

CIRCUIT DESCRIPTION

CD-65741-01
ISSUE 9D
APPENDIX 7D
DWG ISSUE 53D

PBX SYSTEMS
NO. 756A
LINE, LINK, AND MARKER CIRCUIT

CHANGES

D. Description of Changes

- D.1 Circuit Note 134 is added.
- D.2 Circuit Note 104 is revised to reflect issue 53D.
- D.3 Circuit Note 102 is revised to add reference to Note 134 under station dial transfer trunk.
- D.4 Option UL is added to correct a trouble that results in the station dial transfer trunk circuit from being denied access to a central office trunk if any (option UC) trunks are idle.

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DEPT 3223-WVS-FKB

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Page 1
1 Page

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CIRCUIT DESCRIPTION

CD-65741-01
ISSUE 9D
APPENDIX 6D
DWG ISSUE 52D

PBX SYSTEMS
NO. 756A
LINE, LINK, AND MARKER CIRCUIT

CHANGES

D. Description of Changes

D.1 The rating of this circuit is changed from AT&TCO
Standard to Mfr Disc.

BELL TELEPHONE LABORATORIES, INCORPORATED
DEPT 3224-WVS-RVL

CIRCUIT DESCRIPTION

CD-65741-01
ISSUE 9D
APPENDIX 5B
DWG ISSUE 51B

PBX SYSTEMS
NO. 756A
LINE, LINK, AND MARKER CIRCUIT

CHANGES

D. Description of Changes

D.1 This change is required to prevent possible double connections due to the slow release of relay LT- with diode LT- across it.

D.2 Options UJ, rated Mfr Disc., and UK, rated standard, are added. Option UJ removes the LT- diode from the coil of relay LT-. Option UK relocates this diode to protect the camp-on transistors and prevent the slow release of relay LT-.

D.3 Only the product from Drawing Issue 33 to current issue is affected (App Fig. 22).

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 3224-TEH-RVL

PBX SYSTEMS
NO. 756A
LINE, LINK, AND MARKER CIRCUIT

CHANGES

B. Changes in Apparatus

B.1 Superseded

HA and HB diodes, 446F,
XV option

Superseded by

HA and HB diodes, 426H,
UI option

D. Description of Changes

D.1 On Issue 26 option XV was added. This issue changes the code of diodes HA and HB from 446F, option XV, to 426H, option UI.

D.2 The change is required to prevent failure of diodes HA and HB. During a camp-on sequence the marker functions to release and reoperate the trunk hold magnet to transfer from the dial tone link to the busy station link. This release generates a negative pulse which may destroy the HA and HB diodes (446F) if all-registers-busy relays ARBA and ARBB are operated. Option XV is rated Mfr Disc. and option UI is rated Standard to provide 426H diodes which can withstand the reverse voltage surges.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 3224-TEH-RVL

CIRCUIT DESCRIPTION

CD-65741-01
ISSUE 9D
APPENDIX 3A
DWG ISSUE 49A

PBX SYSTEMS
NO. 756A
LINE, LINK, AND MARKER CIRCUIT

CHANGES

B. Changes in Apparatus

B.1 Removed

RT1-4 diodes, 446F, VW option

D. Description of Changes

D.1 On Issue 43B, option VV was designated and rated Mfr Disc. and option VW was added as Standard, but contact 8B of relays HMTA and HMTB used in option VW are not available as they were used in option VU on Issue 42B.

D.2 Option VW is rerated from Standard to Mfr Disc. and option VV is rerated from Mfr Disc. to Standard.

D.3 Circuit Note 104 is revised to reflect Issue 49B.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 3221-WVS-RGP

CIRCUIT DESCRIPTION

CD-65741-01
ISSUE 9D
APPENDIX 2B
DWG ISSUE 48B

PBX SYSTEMS
NO. 756A
LINE, LINK, AND MARKER CIRCUIT

CHANGES

B. Changes in Apparatus

B.1 Superseded

ATB, INT relay, AK6,
Fig. 4, UC option

Superseded by

ATB, INT relay, AK37,
Fig. 4, UC option

B.2 Added

A0, B1 relay, AK6, Fig. 4, UC option

A0, B1 diode, 446F, Fig. 4, UC option

ATB thermistor, 8C, Fig. 4, UC option

IN8 diode, 446F, Fig. 4, UC option

D. Description of Changes

D.1 On sheets B5B, B6, B7, B8A, B8B, and B35 changes are made on a no-record basis to option UC (A&M Only). Option UC is provided on a local basis only (A&M Only). Options UI, UJ, UK, UL, and UM are cancelled due to the modification applied to option UC.

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Page 1
1 Page

PBX SYSTEMS
NO. 756A
LINE, LINK, AND MARKER CIRCUIT

CHANGES

D. Description of Changes

- D.1 The lead index is changed to add reference to the automatic trunk level interconnecting unit.
- D.2 On sheet B35, reference to the automatic trunk level interconnecting unit is added to leads T2, R2, and S2.
- D.3 Circuit Note 102 is changed to reflect Issue 47D.

F. Changes in CD Section

- F.1 In the TABLE OF CONTENTS add under part heading 17., the following:

L. Automatic Trunk Level Interconnecting Unit (Options ZD, ZS, WP, VC, and VE)

- F.2 In SECTION II - DETAILED DESCRIPTION under part heading 17. add the following heading and paragraphs:

L. Automatic Trunk Level Interconnecting Unit (Options ZD, ZS, WP, VC, and VE)

17.83 When a line circuit is assigned to an automatic trunk level interconnecting unit, options ZD, ZS, WP, VC, and VE are used, and leads T2, R2, and S2 are connected to the unit.

17.84 A calling station or trunk is connected to the unit by the marker in the same manner as when a calling station or trunk dials the recorded telephone dictation trunk.

- F.3 In SECTION III - REFERENCE DATA, under 3. CONNECTING CIRCUITS, add:

(ak) Automatic Trunk Level Interconnecting Unit - SD-1E255-01.

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DEPT 3221-WVS-RGP

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Page 1
1 Page

PBX SYSTEMS
NO. 756A
LINE, LINK, AND MARKER CIRCUIT

TABLE OF CONTENTS	PAGE		PAGE
<u>SECTION I - GENERAL DESCRIPTION</u>	1	<u>B. Register Requests Service</u>	13
<u>1. PURPOSE OF CIRCUIT.</u>	1	<u>C. Trunk Testing</u>	13
<u>2. GENERAL DESCRIPTION OF OPERATION.</u>	1	<u>D. Trunk Selection and Hold Magnet Operation</u>	14
<u>A. Subcircuits and Arrangement</u>	1	<u>E. Hold Magnet Check and Marker and Register Release</u>	14
<u>B. Dial Tone Connection (See Note 304)</u>	3	<u>F. All Trunks Busy - Busy Tone Trunk Idle</u>	15
<u>C. Call-Terminating Connections</u>	3	<u>4. CENTRAL OFFICE OR RINGDOWN TIE TRUNK TO STATION CALL TERMINATION (SC5)</u>	15
<u>D. Called Station Line Busy</u>	5	<u>A. General</u>	15
<u>E. Paths Busy</u>	5	<u>B. Register Requests Service</u>	16
<u>F. Camp-On</u>	5	<u>C. Called Station Testing and Select Magnet Operation</u>	16
<u>G. Abandoned Calls</u>	6	<u>D. Hold Magnet Operation</u>	16
<u>H. Marker Time-Out</u>	6	<u>E. Hold Magnet Check and Marker and Register Release</u>	17
<u>I. Checks</u>	6	<u>F. Called Station Busy - Station in Hunting Group Idle</u>	17
<u>J. Permanent Signals</u>	7	<u>G. Camp-On - Called Station and All Other Stations in Hunting Group Busy - No Other Trunk Camped On Called Station (SC9)</u>	18
<u>K. Dial Back by Attendant - No Test</u>	7	<u>H. Camp-On Busy - Called Station and All Other Stations in Hunting Group Busy - Another Trunk Already Camped On Called Station (SC20)</u>	21
<u>L. Alarms</u>	7	<u>I. Camp-On Busy - PBX on Remote Trunk Answer Operation (XF Option)</u>	21
<u>SECTION II - DETAILED DESCRIPTION</u>	1	<u>J. Cancel Camp-On - Called Station Busy Dial Conference Trunk Circuit - Station or Attendant Controlled, or Station Dial Transfer Trunk Circuit in Use (SC26)</u>	21
<u>1. ESTABLISHING DIAL TONE CONNECTIONS</u>	1	<u>K. Called Station Busy - Message Registration Pulse on Sleeve</u>	21
<u>A. Station Dial Tone Connections (SC1)</u>	1	<u>L. Called Station is Inward Restricted (SC28)</u>	23
<u>B. Code 8 Tie Trunk Dial Tone Connections (SC30)</u>	5	<u>5. CENTRAL OFFICE OR RINGDOWN TIE TRUNK TO CODE 8 TRUNK CALL TERMINATIONS (SC6)</u>	23
<u>C. Central Office or Ringdown Tie Trunk Dial Tone Connection (SC2)</u>	5	<u>A. General</u>	23
<u>D. Attendant Trunk Dial Tone Connection</u>	7	<u>B. Register Requests Service</u>	23
<u>E. Busy Verification Trunk Dial Tone Connection</u>	7	<u>C. Trunk Testing and Select Magnet Operation</u>	24
<u>2. STATION-TO-STATION CALL TERMINATING CONNECTIONS (SC3)</u>	7	<u>D. Hold Magnet Operation</u>	24
<u>A. General</u>	7	<u>E. Hold Magnet Check and Marker and Register Release</u>	24
<u>B. Register Requests Service</u>	7	<u>F. All Trunks Busy (SC15)</u>	24
<u>C. Junctor Testing and Selection</u>	8	<u>6. CENTRAL OFFICE OR RINGDOWN TIE TRUNK TO CENTRAL OFFICE OR RINGDOWN TIE TRUNK CALL TERMINATIONS</u>	25
<u>D. Terminating Link Selection</u>	8		
<u>E. Called Station Selection and Testing</u>	8		
<u>F. Connection of Called Station to Junctor</u>	9		
<u>G. Connection of Calling Station to Junctor</u>	9		
<u>H. Marker and Register Release</u>	10		
<u>I. Called Station Busy - Station in Hunting Group Idle (SC8)</u>	11		
<u>J. Called Station and Stations in Hunting Group Also Busy - Busy Tone Trunk Idle (SC7)</u>	11		
<u>3. STATION TO CENTRAL OFFICE OR RINGDOWN TIE TRUNK CALL TERMINATIONS (SC4)</u>	13		
<u>A. General</u>	13		

7. <u>DIAL BACK CALLS FROM CENTRAL OFFICE OR RINGDOWN TIE TRUNKS</u>	25	B. <u>Station Line (Options M, ZD, WP, VC, and VE)</u>	36
8. <u>CALLED LINE OR TRUNK UNASSIGNED (SC14)</u>	25	C. <u>Two-Way Tie Trunk (Options ZD, ZF, WQ, VC, and VE)</u>	36
9. <u>LOCKOUT AND TENS PREFERENCE CONTROL</u>	26	D. <u>Dial Conference Circuit (See Circuit Note 126 - Sheet D1B)</u>	37
A. <u>Lockout Control</u>	26	E. <u>Recorded Telephone Dictation Trunk (Options ZD, ZF, WP, VC, and VE)</u>	37
B. <u>Tens Preference Control</u>	27	F. <u>Loudspeaker Paging Trunk (Options ZD, ZS, WP, VC, and VE)</u>	37
10. <u>ABANDONED CALLS (SC17)</u>	27	G. <u>3A Code Call Circuit (Options ZD, ZG, ZE, WP, VC, and VE)</u>	38
11. <u>ALLOTING AND SEQUENCE CONTROL</u>	27	H. <u>Auxiliary Position Circuit for Remote Trunk Answering (Options ZD, ZF, WP, VC, and VE)</u>	39
A. <u>Register Allotter</u>	27	I. <u>Dial Conference Trunk Circuit - Station Controlled (Options ZD, ZF, XD, WP, VC, and VE)</u>	39
B. <u>Link Group Sequence Control (SC24)</u>	28	J. <u>Dial Conference Trunk Circuit - Attendant Controlled (Options ZD, XC, WP, VC, and VE)</u>	40
C. <u>Link Sequence Control (SC23)</u>	28	K. <u>Interface Trunk Circuit - (Options ZD, ZG, ZE, N, WP, VC, and VE)</u>	40
D. <u>Units Sequence Control (SC25)</u>	29	18. <u>STATION AND TRUNK HUNTING GROUPS</u>	42
12. <u>PATHS BUSY</u>	29	A. <u>General</u>	42
A. <u>All Registers Busy</u>	29	B. <u>Two-Way Station Hunting Group</u>	42
B. <u>All Links Busy</u>	29	C. <u>One-Way Station Hunting Group</u>	42
C. <u>All Junctors Busy (SC12)</u>	30	D. <u>Combined Two-Way and One-Way Station Hunting Group</u>	43
D. <u>Busy Tone Trunk Busy (SC13)</u>	31	E. <u>One-Way Sequential Station Hunting Group</u>	43
E. <u>All Attendant Trunks Busy on Intercepted Call (SC19)</u>	31	19. <u>CORD SWITCHBOARD (OPTION Y AND ZT, OR OPTION XW, OR OPTION XW AND XX)</u>	43
13. <u>LINK SHIFT TIMING</u>	32	20. <u>ALARMS</u>	43
A. <u>General</u>	32	A. <u>General</u>	44
B. <u>Link Shift Timing (Option 22 - SC34)</u>	32	B. <u>Units Alarm</u>	44
C. <u>Link Shift Timing (Option ZO - SC21)</u>	32	C. <u>Release Alarms</u>	45
D. <u>Link Shift Timing (Option ZN - SC10)</u>	33	D. <u>Tens Alarms</u>	45
14. <u>MARKER TIMING (SC16, SC36)</u>	33	E. <u>Link Test Alarm</u>	46
OPTION VQ	33	F. <u>Time-Out Alarm</u>	46
A. <u>General</u>	33	G. <u>Alarm Control</u>	46
B. <u>Second Trial</u>	33	21. <u>MESSAGE WAITING SERVICE (OPTION ZQ)</u>	46
C. <u>No Connection</u>	34	22. <u>DIRECT STATION SELECTION</u>	47
D. <u>Trouble Release</u>	34	A. <u>Attendant Direct Station Selection (Options ZY and ZX)</u>	47
OPTION VR	34	23. <u>SINGLE-DIGIT DIALING</u>	47
A. <u>General</u>	34	A. <u>Make Busy Key and Lamp (Option YD)</u>	47
B. <u>Second Trial</u>	34A	B. <u>Single-Digit Dialing 8 for Long Distance (Options YE, YF, YO, and YP)</u>	47
C. <u>No Connection</u>	34A	24. <u>PAD CONTROL CIRCUIT (OPTIONS WF, 19, 20, 21)</u>	47
D. <u>Trouble Release</u>	34B	A. <u>General</u>	47
15. <u>TIME-OUT CHECK (SC18)</u>	34B	B. <u>Incoming Calls (SC30)</u>	48
16. <u>TRAFFIC REGISTER CONTROL</u>	35	C. <u>Outgoing</u>	49
A. <u>General</u>	35		
B. <u>Peg Count Register Control</u>	35		
C. <u>Overflow Register Control</u>	35		
D. <u>Trouble Register Control</u>	35		
17. <u>UNIVERSAL LINE GROUP 20-29</u>	36		
A. <u>General</u>	36		

TABLE OF CONTENTS

<u>25. MAKE BUSY AND BUSY DISPLAY CIRCUIT</u>	<u>50</u>	<u>27. MISCELLANEOUS</u>	<u>52</u>
<u>A. Function of Links with Make Busy and Busy Display Circuit</u>	<u>50</u>	<u>SECTION III - REFERENCE DATA</u>	<u>1</u>
<u>B. Function of Junctors with Make Busy and Busy Display Circuit</u>	<u>50</u>	<u>1. WORKING LIMITS</u>	<u>1</u>
<u>C. Function of Busy Tone Trunk with Make Busy and Busy Display Circuit</u>	<u>51</u>	<u>2. FUNCTIONAL DESIGNATIONS</u>	<u>1</u>
<u>D. Function of Universal Lines with Make Busy and Busy Display Circuit (Option WQ)</u>	<u>51</u>	<u>3. FUNCTIONS</u>	<u>3</u>
<u>26. TRAFFIC MEASUREMENT SYSTEM NO. 1A REMOTE SCANNER CIRCUIT</u>	<u>51</u>	<u>4. CONNECTING CIRCUIT</u>	<u>5</u>
<u>A. Function of Links with TMS Remote Scanner Circuit</u>	<u>51</u>	<u>5. MANUFACTURING TEST REQUIREMENTS</u>	<u>5</u>
<u>B. Function of Universal Lines with TMS Remote Scanner Circuit</u>	<u>51</u>	<u>6. TAKING EQUIPMENT OUT OF SERVICE</u>	<u>5</u>
<u>C. Function of Busy Tone Trunk with TMS Remote Scanner Circuit</u>	<u>52</u>	<u>7. ALARM INFORMATION</u>	<u>6</u>
		<u>A. Indication</u>	<u>6</u>
		<u>B. Action Required</u>	<u>6</u>
		<u>SECTION IV - REASONS FOR REISSUE</u>	<u>1</u>

SECTION I - GENERAL DESCRIPTION1. PURPOSE OF CIRCUIT

1.01 The circuit provides means for establishing dial tone connections for stations and trunks to dial pulse registers, and talking connections between two stations or two trunks, between a station and a trunk, or between a station or trunk and a special service circuit, through a crossbar switch network.

2. GENERAL DESCRIPTION OF OPERATIONA. Subcircuits and Arrangement

2.01 Line circuits are provided for a maximum of 60 stations, which are assigned numbers from 20 to 79. The line circuits for the 20 to 29 group are made convertible so that they may be used as terminations for tie trunks and miscellaneous special service trunks and circuits. When a trunk or special service circuit is connected to a universal line circuit, the assigned number changes from a 20 to 29 number to the corresponding 80 to 89 number.

2.02 Terminations are provided for ten central office trunks, which are assigned numbers from 90 to 99. A maximum of four ringdown tie trunks may be substituted for four central office trunks; when this is done the ringdown tie trunk assumes the number of the central office trunk it replaces. When all of the trunks in the 90 to 99 group are arranged in a single trunk group, the PBX may be arranged for one-digit operation in this group, and these trunks can be reached by dialing the single digit 9.

2.03 Terminations are provided for three attendant trunks, which may be reached by dialing the single digit 0. If a call is completed to an attendant trunk under an intercept condition, a distinctive mark is given to the trunk so that, upon answering, the attendant may distinguish the call from a dial-zero call.

2.04 Terminations are also provided for one busy tone trunk, two dial pulse registers, and both ends of six junctors.

2.05 The crossbar switching network consists of eight 10 by 10, 6-point crossbar switches. The horizontals are arranged so that a total of sixteen 3-wire links are available. The 16 links are realized by using eight 6-wire horizontals (levels 2 through 9) and choosing either the left or right half of the crosspoints by operating the crosspoints of either the 0 or 1 level in combination with those of one of the 2 through 9 levels.

2.06 The line circuits, busy tone trunk, junctors, attendant trunks, central office and ringdown tie trunks, and the dial pulse registers are terminated on the switch verticals. Each dial pulse register is assigned two verticals. One of these verticals is used as a temporary memory device to record the link number used in the dial tone connection. The crosspoints of the register memory verticals are not multiplied to the crosspoints of other verticals and therefore, do not form part of the links. The junctors also have two vertical appearances each, one for the originating side, the other for the terminating side.

2.07 Only one link is used for establishing dial tone connections, station-to-trunk connections, and trunk-to-trunk connections. Station-to-station connections are established through a junctor and thus use two links per connection. Trunk-to-station connections are established using only one link. An exception is the code 8 tie trunk to station connections, which are established through a junctor and employ two links.

2.08 The central office and ringdown tie trunks are usually arranged so that they may be dial selected for outgoing calls. Incoming calls over these trunks, however, can be answered and completed only by the attendant, unless an auxiliary position circuit is provided as a special service circuit. If an attempt is made by the attendant to complete an incoming call over one of these trunks to a busy station (assuming all other stations in the same hunting group, if any, are also busy), the trunk will camp-on the busy station, provided no other trunk is already camped-on the same station.

2.09 Incoming calls over central office trunks may be answered and completed by any PBX station if the PBX is provided with an auxiliary position circuit and the attendant places the PBX on remote trunk answer operation. In this case, any attempt by the answering station to complete the incoming call to a busy station will not cause the trunk to camp-on the busy station.

2.10 Although the central office and ringdown tie trunks are dial selected, only nonrestricted station, nonrestricted code 8 tie trunks, and other central office and ringdown tie trunks will be connected to them directly. Restricted stations and code 8 tie trunks, upon dialing a 9 code, will be connected to an attendant trunk. For restricted stations, the attendant may then hold the call at the attendant trunk and connect a central office or ringdown tie trunk to the calling station on

a dial-back (no-test) basis. In the course of establishing this connection, the attendant trunk, which is holding the calling station, will be made to release. For restricted code 8 tie trunks, the attendant may not use the dial-back feature. Instead, the restricted code 8 tie trunk must be asked by the attendant to go on hook to be called back later on a central office or ringdown tie trunk to code 8 tie trunk connection basis.

2.11 Stations may be arranged into one-way or two-way hunting groups, or in combinations of both types, but with the restriction that all stations in a hunting group must be within the same tens group. Trunks of the same type may also be arranged into two-way hunting groups.

2.12 The following conditions will signal the marker to set up a dial tone connection to the station or trunk; the removal of a handset from a station switchhook; an incoming seizure signal from a code 8 tie trunk; the operation of a pick-up key associated with an attendant trunk; the operation of a pick-up associated with a central office or ringdown tie trunk followed by the operation of the hold key in the attendant cordless position circuit or the remote answering of an incoming call over a central office trunk through the auxiliary position circuit followed by a switchhook flash from the answering station. The completion of dialing in a dial pulse register will signal the marker to set up a connection between the dialing station, trunk or remote answered central office trunk, and the station or trunk corresponding to the dialed number.

2.13 Since the marker will process only one call at a time, a gating and preference arrangement is provided to cope with simultaneous bids for its service. When the marker is idle, the gate is open. One call or a group of simultaneous calls for the marker will close the gate. The marker will proceed to process each register bid, one trunk bid in each of two trunk preference groups (not including code 8 tie trunks), one station or trunk bid in the 20 to 29 (and 80 to 89) tens groups, and one bid in each of the higher numbered tens group in ascending order, until all groups have been accommodated.

2.14 Only those trunk and tens groups in which a bid was admitted while the gate was open will be served. Once a trunk or tens group has registered a bid, individual bids within those trunk and tens groups, which are originated before the group is served, will be recognized. The station or trunk actually served is

under control of a units sequence circuit in the marker. When both registers are busy, the marker will stop serving any trunk or tens group and wait until a register requests service, thereby making it available again before proceeding to serve the next lower preference group.

2.15 The particular station or code 8 tie trunk served within a tens group is controlled by the position of a units sequence circuit within the marker, which determines preference in accordance with the units digit of the station or code 8 tie trunk. The mechanical and electrical interlocks in the attendant cordless position circuit prevent more than one code 9 or code 0 trunk, under control of the attendant, from originating more than one call at the same time. The units preference changes after each marker operation involving units selection.

2.16 The units sequence circuit in the marker also controls the order of preference in the selection of trunks, attendant trunks, junctors, and stations in a hunting group under call-terminating conditions. Other sequence control circuits control and change the order of preference for the selection of link groups and links within a link group. A register allotter circuit is also provided to equalize to some extent the use of the two registers.

2.17 The marker contains a timing circuit that starts functioning at the beginning of each marker usage. If a blockage occurs and a connection is not completed within an interval of time, the processing of the call is restored to its initial stages and a second trial is made. If the connection is not completed on the second trial within another interval of time, the marker will attempt to provide a connection that will return busy tone to the calling end. If this cannot be accomplished within still another time interval, the marker will release on a trouble-release basis and restore to normal.

2.18 Arrangements are provided to prevent an auxiliary switchboard, which can be used in conjunction with the PEX on an optional basis, from interfering with the marker while it is processing a call.

2.19 Provisions are made for scoring groups of peg count, overflow, and trouble registers under appropriate circumstances.

2.20 Alarm circuitry and alarm lamps are provided to record circuit irregularities.

B. Dial Tone Connection (See Note 304)

- 2.21 When a PBX station lifts the receiver to make a call, the line relay operates. The line relay operated passes the tens and units identity of the calling station to the marker. All calls desiring service compete for the marker. The tens selection circuit (FS2) of the marker accepts the tens information and allows only one call at a time to be processed.
- 2.22 Lines, trunks, and registers are assigned a location in the tens preference chain (FS3), and simultaneous calls are served according to that location. (When no more registers are available, the marker stops processing dial tone connections until it can serve a register, thus freeing it for another dial tone connection.)
- 2.23 When an originating station line has been given preference, the tens connector (FS4) for the group of tens lines in which that station is located operates. The tens connector allows the units information from the line relay to be extended to the units selection circuit (FS5).
- 2.24 All stations in the preferred tens group that desire service will pass units information to the units selection circuit. However, only that line which has the highest units preference in that tens group will be served at this time. The line and trunk hunting circuit (FS6) determines which line will be served.
- 2.25 The operation of the tens preference chain also signals the register control circuit (FS10) to connect an idle dial pulse register. The register control circuit connects a register and passes class-of-service information from the class-of-service circuit (FS11) to the register. The register control circuit also directs the link test circuit (FS12 or FS28) to find an idle link.
- 2.26 When an idle link has been found, the select magnet control circuit (FS13) operates the select magnets that correspond to that link, signaling the register control circuit and the line and trunk hunting circuit to operate the hold magnets associated with the selected dial pulse register and with the calling station. The station is thereby connected to a dial pulse register.
- 2.27 The line and trunk hunting circuit functions to check that the register is holding the connection to the station and then signals the route control circuit (FS9) to release the marker.

2.28 When the attendant is completing a call on an incoming trunk to a PBX station or another trunk, when the attendant is placing a call via an attendant trunk, or when the PBX is on remote trunk answer operation and a PBX station is completing a call on an incoming trunk to a PBX station, the trunk passes its tens and units identity to the marker. The marker connects the trunk to a dial pulse register in the same fashion and through the same circuits as for a station line.

C. Call-Terminating ConnectionsGeneral

2.29 When the dial pulse register has received all the dialed information, it signals the marker for service. The tens selection circuit recognizes the register request for service and passes the information on to the tens preference circuit. The registers have the highest preference in the marker and will be served before any trunks or stations that might originate calls at the same time that a register requests service.

2.30 Ordinarily the marker will continue to serve lines or trunks that were waiting when the register called. However, if the marker encounters an all-registers-busy condition, it will serve a waiting register first, in order to free that register for another dial tone call.

Station Line to Station Line
(See Notes 305 through 307)

2.31 When the register has been given preference, the tens preference chain connects leads from the register through to the sequence control circuit (FS8). Information passes over the circuit that a junctor will be required. The sequence control circuit requests the line and trunk hunting circuit to find an idle junctor.

2.32 When an idle junctor has been found, its identity is stored on the junctor register relays (FS7) by the class-of-service circuit. The sequence control circuit advances to operate the register connector relays of the tens connector circuit and to signal the link test circuit to find an idle line (see Note 306).

2.33 The register connector operated allows the tens and units identity of the called station to be transmitted to the marker. The tens connector corresponding to the tens digit of the station is operated, and the units relay of the units selection circuit corresponding to the units digit of the called station is operated. The line

and trunk hunting circuit then tests the sleeve of the called line to see if it is idle.

2.34 The link test circuit, finding an idle link, signals the select magnet control circuit to operate the select magnets corresponding to the selected link. The select magnet control circuit then signals the line and trunk hunting circuit to operate the hold magnet associated with the called station (assuming it is idle) and to operate the terminating hold magnet of the selected junctor.

2.35 The line and trunk hunting circuit functions to check that the junctor is holding the called line and then signals the sequence control circuit to advance from the terminating to the originating part of the call. The sequence control circuit advances and restores the tens connector, the units selection, the line and trunk hunting, the link test, and the select magnet control circuits.

2.36 The sequence control circuit then signals the register control circuit to operate the select magnets corresponding to the link to which the calling line and the dial pulse register are connected (see Note 307). The sequence control circuit also signals the line and trunk hunting circuit to operate the originating hold magnet of the selected junctor.

2.37 The line and trunk hunting circuit checks that the junctor is holding the originating station and signals the route control circuit to release the marker. The route control circuit signals the register control circuit to release the dial pulse register, and the route control circuit restores the marker to normal.

Station Line to Trunk (See Note 308)

2.38 When a register calls for the marker and desires to connect the calling station to a trunk, the tens preference chain connects leads from the register through to the sequence control circuit. Information passes over the circuit that a junctor will not be required. The sequence control circuit then operates the register connector of the tens connector circuit and signals the register control circuit to operate the select magnets associated with the link to which the calling station and the register are connected.

2.39 The register connector allows the identity of the called trunk group to be transmitted to the marker, operating the corresponding trunk relays in the tens

connector circuit. Units information is also transmitted from the register to operate the units selection circuit. By means of the H terminal strapping in the units selection circuit, units relays corresponding to all the trunks in the desired group are operated. The units selection circuit then signals the line and trunk hunting circuit to select an idle trunk.

2.40 When an idle trunk has been found, the line and trunk hunting circuit operates the hold magnet associated with that trunk to check that the trunk is holding the connection. Then the line and trunk hunting circuit signals the route control circuit to release the marker. The route control circuit signals the register control circuit to release the register and then restores the marker to normal. Class-of-service information is passed from the register to the selected trunk through the register connector.

Trunk to Station Line (See Note 309)

2.41 When a register calls for the marker and desires to connect a calling trunk to a station line, the tens preference chain connects leads from the register through to the sequence control circuit. Information passes over the circuit that a junctor will not be required. The sequence control circuit then operates the register connector of the tens connector circuit and signals the register control circuit to operate the select magnets associated with the link to which the calling trunk and the register are connected.

2.42 The register connector allows the tens and units identity of the called station to be transmitted to the marker operating the corresponding tens connector and the corresponding units relay of the units selection circuit. The units selection circuit then signals the line and trunk hunting circuit to test the sleeve of the called station to determine if it is idle.

2.43 The line and trunk hunting circuit then operates the hold magnet associated with the called station (if it is idle) and checks that the trunk is holding the connection. The line and trunk hunting circuit then signals the route control circuit to release the marker. The route control circuit signals the register control circuit to release the register and then restores the marker to normal.

Trunk to Trunk

2.44 When a register calls for a marker and desires to connect a calling trunk

to another trunk, the operation is generally the same as when it connects a calling station to a trunk.

D. Called Station Line Busy

2.45 When the line and trunk hunting circuit tests a station line and finds it busy, the hunt connector relays of that circuit operate to test whether the line is in a hunting group and whether any lines in the hunting group are idle. If an idle line is found, the marker proceeds to complete the call to that line.

2.47 If the line busy is verified, the marker either connects the calling station to a busy tone trunk or returns a busy signal to the calling trunk, which returns both an audible and a visual signal to the attendant.

2.48 If the line busy is not verified, the marker completes the call to the intercept portion of an attendant trunk.

E. Paths Busy

All Links Busy

2.49 If all links are busy when the marker tries to connect a station line or a trunk to a dial pulse register, the link test circuit signals the units selections circuit to abandon the call. This marker action is repeated on successive calls until a link becomes idle.

2.50 If all links are busy when the marker tries to complete a call from a dial pulse register, the link test circuit will signal the route control circuit to complete the call to a busy tone trunk. The link used for this connection is the same one connecting the calling station or trunk to the register.

All Trunks Busy

2.51 If all trunks in a desired group are busy, the line and trunk hunting circuit signals the route control circuit to complete the call to the busy tone trunk.

Busy Tone Trunk Busy

2.52 If the busy tone trunk is busy, the marker, through the line and trunk hunting circuit and the register control circuit, signals the register to return busy tone to the calling subscriber and releases.

F. Camp-On

Station Busy - No Trunk Camped-On

2.53 When the marker attempts to complete a call from a central office or ring-down tie trunk to a station line and finds that the station and all other stations in the same hunting group are busy, it sets the trunk to camp-on the station line so that it will become connected to the station as soon as the station becomes idle. If the PBX is on remote trunk answer operation, the marker will function as described in Line Busy - Trunk Already Camped-On and will not set the trunk to camp-on the station line.

2.54 When the line and trunk hunting circuit finds that the station line is busy, it passes this information to the route control circuit. The route control circuit recognizes the line busy and the central office or ringdown tie trunk class indication from the register as instructions to set up a camp-on condition in the trunk.

2.55 The route control circuit signals the link test circuit to find the link to which the desired station line is connected and directs the line and trunk hunting circuit, after a suitable interval, to release the hold magnet of the central office trunk. The line and trunk hunting circuit tells the central office or ringdown tie trunk that the line is busy.

