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CROSSBAR SYSTEMS
NO. 3
MARKER CIRCUIT

CHANGES

B. Changes in Apparatus

B.01	Superseded	Superseded By
	RTF Relay, 1/2AK501, Option Q	RTF Relay, AF88, Option M

D. Description of Changes

D.01 During load and volume tests, where six of 2-line number calls are initiated simultaneously, a situation occurs where nonproductive trouble records may be called by one marker. This condition is caused by an incomplete recycle of the work timer. Option N is added to ensure a recycle under all call conditions.

D.02 The release of the trunk relay F releases relays JC- and SW- in the trunk switch and connector circuit, which in turn releases the select magnets which may cause additional contact erosion. Break contacts of relay RTF are added in the select magnet operate paths to alleviate this condition.

D.03 This class AC change is to be applied to all new production and to field locations only when trouble is encountered and reported by the customer via an engineering complaint.

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DEPT 55212-RBC

AT&T NETWORK SYSTEMS
DEPT 20610-HWB-RW-LHN

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CROSSBAR SYSTEMS
NO. 3
MARKER CIRCUIT

CHANGES

A. Changed and Added Functions

A.1 The marker is arranged to function with the crossbar No. 3, 200- to 1200-line application which includes additional 2-line blocks, three trunk blocks, and two additional trunk block allotters.

B. Changes in Apparatus

B.1 Added

AL2 - 1/2AK501 Relay - Fig. 2 - Option Y

AL3 - 1/2AK501 Relay - Fig. 2 - Option Y

BL(8-11) - 1/2AK501 Relay - Fig. 3 - Option Y

LB(4-5) - 1/2AK502 Relay - Fig. 3 - Option Y

TB(7-9) - 1/2AK502 Relay - Fig. 3 - Option Y

TIP - AJ202 Relay - Fig. 2 - Option T

TST1 - 1/2AK502 Relay - Fig. 2 - Option Y

TT12 - 1/2AK502 Relay - Fig. 2 - Option Y

AL(2-3) - 185A Network - Fig. 2 - Option Y

LB(4-5) - 185A Network - Fig. 3 - Option Y

TB(7-9) - 185A Network - Fig. 3 - Option Y

TT12 - 185A Network - Fig. 2 - Option Y

B.2 Removed

MPA - 1/2AK502 Relay - Option X - Fig. 1

MPF - 1/2AK502 Relay - Option X - Fig. 3

PT1 - 1/2AK502 Relay - Option X - Fig. 2

PT(2-4) - AJ12 Relay - Option X - Fig. 2

SBT(0-3) - 1/2AK501 Relay - Option X - Fig. 2

SKB - AF24 Relay - Option V - Fig. 3

MPA - 185A Network - Option X - Fig. 1

MPF - 185A Network - Option X - Fig. 3

PT(1-4) - 185A Network - Option X - Fig. 2

SBT(0-3) - 185A Network - Option X - Fig. 2

D. Description of Changes

Operation With 200-1200 Line Application

D.1 The marker is equipped to function with the increased line and trunk capacity of the crossbar No. 3, 200- to 1200-line application. The two additional line block relays are added to accommodate the 200 additional lines per line unit, and three additional trunk block relays, and one trunk test relay are added for the trunk expansion, along with an additional two trunk block allotters. To function with the increased number capacity, four additional line number translator block relays are added. Option Y

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provides the new feature. Option Z, rated Mfr Disc., is existing wiring to be removed when option Y is provided.

Removal of Obsolete Equipment

D.2 The apparatus provided for the identification of party lines is removed since this feature was never implemented in the system. Option X, rated Mfr Disc., provides for the removal of the equipment, and option W provides new wiring to be provided when option X is removed.

Increased Trouble Recording Facilities

D.3 In conjunction with the increased line and trunk capacities as described in D.1, additional trouble recording leads are required. Option T provides a larger trouble indicating relay. When option T is provided, option V, rated Mfr Disc. is to be removed.

Traffic Registration On A Per-Marker Basis

D.4 To provide improved traffic studies, the following traffic registration leads have been provided on a per-marker basis rather than a per-marker-group basis.

Lead Designation	Function
APC	ANI Peg Count
DOR	Originating Register - Dial Pulse
DPS	Sender Dial Pulse
MFS	Sender MF Pulse
MOR	Originating Register - TOUCH TONE®
SCH	Sample Channel
TCH	Total Channel
TCM	Total Completing Marker
TDT	Total Dial Tone
TOF	Total Office Overflow
TOR	Total Originating

Option R provides the wiring for this feature. Option S, rated Mfr Disc. is removed when option R is provided.

F. Changes in CD Sections

F.1 In SECTION II, 44.02, change PEG Leads to Traffic Register Circuit - "One Per Marker Group", to read "One Per Marker" for the following Lead Designations:

APC, DOR, DPS, MFS, MOR, SCH, TCH, TCM, TDT, TOF, TOR.

F.2 In SECTION III, 2. FUNCTIONAL DESIGNATIONS, 2.01 Relays change Designation:

From	To
AL 0, 1	AL 0-2
BL4-7	BL 4-11
LB0-3	LB 0-5
SKA,SKB	SKA
TI(A-M)	TI(A-P)
TST	TST,TST1
TT 0-11	TT 0-12

F.3 In SECTION III, 2. FUNCTIONAL DESIGNATIONS, 2.01 Relays, remove:

Designation	Meaning
MPA	Multiparty - ANI
MPF	Multiparty Failure
PT1-4	Party
SBT0-3	Split Block Translator

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MARKER CIRCUIT

CHANGES

D. Description of Changes

D.1 Open MRL Connector Lead - To eliminate the possibility of setting two trunks to the calling line on SOG linkage or both ringing and line-busy tone on IAO calls due to an open MRL lead, the marker is changed to prevent a second trial attempt after DIS1 has operated.

D.2 False Disc or TRL Trouble Indications - A TRB relay contact is added in the disc indicating path, and the TRL indication is derived from a TRL contact to eliminate possible false lamp indications when TRB relay operates at the completion of the record.

D.3 False Time-Out on PBX Hunting - The work timer is recycled with an HTL relay contact and the BNT resistor is added to prevent false marker time-out on PBX hunting calls.

D.4 Improved Trunk Selection - Contacts of the FB and OTF relays are added in the FT relays operate path so that a test call directed to a particular trunk unit will not fail due to operation of the FT relay associated with the undesired trunk unit.

D.5 False Trouble Indications on Class of Service - An IAO call that encounters a crossed RC or BL condition could falsely operate a second CS relay, or both CSA and CSB resulting in a misleading trouble record. To correct this condition, break-contacts of the RC and BL relays are added in the CS, CSA, and CSB relays operate paths.

D.6 ANI Line Verification Test - An OTF1 terminal is added and cross-connect information, part 20, and Note 412 is added so that by using an unassigned code point, the line number translator cross-connection for a line to number translation may be easily verified.

D.7 False RV Trouble Indication - The RV trouble indication is derived from an RV2 relay make-contact to prevent possible false RV trouble indications.

D.8 Failure of Coin Class Call to TSPS - A prefix 0 or zero operator call to TSPS from a coin class customer would fail storage check and block the call. A contact of CN relay is added through ID2 normal to bypass the SK7 relay on this class of call.

D.9 False ATB and RA Lamp Indications - An all trunk busy, or route advance in a marker not under test could falsely operate the test circuit ATB or RA lamps to give an incorrect test indication. The ATB and RA leads are isolated through an OTF contact to correct this condition.

D.10 False CTR or DTR Plant Register Operation - On a test call where a trouble record is taken by operating the test circuit call block key, the CTR or DTR plant registers would be scored giving a false record of marker failures. An OTF1 transfer contact is added to score these calls on the VRF register.

D.11 False CST Plant Register Operation - A second trial ground test failure on an incoming call would score both GTF and CST plant registers due to the release of LPK relay. Contacts of IR and FLA

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relays are added in the CST operate path to prevent CST operation under this condition.

D.12 Misdialed Ringer Test Call - A ringer test call is made by dialing a special ringer test ABC code and the last four digits of the stations directory number. Upon recognition that the line location of the calling and called numbers match, the call is directed to a reverting trunk. If a dialing error is made a trouble record would be taken on the call. This operation is changed to return overflow tone without taking a record to reduce nonproductive trouble records and to make operation compatible with other Crossbar Systems.

D.13 Sequence Charts - The sequence charts are reissued to correct drafting errors and to correct relay designations that were incorrect.

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SECTION I - GENERAL DESCRIPTION

1. PURPOSE OF CIRCUIT

1.01 The general purpose of the marker is to recognize, serve, and control requests for service by setting up connections between customer lines and/or trunks and originating registers in the No. 3 crossbar office.

1.02 The marker is the major common control equipment unit in the office. Its use is time shared by requests from all sources and when it has caused a connection to be established it releases, in order that another request may be served.

1.03 The principal functions of the marker are:

(a) To establish the connection from a calling customer to an idle originating register.

(b) To determine the proper route for the call from the digits and class information received.

(c) To establish the connection from a calling customer to a trunk, or from a trunk to a called customer.

(d) To determine the location of a called line from the proper line number translator.

(e) To seize an outgoing sender when required for transmitting information to a connecting office.

(f) To recognize line-busy, vacant number, intercept, and trouble conditions, etc, and take appropriate action.

(g) To recognize requests for automatic number identification and to obtain the calling number from the line number translator.

2. MARKER EQUIPMENT ARRANGEMENT

2.01 A marker group consists of two markers. The marker frame consists of one bay of equipment each 30-1/2 inches wide by 7 feet high.

NOMENCLATURE

2.02 The marker is required to operate with external relay equipments such as: line links, trunk links, outsender connectors, etc. These equipments are mentioned many times in the body of this description using abbreviated titles.

2.03 A list of the equipments and their abbreviations as used in this description is shown below.

Abbreviation	Title
LL	Line, Line Switch, and Connector
TL	Trunk Switch and Connector
MKR CONN	Marker Connector
LNT	Line Number Translator and Connector
OS	Outgoing Sender and Connector
TEST	Test

3. GENERAL DESCRIPTION OF OPERATION

MARKER SEIZURE

3.01 When a marker connector seizes a marker, it causes the operation of a group of off-normal relays that operate on all calls, and provide off-normal control of the battery and ground leads for marker operation. The marker at this time also returns ground to operate CB- relays in both marker connectors to make this marker appear busy to the other marker connector. The marker connector closes through a large group of leads between the line link or register and the marker in order that the line link or register can transmit many pieces of information at the same time. After the off-normal relays operate, the marker examines the connector leads to determine how the call should be handled.

A. Originating Register Calls

3.02 A ground on the OR lead from the MKR CONN indicates that the call is from an originating register.

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B. Incoming Register Calls

3.03 A ground on the IR lead from the MKR CONN indicates the call is from an incoming register serving an incoming type trunk.

C. Dial Tone Calls

3.04 A ground on the DT lead from the MKR CONN indicates the call is from a customer requiring dial tone connection to an originating register.

TRANSLATION

3.05 The destination requested by the calling customer may be indicated by the code digits passed to the marker from the register, or it may be indicated by the incoming trunk over which the call originated. If the customer does not complete the order the register indicates a permanent signal or partial dial registration. After receiving the customer order, the marker makes whatever translation is required for the purpose of grounding a code point. This grounded code point is the marker record of the customer order on this call.

3.06 The registers transmit direct signals or transmit coded information that is translated by the marker. The former indicates the type of call directly and the latter grounds a code point. This code point is cross-connected to operate a preroute or route relay, which indicates the type of call.

A. Incoming Register Signals, Not Requiring Translation

3.07 The OA, OB, and AB leads are used to indicate a TER call.

3.08 The RO, LR, and DCK leads are used to indicate trouble detected by the register and request the marker to set the incoming trunk to return overflow tone, and/or cause a trouble record to be taken.

B. Originating Register Signals Not Requiring Translation

3.09 The PS and PD leads are used to indicate line irregularities or faulty operating procedure by the customer.

C. Translator Signals

3.10 Marker translation requires the following information to operate a route or local completion relay, which indicates the type of call.

3.11 Type of Translator - The registers indicate to the marker which of several translators to use, by grounding one of the following leads.

LT - Local Translator No Prefix

P1 - Direct Routing or Local Translator Prefix 1

PO - Direct Routing or Local Translator Prefix O

AB - Five-Digit Translator

3.12 Dialed Digits - Marker translation results in the grounding of a code point corresponding to the A, AB, ABC, or ABCD digits recorded in the registers.

CLASS OF SERVICE

3.13 When a call comes to the marker from an originating register, the register passes information to the marker to identify the class of service to which the calling customer is entitled. When a call comes to the marker from an incoming register, the office termination of calls arriving over that trunk group are indicated as office A (OA), office B (OB) or office A or B (AB).

A. Class of Customer or Trunk Indication

3.14 Proper routing of the call may require different marker action for specific codes, depending on the class of customer service and trunk restrictions.

3.15 The class of customer service is indicated by the originating register over the CSO-7, CSA, and CSB leads.

3.16 The class of trunk for office termination is indicated by the incoming register over the OA, OB, (office A or B) and AB (office A-B) leads.

3.17 The class of customer or trunk indication determines which of the corresponding screening (S) relays operate. Marker action can then be varied by connecting the code point through contacts of the S relays, and thus obtain an S point for each class of service. This S point is treated as a new code point.

SERVICE TREATMENT AND ROUTING

3.18 The marker combines the information indicated by the grounded code point and the class of service to determine the routing of the call. The calling customer is routed to the destination the calling

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(e) To seize an outgoing sender when required for transmitting information to a connecting office.

(f) To recognize line-busy, vacant number, intercept, and trouble conditions, etc, and take appropriate action.

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3.10 Marker translation requires the following information to operate a route or local completion relay, which indicates the type of call.

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LT - Local Translator No Prefix

P1 - Direct Routing or Local Translator Prefix 1

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AB - Five-Digit Translator

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CLASS OF SERVICE

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SERVICE TREATMENT AND ROUTING

3.18 The marker combines the information indicated by the grounded code point and the class of service to determine the routing of the call. The calling customer is routed to the destination the calling

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customer requested if the class of service indicates that the customer is entitled to make such calls. Otherwise, the customer is connected to an operator, a recorded announcement, or a reorder tone. The marker operates a route relay to control the routing that it has decided to give.

3.19 The route relay is a memory device whose memory can be varied by means of cross connections. It permits the selection of a desired trunk group, and a sender when required. If senders are required, other route relay contacts furnish information that the sender needs to complete its functions.

3.20 The marker also provides a route advance feature that permits the marker to change routes and advance to an alternative route, or to set overflow in case all channels or all trunks are busy.

A. Operation of Route and Local Completion Relay

3.21 As described in 3.21, 3.22, and 3.23, the type of call may be indicated by a direct signal from the register or line link or by signals that must be translated by the marker.

3.22 When translation is required, the code points are cross connected to operate the route, R and/or local completion, OAT, OBT, etc, relays as follows.

B. Marker Selects an Outgoing Trunk

3.23 The code point is cross connected to operate a route relay when the marker is required to select an outgoing trunk.

C. Marker Selects an Intraoffice Trunk

3.24 The code point is cross connected to operate the fixed IAO route relay IOA or IOB, which in turn will control the selection of the line number translation and the ITR trunk.

D. Marker Does Not Select a Trunk or Originating Register

3.25 On TER class calls the marker operation is varied as directed by the trunk class. Four-digit calls do not use a route relay or a code point. Five-digit calls use one of the local translator relays ABT to derive the code point.

