

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

CHANGES

B. Changes in Apparatus

B.1 Added

- HA Diode 446F App. Fig. 8
- HB Diode 446F App. Fig. 8
- HE Diode 446F App. Fig. 8
- HO Diode 446F App. Fig. 8

D. Description of Changes

D.1 On sheet B2, diodes HE and HO are added to provide a holding path for the HM relay in the two-way trunk circuit to central office from the operated RLA,B relays. Ground on the ME and MO leads must be provided until the MC relay in the central office trunk releases since the addition of YC option has delayed the release of the MC relay.

D.2 On sheet B2, diodes HA and HB are added to isolate a holding path for the HM relay in the two-way trunk circuit to central office when both registers are busy.

D.3 On sheet B2, B9 and C7 options XV and XU are added.

D.4 On sheets E10 and E11, SC-9 is revised to show the change in sequence of operations.

F. Changes in CD Sections

F.1 In SECTION II - DETAILED DESCRIPTION section 2.307, the second-last paragraph should read as follows: The RRL(A,B) relays in the register in operating will . . . . . and (3) release the RRL(A,B) relays in the register.

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PBX SYSTEMS  
NO. 756A  
LINE, LINK AND MARKER CIRCUITCHANGESD. Description of Changes

- D.1 On sheets B1, B9, B19 and B35, connections to inward restriction circuit are added.
- D.2 On sheets B1, B6, B7, B9, B12 and B35, options XO and XP are added.
- D.3 On sheet B19, options XQ and XR are added.
- D.4 On sheet D1, options XO, XP, XQ and XR are added to notes 102 and 104. Note 118 was also added.
- D.5 On sheet D5, note 319 was added.
- D.6 Sheet E23 is added.

F. Changes in CD Sections

- F.1 Under TABLE OF CONTENTS, Page 1, SECTION II - DETAILED DESCRIPTION  
4. CENTRAL OFFICE OR RINGDOWN TIE TRUNK TO STATION CALL TERMINATION (SC5), add:

L. Called Station is Inward Restricted (SC28)

- F.2 In SECTION II - DETAILED DESCRIPTION, add the following paragraphs after 4.78.

L. Called Station is Inward Restricted (SC28)

- 4.79 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 TCS5 relay. Relays AUO-9 in the inward restriction circuit operate in parallel with UO-9 relays.
- 4.80 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.
- 4.81 The marker proceeds to complete the call to an attendant trunk. When the call is completed, the marker releases by the operation of relays RL(A, AA, AB, B, BA, BB) also releasing the inward restriction circuit.
- F.3 In SECTION III - REFERENCE DATA  
4. CONNECTING CIRCUITS, add:
- 4.01
- (z) Inward Restriction Circuit - SD-5E003-01.

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PBX SYSTEMS  
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LINE, LINK, AND MARKER CIRCUITCHANGESA. Changed and Added Functions

- A.1 The SO-9 diodes (XH option) are added to prevent the operation of any S-relay associated with a busy line having +48V on the sleeve during units selection.
- A.2 XK option is added to disable the link testing function of the marker for a camp-on call when +48V is present on the sleeve of any link. This will prevent the possibility of a camp-on termination being made to the wrong address. Normal camp-on denied indications will be returned to the attendant.
- A.3 XH and XK options are added to permit the use of the sleeve lead for station message registration pulsing.

B. Changes in Apparatus

## B.1 Added

10	446F	Diode	SO-9	XH Option	Fig. 7
2	446F	Diode	SMTA,B	XH Option	Fig. 7
2	446F	Diode	LSTA,B	XH Option	Fig. 9
1	446F	Diode	HG	XK Option	Fig. 18
1	AF20	Relay	COD	XK Option	Fig. 18
1	AF132	Relay	H	XK Option	Fig. 18

D. Description of Changes

- D.1 On sheets B1 and B35, connections to message register circuit are added.
- D.2 On sheets B9, 10, 11, 20, and 21, options XH and XG are added.
- D.3 On sheets B9, 16, 17, and 19, option XK is added.
- D.4 On sheet B16, XJ option is added.
- D.5 On sheet B19, XL option is added.
- D.6 On sheets C6 and 8, XH option apparatus is added.
- D.7 On sheet C11, XK option apparatus is added.
- D.8 Sheet D1, XG, XH, XJ, XK, and XL options are added to notes 102 and 104.
- D.9 Sheet E22 is added.
- D.10 COD and H relay requirements are added to circuit requirement tables.