2.56 When the link test circuit finds the proper link, it signals the select magnet control circuit to operate the select magnets corresponding to that link. The select magnet control circuit then directs the line and trunk hunting circuit to re-operate the hold magnet associated with the central office trunk. The line and trunk hunting circuit then checks that the hold magnet has operated and signals the route control circuit to release the marker. The route control circuit signals the register control circuit to release the register and then restores the marker to normal.

Line Busy - Trunk Already Camped-On

2.57 If the marker finds another trunk already camped-on the called station line, it will signal the central office or ringdown tie trunk that a call is already waiting.

2.58 When the link test circuit starts to look for the link to which the desired station line is connected, the

trunk already camped-on that station line signals the link test circuit that it should not try to set up another call to that station. The link test circuit signals the central office or ringdown tie trunk to return a camp-on busy signal and directs the line and trunk hunting circuit to reoperate the trunk hold magnet. The line and trunk hunting circuit signals the route control circuit to release the marker. The route control circuit directs the register control circuit to release the register and then restores the marker to normal.

Station Busy - Dial Conference Trunk Circuit - Station or Attendant Controlled, or Station Dial Transfer Trunk Circuit

2.59 A provision is made to cancel the normal camp-on function if the marker encounters a busy station when attempting to add a station to either of the dial conference trunk circuits or when attempting to transfer an incoming central office trunk call via the station dial transfer trunk circuit.

Line Busy - Remote Trunk Answer Operation

2.60 When the PEX is on remote trunk answer operation and the marker attempts to complete a call from a central office trunk to a station line and finds that the station and all other stations in the same hunting group are busy, it sets the trunk to return a camp-on busy signal to the answering station as an indication of a busy line.

2.61 The link test circuit recognizes the line busy and the central office trunk class indication from the register as instructions not to set the trunk to camp-on the busy line. The link test circuit signals the central office trunk to return a camp-on busy signal and directs the line and trunk hunting circuit to reoperate the trunk hold magnet. The line and trunk hunting circuit signals the route control circuit to release the marker. The route control circuit directs the register control circuit to release the register and then restores the marker to normal.

G. Abandoned Calls

2.62 If a station line or a trunk starts to make a call and then disconnects before the marker can connect it to a dial pulse register, an abandoned call condition is presented to the marker. The marker proceeds normally up to units selection. Since the calling party has already disconnected, no units information is available.

The units selection circuit recognizes an abandoned call and signals the route control circuit to release the marker.

2.63 If the abandonment is after the units information has been identified, the marker timing circuit must advance to no connection before the marker restores to normal via the abandoned call route.

H. Marker Time-Out

Second Trial

2.64 As soon as the marker is seized, the advance, time-out, and release circuit starts timing the marker. If the route control circuit has not released the marker within a short time, the advance, time-out, and release circuit functions to advance the marker to second trial. The marker is restored to its call start condition, and the sequence circuits of the line and trunk hunting circuit and the select magnet control circuit are advanced.

No Connection

2.65 If the marker is unable to complete a connection on a second trial before the advance, time-out, and release circuit functions for the second time, the route control circuit is directed to complete the call to the busy tone trunk, and the marker is restored to normal.

Trouble Release

2.66 If the marker is unable to complete the call to the busy tone trunk before the advance, time-out, and release circuit functions for the third time, the marker is released. The marker proceeds to serve the next lower preference tens group.

I. Checks

Downcheck

2.67 The downcheck circuit functions to check that certain critical circuits of the marker have released before the route control circuit or the advance, time-out, and release circuit is allowed to remove the release condition. The downcheck circuit also guards the release relays from being falsely operated.

Time-Out Check

2.68 The time-out check circuit functions to check the advance, time-out, and release circuit every time the marker completes a call to the busy tone trunk. When

the marker becomes idle after completing a busy tone call and having finished serving all calls within the gate, the time-out check circuit holds the marker busy, exercising and checking the advance, time-out, and release circuit. After it has completed its check, the time-out check circuit releases the marker and locks itself out of action until the busy tone trunk has been used again.

J. Permanent Signals

Before Dialing

2.69 A permanent signal, such as a station handset removed from the switchhook by mistake or crossed tip and ring leads, will cause that station line to be connected to a dial pulse register. If no dialing, or only partial dialing, is received by the register, the register will time out and the call will be completed to an attendant trunk.

2.70 If all attendant trunks are busy, the marker will connect the line to the busy tone trunk. If the busy tone trunk is also busy, the marker will set the dial pulse register to return busy tone to the station line.

2.71 If the station line remains off-hook, it will be reconnected to a register, and the register will again time out. This action continues until the permanent signal line hangs up or an attendant trunk or the busy tone trunk becomes idle.

After Dialing

2.72 If a called station line or code 8 tie trunk remains off-hook after the calling end disconnects, the connection will release and the station or tie trunk will be connected to a dial pulse register. If a calling station or line or tie

trunk remains off-hook after the called station line or tie trunk disconnects, no alarm will be given but the line or trunk and junctor used in the call will remain busy to other calls.

K. Dial Back by Attendant - No Test

2.73 In order that a restricted line be able to make a call to a central office or to a distant PEX over a ringdown tie trunk, the assistance of the attendant is required. The attendant may complete the call by placing the attendant trunk, to which the line is connected, on hold, seizing an idle central office or ringdown tie trunk, and, if the request was for a central office trunk, dialing the called number.

2.74 After dialing, the attendant momentarily operates the hold key to obtain PEX dial tone, momentarily operates the DIAL BACK key, and then dials the number of the calling restricted line. The marker functions to ignore the busy test and connects the central office trunk to the restricted line. The marker also dismisses the attendant trunk to which the restricted line was connected. When the attendant is disconnected, the restricted line is connected to the central office or ringdown tie trunk.

L. Alarms

2.75 The marker alarms are arranged to detect any irregularity in marker operation. The dual operating paths in the marker are checked by alarm relays so that a failure of one of the relays associated with respect to the other will be detected. The marker is arranged so that it will continue to process calls with one of its dual paths not operating. However, the alarm relays and their associated lamps will function to assist in locating trouble conditions.

SECTION II - DETAILED DESCRIPTION1. ESTABLISHING DIAL TONE CONNECTIONSA. Station Dial Tone Connections (SC1)Station Requests Service

1.01 When the PBX subscriber lifts a handset to make a call, the switchhook contact in the telephone set closes the loop to operate the associated relay L--. Relays L-- for stations 20 to 29 are shown on FS 26 and those for stations 30 to 79 appear on FS 1.

1.02 Assuming no other requests by lines, trunks, or registers for marker service, relay L--, in operating, will operate a tens relay T- (FS2) corresponding to the tens group the originating station is located in.

1.03 The operation of any tens relay will operate the tens end relays TEAO, A1, A2, A3, B0, B1, B2, B3 (FS2). The tens end relays operated:

- (a) Provide a locking path for the operated tens relay.
- (b) Open the operating paths of all tens relays.
- (c) Operate the test disconnect relays TSDA, B and tens check relays TCKL, 2, 3, 4 whose functions are described later.
- (d) Start the marker timing.
- (e) Close paths for operating the preference relays shown on FS3.

1.04 With the tens end and the one tens relay operated, the associated tens preference relay TP- (FS3) will operate. Any tens preference relay operated will operate the tens auxiliary connector relays TACA, B and TACAA, BA (FS4); the particular tens preference relay operated will operate the associated tens connector relays TCS-, THC-, TU- (FS4). If option VG is provided, relay TM- will also be operated directly from the particular tens preference relay. However, if option VH is provided, relay TU- in operating operates relay TM--.

1.05 Relays TACA, B and TACAA, BA operated:

- (a) Operate the line units connector relays LUCA, B and units lock relays ULA, B (FS5) to start units selection.

(b) Operate the register group relays RGA, B and RGAA, BA (FS10) to start link testing and selection.

1.06 Relays LUCA, B, in operating, also start the abandoned call timing. Relay THC-, in operating, will operate the select magnet connector relay SMC- (FS13) associated with the crossbar switch in which the calling line is located. Relays RGAA, BA will operate relays SMC0, 1 which are associated with switch 0 and 1 in which the registers appear.

Units Selection

1.07 With the associated relay TU- operated and relays LUCA, B operated, the units relay U- (FS5) corresponding to each operated relay L-- in the tens group will operate and lock to operated relays ULA, B. With relays TEAO, A1, A2, A3, B0, B1, B2, B3, and LUCA, B operated, the operation of a relay U- will operate the units end relays UEA, B (FS5). The operation of relays UEA, B will release relays LUC- stopping the abandoned call timing.

1.08 Operated relays U- and TM- connect the secondary winding of the associated sleeve relays S- (FS6) to lead S of the associated line circuit. The -48 volt battery through the winding of the line hold magnets LHM-- will operate the associated relay S-. In the case of a station in the 20 to 29 group, the -48 volt battery through the winding of relays IN-- will operate relay S--.

1.09 With relays UEA, B operated, the operation of relay S- will cause the sleeve end relays SEA, B and SEAA, BA (FS6) to operate to complete the units selection sequence.

Link Testing and Selection (Option 9) Mfr Disc.

1.10 Operation of relays RGA, B and RGAA, AB will cause the link test relays LTA, B and LTAA, BA (FS12) to operate. The link test relays operated:

- (a) Operate the link test connector relays LTCA, B (FS12).
- (b) Start the link shift timing, which controls the shift of the link testing from one group to the other.
- (c) Pulse the link group sequence and link sequence control circuits.
- (d) Prepare a locking path for the link test slave relays LTS2-9 (FS12)

(e) Connect a portion of the link testing circuit to relays LT2-9 (FS12).

(b) Operate the select magnet timing relays SMTA,B (FS13).

1.11 The state of the transfer link relays TRLA,B (FS12) will determine which of the two link groups will be tested first. Assuming relays TRLA,B operated, the operation of relays LTA,B and LTCA,B will connect a potential dividing network consisting of resistors LTA2-9 and LTB2-9 to the positive side of the secondary windings of relays LT2-9 and the negative side of the winding to the potential-dividing network consisting of links 12 to 19 and resistors L12-19. The potential at the positive side of the secondary windings of relays LT2-9 will then be approximately -7 volts.

(c) Operate select magnets SMO-9 on the appropriate switches.

1.17 If more than one link in the group tested is idle, the selection of the link that will be used is dependent upon the state of the link sequence control circuit and the position of the LTS2-9 relay contacts corresponding to the idle links in the group in the chain shown on FS13.

1.18 Assuming the link sequence control circuit in the state whereby relays WIL and ZL are operated and relay LTS2 is operated, the operation of relays LEAA,BA will cause select magnet 2 on switches 0 and 1 and the switch in which the calling line appears to operate.

1.12 If a link is in use, -48 volts through a 900-ohm hold magnet (or relay IN-- or the sleeve circuit of a trunk), ground through 100 ohms in the sleeve circuit of a trunk or junctor, and -48 volts through 1000-ohm resistor L12-19 will result in a potential of approximately -8 volts at the negative side of the secondary winding of a relay LT2-9. Thus, the net voltage across the winding is approximately 1 volt, which is not sufficient to operate the relay.

1.19 With a relay LTS2-9 and relays TRLA,B operated, the operation of relays LEA,B will operate select magnet 1 on switches 0 and 1 and the switch in which the calling line appears. Thus, idle link 12 has been selected for the call and the appropriate select magnets operated.

1.13 If a link is idle, only the -48 volts through 1000-ohm resistor L12-19 is connected to the negative side of the secondary winding of relays LT2-9, producing a net voltage across the winding of approximately 30 volts, which will operate the relay.

Link Testing and Selection (Option 22)

1.20 Operation of relays RGA,B and RGAA,AB will cause the link test relays LTA,B and LTAA,BA (FS28) to operate. The link test relays operated:

(a) Operates the link test connector relays LTCA,B (FS28).

1.14 Therefore, relays LT2-9 associated with idle links in the group being tested will operate but those associated with busy links will not. When relays LT2-9 operate, the corresponding relays LTS2-9 operate and lock.

(b) Starts the link shift timing, which controls the shift of the link testing from one group to the other.

1.15 Any relay LTS2-9 operated:

(c) Pulses the link group sequence and link sequence control circuits.

(a) Operates the link end relays LEA,B and LEAA,BA (FS12).

(b) Opens the operating path for the link busy relays LBA,B (FS12), thus halting the link shift timing.

(d) Connects a portion of the link testing circuit to link test relays LT2-9 (FS28).

(c) With relays TRLA,B operated, prepares a path for operating select magnet SM1 (FS13) on switches 0 and 1 and the switch in which the calling line appears.

(e) Prepares a locking path for relays LT2-9 (FS28).

1.16 Relays LEA,B and LEAA,BA operated:

(a) Release relays LTA,B.

1.21 The state of the transfer link relays TRLA,B (FS28) will determine which of the two link groups will be tested first. Assuming relays TRLA,B operated, the operation of relays LTA,B and LTCA,B will connect resistors LTA2-9 to relays LT2-9 and connect the sleeve of the links to the lower terminal of relays LT2-9.

1.22 If the link is in use, -48 volts through a 900-ohm hold magnet (or relay IN-- or the sleeve circuit of a trunk) will be connected to the sleeve of the link and will ground through 100 ohms in the sleeve circuit of a trunk or junctor. With this voltage divider network on the sleeve of the link, the -48 volts through resistors LTA2-9 will result in a net current of approximately 14 ma through the winding of the LT- relay associated with the busy link. A net current of 14 ma is not sufficient to operate the LT- relay.

1.23 If a link is idle, the sleeve of the link is open and only the -48 volts through the respective LTA- resistor will be connected to the winding of the LT- relay. This will produce a net current through the winding of approximately 37 ma which is sufficient to operate the LT- relay.

1.24 Therefore, relays LT2-9 associated with idle links in the group being tested will operate but those associated with busy links will not.

1.25 Any relay LT2-9 operated:

- (a) Operates the link end relays LEA,B and LEAA,BA (FS28).
- (b) Locks under control of the operated LEA,B and LTAA,BA relays.
- (c) Opens the operating path for the link busy relays LBA,B (FS28), thus halting the link shift timing.
- (d) Opens the operating path for the camp-on alarm relay COAL (FS21) which serves no useful purpose at this time.
- (e) With relays TRLA,B operated, prepares a path for operating select magnet SM1 (FS13) on switches 0 and 1 and the switch in which the calling line appears.

1.26 Relays LEA,B and LEAA,BA operated:

- (a) Applies ground to the operated LT2-9 relays.
- (b) Releases relays LTA,B.
- (c) Operates the select magnet timing relays SMTA,B (FS13).
- (d) Operates select magnets SMC-9 on the appropriate switches.

1.27 If more than one link in the group tested is idle, the selection of the link that will be used is dependent upon the state of the link sequence control circuit and the position of the LT2-9 relay contacts corresponding to the idle links in the group in the chain shown on FS13.

1.28 Assuming the link sequence control circuit in the state whereby relays WIL and ZL are operated and relay LT2 is operated, the operation of relays LEAA,BA will cause select magnet 2 on switches 0 and 1 and the switch in which the calling line appears to operate.

1.29 With a relay LT2-9 and relays TRLA,B operated, the operation of the LEA,B relay will operate select magnet 1 on switches 0 and 1 and the switch in which the calling line appears. Thus, idle link 12 has been selected for the call and the appropriate select magnets operated.

Register Selection

1.30 The register selected for the call is dependent upon the state of the register allotter relays RAOA,OB,1A,1B (FS10) which are preset at the start of any marker operation.

Hold Magnet Operation

1.31 The operation of relays SMTA,B will operate the select magnet register relays SMRA,B and SMRAA,BA (FS9), which provide a locking path for any operated S- relays. With relays SMTA,B and SMRAA,BA operated, ground from contacts of relays SMTA,B will operate the line hold magnet LHM-- of the calling station (or relay IN-- which, in turn, operates the line hold magnet) through the chain of relay SO-9 contacts in the line and trunk hunting circuit shown on FS6.

1.32 If more than one station in the tens group is requesting marker service, the one to be served is dependent upon the state of the relay ZU in the units sequence control circuit on FS6 and the position of the corresponding relay S- in the trunk and line hunting preference chain.

1.33 At the same time that the line hold magnet is being operated, a ground from the relays SMTA,B will operate the register hold magnets THM-8,-9 as shown on FS10.

1.34 When the hold magnets operate, the crosspoints close, and the selected link connects leads T, R, and S of the calling station line circuit to the allotted register. The switchhook bridge in the calling station telephone set will operate relays L and SR in the register circuit in that sequence.

1.35 Register relay SR, in operating, will connect a 100-ohm ground to the sleeve of the link to maintain the line hold magnet (or relay IN--) operated and a solid ground on the lead RHM-, to maintain the register hold magnets operated.

1.36 The line hold magnet, in operating, disconnects the calling station relay L-- from the tip and ring conductors by the operation of the off-normal contacts, thus releasing relay L--.

Hold Magnet Checks

1.37 The operation of relays SMTA,B will close the operating path of the hold magnet timing relays HMTAA,BA (FS9). The hold magnet timing relays operated:

(a) Remove the original operating ground for the hold magnets.

(b) Close the operating path for the hold magnet timing relays HMTA,B (FS9).

1.38 When relays HMTA,B operate, the hold magnet check relays HMKA,B (FS6) are connected to the line hold magnet or relay IN-- (over the path by which it originally operated), and the register hold magnet relays RHKA,B (FS10) are connected to the register hold magnets.

1.39 If the 100-ohm holding ground is present at the line hold magnet, relay HMKA,B will operate; if the solid holding ground is present at the register hold magnets, relays RHKA,B will operate.

Marker Release

1.40 The downcheck relays DCKA,B (FS15) in the marker are normally locked operated. The operation of relays HMKA,B and RHKA,B will open the locking paths, and relays DCKA,B will release. The release of relays DCKA,B will operate the release relays RLA,AA,AB,B,BA,BB (FS9).

1.41 Relays RLA,AA,AB,B,BA,BB operated:

(a) Release relays MTA,B, thus halting the marker timing.

(b) Open the operating paths for the relays in the tens preference chain on FS3, causing relays TCKL,2,3,4 and the TP- to release.

(c) Operate the tens auxiliary relay TA- (FS2) associated with the tens group just served, which, in turn, releases the corresponding relay T--.

(d) Release relays LEA,B and LEAA,BA which in turn, release any operated relays LTS- (option 9) and the operated select magnets.

(e) Release the relays SMTA,B which, in turn, release relays HMTA,B and HMTAA,BA and, in sequence, relays SMRA,B and SMRAA,BA, S-, and SEA,B and SEAA,BA.

1.42 The release of relay TP- causes relays TACA,B, TACAA,BA, RGA,B, RGAA,BA, TCS-, THC-, TU-, and TM- to release.

1.43 Diodes TRPO,1 and TP2-7 (option YM or VK) delay the release of the trunk and station preference relays. This insures the operation of alarm relay TRAL in the event that relay TA- or TRA- fails to operate on the completion of a dial tone connection. When relay TRAL operates, the operate path of the abandon call relays is opened. This prevents the failure of relay TA- or TRA- from causing the marker to recycle in the abandon call stage.

1.44 Relays TACA,B and TACAA,BA in releasing, cause relays ULA,B and UEA,B to release. The release of ULA,B, in turn, releases any operated relay U--.

1.45 Relay THC-, in releasing, releases the associated relay SMC-. The release of the relay TM- releases relays HMKA,B.

1.46 Relays RGA,B and RGAA,BA, in releasing, release relays SMCO,1, RHKA,B, and LTAA,BA. The relays LTAA,BA in releasing, advance the link group sequence and link sequence control circuits and release any operated relays LT2-9 (option 22).

1.47 When relays TCKL,2,3,4, HMKA,B, RHKA,B, and HMTA,B are all released, relays DCKA,B reoperate and lock. The operation of relays DCKA,B release RLA, AA,AB,B,BA,BB and the marker is ready to process another call.

1.48 If there are no other relays T-, TR-, or R- operated at this time, relays TEAO,A1,A2,A3,B0,B1,B2,B3 will also release, releasing all operated relays TA- and TRA- and restoring the marker to normal.

Originating Class of Service

1.49 A station line may have any one of three classes of service: toll-allowed,

toll-denied, or restricted. A toll-allowed station may dial-select central office and ringdown tie trunks and dial toll codes over central office trunks. A toll-denied station may dial-select central office and ringdown tie trunks but will be prevented from completing toll calls through the central office trunks. A restricted station cannot dial-select a central office or ringdown tie trunk; an attempt to do so will result in a completion to an attendant trunk.

1.50 A station is assigned a class of service by cross connection, as shown on FS11. To assign a toll-allowed class of service to a station, the corresponding terminal CS-- is strapped to terminal TLA. A toll-denied class of service is provided by strapping the terminal CS-- to the terminal TLD. A station is restricted when both of the straps are omitted.

1.51 The class of service of a station originating a dial tone connection is passed to the register, where the information is stored and used after dialing is completed. The class-of-service information is transferred to the register over leads TLA- and TLD-. When relays SEA,B operated at the completion of the units selection sequence, 48-volt battery through resistance lamp CS is connected through contacts of relays ZU, S-, and TCS- to terminal CS.

1.52 If the station is strapped for toll-allowed service, the battery on terminal CS will be connected through contacts of relays RGA,B and RAOA,OB,1A,1B to the lead TLA- to the appropriate register, where it will operate the corresponding class relays in the register. If the station is strapped for toll-denied service, the corresponding class relays in the register are operated over leads TLD- in a similar manner.

B. Code 8 Tie Trunk Dial Tone Connections (SC30)

1.53 A code 8 tie trunk is terminated on a universal line circuit in the 20 to 29 line group shown on FS26, with options ZD, ZF, and WQ provided.

1.54 A seizure of the trunk by the distant end will result in a bridge being connected across leads T1 and R1, which will operate the associated line relay L--. Relay L-- will operate the tens preference relay T2, and the marker will process the call in the same manner as for a station in the 20 to 29 group, except for a slight difference in the way originating class-of-service indications are handled.

1.55 A code 8 tie trunk may also be assigned one of three classes of service;

toll-allowed, toll-denied, or restricted. Referring to FS11, a tie trunk may be assigned to toll-allowed class of service by strapping the corresponding terminal CS2 to terminal TTLA. A toll-denied classification is provided by strapping terminal CS2 to terminal TTLD. A tie trunk is restricted when the terminal CS2- is strapped to terminal RTT.

1.56 When relays SEA,B operate, 48-volt battery through resistance lamp CS is connected through contacts of relays ZU, S-, and TCS2 to the terminal CS2- corresponding to the trunk being served. If the trunk is strapped for toll-allowed service, the battery on the terminal CS2- will be connected through the primary winding of relay TT and contacts of relays RGA,B and RA-A,-B to lead TLA- to the appropriate register.

1.57 Relay TT will operate in series with a class relay in the register and connect battery through contacts of relays RGA,B and RA-A,-B to lead RTT- to the register. The battery potential on leads TLA- and RTT- operates class memory relays in the register, indicating a calling toll-allowed tie trunk.

1.58 In a similar manner, a toll-denied tie trunk will cause a battery potential to be applied to leads TLD- and RTT-. A restricted tie trunk will cause battery potential to be applied to lead RTT- only.

1.59 When a tie trunk is arranged for pad control, options 19, 20, and 21 are provided for that trunk. The pad control circuit will be activated when relay IN-- operates as described for Universal Line Group 20-29 - two way tie trunk (Paragraph 17C).

C. Central Office or Ringdown Tie Trunk Dial Tone Connections (SC2)

General

1.60 To obtain a dial tone connection for a trunk, the attendant will operate the pickup key associated with the trunk and momentarily operate the common hold key of the console position or keyset. If the PEX is on remote trunk answer operation, a PBX station answering a trunk call through the auxiliary position circuit by dialing the remote trunk answer code is equivalent to the attendant operating a pickup key; a switchhook flash from the answering station is equivalent to the attendant momentarily operating the common hold key. These actions will cause a ground to be placed on leads TR- and U- corresponding to the trunk being used.

1.61 The trunks are divided into two groups of five each. Trunks 0 through 4 are associated with lead TR0, and trunks 5 through 9 with lead TR1, as shown on FS2. There is a direct correspondence between leads U- and the trunk equipment numbers, for example, trunk 0 is associated with units lead U0, as shown on FS5.

1.62 Ground on the lead TR- will operate the associated trunk tens relay TR- (FS2). Assuming no other requests for marker service, the operation of relay TR- will operate relays TEAO,A1,A2,A3,B0,B1,B2,B3. These relays operated:

- (a) Provide a locking path for the operated relay TR-.
- (b) Open the operating paths of all other tens relays.
- (c) Operate relays TSDA,B.
- (d) Start the marker timing.
- (e) Close paths in the preference relay chain on FS3, causing relays TCK1,2, 3,4 and the trunk preference relay TRP- to operate.

1.63 Relay TRP-, in operating, will operate relays TACA,B and TACAA,BA and the associated trunk tens connector relays TRM-, TRU-, and TRC- on FS4.

1.64 Relays TACA,B and TACAA,BA, in operating, will operate relays LUCA,B, ULA,B and RGA,B and RGAA,BA. Relays TRC- and TRU-, in operating, will operate relays SMCO and SMCS. Relays RGA,B and RGAA,BA, in operating, will operate the relay SMCL. Relays LUCA,B, in operating, will start the abandoned call timing.

Units Selection

1.65 With relays TRU- and LUCA,B operated, relay U- corresponding to the trunk requesting service will operate and lock to the operated relays ULA,B. It should be noted here that, since an attendant can steer inward on only one trunk at a time because of the interlocking action of the pickup keys, only one relay U- will operate. Relay U-, in operating, will operate relays UEA,B, which, in turn, will release relays LUCA,B and halt the abandoned call timing.

1.66 Operated relays U- and TRM- will connect the secondary winding of the corresponding relay S- to the corresponding trunk hold magnet THM-- (FS25) in parallel with the winding of the relay HM in the trunk (over lead ST--). The 48-volt battery through the trunk hold magnet relay HM in parallel will operate relay S- and cause relays SEA,B and SEAA,BA to operate, completing the units selection sequence.

Link Testing and Selection

1.67 The link testing and selection for a trunk dial tone connection is made in the same manner as for a station dial tone connection.

Register Selection

1.68 The register allotted for the call is dependent upon the state of relays RAOA,OB,1A,1B (FS10) that are present at the start of a marker operation.

Hold Magnet Operation

1.69 The operation of relays SMTA,B at the end of link testing and selection will operate relays SMRA,B and SMRAA,BA. These relays operated:

- (a) Provide a locking path for the operated relay S-.
- (b) Close the path for operating relay HM in the trunk and the trunk hold magnet from ground at the contacts of relays SMTA,B.

1.70 When the trunk hold magnet operates, the associated crosspoints close and connect leads T, R, and S of the trunk to one end of the selected link.

1.71 The operation of relays SMTA,B also operates the hold magnets associated with the register selected for this call. When the hold magnets operate, they close the register appearance crosspoints, thus connecting leads T, R, and S of the register to the other end of the selected link.

1.72 When the connection of the register to the trunk via a link is completed, an inductor in the attendant cordless position circuit, which is connected across leads T and R of the trunk, will operate relay L in the register. Relay L, in turn, operates relay SR in the register. Relay SR, in operating, connects a 100-ohm ground to the link sleeve, connects solid ground on lead RHM- to the marker, and operates register relay AC.

1.73 The register hold magnet is held operated by the ground on lead RHM, and the trunk hold magnet is held operated by off-normal ground in the trunk through a contact of the operated relay HM in the trunk. The 100-ohm ground on the link sleeve will operate relay SL in the trunk; relay SL serves no useful function at this time.

Hold Magnet Checks and Marker Release

1.74 The hold magnet checks are made and the marker releases in the same manner as for a station dial tone connection. In the description of the marker release, however, relay TRA- should be substituted for relay T-, relay TRP- for relay TP-, and relays TRM-, TRU-, and TRC- for relays TCS-, THC, TU-, and TM-.

Originating Class of Service

1.75 The originating class of service of a central office or ringdown tie trunk is fixed and is toll-allowed. This information if passed from the marker to the register over lead COT- shown on FS11.

1.76 When relays SEA,B operate at the completion of the units selection sequence, 48-volt battery through resistance lamp CS is connected to lead COT- to the register allotted for the call via contacts of relay ZU and the operated relays S-, TRC-, RGA,B and RA-A,-B. This battery will operate relay COT in the register, thereby marking the class-of-service registration.

Station Dial Transfer Trunk Circuit with Add-On Conference Dial Tone Connection

1.77 Operation of the switchhook of a station connected to an outside party through a central office trunk or connected to a station dial transfer trunk circuit with add-on conference will start the marker for the purpose of obtaining dial tone. The marker will process this call in the manner described for a central office dial tone connection. The camp-on action of the marker is disabled so that a camp-on connection cannot be made to a station which is busy.

D. Attendant Trunk Dial Tone Connection

1.78 An attendant may obtain a dial tone connection over an attendant trunk by operating the pickup key associated with an idle trunk. This action will cause a ground to be placed on leads TR- and U- corresponding to the trunk selected.

1.79 The three attendant trunks are distributed between the trunk tens preference groups, with trunks 1 and 2 associated with the relay TRO and trunk 0 with relay TR1. Therefore, a service request from trunks 1 or 2 will ground lead TRO and one from trunk 0 will ground lead TR1. The correspondence between lead U- and the trunk equipment numbers is as follows: Trunk 0 is associated with units lead U0 and trunks 1 and 2 are associated with leads U5 and U6, respectively.

1.80 The marker will process this call in essentially the same manner as a central office or ringdown trunk dial tone connection, except for the originating class of service indication. The attendant trunk has the same class of service as a restricted station; therefore, none of the class of service leads to the register are activated on this type of call.

E. Busy Verification Trunk Dial Tone Connection

1.81 The attendant may obtain dial tone over the busy verification trunk option YT by operating the DIAL BACK key after dial tone has been obtained over attendant trunk 2. This action will cause leads ITO7 and U0 from the attendant trunk to be transferred to the marker leads ST90 and U6 corresponding to central office trunk 0. The marker will process this call in the same manner as a central office dial tone connection. The camp-on stop action of the marker is disabled so that a connection may be made to a station which is busy and camped-on.

2. STATION-TO-STATION CALL TERMINATING CONNECTIONS (SC3)A. General

2.01 When a station completes dialing a station code into a register, the register will originate a request for marker service. The marker, in serving the register, will connect the calling station to the called station via an idle junctor. The same link used for the dial tone connection will be reused for connecting the calling station to the originating side of the junctor, and an idle link will be selected and used to connect the terminating side of the junctor to the called station. If the called station is busy, the marker will look for an idle station in the hunting group and connect to it instead. If the called station and all other stations in the hunting group (if any) are busy, the marker will connect the calling station to the busy tone trunk, using the same link that was used for the dial tone connection.

B. Register Requests Service

2.02 When a register has received all of the dialed digits, the dial completion relay DC in the register will operate, which, assuming no other requests for marker service, will operate the associated register relay R- (FS2). Relay R- in operating, will operate relays TEA0,A1,A2,A3, B0,B1,B2,B3. These relays operated:

- (a) Open the operating paths for the other register relay R- and the trunk tens relays TRO,1 and tens relays T2-7.
- (b) Operate relays TSDA,B.

- (c) Start the marker timing.
- (d) Close paths in the preference relay chain on FS3, causing relays TCK1, 2,3,4 and the register preference relay RP- to operate.

2.03 Relay RP-, in operating, operates the register preference auxiliary relay RPA- (FS4).

2.04 Relay RPA- operated:

- (a) Operates the register units connector relays RUCA,B (FS5).
- (b) Closes the path for operating the junctor terminating relays JTA,B (FS8) over leads JTA- and JTB- from the register.

2.05 The register will have connected battery to these leads after determining, from the originating class of service of the calling station and the dialed code, that a junctor class type of call completion is required. Relays JTA,B, in operating, operate relays JTAA,BA (FS8).

C. Junctor Testing and Selection

2.06 The six junctors are associated with relays U-. Junctors 0,1,2,3,4 and 5 are associated with units relays U0,U1,U2, U5,U6 and U7, respectively. The operation of relays JTA,B and JTAA,BA and RUCA,B operates relays U0,U1,U2,U5,U6 and U7, thus connecting the primary windings of the corresponding relays S- to hold magnets THM1, THM3, THM5, THM7, THM82, and THM84, respectively. The hold magnets are associated with the terminating side of the junctors. Relays S- corresponding to the idle junctors will operate from battery through the terminating hold magnets. If a junctor is in use, the ground in the busy junctor holding the hold magnet operated will prevent the corresponding relay S- from operating.

2.07 With relays UEA,B operated, any relay S-, in operating, will cause relays SEA,B and SEAA,BA to operate. These relays, in operating, release relays RUCA,B which, in turn, release all operated relays U-. Relays U-, in releasing, release relays UEA,B.

2.08 The idle junctor selected for use in this call is dependent upon the state of relay ZU in the units sequence control circuit. When relays SEA,B operate, battery through resistance lamp CS, contacts of relay ZU, contacts of the first operated relay S- in the units sequence chain on FS11, and contacts of operated relays JTA,B and released relays UEA,B will operate the junctor register relay JR- (FS7) corresponding to the junctor selected.