E. Marker Selects an Originating Register

3.26 On dial tone calls relay DT operates fixed dial tone route DTR that enables the marker to select an originating register.

ALTERNATE ACTIONS

3.27 On any type of call, the marker may receive a signal or detect a condition indicating that the call cannot be completed in a normal manner and, therefore, an alternative action is necessary. The alternative action taken by the marker depends on the type of call and the reason the call could not be completed.

3.28 Some of the more common reasons for alternative actions are:

(a) TB, all trunks busy.

(b) SB, all senders busy.

(c) PB failure to match (Paths Busy).

(d) LB, called line-busy.

3.29 Some of the more common alternative actions that may be taken by the marker are:

(a) RAV, route advance.

(b) ROT, reorder tone. On incoming calls the trunk is set to the tone level of the trunk switch. On SOG and ITR calls the line circuit returns tone.

4. LINKAGES REQUIRED AND MARKER OPERATION CLASSES

4.01 The markers main function is to form a talking connection from a line appearance on a line link frame to a trunk appearance on a trunk link frame. The connection is composed of two elements, a line link, and a trunk junctor. These elements when connected together form a 3-wire channel composed of a T lead, R lead, and S lead. The T and R form the talking channel with S being the holding path. The marker is required to select the two elements under the following operational classes.

(a) Connect one line appearance to one of many trunk or originating register appearances (SOG class).

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(b) Connect one trunk appearance to one line appearance (TER class).

(c) Connect one line appearances to one of many trunk appearances and connect the selected trunk to some other line appearance (ITR class).

CALL FORWARD LINKAGES - FLG

4.02 The marker classes TER and ITR use FLG operation to connect a line appearance to a trunk appearance.

CALL BACK LINKAGES - CB

4.03 The marker classes ITR and SOG use CB operation to connect a trunk or originating register appearance to a line appearance. The marker does not take down the dial tone links before it establishes the CB linkage to the trunk.

5. CONTROL OF ASSOCIATED CIRCUITS

LINE NUMBER TRANSLATOR CONTROL

5.01 After the marker receives the called line directory number or the calling line location, it passes it to the LNT. The LNT translates this information into the equipment locations (line select information magnet) on the line link frame class of service of the calling line on dial tone requests, or the calling line directory number on ANI calls and passes this to the marker.

A. Equipment Location of Called Line

5.02 The LNT translation for equipment location is in terms of the LL number, the line block, line group, and line of the frame.

B. Trunk Ringing Control

5.03 The marker receives the equipment location and the ringing information from the LNT at the same time. The ringing information is used by the marker to set the ringing relays in the associated trunk.

TRUNK LINK FRAME CONTROL

5.04 The marker controls the operation of the TL by operating the trunk link connector for that frame. The connector closes through a large group of leads between the TL and the marker.

5.05 Selection of the TL is controlled as follows:

(a) If the call is SOG or ITR, it requires a route relay; the marker selects an idle frame and an idle trunk or originating register on the frame. Class information required by the trunk is obtained from a route charge relay.

(b) On TER calls from incoming trunks, no route relay is required; the number of the TL associated with the incoming trunk is received from the incoming register. After the TL has been selected, the marker closes a potential to the F relay of the trunk involved.

LINE LINK FRAME CONTROL

5.06 Control of the LL is obtained on CB linkages from information stored in the originating register on the dial tone connection or for dial tone connections from information received from the marker connector. On FLG linkages, the line location is received by the marker as a directory number. The marker calls in the LNT on such calls and obtains a translation in terms of equipment location.

SENDER CONTROL

5.07 Sender control is provided when pulsing to a distant office is required. Sender operation and selection is controlled via the OS- punching associated with an operated route relay. Cross-connections permit the marker to select a sender or indicate no sender operation (NSO). When a sender is selected, the marker controls the connection of the sender to the trunk through the outsender link (OSL)

SELECT AND HOLD MAGNET CONTROL

5.08 The marker controls the LL and TL select and hold magnets, which provide a linkage between the line location and the trunk or originating register.

6. BASIC TYPES OF CALLS

ORIGINATING CALLS

6.01 After a customer has dialed into an originating register, the register is connected to a marker through the marker connector. Using this information, the

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marker determines how the request for service should be processed.

6.02 Any call containing an area code, or containing an office code other than those associated with the originating office, will be treated as a subscriber outgoing call. If the office code is contained within the originating office, the call will be treated as an intraoffice call.

A. Subscriber Outgoing Call - SOG

6.03 This type of call requires a connection between the customer line appearance on the line link (LL) frame and a trunk appearance on the trunk link (TL) frame. The trunk would generally be one of the following:

(a) An outgoing trunk to another office.

(b) A trunk to a switchboard.

6.04 An outgoing sender may be required to send pulses over the trunk to the connecting office. The general sequence of operation on an outgoing call is as follows:

(a) The marker determines from the translation of the called number and signals received from the OR, the required route, and operates the route relay.

(b) The LNT is seized to obtain line translation (ANI) if required.

(c) A TL is selected containing the desired idle trunks by testing the FT-, DTR-, or IR- leads of the TL, and an idle trunk is selected according to required trunk block (TB-) and trunk group (TG-) information.

(d) Following possession of the TL (TUK relay operated), the LL is seized which contains the calling line, giving the marker control of the calling line select and hold magnets.

(e) The channel test leads are closed through to select an idle channel between the calling customer and trunk, and the select and hold magnets are operated to close the linkage through the crossbar switches of the LL and TL frames.

(f) If a sender is required for pulsing information to a connecting office, an outsender is seized and the required information is transmitted to the sender.

(g) Following hold magnet operation, the channel is checked for crosses, continuity, and double connections, and the sender and trunk information is checked to ensure its proper transmission.

(h) With all checks satisfied, the marker disconnects and restores itself to normal, leaving the established connection between line and trunk under supervisory control of the trunk.

B. Intraoffice Call - ITR

6.05 An intraoffice call is one between two customers in the same marker group. This type of connection requires a double-ended trunk. One connection is established between the called customer line appearance and the trunk link appearance of one end of the trunk; another connection is established between the calling customer line appearance and the trunk link appearance of the other end of the trunk.

6.06 After translation and operation of a route relay, the call is recognized as an ITR call. This type of call requires a forward linkage (FLG) to be established to the called line first, followed by a call back (CB) linkage to the calling line. Marker work time is minimized by attempting to select the path from trunk to called customer first, in case the connection cannot be made because of line-busy, or channel busy conditions.

6.07 The general sequence of operation is as follows:

(a) The marker determines the required route, and operates the proper IAO route relay as a result of translation of the called number and signals received from the OR.

(b) A TL is selected containing an idle intraoffice trunk by testing the IRA, IRB leads, and the trunk is selected according to the state of the IAO allotter.

(c) Since the called number does not directly indicate the called line equipment location, a LNT is called in to translate the called number into its equipment location on the LL. This location is by frame, line block, line group, and line. A ringing combination code is also received to control proper ringing for the particular called line.

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(d) The marker seizes the LL containing the called line in order to control selection of the line.

(e) The channel test leads are closed through to select an idle channel between the called customer and one end of the ITR trunks, and the select and hold magnets are operated to connect the linkage through the LL and TL frames.

(f) The established channel is checked for a satisfactory connection, and that the trunk ringing relays have been operated. The marker DCT relay operated indicates that the FLG operation is completed and that advance must be made to set up the call back (CB) linkage.

(g) Certain apparatus associated with channel selection, hold magnet control, and line equipment control is released for use with the CB linkage. The equipment location of the calling line is recorded from information contained in the OR. The LL is seized to provide marker control of the calling line.

(h) The channel test leads are closed through for the call back linkage to select an idle channel between the calling customer and the other end of the ITR, trunk, and the select and hold magnets are operated to connect the linkage.

(i) The call back linkage is checked for a satisfactory connection.

(j) The marker disconnects and restores to normal leaving the established ITR connection under supervisory control of the ITR trunk.

INCOMING CALLS

6.08 Incoming calls may be received from an operator or from a calling customer in a connecting office. The digital information is received by the incoming register which is connected to the marker through the marker connector.

A. Terminating Call - TER

6.09 A terminating call is one placed to a customer served within the marker group which requires a connection to be established between the trunk link appearance of the incoming trunk and the called customer line appearance on the LL.

6.10 A route relay is not required on a TER call. Direct signals or translation determines that the call is to be completed locally and that an FLG linkage is required.

6.11 The general sequence of operation is as follows:

(a) The marker must first seize the trunk link frame on which the incoming trunk terminates. The TL number is received from the IR and the trunk is controlled over its F lead through the IRMC and the incoming register link.

(b) A LNT is selected to translate the called number into an equipment location. This selection is made by the operated OAT or OBT relay and the thousands digit of the called line number.

(c) The LL containing the called number is seized to enable marker control of the desired select and hold magnets.

(d) The channel test leads are closed through to select an idle channel between the incoming trunk and the called customer, and the select and hold magnets are operated to connect the linkage through the LL and TL frames.

(e) The established channel is checked, the line number translator is released, and the trunk ringing relays are operated. The DCT relay operates if all tests are satisfactory and the marker proceeds to disconnect and restore to normal.

REVERTING CALL

6.12 A reverting call is a call to a customer on the same line as the calling customer.

6.13 When a reverting call is required, a connection is established from the customer line through the LL and TL switches to:

(a) A reverting trunk if charging is not required.

(b) An operator trunk if charging is required.

6.14 Due to the unique operation of the No. 3 Crossbar System only one type of reverting trunk is required. By appropriate

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class-of-service screening, those classes requiring the dialing of a stations digit to indicate calling party ringing will initiate a register recall. The originating register will release from the marker while retaining the line connection. A second dial tone will be returned to the customer as a signal to dial the station digit. Upon receipt of the digit the register will seize a marker and indicate by lead RD, that an eighth digit is to be received. By translation of the reverting digit the marker is able to set appropriate ringing relays in the trunk. Those classes not requiring stations digits will be connected directly to the reverting trunk.

6.15 Since all customers on the same line have the same line location, the marker makes the reverting test by matching the calling line location against the called line location, and if a match is made the call is handled as a reverting call.

6.16 The general sequence of operation is as follows:

(a) The calling line location is received from the ORIG REG and stored in the marker. The called number is also received and translation of its office code causes the operation IAO route relay IOA or IOB, which seizes the LNT for translation of the called number to equipment location.

(b) Relay IOA or IOB will operate party match test relay PMT to compare the line location received from the ORIG REG with that received from the LNT. A match is indicated by operation of PM1,2 and RV1,2. The TL is released if seizure has occurred. Relays FLG 1, 2 and ITR release to release the LNT, and relay PMT which closes ground to reverting code point RV.

(c) The call now proceeds as a reverting call.

(d) Ringing relays are operated in the trunk as required. The marker releases and the connection is left under supervisory control of the reverting trunk.

DIAL TONE CALLS

A. Information Necessary to Establish the Dial Tone Connection

6.17 Information necessary to establish the dial tone connection is as follows:

(a) The location of the customers line on the LL frame.

(b) The class of service of the customer.

(c) The location of an idle originating register, if available.

(d) An idle channel between the customer and the register through the line, line switch, and connector and the trunk switch and connector circuits.

B. General Method of Operation

Marker Seizure

6.18 A customer originates a call by removing the receiver from the switchhook which operates the associated line relay of the LL frame causing a start signal to its associated marker connector informing it that a marker is required. The marker connector will seize a marker in competition with registers in the same connector which may also be requesting a marker.

Calling Line Identification

6.19 Identification of the calling line is initiated when the marker is seized. Line location is made in terms of LL frame number, line block, line group, and line. Class of service of the line is obtained by the line number translator, which is seized when line group identification has been completed. The LL frame number is indicated to the marker by the marker connector upon marker seizure.

6.20 A line block of customer lines consists of the 50 horizontals of two physical crossbar switches which are divided into five groups of eight verticals each. All lines in the same block are associated with the same group of eight electrical secondary switches. Each LL may have a maximum of four line blocks. Each horizontal will serve two customers by the use of splitting levels A and B to associate either customer with the link.

6.21 Following seizure the marker determines which line block contains the line requesting service. If more than one line block is requesting service the marker preferentially selects one line block. Having selected line block, the calling line is determined to be among 100 of the possible 400 lines on the LL.

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6.22 A line group of customer lines consists of ten switch horizontals occupying the same position in each of the four line blocks, the ten horizontals accommodating 20 customer lines. The marker determines which line group contains the customer in the selected line block requesting service. If more than one line group in the line block has lines requesting service, the marker preferentially selects one line group for service. By the selection of line block and line group, the customer to be given dial tone service has been identified to be located within a group of 20 lines. Upon operation of relay LGL indicating selection of one line group, the marker will seize the LNT for determination of class of service.

6.23 To complete line identification, the marker must determine which one of the 20 lines associated with the selected line group is requesting service. If more than one line in the group is requesting dial tone, the marker preferentially selects one line.

Determination of Class of Service

6.24 The operation of LSK indicating selection of a particular line completes information required for class-of-service translation. The LNT previously seized after line group check will now by the addition of line information, return class of service to the marker in terms of CSO-7, CSA, CSB and "A" or "B" DP or "A" or "B" MF. The dial pulse or MF class is used to prevent unauthorized use of TOUCH-TONE® sets by customers not entitled to this service.

Selection of an Idle Originating Register and Seizure of the LL

6.25 Upon receipt of class of service, the marker will by means of test leads, select a TL with idle registers and preferentially select and seize an idle register. The line switch circuit containing the line selected for service is seized through its connector and the marker selects an idle channel and operates channel crosspoints. The information relative to line location and class of service is passed to the originating register.

Release of the Marker

6.26 After the connecting path has been established and checked, and the information in the register has been checked, the marker and associated circuits are released. The originating register will transmit dial tone to the customer as an indication that dialing may begin.

7. DESCRIPTION OF CROSSBAR NO. 3 SYSTEM

7.01 The Crossbar No. 3 System is similar in character to the No. 5 System currently in use. However there are some distinct differences as follows.

7.02 The No. 3 crossbar office utilizes a 3-stage switching network of crossbar switches. The lines (customers) appear on the levels (horizontals) of the first stage switches, and the trunks appear on the verticals of the third stage switches. The intermediate or second stage switches are used to interconnect "line links" to the first stage switches and "junctors" to the third stage switches. There are eight possible paths (or channels) between any particular line and any particular trunk.

7.03 Originating and incoming registers, and outgoing senders are used for the same general purposes as in No. 5, however, the No. 3 line circuit provides automatic lockout and reorder tone to the customer. Therefore, lockout is forced any time it is desired to return reorder to an originating call.

7.04 The ringing selection switch of No. 5 has been eliminated. Multiparty ringing is set up by relays within the trunks and line-busy tone and reorder tone are provided by a spare level of the third stage (trunk) switches. Both tones are provided for incoming calls. Line-busy tone only is used on originating calls. Their termination is made through an intraoffice trunk when it is desired to return line-busy to an originating line.

7.05 Line intercept terminations have also been changed. These appear on a second spare level of the trunk switch and are accessible by both incoming and intraoffice trunks.

7.06 The ANI transverter and translators of No. 5 have also been eliminated and their functions taken over by the marker and a common translator for both line ANI and number translations. The translator also provides class-of-service indications.

7.07 Some variations have also been made in the continuity and ground test features, and the permanent signal test feature.

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7.08 As in No. 5 crossbar, and the other crossbar systems, the primary control circuits have been called markers, therefore, this name has been retained.