F. Changes in CD Sections

F.1 Under TABLE OF CONTENTS, Page 1, SECTION II - DETAILED DESCRIPTION, add:

4.K CALLED STATION BUSY - MESSAGE REGISTRATION PULSE ON SLEEVE

F.2 In SECTION II, add following paragraphs after 4.64.

K. CALLED STATION BUSY - MESSAGE REGISTRATION PULSE ON SLEEVE

4.65 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. Relay COD operated will transfer the operating path of the CONA,B and CONAA,BA relays to relay H. If relay COD is operated prior to the operation of the HMKA,B relays during a camp-on call termination, the link testing function of the marker will be disabled.

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

4.67 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 THM-- magnet and trunk relay HM.
- (d) Prepares a path to operate relay BY in the register.
- (e) Operates relay ST in the busy verification circuit (YT and XL options).

4.68 Relays COA,B and COAA,BA operated:

- (a) Operate BY relay 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.

4.69 Relays SOA,B in releasing release relays HMKA,B.

4.70 Relays SMTA,B released release relays SMRA,B and SMRAA,BA in turn releasing relay S-. With relay S- released, relays SEA,B will release operating relays RUCA,B. Relays RUCA,B in operating will reoperate relay U- operating relays UEA,B.

4.71 With the CONA,B and CONAA,BA relays released, no LT- or LTS- relays will operate and the all-links-busy ALBA,B relays will eventually operate operating relays COSA,B and BTTA,B.

4.72 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 SL lamp.

4.73 Relays BTTA,B operated:

- (a) Operate relays TRKA,B and TRKAA,BA.
- (b) Prepare a path to operate the BTCA,B relays.
- (c) Lock under control of the ALBA,B relays.

4.74 Relays TRKA,B and TRKAA,BA operated operate relays TRCA,B and TRCAA,BA which:

- (a) Release TRKA,B, TRKAA,BA, RCTA,B and RCTAA,BA relays.
- (b) Lock under control of RPA- relay.

4.75 Relays RCTA,B and RCTAA,BA released release RCA-, RCB-, RCC-, RCD-, RCE-, BYA,B, BSYA,B and BSYAA,BA relays. Release of the RC(A,-E)<sup>0,1</sup> relays release the TCS-, THC-, TU-, TM- and U- relays and register relay RV.

4.76 Relays TRKA,B and TRKAA,BA in releasing operate relays BTCA,B, which:

- (a) Operate relay UO and register relay BY.
- (b) Release TOLA,B.

4.77 Register relay BY operated releases relay R- and register relay DC. With relay DC released and trunk relay BY operated, opening the T & R connections to the register, register relay L will release. Relay L released will result in the subsequent release of all operated register relays.

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

F.3 In SECTION III, add the following to 2.01.

<u>Designation</u>	<u>SD Location B Sheet No.</u>	<u>Meaning</u>
COD	16	Camp-On Denied
H	16	Hold

F.4 In SECTION III, CONNECTING CIRCUITS, add:

4.01

- (w) Station Message Register Pulse Circuit - SD-66915-01.
- (x) Station Message Register Surcharge Circuit - SD-66922-01 (via Message Register Pulse Circuit).
- (y) Message Register Circuit - SD-65852-01.