2.09 Relay JR- operated will:

- (a) Operate the junctor register end relays JREA,B (FS7).
- (b) Operate relay SMC1 or SMC8 (FS13), whichever corresponds to the switch in which the selected junctor is located.

2.10 The operated relays JREA,B will release relays JTA,B, which, in turn, release relays JTAA,BA and any of relays S1,S2,S6, and S7 that are operated. The release of relays JTAA,BA releases relays S0 and S5, if operated. The release of all relays S- releases relays SEA,B and SEAA,BA ending the junctor selection sequence.

2.11 The release of relays SEA,B and SEAA, BA at this time reoperates relays RUCA,B and operates the register cut-through relays RCTA,B and RCTAA,BA (FS8). The operation of relays RCTA,B and RCTAA,BA will initiate the link testing and selection, and operate the register connector relays RCA-,B-,C-,D-,E- (FS4). The operated relays RCA-,B-,C-,D-,E- and RUCA,B will initiate the called station selection and testing sequence.

D. Terminating Link Selection

2.12 The operation of relays JREA,B and RCTA,B will operate relays LTA,B and LTAA,BA and cause an idle link to be selected.

E. Called Station Selection and Testing

2.13 The operation of relays RCA-,B-,C-, D-,E-, will:

- (a) Connect leads T- from the appropriate register to the tens connector relays on FS4 and operate relays TCS-, THC-, and TU- corresponding to the tens digit of the called station number. If option VG is provided, relay TM- will also operate at this time. However, if option VH is provided, the operation of relay TU- will operate relay TM-.
- (b) Connect leads U- from the appropriate register to the units relays on FS5 and operate relay U- corresponding to the units digit of the called station number.

2.14 Relay THC-, in operating, will operate the relay SMC- corresponding to the switch in which the called station is located.

2.15 Relay U- operated will operate relays UEA,B. With relay U- and relay TM- both operated, the primary winding of the corresponding relay S- will be connected to the line hold magnet LHM of the called station. If the station is idle, battery through the line hold magnet (or relay IN--) will operate relay S-. If the station is busy, the 100-ohm ground maintaining the line hold magnet (or relay IN--) operated will prevent relay S- from operating.

2.16 Assuming the station idle and relay S- operated, relays SEA,B and SEAA,BA will reoperate and release relays RUCA,B, which, in turn, will release relays U-. Relay U-, in releasing, will release relays UEA,B.

F. Connection of Called Station to Junctor

2.17 By the time that relays LEA,B and LEAA,BA have operated at the completion of the link testing and selection sequence, the relays SMC- corresponding to the switches in which the called station and the selected junctor are located will have operated. The operation of relays LEA,B and LEAA,BA will:

- (a) Operate the select magnets in the involved switches corresponding to the selected link.
- (b) Operate relays SMTA,B.

2.18 Relays SMTA,B, in operating, will:

- (a) Operate relays SMRA,B and SMRAA,BA.
- (b) Close the path for operating the slow operate relays HMTAA,BA.
- (c) Operate the terminating hold magnet THM-- of the selected junctor through contacts of operated relay JR-.

2.19 When relays SMRAA,BA operate, ground from contacts of relays SMTA,B will operate the called station line hold magnet LHM-- (or relay IN--) through contacts of relays SEA,B, the operated relay S-, and relay TM-. Relays SMRA,B, in operating, furnish a locking path to keep relay S- operated over its secondary winding.

2.20 When the junctor terminating hold magnet and the called station line hold magnet (or relay IN--) operate, the crosspoints associated with the selected link close and the called station is connected to the terminating side of the junctor.

2.21 When relays HMTAA,BA operate:

- (a) The ground from relay SMTA,B contacts that operated the called station line hold magnet is removed and the

windings of relays HMKA,B connected in its place.

- (b) The operating paths of the slow operate relays HMTA,B are closed.

2.22 The ground from relays SMTA,B contacts that operated the junctor terminating hold magnet will maintain the called station link hold magnet operated via the link sleeve, and operate relays HMKA,B after the relays HMTA,B operate.

G. Connection of Calling Station to Junctor

2.23 The operation of relays HMKA,B with relays JREA,B and RCTA,B operated will operate the terminating route check relays TRKA,B and TRKAA,BA (FS8). These relays, in operating, will:

- (a) Lock to the operated relays SEA,B.
- (b) Release relays HMKA,B, SMTA,B, and HMTA,B and HMTAA,BA.

2.24 When relays HMKA,B and SMTA,B release with relays TRKA,B operated, the terminating route complete relays TRCA,B and TRCAA,BA (FS8) operate.

2.25 Relays SMTA,B, in releasing, also release the following relays in sequence: SMRA,B and SMRAA,BA, S-, and SEA,B and SEAA,BA.

2.26 Relays TRCA,B in operating:

- (a) Provide a ground for holding the junctor terminating and called line hold magnets when relays SMTA,B release.
- (b) Release relays RCTA,B and RCTAA,BA.
- (c) Operate the select magnets associated with the link used for the dial tone connection, through the closed crosspoints of the register memory vertical on the switch in which the selected junctor is located.

2.27 The select magnets in the called line switch may also operate at this time if the associated relay SMC- has not released.

2.28 The release of relays RCTA,B and RCTAA,BA release relays LTAA,BA, RCA-,B-,C-,D-,E-, and TRKA,B and TRKAA,BA.

2.29 The release of relays LTAA,BA:

- (a) Releases relays LEA,B and LEAA,BA and any operated relays LTS- (option 9) or LT- (option 22) causing the select magnets associated with the terminating link to release.
- (b) Advances the link sequence and link group sequence control circuits.

2.30 Relays RCA-,B-,C-,D-,E-, in releasing, release relays TCS-, THC-, TU-, and TM- associated with called station. Relay THC-, in releasing, will release the associated relay SMC-.

2.31 When relays TRKAA,BA release, relays SMTA,B will reoperate, which:

- (a) Operate the originating hold magnet of the selected junctor.
- (b) Close the operating path for the slow operate relays HMTAA,BA.

2.32 When the originating hold magnet of the selected junctor operates, the crosspoints associated with its vertical and the link used for the calling station dial tone connection operate, connecting relay A of the junctor in parallel with the calling station telephone set and the tip and ring circuit of the register. Relay A in the junctor operates, which, in turn, operates relay B in the junctor.

2.33 Relay B in the junctor, in operating, will provide:

- (a) A 100-ohm ground on the originating link sleeve to continue to hold the calling station line hold magnet operated after the register subsequently releases.
- (b) A ground to hold the junctor originating hold magnet operated.
- (c) A 100-ohm ground on the terminating link sleeve to continue to hold the called station line hold magnet operated when the marker releases.
- (d) A ground to hold the junctor terminating hold magnet operated when the marker releases.

2.34 When relays HMTAA,BA operate, they will:

- (a) Remove the original operating ground for the junctor originating hold magnet.
- (b) Close the operating path for the slow operating relays HMTA,B.

2.35 When relays HMTA,B operate, relays HMKA,B are connected to the junctor originating hold magnet through contacts of the operated relays TRCAA,BA, JR- and HMTA,B and the released relays SOA,B and TRCA,B. If relay B in the junctor has operated and is furnishing the ground for holding its originating hold magnet operated, relays HMKA,B will operate.

H. Marker and Register Release

2.36 The operation of relays HMKA,B at this point in the call sequence will release relays DCKA,B, which, in turn, will operate relays RLA,AA,AB,B,BA,BB.

2.37 Relays RLA,AA,AB,B,BA,BB, in operating:

- (a) Release relays MTA,B, thus halting the marker timing.
- (b) Open the operate paths for the relays in the tens preference chain on FS3, causing relays TCK1,2,3,4 and RP- to release.
- (c) Release relays SMTA,B, which, in turn, release relays HMTA,B and HMTAA,BA.
- (d) Operate the register release relays RRLA,B in the register circuit.

2.38 Relay RP-, in releasing, releases relay RPA-, relay JR-, and the select magnets associated with the originating link on the switch in which the junctor used appears. Relay RPA- releases relays TRCA,B and TRCAA,BA and release of relay JR- releases relays JREA,B and HMKA,B and relay SMC- associated with the switch in which the junctor used appears.

2.39 Relays RRLA,B in the register, in operating:

- (a) Lock to relay ON in the register.
- (b) Release relay DC in the register

2.40 Relay DC releases relay L which releases relay SR in the register. Relay SR, when released, releases relay ON in the register and register hold magnets THM-8,-9 in the marker. When relay ON and hold magnet THM-9 release, relays RRLA,B release, restoring the register to normal.

2.41 Relay DC in the register, in releasing, releases the relay R- in the marker. If there are no other calls for the marker to serve, relay R- will cause relays TEAO, A1,A2,A3,BO,B1,B2,B3 to release, releasing relays TSDA,B.

2.42 When relays HMTA,B, TCK1,2,3,4, TRCA,B, and HMKA,B are all released, relays DCKA,B will reoperate and release relays RLA,AA,AB,B,BA,BB, restoring the marker to normal.

2.43 With relay ON in the register released, the associated relays RA-A, -B in the marker will have reoperated if the register allotter circuit was in a certain state.

I. Called Station Busy - Station in Hunting Group Idle (SC8)

- 2.44 If, during the called station line testing sequence, relay S- corresponding to the called station does not operate, the ground applied to relay SO-9 contact chain on FS6 will pass through the break contacts of all of relays SO-9 to operate the busy test relays BYA,B (FS6).
- 2.45 Relays BYA,B, in operating, lock to the operated relays RCTA,B and operate the hunt connector relays HCA,B (FS6). Relays HCA,B, in operating, close the operating path for the slow operate circuits busy relays BSYAA,BA (FS6) and extend the ground on lead U- from the register corresponding to the called station units digit to terminal H associated with the called station shown on FS1 or FS26. This ground will be extended through the hunting group straps (option X) or any properly poled diodes H (option W or ZR) to terminals H associated with stations in the same hunting group, and operate relays U- corresponding to those stations.
- 2.46 Relays U-, in operating will connect the primary windings of the corresponding relays S- to the line hold magnets (or relays IN--) of these stations. Battery through the line hold magnets (or relays IN--) of the idle stations will operate the associated relays S-.
- 2.47 The operation of any relay S- will:
- (a) Open the operating ground for relays BSYAA,BA.
 - (b) Operate relays SEA,B and SEAA,BA.
- 2.48 The operation of relays SEA,B and SEAA,BA will permit the operated relays SMTA,B to operate relays HMTAA,BA and SMRA,B and SMRAA,BA.
- 2.49 The calling station will be connected to the idle station in the hunting group corresponding to the first operated relay S- (relative to the state of relay ZU) in the line hunting chain of relay S- contacts on FS6.
- 2.50 Relays BTA,B will release when relays RCTA,B release. If relays BSYAA,BA have operated, they will also release at this time.

J. Called Station and Stations in Hunting Group Also Busy - Busy Tone Trunk Idle (SC7)

- 2.51 If the called station is found to be busy, relays BYA,B and HCA,B will operate. If there are no stations in the hunting group idle (or the called station is not part of a hunting group), no relays S- will operate, and the slow operate relays BSYAA,BA will operate from relays

SMTA,B ground on the line hunting relay S- contact chain on FS6. Relays BSYAA,BA in operating, will close the operating path for the slow operate relays BSYA,B.

- 2.52 When relays BSYA,B operate:
- (a) Relays HCA,B release, which, in turn, release relays U- associated with the station in the hunting group (if any).
 - (b) The sleeve operate relays SOA,B (FS9) operate.
- 2.53 With relays SOA,B and relay U- associated with the called station operated, relay S- corresponding to the called station will operate over its secondary winding causing relays SEA,B and SEAA,BA to operate.
- 2.54 Relays SEA,B and SEAA,BA, in operating:
- (a) Operate relays SMRA,B and SMRAA,BA.
 - (b) Release relays RUCA,B which cause the operated relays U- and UEA,B to release in sequence.
- 2.55 With relays SMRAA,BA and SOA,B and the relay S- corresponding to the called station operated, a path is completed between the line hold magnet (or relay IN--) of the called station and relays HMKA,B. The 100-ohm ground maintaining the called station line hold magnet (or relay IN--) operated will then operate relays HMKA,B which in turn will operate relays TRKA,B and TRKAA,BA.
- 2.56 With relays HMKA,B, SOA,B, SMRAA,BA, and SEAA,BA operated, relays BTTA,B (FS9) will operate, which, in turn, will:
- (a) Release the operated relay JR- and relays SOA,B which, in turn, cause relays HMKA,B to release.
 - (b) Lock to the operated relay RPA- (option A) or relay RP- (option B).
- 2.57 Relay JR-, in releasing, will:
- (a) Release relays JREA,B.
 - (b) Release the associated relay SMC- which, in turn, release the select magnets on the junctor switches corresponding to the selected terminating link.
- 2.58 Relays JREA,B, in releasing will:
- (a) Release relays LTAA,BA and LEA,B and LEAA,BA and the operated relay LTS- (option 9) or LT- (Option 22).
 - (b) Release relays RCTA,B and RCTAA,BA.
- 2.59 Relays RCTA,B and RCTAA,BA in releasing will:

- (a) Release relays RCA-, B-, C-, D-, E- which, in turn, release relays TCS-, THC-, TU-, TM- associated with the called station. Relay THC-, in releasing, releases the associated relay SMC-.
- (b) Release relays BYA, B, BSYA, B, and BSYAA,BA if option ZM is used or, if option ZL is used, release relays BYA,B which, in turn, release relays BSYA,B and BSYAA,BA.
- 2.60 The release of relays LTAA,BA will advance the link group sequence and the link sequence control circuits. The release of relays LEAA,BA, or relay LT- (opt. 22) or relay LTS- (option 9), will release the select magnets corresponding to the selected terminating link on the switch in which the called station line appears.
- 2.61 The operation of relays TRKAA,BA starts the slow release of relays SMTA,B which, in turn, release relays SMRA,B and SMRAA,BA, S-, and SEA,B and SEAA,BA in that sequence. The release of relays SEA,B will reoperate relays RUCA,B.
- 2.62 When relays SMTA,B and relays HMKA,B release, a path is closed through contacts of the operated relays TRKA,B for operating relays TRCA,B and TRCAA,BA. The relays in operating, will:
- (a) Lock operated under control of relays BTTA,B and RPA-.
- (b) In conjunction with relays SEA,B releases, release relays TRKA,B and TRKAA,BA.
- 2.63 With relays BTTA,B and TRCA,B operated and relays TRKAA and TRKB released (and if option WZ is provided - relays BYA,B released), the busy tone trunk connector relays BTCA,B (FS9) will operate. Relays BTCA,B, in operating, will:
- (a) In conjunction with the operated relays RUCA,B, operate relay UO, which, in turn, operates relays UEA,B.
- (b) Operate relay SMCO.
- (c) Release the time-out lock relays TOLA,B (FS16), to prepare the time-out checking circuit.
- (d) With relay UO operated, close a path between relay SO primary winding and the busy tone trunk hold magnet.
- 2.64 If the busy tone trunk is idle, the battery through the busy tone trunk hold magnet THMO7 (FS25) will operate the relay SO over its primary winding. Relay SO, in operating, will operate relays SEA,B and SEAA,BA.
- 2.65 Relay SMCO, in operating, will:
- (a) Operate relays SMTA,B.
- (b) Operate the select magnets on switch O corresponding to the link used for the dial tone connection from ground at the contacts of the operated relays TRCAA,BA through contacts of the released relays COA,B, operated relay RP-, and the crosspoints of the register memory hold magnet THM-9.
- 2.66 Relays SEA,B and SEAA,BA, in operating, will:
- (a) With relays SMTA,B operated, close paths for operating the slow operate relays HMTAA,BA and relays SMRA,B and SMRAA,BA.
- (b) Release relays RUCA,B, which release relays UO and UEA,B in that sequence.
- 2.67 At this point in the call, ground from contacts of the operated relays SMTA,B passing through contacts of the released relays HMTA,B, TRKA,B, and SOA,B; the operated relays SEA,B, SO, SMRAA,BA, and BTCA,B and relay ZU either operated or released will operate the busy tone trunk hold magnet THMO7. The hold magnet, in operating, will close the crosspoints in the vertical associated with the operated select magnets, thereby connecting leads T, R, and S of the busy tone trunk to the calling station line circuit in parallel with the register, via the link used in the dial tone connection.
- 2.68 The bridge on leads T and R will operate relay A in the busy tone trunk, which will:
- (a) Apply a 100-ohm ground on the link sleeve for holding the calling station line hold magnet (or relay IN--) operated after the register releases.
- (b) Connect ground to the busy tone trunk hold magnet to keep it operated after the marker removes the operating ground.
- 2.69 When relays HMTAA,BA operate, the operating path for the slow operate relays HMTA,B is closed, and the operating ground for the busy tone trunk hold magnet is removed. When the relays HMTA,B eventually operate, relays HMKA,B eventually operate, relays HMKA,B are connected to the busy tone trunk hold magnet to check for the presence of the holding ground. Assuming the holding ground present, it will operate relays HMKA,B, which, in turn, will release relays DCKA,B. Relays DCKA,B,

in releasing, will operate relays RLA,AA, AB,B,BA,BB, which release the marker.

2.70 Relays RLA,AA,AB,B,BA,BB in operating will:

- (a) Release relays MTA,B, thus halting the marker timing.
- (b) Open the operate paths for the relays in the tens preference chain on FS3, causing relays TCK1,2,3,4 and RP- to release.
- (c) Release relays SMTA,B.
- (d) Operate relays RRLA,B in the register circuit.

2.71 The release of relay RP- releases relay RPA- and the operated select magnets on switch O. Relay RPA-, in releasing, releases the relays BTTA,B, which, in turn, release relays BTCA,B and TRCA,B and TRCAA,BA. Relays BTCA,B, in releasing, releases relay SMC0.

2.72 Relays SMTA,B, in releasing, release relays HMTA,B and HMTAA,BA and relays SMRA,B and SMRAA,BA, which, in turn, release relay SO. With the release of relay SO, relay SEA,B, SEAA,BA and relays HMKA,B will release.

2.73 The operation of relays RRLA,B in the register causes the same release sequence to occur as described previously.

2.74 When relays TCK1,2,3,4, TRCA,B, HMTA,B, and HMKA,B release, relays DCKA,B will reoperate. Relays DCKA,B, in turn, release relays RLA,AA,AB,B,BA,BB, restoring the marker to normal.

3. STATION TO CENTRAL OFFICE OR RINGDOWN TIE TRUNK CALL TERMINATIONS (SC4)

A. General

3.01 When a nonrestricted station completes dialing a central office or ringdown tie trunk code into a register, the register will originate a request for marker service. The marker, in serving the register, will select an idle trunk and connect the calling station to the trunk, using the same link that was used for the dial tone connection. If all trunks are busy, the calling station will be connected to the busy tone trunk.

3.02 If a restricted station dials a central office or ringdown tie trunk code, the register will convert the dialed information to a zero code, and the marker will connect the calling station to an attendant trunk.

B. Register Requests Service

3.03 When the register has received all of the necessary digits for the call, relay DC in the register will operate. When the marker is ready to serve the request, relays R-, TEAO,A1,A2,A3,B0,B1,B2, B3,MTA,B, TSDA,B, TCK1,2,3,4,RP-, and RPA- will operate.

3.04 Relay RPA-, in operating, will:

- (a) Operate relays RUCA,B.
- (b) Close a path for operating relays RCTA,B and RCTAA,BA over leads RCTA,B from the register.

3.05 The register will have connected battery to these leads after determining from the dialed code that the call will be completed to a trunk and, therefore, will not require a junctor.

3.06 Relays RCTA,B, in operating, will operate relays RCA-,B-,C-,D-,E-, which connect the tens and units leads from the involved register to the marker.

3.07 Relays TEA3,B3, in operating, will connect ground to leads RLS0,1 to the trunks.

C. Trunk Testing

3.08 If the register is arranged for one-digit code 9 operation, leads T9, U1, and U4 will be grounded and all of the central office trunk hunt terminals H90 through H99 shown on FS5 will be strapped together. If the PBX is equipped with ringdown tie trunks or if the central office trunks have been arranged into more than one group, the register will be arranged for 2-digit code 9 operation and all of the terminals H-- associated with each group will be strapped together.

3.09 When relays RCA-,B-,C-,D-,E- operate, the ground on lead T9 from the register will operate the trunk connector relays TK9,A9,B9. The grounds on the leads U- will operate relays U- associated with the trunks in the group either directly or through the strapping of terminals H--. Any relay U-, in operating, will operate relays UEA,B.

3.10 With relays U- and TK9 operated, the primary winding of the corresponding relays S- will be connected to leads IT-- to the trunk circuit. It should be noted that the trunks are associated in reverse order with respect to relays S-; for example, lead IT99 to trunk 9 is associated with relays SO and UO. A busy trunk will have ground on its lead IT--; thus, the associated relay S- will not operate. Relay S- associated with an idle trunk, however, will operate from battery through the 400-ohm relay MC in the trunk.

3.11 Any relay S-, in operating, will operate relays SEA,B and SEAA,BA which:

- (a) Release relays RUCA,B.
- (b) Prepare paths for operating relays SMRA,B and SMRAA,BA and HMTAA,BA later in the sequence.

3.12 Relays RUCA,B, in releasing, release the operated relays U-, which, in turn, release relays UEA,B.

3.13 Relay TK9, in operating will operate relays SMCO,8, which:

- (a) Cause the select magnets corresponding to the link used for the dial tone connection on switches 0 and 8 to operate from a ground (FS10) through contacts of the released relays JREA,B and COA,B, the operated relays RCTA,B and RP-, and the crosspoints of the register memory vertical THM-9.

- (b) Operate relays SMTA,B.

D. Trunk Selection and Hold Magnet Operation

3.14 With relays SEA,B operated, the operation of relays SMTA,B will:

- (a) Close the operating circuit for relays HMTAA,BA.
- (b) Operate relays SMRA,B and SMRAA,BA.

3.15 When relays SMRAA,BA operate, ground from contacts of relays SMTA,B passing through contacts of the released relays HMTA,B, SOA,B, and TRKA,B, the operated relays SEA,B, relay ZU, and the first operated relay S- in the S- contact chain on FS6, the operated relays SMRAA,BA and TK9 will operate relay MC in the selected trunk.

3.16 Relay MC in the trunk, in operating, will:

- (a) Cause the trunk hold magnet THM-- in the marker and relay HM in the trunk to operate from ground on lead M- from the marker to the trunk.
- (b) Lock operated to the lead RLS- from the marker to the trunk.

3.17 Hold magnet THM--, in operating, closes the crosspoints in the trunk vertical associated with the operated select magnets and connects leads T, R, and S of the trunk to the calling station line circuit in parallel with the register via a link. The bridge on leads T and R will cause a central office trunk to cut through to the central office and ringdown tie trunk to initiate a timed ring to the distant PBX. The trunk furnishes a 100-ohm ground on the link sleeve to keep the calling station line hold magnet (or relay IN--) operated after the register is released from the connection.

E. Hold Magnet Check and Marker and Register Release

3.18 When relays HMTAA,BA operate, the operating path for the slow operate relays HMTA,B is closed and the operating ground for relay MC in the trunk is removed. When relays HMTA,B operate, relays HMKA,B are connected to lead IT-- of the selected trunk.

3.19 If the central office trunk has cut through to the central office and the supervisory relays in the trunk have operated or, in the case of ringdown tie trunk, only the supervisory relays in the trunk have operated, a ground will be present on the lead IT--. This ground will operate relays HMKA,B. Relays HMKA,B, in operating, will release relays DCKA,B, which, in turn, will operate relays RLA, AA,AB,B,BA,BB.

3.20 Relays RLA,AA,AB,B,BA,BB in operating:

- (a) Release relays MTA,B, thus halting the marker timing.
- (b) Open the operate paths for the relays in the tens preference chain on FS3, causing relays TCK1,2,3,4 and RP- to release.
- (c) Release relays SMTA,B, which, in turn, release relays HMTA,B and HMTAA,BA and SMRA,B and SMRAA,BA.
- (d) Operate relays RRLA,B in the register circuit.
- (e) Remove the ground on lead RLS- to the trunk circuit, thereby releasing relay MC in the trunk.

3.21 The release of relay RP-:

- (a) Releases relay RPA-, which, in turn, releases relays RCTA,B and RCTAA,BA.
- (b) Releases relays RCA-, B-,C-,D-,E-, which in turn, release relays TK9, A9, B9.
- (c) Releases the operated select magnets.

3.22 Relays TK9,A9,B9, in releasing, release the relays SMCO and SMC8 and open the operating path for relays HMKA,B releasing them.

3.23 Relays SMRA,B and SMRAA,BA, in releasing, release all operated relays S-, which, in turn, release relays SEA,B and SEAA,BA.

3.24 Relays RRLA,B in the register, in operating:

- (a) Lock to relay ON in the register.
- (b) Release relay DC in the register.

3.25 Relay DC releases relay I which releases relay SR in the register. Relay SR, when released, releases relay ON in the register and register hold magnets THM-8, -9 in the marker. When relay ON and hold magnet THM-9 release, relays RRLA,B release, restoring the register to normal.

3.26 When relays HMTA,B, TCK1,2,3,4 and HMKA,B are all released, relays DCKA,B will release, causing relays RLA, AA,AB,B,BA,BB to reoperate.

3.27 Relay DC in the register, in releasing, will release relay R- in the marker. If there are no other calls to be processed by the marker, the release or relay R- will release relays TEAO,A1,A2,A3,B0,B1,B2,B3 which, in turn, release relays TSDA,B, restoring the marker to normal.

3.28 When relay ON in the register releases, the associated relays RA-A,-B in the marker will reoperate under the conditions describing the register allotter circuit.

F. All Trunks Busy - Busy Tone Trunk Idle

3.29 If all trunks in the group are busy, no relays S- will operate when the trunks are tested. The ground from the contacts of relays SMTA,B will pass through the break contacts of the released relay S- trunk hunting contact chain shown on FS6 and operate relays BYA,B, which will cause relays HCA,B, BSYAA,BA, and BSYA,B to operate in sequence.

3.30 When relays BSYA,B operate:

- (a) Relays SOA,B will operate, which will, in turn, cause all of relays S- corresponding to the trunks in the group (as determined by operated relays U-) to operate.
- (b) Relays HCA,B release.

3.31 Relays S-, in operating, operate relays SEA,B and SEAA,BA, which:

- (a) Operate relays SMRA,B and SMRAA,BA.

(b) Release relays RUCA,B, which, in turn, release the operated relays U- and UEA,B in sequence.

3.32 When relays SMRAA,BA operate, ground on leads IT-- of the busy trunks will operate relays HMKA,B, which, with relays SOA,B,SMRAA,BA and SEA,B operated, will cause relays BTTA,B, to operate.

3.33 Relays BTTA,B, in operating, will:

- (a) Operate relays TRKA,B and TRKAA,BA.
- (b) Release relays SOA,B.

3.34 Relays TRKAA,BA, in operating at this time, will release relays SMTA,B. Relays SOA,B, in releasing, will release relays HMKA,B and operated relays S-. Relays S-, in releasing, will release relays SEA,B and SEAA,BA, which, in turn, will cause relays RUCA,B to operate.

3.35 With relays SMTA,B and HMKA,B released and relays TRKA,B operated, relays TRCA,B and TRCAA,BA will operate causing relays TRKA,B and TRKAA,BA and RCTA,B and TCTAA,BA to release

3.36 Relays RCTA,B and RCTAA,BA, in releasing, will:

- (a) Release relays BYA,B, BSYA,B, BSYAA,BA directly if option ZM is wired, or release relays BYA,B, which, in turn, will release relays BSYA,B and BSYAA,BA if ZL option is wired.

- (b) Release relays RCA-, B-,C-,D-,E-.

3.37 Relays RCA-,B-,C-,D-,E-, in releasing, will release relays TK9,A9,B9, which, in turn, release relays SMCO and SMC8.

3.38 With relays TRCA,B and BTTA,B, operated and relays TRKA,B and TRKAA,BA released, relays BTCA,B will operate and the marker will connect the busy tone trunk to the calling station.

4. CENTRAL OFFICE OR RINGDOWN TIE TRUNK TO STATION CALL TERMINATION SC5)

A. General

4.01 The marker, in completing a call from a code 9 trunk to a station, will make a busy test of the called station and, if the station is idle, complete the connection to the station via the link used for the dial tone connection. If the called station is busy, the marker will look for an idle station in the same hunting group and connect to that station.

4.02 If the called station and all other stations in the same hunting group are busy, the marker will test to determine whether another code 9 trunk is camped on the called station and, if not, will camp the trunk on the busy called station, using the link connected to the busy station. If another trunk is already camped on to the busy station, the marker will pass appropriate indications back to the calling trunk and release the register.

B. Register Requests Service

4.03 When dialing is completed, relay DC in the register will operate and, in turn, release register relay AC. When the marker is ready to admit the request for service, relays R-, TEAO, A1, A2, A3, B0, B1, B2, B3, MTA, B, TSDA, B, TCK1, 2, 3, 4, RP-, and RPA- will operate.

4.04 Relay RPA-, in operating, will:

- (a) Operate relays RUCA, B.
- (b) Close a path for operating relays RCTA, B and RCTAA, BA over leads RCTA, B from the register.
- (c) Close a path for operating the central office trunk relays COTA, B (FS9) over leads CTA-, B- from the register.

4.05 Relays RCTA, B and RCTAA, BA, in operating, operate relays RCA-, B-, C-, D-, E-, which, in turn:

- (a) Connect the tens leads from the register to operate relays TCS-, THC-, and TU- corresponding to the tens digit of the called station number. If option VG is provided, relay TM- will also operate at this time. However, if option VH is provided, the operation of relay TU- will operate relay TM-.
- (b) With relays RUCA, B operated, connect the units leads from the register to operate relays U- corresponding to the units digit of the called station number, which, in turn, operate relays UEA, B.
- (c) Operate relay RV in the register, which, in turn, causes relays P and MC in the trunk to operate in sequence.

4.06 Relay MC in the trunk, in operating:

- (a) Locks operated to leads RLS- from the marker.
- (b) Connects the trunk to the common leads M, RS, BY, FF, TT, TLA, and NT from the marker.
- (c) Releases trunk relay P.

C. Called Station Testing and Select Magnet Operation

4.07 The operation of relays TM- and U-

provides a path between the hold magnet associated with the called station and the primary winding of relay S- corresponding to the called station units digit. If the station is idle, the battery through the line hold magnet will operate relay S-, which, in turn, will operate relays SEA, B and SEAA, BA.

4.08 Relays SEA, B and SEAA, BA, in operating will:

- (a) Release relays RUCA, B, which, in turn, will release relays U- and UEA, B in sequence.
- (b) Prepare paths for operating relays HMTAA, BA and SMRA, B and SMRAA, BA.

4.09 Relay THC-, in operating, will operate relay SMC- corresponding to the switch in which the called station line is located. Relay SMC-, in operating, will:

- (a) Operate relays SMTA, B.
- (b) Cause the select magnets corresponding to the link used for the dial tone connection on the switch corresponding to the operated relay SMC- to operate from a ground through contacts of the released relays JREA, B and COA, B, the operated relays RCTA, B and RP-, and the crosspoints of the register memory vertical THM-9.

D. Hold Magnet Operation

4.10 The operation of relays SMTA, B and SEA, B will:

- (a) Close the operating path for the slow operate relays HMTAA, BA.
- (b) Operate relays SMRA, B and SMRAA, BA, which will extend ground from contacts of relays SMTA, B through contacts of the released relays HMTA, B, SOA, B, TRKA, B and ZU, and operated relays S- and TM- to operate the line hold magnet LHM-- (or a relay IN-- which, in turn, operates the line hold magnet) associated with the called station.

4.11 The operation of the hold magnet connects leads T, R, and S of the line circuit to the trunk in parallel with the register, via the link used in the dial tone connection.

4.12 When relay HMTAA, BA operates:

- (a) The operating paths for the slow operate relays HMTA, B are closed.
- (b) Relay RV in the register is released.

(c) The original operating path for the called station line hold magnet (or relay IN--) is opened.

(d) Ground is connected to leads RS- to the trunk, causing relay RS in the trunk to operate and lock to the trunk off-normal ground.

4.13 Relay RS in the trunk, in operating, causes relay HD in the trunk to release, changing the link sleeve at the trunk end from 945-ohm battery to a 100-ohm ground. The 100-ohm ground on the trunk sleeve will maintain the called station line hold magnet (or relay IN--) operated when the register is eventually released from the connection. The trunk hold magnet THM--will be maintained operated by off-normal ground in the trunk.

E. Hold Magnet Check and Marker and Register Release

4.14 When relays HMTA,B operate, relays HMKA,B are connected to the line hold magnet of the called station, and the link sleeve ground present at the point will operate them. Relays HMKA,B, in operating, will release relays DCKA,B, which, in turn, will operate relays RLA,AA,AB,B, BA,BB.

4.15 Relays RLA,AA,AB,B,BA,BB, in operating:

(a) Release relays MTA,B, halting the marker timing.

(b) Open the operate paths for the relays in the tens preference chain on FS3, causing relays TCK1,2,3,4 and RP- to release.