7.09 The No. 3 marker establishes all connections through the office. The services of the marker may be requested by lines (line switch circuit) for dial tone, originating registers for completion of originating calls and incoming registers for termination of incoming calls.

7.10 Seizure of the marker is established by either of two marker connector circuits. Each connector serves approximately one-half the line switch circuits (line units), originating registers and incoming registers in the office. Upon seizure, the marker translates the service request and establishes the required connections.

GENERAL FUNCTIONAL SEQUENCE

7.11 The general sequence of marker functions is as follows.

(a) Dial Tone Request

(1) Line identification.

(2) Translator seizure and class-of-service translation.

(3) Trunk switch and connector seizure.

(4) Selection of an originating register and seizure of line switch and connector.

(5) Select channel.

(6) Operate channel crosspoints and store information in originating register.

(7) Check channel and storage of information.

(8) Release.

(b) Originating Request

(1) Translate office code.

(2) Translator seizure and number (intraoffice) or line (ANI) translation if required.

(3) Trunk switch and connector seizure.

(4) Trunk selection and seizure of line switch and connector and sender seizure if required.

(5) Select channel.

(6) Operate channel crosspoints and store information in trunk and sender if required.

(7) Check channel and information storage.

(8) Release.

(c) Incoming Request

(1) Office code translation if required.

(2) Translator seizure and translation of called number.

(3) Seizure of trunk switch and connector.

(4) Seizure of line switch and connector.

(5) Select channel.

(6) Operate channel crosspoints and store ringing information in trunk.

(7) Check channel and ringing storage.

(8) Release.

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SECTION II - DETAILED DESCRIPTION

1. MARKER SEIZURE

SEIZURE OF MARKER BY MARKER CONNECTORS - FS1

1.01 Operation of an MS- relay in the marker connector to seize the marker releases the MSK and MCK relays of the marker which in turn recognizes the seizure by operating relay TM to start timing which operates relay MCB to make the marker busy to other seizures. Operation of the marker connector MC- relays operate DT/OR/IR indicating the source of the request, TR1/2 indicating trial and CNG to provide off-normal grounds or batteries. The OR/IR operates RGK to provide a short delay in making number check to permit time for all number registration relays to operate. Miscellaneous relay TA and TRT provide for alarms if the marker encounters a long time out or trouble recorder time out. Operation of TOA by TOA TMR started by TM operates TA. Operation of WT by WT TMR started by TRST operates TRT. The W1-2 and Z1-2 provide a walking circuit stepped by the D1S1 relay on each marker release. These relays are used to alter marker preference and selection circuits on successive usages.

REGISTER INFORMATION TO THE MARKER

1.02 The marker starts its action in accordance with information received over the large group of leads from the register. The information passed by these leads is summarized below:

Leads	Information
AO/7-KO/7,EK	Called number from Orig or Inc Register
OA,OB,AB	Translation marker from Inc register
LBO-3, LGO-4	Control lead to LL for block and group relay operation
LBSO-3, LGSO-4, LOO-19, LUO,1	Line Identification Leads from OR or LL
IR,DT,OR	Type of Call
SPL	Special call, IR
CSO-7, CSA, CSB, MP	Class-of-Service, OR
CTR, MRL, TRL, RLL	Marker release information
DCK, LR, RO	Trouble and check signal from IR
F	Operate Trunk F Relay, IR
HC	Control of LL on DT Calls
TR1,2 TRS	First, Second trial and transfer start indication from marker connector
TST	Test Call
TUO,1	TL Location of Inc Trunk, IR
LT,PO,P1, PX,PX1,ZO	Translation marks from OR
PS,PD	Line Irregularities from OR
RD, RP, TP RR,RV1,PT1-4	Party Indication, Reverting and PBX control from OR
T,R	Tip and ring for permanent signal test from OR
MSK,MCK,CB-	Marker Seizure
CNG	

2. LINE UNIT AND BLOCK IDENTIFICATION - FS2

2.01 Line identification is established immediately following seizure with either DT or OR operated. Line unit relays LUO or 1 are operated directly from marker connector relays on DT calls or from memory previously stored in the originating register on OR calls. Block gate relay BG is operated by either DT or OR for line block identification. Line block relays LBO-3 are operated directly from memory relays in the originating register or corresponding relay of the line unit. Operation of any LB- operates line block register or release relay LBR. With DT operated, more than one LB- may be operated when simultaneous requests occur in different line blocks. Selection of only one is provided by line block lock relay LBL which operates from any LB-. Operation of LBL and DT and LBR operates line block select relay LBS which in turn operates line block auxiliary relay

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LBA in series with an LBS winding to provide a positive lock indication. The LBA releases BG to open the LBS- leads to the line unit. With BG released, only one LB- is locked if more than one was operated. Release of BG with LBS operated operates line block check relay LBK. The LBK operates hold connector relay HC in series with the MST relay of the connector. Operation of HC permits operation of the LB- relay of the line unit to permit line group identification. If more than one LB- is operated on the line unit, relay XLB will operate to block line group identification.

3. LINE GROUP IDENTIFICATION - FS3

3.01 Relay OR operates groups gate relay GG for immediate operation of an LG- relay from the originating register memory relays. On dial tone calls, relay GG is operated by the dial tone route relay DTR following operation of DT. When the LB- relay of the line unit is operated (by HC), one or more of the LG- relays will be operated. Any LG- operates line group register or release relay LGR and with DT operates line groups lock relay LGL. Operation of LGL operates line groups select relay LGS. The LGS in turn operates line group auxiliary relay LGA which releases GG to operate line groups check relay LGK. Operation of LGK operates the LG- relay of the line circuit to permit line identification. If more than one LG- is operated, on the line unit, relay XLG will operate to block line identification.

4. LINE IDENTIFICATION - FS4

4.01 Identification of the line within the line group is made similar to line group identification. Line selection gate relays LSG 1, 2 are operated by either DT or OR and are followed by the operation of an L- and LSR, and with DT, LSL, LSS, LSA, the release of LSG1, 2, and final operation of LSK to permit class-of-service identification. On dial tone calls, release of LBR, LGR, or LSR indicating an abandoned call prior to class-of-service identification will operate relay D1S1 to release the marker.

5. CLASS IDENTIFICATION - FS5

5.01 Class identification on OR calls is obtained directly from memory relays in the originating register, and on DT calls from the translator circuit. The line location is passed to the translator with the operation of LSK and the translator operates an RC- and BL- to indicate the class of service. Operation of the RC- and BL- relays with LBL operated, operates one of the class-of-service CSO-7 relays and CSA or CSB to indicate office. Operation of a CS- and CSA or CSB with LBA operated operates class check relay CSK. On OR calls, the CS- and CSA or CSB relays along with the ring party RP or tip party TP or reverting digit RD relay and one of the party PT- relays are operated by the memory relays in the register. Operation of the party and class relays with LBR, LGR, and LSR operated, operates CSK. The CSK operates one of the type of service relays through cross connections to the CS- relays. The type of service relays are 2-party (2P), PBX, manual (MAN), multiparty (MPN), coin (CN), and all other classes (AOC).

6. TRANSLATION INFORMATION - FS6

6.01 Translating information, in addition to the called number, is received directly through the marker connector from the originating and incoming registers to operate translation relays for zero operator (ZO), no prefix or local translation (LT), prefix 1 (P1), prefix 0 (PO), permanent signal (PS), partial dial (PD), office A (OA), office B (OB), office A or B (AB), special call (SPL), or reorder request (RO). Operation of a single translation relay operates translation check relay TNK to permit further translation of called number. The SPL is excluded from this check.

7. NUMBER REGISTRATION - FS7

7.01 The called number is registered directly from the originating or incoming registers on a 2-out-of-5 basis on the A- to K- and AC- to DC- relays. The first digit appears on the A- and AC- relays, the second on B- and BC- etc. End check relay EK provides final check of 10-digit calls. The operating grounds of the A- to K- and EK relays are extended to the outsender for registration of the called number in the sender on outgoing calls. Checks of the sender memory is made by the A- to K- and EK relays when relays KN 1-3 are operated to check storage. Relays AC- to DC- provide independent control of the office code and D-digit translation.

8. NUMBER CHECK - FS8

8.01 The validity of the called number registration is checked through contacts

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of the number registration relays by the number check ground relay NKG and number check relay NK. If the number is properly registered and there are no crosses to ground or battery in the check path, both NKG and NK operate when RGK of FS1 operates. Operation of NKG and NK operates number check start relay NKS which operates number check auxiliary relay NK1 as a positive lock indication. If the number is not properly registered, the mutilated digits relay MUD will operate to provide a trouble record and reorder to the calling customer. The number check is not made on permanent signal calls. Relay NK1 shunts down relay NKG through back contacts of relays KN1 and KN2 to provide a check of their operation on outsender calls when storage check is made.

9. NUMBER TRANSLATION - FS9

9.01 The called number information is converted from 2-out-of-5 to 1-out-of-10 indications per digit through contacts of the number registration relays AC- to DC- and A to G. Operation of NKS provides ground through the AC- to DC- relays for office code and D digit translation. Operation of relays NA-, NB- or ND- provides ground or battery through the A- to G- relays for the translation of the called number by the translator circuit.

10. CODE POINT AND OFFICE SELECTION - FS10

10.01 The establishment of a code point for the selection of a route on outgoing calls in normally provided by the operation of the local translator auxiliary relay LTA by relays TNK, CSK, and LT. Operation of LTA permits one of the B-digit relays BDO or BD1 or the AB- digit translation relays AB2-9 to operate from the BC- registration relays. The operation of BDO or 1 indicates an area code and grounds code point terminal AC for routing. Relays AB2-9 close ground from the AC- register relays to one of the codes point terminals AB22-99 (64) for routing or further translation by the C-digit translation relays CTAO-9 and CTBO-9. The CT- relays corresponding to the C digit are operated by relay LTA through the CC- relay contacts. When three digit translations are required, the AB- code point is cross-connected to one of the ABX- terminals and the ground is extended through contacts of the CT- relays to one of the code point terminals COOO-479 according to the ABX- terminal and C-digit dialed for routing or further translation. When thousand digit translation is required, the C--- code point terminal is cross connected to terminal DTA or DTB to operate D-digit translator relay DTA or DTB. The DTA or DTB terminals close ground from the DC- relay contacts to one of the code point terminals DA- or DB- according to the D-digit dialed for routing. When desired NNO codes may be treated separately as a unit by cross connecting terminal CCO to terminal CDO to operate C-digit zero relay CDO whenever an NNO code is dialed. Relay CDO grounds code point terminal ABO for routing. Relays PO and P1 indicating a prefix 0 or 1 was dialed, ground code point terminals PO and P1, respectively, to permit direct treatment if desired or cross-connection to terminal LT to operate LTA for code translation as with LT. Relay ZO and PD close ground to code point terminal ZO and PD, respectively, for direct routing of zero operator calls and partial dial. Relay PS closes ground through contacts of relay ROH to receiver off-hook code point terminal ROH and relay PSG to permanent signal ground terminal PSG for routing. Relays ROH or PSG are operated following permanent signal test (FS38). Ten-digit calls are automatically routed to reorder (disconnect) by relay EK when the D-digit or first digit of the office code is an "0" or "1". Relay EK closes ground on either of the DCO or DC1 leads to the D1S1 relay to return reorder to the calling customer.

10.02 Office selection on incoming and intraoffice calls is made by relays OAT and OBT. These relays control selection of translators for line number translations. Office A translation relay OAT is operated by relay OA on incoming calls and IOA on intraoffice calls. Correspondingly, relays OB and IOB operate office B translation relay OBT. On 5-digit incoming calls, relay AB operates to offices A or B translation relay ABT. Relay ABT closes ground from the AC- relay to one of the FVD- terminals corresponding to the "A" digit for translation. The FVD- terminals are cross connected to terminals OAT and OBT as required for office selection and to terminal ROT (FS11) for vacant office digits. When the office is used as a PBX, intraoffice (PBX) calls are handled on a 4-digit basis and

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the originating register operates relay OA which operates private exchange relay PX. Relay PX closes ground from the AC- relay to one of the terminals AXO-9 depending on the A digit for routing to the PBX attendant (O), intraoffice route, or reorder (ROT). Tie line codes beginning with a "1" or CCSA calls identified by a prefix "1" cause the originating register to operate the OB relay which operates private exchange auxiliary relay PX1. Relay PX1 closes ground from the AC- relay to one of the AX10-19 terminals depending on the "A" digit for routing.

11. ROUTING AND SCREENING - FS11

11.01 Routing is established by the operation of one of the route relays RO-19 from a code point ground, dial tone route relay DTR from relay DT or intraoffice route relay ITR from intraoffice relays IOA or IOB, or ringer test relays RTA or RTB. With the exception of relay DTR and ITR, all route relays are operated via cross-connection to the appropriate code points either directly or through screening contacts of the CS-, LT, P1, PO, screening relays SO-9 or auxiliary relays ARO-9. Relay DTR provides information for the dial tone route (ORs). Relays IOA and IOB are operated from the office A and B code points, respectively. Relays RTA and RTB are operated from the office A and B ringer test code points and operate the corresponding IOA and IOB relay. The IOA or IOB operates ITR which in turn operates IRA or IRB depending on the setting of W1. Together, ITR and either IRA or IRB provide the information for intraoffice routes A and B. When an intraoffice code is dialed and a party match is detected, reverting relay RV2 (FS19) will operate to transfer the operating ground from ITR to the reverting code point RV for routing to a revertive call trunk. When a ringer test code is dialed, relays RTA or RTB prevent operation of IRA or IRB and therefore require the operation of RV2 to ground the ringer test code point RT for routing to a revertive trunk. When a party digit is required for the reverting call trunk, code point RV is connected (through screening) to recall originating register terminal ROR to operate register recall relay RR. Relay RR will cause the originating register to release the marker (FS29) and return dial tone for receipt of the reverting party digit from the customer. When the customer dials the party digit the register will reseize the marker with reverting digit relay RD operated to extend the ground to terminal ROR to revertive advance code point RVA for completion of routing to a revertive trunk. If the customer dialed either "O" or "1" as the party digit, wrong digit relay WRD (FS32) will be operated to cause revertive error code point RVE to be provided for routing to reorder ROT. When all trunks to a route are busy (except dial tone) relay GSA or GSB (FS12) will operate to ground a route advance terminal RAO-19 on regular routes or cause the nonoperated IRA or IRB to operate to advance to a second route or group of trunks. If no second group of trunks is provided, the RA- terminal is cross-connected to ROT. When a second group is provided and these trunks are also busy, ground from the GSA or GSB is always connected to ROT. (The ITR always has two groups IRA and IRB.) The R- relays are normally connected to route battery terminal RB, but may be connected to either RB or one of the auxiliary relays ARO-9 (through screening) for denied or diverted routes. Relays ARO-9 are high-resistance and prevent operation of the R- relay. The AR- relays in turn ground reroute terminals RR- for the required routing or reorder. Screening, either before or after the route relays, is provided directly from the class and prefix relays CS-, LT, P1, and PO via input terminals SC-, CSC-, and PSC; and output terminals SA-, SB-, CSA-, CSB-, LC-, TC-, and PP-. Additional screening can be provided by screening relays SO-9 and the AR- relay when required. Ground terminal GD is provided for operation of the S- and AR- relays through the class and prefix screens. The contacts of the S- and AR- relays may be cross-connected in any manner desired for any purpose through terminals AS-, S-, and ARA- to ARH-.