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

TABLE OF CONTENTS	PAGE	TABLE OF CONTENTS	PAGE
<u>SECTION I - GENERAL DESCRIPTION</u> .....	1	<u>E. Hold Magnet Check and Marker and Register Release</u> .....	12
<u>1. PURPOSE OF CIRCUIT</u> .....	1	<u>F. All Trunks Busy - Busy Tone Trunk Idle</u> .....	13
<u>2. GENERAL DESCRIPTION OF OPERATION</u> ....	1	<u>4. CENTRAL OFFICE OR RINGDOWN TIE TRUNK TO STATION CALL TERMINATION (SC5)</u> ...	14
<u>A. Subcircuits and Arrangement</u> .....	1	<u>A. General</u> .....	14
<u>B. Dial Tone Connection (See Note 304)</u> .....	2	<u>B. Register Requests Service</u> .....	14
<u>C. Call-Terminating Connections</u> .....	3	<u>C. Called Station Testing and Select Magnet Operation</u> .....	14
<u>D. Called Station Line Busy</u> .....	4	<u>D. Hold Magnet Operation</u> .....	15
<u>E. Paths Busy</u> .....	4	<u>E. Hold Magnet Check and Marker and Register Release</u> .....	15
<u>F. Camp-On</u> .....	5	<u>F. Called Station Busy - Station in Hunting Group Idle</u> .....	15
<u>G. Abandoned Calls</u> .....	5	<u>G. Camp-On - Called Station and All Other Stations in Hunting Group Busy - No Other Trunk Camped on Called Station (SC9)</u> ....	16
<u>H. Marker Time-Out</u> .....	6	<u>H. Camp-On Busy - Called Station and All Other Stations in Hunting Group Busy - Another Trunk Already Camped on Called Station (SC20)</u> .....	18
<u>I. Checks</u> .....	6	<u>I. Camp-On Busy - PBX on Remote Trunk Answer Operation (XF Option)</u> .....	19
<u>J. Permanent Signals</u> .....	6	<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> .....	19
<u>K. Dial Back by Attendant - No Test</u> ..	6	<u>5. CENTRAL OFFICE OR RINGDOWN TIE TRUNK TO CODE 8 TRUNK CALL TERMINATIONS (SC6)</u> .....	19
<u>L. Alarms</u> .....	6	<u>A. General</u> .....	19
<u>SECTION II - DETAILED DESCRIPTION</u> .....	1	<u>B. Register Requests Service</u> .....	19
<u>1. ESTABLISHING DIAL TONE CONNECTIONS</u> ..	1	<u>C. Trunk Testing and Select Magnet Operation</u> .....	19
<u>A. Station Dial Tone Connections (SC1)</u> .....	1	<u>D. Hold Magnet Operation</u> .....	19
<u>B. Code 8 Tie Trunk Dial Tone Connections</u> .....	4	<u>E. Hold Magnet Check and Marker and Register Release</u> .....	20
<u>C. Central Office or Ringdown Tie Trunk Dial Tone Connections (SC2)</u> ..	4	<u>F. All Trunks Busy (SC15)</u> .....	20
<u>D. Attendant Trunk Dial Tone Connection</u> .....	5	<u>6. CENTRAL OFFICE OR RINGDOWN TIE TRUNK TO CENTRAL OFFICE OR RINGDOWN TIE TRUNK CALL TERMINATIONS</u> ....	20
<u>E. Busy Verification Trunk Dial Tone Connection</u> .....	6	<u>7. DIAL BACK CALLS FROM CENTRAL OFFICE OR RINGDOWN TIE TRUNKS</u> .....	20
<u>2. STATION-TO-STATION CALL TERMINATING CONNECTIONS (SC3)</u> .....	6	<u>8. CALLED LINE OR TRUNK UNASSIGNED (SC14)</u> .....	21
<u>A. General</u> .....	6	<u>9. LOCKOUT AND TENS PREFERENCE CONTROL</u> .	22
<u>B. Register Requests Service</u> .....	6	<u>A. Lockout Control</u> .....	22
<u>C. Junctor Testing and Selection</u> ....	6	<u>B. Tens Preference Control</u> .....	22
<u>D. Terminating Link Selection</u> .....	7	<u>10. ABANDONED CALLS (SC17)</u> .....	22
<u>E. Called Station Selection and Testing</u> .....	7		
<u>F. Connection of Called Station to Junctor</u> .....	7		
<u>G. Connection of Calling Station to Junctor</u> .....	8		
<u>H. Marker and Register Release</u> .....	8		
<u>I. Called Station Busy - Station in Hunting Group Idle (SC8)</u> .....	9		
<u>J. Called Station and Stations in Hunting Group Also Busy - Busy Tone Trunk Idle (SC7)</u> .....	9		
<u>3. STATION TO CENTRAL OFFICE OR RINGDOWN TIE TRUNK CALL TERMINATIONS (SC4)</u> ....	11		
<u>A. General</u> .....	11		
<u>B. Register Requests Service</u> .....	11		
<u>C. Trunk Testing</u> .....	12		
<u>D. Trunk Selection and Hold Magnet Operation</u> .....	12		