(c) Release relays SMTA,B, which, in turn, release relays HMTA,B and HMTAA,BA and SMRA,B and SMRAA,BA.

(d) Operate relays RRLA,B in the register circuit.

(e) Remove the grounds on leads RLS- to the trunk, thereby releasing relay MC in the trunk.

4.16 The release of relay RP-:

(a) Releases relay RPA-, which, in turn, releases relays COTA,B and RCTA,B and RCTAA,BA.

(b) Releases relays RCA-,B-,C-,D-,E-, which in turn, cause relays TCS-, THC-, TU, and TM- to release.

(c) Releases the operated select magnets.

4.17 Relay THC-, in releasing, releases the associated relay SMC-; relay TM-, in releasing, will release relays HMKA,B.

4.18 Relays SMRA,B, in releasing, will release the operated relay S-, which, in turn, will release relays SEA,B and SEAA,BA.

4.19 Relays RRLA,B in the register, in operating, cause the register to restore to normal and relays R-, TEAO,A1, A2,A3,BO,B1,B2,B3, and TSDA,B in the marker to release.

4.20 When relays HMTA,B, TCK1,2,3,4, and HMKA,B are all released, the DCKA,B relays will reoperate, releasing relays RLA,AA,AB,B,BA,BB, to restore the marker to normal.

F. Called Station Busy - Station in Hunting Group Idle

4.21 If the called station is busy, the corresponding relay S- will not operate when the line test is made. When relays SMTA,B operate, the grounds from its contacts will pass through the break contacts of relay SO-9 contact chain on FS6 and operate relays BYA,B.

4.22 Relays BYA,B, in operating, lock to the operated relays RCTA,B and operate relays HCA,B, which:

(a) Close the operating path for the slow operate relays BSYAA,BA.

(b) Extend the ground on the lead U- from the register corresponding to the called station units digit to terminal H associated with the called station.

4.23 This ground will be extended through the hunting group straps (option X) or any properly poled diode H (option W or ZR) to terminals H associated with stations in the same hunting group and will operate relays U- corresponding to those stations. Relays U-, in operating, will connect the primary windings of the corresponding relays S- to the line hold magnets (or relays IN--) of these stations. If any of these stations are idle, the corresponding relays S- will operate.

4.24 Any relay S-, in operating, will:

(a) Open the operating ground for relays BSYAA,BA.

(b) Operate relays SEA,B and SEAA,BA.

4.25 Once relays SEA,B and SEAA,BA operate, the marker will continue in the sequence described previously and connect the trunk to an idle station in the hunting group. Relays BYA,B and HCA,B will release when relays RCTA,B release at the end of the marker operation.

G. Camp-On - Called Station and All Other Stations in Hunting Group Busy - No Other Trunk Camped On Called Station (SC9)

4.26 The marker, finding the called station busy, will look for an idle station in the hunting group. Since there are no idle stations in the hunting group (or the called station is not part of a hunting group), no relays S- will operate after relays HCA,B operate. The slow operating relays BSYAA,BA and BSYA,B will eventually operate in sequence.

4.27 The operation of relay BSYA,B will operate relays SOA,B and release relays HCA,B. Relays HCA,B, in turn, release relays U- associated with the stations in the hunting group other than the called station. Relays SOA,B, in operating, operate relay S- corresponding to the called station over its secondary winding, through contacts of the operated relay U- corresponding to the called station.

4.28 Relay S-, in operating, operates relays SEA,B and SEAA,BA which, in turn, will:

- (a) Operate relays SMRA,B and SMRAA,BA.
- (b) Release relays RUCA,B, which, in turn, cause the operated relay U- and relays UEA,B to release in sequence.

4.29 With relays SMRAA,BA and relays S-operated, relays HMKA,B are connected to the called station line hold magnet through contacts of the operated relays SOA,B, SEA,B, TM- and ZU. The 100-ohm ground holding the called station line hold magnet will operate relays HMKA,B.

4.30 With relays SOA,B, SEAA,BA, HMKA,B, SMRAA,BA, and COTA,B operated, the camp-on relays COA,B and COAA,BA and CONA,B and CONAA,BA (FS9) will operate.

4.31 Relays COA,B and COAA,BA, in operating:

- (a) Lock operated to the operated relays RP- and released relay STAR,BR (option B) or the operated relay RPA- (option A) under control of relays COTA,B.
- (b) Operate relays SMCO and SMC8.
- (c) Release the operated select magnets corresponding to the link used for the dial tone connection on the switch in which the called station appears.
- (d) Operate relay BY in the trunk.
- (e) Start the link shift timing.

(f) Pulse the link group sequence control circuit.

(g) Prepare a link in the operating path for the camp-on stop relay COS (options 9 and WS) or the Q5 transistors in the voltage reduction detector circuits (options 22 and WT).

(h) Prepare locking paths for relays LTS2-9 (options 9 and WS) or for relays LT2-9 (options 22 and WT).

(i) Release relays SMTA,B.

4.32 The operation of relay BY in the trunk at this time:

- (a) Opens leads T and R at the PBX end of the trunk.
- (b) Operates relay DR in the trunk.
- (c) Causes relay SL in the trunk to release.

4.33 Relays CONA,B and CONAA,BA, in operating:

- (a) Operate relays LTCA,B.
- (b) Operate relays TRKA,B and TRKAA,BA.
- (c) Provide a holding path for relays SMRA,B and SMRAA,BA.
- (d) Connect solid ground to the called station line hold magnet (or relay IN--) through contacts of the operated relays SEA,B, SMRAA,BA, S-, TM- and ZU.

4.34 The ground extends over the sleeve of the link serving the busy called station.

4.35 The operation of relays CONA,B and COA,B transfers the control of the ground on leads M- to the trunks to relays CONA,B.

4.36 If the line, link, and marker circuit is equipped with options 22 and WT, the operation of relays LTCA,B and CONAA,BA will connect the LT2-9 relays to the sleeves of the links via the voltage reduction detector and the non-operated LTA,B relays as shown on FS28. Two voltage reduction detector circuits VRDA,B are provided. VRDA contains the transistor detectors for LT relays 2-5 and VRDB contains the transistor detectors for LT relays 6-9. Operation of relays CONAA,BA connect the upper terminal of each LT2-9 relay to the collector of the associated transistor in the voltage reduction detector circuit. The emitter of each transistor is connected to the sleeve of the associated link. If the sleeve is open or has a negative potential to ground of 4.5 volts or greater, the associated transistor in the detector circuit will not conduct. If the sleeve of the link is at ground potential, the associated transistor will conduct.

- 4.37 If a link is idle, the associated sleeve lead will be open and the associated transistor in the detector circuit will not conduct. A busy link associated with other than the called station will have the 100-ohm holding ground and the battery connected line hold magnet (or relay IN--) connected to it resulting in a negative potential to ground of approximately 4.8 volts. This voltage will not drive the transistor into conduction.
- 4.38 The sleeve of the link used by the called station, however, will be at ground potential. This ground will drive the transistor into conduction. The conduction of the transistor extends the sleeve ground to the associated LT relay to operate it.
- 4.39 If no LT- relay operates during the testing of the first group of links, the link shift timing and link group control circuits will function and shift the link testing relays to the second group of links.
- 4.40 A relay LT-, in operating, will:
- Prepare its own locking path.
 - Operate relays LEA,B and LEAA,BA.
 - Halt link shift timing.
 - Open the operate path of alarm relay COAL.
- 4.41 If the line, link, and marker circuit is equipped with options 9 and WS, the operation of relays LTCA,B and CONAA,BA connects the midpoint of a potential divider consisting of the grounded 200-ohm resistor LTB- in series with 1200-ohm resistor LTA- battery connected to the negative side of the primary winding to relays LT-. The positive side of the primary winding is normally connected to the link sleeves of the link group through contacts of relays TRLA,B. With relays LTCA,B operated, the battery connected 1000-ohm resistor L-- is also connected to this point. In this condition, the potential at the negative side of the primary winding will be approximately -8 volts.
- 4.42 An idle link will have only the potential due to resistor L-- on it, producing a voltage across the primary winding of approximately 2 volts of the wrong polarity. The voltage will not operate relay LT-. A busy link associated with other than the called station will have the 100-ohm holding ground and the battery connected line hold magnet (or relay IN--) connected to it in addition to the battery connected 1000-ohm resistor L--, resulting in a potential of somewhat less than 1 volt of the correct polarity. This voltage is insufficient to operate the relay.
- 4.43 The link being used by the called station, however, will have a solid ground connected to it, producing a voltage of approximately 1.6 volts of the correct polarity, to operate relay LT-.
- 4.44 If no relay LT- operates during the testing of the first group of links, the link shift timing and link group control circuits will function and shift the link testing relays to the second group of links.
- 4.45 A relay LT-, in operating, will operate its associated relay LTS-, which, in operating, will:
- Prepare a locking path for itself.
 - Provide a locking path for the corresponding relay LT-.
 - Operate relays LEA,B and LEAA,BA.
 - Halt link shift timing.
- 4.46 Relays LEA,B and LEAA,BA, in operating, at this time:
- Cause the select magnets corresponding to the link being used by the busy called station as determined by the operated relay LT- (Options 22 and WT) or relay LTS- (Options 9 and WS) and the state of relays TRLA,B/ to operate in switches 0 and 8.
 - Release relays CONA,B and CONAA,BA.
- 4.47 The release of relays CONA,B and CONAA,BA:
- Removes the ground from leads M- to the trunks, causing the trunk hold magnet THM-- and relay HM in the trunk to release.
 - Releases relays LTCA,B, which, in turn, release the operated relay LT- (options 9 and WS).
 - Releases relays SMRA,B and SMRAA,BA and SOA,B.
- 4.48 The release of either relays SMRAA,BA or SOA,B releases relays HMKA,B. The release of the relays SOA,B releases the operated relay S-, which, in turn, releases relays SEA,B and SEAA,BA.

- 4.49 With relays HMKA,B and SMTA,B released and relays TRKA,B operated, relay TRCA,B and TRCAA,BA will operate. These relays, in reoperating:
- (a) Lock under control of relays RP-.
 - (b) Release relays TRKA,B and TRKAA,BA, which, in turn, reoperate relays SMTA,B.
 - (c) Release relays RCTA,B and RCTAA,BA.
- 4.50 Relay RCTA,B and RCTAA,BA, in releasing:
- (a) Release relays RCA-, B-,C-,D-,E-, which in turn, release the operated relays TCS-, THC-, TU-, and TM- in the marker and relay RV in the register.
 - (b) Release relays BYA,B, BSYA,B, and BSYAA,BA if option ZM is used, or, if option ZL is used, release relays BYA,B, which, in turn, release relays BSYA,B and BSYAA,BA. Relay THC-, in releasing, releases the associated relay SMC-.
- 4.51 Relays SMTA,B, in reoperating, will:
- (a) Reconnect ground to the leads M- to the trunk via contacts of the released relays HMTA,B, SOA,B and ALBA,BA and the operated relays COA,B, which will operate the trunk hold magnet and relay HM in the trunk.
 - (b) Close the operating path for the slow operate relays HMTAA,BA.
- 4.52 When the trunk hold magnet operates, the crosspoints corresponding to the link being used by the called station will close. Although this connects leads T, R, and S of the trunk to the busy link, there will be no interference with the call in progress, since the operated relay BY in the trunk keeps leads T and R open.
- 4.53 When relays HMTAA,BA operate:
- (a) The operating paths for the slow operate relays HMTA,B are closed.
 - (b) Leads RS- to the trunk are grounded, causing relay RS in the trunk to operate, which, in turn, releases relay HD in the trunk.
- 4.54 When relays HMTA,B operate, the ground at contacts of the operated relays SMTA,B through contacts of the operated relays COTA,B and COAA,BA will operate relays HMKA,B. Relays HMKA,B, in turn, release relays DCKA,B.
- 4.55 Relays DCKA,B, in releasing, will operate relays RLA,AA,AB,B,BA,BB, which will:
- (a) Release relays MTA,B, halting the marker timing.
 - (b) Open the operate paths for the relays in the tens preference chain on FS3, causing relays TCK1,2,3,4 and RP- to release.
 - (c) Release relays SMTA,B, which, in turn, release relays HMTA,B and HMTAA,BA.
 - (d) Release relays LEA,B and LEAA,BA, which, in turn, release the operated relay LTS- (options 9 and WS) and select magnets.
 - (e) Operate relays RRLA,B in the register circuit.
 - (f) Remove ground from leads RLS- to the trunks to release the relay MC in the trunk.
 - (g) Diodes HE and HO provide a holding path for relay HM in the two-way tie trunk circuit to central office from operated relays RLA,B. A ground on leads ME and MO must be provided until relay MC in the central office trunk releases since the addition of option YC delays the release of relay MC.
- 4.56 Release of relay RP- releases relay RPA-, which, in turn, releases relays TRCA,B and TRCAA,BA, COTA,B, and RUCA,B. Relays COTA,B, in releasing, release relays COA,B and COAA,BA and HMKA,B. Relays COA,B and COAA,BA released:
- (a) Release relays SMCO and SMC8.
 - (b) Release the operated LT- relay (options 22 and WT).
 - (c) Advance the link group sequence control circuit.
- 4.57 Operation of relays RRLA,B releases relay DC. Relay DC releases register relay L which, in turn, releases relay SR. The release of relay DC in the register also will release relays R-, TEAO,A1,A2,A3, BO,B1,B2,B3, and TSDA in the marker in that sequence.
- 4.58 Relay SR in the register released, releases relay ON in the register and the register hold magnets THM-8,-9. Relay ON in the register released will:
- (a) Release relay COT in the register
 - (b) Reoperate the RA-A,-B in the register allotter circuit.
 - (c) Release relays RRLA,B in the register provided register hold magnets THM-8,-9 have released.

4.59 When relays HMTA,B, HMKA,B, TCK1,2, 3,4 and TRCA,B are all released, relays DCKA,B will reoperate. Relays DCKA,B, in turn, will release relays RLA, AA,AB,B,BA,BB, restoring the marker to normal.

H. Camp-On Busy - Called Station and All Other Stations in Hunting Group Busy - Another Trunk Already Camped On Called Station (SC20)

4.60 Even though another trunk is already camped on to the busy called station, the marker will proceed to camp-on the trunk exactly as if there were no other trunks camped on. However, when relays CONA,B operate, the direct ground applied by these relays to the sleeve of the link being used by the busy called station will pass through contacts of the operated relays BY, RS, and DR and released relay FF in the trunk already camped on back into the marker over lead CW (which then is multiplied through all the code 9 trunks) to:

(a) Operate relay COS (FS12) in the marker (Options 9 and WS), or

(b) Drive the Q5 transistors in the voltage reduction detector circuits VRDA,B (Options 22 and WT).

4.61 Relay COS (Options 9 and WS), in operating, or transistors Q5 in VRDA,B (Option 22 and WT), in conducting, operates relays COSA,B (FS12 or FS28) which will:

(a) Lock operated through contacts of the operated relays LEA,B and COAA,BA.

(b) Ground leads FF- to the trunk through break contacts of relays HMTAA,BA to operate relay FF in the trunk.

4.62 The operation of relay FF along with relays BY and RS in the trunk will activate suitable audible and visual signals in the trunk to indicate to the attendant that the camp-on busy condition exists. Although the trunk is, in effect, camped on to the busy called station along with another trunk, it will be prevented from cutting through by the operated relay FF.

4.63 Relay COS (Option 9 and WS) or transistors Q5 in the voltage reduction detector circuits (Options 22 and WT) will release when relays CONA,B release; relays COSA,B will release when relays LEA,B release.

I. Camp-On Busy - PBX on Remote Trunk Answer Operation (XF Option)

4.64 When the attendant has placed the PBX on remote trunk answer operation

and the marker in attempting to connect the trunk to a PBX station finds the called station and all other stations in the hunting group busy, the marker will proceed to camp on the trunk. However, when relays CONAA,BA operate, battery supplied through the auxiliary position circuit will operate relays COSA,B (FS12 or FS28).

4.65 Relays COSA,B operated:

(a) Lock operated through contacts of the operated relays LEA,B and COAA,BA.

(b) Ground leads FF- to the trunk through break contacts of relays HMTAA,BA to operate relay FF in the trunk.

4.66 The operation of relay FF along with relays BY and RS in the trunk will activate suitable audible signals in the trunk to indicate to the remote trunk answering station that a busy condition exists. Although the trunk is, in effect, camped on to the busy called station, it will be prevented from cutting through by the operated relay FF.

4.67 Relays COSA,B will release when relays LEA,B release.

J. Cancel Camp-On - Called Station Busy Dial Conference Trunk Circuit - Station or Attendant Controlled, or Station Dial Transfer Trunk Circuit in Use (SC26)

4.68 The marker in attempting to add a busy station to either of the dial conference trunk circuits or to transfer an incoming central office trunk call to a busy station via the station dial transfer trunk circuit will function as a central office trunk connection (SC9) to the point of operation of relays COA,B and COAA,BA and CONA,B and CONAA,BA. Relay CCC operated opens the operating path of relays COA,B and COAA,BA and CONA,B and CONAA,BA. Relay CCC operates relays BTTA,B,C. The marker makes a busy tone connection and does not camp on the busy station.

K. Called Station Busy - Message Registration Pulse on Sleeve

General

4.69 A station message registration will be scored with every operation of relay SX in the message register pulse circuit. The operation of relay SX will operate relay COD in the station message register marker controller circuit. If relay COD is operated prior to the operation of relays HMKA,B during a camp-on call termination, the link testing function of the marker will be disabled and the camp-on call termination will not be made. The manner in which this is accomplished depends on marker options XK and WV.

Marker Circuit Equipped With Option WV (SC33)

4.70 Relay COD operated:

- (a) Prepares its own lock path under control of relays COTA,B.
- (b) Transfers the operating path of relays CONAA,BA to relay H in the station message register marker controller circuit.
- (c) Prevents the operation of marker alarm relays COAL and XCAL.

4.71 With relays SOA,B, SEAA,BA SMRAA,BA, COTA,B and COD operated, relay HMKA,B will operate relays H, COA,AA,B,BA, and CONA,B.

4.72 Relay H operated:

- (a) Operates relay ST in the busy verification circuit if the marker is performing the camp-on operation in connection with busy verification.
- (b) Prevents the operation of marker alarm relay LAL1 when relays CONA,B operate and CONAA,BA do not.
- (c) Removes ground from leads MR5 and MR6 to prevent relays LTCA,B from operating.

4.73 Relays COA,B and COAA,BA operated:

- (a) Operates relay BY in the C.O. trunk which in turn, operates relay DR and releases relay SL in the trunk.
- (b) Releases relays SMTA,B.
- (c) Starts link shift timing (SC34) and all links busy timing (SC35).
- (d) Operates relays SMCO,8.
- (e) Opens the operate path of busy tone relays BTTA,B.

4.74 With relays CONAA,BA and LTCA,B non-operated, no LT- relays will operate and the all-links-busy relays ALBA,B will eventually operate. Relays ALBA,B operated:

- (a) Operates camp-on stop relays COSA,B (FS28) which, in turn, operates trunk relay FF.
- (b) Operates link end relays LEA,AA,B,BA in place of relay BTTA,B due to the previously operated COA,AA,B,BA relays.

4.75 Operation of relays LEA,AA,B,BA proceeds to release relays CONA,B and relay H in the message register marker controller circuit. This begins the release of the marker and register as though the camp-on link had been found and the termination made. The trunk hold magnet and relay HM in the trunk releases in preparation for

reoperating to reclose crosspoints on to the camp-on link. However, in this sequence, no select magnets operate and when the trunk hold magnet reoperates, no crosspoints are closed and the trunk is not connected to a link.

4.76 During the marker release, relay FB in the cordless position circuit operates. With trunk relays FF and DR and cordless position circuit relay FB operated, the attendant will receive the camp-on denied indication of 120-ipm tone and flashing lamp SL.

Marker Circuit Equipped With Option XK (SC27)

4.77 Relay COD operated:

- (a) Prepares its own lock path under control of relays COTA,B.
- (b) Transfers the operating path of relays CONA,AA,B,BA to relay H in the station message register marker controller circuit.

4.78 With relays SOA,B, SEAA,BA, SMRAA,BA, COTA,B and COD operated, relay HMKA,B will operate relays H, COA,B and COAA,BA.

4.79 Relay H operated:

- (a) Operates trunk relay RS.
- (b) Provides a holding ground for relays DCKA,B.
- (c) Provides a holding ground for the trunk hold magnet THM-- and trunk relay HM.
- (d) Prepares a path to operate relay BY in the register.
- (e) Operates relay ST in the busy verification circuit.

4.80 Relays COA,B and COAA,BA operated:

- (a) Operate relay BY in the trunk.
- (b) Release relays SOA,B and SMTA,B.
- (c) Operate relays HMTA,B, HMTAA,BA and SMCO,8.

- (d) Lock under control of relay RPA-.
- (e) Start link shift timing (SC10 or SC21) and all links busy timing.
- 4.81 Relays SOA,B in releasing release relays HMKA,B.
- 4.82 Relays SMTA,B released release relays SMRA,B and SMRAA,BA in turn releasing relay S-. With relays S- released, relays SEA,B will release operating relays RUCA,B. Relays RUCA,B in operating will reoperate relay U- operating relays UEA,B.
- 4.83 With relays CONA,B and CONAA,BA released, no relays LT- or LTS- will operate and the all-links-busy relays ALBA,B will eventually operate operating relays COSA,B and BTTA,B.
- 4.84 Relays COSA,B operated will operate trunk relay FF. With relays DR and FF and cordless position circuit relay FB operated, the attendant will receive the camp-on denied indication of 120-ipm tone and flashing lamp SL.
- 4.85 Relays BTTA,B operated:
 - (a) Operate relays TRKA,B and TRKAA,BA.
 - (b) Prepare a path to operate relays BTCA,B.
 - (c) Lock under control of relays ALBA,B.
- 4.86 Relays TRKA,B and TRKAA,BA operated operate relays TRCA,B and TRCAA,BA which:
 - (a) Release relays TRKA,B, TRKAA,BA, RCTA,B and RCTAA,BA.
 - (b) Lock under control of relay RPA-.
- 4.87 Relays RCTA,B and RCTAA,BA released release relays RCA-, RCB-, RCC-, RCD-, RCE-, BYA,B BSYA,B and BSYAA,BA. Release of relays RC(A-E)O,1 release relays TCS-, THC-, TU-, TM-, U-, and register relay RV.
- 4.88 Relays TRKA,B and TRKAA,BA in releasing operate relays BTCA,B, which:
 - (a) Operate relays UO and register relay BY.
 - (b) Release relays TOLA,B.
- 4.89 Register relay BY operated releases relay R- and register relay DC. With relay DC released and trunk relay BY operated, opening the T and R connections to the register, register relay L will release. Relay L released will result in the subsequent release of all operated register relays.

4.90 Relay R- released releases relays RP-, TEA-, and TEB-. Relay RP- released will result in subsequent release of all previously operated marker relays. With relays TEA- and TEB- and TOLA,B released, marker time out check sequence (SC18) will start.

L. Called Station is Inward Restricted (SC28)

- 4.91 The marker in attempting to connect an inward restricted station to a central office trunk will function as in (SC5) to the point of operation of relay TCS5. Relays AUO-9 in the inward restriction circuit operate in parallel with relays UO-9.
- 4.92 Relays TCS5 and AU7 operated operate relay IR- in the inward restriction circuit performing the following functions:
 - (a) Prevents relay S7 from operating and so provides the marker with the necessary signals to consider the called line as unassigned.
 - (b) Locks operated via released marker relays RLA,B.
- 4.93 The marker proceeds to complete the call to an attendant trunk. When the call is completed, the marker releases by the operation of relays RLA,AA,AB,B,BA, BB, also releasing the inward restriction circuit.

5. CENTRAL OFFICE OR RINGDOWN TIE TRUNK TO CODE 8 TRUNK CALL TERMINATIONS (SC6)

A. General

- 5.01 In completing a call from a code 9 trunk to a code 8 trunk, the marker will make a busy test of the trunks in the code 8 trunk group dialed and complete the connection to an idle trunk in the group, via the link used for the dial tone connection. If all trunks in the dialed group are busy, the marker will return a camp-on busy indication to the code 9 trunk.
- 5.02 If the code 8 trunk is arranged for pad control, then options 19, 20 and 21 are provided for the trunk. In the course of completing the connection, the marker will signal the code 8 tie trunk to remove its switch pad.

B. Register Requests Service

- 5.03 The marker reacts to the operation of relay DC in the register in the same way as to a code 9 trunk to station call, except that relays TK8,A8,B8 and SMC2 will operate instead of relays TCS-, THC-, TU-, TM-, and SMC-. Also, when relay MC in the trunk operates, relay TT in the trunk will operate over leads TR- from the marker as a consequence of relay TT in the register being operated.

C. Trunk Testing and Select Magnet Operation

5.04 The grounded lead U- from the register will operate the corresponding relay U- and all others grouped to it via terminals H8-. The busy test is made by looking for battery through relay OT2- or ground on leads IT- on FS26.

D. Hold Magnet Operation

5.05 Relays SMTA,B will operate when relay SMC2 operates; relays SEA,B and SEAA,BA will operate when relay S- operates. Relays SMTA,B and SEA,B and SEAA,BA in operating:

(a) Close the operating path for the slow operate relays HMTAA,BA.

(b) Operate relays SMRA,B and SMRAA,BA.

5.06 Relays SMRAA,BA, in operating, will extend the ground from the contacts of the operated relays SMTA,B through contacts of the released relays HMTA,B, SOA,B, TRKA,B and ZU, the operated relay TK8, and an operated relay S- to operate relay OT2- corresponding to the selected trunk.

5.07 Relay OT2- in operating, will:

(a) Operate the corresponding line hold magnet LHM2-.

(b) Close the operating ground for relay OT2- through to the slow operating relay SL2-.

(c) Connect ground through the 100-ohm resistor S2- to the sleeve of the link.

(d) Transfer leads T and R to the links from its normal connection to leads T1 and R1 associated with the code 8 trunk to leads T2 and R2 of the code 8 trunk.

5.08 The operation of the hold magnet will close the crosspoints and thus connect leads T2 and R2 of the code 8 trunk to leads T and R of the code 9 trunk in parallel with leads T and R of the register, via the link used in the dial tone connection. When the bridging relay in the code 8 trunk operates, a ground will be returned over lead S2 from the code 8 trunk to the line circuit to maintain relays OT2- and SL2- operated.

5.09 The ground on lead S2 will be extended through to lead IT8- to the marker until relay SL2- operates. At that time a ground from contacts of relay SL2- is substituted for lead S2 ground on lead IT8-.

5.10 When relays HMTAA,BA operate:

(a) The operating paths for the slow operate relays HMTA,B are closed.

(b) Relay RV in the register releases, causing relay P in the trunk to release.

(c) The original operating path for relays OT2- and SL2- is opened.

E. Hold Magnet Check and Marker and Register Release

5.11 When relays HMTA,B operate, relays HMKA,B are connected to lead IT8- corresponding to the selected trunk. The ground on lead IT8- will operate relays HMKA,B and start the sequence to release the marker and register.

F. All Trunks Busy (SC15)

5.12 If all trunks in the code 8 group dialed are busy, none of the corresponding relays S- on FS6 will operate, and relays BYA,B will operate. The marker will then proceed to function as if it were camping the code 9 trunk on to a code 8 trunk up to the point where relays CONA,B and CONAA,BA and COA,B and COAA,BA operate.

5.13 When relays CONA,B operate, relays COSA,B operate over a path through the operated relays TK8 and COTA,B. Relays COSA,B, in operating, will cause relay FF in the trunk to operate. The marker will then proceed to generate a camp-on busy condition in the trunk and release.

5.14 When the marker finds all trunks are busy, audible camp-on stop signal is not returned to the attendant when option XA is provided. Relay BTTC operating causes this trouble condition by preventing the marker from signaling the trunk via leads RSE and RSO. Option WA is added and corrects this trouble condition by placing relay BTTC under control of relay CCC, thus preventing relay BTTC from operating.

5.15 When the marker finds all trunks are busy, an all links busy sequence occurs in the marker during either the first or second trial. This is caused by an incomplete path from ground supplied by contact 2 of relays CONA,B to the link test relay LT-. None of the link test relays operate, thus causing the marker to operate relays ALBA,B.

5.16 The marker functions to cause the central office trunk to remove the resistance battery from the link sleeve, allowing the 100-ohm ground from the register to operate the LT- relay associated with the link sleeve. The marker proceeds to release. With option WC or options 22, WT provided, normal marker action is allowed by operating relay LT9 which prevents the all links busy sequence from occurring

6. CENTRAL OFFICE OR RINGDOWN TIE TRUNK TO CENTRAL OFFICE OR RINGDOWN TIE TRUNK CALL TERMINATIONS

6.01 If the PBX is equipped with ringdown tie trunks or if the central office trunks are arranged into more than one group that can be dial selected for outward calls, the register will be arranged for two-digit operation on code 9 calls. Under such circumstances, the attendant may connect code 9 trunks to each other.

6.02 The marker will accomplish these connections in much the same manner as if it were establishing a code 9 trunk connection, except that:

- (a) Relays TK9,A9,B9 will operate instead of relays TK8,A8,A9.
- (b) Relay U- associated with all of the trunks in the trunk group will operate through terminal straps H9- in addition to relay U- associated with the units digit dialed.
- (c) The busy test will be made over leads IT9- to the trunks.

6.03 If all trunks in the group are busy, no relay S- will operate, relays BYA,B will operate, and the marker will follow the all-trunks-busy sequence and return camp-on busy indications to the originating trunk.

7. DIAL BACK CALLS FROM CENTRAL OFFICE OR RINGDOWN TIE TRUNKS

7.01 If the PBX is arranged for restricted access to the code 9 trunks, a restricted station, upon dialing a 9 code, will be connected to the attendant via an attendant trunk. The attendant may then connect a code 9 trunk to the restricted station while the station remains off-hook, using the DIAL BACK key provided. To accomplish this, the attendant will seize a register through an idle code 9 trunk, momentarily operate the DIAL BACK key, and dial the calling station.

7.02 Operation of the DIAL BACK key will operate relay NT in the cordless position circuit, which will lock to ground in the selected code 9 trunk.

7.03 The marker will proceed to process the call as a central office call. When relay MC in the trunk operates, the no test relay NT (FS11) in the marker will operate in series with relay NT in the cordless position circuit.

7.04 Since the calling station is off-hook, the line will test busy and the corresponding relay S- will not operate. When relays SMTA,B operate, ground from their contacts through relay SO-9 contact chain on FS6 will operate relays BYA,B. Because relay NT is operated, the same ground will operate relays BSYAA,BA, which, in turn, will operate relays BSYA,B. The operated relay NT will have opened the operating paths for relays HCA,B to prevent their operating when relays BYA,B operated.

7.05 The marker will then proceed to function as if it were camping on to the calling station, except that relay BY in the trunk will not operate when relays COA,B operate, because the operated relay NT in the marker opened leads BY- to the trunk.

7.06 The operated relay NT in the marker also:

- (a) Grounds leads RT- (FS11) to the trunks, which will operate relay RT in the trunk to prevent ringing the calling station.
- (b) Grounds lead KO (FS11) to the attendant trunks, which will release (kick off) the attendant trunk being held by the calling station.

7.07 When the marker completes its functions, the code 9 trunk will be connected to the restricted calling station via the link used for its connection to the attendant trunk.

8. CALLED LINE OR TRUNK UNASSIGNED (SC14)

8.01 When a line is not assigned, the strap between terminals S and S1 shown on FS1 and FS26 will be omitted. An unassigned code 8 trunk termination will have no optional connection wired to the lead IT8- shown on FS26. Code 9 trunks will not usually be unassigned, but dial access to a particular trunk (for example, a code ringing ringdown tie trunk or a one-way incoming central office trunk) will be prevented by omitting a connection in the trunk equipment to lead IT9- from the marker.