12. ROUTING INFORMATION - FS12

12.01 Routing information is provided by the trunk block relays TBO-6 and trunks groups relays TGO-7 for selecting a trunk. No sender relay NS is provided for routes that do not require a sender and step-by-step (SXS) relay, dial pulse register (DPR) relay, multifrequency (MF) relay and identification (ID1-3) relays are provided for sender routes, relays SXS and DPR indicate a dial pulse route, relays MF and ID- indicate an MF route. The ID- indicates line identification (for toll charging) is required. Either operator or automatic (ANI) identification may be employed. Class relays CLO-3 provide marks to the senders to set up the proper outpulsing conditions. Delete relays DLO-3, DLN, and DLA permit modification of the outpulsing

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of the called number or ANI information. The DLO-3 indicates the number of initial digits of the called number that are to be omitted. The DLN indicates that all digits of the called number are to be omitted and DLA deletes the ANI information. Arbitrary digit relays ADO-4 instruct the sender to prefix the called number with a specific digit set up in the sender circuit. The no-charge (NC) relay, local charge (LC) relay, and the coin signal (CNS) relay indicate to the marker that charging signals are required by the trunks. The NC indicates no signals are to be sent to the trunk. The LC indicates TP must be sent to trunk when present, and CNS requires a coin signal when CN is operated. Allotter relays ALO-1 permit allotting of two TB- indication on the same route. Forward linkage relay FLG1,2 indicates a connection from a trunk (incoming or intraoffice) to a called line (local termination) is required. With the exception of FLG1,2, all routing information relays are operated via cross-connections from the R- relays as required. The grounds for these cross connections are divided into two groups or supplies. One group under the control of ground supply relays GS1 and GSA furnishes ground to relays RO-9. Relays R10-19 receive ground through GS2 and GSB. This permits route advancing from one group of R- relays to the other. Control is established by the route group relays RG1,2 connected in series with the charging relays NC, LC, or CNS. When all trunk of a route are found busy, relay RAV will operate to operate GS1 or GS2 depending on the RG- operated. The GS- relay operates GSA or GSB to lock GS- and opens the information grounds of the operated R- relay in the associated ground supply. This releases the information relays that were operated to permit release of relay RAV. Release of RAV releases the RG- associated with the busy route. Release of the RG- grounds the route advance point of the busy route for selection of the alternate route or returns reorder. Routing information for dial tone, intraoffice, and automatic intercept routes is preset and directly wired. The arbitrary digits required for AIS must be set in the sender as required by the feature.

13. LINE NUMBER TRANSLATOR OPERATION

13.01 The line number translator (LNT) is equipped to provide class-of-service identification, number to line and line to number translation, and its use is required on all dial tone, intraoffice, ringer test, incoming and outgoing identified (ANI) calls. Each translator may be equipped to translate a maximum of 600 numbers arranged in six hundreds blocks HB(A-F), and a maximum of 400 ring or individual lines arranged in four ring hundreds blocks RB(A-D) and 200 tip party lines arranged in four blocks of 50 lines each, TB(A-D).

13.02 The marker selects and seizes a translator and transmits the line location on dial tone and identified (ANI) calls and receives class of service in terms of CSO-7 for office A or B and identification of MF or dial pulse class on dial tone usage, and receives the calling line directory number in terms of thousands, hundreds, tens, and units in the case of an identified call. The marker selects and seizes a translator and transmits the directory number on intraoffice FLG or incoming calls and receives the line location in terms of line unit, line block, line group, and line.

13.03 A summary of the information transmitted over the leads to the translator is contained in the following table:

Leads	Information
STA(0-2) STB(0-2) BS1,2, BSA TCK	Start, Battery, and Check Leads for Selecting LNT
HB(A-F), LB(A-D), TLB(A-D)2-4 LBA,C, 2-4 TLBA,C	Hundreds Block Selection for number or Tip and Ring Block for Line Translation
TNO-9, UNO-9, CSA,B NLK, UK	Tens and Units Numbers; or Line Group and Line For Line or Class-of-Service Translation with Associated Check Leads
AF1,2, BF1,2	Battery Supply for LNT Translation
CO-11	On Number to Line Translation RCO-7 Indicates ringing Combination for Party 1 to 8, RC8,9 Indicates the Lines of a 2-Line Hunt Group; C10 Indicates a Hunting Group and C11 Indicates Intercept

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Leads	Information
CO-11 (Cont)	Condition: On Line to Number Translation CO-9 indicates Hundreds Digit of the Line, and On Class-of-Service Translation CO-7 indicates class-of-service O-7
BO-7	On NBR to line Trans, BO-7 indicates Line Block; O, 2, 4,6, represent LBO-3 of LL-O and 1,3,5,7 represent LBO-3 of LL-1, on line to NBR trans, BO-3 indicates the thousand digit (one of four), and on Class-of-Service Translation BO, 1 indicates DP or MF Class Office A; B2,3 DP or MF for Office B. BO with RC11 indicates RI intercept, B1 with RC11 indicates TI intercept.
TO-9	On NBR to line Trans, TO-9 Indicates Line Group and "A" or "B" Line App, TO,1 etc to T8,9 indicates LGO-4, while Even Tens are "A" App and Odd Tens are "B" App lines; on Line to Number Trans TO-9 indicate the Tens Digit
UO-9	On NBR to Line Trans UO-9 Indicates Unit Line NBR and On Line to NBR indicates Unit Digit O-9
AK,GB,A,AV,LTK LO-9	Test, Check, and Control Leads Associated with Hunting Group Operation

TRANSLATOR SEIZURE - FS13

13.04 Two translators are normally provided and are selected according to the translation block required. The HB- required for number translation is derived from the thousands and hundreds digits of the called number. Since the marker may have received 4 or 5 digits from the INC REG or 7 digits from the ORIG REG, the thousands digit (and remaining) digits will be selected by number start relays NA-, NB-, or ND-. Relays OA and OB operate NA- relays to translate the "A" Digit as the thousands digit. Relay AB operates the NB- relays to start translation with the "B" digit and IOA or IOB operate ND- relays to start translation with the "D" digit. The N- relays will place ground or battery through the "A" to "G" relay contacts as required to complete the translation. The thousand digits is extended from the "A", "B", or "D" digit register, through an operated NA1, NB1, or ND1 relay through an operated OAT or OBT relay for cross connection to the TH(A-D) relay (only four thousands digits may be translated). Unused thousands digits are connected to blank number (BN) relay. The hundreds digit is extended through the operated TH(A-D) relay for cross connection to selection relays OH(A-F) for HB(A-F) relays on LNT-O or to relays 1H(A-F) for HB(A-F) relays on LNT-1. The translator block relay RB- or TB- for class of service or line to number translation is determined by the line link and line block number. The operation of LGL on dial tone calls or the operation of ANI on outgoing calls with MPN and DLA nonoperated will operate line translation relay LTR, which connects ground through LB- contacts and either LUO or 1 for cross connection to the selection relays OB(A-D) for selection of an RB- relay on LNT-O or to 1B(A-D) for selection of an RB- relay on LNT-1. When tip party translation is required, relay TP transfers the translator RB- block relay to a TB- block in the translator.

13.05 Operation of NA-, NB-, ND-, or relay LTR operates translator connector relay TRC. Relay TRC with any one of the selection relays operated closes battery to the desired translator. Operation of the associated MP- relay in the translator will operate the M- and MC- relays and the translator connector check relay TCK in the marker. The proper HB-, RB, or TB- relay in the translator is then operated through the operated selection relays. The tens digit of the called number through contacts of NA-, NB-, or ND- controls the selection of a translator N- relay for number to line translation. The operation of LTRA and the associated LG- and L- relays operated, control the selection of the translator L-

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relay for line to number translation. Relay LTRA isolates the line location leads when number translation is made on intraoffice calls. Class-of-service translation is obtained by the operation of translator CSA or CSB relays through the operated LGK and associated LO-9 or L10-19 relays. Translator relays N-, L-, and CSA, CSB are operated by marker resistance battery. If more than one N-, L- or if both CSA and CSB should falsely operate, XNL will operate to block or release relay UK to prevent translation. The units digits of the line or number through contacts of NA-NB- or ND- or through LTRA and the associated L- relay operates the translator U- relays. Relay LTRA isolates the LS- leads from number translation on intraoffice calls. Operation of one translator U- relay and one splitting relay will operate units check relay UK to permit translation. Upon successful translation, relay TRK will operate to release TRC and LTR releasing the translator.

14. NUMBER AND LINE TRANSLATION - FS14

14.01 The operation of TRC operates blank number timing relay BNT, with the operation of NLK, UK, and BNT, battery is extended over the AF- and BF- leads to the translator relay tree for translation. Battery is returned through LNT cross connection to the marker to operate a ringing class or hundreds relay RC0-11, a block relay BL0-7, a tens relay T0-9, and a units relay U0-9. On class translation the T- and U- relays are not used. Cross relays XRC, XBL, XT, and XU are provided to detect the operation of two or more translation relays within the same group. If any of the cross relays operate, translation check relay TK is blocked. Any RC- operates RCL, any BL- operates BLL, any T- operates TL, and any U- operates UL to lock in the translation. On regular number and ANI translations, operation of all locking relays operates translation complete relay TR which in turn operates translation check relay TRK to lock both TR and TRK. On class translations TL and UL should not operate and their contacts are bypassed by the LSK relay. The TL and UL are also omitted for regular intercept and are bypassed by relays RC11 operated and BL1 normal. On blank numbers no translation is received and the operation of UK and NLK permit the slow-release BNT to release. The release of BNT with all locking relays normal operates relay BN to indicate blank number. On ANI translation, failure of TR to operate will cause the release of BNT which operates identification failure relay IF on second trials. The release time of BNT is checked on class translations. The check is canceled on second trial. The operation of either BN or IF will operate TR and TRK as a translation check. When a translation of a PBX pilot number is received, RC10 transfers the operating ground for the TR to hunting relay HTG. Relay HTG closes the winding of relay TR to contacts of relays CKR and LB to permit operation of TR after an idle line has been selected or the group found busy. On intraoffice calls, the operating ground for TR is transferred by relays IOA and IOB to the RVT lead for party match test. At the completion of the party match test the ground will be returned on the RVK lead to operate TR. Operation of TR and TRK will release the translator.

15. LINE HUNTING - FS15

15.01 When a PBX pilot number is dialed the translator operates a line test LT relay in that circuit in series with line test check relay LTK and cross relay XLT. If more than one line test, relay operates in the translator, relay XLT will operate to block line selection. Relay LTK will also have caused relay HTG to operate from RC10 as an indication that hunting is required. At the same time the line test relay of the translator closes the LT- leads of the hunting lines in the first group (or tens block) to the winding of the hunting line relays HL0-9. If one or more of the lines are idle, one or more of the HL- relays will operate to operate hunting line selection relay HLS. The HLS and HTG will cause hunt line relay HTL to operate to release the translation relays, and line test relays of the translator. Release of the translator relays will release all operated HL- relays except the one that is locked for selection. Release of the translation relays, UK, LTK, RCL, BLL, and UL, and TL will operate check release relay CKR. The CKR locks and releases HTL to permit reoperation of a U- relay on the translator corresponding to the locked HL-. The translator U- operates relay UK to reapply battery to the translator for translation of the selected line. Check of the translation is established by the operation of TRK.

15.02 If there were no idle lines and a second group (ten block) of lines is not required the operation of HTG will operate group busy relay GB through back contacts of HLS, the HL- relays, and a translator cross connection. If a second group

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of lines is required, the operation of HTG will operate an advance relay on the translator (over the GB path) through a cross-connection in that circuit. The translator relay will operate and lock in series with advance check relay AK. Operation of relay AK will operate HTL to release the translation relays, LTK, and N- and U- relay of the translator. When all relays have released relay CKR will operate to test the lines of the second group. The CKR operates a second line test relay on the translator in series with LTK and XLT. If there is an idle line in the second group, one or more of the HL- relays will operate to operate HLS. Operation of HLS with AK operated will release the translator line test relay and LTK. The LTK in turn will release HTL to permit translation of the selected line. The U- and N- relays of the translator will operate to operate UK and NLK to complete translation. If no idle lines are found in the second group, the operation of LTK and AK and CKR operated will operate GB as previously described. Operation of GB will operate LB which in turn will operate TR and TRK to release the translator.

16. OUTGOING SENDER SELECTION AND CONTROL - FS16

16.01 The No. 3 crossbar office is equipped with one sender group with a maximum of five outgoing senders. All the senders may outpulse MF or DP as required. The connection between the sender and the outgoing trunk is established through the outgoing sender link OSL. All senders have access to all outgoing trunks requiring senders. A summary of the leads used to select and control a sender through the connector is shown below:

Leads	Information
AO/7 - KO/7,EK AD1-4	Transmit Called Number to Sender Arbitrary Digit Information
CL1-3	Class Information to OS
DL1-3, DLN	Delete Information
STA, STB, LCB	Connector Control
OSO-4	Sender Number
THO/7, HUO/7, TO/7, UO/7, OA, OB, OI, IF	Transmit ANI Information to Sender
ASB	All Senders Busy
AV	Sender Advance
DP, MF, AI	Type Pulsing Required
NC, PO	Control of ST- Pulse

SENDER SEIZURE

16.02 When no sender is required, relay NS will operate the no sender outgoing relay NSO. When a sender is required and the necessary sender information from the route relay has been registered, the sender outgoing relay SOG will operate either directly from the route information or from the automatic number identification relay. Relay SOG will in turn operate the outsender connector relay OSC following seizure of the trunk switch connector and operation of relay TUK. Relay OSC closes battery to the sender connector to bid for an idle sender. If an idle sender is available, an SS- relay associated with the sender will operate in the sender connector and operate an outsender relay OSO-4 corresponding to the sender selected. Relay OS- will operate outsender check relay OSK as an indication the sender has been seized. If no idle senders are available, the sender connector will return battery on the ASB lead to operate the all-senders-busy (ASB) relay. The ASB will operate RAV to route advance the call.

TRANSMISSION OF INFORMATION TO SENDER

16.03 The marker must record the called number, and if required, the calling number, so that they may be transferred to the sender. The marker must also record and transfer to the sender information received from the route relay such as class, leads deleted, etc. Route relay information is covered in detail in 12. Routing information FS12 and the associated cross connection information is shown in Note 400. The transfer of information to the sender is covered in detail under information storage FS27.

17. SENDER LINK CONTROL - FS26

17.01 When the trunk F relay operates with OSC operated, battery is extended through the primary winding of cross select relay XSS to operate the trunk select magnet SEL on the outsender link. If more than one select magnet is operated relay XSS will

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operate to block operation of the sender link hold magnet. Operation of SEL closes battery through the primary windings of the crossed vertical group (XVG) relay, vertical group check (VGK) relay, and a VG- relay on the OSL to ground on the trunk F to operate VGK and the VG- on the sender link. If more than one VG- is operated, XVG will operate to block the hold magnet. Operation of VGK closes ground through the winding of sender hold magnet relay SHM to the HM- lead to operate the sender link hold magnet. The sender returns locking ground through cross-points to lock the hold magnet and shunt down SHM. The operation of SHM operates sender hold auxiliary relay SHA, and the release operates sender hold check relay SHK to indicate completion of sender link operation and release the sender link selector magnet.

18. SENDER ADVANCE AND RELEASE

18.01 Upon completion of storage check and sender hold check, ground is extended to operate the sender AV relay which returns locking ground to operate AVK, RTF, and D1S1 which releases OSC removing start battery from the connector. This sequence is detailed in 30. for FS29.