TABLE OF CONTENTS	PAGE
<u>11. ALLOTING AND SEQUENCE CONTROL</u> .....	22
<u>A. Register Allotter</u> .....	22
<u>B. Link Group Sequence Control (SC24)</u> .....	23
<u>C. Link Sequence Control (SC23)</u> .....	23
<u>D. Units Sequence Control (SC25)</u> .....	24
<u>12. PATHS BUSY</u> .....	24
<u>A. All Registers Busy</u> .....	24
<u>B. All Links Busy</u> .....	25
<u>C. All Junctors Busy (SC12)</u> .....	25
<u>D. Busy Tone Trunk Busy (SC13)</u> .....	26
<u>E. All Attendant Trunks Busy on Intercepted Call (SC19)</u> .....	26
<u>13. LINK SHIFT TIMING</u> .....	26
<u>A. General</u> .....	26
<u>B. Link Shift Timing (ZO Option - SC21)</u> .....	27
<u>C. Link Shift Timing (ZN Option - SC10)</u> .....	27
<u>14. MARKER TIMING (SC16)</u> .....	27
<u>A. General</u> .....	27
<u>B. Second Trial</u> .....	27
<u>C. No Connection</u> .....	28
<u>D. Trouble Release</u> .....	28
<u>15. TIME-OUT CHECK (SC18)</u> .....	29
<u>16. TRAFFIC REGISTER CONTROL</u> .....	29
<u>A. General</u> .....	29
<u>B. Peg Count Register Control</u> .....	29
<u>C. Overflow Register Control</u> .....	30
<u>D. Trouble Register Control</u> .....	30
<u>17. UNIVERSAL LINE GROUP 20-29</u> .....	30
<u>A. General</u> .....	30
<u>B. Station Line (Options M and ZD)</u> ..	30
<u>C. Two-Way Tie Trunk (Options ZD and ZF)</u> .....	30
<u>D. Dial Conference Circuit (Options N and ZD)</u> .....	31
<u>E. Recorded Telephone Dictation Trunk (Options ZD and ZS)</u> .....	32
<u>F. Loudspeaker Paging Trunk (Options ZD and ZS)</u> .....	32
<u>G. 3A Code Call Circuit (Options ZD, ZG, and ZE)</u> .....	32
<u>H. Auxiliary Position Circuit for Remote Trunk Answering (Options ZD and ZF)</u> .....	33
<u>I. Dial Conference Trunk Circuit - Station Controlled (Options ZD, ZF, and XD)</u> .....	34
<u>J. Dial Conference Trunk Circuit - Attendant Controlled (Options ZD and XC)</u> .....	34

