shipped.

In the design of the switching frames and associated control circuits, one of the objectives realized has been the standardization of equipment units, thereby simplifying manufacturing. This also simplifies the engineering by the telephone companies in preparation of their specifications to meet particular traffic requirements of various control offices.

The marker system used for controlling the switching operations has many advantages. The marker unit is an equipment unit consisting almost entirely of relays, which completes its functional operations in the establishment of a call in a fraction of a second. This short operating time permits a few markers to handle the entire traffic in the largest office. The markers are connected momentarily by means of multi-contact relays to various switching units of the office to control the establishment of the calls through the crossbar switches.

An outstanding advantage of the marker system of control is the "second trial" feature, by means of which two or more attempts can be made to establish a call over alternate switches and trunks when the normally used paths are all busy. The markers are arranged to detect short circuited, crossed, grounded and open circuit conditions at all vital points and before releasing from a connection they make circuit checks to insure that the connection has been properly established. When trouble conditions are detected, they make a second attempt to complete the connection, after sounding an alarm and recording the location and nature of the trouble encountered.

THE NO. 1 CROSSBAR SYSTEM

The No. 1 Crossbar System sets up its call on a marker basis, as explained under "The Crossbar System", which is a general statement applicable to all crossbar systems, such as Crossbar Tandem, No. 4 Toll Crossbar and the No. 5 Crossbar Systems.

The switching frames of the No. 1 Crossbar System are known as the line link, district link, office link and incoming link frames. Each of the crossbar frames consists of primary and secondary switches. The connections from the primary to the secondary switches of the same frame are known as "links" and the connections between frames are known as "junctors". The line link frames are used for connecting subscribers to districts on originating calls and for connecting incoming trunks to subscribers' lines on terminating calls, thereby performing the functions of two frames. The junctors outgoing from each district and incoming frame are distributed evenly over all the office and line link frames respectfully. Similar primary and secondary switching arrangements are used in the sender link frame for connecting subscriber senders to the district junctors and in the terminating sender link frame for connecting the terminating sender to the incoming trunk.

The establishment of a call is taken up in four general steps (two in the originating and two in terminating equipment) and the termination of each step is "marked" before any of the intervening paths are actually seized. In the first step of the originating equipment, the subscriber sender to be used on a particular call is chosen before the line link, district junctor and the sender link are connected to the subscriber's line. In the second step, the outgoing trunk is chosen before the district link, office junctor and office link are tested. The third and fourth steps, in the terminating equipment, are connecting an idle terminating sender to the incoming trunk, locating the call subscriber's line on a particular line link frame and connecting this line to the incoming trunk.

The following condensed description of a crossbar to crossbar call and the sketch of the path of a call through crossbar frames is to be used with XB-8 and XB-8A.

CONDENSED DESCRIPTION OF A CROSSBAR TO CROSSBAR CALL

LINE LINK FUNCTIONS—When a subscriber originating a call lifts the receiver from the switchhook of the subscriber set, a circuit is completed to the central office operating a line relay associated with the calling line and the line link frame primary switch vertical to which the line is connected. The operation of the line relay signals the line link controller circuit that a call is being originated. The controller circuit identifies the calling line by determining the horizontal group, vertical column, and vertical in which the line is located, and if more than one line is trying to originate a call at the same time, selects one of the lines to be served first.

SUB. SENDER LINK FUNCTIONS—It also connects itself to one of five sender link controller circuits on the sender link frames with which the line link frame is associated. The two controller

DISTRICT JUNCTOR SELECTION—circuits function together to select an idle district junctor, making the selection from one of the groups of ten district junctors which has an idle line link back to the calling line and an idle sender link to a sender subgroup which has an idle sender and preferring those district junctor groups having at least two idle junctors. The district junctor selected, the line link primary and secondary select and hold magnets are operated closing crosspoints on the primary and secondary switches to complete the connection between the calling line and the selected district junctor and associated horizontal on the district link frame primary switch.

SUBS SENDER SELECTION—At the same time the sender link controller circuit is selecting an idle sender from one of the subgroups having an idle sender link to the selected district junctor, giving preference to those subgroups having two or more idle senders. With the selection of a sender, the controller circuit operates the sender link primary and secondary select and hold magnets, completing the path from the calling sub-

CLASS OF SERVICE AND DISTRICT FRAME INDICATION—scriber to the sender. The sender registers the class of service of the subscriber's line and the number of the district frame involved over indicating leads.

DIAL TONE—The sender sends out dial tone, indicating that it is ready to receive dial pulses.

RELEASE OF THE CONTROLLER CIRCUITS——The controller circuits get a release signal from the sender making them available to serve another call. The operated hold magnets are now under control of the sender.