- 8.02 A call to an unassigned line or trunk will be handled by the marker in the same way as a call to an assigned line or trunk as described up to the point when relays SOA,B operate, indicating that no stations or trunks in the groups related to the dialed number are idle. SC14 assumes that the call is from a station, Code 8, or attendant trunk (juncator class call) to an unassigned station line. For a call to an unassigned trunk, the sequence would be similar except that the juncator selection circuitry would not be involved.
- 8.03 When relays SOA,B operate, relay S- corresponding to the dialed units digit will operate over its secondary winding, which, in turn, causes relays SEA,B and SEAA,BA and SMRA,B and SMRAA,BA to operate, in that sequence. Relays SEA,B, in operating, release relays RUCA,B, U-, and UEA,B in sequence.
- 8.04 With relays SOA,B, S-, SMRAA,BA, and a tens connector relay operated, relays HMKA,B are connected to lead S or IT-- of the dialed trunk or station. Since no ground will be present on these leads, relays HMKA,B will not operate.
- 8.05 With relays SOA,B, SMRAA,BA, and SEAA,BA operated and relays HMKA,B released, the intercept relays ICTA,B (FS9) will operate. These relays will:
- (a) Release the juncator selection and link test portions of the circuit. (During the release of the juncator selection circuitry, relays JREA, B will release thereby releasing relays RCTA, B and RCTAA,BA.)
 - (b) Operate relays TRKA,B and TRKAA,BA, which, in turn, release relays SMTA,B.
 - (c) Lock under control of relays RPA- or RP-.
- 8.06 Relays SMTA,B, in releasing:
- (a) Operate relays TRCA,B and TRCAA,BA. (At this time, relays RCTA,B and RCTAA,BA will release if the call is to an unassigned trunk.)
 - (b) Release relays SMRA,B and SMRAA,BA.
- 8.07 Relays RCTA,B and RCTAA,BA, in releasing:
- (a) Release relays RCA-,B-,C-,D-,E-, which release the operated tens connector and select magnet connector relays in sequence.
- (b) Cause relays BYA,B, BSYA,B, and BSYAA,BA to release.
- 8.08 Relays BSYA,B, in releasing, cause relays SOA, B-,S-, and SEA,B and SEAA,BA to release in sequence. The release of the latter relays will:
- (a) In conjunction with relays TRCA,B operated, release relays TRKA,B and TRKAA,BA.
 - (b) Operate relays RUCA,B.
- 8.09 The release of relays TRKAA,BA will cause relays TKO,AO,BO, to operate at this time, which, in turn, will operate relay SMC0.
- 8.10 With relays TKO and RUCA,B operated, the operated relays ICTA,B will operate relays UO, U1 and U2. These relays, in turn, will operate relays UEA,B and complete a path between the primary windings of relays SO, S1 and S2 and leads ITOO, IT01, and IT02, respectively, from the attendant trunks. Battery through relays TN in the idle attendant trunks will operate the respective relays S-. Any relay S-, in operating, will operate relays SEA,B and SEAA,BA.
- 8.11 Relay SMC0, in operating, will:
- (a) Cause the select magnets corresponding to the link used in the dial tone connection in switch 0 to operate.
 - (b) Operate relay SMTA,B, which, in turn, operates relays SMRA,B and SMRAA,BA and closes the operating path for the slow operating relays HMTAA,BA.
- 8.12 Beyond this point in the call, the marker will function to connect the calling station or trunk to an idle attendant trunk, make the hold magnet check, and release itself and the register in much the same manner as described previously.
- 8.13 Because the attendant trunk was entered via its ITOO,01, or 02 appearance instead of the ITO5, 06, or 07 appearance, the attendant will receive a burst of tone upon answering, indicating to her that the call was intercepted.

9. LOCKOUT AND TENS PREFERENCE CONTROL

A. Lockout Control

9.01 The operation of any station tens group relay T2-7 will operate the tens end relays TEAO,A1,A2,A3,B0,B1,B2,B3. Competing with these station groups for service are two trunk groups and two registers. Their associated relays TRO,1 and RO,1 perform the same functions as relays T2-7. Relays TEAO,A1,A2, A3,B0,B1,B2,B3 function as a gate in this

circuit such that, once the gate is closed, all calls outside the gate are denied access to the marker until those within the gate are served.

9.02 This function is ensured by opening up the operate path of relays T2-7, TRO,1, and RO,1 with break contacts on relays TEAO,A1,A2,A3,B0,B1,B2,B3. Furthermore, relays TEAO,A1,A2,A3,B0,B1,B2,B3, will lock operated to any operated relays T2-7, TRO,1, and RO,1.

9.03 The marker proceeds to serve each group within the gate only once. This is ensured by the release of relay T2-7, TRO,1, or RO,1 at the end of each marker usage. In the case of relays T2-7 and TRO,1, this is done by the operation of an associated relay TA2-7 or TRA0,1. In the case of relay RO,1, this is done by the release of relay DC in the register, which opens the operate path of relays RO,1.

9.04 The release of all of relays T2-7, TRO,1, or RO,1 allows relays TEAO,A1,A2,A3,B0,B1,B2,B3, to release. This opens up the gate, allowing new calls waiting for service to enter and the cycle to be repeated.

B. Tens Preference Control

9.05 Relays RO,1, TRO,1 and T2-7 are associated with the following respective relays in the preference circuit: RPO,1, TRPO,1, and TP2-7. These relays are arranged in a transfer chain circuit such that one and only one relay can remain operated if more than one relay RO,1, TRO,1, or T2-7 is operated. The register circuits have the highest preference, the trunk circuits have the next preference, and the station lines have the lowest preference. The exact preference is as follows: RPO, RP1, TRPO, TRP1, TP2, TP3, TP4, TP5, TP6, and TP7.

9.06 The preference relays have two independent operating paths, one through their primary windings and one through their secondary windings. The continuity of each operating path is checked by two relays that operate in series with each path. Relays TCK1 and TCK2 operate in series with the primary winding path, relays TCK3 and TCK4 in series with the secondary winding path.

10. ABANDONED CALLS (SC17)

10.01 When a station or trunk originates a call, the marker will try to establish a dial tone connection. When relays TACA,B and LUCA,B operate during the units selection sequence, the operating path for the slow operate abandon call relays ACA,B (FS5) is closed. If the station or trunk abandons the call before relays LUCA,B release (indicating that relay U- and relay UEA,B have operated) relays ACA,B will eventually operate.

10.02 Relays ACA,B, in operating, will release relays DCKA,B, which, in turn, operate relays RLA,AA,AB,B,BA,BB, and release the marker to serve the next call.

10.03 If the abandonment occurs after relays LUCA,B have released (relays ACA,B never having operated), the station or trunk will be connected to a register in normal fashion, but the connection will fall down for lack of holding bridge on leads T and R.

10.04 If a station line or a trunk dials a call into a register and then disconnects after the register is seized, the marker never knows of this abandonment and proceeds to set the call up in the normal fashion. After the marker releases, the connection set up by the marker will also drop off because of the lack of a holding ground provided from the originating end.

11. ALLOTING AND SEQUENCE CONTROL

A. Register Allotter

11.01 The register allotter relays on FS10 associated with registers 0 and 1, RAOA,B and RAlA,B, respectively, operate when the associated register becomes idle. However, the operate path of relays RAOA,B is through break contacts of relays RAlA,B. Consequently, once released, relays RAOA,B cannot reoperate until a call is served by register 1. Relays RAlA,B can operate any time that register 1 becomes idle. If both register 0 and register 1 are idle and their allotter relays are operated, the marker will prefer register 0.

11.02 If both registers are idle and the marker experiences trouble in connecting to register 0, the marker will progress to second trial and relays STA,B will operate and release relays RAlA,B. When the marker attempts to complete the call on the second trial, it will again prefer register 0. However, if the marker initially prefers register 1, the operation of relays STA,B will release relays RAlA,B and, assuming that register 0 is idle, relays RAOA,B will operate. In this case, the marker will prefer register 0 in the second trial attempt.

11.03 In either case, if the marker cannot complete the connection on a second trial, the marker will progress to the no connection sequence and relays NAA,B operate. These relays, in operating, will operate relays BTTA,B which, in turn, cause relays TRKA,B and TRKAA,BA to operate. Relays TRKAA,BA, in operating, release relays SMTA,B, which, in turn, operate relays TRCA,B and TRCAA,BA.

11.04 These relays, in operating, will release relays BTTA,B and TRKA,B and TRKAA,BA and close the operating path for the slow operate relays ACA,B. When

these relays finally operate, relays RALA,B will operate (if not already operated) and relays RAOA,B will release. On the next marker usage, register 1 will be preferred.

B. Link Group Sequence Control (SC24)

11.05 The link group tested first in a marker operation is dependent upon the state of relays TRLA,B (FS12). When these relays are released, the link testing and selection circuits are associated with links 02-09 and, when operated, the association is with links 12-19.

11.06 The state of relays TRLA,B is dependent, in turn, upon the state of relay ZLG. Relay ZLG functions in combination with relays WLG and WLGA.

11.07 Assuming that all of these relays are released, the operation of either relays LTAA,BA or COAA,BA (which are operated during the processing of calls involving link selection or camp-on, respectively) will operate relay WLG. When relays LTAA,BA or COAA,BA release, relay ZLG operates in series with relay WLG. Relay ZLG, in operating, will operate relays TRLA,B.

11.08 On the next operation of relays LTAA,BA or COAA,BA, relay WLGA will operate, shunting down relay WLG. Relay ZLG, however, will be held operated by battery through resistor WLGA. The subsequent release of relays LTAA,BA or COAA,BA will release relays WLGA,ZLG, and TRLA,B, restoring the control circuit to normal.

11.09 Relays LBA,B can also step relay WLG, ZLG, WLGA combination by interrupting the operating grounds from the contacts of the operated relays LTAA,BA or COAA,BA. Relays LBA,B will operate after an interval if all links in the first group tested are busy or, in the case of a camp-on call, the link being used by the station to be camped on is not in the first group tested. The operation of relays LBA,B will thereby cause relays TRLA,B to change state and shift the link testing and selection circuitry to the alternate group of links.

C. Link Sequence Control (SC23)

11.10 The selection of a particular idle link in a link group being tested is governed by the state of relays WL, ZL, WIL, and ZIL on FS13. If during link selection relays ZL and WIL are operated, the link preference order will be -2 through -9. When relay ZL is released and relay ZIL operated, the preference order is -4 through -9,-2,-3. With relay ZL operated and relay WIL released, the preference order is -6 through -9, -2 through -5. Finally, with both relays ZL and ZIL released, the preference order is -8,-9,-2 through -7.

11.11 The preference is changed every marker operation involving link selection. If the marker operation involving link selection progresses to second trial, the preference order will change twice during the marker operation.

11.12 Assuming that relays WL, ZL, WIL, and ZIL are initially released, relays LTAA,BA, in operating, will operate relay WL. With relays LTAA,BA and WL operated, relay ZL is shunted down. Relay WL, in operating, will also operate relay WIL. With relay WL and WIL operated, relay ZIL is shunted down. Thus, on this first marker operation, the link preference order will be that associated with relays ZL and ZIL, both released. The release of relays LTAA,BA removes the shunt from relay ZL, which will then operate.

11.13 The next operation of relays LTAA,BA will shunt down relay WL but maintain relay ZL operated. The release of relay WL will remove the shunt from relay ZIL, allowing it to operate. Thus, on this second marker operation involving link selection, the link preference order will be that associated with relays ZL and WIL operated. When relays LTAA,BA release, relay ZL releases.

11.14 The third operation of relays LTAA,BA will reoperate relay WL, which, in turn, will shunt down relay WIL. Relay ZIL, however, will remain operated. Thus, on this third marker operation, the link preference order will be that associated with relay ZL released and relay ZIL operated. The release of relays LTAA,BA at this time will remove the shunt from relay ZL, permitting it to operate.

11.15 The fourth operation of relays LTAA,BA will shunt down relay WL but maintain relay ZL operated. Relay WL, in releasing, will release relay ZIL. Thus, on the fourth marker operation, the link preference order will be that associated with relay ZL operated and relay WIL released. When relays LTAA,BA release, relay ZL will release.

11.16 At the end of the fourth marker operation involving link selection, the link sequence control circuit will be restored to the state it was in prior to the first marker operation.

11.17 If during any marker operation involving link selection the marker progresses to second trial, relays LTA,B will operate, followed after a short interval by the operation of relays SAA,B. Referring to FS13, it can be seen that the operation of these relays interrupts the ground from the contacts of the operated relays LTAA,BA to relays WL and ZL, which will advance the link sequence control circuit in the same manner as if relays LTAA,BA were released and reoperated.

D. Units Sequence Control (SC25)

- 11.18 The state of relay ZU on FS6 will determine:
- (a) The preferential order with which stations and code 8 trunks within a tens group will be selected for dial tone calls.
 - (b) The preferential order with which code 8 trunks or stations within a hunting group will be selected for the completion of calls to them.
 - (c) The preferential order with which the junctors will be selected for the completion of station-to-station calls.
 - (d) The preferential order with which code 9 trunks will be selected for outgoing calls by the marker.
- 11.19 The preceding preference orders change whenever the marker is seized for a dial tone call or whenever the marker progresses to second trial on any type of call.
- 11.20 The preference order of stations in a tens group is related to the units digit of a station. When relay ZU is operated, the order is 5-9, 0-4. When relay ZU is normal, the preference order is 0-9. The code 8 trunks take their preference order in the same manner from the units digit of their number assignment.
- 11.21 The preference order of junctor selection when relay ZU is operated is 3,4,5,0,1, and 2; when relay ZU is released, the order changes to 0,1,2,3,4, and 5.
- 11.22 The preference order for the outward selection of code 9 trunks when relay ZU is operated in accordance with trunk equipment numbers is 4,3,2,1, 0,9,8,7,6, and 5. With relay ZU normal the order changes to 9,8,7,6,5,4,3,2,1, and 0.
- 11.23 Assuming relays WU and ZU to be normal, the operation of relays TACAA,BA on a dial tone call will:
- (a) Operate relay WU, which locks to its own contacts.
 - (b) Shunt the winding of relay ZU to prevent it from operating.
- 11.24 When relays TACAA,BA release, the shunt is removed from relay ZU, and it operates from ground at the contacts of the operated relay WU.
- 11.25 On the next operation of relays TACAA,BA on a subsequent marker usage, relay WU will be shunted down, but relay ZU will remain operated over a path

to ground through a break contact of the released relay WU. When relays TACAA,BA releases, relay ZU releases, restoring the circuit to the state prior to the first relay TACAA,BA operation.

11.26 If the marker progresses to second trial while it is processing a dial tone call, the ground from the contacts of operated relays TACAA,BA will be interrupted by the operation of the relays STA,B and reapplied an interval later when relays SAA,B operate, thus changing the state of relay ZU and changing the units sequences.

11.27 If the marker progresses to second trial while it is processing other than a dial tone call, relays TACAA,BA will be normal. The operation of relay STA,B and subsequent operation of relay SAA,B will apply and release ground from break contacts of relays TACAA,BA and thus change the state of relay ZU.

12. PATHS BUSY

A. All Registers Busy

12.01 If all registers are busy when a station line or trunk tries to make a call, the marker will hold that call and serve the first register wanting to complete a call before the station line or trunk will be served.

12.02 When relays RLAA and RLBA operate to release the marker after the marker has set up a call to a register, and both registers are then busy, relay TP- or TRP- will release and release relays TACA,B and TACAA,BA. These relays release the register allotter relays RAOA,1A or RAOB,1B, which were involved in the call just served.

12.03 With relays RLA,B operated and relays RAOB and RA1B released, the all registers-busy relays ARBA,B (FS2) will operate. Relays ARBA,B lock through their own contacts independently of relays RLA,B, close an operating path for relays RO and R1 independently of relays TEAO,A1,A2,A3, BO,B1,B2,B3, and open the operating circuit of relays TRP- and TP-.

12.04 When a register becomes idle again, its associated relays RA-A and RA-B operate, which, in turn, release relays ARBA and ARBB. The marker will then again continue to serve station or trunk calls within the gate.

B. All Links Busy

Station-to-Station Call (SC11,SC22, or SC35)

12.05 If during the link testing sequence of the marker, while setting up a station-to-station call, all links in the first group of links tested are found to be busy, the marker will shift the link

testing circuitry to the second group of links and look for an idle link in that group. If there are no idle links in the second group tested, the all-links-busy relays ALBA,B (FS12 or FS28) will operate.

12.06 Relays ALBA,B operated:

- (a) Operate the busy tone relays BTTA,B.
- (b) Operate the camp-on stop relays COSA,B (FS12 or FS28).

12.07 Relays BTTA,B operated:

- (a) Operate relays TRKA,B and TRKAA,BA.
- (b) Lock operated to the operated relays RP- or RPA-.
- (c) Release relay JR- corresponding to the junctor selected.

12.08 The release of relay JR- will release relays JREA,B. Relays JREA,B, in releasing, will release relays LTA,B and LTAA,BA.

12.09 If option ZN is provided, the release of relays LTA,B releases relays LBA,B and LTCA,B. The release of relays LBA,B, in turn, will release relays ALBA,B and relays COSA,B in sequence.

12.10 If options 22 or Z0 are provided, the release of relays LTA,B releases relays LBA,B, LTCA,B, and ALBA,B. The release of relays LBA,B, in turn, will release relays LSHA,B. The release of relays ALBA,B will release relays COSA,B.

12.11 After relays TRKA,B and TRKAA,BA operate, the marker will function to complete the call to a busy tone trunk using the link used for the dial tone connection.

Dial Tone Call

12.12 If, while the marker is processing a dial tone call, it finds all links busy, relays ALBA,B will operate. Since, on this type of call relays TACA,B and TACAA,BA are operated, the operation of relays ALBA,B will close paths for operating the slow operate relays ACA,B on FS5.

12.13 When relays ACA,B operate, relays DCKA,B release, which, with relays ACA,B operated, cause relays RLA,AA, AB, B, BA, BB relays to operate, releasing the marker.

12.14 When the marker is released, it will continue to try to complete calls required of it even though all links are still busy.

C. All Junctors Busy (SC12)

12.15 When a marker is trying to complete a call requiring a junctor and all

junctors are busy, the call will be routed to a busy tone trunk.

12.16 When relays U- operate during the junctor selection sequence, no relays will operate, since all junctors are busy, and the ground from the contacts of relay JTAA,BA will operate relays BYA,B. This will operate relays HCA,B, which will then provide a path for operating relays BSYAA,BA and BSYA,B, in sequence.

12.17 Relays BSYA,B, in operating, will operate relays SOA,B and release relays HCA,B. Relays SOA,B, in operating, will operate relays SO-2 and S5-7, which, in turn, operate relays SEA,B and SEAA,BA. These relays, in operating at this time, operate relays SMRA,B and SMRAA,BA, and release relays RUCA,B.

12.18 With relays SMRAA,BA, SEA,B, SO, SOA,B, and JTA operated, relays HMKA,B are connected to the hold magnet of junctor O. The ground at that point will operate relays HMKA,B. Meanwhile, relays RUCA,B, in releasing, cause a sequence releasing relays UO-2, U5-7, and UEA,B. Relays UEA,B, in releasing, will release relays BYA,B, BSYA,B, and BSYAA,BA if option ZM is provided or, if option ZL is used the release of relays UEA,B will release relays BYA,B which, in turn, release relays BSYAA,BA and BSYA,B. However, if option WX is provided, the release of relays BYA,B, BSYAA,BA, and BSYA,B (whether option ZL or ZM is provided) will delay until relays JTAA,BA release.

12.19 With relays SOA,B, SMRAA,BA, and HMKA,B operated, relays BTTA,B will operate and lock to operated relays RP- or RPA-. Relays BTTA,B operated will:

- (a) Operate relays TRKA,B and TRKAA,BA.
- (b) Release relays JTA,B, which, in turn, release relays JTAA,BA, SMRA,B and SMRAA,BA, SO-2, S5-7, and SEA,B and SEAA,BA, in that sequence.
- (c) Release relays SOA,B, which, in turn, release relays HMKA,B.

12.20 With relays TRKA,B operated and relays HMKA,B released, relays TRCA,B and TRCAA,BA will operate.

12.21 The release of relays SEA,B and SEAA,BA will:

- (a) In conjunction with relays TRCA,B operated, release relays TRKA,B and TRKAA,BA.
- (b) Reoperate relays RUCA,B.

12.22 With relays BTTA,B and TRCA,B operated and relays TRKAA and TRKB released (and if option WZ is provided - relays BYA,B released), relays BTCA,B will operate. Relays BTCA,B, in operating, will

operate relay SMCO and release relays TOLA,B. Relay SMCO, in operating will:

(a) Provide a path for operating the select magnets on switch O used for the dial tone connection from grounds at the contacts of the operated relays TRCAA,BA passing through relay RP- and the register memory hold magnet THM-9.

(b) Operate relays SMTA,B.

12.23 With relays BTCA,B and RUCA,B operated, the relay UO will operate, which, in turn, will operate relays UEA,B. If the busy tone trunk is idle, battery through its trunk hold magnet THMO7 will operate relay SO, which, in turn, will operate relays SEA,B and SEAA,BA.

12.24 Beyond this point in the sequence, the marker will function to connect the calling station to the idle busy tone trunk and release itself and the register.

D. Busy Tone Trunk Busy (SC13)

12.25 When the marker reaches the point in a sequence where it starts to set up the call to the busy tone trunk as described previously, it will first make a busy test on the busy tone trunk by connecting relay SO primary winding to the hold magnet of the trunk.

12.26 If the trunk is busy, the ground at the hold magnet will prevent relay SO from operating. When relays SMTA,B are operated by relay SMCO, ground from the contacts of relays SMTA,B will pass through the break contact chain of the unoperated relays SO-9 on FS6 and operate relays BYA,B.

12.27 Relays BYA,B, in operating, will:

(a) Release relays DCKA,B, which, in turn, will operate relays RLA,AA, AB,B,BA,BB, and start the sequence to release the marker.

(b) Operate relays HCA,B, which have no function at this time.

(c) Lock operated to the operated relays UEA,B.

(d) Ground leads BY- to the register through contacts of the operated relays BTCA,B and RPA- as shown on FS10, which will operate relay BY in the register.

(e) Open leads RRA-, B- from the marker to the register to prevent the release of the register during the marker release (option VM provided).

12.28 Relay BY in the register, in operating, will:

(a) Lock operated to relay ON in the Register.

(b) Release relay DC in the register.

(c) Open leads RRA-, B- from the register to the marker to prevent the release of the register during the marker release (option VL provided).

(d) Apply busy tone over the tip and ring conductors to the calling station or trunk.

12.29 The release of relay DC in the register will release relay R- in the marker. The operation of relays RLAA,BA or the release of relay R- will:

(a) Release relay RP-, which, in turn, will release relay RPA- and the operated select magnets on switch O.

(b) Release relays TCK1,2,3,4.

(c) Release relay MTA,B, which stops the marker timing.

12.30 The release of relay RPA- releases relays BTTA,B, and RUCA,B. Relays BTTA,B, in releasing, will release relays TRCA,B and TRCAA,BA and BTCA,B. The release of relays RUCA,B will cause the release of relays UO, UEA,B, BYA,B and HCA,B, in sequence. The release of relays BTCA,B will release relays SMCO and SMTA,B in sequence.

12.31 With relays TCK1,2,3,4 and TRCA,B released and relays RLAA,BA operated, relays DCKA,B will reoperate, causing relays RLA,AA,AB,B,BA,BB to release and thereby restore the marker to normal.

12.32 The register will continue to furnish busy tone to the calling station or trunk until it times out and releases.

12.33 When the called station is busy, dial tone in place of busy tone may be returned to the calling station when the busy tone trunk is in use. This trouble occurs when the marker timing becomes such that it signals the register to release before the register has time to respond to the previous signal to hold and return busy tone. Option VM is added to prevent this trouble condition. When the register is signaled to hold and return busy tone, option VM prevents the marker from signaling the register to release.

E. All Attendant Trunks Busy on Intercepted Call (SC19)

12.34 If a call has been intercepted but all attendant trunks are busy, relays BYA and BYB and BSYA and BSYB will operate when no relay S- operates. At that point the marker will block and wait for its timing circuit to direct it to second trial. If on second trial the same condition results, the marker will block again and wait for the timing circuit to

direct it to a no-connection situation. At that time the marker will connect the call to the busy tone trunk.

13. LINK SHIFT TIMING

A. General

13.01 Whenever the marker is processing a call requiring link selection or completing a camp-on sequence for the completion of a trunk call to a busy station, relays LTA,B or COA,B will operate at the start of the link hunting sequence. These relays operated will close the operating path of the slow operate relays LBA,B (FS12 or FS28).

13.02 If all links are busy in the first group tested or if the link to be camped on is not in the first group tested, relays LBA,B will operate. The link group sequence control circuit will advance and change the state of relays TRLA,B. Relays TRLA,B, in operating or releasing, will shift the link testing circuitry from one group of links to the other.

B. Link Shift Timing (Option 22 - SC34)

13.03 The operation of relays LTA,B or COA,B will connect ground to one side of the winding of the slow operate relays LBA,B. The other side of the winding is connected to battery through break contacts of the released relays LSHA,B and the break contact chain of relays LT2-9 as shown on FS28. If no LT- relays operate within approximately 50 milliseconds, relays LBA,B will operate.

13.04 Relays LBA,B, in operating, will:

- (a) Lock operated to their own contacts under control of relays LTA,B or COA,B.
- (b) Advance the link group sequence control circuit.
- (c) Open the operating path for relays LEA,B and LEAA,BA to prevent them from operating prematurely if a LT- relay has operated just prior to the operation of relays LBA,B.
- (d) Release relays LTCA,B to open the circuit to relays LT2-9 to prevent them from operating or to release any that may have operated during the link shifting operation.
- (e) Operate relays LSHA,B.

13.05 Relays LSHA,B, also slow in operating, will operate in approximately 29 milliseconds. These relays, in operating, will:

- (a) Reoperate relays LTCA,B.

(b) Restore the operating paths for relays LEA,B and LEAA,BA.

(c) Start the all-links-busy timing by connecting relays ALBA,B to battery through the chain of relay LT2-9 break contacts.

13.06 If a LT- relay operates during the testing of the second group of links, relays LEA,B and LEAA,BA will operate and the marker will proceed to process the call and release. Relays LBA,B will release when relays LTA,B or COA,B release. Relays LBA,B, in releasing, will release relays LSHA,B thereby returning the link shift timing circuit to normal.

C. Link Shift Timing (Option ZO - SC21)

13.07 The operation of relays LTA,B or COA,B will connect ground to one side of the winding of the slow operate relays LBA,B. The other side of the winding is connected through break contacts of the released relays LSHA,B to the break contact chain of relays LTS2-9 to battery, as shown on FS12. If no relays LTS- operate within approximately 50 milliseconds, indicating that all links are busy in the first group tested (or that the link to be camped on is not in the first group tested), relays LBA,B will operate.

13.08 Relays LBA,B, in operating, will:

- (a) Lock operated to their own contacts under control of relays LTA,B or COA,B.
- (b) Advance the link group sequence control circuit.
- (c) Open the operating path for relays LEA,B and LEAA,BA to prevent them from operating prematurely if a relay LTS- has operated just prior to the operation of relays LBA,B.
- (d) Release relays LTCA,B to open the circuit to relays LT2-9 to prevent them from operating or release any that may have operated during the link shifting operation.
- (e) Operate relays LSHA,B.

13.09 Relays LSHA,B, also slow in operating, will operate in approximately 29 milliseconds. These relays, in operating, will:

- (a) Reoperate relays LTCA,B.
- (b) Restore the operating paths for relays LEA,B and LEAA,BA.
- (c) Connect relays ALBA,B to the chain of relay LTS2-9 break contacts to start the all-links-busy timing.

13.10 Relays LBA,B will release when relays COA,B or LTA,B release. Relays LBA,B in releasing, will release relays LSHA,B.

D. Link Shift Timing (Option ZN - SC10)

13.11 The operation of relays LTA,B or COA,B will connect the slow operate relays LBA,B to battery through the chain of relay LTS2-9 break contacts as shown on FS12. If no relays LTS- operate within the operating time (approximately 50 milliseconds) of relays LBA,B, these relays will operate.

13.12 Relays LBA,B, in operating, will:

- (a) Advance the link group sequence control circuit.
- (b) Open the operate paths of relays LEA,B and LEAA,BA.
- (c) Connect ground to one side of relay ALBA,B and connect the other side of the winding to relay LTS2-9 break contact chain in parallel with relays LBA,B to start the all-links-busy timing.

13.13 If a relay LTS- operates during the testing of the second group of links, relays LBA,B will release, restoring the operating path for relays LEA,B and LEAA,BA and allowing them to operate.

14. MARKER TIMING (SC16, SC36)

OPTION VQ

A. General

14.01 Whenever the marker is seized to process a call, a relay timing circuit shown on FS14 begins to function. The circuit is arranged to recycle three times, timing three distinct intervals. The timing will be stopped and the circuit restored to its starting condition whenever the marker has completed its functions and released in the normal manner.

14.02 If the marker has not released before the timing circuit has run through its initial cycle, the marker will restore the call sequence to an earlier state and initiate a second trial.

14.03 If the marker has not been able to complete the call and release in the normal manner on the second trial before the timing circuit has completed its second cycle, it is assumed a no-connection condition exists; the marker will attempt to complete the call to the busy tone trunk. If the marker has still not disposed of the call by the time the timing circuit has recycled for the third time, the marker will release on a trouble-release basis.

B. Second Trial

14.04 When the marker is seized for any type of call, relays MTA,B will

operate as described previously to start the marker timing. Relays MTA,B, in operating, will operate relays TMA,B, which, in turn, will operate relays TOA,B. Relays TOA,B, in operating, operate the slow operating relays TAA,B.

14.05 When relays TAA,B operate, the slow releasing relays TMA,B release. When relays TMA,B release, the slow releasing relays TOA,B release.

14.06 With relays TOA,B released and relays TAA,B operated, relays STA,B and STAR,BR will operate and lock to the operated relays MTA,B.

14.07 The release of relays TOA,B will also release relays TAA,B, which will:

- (a) Reoperate relays TMA,B to start the timing circuit on its second cycle.
- (b) Operate relays SAA,B, which lock to the operated relays MTA,B and release relays STAR,BR.

14.08 The approximate time interval between the operation of relays MTA,B and the STA,B and STAR,BR is 600 milliseconds. The approximate time interval between the operation of relays STA,B and SAA,B is 70 milliseconds.

14.09 The operation of relays STAR,BR will release relays SMTA,B and also release relays RPA-, if operated. Relays STA,B, in operating, will:

- (a) Release any operated relay JR-.
- (b) Release relays RALA,B, if operated.

14.10 The subsequent operation of relays SAA,B will:

- (a) Release relays STAR,BR which will restore the operating path for relays SMTA,B.
- (b) Restore the locking path for relays JRO-5. The sequential operation of relays SAA,B will also advance the link and units sequence control circuit.

14.11 On a dial tone call, the release of relays SMTA,B will cause the release of relays SMRA,B and SMRAA,BA, HMTA,B, and HMTAA,BA. The advance in the link sequence control circuit will cause a new link to be selected (if another link is idle in the same group).

14.12 If on the first trial the marker preferred register 1, the release of relay RALA,B will cause the marker to attempt to connect to register 0 (if idle) on the second trial.

14.13 If the marker preferred register O on the first trial, the release of relay RALA,B will cause the marker to prefer register O again on the second trial. The advance of the units sequence control circuit will change the state of relay ZU. When relays SMTA,B reoperate, the grounds from their contacts will pass through relay S- contact chain on FS6 by the alternate route.

14.14 If the marker is processing a terminating call, the release of relays RPA-, JR-, and SMTA,B will cause the release of most of the relays involved in processing the call on the first trial. On the second trial, the marker will make new link and junctor selections.

C. No Connection

14.15 While the marker is processing a call on a second trial basis, the timing circuit will recycle. If the call has not been completely processed and the marker released before relays TOA,B release on the second cycle, relays NCA,B will operate and release relays JTA,B, ICTA,B, and TRCA,B and TRCAA,BA if operated. When relays TAA,B release, relays TMA,B will operate to start the timing circuit on its next cycle and operate relays NAA,B.

14.16 Relays NAA,B, in operating, will:

- (a) Release relays RCTA,B and RCTAA,BA, if operated.
- (b) Restore the operating path for relays TRCA,B and TRCAA,BA.
- (c) Operate relays BTAA,B through contacts of the released relays TRCAA,BA.

14.17 Relays BTAA,B, in operating with relays TRCA,B released, will operate relays TRKA,B and TRKAA,BA, which, in turn, release relays SMTA,B and SMRA,B and SMRAA,BA, in sequence. With relays HMKA,B released, relays TRCA,B and TRCAA,BA will reoperate when relays SMTA,B release. When relays TRCA,B operate, relays TRKA,B and TRKAA,BA will release; since relays BTAA,B, are operated, relays BTCA,B will operate.

14.18 When relays BTCA,B operate, the marker will attempt to complete the connection to the busy tone trunk.

D. Trouble Release

14.19 If the marker is unable to complete processing the call to the busy tone trunk on a no-connection basis before relay TOA,B releases on the third cycle of the timing circuit, relays TRA,B will operate over a path through contacts of the released relays TOA,B and the operated relays TAA,B and MTA,B.

14.20 Relays TRA,B, in operating, will:

- (a) Lock to the operated relays MTA,B.

(b) Release the normally operated release check relays RCKA,B (FS15).

(c) Release relays TAA,B, which, in turn, reoperate relays TMA,B.

14.21 The release of relays RCKA,B will operate the trouble release relays RLSA,B and RLSAA,BA from ground at make contacts of the operated relay TRA,B.

14.22 The trouble release relay, in operating, will:

(a) Release relays TEAO,A1,A2,A3,BO,B1,B2,B3, and TCK1,2,3,4.

(b) Release any operated relays RP-, TRP-, TP-, TACA,B and TACAA,BA, SEA,B and SEAA,BA, LEA,B and LEAA,BA, and SMTA,B.

(c) Release relay MC in a trunk, if operated.

(d) Operate relays RRLA,B in a register if a register is connected.

(e) Release relays MTA,B.