19. TRUNK SWITCH SEIZURE - FS17

19.01 A summary of information transmitted over leads to the trunk switch and connector is continued in the following table:

Leads	Information
IRA-, IRB-, FT-FBO,1, DTR-	Frame Test and Busy Indications
STA-, STB-, BS18-20, TUK	Trunk Switch Seizure
TBO-6, TGO-7, TBK, TTO-11	Trunk Block, Trunk Group, For Trunk Selection
R1, R2, R3, SDG, TPG R2G, R3G, RA, RC, CN/TPC, TPR, NA, NB, BY, RO, SA, SB	Class Information to Trunk For Charge, Ringing or Intercept Control or Test
SSB, HMO-4, VGK	Outsender Link Control
T1, R1, SL	Tip, Ring, and Sleeve Control
TFO-11	Operate Trunk F Relay
NN, NH, NT	Control for No-Test and Special Trunks
TSS, CSB, CSO-9, TSO-9	Select Magnet Control
LJK, JCK, LJO,1	Trunk Switch LJ- Operation and JC-, LJ- Check
JSO-7	Junctor Test

19.02 Seizure of the trunk switch and connector circuit is made immediately following the operation of a route relay on those calls that do not require use of the translator. When the translator is required, seizure of the trunk switch and connector is delayed until after the translator has been seized. When the marker is seized relay CNG operates trunk unit connector relay TUC to prepare for seizure of the trunk switch connector. When one of the route relays R-, IRA, IRB, or DTR operates, test leads are closed from the windings of the frame test relay FTO and FT1 to the trunk switch and connector circuits to determine the presence of idle trunks. If one or more trunks of the desired route are idle, the test lead of the trunk switch connector circuit on which the trunk or trunks appear will be grounded to operate the FT- relay associated with the connector circuit. If the other marker has engaged a connector circuit, the frame busy relay FBO or FB1 will operate for the circuit being used. A combination of an operated FT- and a normal FB- for the same connector circuit will permit the operation of the trunk unit relay TU- to identify the circuit having an idle trunk. If both FT- relays, are operated, only one TU- is permitted to operate according to the setting of the W2 and the FB- relays. On incoming calls, the TU- relay is operated from the incoming register for the unit on which the trunk appears. When the marker has progressed to the point where the trunk switch and connector is to be seized according to the translation, battery is closed through contacts of the ST- leads to the connector to operate the MP- relay of that circuit. The MP- in turn operates the M- and MC- relays of the connector. Relay M also operates trunk unit check relay TUK as an indication that seizure has occurred. On dial tone and originating calls when all trunks are busy, neither FT-

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nor TU- relays will be operated and battery to the start leads will be open and closed to the all trunks busy (ATB) relay. Operation of ATB will operate RAV to route advance the call.

20. TRUNK AND REGISTER SELECTION - FS18

20.01 Operation of TUC operates trunk test gate relays TTG1,2 and operation of the MC- relays of the trunk switch connector closes the TB-, TG-, and TT- leads to the marker for trunk (or register) selection. Relay TB- operates a correspondingly designated relay of the trunk switch circuit which in turn operate the trunk block check relay TBK. Relay TBK closes ground through contacts of the TG- relays to the TG- leads for selection of an idle trunk. A TG- lead is cross connected on the trunk switch circuit to all of the trunks in the same route. Ground to the TG- lead is extended through all of the idle trunks to the TT- leads to operate the trunk test relays TTO-9 for all idle trunks. Operation of any TT- operates trunk test lock relay TTL. Relay TTL furnishes locking ground to the TT- relays and operates the release trunk gate relay RTG in series with a TTL winding to lock both relays. Relay RTG releases TTG1,2. The release of TTG1,2 releases all TT- relays except the one that is locked operated and operates the trunk test check relay TTK as an indication that a trunk has been selected. Relay TTK closes battery through the XF relay and contacts of the operated TT- relay to the TF- lead associated with the trunk to operate an F relay in trunk indicating seizure. If more than one F relay should operate, relay XF will operate to block channel selection. On incoming calls, the incoming trunk F relay is operated over the F lead to the marker connector as soon as relay TUK operates. The unused TB- and TG- leads are checked for crosses by cross relays XTB and XTG, respectively. Operation of XTB will block TBK and operation of XTG will block TTK.

21. LINE SWITCH SEIZURE AND PARTY MATCH - FS19

21.01 A summary of the information transmitted over the leads to the line, line switch, and connector is contained in the following table:

Leads	Information
STA-, STB-, BS1,2, LFK	Line Switch Seizure
LBO-3, LGO-4, LTOO-19	Line Location
CSO-9, CSA, CSB, LSO-9 LSA, LSB	Line and Channel Switch Select Magnet Control
LLO-7	Line Test and Hold Magnet Control
GK	Line Switch LG- Check

21.02 Line switch seizure and select magnet operation is controlled by line location information obtained by line identification (dial tone) or received from the originating register or translator circuit. Since the information received from the translator is held on different relays from that received from the originating register, these two sets of relays are used on intraoffice and ringer test calls to compare calling and called parties for party match. This match test is made before seizure of the line switch is required. Operation of relay IOA or IOB on intraoffice calls operates party match test relay PMT. Relay PMT closes a path from battery through the party match relay PM2 to contacts of the U-, L-, T-, T-, LG-, BL-, LB-, BL-, and LU- in that sequence to the winding of PM1 and thence to the RVT lead to the translation checking ground to compare the line locations of the called and calling parties. When the translation check ground is closed to operate TR by relays RCL, BLL, TL, and UL, the ground is directed to the winding of PM1 over the RVT lead by relay IOA or IOB. If the line locations match, relays PM1 and PM2 operate to operate reverting call relay RV1 which in turn operates RV2. Relay RV1 releases the trunk switch connector if it has been seized to release TUK. Relay RV2 releases relay ITR which in turn releases relays FLG1,2. Release of relays FLG1,2 and TUK operates relay TR which operates TRK to release the translator and relay PMT. Release of PMT closes ground to the reverting code point, RV or RT for selection of a reverting call trunk. Relay PMT is made slow-release to allow time for the FT- and TU- relays for the intraoffice route to release.

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21.03 If the line locations do not match PM1 and PM2 will not operate when ground is closed to the RVT lead and relay TR will operate through normal contacts of the PM- relays. The TR will operate TRK to release the translator and relay PMT to permit seizure of the line switch connector.

21.04 When the marker is seized, relay CNG operates line unit connector relay LUC to prepare for seizure. If the use of the translator is required the LUC is released by relay TRC to prevent seizure of a line unit while the translator is being used. This is necessary as the same leads used for trunk unit seizure and select magnet operation are also used to the translator for line and class translations. Release of the translator and relay TRC permits the reoperation of LUC. When the trunk unit has been seized to operate TUK and LUC is operated, battery is closed through contacts of the LU- or BL- relays to the ST lead of the desired line switch connector to operate the MP- relay of that circuit. Operation of the MP- operates relay M- in the same circuit to operate line unit check relay LUK and the MC- relays of the connector. Operation of the connector MC- relays closes all leads to the marker and permits operation of an LBC- relay in the line switch circuit from battery through the LB- or BL- contacts to the LB- leads. Operation of the line switch LBC- relay closes through the LG- leads to operate an LGC- relay in the line switch. The LGC- relay is operated through contacts of the LG- or T- and LGU or LGD relays. The latter two relays are used for 2-line hunting groups to add one or subtract one from the registered LG-. If the initial line is found busy relay 2LA will operate to release the initial LGC- and relay 2LB will operate to operate either line group up relay LGU or line group down relay LGD according to the RC- relay operated. The LGU shifts the battery to the LG- leads up one lead and LGD shifts it down one lead. Operation of 2LD then operates the second LGC- for test of the second line. Operation of an LGC- in the line switch circuit operates group check relay GK in series with XG. If more than one LGC- is operated, XG will operate to block channel selection. The LBC- also closes the line select magnet leads LSA, LSB, and LSO-9 to operate the line switch select magnets. Battery to operate the select magnets is supplied through contacts of the L- or T- relays to the LSA or LSB leads and through contacts of the L- or U- relays to one of the LS- leads. The select magnet battery is also extended to the LS-, LTE, and LTO relays of FS20 for line test.

22. LINE IDLE OR BUSY TEST - FS20

22.01 When LUC and L- or U- closes battery to the LS-, LSA, and LSB leads, a line select relay LS- and a line tens even or odd relay LTE or LTO are operated in parallel with the select magnets. Operation of an LS- and LTE or LTO closes the winding of the line idle test relay LIT and line-busy test relay LBT to the LT- leads of the line circuit. The line cut-off relay CO- of the line circuit will place battery on the LT- lead when the line is idle and ground on the lead when the line is busy (or locked out). Battery on the LT- lead will operate relay LIT and ground will operate relay LBT. The LS- and LTE or LTO relays will also operate test line check relay TLK. If more than one LS- or both LTE and LTO are operated indicating crossed select magnets, relay XLS will operate to block operation of relay HMS for channel operation. Relay LIT operated is required to select a channel on forward linkages, and LBT is required for line-busy indication.

23. TWO-LINE HUNTING - FS21

23.01 Two-line hunting groups are identified by RC8 or RC9 which operate 2-line relay 2L. When LBT operates indicating a busy line with 2L operated, relay 2LA operates to release the original LGC- relay of the line switch circuit and operates relay 2LB to lock both. Relay 2LA operates LGU or LGD according to the RC- operated to select a new LGC- on the line switch. Operation of the LGU or LGD operates 2LC which operates 2LD to lock both and operate the new LGC- of the line switch to select the second line. The 2LD also transfers the LBT lead back to the LB to operate relay LB if the second line is also found busy.

24. SPECIAL CALLS - FS22

24.01 Special calls are identified by the operation of SPL. The type of treatment is obtained when the F relay of the trunk is operated. Relay NN is operated for nonno-test calls, NH for nonhunting calls and NT for no-test calls. Relay SPL cancels ground test. The NN serves only as a check relay. The NH blocks hunting on calls to hunting lines and NT allows connection to busy lines and also blocks hunting. A proper combination of relays, must be registered to permit translation (operation of NLK).

25. CHANNEL TEST AND CONTROL - FS23

25.01 When the LBC- of the line unit operates, the channel switch CSA/B select

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magnet operates. When the line unit LGC- is operated the sleeve leads of the eight line links serving the line group are closed over the LLSO-7 leads to the winding of the path busy relay PBO-7. Ground on any link will operate the corresponding PB- relay indicating a busy link. When the MC- relay of the trunk switch connector is operated on normal calls, relay LJO or LJ1 is operated on the trunk unit by the operated LU- or BL-. The LJ- relay operates line junctor check relay LJK and closes in part the junctor test leads. When the trunk F relay is operated, it operates a JC- relay on the trunk unit which in turn operates junctor choice check relay JCK and the channel select magnet and closes the remaining path of the test leads JSO-7 from the winding of the PBO-7 relays to the sleeve of the junctors serving the trunk. Ground on any sleeve will operate the corresponding PB- relay indicating a busy junctor. Therefore a nonoperated PB- indicates both an idle link and idle junctor or idle channel. When the check relays GK, LJK, and JCK have all operated relay TCH (FS24) will operate to permit selection of an idle channel. Operation of the selected channel relay CH- will transfer the sleeve test leads from the winding of the PB- relay to the link check and junctor check relays LK and JK and operate the trunk switch select magnet. The LK operates to the hold magnet battery of the line switch and JK operates to resistance battery on the junctor sleeve to assure that the test leads are not open. Operation of LK and JK will permit the operation of relay HMS (FS24) to operate the hold magnets of the channel. Relay HMS grounds the SL lead to the trunk to operate the trunk hold magnet on the trunk switch, and transfer the LLS- lead from the LK relay to ground through the primary winding of junctor test relay JT to operate line switch and channel switch hold magnets of the line link. The JT operates in series with the two hold magnets. When the channel and trunk switch crosspoints have closed, ground on the SL lead will be closed over the channel sleeve to shunt down relay JT. The operation and release of JT will cause the operation of JTA and JTK (FS24). The JTA removes the JK relay from the junctor sleeve and JTK transfers the LLS- lead to ground through the primary winding of double connection test relay DCT. At the same time JTK opens the ground to the SL lead leaving the DCT ground to hold the channel. Relay DCT should operate to the channel battery and on dial tone and forward linkages to the L- relay battery of the line circuit. The DCT is biased such that the L- relay battery must be present on dial tone and forward linkages to check for a possible double connection on the line switch beyond the sleeve diode or an open crosspoint. A false ground (double connection) elsewhere on the channel will also prevent DCT from operating. Failure of DCT to operate indicates a double connection or open line switch crosspoint. Cross relays XSL, XTS1-2, and XCS1,2 check for false ground on the SL lead or crossed select magnets on the trunk and channel switches. Operation of any of the cross relays will block channel selection.

26. CHANNEL SELECTION - FS24

26.01 Channel selection is started by the operation of test channel relay TCH. When GK, JCK, and LJK operate, ground is closed through a series of checking contacts to operate TCH. Operation of TCH indicates that the HMS, HMT, TMR, LK, JK, JTK, DCK, GTK, RR, or APB relays are not permanently or falsely operated, that relay GTT and SKN have operated as a prerequisite for ground and storage tests, that a sender has been seized (OSK operated) if necessary, and that a toll diversion reversal (TDK operated) has been made if required. The TCH operated closes ground through contacts of the PB- relays to operate a channel relay CHO-7 or all-paths-busy (APB) relay. The APB will cause route advance. Relay CH- will operate channel start relay CHS to start the hold magnet timer HMT TMR. When HMT TMR operates, hold magnet start relay HMS operates to apply ground to the channel hold magnets over the SL lead to the trunk and through the winding of relay JT to the line and channel switches. Relay JT operates in series with the line switch and channel switch hold magnets to operate junctor test auxiliary relay JTA. Closure of the channel crosspoint will then cause the ground on the SL lead to be extended over the junctor sleeve to shunt down JT. On dial tone and forward linkages, the SL ground will be extended over the line link sleeve to operate the L- and CO relays of the line circuit. Relay CO- of the line circuit will ground the LT- lead to release relay LIT and operate LBT. The release of JT and LBT operated operates junctor check relay JTK as an indication that the channel is closed and transfers the holding path to the DCT relay for double connection test.

27. CONTINUITY AND GROUND TEST - FS25

27.01 A DC continuity test is made through the channel crosspoints on dial tone,

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outgoing, and intraoffice call back calls to the line loop or originating register. A ground test of the channel tip or ring lead is made on all forward linkages except for special calls. Loop ground test relay is used for both tests. When TUK operated, ground test timing relay GTT was operated to time the test interval. When DCT operates, double connection check relay DCK operates to operate loop test relay LPT which locks both relays. The DCK closes the T1 and R1 leads from the channel through the trunk F relay to the test circuit. One of the leads connects directly to the primary winding of the LGT relay and the other lead connects to the contact of LPT. Both leads run through contacts of tip party ringing relay TPR to control testing of the ringing side of the line. The LPT grounds T1 or R1 depending upon TRP to operate LGT. With FLG2 up, LGT is forced up directly. If FLG2 is down, LGT operates over the customers loop on dial tone calls or through the originating register short on outgoing or call back connections. Operation of LGT operates loop check relay LPK to release LGT. If FLG is operated, LPK removes the ground to the LGT winding. If no ground of less than 12K exists on the line, LGT will release. If FLG is not operated, LPK removes the loop to force LGT down. The release of LGT operates ground test check relay GTK to indicate a clear test and stop the release of GTT. The release of GTT was started by the operation of LPT with FLG down or by the operation of LPK with FLG up. If GTK does not operate within the release time of GTT, GTT releases. Release of GTT prevents operation of GTK and causes a time out if FLG is up. If FLG is down, the release of GTT operates release channel relay RCH to remove ground to the channel and L- relay of the line circuit. If the call has been abandoned by the customer, the CO- relay of the line circuit will release to operate LIT. Operation of LIT with RCH will operate D1S1 for release. If the call was not abandoned, time out will occur. On outgoing or call back connections, relay TPR is alternately operated to assure the continuity of the TPR contacts.