DIAL NUMBER——The subscriber now dials the office code and directory number of the called subscriber. The sender counts the dial pulses and registers all digits dialed on the register switch.

ORIGINATING MARKER SELECTION——As soon as the office code is registered, the sender signals the originating marker connector which connects the sender to an idle originating marker cutting through a large number of leads over which the sender and marker exchange information.

MARKER (DECODING)——The marker checks the integrity of these leads and then receives from the sender the class of service of the subscriber, the district frame number and the office code dialed. It decodes this information and sends back to the sender the information it needs to complete its part in handling the call. The major items are the "class of call" (To crossbar, panel, manual, tandem, or operator, etc.) "compensating resistance" (the amount of resistance to be added to the fundamental circuit to permit the sender relays to function properly) and "office brush and group selections" (when the call is to be routed through panel office selector or crossbar tandem).

MARKER (TEST OF THE OUTGOING TRUNK)——From the office code, the marker also determines the pair of office frames on which trunks to the desired office are located, connects itself to these frames and causes the office link and connector circuits to connect the sleeve leads of the trunk group through to the marker trunk test relays. The marker then tests this trunk group and selects one of the idle trunks.

MARKER (CHANNEL SELECTION)——The marker also connects itself to the district link and connector circuit of the district frame with which the selected district junctor is associated. The marker also causes the office link and connector circuit to cut through to the marker channel test relays the sleeve leads of the 20 office links serving the office link secondary switch on which the selected trunk is located. The district link and connector circuit cuts through to the marker channel test relays the sleeve leads of the 20 district links serving the primary switch to which the district junctor is connected. The marker then operates a junctor connector relay on the district frame cutting through to the channel test relays the sleeve leads of 10 to 20 office junctors associated with that relay. In some cases all, and in other cases only part of these junctors will be connected to the office frame on which the selected trunk is located. The marker now has the sleeve leads of the three parts of the channels connected to its channel test relays. The marker tests these channels and selects one having all three parts idle. Any of the channels that are incomplete or that will not connect the district junctor to the selected trunk will be made busy artificially.

MARKER (CHANNEL CLOSURE)---------With the channel selected, the marker now operates the select and hold magnets on the district and office link frames necessary to complete the path from the subscriber sender to a trunk to the called office. The marker now has completed its functions and releases.

INCOMING TRUNK IN TERMINATING OFFICE--------The outgoing trunk is connected to an incoming trunk in the terminating office.

TERMINATING SENDER SELECTION-----The incoming trunk when seized will cause the terminating sender link controller circuit to select an idle terminating sender (full selector) and connect it to the incoming trunk.

CALLED NUMBER TRANSFERRED TO SENDER---The two senders are now connected together and the terminating sender begins to generate revertive pulses to satisfy the originating sender, the number of pulses required depending on the number set up on the register switch of the originating sender. The terminating sender counts the pulses generated and sets up the result on a register switch, thus transferring the called number from the originating to the terminating sender. This number is not transferred as thousands, hundreds, tens, and units digits, but is transferred as incoming brush, incoming group and final brush, tens and units selections. This is done so that panel to crossbar, crossbar to panel, and crossbar to crossbar calls can be handled in the same way. This method of registering the called number in the terminating sender is used to conform with existing panel equipment. The terminating sender, however, will transmit the number to the terminating marker as dialed. With this information transferred from the originating to the terminating sender, the originating sender has completed its functions and releases.

TERMINATING MARKER SELECTION-----The terminating sender now signals the terminating marker connector which connects an idle terminating marker to the sender cutting through the leads over which information is passed. The marker checks the integrity of these leads and then receives the called number and the incoming frame number from the sender.

NUMBER GROUP AND BLOCK RELAY SELECTION----------The terminating marker translates the called number as being in a block of five hundred numbers, the particular block of one hundred in the five hundred and finally as being in one of five blocks of twenty lines in the selected block of one hundred numbers. By means of crossconnections, the marker will then operate its marker connector relays in the proper number group, the proper hundreds block relay in the block relay frame and through them the twenty block relay associated with twenty consecutively numbered lines, one of which is the called number.

CALLED LINE TEST & LOCATION-----This connects to the marker line test relays, the sleeve leads of twenty line circuits which are cabled from the line link frames to the HLDF and crossconnected to the directory number sleeves which are cabled from the twenty block relays on the block relay frames to the VLDF.

The twenty block relay operating also cuts through a number of control leads which are crossconnected on the block relay frame, to give the marker necessary information regarding the line and its location. The marker then tests the called line to determine whether it is busy or idle. If busy, the marker will set the incoming trunk so that the calling subscriber will receive busy tone. (The marker and the terminating sender will then release immediately.)