14.23 The release of relays MTA,B releases relays STA,B, SAA,B, NCA,B, NAA,B and slow release relays TRA,B and TMA,B. When relays TRA,B release, relays RLSA,B and RLSAA,BA release and the slow operate relays RCKA,B reoperate.

14.24 When relays RLSAA,BA operate, relay TA- or TRA- corresponding to the operated relay TP- or TRP will operate and lock to the released relays RCKA,B. The released relays RCKA,B will also maintain the locking path for any other operated relays TA- and TRA- when relays TEAO,BO release. The release of relays TRP-, TP-, TACA,B and TACAA,BA, SEA,B and SEAA,BA, LEA,B and LEAA,BA, and SMTA,B will otherwise restore the marker to normal.

14.25 The release of relays TEAO,A1,A2,A3,BO,B1,B2,B3 will reopen the gate circuits and admit new requests for the services of the marker in those tens groups whose corresponding relays TA- or TRA- are not locked operated. When relays RLSA,B and RLSAA,BA release, any operated relay T-, TR-, or R- will operate relays TEAO,A1,A2,A3,BO,B1,B2,B3, which will maintain the locking path for any operated relays TA- and TRA- when relays RCKA,B release.

14.26 The marker will then process the calls in the preferential order omitting those tens and trunk tens groups which had been served before the trouble release.

OPTION VR

A. General

14.27 Whenever the marker is seized to process a call, a relay timing cir-

cuit shown on FS14 begins to function. The circuit is arranged to recycle three times, timing three distinct intervals. The timing will be stopped and the circuit restored to its starting condition whenever the marker has completed its functions and has released in the normal manner.

14.28 If the marker has not released before the timing circuit has run through its initial cycle, the marker will restore the call sequence to an earlier state and initiate a second trial.

14.29 If the marker has not been able to complete the call and release in the normal manner on the second trial before the timing circuit has completed its second cycle, it is assumed a no-connection condition exists; the marker will attempt to complete the call to the busy tone trunk. If the marker still has not disposed of the call by the time the timing circuit has recycled for the third time, the marker will release on a trouble-release basis.

B. Second Trial

14.30 When the marker is seized for any type of call, relays MTA,B will operate as described previously to start the marker timing. Relays MTA,B in operation will start the timer. After a delayed time (approximately 790 ms), the timer extends ground over lead T1 and T7, operating relays TA and TB, respectively.

14.31 With relays TA and TB operated, relays STA,B, and STAR,BR will operate and lock to the operated relays MTA,B.

14.32 Relays STA,B operated:

- (a) Prepare the operate for relays SAA and SAB.
- (b) Release relays JR(0-5) and RAlA,B if operated.
- (c) Stop the link and unit sequence control circuit.

14.33 Relays STAR,BR operated:

- (a) Stop the timer.
- (b) Release relays SMTA,B RPA(0,1) if operated, and TA,B.

14.34 Relays TA,B released, operate relays SAA and SAB.

14.35 The approximate time interval between the operation of relays MTA,B and the STA,B and STAR,BR is 800 ms. The approximate time interval

between the operation of relays STA,B and SAA,B is 70 ms.

14.36 Relays SAA,B operated:

- (a) Lock to the operated relays MTA,B.
- (b) Release relays STAR,BR which restore the operating path for relays SMTA,B.
- (c) Restore the locking path for relays JRO-5. The sequential operation of relays SAA,B will also advance the link and units sequence control circuit.

14.37 On a dial tone call, the release of relays SMTA,B will cause the release of relays SMRA,B; SMRAA,BA; HMTA,B; and HMTAA,BA. The advance in the link sequence control circuit will cause a new link to be selected (if another link is idle in the same group).

14.38 If on the first trial the marker preferred register 1, the release of relays RAlA,B will cause the marker to attempt to connect to register 0 (if idle) on the second trial.

14.39 If the marker preferred register 0 on the first trial, the release of relays RAlA,B will cause the marker to prefer register 0 again on the second trial. The advance of the units sequence control circuit will change the state of relay ZU. When relays SMTA,B reoperate, the grounds from their contacts will pass through relays S- contact chain on FS6 by the alternate route.

14.40 If the marker is processing a terminating call, the release of relays RPA-, JR-, and SMTA,B will cause the release of most of the relays involved in processing the call on the first trial. On the second trial, the marker will make new link and junctor selections.

C. No Connection

14.41 While the marker is processing a call on a second trial basis, the timing circuit will recycle. If the call has not been completely processed and the marker released before relays TA and TB operate on the second cycle, relays NCA,B will operate and release relays JTA,B; ICTA,B; TRCA,B; and TRCAA,BA if operated. When relays TA and TB release, relays NAA,B will operate to start the timing circuit on its next cycle.

14.42 Relays NAA,B operated:

- (a) Release relays RCTA,B and

RCTAA,BA if operated.

- (b) Restore the operating path for relays TRCA, B and TRCAA, BA.
- (c) Start the timer.
- (d) Operate relays BTTA,B through contacts of the released relays TRCAA,BA.

14.43 Relays BTTA,B, in operating with relays TRCA,B released, will operate relays TRKA,B and TRKAA,BA; which, in turn, release relays SMTA,B, SMRA,B; and SMRAA,BA in sequence. With relays HMKA,B released, relays TRCA,B and TRCAA,BA will reoperate when relays SMTA,B release. When relays TRCA,B operate, relays TRKA,B and TRKAA,BA will release; since relays BTTA,B are operated, relays BTCA,B will operate.

14.44 When relays BTCA,B operate, the marker will attempt to complete the connection to the busy tone trunk.

D. Trouble Release

14.45 If the marker is unable to complete processing the call to the busy tone trunk on a no-connection basis before relays TA,B operate on the third cycle of the timing circuit, relays TRA,B will operate over a path through contacts of the operated relays, TA,B and the operated relays MTA,B.

14.46 Relays TRA,B in operating:

- (a) Lock to the operated relays MTA,B.
- (b) Release the normally operated release check relays RCKA,B (FS15).

14.47 The release of relays RCKA,B will operate the trouble release relays RLSA,B and RLSAA,BA from ground at make contacts of the operated relays TRA,B.

14.48 The trouble release relay, in operating will:

- (a) Release relays TEAO, A1, A2, A3, B0, B1, B2, B3, and TCK1, 2, 3, and 4.

(b) Stop the timer.

(c) Release any operated relays RP-; TRP-; TP-; TACA,B; TACAA,BA; SEA,B; SEAA,BA; LEA,B; LEAA,BA, and SMTA,B.

(d) Release relay MC in a trunk, if operated.

(e) Operate relays RRLA,B in a register if a register is connected.

(f) Release relays MTA,B.

14.49 The release of relays MTA,B release relays STA,B; SAA,B; NCA,B; NAA,B; TA,B; and slow release relays TRA,B. When relays TRA,B release, relays RSLA,B and RSLAA,BA release and the slow operate relays RCKA,B reoperate.

14.50 When relays RSLAA,BA operate, relay TA- or TRA- corresponding to the operated relay TP- or TRP will operate and lock to the released relays RCKA,B. The released relays RCKA,B will also maintain the locking path for any other operated relays TA- and TRA- when relays TEAO,B0 release. The release of relays TRP-; TP-; TACA,B; TACAA,BA; SEA,B; SEAA,BA; LEA,B; LEAA,BA; and SMTA,B will otherwise restore the marker to normal.

14.51 The release of relays TEAO, A1, A2, A3, B0, B1, and B3 will reopen the gate circuits and admit new requests for the services of the marker in those tens group whose corresponding relays TA- or TRA- are not locked operated. When relays RLSA,B and RLSAA,BA release, any operated relay T-, TR-, or R- will operate relays TEAO, A1, A2, A3, B0, B1, B2, and B3, which will maintain the locking path for any operated relays TA- and TRA- when relays RCKA,B release.

14.52 The marker will then process the call in the preferential order omitting those tens and trunk tens groups which had been served before the trouble release.

15. TIME-OUT CHECK (SC18)

15.01 The time-out check circuit on FS16 is provided to exercise the marker timing circuit on FS14. When the marker is functioning normally, the timing circuit

will never run through its full sequence. The time-out check circuit is designed to run the timing circuit through its full sequence whenever the normally operated time-out lock relays TOLA,B (FS16) release, due to a power failure, or relays BTCA,B operate when the marker connects a call to the busy tone trunk.

15.02 When relays TOLA,B release, a path is prepared for operating the time-out check relays TOKA,B when the marker has finished processing all of the calls in the tens preference chain and relays TEA2,BO,B2 release.

15.03 Relays TOKA,B, in operating, will:

- (a) Operate relays MTA,B, which will start the timing circuit.
- (b) Lock operated under control of relays RLSA,B.
- (c) Open the operating path for relays TEAO,A1,A2,A3,BO,B1,B2,B3 and the tens preference chain on FS3.
- (d) Reoperate relays TOLA,B.

15.04 When the marker timing circuit has completed its third cycle, relays RLSA,B and RLSAA,BA will operate, releasing relays TOKA,B and returning the marker to normal.

16. TRAFFIC REGISTER CONTROL

A. General

16.01 Contacts on relays in the marker are provided for operating internal and external registers in the traffic register control circuit as shown on FS24. These leads may be grouped as peg count and overflow and may be cross-connected to a maximum of six internal and ten external registers.

B. Peg Count Register Control

16.02 Whenever the marker attempts to serve a line or code 8 trunk for a dial tone call, relay TP- will operate and ground lead OPC to the traffic register circuit, scoring the associated register. On a code 9 or attendant trunk dial tone call, relay TRP- will operate and ground lead TPC to score the associated register. A code 9 trunk dial tone call will cause lead OPC9 to be grounded, and a code 8 trunk dial tone call will cause the lead OPC8 to be grounded. The grounding occurs as a result of relays RGAA,BA and RA-A in the marker being operated in conjunction with relays COT or TT in the register.

16.03 Whenever the marker attempts to complete a call to a code 9 trunk, relay TKB9 will operate, grounding lead

TPC9 and thereby scoring the corresponding register. Attempts to complete calls to code 8 and attendant trunks will operate relay TKB8 or TKO, respectively, grounding leads TPC8 or TPC0 and scoring the associated registers.

16.04 An attempt by the marker to connect to the busy tone trunk will cause relays BTCA,B to operate, which will ground lead BTPC and operate the corresponding register. Whenever relays TOLA,B in the marker release and reoperate, indicating that the marker timing circuit has been exercised, ground is removed from lead TOPC and causes the corresponding register to score once.

16.05 Every attempt by the marker to terminate a call involving the use of a junctor will operate relays JTAA,BA, which will ground lead JPC and score the corresponding register.

C. Overflow Register Control

16.06 If relay T- or TR- is operated, indicating a dial tone call is waiting to be processed, and relays ARBA,BB operate, indicating that all registers are busy, lead ROF will be grounded, which will score the corresponding register.

16.07 Each time relays ALBA,B operate, indicating an all-links-busy condition, lead LOF will be grounded and the corresponding register will score.

16.08 When the marker attempts to complete a call to a code 9 trunk, relay TKB9 will operate. If all trunks in the group are busy, relays BYA,B will also operate and ground lead OF9, which will operate the corresponding register.

16.09 In a similar manner, if all trunks in a code 8 trunk group are busy when the marker attempts to complete a call to such a group, lead OF8 will be grounded, causing the corresponding register to score. If all attendant trunks are busy when the marker attempts to connect a call to one of them, lead OF0 will be grounded and the corresponding register scored.

16.10 If the busy tone trunk is busy when the marker attempts to connect a call to it, relays BTCA,B and BYA,B will be operated, causing lead ETOF to be grounded and the corresponding register operated. If all junctors are busy when the marker is attempting to complete a station-to-station or code 8 trunk-to-station call, relays JTAA,BA and BYA,B will be operated, causing lead JOF to be grounded. The corresponding register will be scored.

D. Trouble Register Control

16.11 The trouble registers indicate the number of times the marker timing circuit progresses to the second trial

stage and beyond. When relays STAR, BR operate, indicating that the marker has progressed to the second trial stage, lead STPC is grounded and the corresponding register scored. If the marker progresses to the no-connection state, relays NAA, B will operate, grounding lead NCPC and causing the corresponding register to operate. When relays RLSAA, BA operate, indicating that the marker has progressed to the trouble release stage, lead TRPC is grounded and the corresponding register scored.

16.12 It should be noted that the trouble registers will score when the marker is exercising the timing circuit as well as when actual trouble conditions are encountered.

17. UNIVERSAL LINE GROUP 20-29

A. General

17.01 A line circuit in the 20-29 group may be connected to a station line, 2-way (Dial-Repeating Type) Tie Trunk, Dial Conference Circuits, Recorded Telephone Dictation Trunk, Loudspeaker Paging Trunk, Auxiliary Position Circuits, or either the calling or answering end of a 3A Code Call Circuit. When the line circuit is assigned to a station line or the answering end of the 3A code call circuit, it is reached by dialing the corresponding number in the 20 series. Otherwise it is reached by dialing the corresponding number in the 80 series. If the line circuit is unassigned, calls to it will be intercepted.

17.02 If the line circuit is assigned to a connecting circuit requiring a number in the 20 series, calls dialing the corresponding number in the 80 series will be intercepted as an unassigned number. Likewise, if the line circuit is assigned to a connecting circuit requiring a number in the 80 series, a call dialing the corresponding number in the 20 series will also be intercepted.

B. Station Line (Options M, ZD, WP, VC, and VE)

17.03 Options M, ZD, WP, VC, and VE are provided when a line circuit is assigned to a station line. Calls to and from the station line are processed by the marker in the same manner as described previously, except that lead S from the marker operates relay IN instead of the line hold magnet directly. The line hold magnet is operated by relay IN. The 100-ohm ground on the sleeve of a connected link will hold relay IN operated after the marker completes its functions and leaves the connection

C. Two-Way Tie Trunk (Options ZD, ZF, WQ, VC, and VE)

17.04 When a line circuit is assigned to a 2-way tie trunk, leads T1, R1, T2, R2, and S2 are connected to the trunk and

options ZD, ZF, WQ, VC, and VE are used. However, if delay dial signaling is required, option VC must be removed and replaced by option VD. NOTE: With some types of tie trunks lead S1 may also be required in addition to the leads mentioned above.

17.05 When the circuit is seized for an incoming call, a bridge on the tip and ring or a ground on the ring in the trunk will operate relay L over leads T1 and R1 and the marker will process the call as if it were a station. Relay L, in operating, will close a path between lead S to the marker and the winding of relay IN. This path is maintained by make contacts of relay IN after the marker operates relay IN over lead S. Relay IN operated operates the line hold magnet which causes relay L to release. With pad control options 19, 20, and 21 specified, relay IN activates trunk pad control as described for Pad Control Circuit (Paragraph 24).

17.06 After the connection has been established, relay IN is held operated by the 100-ohm ground on the sleeve of the link. This ground will in some cases also cause a relay to operate in the trunk (over lead S1) that will return ground to the line circuit over lead S2 operating relay SL. In other trunks the ground on lead S2 is present immediately upon seizure.

17.07 Thermistor T in series with relay SL delays the operation of this relay by approximately 250 milliseconds. The purpose of this delay is explained subsequently. Relay SL, in operating, opens the operate path for relay OT and places a ground on lead IT to the marker as a busy indication. Until relay SL operates, however, this make-busy function is performed in sequence by relays L and IN.

17.08 When the marker seizes the circuit for an outgoing call by grounding lead IT, relay OT operates. Relay OT, in operating:

- (a) Operates the line hold magnet, thus closing the crossbar switch cross-points.
- (b) Transfers the link tip and ring leads from their normal connection to the incoming leads of the trunk (leads T1 and R1) to the outgoing leads of the trunk (leads T2 and R2).
- (c) Disconnects the link sleeve from its normal connection to lead S1 of the trunk and connects 100-ohm ground to it.
- (d) Prepares a path for locking itself to lead S2 of the trunk.
- (e) Starts the operation of relay SL.

17.09 If the trunk is of the type that requires a forward ground on lead S2 for seizure on an outgoing call, this

requirement is satisfied by the operation of relay OT since the ground from the marker which operates it is extended to the lead S2 when the relay operates.

17.10 The calling party's bridge on the tip and ring of the link will operate a relay in the trunk, causing it to return a ground over lead S2 to keep relay OT operated when the marker removes ground from lead IT. This ground on lead S2 also operates checking relays in the marker and completes the operation of relay SL.

17.11 Relay SL, in operating, opens the operate path for relay OT and grounds lead IT to the marker as a busy indication. Relay SL is made slow in operating to allow sufficient time for the trunk to return locking ground on lead S2 to hold relay OT operated before the operating path for relay OT is opened. When relay SL operates, thermistor T is short-circuited by contacts of relay SL to allow it to start cooling immediately, thus ensuring that relay SL will operate in approximately the same time interval on subsequent operations.

17.12 If the trunk is of a type arranged for joint usage with a switchboard, ground will be connected to lead S2 when the trunk is being used by the switchboard. The trunk may also be made busy for maintenance or traffic reasons at the trunk equipment. In this case, a ground will also be connected to lead S2. Ground on lead S2 will operate relay SL, grounding lead IT to the marker and preventing its selection for an outgoing call at the PBX.

17.13 Diode L (option J - FS35) in the battery supply lead for relays L20-29 prevents the transfer relays AT and ATA of the alarm, transfer, and test circuit from being held up falsely via a tie trunk at the distant end when the PBX power fails.

D. Dial Conference Circuit
(See Circuit Note 126 - Sheet D1B)

17.14 When a line circuit is assigned to a terminal of the dial conference circuit, options N, ZD, WP, VC, and VE are provided and leads T2, R2, and S2 are connected to the dial conference circuit.

17.15 When connecting a station or trunk to the dial conference terminal via this line circuit, the marker will ground lead IT operating relay OT in the same manner as when setting up a connection to a 2-way tie trunk. When the crossbar switch points operate, connecting the link through to the dial conference circuit, the station or trunk bridge will operate a relay in the dial conference circuit, which causes ground to be returned on lead S2.

17.16 Ground on lead S2 locks relay OT operated and grounds lead IT as the

busy indication. Relay SL will operate whenever lead S2 is grounded and replaces lead S2 on lead IT with a ground from its own contacts.

E. Recorded Telephone Dictation Trunk
(Options ZD, ZF, WP, VC, and VE)

17.17 When a line circuit is assigned to a recorded telephone dictation trunk, leads T2, R2, and S2 are connected to the trunk, and options ZD, ZF, WP, VC, and VE are used. However, if a cord switchboard is used in connection with the PBX, option VE must be removed and replaced by option VF.

17.18 The marker will connect a calling station to the recorded telephone dictation trunk in the same manner as when setting up a call to a 2-way tie trunk. The trunk will return ground over lead S2 to complete operating relay SL and lock relay OT operated.

17.19 When the calling station hangs up, the trunk normally removes the ground on lead S2, causing relays OT and SL to release. Relay OT, in releasing, releases the line hold magnet, restoring the circuit to normal. If, however, the dictation trunk attendant had been called in on the connection and the attendant remains on the line after the calling station disconnects, the trunk will remove ground from lead S2 for an instant, after which the ground is restored.

17.20 During the momentary removal of lead S2 ground, relays SL and OT will release, causing the line hold magnet to release. The release of the magnet frees the link and restores the line circuit to normal. The reappearance of the ground on lead S2 will reoperate relay SL and ground lead IT to the marker as a busy indication. If the trunk is taken out of service for maintenance of the trunk or the associated dictation machine, lead S2 will be grounded, which will operate relay SL and connect a busying ground to lead IT.

F. Loudspeaker Paging Trunk
(Options ZD, ZS, WP, VC, and VE)

17.21 When a line circuit is assigned to the loudspeaker paging trunk, options ZD, ZS, WP, VC, and VE are used, and leads T2, R2, and S2 are connected to the trunk.

17.22 A calling station or trunk is connected to the loudspeaker paging trunk by the marker in the same manner as when a calling station or trunk dials the recorded telephone dictation trunk.

17.23 If the loudspeaker trunk is seized by the attendant, ground will be connected by the trunk to lead S2, which will operate relay SL. Relay SL, in operating, will ground lead IT to the marker, thus preventing its selection for an outgoing call at the PBX.

G. 3A Code Call Circuit
(Options ZD, ZG, ZE, WP, VC, and VE)

- 17.24 Two line circuits are required to connect to one channel of the 3A code call circuit; one circuit is required for association with the calling end and the second circuit for association with the answering end. The line circuit assigned to the calling end should be provided with options ZD, ZG, WP, VC, and VE and leads T2, R2, and S2 connected to the code call circuit.
- 17.25 The line circuit assigned to the answering end should be provided with options ZE, WP, VC, and VE and leads T1, R1 A and S1A connected to the code call circuit. It is also required that leads HM, IT, and S2 be interconnected between the two line circuits and that the line hold magnet contacts in the line circuit assigned to the answering end be permanently insulated with a blocking tool to isolate the associated relay L windings from the circuit.
- 17.26 A calling party will originate a call to the 3A code call circuit by dialing the number in the 80 series corresponding to the line circuit to which the calling end is assigned. Assuming the answering end line circuit idle, the marker will process the call in the same manner as when connecting a call to a 2-way tie trunk.
- 17.27 The ground on lead IT originating in the marker will operate relay OT in the calling end line circuit through break contacts of relay IN and SL in the answering end line circuit and break contacts of relays L and IN in the calling end line circuit. When relay OT operates, operating the line hold magnet, the calling party bridge on the tip and ring of the link will function relays in the code call circuit, causing it to return a holding ground for relay OT on lead S2.
- 17.28 Ground on this lead will also operate relay SL in the line circuit associated with both the calling and answering ends. However, only relay SL associated with the calling end performs a useful function in this application. The answering end relay SL, in operating, will open the operating path of relay OT in the calling end line circuit and connect ground to lead IT as a busy indication to the marker.
- 17.29 After the connection to the calling end of the code call circuit is completed, the calling party will hear the code call circuit dial tone, indicating that the code of the desired party should be dialed.
- 17.30 When the code call circuit is idle, leads S and S1A to the answering end line circuit will be opened. Consequently, a station dialing the line number corresponding to the answering end will be intercepted in the same manner as a call to an unassigned line. However, when a calling party has seized the calling end, a relay in the code call circuit will close a path between leads S and S1A, thus making the answering end line circuit available for seizure by the marker.
- 17.31 Also, when relay SL operates in the answering end line circuit due to a seizure of the calling end of the code call circuit, the tip and ring conductors from the answering end of the code call circuit will be extended to the crossbar switch crosspoints prepared for connection to the answering call.
- 17.32 A called party responding to the code signal broadcast by the code call circuit will originate a call to the answering end of the code call circuit from any station in the PBX. The called party will dial the number in the 20 series corresponding to the line circuit assigned to the answering end of the code call circuit. The marker will process this call as a station-to-station call, using a junctor in the connection. When the marker grounds lead S of the answering end line circuit, relay IN will operate.
- 17.33 Relay IN, in operating, will operate the line hold magnet, cutting through the tip and ring conductors of the answering end of the code call circuit to the terminating end of the junctor via the connected link. Relay IN will lock over the sleeve lead of the link to a 100-ohm ground in the junctor.
- 17.34 The operation of relay IN will open a link in the operate path of relay OT in the calling end line circuit and prepare a path for connecting ground to lead IT associated with the calling end line circuit if the answering end relay SL should release before relay IN.
- 17.35 When a calling party is connected to the code call circuit to the answering party for conversation, lead S to the marker in the answering end line circuit will be grounded by the same ground that holds relay IN operated. Thus, if a station tries to dial the number of the answering end line circuit during this period, it will receive a busy indication rather than be intercepted as an unassigned line.
- 17.36 If the calling party disconnects first, the removal of the station bridge from the calling end of the code call circuit will cause ground to be removed from lead S2. This will release relay OT in the calling end line circuit and release relay SL in the answering end line circuit. Relay OT, in releasing, will release the line hold magnet, restoring the calling end line circuit to normal, except that the operate path of relay OT is held open and ground is maintained on lead IT by the operated relay IN in the answering end line circuit.

17.37 In the answering end line circuit relay IN is held operated by the junctor that is under control of the answering party. The answering end relay SL, in releasing, opens the code call circuit bridge on the tip and ring conductors at the answering end, releasing a relay in the terminating end of the junctor.

17.38 When the answering party finally disconnects, the junctor removes the 100-ohm ground on the sleeve lead of the link, releasing relay IN. Relay IN, in releasing, releases the line hold magnet in the answering end line circuit, restoring that circuit to normal. In the calling end line circuit, relay IN, in releasing, removes the ground from lead IT and closes the operating path of relay OT, thus restoring that circuit to normal and making the code call circuit available for another call.

17.39 If the answering party should disconnect first, the removal of the bridge at the originating end of a junctor will release only the link between the originating end of the junctor and the party responding to the code call signal. The remainder of the connection will remain intact under control of the calling party.

17.40 When the calling party finally disconnects, the code call circuit will remove ground from lead S2 to the calling end line circuit, releasing relay OT in that line circuit and relay SL in the answering end line circuit. Relay OT, in releasing, will release its associated line hold magnet.

17.41 The answering end relay SL, in releasing, will remove the bridge towards the terminating end of the junctor, allowing the junctor to release. The junctor, in releasing, will release relay IN in the answering end line circuit, which releases the associated line hold magnet. Thus, both line circuits are restored to normal and the code call circuit is available for another call.

17.42 When the code call circuit is made busy for maintenance reasons at the code call equipment, the ground will be connected to lead S2. This ground will operate relay SL in the answering end line circuit, which will ground lead IT to the marker at the calling end line circuit as a busy indication.

H. Auxiliary Position Circuit for Remote Trunk Answering (Options ZD, ZF, WP, VC, and VE)

17.43 When a line circuit is assigned to the auxiliary position circuit, options ZD, ZF, WP, VC, and VE are provided and leads T2, R2, and S2 are connected to the auxiliary position circuit.

17.44 The marker will connect a calling station to the auxiliary position circuit in the same manner as when setting up a call to a 2-way tie trunk. The auxiliary position circuit will return ground over lead S2 to complete operating relay SL and lock relay OT operated.

17.45 When the calling station hangs up, the auxiliary position circuit removes the ground on lead S2, causing relays OT and SL to release. Relay OT, in releasing, releases the line hold magnet, restoring the circuit to normal. If the auxiliary position circuit is taken out of service for maintenance, lead S2 will be grounded, causing relay SL to operate, which connects a busy ground to lead IT.

I. Dial Conference Trunk Circuit - Station Controlled (Options ZD, ZF, XD, WP, VC, and VE)

17.46 Six line circuits may be used as conference ports of the dial conference trunk circuit - station controlled. The line circuit assigned as the conference control port (port 0) should be provided with options ZC, ZF, WP, VC, and VE and leads T2, R2, and S2 connected to the dial conference trunk circuit. The line circuits assigned as conference ports 1-5 should be provided with options ZD, WP, VC, and VE and leads T1, R1, and S1 connected to the dial conference trunk circuit. In addition, the line circuit assigned as conference port 5 should be provided with option XD.

17.47 To originate a conference, any PBX station may dial the number in the 80 series corresponding to the line circuit to which the conference control port 0 is assigned. The marker will process the call in the same manner as when connecting a call to a 2-way tie trunk. The ground on lead IT originating in the marker will operate relay OT in the control port line circuit.

17.48 When relay OT operates, operating the line hold magnet, the bridge on the tip and ring of the line will function relays in the dial conference trunk circuit, causing it to return a holding ground for relay OT on lead S2. Ground on this lead also operates the checking relays in the marker and relay SL. Operation of relay SL opens the operating path for relay OT and grounds lead IT to the marker as a busy indication.

17.49 Operated relays in the dial conference trunk circuit short-circuit the tip and ring of the trunk vertical associated with conference port 1, which signals the marker to connect the trunk termination to a register and return dial tone to the originator (now the control station). After receiving dial tone, the control station dials the station code of the first conferee station. The marker will process

the call in the same manner as when connecting a call to a central office trunk. Additional PBX stations are added as conferees in the same manner.

17.50 The line circuit assigned as conference port 5 is arranged so that a central office trunk may be added to the conference by the controller with attendant assistance. The diode SCC is provided so that under the all-ports-busy condition when the controller dials 0 to reach the attendant, the conference circuit is not activated by operation of the associated relay IN.

17.51 However, relay TKO is operated and a path prepared between punchings IT and HM through the relays COTA,B operated to operate the associated relay OT and ground lead IT as a busy indication. After reaching the central office trunk party, the attendant dials the assigned line circuit code for port 5. The marker functions in the normal manner for connecting a central office trunk to a tie trunk.

J. Dial Conference Trunk Circuit - Attendant Controlled (Options ZD, XC, WP, VC, and VE)

17.52 Five line circuits may be used as conference ports of the dial conference trunk circuit - attendant controlled. The line circuits assigned as conference ports 1-5 should be provided with options ZD, XC, WP, VC, and VE and leads T1, R1, and S1 connected to the dial conference trunk circuit. However, only the line circuit assigned as conference port 5 should be provided with the wiring of terminals IT and HM and the strapping of leads T1 and R2, R1 and T2, and S1 and S2.

17.53 A PBX station, tie trunk, or a central office trunk party may request a conference when connected to the attendant by normal means. A PBX station or tie trunk party must hang up after the request has been made. After this release, the attendant can connect the originator through to the conference circuit. A central office call requesting a conference can be held and connected to the conference circuit on a dial-back basis by the attendant.

17.54 The attendant initiates conference connections by depressing the CONF key at the attendant position. Operated relays in the dial conference trunk circuit place a short circuit on the tip and ring of the trunk vertical assigned to conference port 1 as a signal to connect vertical S1 to a register and return dial tone to the attendant. The attendant dials the station code of the first conferee station and the marker processes the call in the same manner as when connecting a call to a central office trunk. Additional PBX stations are added as conferees in the same manner.

17.55 The line circuit assigned as conference port 5 is arranged so that a central office trunk may be added to the conference by the attendant, using the normal dial-back procedure.

17.56 The action of dialing the code for terminating the call on the switch vertical assigned to port 5:

(a) Prepares a path between punchings IT and HM through the relays COTA,B operated to operate the associated relay OT.

(b) Grounds lead IT as a busy indication.

(c) Grounds lead central office to function relays in the dial conference trunk circuit to connect the central office trunk party to the conference amplifier.

17.57 The marker continues to function in the normal manner for connecting a central office trunk to a tie trunk.

K. Interface Trunk Circuit - (Options ZD, ZG, ZE, N, WP, VC, and VE)

General

17.58 The interface trunk circuit may be used to connect to customer owned and maintained (COAM) equipment. It has two channels.

17.59 Depending on the COAM equipment, 1, 2, or 4 universal line circuits may be used with the interface trunk circuit.

Connections

17.60 Whenever the second channel is employed, the line circuits should be arranged for one-way hunting from the line circuit connected to channel 1 to the corresponding channel 2 line circuit. One-way hunting is explained in SD note 302.

17.61 The line circuit assigned to the calling end of a channel should be provided with options ZD, ZG, WP, VC, and VE and leads T2, R2, and S2 should be connected to the interface trunk circuit.

17.62 If the COAM equipment requires no answering end, a line circuit assigned as a calling end should be provided with option N in addition to options ZD, WP, VC, and VE.

17.63 When answering line circuits are used, a line circuit assigned to an answering end should be provided with options ZE, WP, VC, and VE and leads T1, R1, S and S1A should be connected to the corresponding leads of the interface trunk circuit. For each channel which has an answering end, it is also necessary that leads HM, IT, and S2 of the calling and answering line circuits be connected together. The line hold magnet contacts in line circuits assigned as an

answering end must be permanently insulated with blocking tools to isolate the associated relay L windings.

Operation

Originating a Call to Recorded Message or Message Recorder COAM Equipment

17.64 A calling party originates a call to the interface trunk circuit (ITC) by dialing the number in the 80 series corresponding to the line circuit assigned to the calling end of ITC channel 1. If the ITC is idle, the marker processes the call in the same manner as when connecting a call to a two-way trunk.

17.65 The ground on lead IT originating in the marker operates relay OT in the calling end line circuit through strapping provided by option N and break contacts of relays L and IN in the line circuit associated with the calling end of ITC channel 1.

17.66 When relay OT operates, operating the line hold magnet, the ITC channel 1 calling end tip and ring are bridged by the calling party via the links and make contacts of relay OT. This causes the COAM equipment to be seized and causes a ground to be returned on lead S2 of channel 1. This ground holds relay OT operated.

17.67 After the connection to the calling end of the ITC is completed, the calling party hears dial tone through the ITC, indicating that the COAM equipment is ready to receive dial pulses.

17.68 When dialing is completed, ringing is returned to the calling party until the COAM equipment connects a transmission path through to or from the calling party.

Originating A Call to Called-Party-Answer COAM Equipment

17.69 A calling party originates a call to the ITC by dialing the number in the 80 series corresponding to the line circuit assigned to the calling end of ITC channel 1. If the ITC is idle, the marker processes the call in the same manner as when connecting a call to a two-way tie trunk.