TABLE OF CONTENTS	PAGE
<u>18. STATION AND TRUNK HUNTING GROUPS</u> ...	35
<u>A. General</u> .....	35
<u>B. Two-Way Station Hunting Group</u> ...	35
<u>C. One-Way Station Hunting Group</u> ...	35
<u>D. Combined Two-Way and One-Way Station Hunting Group</u> .....	35
<u>E. One-Way Sequential Station Hunting Group</u> .....	35
<u>19. MANUAL SWITCHBOARD (Y OPTION AND ZU OR ZT OPTION)</u> .....	36
<u>20. ALARMS</u> .....	36
<u>A. General</u> .....	36
<u>B. Units Alarms</u> .....	37
<u>C. Release Alarms</u> .....	37
<u>D. Tens Alarms</u> .....	38
<u>E. Link Test Alarms</u> .....	38
<u>F. Time-Out Alarms</u> .....	38
<u>G. Alarm Control</u> .....	39
<u>21. MESSAGE WAITING SERVICE (OPTION ZQ)</u> ..	39
<u>22. DIRECT STATION SELECTION</u> .....	39
<u>A. Attendant Direct Station Selection (Options ZY and ZX)</u> .....	39
<u>23. SINGLE-DIGIT DIALING</u> .....	39
<u>A. Make Busy Key and Lamp (Option YD)</u> .....	39
<u>B. Single Digit Dialing 8 for Long Distance (Options YE, YF, YO, and YP)</u> .....	39
<u>24. MISCELLANEOUS</u> .....	40
<u>SECTION III - REFERENCE DATA</u> .....	1
<u>1. WORKING LIMITS</u> .....	1
<u>2. FUNCTIONAL DESIGNATIONS</u> .....	1
<u>3. FUNCTIONS</u> .....	2
<u>4. CONNECTING CIRCUITS</u> .....	3
<u>5. MANUFACTURING TEST REQUIREMENTS</u> .....	3
<u>6. TAKING EQUIPMENT OUT OF SERVICE</u> .....	3
<u>7. ALARM INFORMATION</u> .....	3
<u>A. Indication</u> .....	3
<u>B. Action Required</u> .....	4
<u>SECTION IV - REASONS FOR REISSUE</u> .....	1
<u>A. Changed and Added Functions</u> .....	1
<u>B. Changes in Apparatus</u> .....	1
<u>D. Description of Changes</u> .....	1

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 stations, 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. The attendant may then hold the call at the attendant trunk and connect a central office or ringdown tie trunk to the calling station or code 8 tie trunk on a dial-back (no-test) basis. In the course of establishing this connection, the attendant trunk, which is holding the calling station or code 8 tie trunk, will be made to release.

2.11 Stations may be arranged into one-way or 2-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 a same kind may also be arranged into 2-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 key 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 services. 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 PBX 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) 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 Connections

#### General

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 link (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.

2.46 If all lines in the hunting group are busy or if the called line is not in a hunting group, the route control circuit functions with the line and trunk hunting circuit to verify that the called line is busy.

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 BusyAll 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 ringdown tie trunk to a station line and finds that the station and all other stations in 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 2.57 and 2.58 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 reoperate 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 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 PBX 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 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 PBX 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 PBX 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 the dual paths to either operate or release 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 (SCL)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 L-- relay. The L-- relays for stations 20 to 29 are shown on FS26 and those for stations 30 to 79 appear on FS1.

1.02 Assuming no other requests by lines, trunks, or registers for marker service, the L-- relay, in operating, will operate a tens T- relay (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 TEAO,A1,A2,A3,B0,B1,B2,B3 relays (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 TSDA,B relays and tens check TCK1,2,3,4 relays, 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 TP- relay (FS3) will operate. Any tens preference relay operated will operate the tens auxiliary connector TACA,B and TACAA,BA relays (FS4); the particular tens preference relay operated will operate the associated tens connector TCS-, THC-, TU-, and TM- relays (FS4).

1.05 The TACA,B and TACAA,BA relays operated:

- (a) Operate the line units connector LUCA,B relays and units lock ULA,B relays (FS5) to start units selection.
- (b) Operate the register group RGA,B and RGAA,BA relays (FS10) to start link testing and selection.

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

Units Selection

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

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

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

Link Testing and Selection

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

- (a) Operate the link test connector LTCA,B relays (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 sleeve LTS2-9 relays (FS12).
- (e) Connect a portion of the link testing circuit to the LT2-9 relays (FS12).