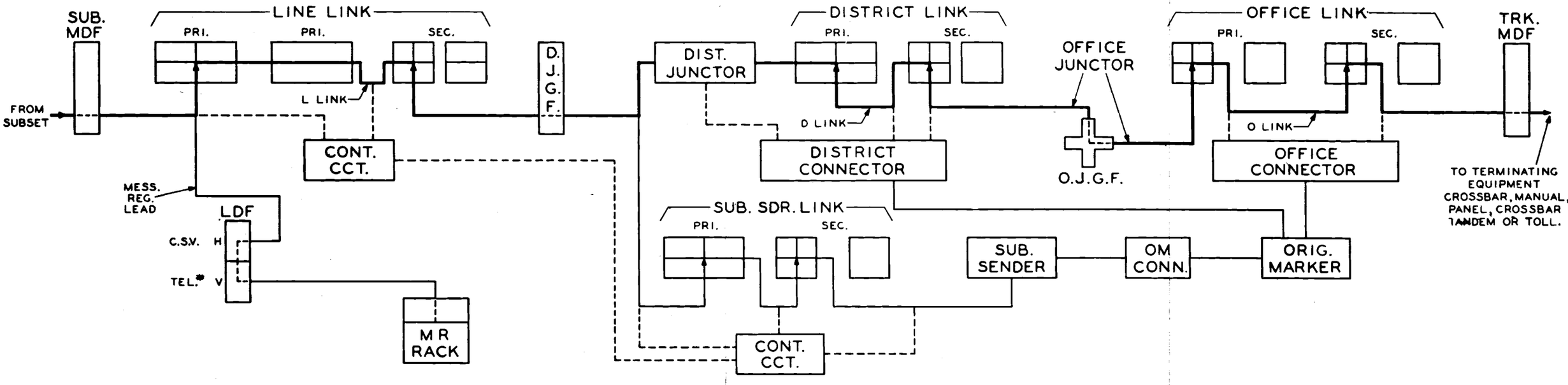
LINE CHOICE SELECTION-----If idle, the marker will determine from crossconnections on the block relay frame whether it is an individual or P.B.X. line, whether tip or ring party ringing is required, in which line choice, on which one of the four line link frames of the choice and in which horizontal group of the line link frame, the called line is located.

MARKER CHANNEL TEST & CLOSURE--From this information and the incoming frame number indication it has previously received, the marker will connect to the incoming link frame through the incoming link connector and through the line choice connector and line junctor connector to the line link frame and cut through to its channel test relays the sleeve leads of the incoming links, line junctors, and line links which form paths between the selected incoming trunk and the called line. These channels are then tested, and an idle path is selected. The marker will then operate the primary and secondary select and hold magnets on the line link and incoming link frames necessary to close the path between the incoming trunk and the called subscriber.

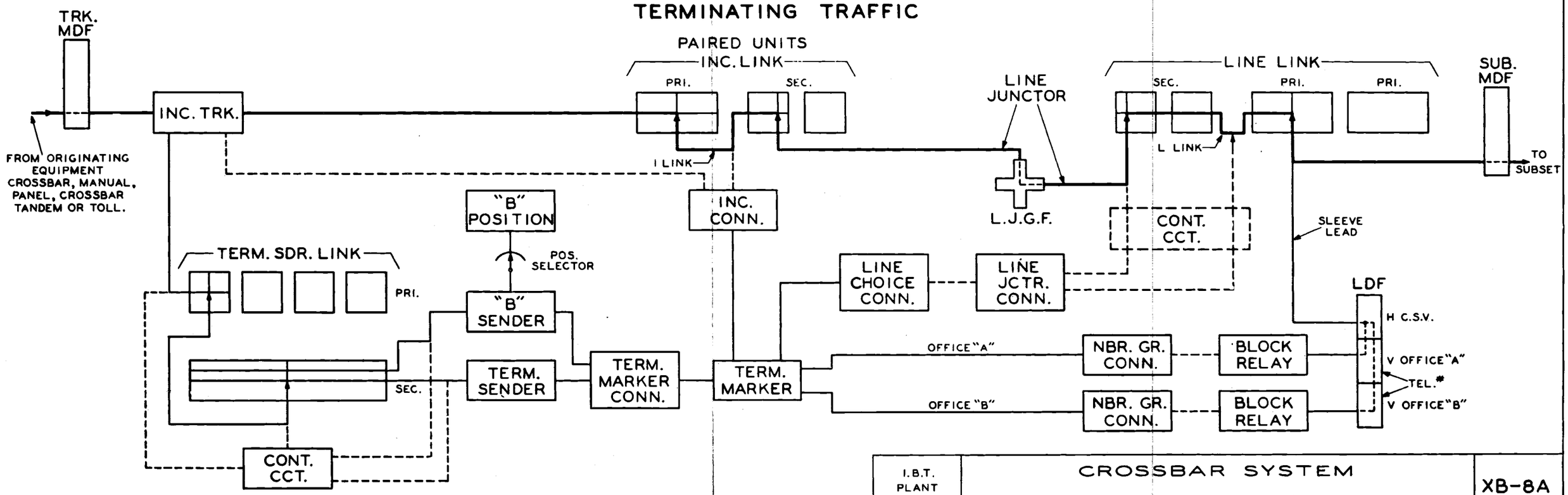
RINGING CONTROL---------The marker also sets the incoming trunk to apply proper ringing to the called line. The marker and terminating sender now release.