17.70 Ground on lead IT originating in the marker operates relay OT in the calling end line circuit through break contacts of relays IN and SL in the answering end line circuit and break contacts of relays L and IN in the calling end line circuit. When relay OT operates, operating the line hold magnet, the ITC channel 1 calling end tip and ring are bridged by the calling party via the links and make contacts of relay OT. This causes the COAM equipment to be seized and causes a ground to be returned on lead S2 of channel 1. This ground holds relay OT operated.

17.71 Ground on lead S2 operates relay SL in both the line circuit associated with the calling end and the answering end. Relay SL associated with the answering end performs no function. The answering end relay SL operated opens the operating path of relay OT in the calling end line circuit and connects ground to lead IT as a busy indication to the marker.

17.72 After connection to the calling end of the ITC is completed, the calling party hears dial tone through the ITC indicating that the COAM equipment is ready to receive dial pulses.

17.73 When dialing is completed, ringing is returned to the calling party until the COAM equipment connects a transmission path through to or from the calling party.

17.74 When the called party is to answer an incoming call, he originates a call to the line circuit assigned to the answering end of channel ITC through which he is being called. The marker processes this call as a station-to-station call. When the marker grounds lead S of the answering end line circuit, relay IN operates.

17.75 Relay IN operated operates the line hold magnet, cutting through the tip and ring conductors of the answering end of the ITC channel to the terminating end of the junctor via the connected link. Relay IN locks over the sleeve lead of the link to a 100-ohm ground in the junctor.

17.76 The operation of relay IN opens a link in the operate path of relay OT in the calling end line circuit and prepares a path for connecting ground to lead IT associated with the calling end line circuit if the answering end relay SL should release before relay IN.

17.77 When a calling party is connected via ITC to the answering party, lead S to the marker in the answering end line circuit is connected to the same ground that holds relay IN operated. If a station dials the number of the answering end line circuit during this period, it will receive a busy indication rather than be intercepted as an unassigned line.

Disconnection from Un-Manned Equipment

17.78 When the calling party disconnects, the removal of the station bridge from the calling end of the ITC causes ground to be removed from lead S2. This releases relay OT in the line circuit. Relay OT, in releasing, releases the line hold magnet restoring the line circuit to normal.

Disconnection form Called-Party-Answer COAM Equipment

17.79 Calling party disconnects first:

(a) Removal of the station ITC bridge from the calling end of the ITC causes ground to be removed from lead S2. This releases relay OT in the calling end line circuit and releases relay SL in the answering end line circuit. Relay OT released releases the line hold magnet restoring the calling end line circuit to normal except that the operate path of relay OT is held open and ground is maintained on lead IT by operated relay IN in the answering end line circuit.

(b) In the answering end line circuit, relay IN is held operated by the junctor that is under control of the answering party. The answering end relay SL released opens the ITC bridge on the tip and ring conductors at the answering end.

(c) When the answering party disconnects, the junctor removes the 100-ohm ground on the sleeve lead of the link releasing relay IN. Relay IN in releasing releases the line hold magnet in the answering end line circuit restoring that circuit to normal. In the calling end line circuit, relay IN in releasing removes ground from lead IT and closes the operating path of relay OT restoring that circuit to normal.

17.80 Called party disconnects first:

(a) Removal of the bridge at the originating end of a junctor releases only the link between the originating end of the junctor and the called party. The remainder of the connection remains intact under control of the calling party.

(b) When the calling party disconnects, the ITC removes ground from lead S2 to the calling end line circuit releasing relay OT in that line circuit and relay SL in the answering end line circuit. Relay OT released releases its associated line hold magnet.

(c) The answering relay SL released removes the bridge towards the terminating end of the junctor allowing the junctor to release. The junctor released releases relay IN in the answering end line circuit which releases the associated line hold magnet.

Allotted Time Exceeded

17.81 When a calling party exceeds the allotted time, he is disconnected from the COAM equipment and the COAM equipment is connected to the second ITC if it is not busy and busy ground is removed from lead S of the second channel.

Taking Equipment Out of Service

17.82 The ITC is made busy for maintenance at the ITC equipment by grounding

lead S2. This ground operates relay SL in the answering end line circuit which grounds the calling end line circuit lead IT as a busy indication.

18. STATION AND TRUNK HUNTING GROUPS

A. General

18.01 Any number of stations within the same tens group may be formed into a hunting group. Each station has a corresponding terminal H-- shown on FS1 and FS26. A hunting group is formed by connecting option X or ZR between pairs of terminals until the desired pattern is established. A variety of patterns can be created; in general, they can be classified as 2-way hunting groups, one-way hunting groups, combined 2-way and one-way hunting groups, or one-way sequential hunting groups.

18.02 Groups of code 8 trunks are established by strapping terminals H8- shown on FS5 as desired. Likewise, code 9 trunks are grouped by strapping terminals H9- also shown on FS5 as desired.

18.03 As described previously, the marker, in completing a call to a station, will first attempt to connect to the station corresponding to the dialed number. Only if this station is busy will the marker attempt to complete the call to an idle station in the same hunting group. In completing a call to a trunk, however, the marker will connect to any idle trunk in the group on the first attempt.

B. Two-Way Station Hunting Group

18.04 Two-way station hunting groups are created by connecting option X straps between terminals H-- corresponding to the stations to be included in the group.

18.05 If the station dialed is busy, the marker will progress to the station hunting sequence and operate all of relays U- corresponding to stations in the hunting group, and relays S- corresponding to the idle stations in the group will operate. The marker will then connect to the station associated with the first operated relay S- in the line hunting chain circuit on FS6. It should be noted that if relay ZU is operated, the preference order of selection is S5-S9, S0-S4. If relay ZU is released, the preference order is S0-S9.

C. One-Way Station Hunting Group

18.06 A one-way station hunting group is created by connecting diode H (option ZR) between pairs of terminals H-- corresponding to stations to be included in the hunting group, being careful to pole the diodes so that the arrow direction corresponds to the hunting direction desired.

18.07 In this case, when the marker progresses to the hunting sequence, only relays U- corresponding to the stations beyond the dialed station in terminal H-- strapping order will operate. The marker will connect the call to an idle station corresponding to the operated relays U- in a preference determined by the state of relay ZU and the position of the relays S- corresponding to the operated relays U- in the line hunting chain on FS6.

D. Combined Two-Way and One-Way Station Hunting Group

18.08 A combined station hunting group is created by using option X between pairs of terminals H-- and option ZR between other pairs, to accomplish a desired result. For example, if it is desired that a call to station 40 or 46 be routed to the other station if the dialed station is busy, option X will be connected between terminals H40 and H46. If it is further desired that calls to station 47 be routed to either station 40 or 46 when station 47 is busy, option ZR will be provided between terminals H47 and H46 (or H40) with the diode arrow pointing in the direction of punching H46 (or H40).

18.09 In this case, if the marker is processing a call to station 47 but finds it busy, it will progress to the hunting sequence and operate relays UO and U6; if both stations 40 and 46 are idle, relays SO and S6 will operate. The marker will then complete the call to either station 40 or 46, depending upon the state of relay ZU.

18.10 However, if the marker is processing a call to station 46 and finds it busy, the marker, after progressing to its hunting sequence, will operate only relay UO; if station 40 is idle, relay SO will also operate. The marker will then complete the call to station 40.

E. One-Way Sequential Station Hunting Group

18.11 A one-way sequential hunting group may involve only stations within the same subgroup of five stations in a tens group. Such a group may be formed by connecting option ZR between pairs of terminals H-- corresponding to the stations involved, with the diode arrows always pointed in the direction of the higher numbered terminal H--.

18.12 For example, assume that stations 50, 52, and 54 are to be arranged in a hunting pattern such that calls to a busy station 50 will be routed to station 52 unless that station is also busy (in which case it will be routed to station 54). Further, calls to a busy station 52 will be routed to station 54, but calls to a busy station 54 will not be routed to any other

station. To create this pattern, option ZR should be provided between terminal H50 and H52 and between H52 and H54, with the diode arrow pointed towards the higher-numbered terminals in each case.

18.13 In this case, if the marker is processing a call to station 50 but finds it busy, it will progress to the hunting sequence and operate relays U2 and U4 which, in turn, will cause relays S2 and S4 to operate if stations 52 and 54 are idle. Regardless of the state of relay ZU, relay S2 will be ahead of relay S4 in the line hunting chain on FS6, and the marker will always connect the call to station 52 if idle. If station 52 is also busy, relay S2 will not be operated and the call will be connected to station 54.

18.14 If the marker is processing a call to station 52 but finds it busy, it will progress to the hunting sequence and operate relay U4 through diode H between terminals H52 and H54. Relay UO will not operate, since diode H between terminal H50 and H52 is poled in the wrong direction to pass the ground on terminal H52. If station 54 is idle, relay S4 will operate, and the call will be completed to that station.

18.15 If the marker is processing a call to station 54 but finds it busy, it will progress to the hunting sequence. No relays U- will operate (other than relay U4 which is already operated), since diodes H between terminals H50, H52 and H54 are poled in the wrong direction to operate relays UO and U2 from the ground on terminal H54. The marker will therefore attempt to connect the call to the busy tone trunk (or camp on to station 54 if the originating call is from a code 9 trunk).

19. CORD SWITCHBOARD (OPTION Y AND ZT, OR OPTION XW, OR OPTION XW AND XX)

19.01 On some installations, a cord switchboard will be required to supplement or replace the cordless attendant positions. If a 556A cord switchboard is used, options Y and ZT will be provided. These options will furnish jacks L20-79 and relays CO20-79 and MON2-7 shown on FS1 and FS26. If a 608A or 608D cord switchboard is used, option XW will be provided for 40 line PBX and options XW and XX will be provided for 60 line PBX. Option ZW furnishes relays CO20-59, and MONA,B shown on FS1 and FS26. Option XX furnishes relays CO60-79 and MONC relays shown on FS1. This equipment is located in the switchboard when the 556A is used and in an apparatus cabinet when the 608A or 608D is used. The purposes of relays CO-- and MON- are to minimize interference from switchboard attendant to marker operation as well as provide an exchange of station busy indications between the switchboard and the marker.

19.02 When the marker is processing a call

to a station, ground furnished by the marker over lead S, will operate line hold magnet LHM-- or relay IN--, and also operates the associated relay CO--.

19.03 Relay CO--, in operating, will:

- (a) Connect busying ground to the sleeve of the associated switchboard jack L--.
- (b) Connect the tip and ring of the station to the associated switchboard jack to permit the switchboard attendant to override the busy test and talk to the busy station.
- (c) Provide a locking path for keeping relay CO-- and line hold magnet LHM-- or relay IN-- operated if the machine completed call to the station disconnects while the attendant cord is still in the jack after having overridden the busy condition.

19.04 A switchboard attendant wishing to complete a call to a station through the station line jack will make a busy test looking for ground on the jack sleeve. Finding the line idle, the attendant will plug a cord into the jack, which will operate the associated relay CO-- and line hold magnet LHM-- from ground at the jack contact.

19.05 Relay CO--, in operating, will:

- (a) Lock to the ground at the jack contact.
- (b) Cut through the tip and ring of the jack to the station line.

19.06 With relay CO-- operated, the associated lead S to the marker will have the 100-ohm ground (consisting of the non-inductive secondary winding of relay CO--) in parallel with battery through the 900-ohm line hold magnet or 950-ohm relay IN-- connected to it, thus furnishing the appropriate busy potential to the marker.

19.07 Relays MON2-7 will operate every time the marker is serving a call and will release at the end of each marker usage. They function to prevent the switchboard attendant from operating relay CO-- during a marker usage by opening the operate path of all relays CO--. This will prevent the associated line hold magnet from operating while select magnets may be operated and thus connecting the station to a link to cause an unintended double connection.

20. ALARMS

A. General

20.01 The alarm relays shown on FS18 through FS22 are arranged to check various parts of the marker. For the most part, these relays check that both relays of a pair of relays that perform the same function (for example, relays SMTA and SMTB) and

multiplied (for example, relays TKO and TKAO) operate and release in unison. However, other marker operations are also checked as described in the following paragraphs.

20.02 The alarm relays are provided with locking paths to the alarm, transfer, and test circuit, which functions to lock an alarm relay only after alarm conditions have been encountered on several successive marker usages. The three exceptions to this are the timeout alarm relay TOALA (FS22), the camp-on alarm relay COAL (Option WT-FS21), and the cross check alarm relay XCAL (Option WT - FS21). Any of these three relays, in operating, will cause the alarm, transfer, and test circuit to activate the locking path for all the alarm relays on its initial operation. Once locked, the alarm relays can be released by the operation of an alarm release key in the alarm, transfer, and test circuit.

20.03 The operation of an alarm relay will light its associated lamp as shown on FS23.

B. Units Alarm

20.04 The units alarm group consists of relays UAL, UAL1A, UAL2, and JRAL shown on FS18. Each of these relays in operating, will light their associated lamp on FS23 with exception of relay UAL1A which will light lamp UAL1.

20.05 Relay UAL will operate if:

(a) The following pairs of relays are not in the same state for a longer period than the operate time of relay UAL: relays UEA and UEB, JREA and JREB, ULA and ULB, RUCA and RUCB, SEAA and SEBA, HCA and HCB, TRKA and TRKAA, TRKB and TRKBA, and TRKA and TRKB.

(b) Relays TRCA,B and TRCAA,BA are not all in the same state for a longer period than the operate time of relay UAL.

(c) If more than one relay JR- is operated at one time during a marker usage.

(d) Relay WU and ZU combination in the units sequence control circuit is not functioning properly.

20.06 As is shown on SC25, relay WU (FS6) and relay WUA (FS18) will always both be either operated or released together if the units sequence control circuit is functioning properly.

20.07 Relay UAL1A is connected in tandem with relay UAL1 to increase the effective operating time of the combination since this alarm relay is wired to detect the malfunctioning of pairs of some slow-acting relays.

20.08 Relays UAL1 and UAL1A will operate if:

- (a) The following pairs of relays do not operate or release in unison within the limits of the combined slow-operating characteristics of the two alarm relays: Relays ACA and ACB, BSYA and BSYB, HMTA and HMTB, HMTAA and HMTBA, BYA, and BYB, and BSYAA and BSYBA.
- (b) If the units sequence circuit does not advance when the marker progresses to the second trial stage while trying to complete a dial tone connection.

20.09 Relay UAL2 will operate if:

- (a) The following pairs of relays are not in the same state for a longer period than the operate time of relay UAL2: relays RGA and RGB, RGA and RGAA, RGB and RGBA, JTAA and JTBA, RCTAA and RCTBA, BTTA and BTTB, ICTA and ICTB, RAOA and RAOB, RALA and RALB, and COTA and COTB.
- (b) Relays SMRA,B and SMRAA,BA are not all in the same state for a longer period than the operate time of relay UAL2.

20.10 Relay JRAL checks that at least one relay JR- operates during the junctor selection sequence of the marker. If while relays SEAA,BA are still operated, no relay JR- operates but relays JTAA or JTBA release and relays JREA or JREB operate, signifying the completion of junctor selection, relay JRAL will operate.

C. Release Alarms

20.11 The release alarm group consists of relays RLAL, TAAL, and MAL shown on FS19.

20.12 Relay RLAL will operate if:

- (a) The following pairs of relays are not in the same state for a longer period than the operate time of relay RLAL: relays RLSA and RLSAA, RLSB and RLSBA, RLA and RLB, RLSA and RLSB, and TSDA and TSDB.
- (b) Relays RLA, RLAA, and RLAB are not all in the same state for a longer period than the operate time of relay RLAL.
- (c) Relays RLB, RLBA, and RLBB are not all in the same state for a longer period than the operate time of relay RLAL.

20.13 The operate path for relay RLAL is opened whenever relays ALBA or ALBB operate, since during an all-links-busy condition the marker will release and make repeated new attempts to complete calls, which under certain unfavorable conditions, can cause the alarm relay to operate falsely.

20.14 Relay TAAL will operate whenever the marker progresses to the trouble release stage. The operation of relays TRA,B will operate relays RLSA,B and RLSAA,BA, which, in turn, release relays MTA,E and the slow release relays TRA,B.

20.15 While relays RLSAA,BA and TRA,B are operated, relay TAAL will operate unless relays TOKA,B are operated, indicating that the marker timing circuit is being exercised on a time-out check. Relays TOKA,B operated open the battery supply for relay TAAL.

20.16 Relays MAL check that the following miscellaneous fast-acting relay pairs are not in the same state for a longer period than the operate time of relay MAL; relays LUCA and LUCB, BTCA and BTCB, HMKA and HMKB, and LTA and LTB.

D. Tens Alarms

20.17 The tens alarm group consists of relays TRAL and TAL shown on FS20.

20.18 Relays TRAL check that the marker, having completed a dial tone connection request, will properly operate relay TA- or TRA- associated with the tens group that was just served. Relay TRAL will operate, if, while relays RLAB, RLBB, RLSAA, or RLSBA, TRP- or TP-, and TR- or T- are operated, relays TRA- or TA- associated with the tens group just served operate within the operate time of the alarm relay.

20.19 Relay TAL will operate if:

- (a) The following pairs of relays are not in the same state for a longer period than the operate time of relay TAL: relays TU2 and TCS2, TU3, and TCS3, TU4 and TCS4, TU5 and TCS5, TU6 and TCS6, TU7 and TCS7, RCC1 and RCD1, RCA1 and RCB1, RCA1 and RCC1, TACAA and TACBA, RCO and RCEO, RCO and RCCO, RCO and RCDO, RCDO and RCEO, RCD1 and RCEL, ARBA and ARBE, TKO and TKA0, TK9 and TKA9, TK8 and TKA8, TRC1 and TRU1, TRCO and TRUO, TU2, and THC2, TU3 and THC3, TU4 and THC4, TU5 and THC5, TU6 and THC6, TU7 and THC7, TCK1 and TCK3, and TCK2 and TCK4.
- (b) A relay RP-, TRP-, or TP- is operated while relay RLAA or RLBA is operated for a longer period than the operate time of the alarm relay.
- (c) Relays TEA0, TEA1, TEA2, TEA3, TEBO, TEB1, TEB2, and TEB3 are not all operated whenever relays TA2-7, TRA0,1, or RO,1 are operated.
- (d) If option Y is provided and any one of the relays MON2-7 does not operate while any relay TP2-7, TRPO,1, or RPO,1 is operated (relays TEA1 and TEB1 are

assumed to be functioning properly and operated at this time).

(e) On a dial tone call, more than one of relays TRMO,1 and TM2-7 are operated while one of relays TRO,1 or T2-7 are operated.

(f) On a terminating call when relays RCEO,1 will be operated, more than one of relays TKB8, TKB9, TKBO, and TM2-7 are operated.

E. Link Test Alarm

20.20 The link test alarm group shown on FS21 consists of relays LAL1, LAL2A, COAL (option WT), and XCAL (option WT). Each of these relays, in operating, will light their associated lamp on FS23 with the exception of relay LAL2A which will light lamp LAL2.

20.21 Relay LAL2A is connected in tandem with relay LAL2 to increase the effective operating time of the combination since this alarm relay is wired to detect the malfunctioning of some slow acting pairs of relays.

20.22 Relays LAL2 and LAL2A will operate in tandem if:

(a) The following pairs of relays do not operate and release in unison within the limits of the combined slow-operating characteristics of the tandem alarm relays: relays SMTA and SMTB, ALBA and ALBB, LBA and LBB (option ZN), and LSHA and LSHB (option ZO or 22).

(b) The link sequence control circuit functions improperly.

(c) The link group sequence control circuit functions improperly.

20.23 Relay LAL1 will operate if:

(a) The following pairs of relays are not in the same state for a longer period than the operate time of the alarm relay: relays LTAA and LTBA, COA and COB, CONA and CONB, LEAA and LEBA, TRLA and TRLB, LEA and LEAA, LEB and LEBA, CONA and CONAA, CONB and CONBA, COSA and COSB, WLL and WLLA, and WL and WLA.

(b) Relays LCK1 or LCK2 operate.

(c) Relays WLG and WLGA operate for a longer period than the operate time of the alarm relay.

20.24 Relays LCK1 and LCK2 shown on FS13 operate if false grounds appear on the leads that operate the select magnets.

20.25 Relay XCAL (option WT) will operate if relay XC(option 22-FS28) operates.

Relay XC is a marginal relay which will operate only if two or more LT2-9 relays operate during the link testing sequence for a camp-on call termination.

20.26 Relay COAL (option WT) will operate if no LT2-9 relay operates during the link testing sequence for a camp-on call termination.

F. Time-Out Alarm

20.27 The time-out alarm group consists of relays TOAL and TOALA shown on FS22. Relay TOALA, in operating, will light lamp TOAL.

20.28 Relay TOALA is connected in tandem with relay TOAL to increase the effective operating time of the combination. Relays TOAL and TOALA will operate in tandem if the following pairs of relays are not in the same state for a longer period than the combined operate time of relays TOAL and TOALA: relays MTA and MTB, NAA and NAB, STA and STB, and TOLA and TOLB.

G. Alarm Control

20.29 The alarm control circuit is also shown on FS22. Relays MTA,B operate whenever the marker is in use and furnish a ground over lead MT to the alarm, transfer, and test circuit. Relay TS or any of the alarm relays, when operated, will ground lead AT to the alarm, transfer, and test circuit. The alarm, transfer, and test circuit will relate the number of times ground is received over lead AT with respect to marker usages.

20.30 If an alarm indication is received for two successive marker usages for terminating calls, the alarm locking relay in the alarm, transfer, and test circuit will operate and lock to the alarm release key and, in doing so, will activate the locking ground leads UA and JA on FS18, RA on FS19, TA and KA on FS20, LA and LAL on FS21, OA on FS22, and CA on FS11.

20.31 Relay TOALA, COAL (Option WT), or XCAL (Option WT), in operating, will ground lead TT to the alarm, transfer, and test circuit, which will cause it to disregard its alarm signal versus marker operation-counting circuitry and operate the alarm locking relay immediately.

20.32 Relay TS is an alarm relay shown on FS11 that will detect false standing grounds on leads TT, TLA,RS, BY, and FF to the central office and ringdown tie trunks. Relay TS is connected to these leads through break contacts of relays TSDA,B, which operate during every marker usage.

21. MESSAGE WAITING SERVICE (OPTION ZQ)

21.01 When the PBX is arranged for message

waiting service, option ZQ on FS1 and FS26 will be provided and a Message Waiting Service Key, Interrupter, and Power Supply Circuit furnished as a connecting circuit. Also the station sets will be equipped with message waiting lamps.

21.02 The connecting circuit provides a diode across leads L and R poled to permit the line relay to operate from a switchhook operation.

21.03 If the message waiting lamp of a station is to be lit, the associated key in the connecting circuit will be operated, connecting -150 volts DC interrupted at 60 ipm to lead R. This voltage will flash the neon-type message waiting lamp in the station subset to the ground on the tip side of an idle line.

21.04 The back resistance of the diode in the connecting circuit between leads L and R is sufficiently high to prevent the line relay from operating from the message waiting signal voltage.

21.05 The message waiting lamp at the station will be extinguished:

(a) By the operation of the line hold magnet resulting from the station originating a call or a call being completed to the station.

(b) When the key in the connecting circuit is restored to normal.

22. DIRECT STATION SELECTION

A. Attendant Direct Station Selection (Options ZY and ZX)

22.01 With direct station selection, the attendant may enter a call into the PBX over an attendant trunk or complete a call into the PBX from a central office, long distance, or ringdown tie trunk.

22.02 When an attendant trunk, ringdown tie trunk, long distance, or central office trunk initiates a request for dial tone, one of the marker relays TRCO or TRC1 will be operated. Depending on which register is available to serve the call, ground from the operated relay TRCO or TRC1 is extended through the marker relays RGA and RAOA or RGB and RALA to operate relay AC in the connected register.

22.03 When the hold magnet operates for any station, ground via the off normal spring assembly and lead BL lights the station busy lamp in the attendant cordless position (612 type telephone set) or (4A or 4B console).

23. SINGLE-DIGIT DIALING

A. Make Busy and Lamp (Option YD)

23.01 When a station is arranged for selec-

tion by single digit dialing and a make busy key and lamp are required, the operation of key MB opens lead S and S1 and lights lamp MB as an indication to the station that key MB is operated. With leads S and S1 open, any call directed to this station will be intercepted.

B. Single-Digit Dialing 8 for Long Distance (Options YE, YF, YO and YP)

23.02 When the dial pulse register receives the necessary information for long distance by single-digit dialing 8, the register completes to the marker. The marker will make the connection to one of the central office trunk units No. 9, 8, 7, or 6.

24. PAD CONTROL CIRCUIT (OPTIONS WF, 19, 20, 21)

A. General

24.01 When a code 8 tie trunk facility specifies pad control, options 19, 20 and 21 are provided for that trunk. These options, when used with option WF constitute a pad control circuit to be associated with the trunk. Over a control lead designated as lead O, this circuit will perform two functions. The first and primary function is to control the switch pad of the associated trunk. The second function which is operative only if a manual switchboard is in use is to seize the switchboard applique circuit of the trunk whenever the trunk dials "0" into the PBX.

24.02 Two pad control arrangements are provided:

(a) Pad control of code 8 tie trunks on all code 8 to code 8 trunk calls as well as all code 8 to code 9 trunk calls and all code 9 to code 8 calls.

(b) Pad control of code 8 tie-trunk only on code 8 to code 8 calls.

24.03 Choice (a) is provided by options 19, 20, 21, WF and WK and dial pulse register circuit option XC. Choice (b) is provided by options 19, 20 and 21 and register option XD.

24.04 With option WK and register circuit option XC: when a code 8 trunk forms a tandem connection (that is: either a code 8 to code 8 trunk connection or a code 8 to code 9 or a code 9 to a code 8 trunk connection), a resistance ground is placed on control lead O to signal the trunk to remove its pad from the transmission path.

24.05 If the trunk forms a non-tandem connection or if the trunk forms a tandem connection from code 8 trunk to code 9 trunk - or vice versa - when marker

option WK is not used and register option XD is used, no signal is sent over control lead O and the switch pad of the trunk remains in the transmission path.

24.06 If a manual switchboard is used with the PBX, then upon dialing "0" through the trunk and into the PBX, a solid ground will be momentarily placed on control lead O. This will cause the switchboard applique circuit of the trunk to be seized which results in the call being diverted from an attendant trunk to the jack and line circuit of the trunk at the switchboard. The responsibility for pad control now rests in the hands of the switchboard attendant. The attendant must determine whether the manual connection to be made is tandem or non-tandem. If tandem, then the attendant removes the switch pad simply by using the "thru" jacks of the trunks. Otherwise, the standard connecting jacks are used. However, if instead the call is "intercepted", then the call will be routed through to an attendant trunk on a non-tandem basis and appear at the jack and line circuit of the attendant trunk.

24.07 If an attendant console is used with the PBX, then upon dialing "0" or being "intercepted", the call will be routed on a non-tandem basis through to an attendant trunk.

B. Incoming Calls (SC30)

24.08 A seized incoming trunk will be serviced by the marker first for a dial tone connection. When relay IN-- of the associated line circuit operates, either relay A or B of the associated pad control circuit will operate.

24.09 Ground passing on lead MS-- of the associated line circuit from a contact of relay IN-- operated, through a contact of relay MS released, and diodes A and B of the associated pad control circuit is available to both relays A and B. However, operating battery is available to only one of these relays. Battery passing on contacts of relays HMTA,B released and relays RGAA,BA operated can pass on either control lead RO or R1, but not on both, depending on the state of relays RAOB and RALB.

24.10 If allotment of register O had been made by the marker to process the call, then the register O allotment relay RAOB will be operated and battery will be available on control lead RO. However, if allotment of register 1 had been made, then the register 1 allotment relay RALB will be operated, relay RAOB will be released, and battery will be available on control lead R1.

24.11 Battery on control lead RO operates relay A and battery on control lead R1 operates relay B. In the following discussion it will be assumed that register O has been selected and consequently relay A has operated.

24.12 Relay A operated:

- (a) Provides a locking ground for itself and an operate ground for relay B subject to relay IN-- operated.
- (b) Transfers its operate battery from control lead RO to control lead RLO subject to relay RLO released.
- (c) Transfers operate battery for relay B from control lead R1 to control lead TDMO. Control lead TDMO supplies battery whenever a tandem connection is being completed through register O.
- (d) Prepares a locking battery for relay B.
- (e) Extends control lead TKOO to associated tie trunk control lead O. A solid ground is placed on control lead TKOO when the trunk dials "0" into register O.
- (f) Partially extends a 3000 ohm ground to control lead O.
- (g) Operates marker seizure relay MS.

24.13 Relay MS operated locks to relay IN-- operated and opens the operate ground for relay A.

Incoming Call: Tandem Connection (SC31)

24.14 Since the incoming call is through a code 8 tie trunk, trunk terminating relay TT in register O will have operated as soon as the register receives class of service information from the marker.

24.15 When the incoming trunk dials a code 8 or code 9 trunk, relay TKB8 or TKB9 will operate while the marker functions to complete the connection.

24.16 If option WK is omitted per paragraph 24.03, the path from the contact of TKB9 will not be complete, and any call to a code 9 trunk will result in pad control circuitry action as described below under "Incoming Call; Non-Tandem Connection".

24.17 If option WK is used or relay TKB8 is operated, circuit action will be as follows: when relays HMTAA,BA operate, relay B operates over control lead TDMO through contacts of operated relays HMTAA,BA, either relay TKB8 or TKB9 operated, register O relay TT operated, relay RAOB operated, and operated relay A.

24.18 Relay B operated:

- (a) Transfers its operate battery from control lead TDMO to locking battery provided by relay A operated.
- (b) Transfers holding battery of relay A from control lead RLO to locking battery.

- (c) Opens the connection between control lead TKOO and control lead O.
- (d) Extends a 3000 ohm holding ground over control lead O. This holding ground signals the associated tie trunk to remove its switch pad out of the transmission line.

24.19 However, if the dialed code 8 or code 9 trunk was busy with all other trunks in the same hunting group also busy, then the switch pad of the incoming trunk will not be removed. This is because relay RCAO releases while the marker proceeds to direct the call to the busy-tone trunk and before relays HMTAA,BA operate. Consequently, the battery path over control lead TDMO is never completed and relay B remains normal. Since relay B remains normal, the pad control circuit will handle the call as if it were a non-tandem connection.

Incoming Call: Non-Tandem Connection:

Non-tandem Call - without manual switchboard or with switchboard and other than a dial "O" call (SC3):

24.20 When a code 8 or code 9 trunk is not dialed, relays TKB8 and TKB9 remain normal. Therefore, operate battery is not available over control lead TDMO and relay B remains normal.

24.21 When digit 0 is dialed into the PBX, relay TKA0 will operate and the register will pass ground on leads U5-7 to the marker. With relay A operated, a solid ground will pass from control lead TKOO to control lead O seizing the switchboard applique circuit of the trunk.

24.22 The switchboard applique circuit responding to this signal will:

- (a) Open the T and R loop between the tie trunk and the PBX.
- (b) Light the trunk lamp at the switchboard.
- (c) Ring for the switchboard attendant and extend audible ring tone to the tie trunk.

24.23 In the meantime, the marker proceeds to connect the tie trunk to an attendant trunk because the register continues to bridge leads T and R until the marker releases.

Release of the pad control circuit (SC3 or SC32)

24.24 When the down check relays DCKA,B release on a dial completed connection basis, ground will pass through contacts of relays DCKA,B released, relays HMTA,B operated, and relay RPO operated to operate relay RLO.

24.25 This would be the normal way in which relay RLO is operated. However, two important special cases exist that do not require relays HMTA,B to operate when the marker prepares for its release cycle on a completed connection basis.

24.26 One case is created when the busy tone trunk is busy and the marker therefore requests the register to give busy tone. For this case, when the busy test relays BYA,B operate, ground passes through on contacts of the busy tone trunk connector relays BTCA,B operated, relays BYA,B operated, and relay RPO operated operating relay RLO.

24.27 The second special case exists when the marker releases on a trouble release condition. With relay RPO operated, diodes RLSA,B provide the operating ground for relay RLO when the trouble release relays RLSA,B, AA,BA are operated.

24.28 Relay RLO operated locks to relay DCKA,B released and with relay B normal, releases relay A over control lead RLO.

24.29 Relay A released opens operate ground for itself and relay B and opens the connection between control lead TKOO and control lead O.

24.30 Relay MS remains operated while the trunk is busy to prevent the re-seizure of the associated pad control circuit. When the trunk releases relay MS will release.

24.31 When a switchboard applique circuit was seized by the pad control circuit as described in non-tandem call - dial 0 with a manual switchboard, then relay MS will release differently. When the register is dismissed by the marker during its release cycle, the T and R loop to the attendant trunk is left open. The attendant trunk then proceeds to return to normal.

24.32 When the attendant trunk releases its 100-ohm holding ground from the sleeve lead, relay IN-- of the associated line circuit will release. Thus, both the attendant trunk and line circuit return to normal. Relay IN-- released releases relay MS of the associated pad control circuit, returning the circuit to normal.

24.33 When the marker returns to normal, relays DCKA,B operate releasing relay RLO.

C. Outgoing Calls

24.34 An outgoing trunk will be seized by the marker on a dial completed connection basis. When relay OT-- of the associated line circuit operates, then as

with incoming calls either relay A or B will operate first.