28. INFORMATION STORAGE - FS27

28.01 All information storage in trunks, registers and senders with the exception of the called number is made by the operation of STR1,2 relays of FS28. The called number is stored in the sender as soon as the sender connector operates.

28.02 The operation of STR1,2 grounds all information leads connected to the winding of the SK- relays which in turn operate the external register or memory relays which are in parallel with the SK- relays. If a cross is present, or a false ground is present on any unused leads cross information relay XIF will operate through one or more R- resistors to block storage check.

TRANSMISSION OF INFORMATION TO THE ORIGINATING REGISTER

28.02 On a dial tone connection, the marker must pass to the register, the line location and class of service of the calling line which is stored for transmission to the marker on the completing function and the class of line which is used by the register for test. After the marker has selected a particular register and operated its F relay, a path is established to the register storage relays. The operation of relay STR1 will operate the register storage relays through marker relays operated by the line link frame (line location) and line number translator (class of service). Line location is passed to the register in terms of line unit (LUO,1), line block (LBO-3), line group (LGO-4), and line (LOO-19). Class of service is sent in terms of CSO-7, CSA, CSB (office A or B), and dial pulse only (DPO) which tells the register that the line is not entitled to TOUCH-TONE service and to terminate the call if TOUCH-TONE frequencies are detected. In addition class of line is sent in terms of 2P, MAN, coin line (CN/TPC), and multiparty identified line (MP), and multiparty. The marker will check for the return of locking ground as described under storage check, FS28.

TRANSMISSION OF INFORMATION TO TRUNK CIRCUITS

28.03 All trunks which can complete to lines (incoming, FLG portion of IAO and reverting trunks) require ringing information to properly ring the called line. Outgoing trunks may require a coin indication or a tip party indication for proper charging of message rate calls. Reverting trunks also require ringing information for the calling line. The call back portion of the IAO trunk requires tip party indication for charging, and trunks on the intercept levels of the trunk switch require signals on the N- lead to set intercept conditions. The marker having seized an incoming trunk on the trunk switch will ground lead RC to operate ringing

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control relay in the trunk. As an indication that RC has operated, ground is returned on lead RA. Ringing condition is established by grounding leads as indicated in the following table:

PARTY	RING COMB	CODE	SIDE OF LINE	SIGNAL TO TRUNK
1	RC-O	C1-	Ring	None
2	1	C1-	Tip	TPR
3	2	C1+	Ring	R2
4	3	C1+	Tip	R2,TPR
5	4	C2-	Ring	R3
6	5	C2-	Tip	R3,TPR
7	6	C2+	Ring	R2,R3
8	7	C2+	Tip	R2,R3,TPR

The same sequence occurs on the FLG portion of an IAO call and on the reverting call except that in addition, calling line ringing information may be transmitted as indicated in FS32.

28.04 Outgoing trunks equipped with CN relays require a coin mark CN on coin classes, and outgoing trunks requiring charging require a tip party charge TPC mark on tip party classes.

28.05 Intercept trunks on level 8 of the trunk switch require ground on the N-lead for TI and RI indication. The marker will check for return ground on these leads as described under storage check Part 29 FS28.

TRANSMISSION OF INFORMATION TO THE OUTSENDER

28.06 As mentioned previously, the called number is stored in the sender when the connector operates. The balance of the information required by the sender is transmitted by the operation of STR1 on non-ANI and by both STR1 and STR2 on ANI calls. The operation of STR2 will place the thousand, hundreds, tens, and unit digits of the calling number in sender storage along with an OA or OB indication for the sender to construct from cross connections the ABC digit of the calling number. The operation of STR1 will transmit information stored on the route relay to instruct the sender as to type of pulsing required by leads DP, MF, or AI, deletion of digits by leads DL1-3, and DLN, prefix one of four arbitrary digits by leads AD1-4, type of outpulsing by leads CL1-3, and information for start pulse information by leads PO, NC, OI, and IF. The marker will check for return ground on these leads as described under storage check FS28.

29. STORAGE CHECK - FS28

29.01 Storage check normal relay SKN operates to indicate all SK- relays and storage check relay STK are normal and certain information relays not otherwise checked are properly operated. Operation of SKN permits channel selection and operation of CHS, CHS operates STR1 and/or STR2 depending on the type of call. Relay STR1 operates the SK1-9 relays and the external circuit relays connected to their windings. Relay STR2 correspondingly operates relays SK10-17 and the external relays connected to their windings. All necessary external circuit relays should operate and lock. When HMS operates following hold magnet timing, relays STR1 and 2 are released and check number relays KN1-3 are operated to check called number registration in the sender on SOG calls. All other stored information relays should lock the SK- relays to which they are connected. The remaining SK- relays release. Storage check relay STK will operate when all SK- relays operate and will remain operated if all information has been locked in. If some part of the information is not locked, the SK- to which it is connected will release to release STK to block the call. If an ANI failure occurs on second trial, the release of STK will operate relay IF if all other information is properly registered. Relay IF will in turn send an IF indication to the sender and operate relay SK8 and STK for completion of the call.

30. RELEASE OF TRUNK F, SENDER ADVANCE REGISTER RECYCLE AND FORWARD LINKAGE CHECK - FS29

30.01 On all calls except intraoffice forward linkages and outgoing with a sender, the operation of GTK and STK operates release trunk F relay RTF to release the trunk or register F relay to ground the channel sleeve and shunt down DCT.

30.02 On outsender calls, the ground from the GTK and STK, relays is extended through the NK and SHK relay contacts and the winding

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of advance check relay AVK to the AV lead to the sender to operate the AV relay in that circuit. Operation of the AV in the sender returns locking ground on lead AV to operate AVK through the AV2 resistor. Operation of AVK operates RTF through a transfer of STK. The STK contacts are provided to check for a premature or false ground on the AV lead. If this should occur before STK operates, AVK will operate a crossed advance or recycle relay XAR to block sender advance.

30.03 On intraoffice forward linkages, the ground from GTK and STK is transferred to the forward linkage check relay FLK by the ITR relay. Operation of FLK operates trunk call back relay TCB to lock both relays and ground the CB lead to the trunk to operate the trunk CB relay. The operation of the trunk CB will release relay F1 placing ground on the FLG sleeve releasing the marker DCT relay and allowing advance to the call back stage. Release of the trunk F1 relay and marker DCT relay provides a positive indication that the forward linkage is held.

30.04 On multiparty reverting calls requiring a party digit, relay RR will be operated following party match to recall the register to receive the digit. Relay RR will ground the RR lead to the originating register through the winding of AVK to operate the RR relay of the register. The register relay will return locking ground to operate relay AVK. The AVK will then operate disconnect relay DISC to ground the MRL to the register. If a false ground should appear on the RR lead before RR operates, relay XAR will operate to block RR. When REC is operated, a trouble record will be taken to operate RCC before RTF is allowed to operate.

31. DISCONNECT AND FORWARD LINKAGE ADVANCE - FS30

31.01 Intraoffice advance from the forward linkage to the call back stage is enabled by the operation of the forward linkage advance relay FLA following release of the DCT on the forward linkage. Operation of FLA causes release of the line unit and all channel and checking relays used on the forward linkage setup. When all necessary relays have released, relay CB of FS31 will operate to release FLA and complete the call back. The FLA is also used on incoming trouble release to release line unit and channel check relays to permit connecting the incoming trunk to reorder tone.

31.02 Normal disconnect is established by the operation of disconnect auxiliary relay DIS1 followed by operation of disconnect relay DISC. Release of DCT following the operation of RTF indicating a satisfactory connection operates DIS1. The DIS1 releases LUC and TUC to drop the connections, steps the W-Z circuit and closes ground through checking contacts to operate DISC. The checking contacts verify that either TR1 or TR2 has operated, the W-Z has stepped and the MSK, MCK, MCB, and TM relays are functioning. The DISC closes ground to the MRL lead of the marker connector to release the registers or line switch and marker connector. The DIS1 and DISC lock to the CNG relay. When the connector releases CNG, DIS1 and DISC release to drop the MCB and allow reseizure of the marker.

31.03 The DIS1 is also operated on abandoned dial tone calls before operation of CSK by the release of LBR, LGR, or LSR and after loop test by the operation of RCH and LIT. The DIS1 is also operated on a dial tone route advance by the operation of RDL and LBK, and by any route advance to reorder tone or by an improperly dialed office code on 10-digit calls.

31.04 The DISC is also operated directly on register recycle by the operation of RR and AVK and following a trouble record with normal release by the operation of TRB with TRR. The TRR is operated instead of DIS1 on the receipt of mutilated digits or a permanent signal ground as indicated by the operation of relays MUD or PSG. The TRR is also operated after DIS1 on transfer start indications by relay TRS.

32. ROUTE ADVANCE AND CALL BACK START - FS31

32.01 Intraoffice call back is initiated following the operation of FLA and the release of the line switch connector and channel and check relays of the forward linkage. The release of GK, JTK, LJK, TCH, CHS, DCK, FLG2, and NCH if necessary operates call back relay CB. Relay CB locks and releases relay FLA to permit reseizures of the line unit to set up the call back linkage. Route advance occurs whenever an all trunks busy, all paths (channels) busy, or all senders busy condition is encountered. Operation of ATB, APB, or ASB operates trunk busy relay TB, paths busy relay PB, or senders busy relay SB, respectively. Operation of any of these relays will operate ROT of FS36 on incoming calls to return

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reorder to the trunk or route advance relay RAV on originating calls. The RAV locks, returns locking ground to TB, PB, or SB and releases LUC and TUC to release the connectors. Release of the connectors releases the same check relays required for relay CB to operate. The RAV releases relay CB and upon release of the check relays, release delay relay RDL operates. The RDL is slow-operate to permit operation of traffic registers. Operation of RDL operates the GS1 or GS2 associated with the route ground supply to release the route information relays and operates GSA or GSB. The GSA or GSB and RDL removes the locking ground to RAV. The RAV releases and removes locking battery to the RG- relay associated with the GS-. The RG releases to apply ground to the route advance terminal of the blocked route for advance to a new route or reorder tone.

33. REVERTING DIGIT - FS32

33.01 On reverting calls requiring a party digit indication, the originating register is instructed to return dial tone to the customer for the extra digit. When the customer has dialed the extra party digit, it is stored on the H register and the marker is recalled with the reverting digit RD lead grounded. Relay RD of the marker operates and when NK1 operates the H digit is decoded into ringing information by tip party calling relay TPG, ringing 2 calling R2G, ringing 3 calling R3G, or wrong digit relay WRD. Excluding WRD, any, all, or none of the ringing relays may be operated as follows:

DIGITS	RELAYS
0/1	WRD
2	none
3	TPG
4	R2G
5	TPG,R2G
6	R3G
7	TPG, R3G
8	R2G, R3G
9	TPG, R2G, R3G

Relays TPG, R2G, and R3G control signals to the trunk for ringing of the calling party.

34. TRUNK BLOCK ALLOTTER - FS33

34.01 Trunk block allotting is provided on all intraoffice calls and may be employed on other routes by cross connections to relays AL0 or AL1. When allotting is used, allotter relay ALA or ALB is operated according to the setting of W2. Each relay is assigned or cross-connected to operate one of two TB- relays. When trunk selection is to be made and no idle trunk is found in the first trunk block tested, relay ATB operates to operate step relay STP if an idle trunk still exists on the trunk unit as indicated by the FT- relays. If the FT- relay associated with the trunk unit has released (this can happen with 2-way trunks) the ATB ground is transferred to lead TB to route advance. Operation of STP operates relay STP1 to lock both and release the operated ALA or ALB, release of the ALA or ALB will release the operated TB- to release the trunk unit TB- relay and the TBK relay. Release of TBK will release the ATB to remove the shunting ground to relay STP2. The STP2 re-operates the other ALA or ALB for the second TB- for selection of a trunk in the second group.

35. TOLL DIVERSION - FS34

35.01 Toll diversion is employed on all PBX class calls to zero operator or toll points by instructing the originating register to reverse the polarity to the calling line. The no toll diversion relay NTD is operated on all dial tone calls by relay LBL and on all non-PBX originating calls by relay OR. When ZO or ANI operate with PBX operated, ground from the OR relay contact operates toll diversion check relay TDK in parallel with the RV1 relay in the originating register. The register relay reverses the polarity to the line and returns locking ground to hold TDK when TBK operates as a check of the register relay. If TDK releases when TBK operates, channel selection will be blocked.

36. ANI THOUSANDS DIGIT - FS35

36.01 Only four different thousands digits are allowed for line numbers. On ANI translations, these digits are represented by relay BLO-3. Each must be cross-connected to two of the TH- relays to indicate the digit on a 2-out-of-5 basis.

37. LINE-BUSY AND REORDER TONE - FS36

37.01 Line-busy and reorder tone are provided by level 9 of the trunk switch directly

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through crosspoints to the incoming or intraoffice trunk. Line-busy only is given to IAO trunks. When a line-busy condition is encountered, relay LBT or GB operates line-busy relay LB. When reorder tone is required on incoming calls, relay ROT will be operated. This may result from all paths busy (PB), a reorder signal from the incoming register (RO), a vacant code on AB translator, a link release (LR), or a second trial trouble record (FLA). Operation of either LB or ROT operates tone relay TN. Relay TN operates NCH (FS24) to operate the TS9 select magnet on the trunk switch and an LJ- relay of the trunk unit to operate the TSA select magnet of the trunk switch for line-busy or TSB for reorder tone. The LJ- relay of the trunk unit also operates LJK to operate CHS. The CHS starts the HMT timer to allow time for the select magnets to operate. Operation of HMT TMR operates HMS to apply ground to the trunk hold magnet. Operation of the hold magnet closes the crosspoints to the tone circuit which returns ground on the T1 lead from the trunk F relay to operate tone check relay TOK. Relay TOK operates GTK to permit operation of RTF after storage check.

38. LINE INTERCEPT - FS37

38.01 Line intercept is provided by level 8 of the trunk switch directly through crosspoints to the incoming or intraoffice trunk. Manual or automatic intercept may be provided. Line translation may operate BN or RC11 and BLO to operate regular intercept relay RIN or BL1 to operate temporary or trouble intercept relay TIN. Operation of BN, RIN, or TIN is cross connected to operate automatic intercept relay AIS or local intercept relay LIN. When AIS is operated, it will provide sender information and cause OSK to operate LIN. Relay LIN connects the sleeve leads SA and SB of the two intercept trunks on the level to test intercept relays TNA and TNB, respectively, and operates relay NCH. If battery appears on either or both sleeves, indicating an idle condition, TNA and/or TNB will operate. Operation of TNA or TNB will operate intercept relay INA or INB for selection. If both trunks are idle, INA will operate. Relay NCH operates TS8 select magnet on the trunk switch and with INA or INB one of the trunk unit LJ- relays to operate the TSA or TSB select magnet. The trunk unit LJ- also operates LJK to operate CHS. The CHS starts the HMT timer to allow time for the select magnets to operate. Operation of HMT TMR operates HMS to ground the SL lead to operate the trunk hold magnet. Operation of INA or INB transferred the SA or SB lead to the winding of intercept check relay INK and when the trunk switch crosspoints close, the SL ground is extended to operate INK. The INK closes the sleeve lead to the winding of DCT and opens the SL lead ground to operate DCT. The DCT will operate DCK as on a normal call and release when the sleeve holding ground is applied by the release of the trunk F.