LINE SUPERVISION----------The incoming trunk applies ringing current to the called line, and when the called party answers, stops the ringing and signals the district junctor that the called party has answered so that the correct charge may be made. The calling subscriber may now talk to the called subscriber, the district junctor supplying talking battery to the calling subscriber and the incoming trunk to the called subscriber. At the end of the conversation, the two parties will hang up, and all circuits will release.

ORIGINATING TRAFFIC



TERMINATING TRAFFIC



I.B.T. PLANT SCHOOL	CROSSBAR SYSTEM BLOCK DIAGRAM OF A PATH OF A CALL	XB-8A

PATH OF CALL THRU CROSSBAR FRAMES

I. B. T. PLANT SCHOOL	XB-8	11-1-47 B.E.F.S.

DISTRICT LINK FRAME #0

OFFICE LINK FRAME #0

OFFICE LINK FRAME #1

SUBSCRIBER SENDER FRAME #0

ORIGINATING MARKER CONNECTOR FRAME #0

ORIGINATING MARKER FRAME #0

TERMINATING MARKER CONNECTOR FRAME #0

TERMINATING MARKER FRAME #0

LINE CHOICE CONNECTOR FRAME #0

LINE JUNCTOR CONNECTOR FRAME #0

NUMBER GROUP CONNECTOR FRAME #1

BLOCK RELAY FRAME #5

LINE DISTRIBUTING FRAME (PARTLY SHOWN)

LINE-LINK FRAME #0

OFFICE JUNCTOR GROUPING FRAME

TRUNK MAIN DISTRIBUTING FRAME

LINE JUNCTOR GROUPING FRAME

CALLED SUBSCRIBER

SUBSCRIBER MAIN DISTRIBUTING FRAME

NOTE 1. - A PATHS SELECTED BY CONTROL CIRCUITS.

NOTE 2 - B PATHS SELECTED BY ORIGINATING MARKER.

NOTE 3 - C PATHS SELECTED BY TERMINATING MARKER.

XB-8

SUBSCRIBER MAIN DISTRIBUTING FRAME

CALLING SUBSCRIBER

LINE-LINK FRAME #20

SEC. H TO H PRI.

PRI.

BASIC UNIT

SUPR. UNIT

CONTROL CKT.

SEE NOTE #1

SUBSCRIBER SENDER LINK FRAME #0

SEC. H TO V PRI.

DISTRICT JUNCTOR FRAME #0

DISTRICT LINK FRAME #0

PRI. H TO V SEC.

DISTRICT JUNCTOR GROUPING FRAME

SEE NOTE #2

OFFICE LINK FRAME #0

OFFICE LINK FRAME #1

EXT.

PRI. H TO V SEC.

EXT.

OFFICE JUNCTOR GROUPING FRAME

SUBSCRIBER SENDER FRAME #0

TRUNK MAIN DISTRIBUTING FRAME

CONNECTING CABLE PAIR

TERMINATING SENDER LINK FRAME #0

INCOMING TRUNK FRAME #0

INCOMING LINK FRAME #0

PRI. V TO H SEC.

V TO V

TRUNK MAIN DISTRIBUTING FRAME

SEE NOTE #3

TERMINATING SENDER FRAME #0

4 FULL SELECTOR

3

2

1

0 "B SENDER"

TERMINATING MARKER CONNECTOR FRAME #0

TERMINAL STRIPS

TMC

TERMINATING MARKER FRAME #0

SEE NOTE #5

SH

LINE CHOICE CONNECTOR FRAME #0

MCC

MCB

MCA

LC(1) MCC

LC(1) MCB

LC(1) MCA

LC(0) MCC

LC(0) MCB

LC(0) MCA

LINE JUNCTOR CONNECTOR FRAME #0

LC(3) LJ B

LC(3) LJ A

LC(0) LJ B

LC(0) LJ A

NUMBER GROUP CONNECTOR FRAME #1

MCB

MCA

MCB

MCA

MCB

MCA