24.35 When register O is processing the call, relay A will operate or when register I is processing the call, relay B will operate. Ground is available to both relays over control lead MS-- from a contact of relay OT--operated.

24.36 Assuming that register O processes the call, operating battery will be available over control lead RO through contacts of relay RAO operated and relay RLO released operating relay A.

24.37 Relay A operated performs the same functions as it did for the case of an incoming trunk being serviced by the marker in a dial tone connection basis.

Outgoing Calls: Tandem Connection (SC31)

24.38 With relay A operated, the pad control circuit functions for the outgoing trunk the same as described for incoming call - a tandem connection, except, a clarification will be made regarding the situation when the incoming call is from a code 9 trunk.

24.39 When the incoming trunk is a code 9 trunk, relay COT in register O will operate as soon as the register receives class-of-service information from the marker. When the attendant dials a code 8 trunk, relay TT in the register operates.

24.40 If, per paragraph 24.03, register option XD is used, register relay COT keeps the operate path of relay B from being complete; this prevents removal of the pad. Pad control circuit release is as described under "Incoming Call; Non-Tandem Connection". If, per paragraph 24.03, register option XC is used, relay B will operate from control lead TDMO and operation will proceed as in paragraph 24.18 above.

Outgoing Calls: Non-Tandem Connection (SC29)

24.41 When the incoming call is not from a code 8 or code 9 trunk, relay TT in the register will not operate. Consequently, operating battery for relay B will not be available over control lead TDMO and relay B will remain normal. With relay B normal, the pad control circuit will release in the same manner as described for release of the pad control circuit for an incoming call - non-tandem connection.

25. MAKE BUSY AND BUSY DISPLAY CIRCUIT

A. Function of Links with Make Busy and Busy Display Circuit

Link Key Normal

25.01 With the link key (LINK key) normal in the make busy and busy display circuit, the link busy lamp (LINK lamp) will light when a direct or resistance ground is applied to the associated S sleeve lead.

25.02 Therefore, when the marker operates the LT relays associated with the idle links during the link testing sequence, those busy lamps associated with idle links will light momentarily. As the marker proceeds to select and busy one of the idle links during the link selection sequence, the busy lamp associated with the selected link will relight through the resistance ground applied to the sleeve of the selected link.

25.03 The re-lighting of the associated LINK lamp indicates that the link has been made busy to the marker through normal operations.

Link Made Busy

25.04 If it is desired to make a link busy to the marker, the associated LINK key in the make busy and busy display circuit is operated. Key LINK operated applies a 909-ohm resistor and 8 volt zener diode voltage divider circuit to the associated sleeve lead.

25.05 The zener diode connected to the sleeve:

- (a) Holds the sleeve to ground voltage at approximately -8 volts, thereby making the link busy to the marker.
- (b) Lights the associated LINK lamp in the make busy and busy display circuit indicating that the link has been made busy.

B. Function of Junctors with Make Busy and Busy Display Circuit

Junctor Key Normal

25.06 With the junctor key (JCTR key) normal in the make busy and busy display circuit, the junctor terminating lamps (JCTR TERM lamps) associated with the idle junctors will light momentarily during the junctor testing sequence. As the marker proceeds to select and busy one of the idle junctors, the JCTR TERM lamp associated with the selected junctor will re-light when relays SMTA and SMTB in the marker circuit operate the terminating hold magnet of the selected junctor. The junctor originating lamp (JCTR ORIG lamp) will light when the originating hold magnet is operated.

25.07 The lighting of lamps JCTR TERM and JCTR ORIG indicates that the junctor has been made busy through normal operations.

Junctor Made Busy

25.08 If it is desired to make a junctor busy, key JCTR is the make busy and busy display circuit is operated. Key JCTR operated grounds leads THM of the terminating hold magnet in the marker circuit. Grounding lead THM:

- (a) Operates the terminating hold magnet of the associated junctor in the marker circuit.
- (b) Makes the junctor appear busy to the marker on subsequent requests for service.
- (c) Lights the associated JCTR TERM lamp in the make busy and busy display circuit.

25.09 The lighting of lamp JCTR TERM indicates that the junctor has been made busy.

C. Function of Busy Tone Trunk with Make Busy and Busy Display CircuitBusy Tone Trunk Key Normal

25.10 With the busy tone trunk key (BT key) normal in the make busy and busy display circuit, the busy tone trunk lamp (BT lamp) will light when the marker, in placing a busy test on the idle busy tone trunk, operates relay SO. As the marker proceeds to seize the idle busy tone trunk by operating the trunk hold magnet THM07, lamp BT will remain lit.

25.11 The lighting of lamp BT indicates that the busy tone trunk has been made busy by the marker through normal operations.

Busy Tone Trunk Made Busy

25.12 If it is desired to place the busy tone trunk in a busy condition, key BT is operated. Key BT operated grounds lead HM in the line, link, and marker circuit. Grounding lead HM in the marker circuit:

- (a) Operates the busy tone trunk hold magnet (THM07) in the marker circuit.
- (b) Makes the busy tone trunk busy to the marker on subsequent requests for service.
- (c) Lights lamp BT in the make busy and busy display circuit.

25.13 The lighting of lamp BT indicates that the busy tone trunk has been made busy. Under this condition, the marker directs the register to furnish the busy tone to the calling station on subsequent busy connections.

D. Function of Universal Lines with Make Busy and Busy Display Circuit (Option WQ)Universal Line Key Normal

25.14 The make busy and busy display circuit is used in conjunction with a universal line circuit only when the universal line is assigned to a two-way tie trunk.

25.15 When a universal line circuit is assigned to a two-way tie trunk, the associated line busy lamp (LINE lamp) in the make busy and busy display circuit will light when direct or resistance ground is applied to the operate path of relay OT.

25.16 The lighting of the associated LINE lamp indicates that the line circuit assigned to the associated two-way tie trunk has been made busy through normal operations.

Universal Line Made Busy

25.17 If it is desired to make a universal line circuit busy to the marker for outgoing tie trunk calls, key LINE in the make busy and busy display circuit is operated. Key LINE operated:

- (a) Opens the operate path for relay OT in the marker circuit.
- (b) Applies ground to lamp LINE in the make busy and busy display circuit.

25.18 The lighting of lamp LINE indicates that the tie trunk has been made busy. Opening the operate path of relay OT prevents the operation of the associated S relay in the marker circuit. Grounding the operate path toward the S relay makes the line busy to the marker for outgoing tie trunk calls.

25.19 To prevent the use of the tie trunk for an incoming call, the tie trunk must be made busy at the distant PBX.

26. TRAFFIC MEASUREMENT SYSTEM NO. 1A
REMOTE SCANNER CIRCUITA. Function of Links with TMS Remote Scanner Circuit

26.01 When a link is requested, the marker operates relays LTA,B and LTCA,B in the line, link, and marker circuit. If a link is idle, the respective sleeve will be open. If a link is busy, the respective sleeve will have a potential of approximately -8 volts to ground. This ground signal will be extended over lead L-- to the TMS Remote Scanner to indicate a busy condition.

B. Function of Universal Lines with TMS Remote Scanner Circuit

Outgoing Call

26.02 When the marker applies a busy test on the line by applying battery through relay OT, the associated S relay operates. The resistance ground of relay S is extended over lead L8-- to the TMS Remote Scanner to indicate a busy condition. In the following sequences, the marker operates relay SMR-- to operate relay OT. After the marker completes and releases from the connection, relay OT is maintained by the ground applied on lead S2 from the tie trunk. The TMS Remote Scanner will receive a ground signal until relay OT releases.

Incoming Call

26.03 When the universal line circuit is seized and made busy to the marker by the operation of relay L in the line circuit, a ground signal is extended over lead L8-- to the TMS Remote Scanner. The marker operates relay IN which in turn releases relay L. After the marker completes and releases from the connection, relay IN is maintained by the ground applied on lead S2 from the Tie Trunk. The TMS Remote Scanner will receive a ground signal until relay IN releases.

C. Function of Busy Tone Trunk with TMS Remote Scanner Circuit

26.04 When a PBX line or trunk other than a two-way central office trunk originates a call to a PBX line or trunk which is found busy by the marker, the marker will attempt to establish a connection between the calling line or trunk and the busy tone trunk. Before seizing the busy tone trunk, the marker will proceed to place a busy test. If the trunk is busy relay SO will be operated. With relay SO operated a ground signal is extended over lead BTT to the TMS Remote Scanner.

27. MISCELLANEOUS

27.01 A reported trouble of pretripping in the central office trunk on a call being completed by the attendant to a station is as described in the following paragraphs.

27.02 The first possibility of pretripping occurs when the marker releases relay MC in the trunk and operates relays RRLA and RRLB in the register. Both of these actions result from the operation of relays RLAB and RLBB in the marker.

27.03 The release of relay MC in the trunk connects ringing current to the ring side of the trunk. and the operation of relays RRLA and RRLB opens the tip and ring conductors in the register. If relay MC releases before relays RRLA and RRLB operate, the tip and ring bridge in the register can trip the trunk.

27.04 The first possibility is corrected by transferring control of the release of relay MC in the trunk from marker relays RLAB and RLBB to relays RLAA and RLBA. Relays RLAA and RLBA are slower to operate, thereby increasing the time of release of relay MC.

27.05 The second possibility of pretripping occurs when relays RRLA and RRLB in the register release. At the end of a call, relays RRLA and RRLB operate to:

- (a) Open the tip and ring conductor to the register.
- (b) Lock to relay ON.

27.06 As the register releases, relay ON releases, in turn releasing relays RRLA and RRLB, which reconnect the tip and ring conductors. Pretripping may occur if relays RRLA and RRLB release before the crosspoints are opened.

27.07 To eliminate this pretripping, the release of relays RRLA and RRLB are connected under control of the register memory hold magnets, thereby delaying the release of relays RRLA and RRLB until the crosspoints are open.

27.08 The elimination of pretripping in the register is covered by wiring option ZH on SD-65742-01 and by wiring option YC in this circuit.

27.09 Available break contacts of relays RLA,B are added (options WM or YR) in leads RSE,0 to prevent false operation of trunk relay RS on dial 8 or dial 9 calls. Ground on leads RSE,0 must be removed before relay TK8 or TK9 releases, since the addition of option YC has delayed the release of trunk relay MC. Option WM, in addition to preventing false operation of trunk relay RS from a ground in the marker circuit, prevents operation of trunk relay RS from trunk circuit off-normal ground over leads TLAE,0 through break contacts of marker circuit relays TSDA,B during marker release of toll-allowed dial 9 calls.

27.10 In option ZR, diodes H were formerly specified on the dial conference circuit. They are for hunting as described in the circuit descriptions for that circuit.

27.11 The difference between the switch 324AJ (options ZW and ZV) and the 324AK switch (options ZY and ZW) is in the hold magnet off-normal spring assembly. A 324AJ switch may be converted to a 324AK switch by changing out the hold magnet off-normal spring assembly to a P463604 spring assembly.

27.12 If relay TA- or TRA- fails and relay TRAL is operated, the marker advances to no-connection, at which time

- a buzzing condition exists between relays TRC- and TRK-. This buzzing prevents the slow release timing relays TMA,B from releasing and the timing is disabled. The marker will now be locked up in this state until another station in the troublesome tens group goes off-hook. This condition is eliminated by option YL, which replaces option YK. This option opens, on dial tone connections, the operate path of relays TMA,B which is affected by the buzzing condition.
- 27.13 Option VR is added and rated Standard to provide for an improved advance, timeout, and release circuit. Option VQ is designated and rated Mfr Disc. Option VS is designated and rated Standard. Options A and YL are rated Mfr Disc.
- 27.14 Option 22 is designated on relay ZU to agree with the Western Electric manufacturing drawing.
- 27.15 On a dial tone connection, if both registers are idle and the marker experiences trouble in connecting to register 1, there exists a race condition in the advance, time-out, and release circuitry resulting in the failure of the marker to connect to register 0. Option VT is added and rated Mfr Disc. Option VU is added and rated Standard. Option VU adds #8-break contacts of relays HMTA and HMTB into the operate paths of relays SAA and SAB. This delays the start of second trial until the operate paths of the line hold magnet and register 0 hold magnet have been re-established.
- 27.16 This circuit is reissued to reduce voltage transients present on lead SL when this system is used with 608- manual switchboard. Option VZ is added and rated Standard.
- 27.17 When station C flashes for dial tone, and the PBX attendant subsequently depresses a DSS key during an incoming central office trunk call or an attendant trunk call, station C will be connected to the station the attendant is trying to direct station select. Investigation shows that when station C flashes for dial tone, relay AC- in the dial pulse register operates, permitting station C to be connected to the party the attendant is trying to direct station select. Option UA is added and rated Standard. Option UA adds a new TR lead to give a locking path for relays RCO and RCl (in the station dial transfer controller circuit) through contacts of marker relays RGA and RGB, thus assuring that relay AC- in the register does not operate when station C flashes for dial tone.
- 27.18 Option UC provides the equipment and wiring necessary for the switching of six additional outgoing one-way central office trunk circuits and the required wiring for the first trunk circuit.
- 27.19 Each trunk circuit is connected to a universal line circuit starting with 89 and descending to 84 depending upon the number of trunks added. Each trunk must be strapped for two-way hunting.
- 27.20 All stations must be either toll allowed or restricted.
- 27.21 The PBX must be arranged for single digit 9 selection of central office trunks.
- 22.22 The added outgoing trunks are connected to relay ATB which operates when all trunks are busy using a series ground circuit through each trunk.
- 27.23 The dialing of a single digit 9 into the dial pulse register operates register relay TD9 which connects ground to lead TD9 through the register connect relay contacts to the marker circuit. If the ATB relay is operated, this ground will operate marker relay TK9 resulting in the marker setting up a connection to a regular two-way central office trunk. If the ATB relay is normal the ground will operate marker relays TK8 and U9 resulting in the marker making a connection to universal line circuit 89, thus the originating station line is connected to an outgoing one-way trunk.
- 27.24 To prevent the improper seizure of the outgoing one-way trunk by dialing a 2-digit code, 89 through 84, an arrangement is made to intercept the call. The dialing of the code 89 will operate the TD8 and U9 relays in the register resulting in ground being connected to leads T8 and U9 toward the marker. The ground on lead T8 will operate marker relay INT when the register preference relays RPO or RP1 and the register connector relays RECO or REC1 operate. The ground on lead U9 will operate marker relay IN8 after relay INT operates. Relay IN8 operated opens the operating path for marker relay U9 and connects ground to operate relays U1 and U4. With relays U1 and U4 operated the marker will connect the call to an attendant trunk on an intercept basis.
- 27.25 Options UD, UE, UF, UG, and UH provide wiring and diodes for the additional five trunks.

SECTION III - REFERENCE DATA

1. WORKING LIMITS

1.01 Lines and Trunks

Maximum external circuit loop resistance - 1500 ohms

Minimum insulation resistance - 10,000 ohms

1.02 Voltage Limits

Potential	Minimum	Maximum
-48	-45	-52
+48	+45	+52.6

2. FUNCTIONAL DESIGNATIONS

2.01 Relays

Designation	SD Location B Sheet Number	Meaning			
A	36	Pad Control A Sequence	COS	22	Camp On
ACA, ACB	8	Abandoned Call	COSA, COSB	22, 40	Camp-On Stop
ALBA, ALBB	22, 40	All Links Busy	COTA, COTB	15	Central Office Trunk
ARBA, ARBB	2	All Registers Busy	DCKA, DCKB	26	Down Check
ATB	5B	All Trunks Busy	HCA, HCB	9	Hunt Connector
B	36	Pad Control B Sequence	HMKA, HMKB	9	Hold Magnet Check
BSYA, BSYAA	12	Circuits Busy	HMTA, HMTAA	15	Hold Magnet Timing
BSYB, BSYBA		Circuits Busy	HMTB, HMTBA		Hold Magnet Timing
BTCA, BTCB	15	Busy Tone Trunk Connector	ICTA, ICTB	16	Intercept
BTTA, BTTB, BTTC	16	Busy Tone	INT	5B	Intercept
BYA, BYB	12	Busy Test	IN8	8B	Intercept 8
CCC	16	Cancel Camp-on	IN20-29	35	In
CO20-29	35	Cut Off	JR0-5	13	Junctor Register
CO30-79	1	Cut Off	JRAL	29	Junctor Register Alarm
COA, COAA	16	Camp On	JREA, JREB	13	Junctor Register End
COB, COBA		Camp On	JTA, JTAA	14	Junctor Terminating
COAL	32	Camp-On Alarm	JTB, JTBA		Junctor Terminating
CONA, CONAA		Camp On	L20-29	35	Line
CONB, CONBA		Camp On	L30-79	1	Line
			LAL1, LAL2, LAL2A	32	Link Alarm
			LBA, LBB	22, 40	Link Busy
			LCK1, LCK2	24	Link Check
			LEA, LEAA	23, 38	Link End
			LEB, LEBA		Link End
			LSHA, LSHB	23, 40	Link Shift
			LT2-5	20, 38	Link Test
			LT6, 7	20, 39	Link Test
			LT8, 9	21, 39	Link Test
			LTA, LTAA	22, 40	Link Test
			LTB, LTBA		Link Test
			LTCA, LTCB	22, 40	Link Test Connector
			LTS2-6	21	Link Test Slave

CD-65741-01 - ISSUE 9D - SECTION III

LTS7-9	22	Link Test Slave	RUCA,RUCB	8	Register Units Connector
LUCA,LUCB	8	Line Units Connector	SO-4	10	Sleeve
MAL	30	Miscellaneous Alarm	S5-9	11	Sleeve
MONA,B MONC	1	Marker Off Normal	SAA,SAB	25	Second Trial Auxiliary
MON2-7	1	Marker Off Normal	SEA,SEAA	12	Sleeve End
MS	36	Marker Seizure	SEB,SEBA		Sleeve End
MTA,MTB	25	Marker Timing	SL20-29	35	Line Sleeve
NAA,NAB	25	No-Connection Auxiliary	SMCO-8	24	Select Magnet Connector
NCA,NCB	25	No Connection	SMRA,SMRAA	15	Select Magnet Register
NT	18	No Test	SMRB,SMRBA		Select Magnet Register
OT20-29	35	Out			
RO,R1	2	Register	SMTA,SMTB	23	Select Magnet Timing
RAOA,RAOB	17	Register Allotter	SOA,SOB	15	Sleeve Operate
RALA,RALB		Register Allotter	STA,STB	25	Second Trial
RCAO,1,RCBO,1	5	Register Connector	STAR,STBR	25	Second Trial Register
RCCO,1,RCDO,1		Register Connector			
RCEO,1		Register Connector	T2-7	3	Line Tens
RCKA,RCKB	26	Release Check	TA2-7	2	Line Tens Auxiliary
RCTA,RCTAA	14	Register Cut Through			
RCTB,RCTBA		Register Cut Through	TA,TB	25B	Timing
RGA,RGAA	17	Register Group	TAA,TAB	25	Time-out Auxiliary
RGB,RGBA		Register Group	TAAL	30	Trouble Advance Alarm
RHKA,RHKB	17	Register Hold Magnet Check	TACA,TACAA, TACB,TACBA	4	Tens Auxiliary Connector
RLA,RLAA,RLAB	15	Release	TAL	31	Tens Alarm
RLB,RLBA,RLBB		Release	TCK1-4	3	Tens Check
RLAL	30	Release Alarm	TCS2-7	4	Tens Class
RLO,1	37	Release Register 0,1	TEAO-3	2	Tens End
RLSA,RLSAA	25	Trouble Release	TEBO-3		Tens End
RLSB,RLSBA		Trouble Release	THC2-7	4	Tens Hunt Connector
RPO,RP1	3	Register Preference	TKO,TK8,TK9	5	Trunk Connector
RPAO,RPAL	5	Register Preference Auxiliary	TKAO,TKA8,TKA9		Trunk Connector

TKB0,TKB8,TKB9	5	Trunk Connector	WLG,ZLG	22,40	Link Sequence WZ
TM2-7,TMA,TMB	4	Tens Magnets	WU,ZU	12	Units Sequence WZ
TOA,TOB	25	Time Out	WLLA,WLA	32	W Auxilliary
TOAL,TOALA	33	Time-Out Alarm	WLGA	22,40	W Auxilliary
TOKA,TOKB	26	Time-Out Check	WUA	29	W Auxilliary
TOLA,TOLB	26	Time-Out Lock	XC	38	Cross Check
TP2-7	3	Tens Preference	XCAL	32	Cross Check Alarm
TRO,TR1	2	Trunk Tens			
TRA,TRB	25	Trouble Relays			
TRAO,TRAL	2	Trunk Tens Auxiliary			
TRAL	31	Tens Release Alarm			
TRCO,TRC1	4	Trunk Class			
TRCA,TRCAA, TRCB,TRCBA	14	Terminating Route Complete			
TRKA,TRKAA, TRKB,TRKBA	14	Terminating Route Check			
TRLA,TRLB	22,40	Transfer Links			
TRMO,TRM1	4	Trunk Magnets			
TRPO,TRP1	3	Trunk Preference			
TRUO,TRU1	4	Trunk Units			
TS	19	Test			
TSDA,TSDB	18	Test Disconnect			
TT	18	Tie Trunk			
TU2-7	4	Tens Units			
UO-3	6	Units			
U4-7	7	Units			
U8,U9	8	Units			
UAL,UAL1	29	Units Alarm			
UAL1A,UAL2		Units Alarm			
UEA,UEB	8	Units End			
ULA,ULB	8	Units Lock			
WIL,WL,	24	Link Sequence WZ			
ZIL,ZL		Link Sequence WZ			

3. FUNCTIONS

- 3.01 Connects a calling station line or trunk to a dial pulse register
- 3.02 Connects a station line to a station line through a junctor.
- 3.03 Connects a station line to a trunk.
- 3.04 Connects a trunk to a station line.
- 3.05 Connects a trunk to a trunk.
- 3.06 Connects a station line or trunk to the busy-tone trunk if the called line or trunk group is busy.
- 3.07 Sets the dial pulse register to return busy tone if the busy-tone trunk is busy.
- 3.08 Connects a station line or a trunk to the intercept portion of the attendant trunk if the called line or trunk group is unassigned.
- 3.09 Sets a central office or ringdown tie trunk circuit to camp on the called station line if that line is busy and no other trunk is camped on that line.
- 3.10 Signals a central office or ringdown tie trunk and refuses to set up a camp-on if the called station line already has a trunk camped on.
- 3.11 Signals a central office trunk and refuses to set up a camp-on if the called station line is busy when the PBX is provided with an auxiliary position circuit and the attendant has placed the PBX on remote trunk answer operation.
- 3.12 Cancels camp-on if the marker encounters a busy station when attempting:
 - (a) To add a station to either of the dial conference trunk circuits (attendant or station controlled).

- (b) To transfer an incoming central office trunk call via station dial transfer trunk circuit.
- 3.13 Release and abandons a call under the following conditions:
- (a) The calling party disconnects before receiving dial tone.
- (b) The calling party disconnects after the dial pulse register seizes the marker and before the call is completed.
- (c) The calling station line or trunk does not test idle.
- 3.14 Serves calls from register, trunk, and station lines in a predetermined order and prevents calls from interfering with each other.
- 3.15 Selects an idle link for a call.
- 3.16 Allots an idle dial pulse register for a call.
- 3.17 Selects an idle trunk from the group desired.
- 3.18 Hunts over lines strapped in a hunting group.
- 3.19 Recognizes an all-registers-busy condition and blocks until a busy register has been served and becomes idle.
- 3.20 Releases the dial pulse register when a call has been completed.
- 3.21 Goes to second trial if a call is not completed in a predetermined length of time.
- 3.22 Connects the calling party to the busy-tone trunk if the call is not completed on a second trial in a predetermined length of time.
- 3.23 Releases and gives an alarm if the call cannot be completed to the busy-tone trunk in a predetermined length of time.
- 3.24 Checks the time-out circuits every time the busy-tone trunk is used.
- 3.25 Operates an alarm relay whenever a faulty operation is detected, but otherwise completes most calls as if the faulty condition did not exist.
- 3.26 Signals the PBX alarm circuit when a marker alarm relay operates.
- 3.27 Provides a visual indication of a trouble.
- 3.28 Recognizes the class of service on a line or trunk when a call is originated and extends this to the register. Sends TLA and TT class of service indications from the register to the trunks.
- 3.29 Provides for operating internal or external traffic peg count, traffic overflow and trouble peg count registers.
- 3.30 Provides for the optional use of a manual switchboard as an attendant position.
- 3.31 Provides for message waiting service on an optional basis.
- 3.32 Cross-connect terminals are added to provide for operating external as well as internal traffic registers.
- 3.33 Provides for the optional use of the 756A attendant position when using a 608A or 608D switchboard.
- 3.34 Provides a jack appearance of port 5 of the station dial conference at 608A or 608D switchboard on an optional basis.
- 3.35 Provides pad control for code 8 tie trunks that use switchable pads.
- 3.36 To provide a link busy indication to the make busy and busy display circuit.
- 3.37 To provide a means for links to be made busy by the make busy and busy display circuit.
- 3.38 To provide a busy indication to the make busy and busy display circuit that the terminating side of the junctor is connected.
- 3.39 To provide a means for junctors to be made busy by the make busy and busy display circuit.
- 3.40 To provide a busy tone trunk busy indication to the make busy and busy display circuit.
- 3.41 To provide a means for a busy tone trunk to be made busy by the make busy and busy display circuit.
- 3.42 To provide a universal line (assigned to a two-way tie trunk) busy indication to the make busy and busy display circuit.
- 3.43 To provide a means for a universal line (assigned to a two-way tie trunk) to be made busy to outgoing tie trunk calls by the make busy and busy display circuit.

3.44 Provides a means of releasing relay SV in the telephone dictation trunk when the attendant plugs into a station line jack which is connected to a dictation machine (Option VF).

3.45 Provides a means of battery and ground reversal on leads T and R as a delay dial signal when the 756A is connected for delay dial tie trunk operation (Option VD).

3.46 To provide for operation of the Line, Link and Marker Circuit with the Traffic Measurement System No. 1A Remote Scanner.

4. CONNECTING CIRCUITS

4.01 When this circuit is listed on a key sheet, the information thereon is to be followed:

- (a) Dial Pulse Register Circuit - SD-65742-01.
- (b) Alarm, Transfer, and Test Circuit - SD-66796-01.
- (c) Traffic Register Circuit - For Internal Traffic and Trouble Registers - SD-65744-01.
- (d) Dial Conference Circuit - SD-65745-01.
- (e) Junctor Circuit - SD-65750-01.
- (f) Two-Way Central Office Trunk Circuit - SD-65752-01.
- (g) Attendant Trunk Circuit - SD-65753-01.
- (h) Busy-Tone Trunk Circuit - SD-65754-01.
- (i) Dial Repeating Type Tie Trunk Circuits - SD-65755-01, SD-65718-01, SD-65535-01 (typical).
- (j) Dial Long Line Circuit - SD-66060-01 (typical).
- (k) Loudspeaker Paging Trunk Circuit - SD-65747-01.
- (l) Cordless Position Circuit - SD-65751-01, SD-65757-01.
- (m) Ringdown Tie Trunk Circuit - SD-65756-01.
- (n) 3A Code Call Circuit - SD-66610-01.
- (o) Recorded Telephone Dictation Trunk - SD-65788-01.
- (p) Message Waiting Service Key, Interrupter, and Power Supply Circuit - SD-65784-01.
- (q) Busy Verification Auxiliary Trunk Circuit - SD-66911-01.
- (r) Station Dial Transfer Trunk Circuit with Add-On Conference - SD-66921-01.
- (s) Station Dial Transfer Controller Circuit - SD-66909-01.
- (t) Auxiliary Position Circuit - SD-66910-01.
- (u) Dial Conference Trunk Circuit - Station Controlled - SD-66902-01.
- (v) Dial Conference Trunk Circuit - Attendant Controlled - SD-66908-01.
- (w) Traffic Register Circuit - For External Traffic and Trouble Registers - SD-5E010-01.
- (x) Station Message Register Pulse and Surcharge Circuit - SD-5E021-01.
- (y) Message Register Circuit - SD-65852-01.
- (z) Inward Restriction Circuit - SD-5E003-01.
- (aa) Interface Trunk Circuit - SD-66926-01.
- (ab) Tie Trunk Access Circuit - SD-1E052-01 or SD-1E034-01.
- (ac) 608D Jack and Lamp Circuit - SD-65997-01.
- (ad) 552A, 552B, 552D, 552E, 605A, 607A, 607B, or 608A Jack Circuit - SD-65778-01.
- (ae) Line or Trunk Access Circuit (ground start) - SD-1E045-01.
- (af) Make Busy and Busy Display Circuit - SD-5E029-01.
- (ag) Voltage Reduction Detector Circuit - SD-5E037-01.
- (ah) Traffic Measurement System No. 1A Remote Scanner and Encoder Circuit Portable Type - SD-3B200-01.
- (ai) Relay Delay Timer - SD-99361-01.
- (aj) Trunk Circuit to Central Office - SD-5E001-01.

5. MANUFACTURING TEST REQUIREMENTS

5.01 The line, link, and marker circuit shall be capable of performing all the functions specified in this circuit description and meeting all the requirements of the Circuit Requirements Table.

6. TAKING EQUIPMENT OUT OF SERVICE

6.01 Station Lines: A station line may be removed from service by disconnecting lead S from the line hold magnet to the marker. All calls directed to that station

line then will be intercepted. If that station line tries to make a call, the marker will not find the idle verification and will abandon the call.

6.02 Links: A link may be removed from service by insulating the contacts of relays LTCA and LTCB, which connect the battery through resistor L- to lead S of the link.

6.03 Marker: There is no way in which the marker can be taken out of service without disrupting all traffic through the PBX. Individual relays, however, may be tested for adjustment by observing the preparation information in the Circuit Requirements Table. The effect of the marker operation is noted in those tables.

6.04 Trunks: Instructions for taking trunks out of service are given in the circuit description applying to the specific trunk circuit.

7. ALARM INFORMATION

A. Indication

7.01 A marker alarm relay, in operating, will transmit information to the alarm, transfer, and test circuit and light the associated alarm lamp in the marker circuit. Except for the time-out alarm condition, the alarm relay will normally not remain operated (unless the trouble condition remains when the marker releases). However, if the same or any other marker

alarm relay operates within the time of the next two register usages of the marker, the alarm, transfer, and test circuit will close a locking path for the marker alarm relay. This locking path will remain closed until it is opened manually. Any marker alarm relay that operates on subsequent marker operations before the alarm release key is operated will also lock operated. In the case of relays TOLA and TOALA, COAL (option WT), and XCAL (option WT), the alarm, transfer, and test circuit will close the locking path immediately, and those relays will remain operated. All operated marker alarm relays keep their associated alarm lamps lit to indicate the part of the marker in which trouble was encountered. If on the next marker usage after an alarm condition was encountered, no marker alarm relays operate, the alarm, transfer, and test circuit will release the alarm memory and restore to normal.

B. Action Required

7.02 When an alarm has been locked in, it is not possible to remove the marker from service for maintenance purposes. In general, the lighted alarm lamps should be noted and then the alarm released manually. If the trouble has cleared itself, no alarm lamps will relight on subsequent calls. If the alarm lamp or lamps do relight, the circuits of the marker involved as indicated by the lighted lamps should be observed to see if any relay or relays are out of step with the other of a pair. The faulty relays can be tested in accordance with the Circuit Requirements Table.

SECTION IV - REASONS FOR REISSUE

A. Changed and Added Functions

A.1 Provision is made to add up to six additional outgoing one-way central office trunks.

B. Changes in Apparatus

B.1 Added

INT relay, AK6, UC option, FS4, App Fig. 4

ATB relay, 1/2 AK6, UC option, FS4, App Fig. 4.

IN8 relay, AF515, UC option, FS5, App Fig. 4

U1 diode, 446F, UC option, FS5, App Fig. 4

U4A diode, 446F, UC option, FS5, App Fig. 4

U9 diode, 446F, UC option, FS5, App Fig. 4

INT1 diode, 446F, UC option, FS4, App Fig. 4

INT2 diode, 446F, UC option, FS4, App Fig. 4

TK8 diode, 446F, UC option, FS4, App Fig. 4

ATB1 diode, 446F, UC option, FS4, App Fig. 4

ATB2 diode, 446F, UC option, FS4, App Fig. 4

U8 diode, 446F, UD option, FS5, App Fig. 4

U7 diode, 446F, UE option, FS5, App Fig. 4

U6 diode, 446F, UF option, FS5, App Fig. 4

U5 diode, 446F, UG option, FS5, App Fig. 4

U4 diode, 446F, UH option, FS5, App Fig. 4

D. Description of Changes

D.1 The apparatus and option indexes are changed.

D.2 Options UB, UI, UJ, UK, UL, and UM are designated and rated Standard.

D.3 Options UC, UD, UE, UF, UG, and UH are added and rated A&M Only.

D.4 The connecting information for leads T2, R2, and S2 of the universal line circuit is changed to add reference to outgoing central office trunks.

D.5 Circuit Notes 102 and 104 are revised to reflect Issue 46D.

D.6 Circuit Note 131, 132, 324, 325, and 326 are added.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 3221-WVS-RGP