39. PERMANENT SIGNAL TEST - FS38

39.01 Permanent signal calls are tested to determine if the receiver is off-hook (ROH) or a permanent ground (PSG) exists. When relay PS operates on a permanent signal call, the tip and ring of the line is connected to the marker through the marker connector and ground is applied to the secondary winding of tip party test relay TPT in series with the primary winding of permanent ground test relay PGT to operate both. Operation of TPT and PGT with GTT operated operates PST to enable the test. The PST connects the tip and ring of the line to the windings of TPT according to the type of test required. If TP is not operated, the ring lead is connected to both windings, of TPT, in series with the PGT. If a ground of less than 3K exists on the ring lead, relay PGT will hold operated and relay GTT will release to operate permanent signal ground relay PSG. If a ground of greater than 3K is found (insufficient to operate a line relay) both TPT and PGT will release to operate receiver off-hook relay ROH. If TP is operated with 2P indicating a grounded party line, the tip party may be off-hook. Therefore the tip is connected to the primary of TPT and the ring to the secondary both in series with PGT. The windings of TPT are connected differentially, and if the ground is balanced and greater than 1K (tip party off-hook) both TPT and PGT will release to operate ROH. If the ground is not balanced and greater on the ring, TPT will hold. If the ground is balanced but less than 1K, PGT will hold. If both conditions exist, both relays will hold. If either relay fails to release, GTT will release to operate PSG. Operation of either ROH or PSG will ground the ROH and PSG code points for routing. Relay PSG will cause a trouble record before disconnect.

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40. SERVICE VERIFICATION AND NUISANCE CALL RECORDING - FS39

40.01 Nuisance call recording and recording of selected marker conditions is provided by relays NCR, XO-9, YO-9, and REC. Operation of REC transfers the operating ground from RTF to operate TRST to take a trouble record before releasing the trunk F relay. When the trouble record has been taken, relay RCC will operate to permit RTF to complete the call. The XO-9 and YO-9 may be cross connected to any desired points in the marker and their contacts connected to either NCR or REC. The NCR is used only for nuisance call tracing and REC for all other purposes. The NCR provides a mark and alarm with the trouble record. The X- and Y- relays may be used to provide nuisance call tracing of a particular called number or service verification of an ANI translation by cross connecting their windings to the proper information points. They may also be used to trap reorder or other conditions that may be desired. Relay NCR may also be operated by the translator by an appropriate cross connection of the line number translation on terminating FLG calls. Relay REC is also used to record link release and mutilated digit conditions on incoming calls.

41. TIMING - FS40

40.01 Three timers are provided for circuit control. The hold magnet timing HMT timer provides timing for select magnet operation prior to hold magnet operation. The HMT timer is set for 30 and 60 milliseconds and is controlled by relay CHS. A work timer WT is provided to detect faulty circuit operation or failure. The WT timer has an initial setting of 1000 milliseconds. Upon operation of TUK timing is reduced to 700 milliseconds for intermediate timing. The operation of both TUK and LUK or operation of TRC result in a short timing interval of 620 milliseconds. The WT is controlled by the TMS, RYT, and HWT relays. The TMS operates on marker seizure, to start timing. Relay RYT is used to recycle the timer at various points of marker operation. Relay HWT holds the timer when the other marker is taking a trouble record. Release recycle relay RRY is operated by RYT to the RYT operating ground. The RRY releases RYT and holds operated until the removal of the recycle ground. The work timer will be recycled at various points in the call progress. In general the recycle points occur while the marker is awaiting seizure of the line number translator, a trunk unit, or line unit and when the IAO call back linkage is established. The timer will also be recycled on route advance and a trouble recorder start. Operation of WT TMR will operate work timer relay WT to cause a trouble record and release. A time-out alarm is also provided by the TOA timer. This timer is set for 1.8 seconds and serves as a back-up of WT in the event the marker fails to release properly. The timer is controlled by relay TM and will function whether or not the marker is in use. The TOA TMR operates relay TOA to cause an alarm and release if possible. The timers all function the same. When ground is applied to the junction of the timing capacitors C1 and C2 and the timing resistor, transistors Q1 and Q2 are held off and the current through relay TMR and the voltage divider resistors DR1 and DR2 is insufficient to operate or hold the relay. When ground to the timing capacitors is removed by the control relays, the capacitors charge through the timing resistors H-, WT-, or TO-. When the voltage in the capacitor reaches a point approximately 0.5 volts more negative than the base of Q1 (junction of DR1 and DR2), Q1 turns on and in turn turns Q2 on. The Q2 shunts out DR2 and relay TMR operates through DR1 and the Q2 collector emitter junction. This condition will remain until ground is reapplied to the timing capacitor.

42. TROUBLE RECORDING - FS41

42.01 Trouble recording is accomplished by connecting a multiplicity of points in the marker to the trouble recorder circuit to register the condition of the marker at the time of connection. When the marker encounters trouble in processing a call, relay WT will operate to operate trouble record trouble release relay TTR if a double connection is not apparent. If a double connection exists as indicated, trouble record regular release relay TRR will be operated. The TRR will also be operated to record permanent signal grounds, mutilated digits and transfer starts by the PSG, MUD, or TRS relays, respectively. The operation of either TTR or TRR will operate trouble recorder start relay TRST to take a trouble record. The TRST may also be operated by relay REC prior to release of the trunk F relay for information recording. Relay TRST applies resistance battery to the TRST lead to the trouble indicator and test circuit to operate a preference relay in that circuit. Operation of the preference relay will ground the CI lead to operate the cut-in trouble indicator relay CIT if the trouble indicator is not busy. If the indicator is busy ground will appear on the TRB lead to operate trouble recorder busy relay TRB. In

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this case, TRB will operate the display lost relay DL and advance marker progress as if a trouble record had been taken. When the trouble indicator is not busy, relay CIT operates cancels display lost relay CDL, and relays TI A-M and SKA, SKB to cut in the trouble indicator. Following receipt of the marker trouble information, the trouble indicator grounds lead TRB to operate relay TRB. The TRB continues the advance of the marker according to the condition requiring the trouble record. With relay REC operated, TRB operates record complete relay RCC to permit operation of RTF and release TRST and TRB. With TRR operated, TRB operates DISC to send a release signal MRL to the line switch or register circuit. With TTR operated, TRB operates trouble release relay TRL except on incoming second trials. The TRL sends a trouble release to the connector or register. On incoming second trials, TRB operates FLA to release channel and check relays if operated and operates ROT to connect the incoming trunk to reorder tone. If this cannot be done, a second trouble record will be taken followed by TRL.

43. RELEASE OF REGISTERS AND CONNECTORS - FS42

43.01 Normal release of the register or line switch is made by grounding the MRL lead by relay DISC to cause the register or line switch to release the marker connector. Second trials may be attempted on trouble conditions by grounding the connector trouble release lead CTR to the connector to cause the connector to release the marker and reseize the same or other marker for a second trial. The CTR lead is grounded by relay TRL on first trials, with TR1 operated. On second trials, relay TR1 is normal and grounds the TRL lead to the register or line switch as an alternative to the MRL for redundancy. Relay XRLS checks the release leads for false grounding. If any of the leads are crossed or grounded, relay XRLS will operate to operate TTR to produce a trouble record. Relay XRLS locks to TRB normal to assure the trouble indication although the connector may release.

44. TRAFFIC AND PLANT REGISTER OPERATION - FS43

44.01 The marker is provided with means for operating traffic and plant registers. The traffic registers record the number of usages of certain equipment or record number of calls of a type.

44.02 The various traffic registers operated under control of the marker are shown in the following table.

TRAFFIC REGISTERS

Lead Designation	PEG Leads to Traffic Register Circuit	Condition for Operating Traffic Registers
APC	One Per Marker Group	ANI PEG Count - PEGS Whenever the marker receives a line to number translation from the LNT
ASB	One Per Marker Group	Marker finds all senders busy.
DOR	One Per Marker Group	Total originating dial pulse, PEGS on any call from an originating register handling a dial pulse call when a linkage between line switch and trunk switch has been established.
DOF, IOF, OF-	One Per Dial Tone Route, One Per IAO Route, One Per Route Per Marker Group	All trunks or originating registers associated with a route found busy.
DPC, IPC, PC-	One Per Dial Tone Route, One Per IAO Route, One Per Route Per Marker Group	All calls offered to a route.
DPS	One Per Marker Group	Marker selects a sender for dial pulsing.

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Lead Designation	PEG Leads to Traffic Register Circuit	Condition for Operating Traffic Registers
IFM	One Per Marker Group	Incoming Matching Loss
INT	One Per Marker Group	Marker Encounters an intercept condition (BN, TI, or RI)
MFS	One Per Marker Group	Marker Selects a sender for multifrequency pulsing
MOR	One Per Marker Group	Total originating TOUCH-TONE PEGS on any call from an originating register handling a TOUCH-TONE call when a linkage between line switch and trunk switch has been established.
PSC	One Per Marker Group	Permanent signal PEG count - the marker has received a permanent signal from the originating register.
SCH	One Per Marker Group	Marker Selects Channel 0 or 4.
TCH	One Per Marker Group	Total Channel PEG Count - PEGS Whenever the marker establishes a linkage between a line switch and trunk switch.
TCM	One Per Marker Group	Total PEG count - PEGS on any completing marker seizure.
TDT	One Per Marker Group	Total PEG count - PEGS on any dial tone marker seizure.
TFM	One Per Marker Group	Total matching loss - PEGS on any seizure encountering an all channels busy.
TMB	One Per Marker Group	Incoming calls to busy lines
TOF	One Per Marker Group	Total office overflow - PEGS Whenever a customer originated call except a permanent signal does not complete.
TOR	One Per Marker Group	Total originating PEG count - PEGS on any call from an originating register.

44.03 Plant Register Operation - Plant registers record the number and type of trouble conditions encountered.

44.04 The various plant registers operated under control of the marker are shown in the following table:

PLANT REGISTERS

Lead Designation	Lead Furnished	Conditions for Operating Plant Registers
AIF	One Per Marker Group	Automatic identification failure PEG count - PEGS each time the marker attempts an ANI identification and experiences a failure after second trial.

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Lead Designation	Lead Furnished	Conditions for Operating Plant Registers
CST	One Per Marker Group	Completing second trial failure PEG count - PEGS each time trouble is encountered on second trial except on a condition which would score another register.
CTR	One Per Marker Group	Completing trouble record PEG count - PEGS each time trouble is encountered on first trial with same exceptions listed for CST.
DTF	One Per Marker Group	Dial-tone-failure PEG Count - PEGS each time trouble is encountered on a dial tone call with the exceptions listed for CST.
GTF	One Per Marker Group	Ground test failure PEG count - PEGS each time a ground or continuity test failure occurs.
LR	One Per Marker Group	Link release PEG count - PEGS each time trouble is encountered in the incoming register link.
MUD	One Per Marker Group	Mutilated digit PEG count, PEGS each time the marker detects a failure in number checking called number from registers except permanent signal calls.
PSG	One Per Marker Group	Permanent signal ground PEG count, PEGS each time the marker detects a permanent signal caused by a trouble condition.
VRF	One Per Marker Group	Verification PEG count - PEGS each time the marker takes a trouble record for (a) nuisance call recording, (b) test frame request, (c) a service or verification request.

45. TEST CALLS

45.01 The marker completes test connections initiated at the test frame as well as no-test, no-hunt, and special hunt test calls.

45.02 The test connections that the marker completes are the marker test connections, the register and sender test connections, the marker line verification tests, and the customer line tests.

45.03 No test calls are originated at the test desk or DSA switchboard, no-hunt calls are originated at the test frame, and special hunt calls are originated at the test desk.

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TEST FRAME TESTS

45.04 The test frame is capable of selecting and testing a particular register, sender, marker, or trunk as required.

45.05 Marker test relays that may be operated from the test frame are as follows:

OTF - Operates on every test call to provide general control of the marker by the test frame.

OTF1 - Operates only when marker progress is to be stopped, forcing a trouble record without completing the call.

TST - Operates only when a particular trunk or register is to be selected. The TST opens marker battery to the TT- relays. The test frame applies battery on the lead corresponding to the trunk or register to be selected.

PBXT - Operates on PBX tests to force a group busy indication by removing marker grounds supplied to HL- relays.

45.06 The test frame trouble indicator provides a visual lamp display when a trouble is indicated from any of the associated circuits under test, when trouble occurs under normal operation or when the test circuit request a record by ground on lead REC. When used with a marker, the trouble indicator provides a record of circuits involved, called number, class information, calling line location, trunk location, output to sender, register or trunk, and a variety of signals indicating checks and call progress.

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SECTION III - REFERENCE DATA

1. WORKING LIMITS

1.01 Working limits for the marker are as follows:

Working Limits

Condition	
Voltage	-45V to -50V
Minimum Insulation Res	15,000 Ohms

2. FUNCTIONAL DESIGNATIONS

2.01 Relays

Designation	Meaning
2L	Two-Line
2LA	Two-Line Advance
2LB	Two-Line Auxiliary B
2LC	Two-Line Auxiliary C
2LD	Two-Line Auxiliary D
2P	Two-Party
2TR	Second Trial
AO/7	A-Digit
AB	Office A or B
AB2-9	AB-Digit
ABT	Office A or B Translator
ACO/7	A-Digit Code
ADO-4	Arbitrary Digit
AIS	Automatic Intercept
AK	Advance Check
ALO,1	Allotter Operation
ALA	Allotter "A"
ALB	Allotter "B"
ANI	Automatic Number Identification
ANIA	Automatic Number Identification
AOC	All Other Class
APB	All Paths Busy
ARO-9	Auxiliary Route Relay
ASB	All Senders Busy
ATB	All Trunks Busy
AVK	Advance Check
BO/7	B Digit
BCO/7	B-Digit Code
BDO,1	"B" Digit 0,1
BG	Block Gate
BLO-3	Block
BL4-7	Block
BLL	Block Lock
BN	Blank Number
BNT	Blank Number Timing
BT(A-D)	Block Translator
CO/7	C Digit
CB	Call Back
CCO/7	C-Digit Code
CDL	Cancel Display Lost
CDO	"C" Digit Zero
CHO-7	Channel
CHS	Channel Select
CIT	Cut-In Trouble Indicating
CKR	Check Release
CLO-3	Class
CN	Coin
CNG	Connector Ground
CNS	Coin Signal
CSO-7	Class of Service

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Designation	Meaning
CSA	Class of Service
CSB	Class of Service
CSK	Class-of-Service Check
CTAO-9	"C" Digit Translator
CTBO-9	"C" Digit Translator
DO/7	D Digit
DCO/7	D-Digit Code
DCK	Double Connection Check
DCT	Double Connection Test
DIS1	Disconnect Auxiliary
DISC	Disconnect
DL	Display Lost
DLO-3	Delete Digit
DLA	Delete ANI
DLN	Delete Number
DPR	Dial Pulse Route
DT	Dial Tone Call
DTA	"D-Digit" Translator
DTB	"D-Digit" Translator
DTR	Dial Tone Route
EO/7	E Digit
EK	End Check
FO/7	F Digit
FA	Fuse Alarm
FA1	Fuse Alarm
FBO,1	Frame Busy
FLA	Forward Linkage Advance
FLG1,2	Forward Linkage Ground
FLK	Forward Linkage Check
FTO,1	Frame Test

Designation	Meaning
GO/7	G Digit
GB	Group Busy
GG	Group Gating
GK	Group Check
GS1	Ground Supply
GS2	Ground Supply
GSA	Ground Supply Auxiliary A
GSB	Ground Supply Auxiliary B
GTK	Ground Test Check
GTT	Ground and Loop Test
HO/7	H Digit
HC	Hold Connector
HLO-9	Hunting Line
HLS	Hunting Line Selection
HMS	Hold Magnet Start
HT(A-F)	Hundreds Translator
HTG	Hunting Group
HTL	Hunt Line
HWT	Hold Work Timer
ID1-3	Identification 1-3
IF	Identification Failure
INA	Intercept A
INB	Intercept B
INK	Intercept Check
IOA	Intraoffice A
IOB	Intraoffice B
IR	Incoming Register Call
IRA	Intraoffice Route A
IRB	Intraoffice Route B

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Designation	Meaning
ITR	Intraoffice Class
JO/7	J Digit
JCK	Junctor Choice Check
JK	Junctor Check
JT	Junctor Test
JTA	Junctor Test Auxiliary
JTK	Junctor Test Check
KO/7	K Digit
KN1-3	Check Number
LOO-19	Line Number
LA OO	Line Auxiliary Test
LB	Line Busy
LBO-3	Line Block
LBA	Line Block Auxiliary
LBAOO	Line Block Auxiliary - Test
LBK	Line Block Check
LBL	Line Block Lock
LBR	Line Block Register or Release
LBS	Line Block Select
LBT	Line-Busy Test
LC	Local Charge
LGO-4	Line Group
LGA	Line Group Auxiliary
LGD	Line Group Down
LGK	Line Group Check
LGL	Line Group Lock
LGR	Line Group Release
LGS	Line Group Select
LGT	Loop Ground Test
LGU	Line Group Up
LIN	Local Intercept
LIT	Line Idle Test
LJK	Line Junctor Check
LK	Line Check
LPK	Loop Check
LPT	Loop Test
LR	Link Release
LSO-9	Line Select
LSA	Line Select Auxiliary
LSG1,2	Line Select Gate
LSK	Line Select Check
LSL	Line Select Lock
LSR	Line Select Release
LSS	Line Select Start
LT	Local Translator
LTA	Local Translator
LTE	Line Test Even
LTK	Line Test Check
LTO	Line Test Odd
LTR	Line Trans
LTRA	Line Trans Auxiliary
LUO,1	Line Unit
LUC	Line Unit Connector
LUK	Line Unit Check
MAN	Manual Line
MCB	Marker Connector Busy
MCK	Marker Connector Cut Through

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Designation	Meaning
MF	Multifrequency
MFA	Multifrequency
MPA	Multiparty - ANI
MPF	Multiparty Failure
MPN	Multiparty
MSK	Marker Connector Cut Through
MUD	Mutilated Digit
NA1,2	Number Thousand A
NB1,2	Number Thousand B
NC	No Charge
NCH	No Channel
NCR	Nuisance Call Record
ND1,2	Number Thousand D
NH	No Hunt
NK	Number Check
NK1	Number Check Auxiliary
NKG	Number Check Ground
NKS	Number Check Start
NLK	Number - Line Check
NN	Non-No Test
NS	No Sender
NSO	No Sender Outgoing
NT	No Test
NTD	Not Toll Diverted
OA	Office "A"
OAT	Office "A" Translator
OB	Office "B"
OBT	Office "B" Translator
OR	Originating Register Call
OSO-4	Outsender
OSC	Outsender Connector
OSK	Outsender Check
OTF	Test Frame
OTF-1	Test Frame - Call-Block
PO,1	Prefix 0,1
PB	Paths Busy
PBO-7	Paths Busy 0-7
PBX	PBX Line
PBXT	PBX Test
PCD	Peg Count Delay
PD	Partial Dial
PEG	Peg Count
PGT	Permanent Signal Ground Test
PM1,2	Party Match
PMT	Party Match Test
PMTA	Party Match Test
PS	Permanent Signal
PSG	Permanent Signal Ground
PST	Permanent Signal Test
PT1-4	Party
PX	PBX
PX1	PBX - 1X
ROO-19	Route Relay
R2G	Ringing 2 Calling
R3G	Ringing 3 Calling
RAV	Route Advance
RCO-11	Ring Class
RCC	Record Complete
RCH	Release Channel
RCL	"RC" Lock

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Designation	Meaning
RD	Reverting Digit
RDL	Release Delay
REC	Record
RG1	Route Ground Supply
RG2	Route Ground Supply
RGK	Register Check
RIK	Ring Check
RIN	Regular Intercept
RO	Reorder
ROH	Receiver Off-Hook
ROT	Reorder Tone
RP	Ring Party
RR	Recall Register
RRY	Release Recycle
RTA	Ringer Test Office "A"
RTB	Ringer Test Office "B"
RTF	Release Trunk F Relay
RTG	Release Trunk Gate
RV1	Reverting
RV2	Reverting
RYT	Recycle Timer
SO-9	Service Screening
SB	Sender Busy
SBTO-3	Split Block Translator
SHA	Sender Hold Auxiliary
SHK	Sender Hold Check
SHM	Sender Hold Magnet
SK1-17	Storage Check
SKA,SKB	Storage Check - Trouble Indicating
SKN	Storage Check Normal
SOG	Sender Outgoing
SPL	Special Call
STK	Storage Check
STP	Step
STP1,2	Step
STR1,2	Store
SXS	Step-By-Step
TO-9	Tens
TA	Time Alarm
TB	Trunk Busy
TBO-6	Trunk Block
TBK	Trunk Block Check
TCO-2	Translator Connector
TCB	Trunk Call Back
TCH	Test Channel
TCK	Translator Connector Check
TDK	Toll Diversion Check
TGO-7	Trunk Group
THO/7	Thousands
TH(A-D)	Thousands Block (A-D)
TI(A-M)	Trouble Indicating
TIN	Temporary or Trouble Intercept
TL	Tens Lock
TLK	Test Line Check
TM	Marker Off-Normal Timing
TMR	Timer Relay
TMS	Timing Start

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Designation	Meaning
TN	Tone
TNA	Test Intercept A
TNB	Test Intercept B
TNK	Translation Check
TOA	Time Out Alarm
TOK	Tone Check
TP	Tip Party
TPG	Tip Party Calling
TPR	Tip Party Ringing
TPT	Tip Party Test
TR	Translation Complete
TR1,2	First or Second Trial
TRB	Trouble Recorder Busy
TRC	Translator Connector
TRK	Translation Check
TRL	Trouble Release
TRR	Take Trouble Record, Regular Release
TRS	Transfer Start
TRST	Trouble Recorder Start
TRT	Trouble Recorder Time Out
TST	Test
TTO-11	Trunk Test
TTG1,2	Trunk Test Gate
TTK	Trunk Test Check
TTL	Trunk Test Lock
TTR	Take Trouble Record, Trouble Release
TUO,1	TL Frame
TUC	TL Connector
TUK	TL Check
UO-9	Units
UK	Units Check
UL	Units Lock
VGK	Vertical Group Check
WRD	Wrong Digit Dialed
W1,2	W-Walk
WT	Work Timer
XO-9	X-Bit
X11	Service Code
XAR	Cross Advance or Recycle: Checks false ground on AV lead to sender or RR lead to originating register.
XBL	Cross Block Lock: Detects the operation of more than one of BLO-3 relays from LNT.
XCS1,2	Cross Channel Select: Detects a false ground on CSO-9 leads, or the operation of more than two channel switch select magnets.
XCS2	Cross Channel Select: Detects a false ground on CSA, CSB leads or the operation of more than two "A" or "B" level channel switch select magnets.
XF	Cross F Relay: Detects the operation of more than one trunk F relay.
XG	Cross Group: Detects the operation of more than one LGC- relay in line, line switch, and connector circuit.

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Designation	Meaning
XIF	Cross Information: Detects a false ground on unused leads on information storage to originating registers, senders, or trunks.
XJC	Cross Junctor Choice: Detects the operation of more than one JC relay in trunk switch and connector circuit.
XLB	Cross Line Block: Detects the operation of more than one LB relay in the line, line switch, and connector circuit.
XLG	Cross Line Group: Detects the operation of more than one LG relay in the line, line switch, and connector circuit.
XLS	Cross Line Select: Detects the operation of more than one line select magnet or both level A and B magnets of line, line switch, and connector circuit.
XLT	Cross Line Test: Detects the operation of more than one LT- relay in the LNT circuit, associated with PBX hunting.
XNL	Cross Number/Line: Detects the operation of more than one N-, L-, or both CSA and CSB relays in the LNT circuit.
XRC	Cross RC: Detects the operation of more than one RC relay from LNT circuit.
XRL	Cross RLL Relay: Detects false ground on RLL lead to originating register.
XRLS	Cross Release: Detects false ground on MRL, TRL, CTR leads to marker connector.
XSL	Cross Sleeve: Detects false ground on SL lead to trunk switch and connector circuit.
XSS	Cross Sender Select: Detects the operation of more than one select magnet on the outsender link switch.
XT	Cross Tens: Detects the operation of more than one T- relay from LNT circuit.
XTB	Cross Trunk Block: Detects the operation of more than one TB- relay or a cross on TBO-6 leads to trunk switch and connector circuit.
XTG	Cross Trunk Group: Detects a cross on leads TGO-7 to trunk switch and connector circuit.
XTS1	Cross Trunk Select: Detects a false ground on leads TSO-9 or the operation of more than two trunk switch select magnets.
XTS2	Cross Trunk Select: Detects a false ground on TSS lead, or the operation of more than two "A" or "B" level trunk switch select magnets.
XU	Cross Units: Detects the operation of more than one U relay from LNT circuit.
XVG	Cross Vertical Group: Detects a false ground on VGR lead, or the operation of more than one VG- relay in the outsender link.

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Designation	Meaning
YO-9	Y-Bit
ZO	Zero Operator
Z1, Z2	Z-Walk

3. FUNCTIONS

3.01 For circuit functions, see SECTION I of this Circuit Description.

4. CONNECTING CIRCUITS

4.01 When this circuit is listed on a key-sheet, the connecting information thereon should be followed.

(a) Alarm Circuit - SD-26393-01.

(b) Line, Line Switch, and Connector Circuit - SD-26382-01.

(c) Line Number Translator and Connector Circuit - SD-26388-01.

(d) Marker Connector Circuit - SD-26389-01.

(e) Miscellaneous Circuit - SD-26405-01.

(f) Originating Register Circuit - SD-26385-01.

(g) Outsender and Connector Circuit - SD-26387-01.

(h) PRTD Circuit - SD-26414-01.

(i) Test Circuit - SD-26411-01.

(j) Traffic and Plant Register Circuit - SD-26437-01.

(k) TBL Permanent Signal OVFL Counter Circuit - SD-26405-01.

(ℓ) Trunk Switch and Connector Circuit - SD-26383-01.

(m) Traffic Usage Recorder Circuit - SD-96494-01 (Typical).

5. MANUFACTURING TESTING REQUIREMENTS

5.01 The marker shall be capable of performing all the functions listed in this Circuit Description and meeting all the requirements of the Circuit Requirement Tables.

6. ALARM INFORMATION

TROUBLE RECORDER REQUESTS

6.01 When the marker encounters a trouble as indicated by the operation of the work timer, a minor alarm is sounded accompanied by the lighting of the red trouble recorder request lamp TREC on the test frame.

6.02 When the trouble recorder is summoned as indicated by the operation of TRST, the marker work timer is recycled to allow for the trouble recorder to take a trouble record. If the trouble recorder is busy, ground will appear on the TRB lead to operate the display lost relay DL which lights a DL- lamp at the test frame. The marker will proceed as if the record had been taken. Momentary operation of the test frame MAR key retires the minor alarm and lamp signal. Operation of RLS key releases the display lost lamp and releases the marker DL relay.

6.03 The trouble recorder is also summoned when any of the following conditions occur:

(a) The marker has encountered a mutilated digit, indicated by operation of relay MUD.

(b) The marker has detected a trouble permanent signal as indicated by operation of relay PSG.

(c) The marker has received a transfer start indication from the marker connector as indicated by the operation of relay TRS.

(d) The marker is requested to take a record by the operation of REC by signal from the test frame or in response to an information or nuisance call request.

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TROUBLE RECORDER TIME OUT

6.04 As indicated in 6.02 the marker work timer is recycled by the operation of TRST. If the marker has not released from the connection prior to the operation of WT, trouble recorder time out relay TRT will operate and lock under control of the alarm sending circuit. Relay TRT in operating will cause the following.

(a) Cause the release of the marker by operating TRB and DISC or TRL.

(b) Sounds a major alarm.

(c) Lights the red TRT lamp at the marker frame.

(d) Lights the aisle pilot light at the test frame.

6.05 The alarm is retired and the lamps are extinguished by the momentary operation of the AR key on the marker or MAR key at the test frame.

OVERALL TIME OUT

6.06 The marker overall time TOA circuit is started when the marker is seized by the marker connector or by the operation of relay TRST and is stopped when the marker is returned to normal. If the overall timer completes its timing cycle, relay TOA operates operating relay TA which locks under control of the alarm sending circuit. Relay TOA in operating will attempt to release the marker by grounding MRL and TRL leads to the marker connector. Relay TA in operating will cause the following:

(a) Sound a major alarm.

(b) Light the red TA lamp at the marker frame.

(c) Light the aisle pilot light at the test frame.

6.07 The alarm is retired and the lamps are extinguished by the momentary operation of the AR key on the marker or the MAR key at the test frame.

ALL MARKERS - BUSY ALARM

6.08 Whenever a marker is seized, or is off-normal for any reason, or when a fuse is operated, the white MMB- marker in use lamp lights on the test frame.

6.09 When all markers in a group become busy the white AMB lamp lights at the test frame. If a group of markers remain busy for 46 to 54 seconds, a minor alarm sounds, a red aisle pilot, and red MBA lamps on the test frame light. The alarm and lamps with the exception of the AMB lamp, lock under control of the MAR key. The AMB lamp remains lighted as long as all markers in the group are busy.

FUSE ALARMS

6.10 Operation of the marker 48-volt fuses operates the marker fuse alarm relay which operates FA1. Relay FA1 is locked under control of the alarm sending circuit. The blown fuse will sound a major alarm, operating the FA lamp on the marker and the aisle pilot lamp on the test frame. Relay FA1 operates relay MCB to make the marker busy to both connectors to prevent its seizure. Replacement of the fuse releases relay FA, which lights the marker fuse guard lamp. The alarm will persist and the marker remains busy until the momentary operation of the AR key on the marker or the MAR key on the test frame releases relay FA1 to restore the marker to normal, releases the alarm and extinguishes the FG and aisle pilot lamps.

7. TAKING EQUIPMENT OUT OF SERVICE

7.01 When necessary a marker may be taken out of service by the operation of the marker make busy key at the test frame,

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where one key is provided for each marker. The MMB- lamp which is an integral part of the key, lights in a steady state as an in use indication; when the key is operated to make the marker busy, the associated MMB- lamp will be flashed at a 120-IPM rate.

7.02 Operation of the MMB- key will operate the marker MCB relay which grounds the CB- leads to the connectors. The marker appears busy to the connectors thereby preventing its seizure.

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