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

1.12 If a link is in use, -48 volts through a 900-ohm hold magnet (or an IN-- relay

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

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

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

1.15 Any LTS2-9 relay operated:

- (a) Operates the link end LEA,B and LEAA,BA relays (FS12).
- (b) Opens the operating path for the link busy LBA,B relays (FS12), thus halting the link shift timing.
- (c) With the TRLA,B relays operated, prepares a path for operating select magnet SM1 (FS13) on switches 0 and 1 and the switch in which the calling line appears.

1.16 The LEA,B and LEAA,BA relays operated:

- (a) Release the LTA,B relays.
- (b) Operate the select magnet timing SMTA,B relays (FS13).
- (c) Operate the 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 the WIL and ZL relays are operated and the LTS2 relay is operated, the operation of the LEAA,BA relays will cause select magnet 2 on switches 0 and 1 and the switch in which the calling line appears to operate.

1.19 With an LTS2-9 relay and the TRLA,B relays operated, the operation of the LEA,B relays 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

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

### Hold Magnet Operation

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

1.22 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 ZU relay in the units sequence control circuit on FS6 and the position of the corresponding S- relay in the trunk and line hunting preference chain.

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

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

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

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

### Hold Magnet Checks

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

- 1.28 When the HMTA,B relays operate, the hold magnet check HMKA,B relays (FS6) are connected to the line hold magnet or IN-- relay (over the path by which it originally operated), and the register hold magnet RHKA,B relays (FS10) are connected to the register hold magnets.
- 1.29 If the 100-ohm holding ground is present at the line hold magnet, the HMKA,B relays will operate; if the solid holding ground is present at register hold magnets, the RHKA,B relays will operate.

#### Marker Release

- 1.30 The downcheck DCKA,B relays (FS15) in the marker are normally locked operated. The operation of the HMKA,B and RHKA,B relays will open the locking paths, and the DCKA,B relays will release. The release of the DCKA,B relays will operate the release relays RLA,AA,AB,B,BA,BB (FS9).
- 1.31 The RLA,AA,AB,B,BA,BB relays operated:
- Release the MTA,B relays, thus halting the marker timing.
  - Open the operating paths for the relays in the tens preference chain on FS3, causing the TCK1,2,3,4 and the TP- relays to release.
  - Operate the tens auxiliary TA- relay (FS2) associated with the tens group just served, which, in turn, releases the corresponding T- relay.
  - Release the LEA,B and LEAA,BA relays, which, in turn, release any operated LTS- relays and the operated select magnets.
  - Release the SMTA,B relays, which, in turn, release the HMTA,B and HMTAA,BA relays and, in sequence, the SMRA,B and SMRAA,BA, S-, and SEA,B and SEAA,BA relays.
- 1.32 The release of the TP- relay causes the TACA,B and TACAA,BA, RGA,B and RGAA,BA, TCS-, THC-, TU-, and TM- relays to release.
- 1.33 TRPO,1 and TP2-7 diodes (YM option) delay the release of the trunk and station preference relays. This ensures the operation of the TRAL alarm relay in the event that a TA- or TRA- relay fails to operate on the completion of a dial tone connection. When the TRAL relay operates, the operate path of the abandon call relays is opened. This prevents the failure of a TA- or TRA- relay from causing the marker to recycle in the abandon call stage.
- 1.34 The TACA,B and TACAA,BA relays, in releasing, cause the ULA,B and UEA,B relays to release. The release of the ULA,B relays, in turn, releases any operated U- relays.

- 1.35 The THC- relay, in releasing, releases the associated SMC- relay. The release of the TM- relay releases the HMKA,B relays.
- 1.36 The RGA,B and RGAA,BA relays, in releasing, release the SMCO,1, RHKA,B, and LTAA,BA relays. The LTAA,BA relays, in releasing, advance the link group sequence and link sequence control circuits.
- 1.37 When the TCK1,2,3,4, HMKA,B, RHKA,B, and HMTA,B relays are all released, the DCKA,B relays reoperate and lock. The operation of the DCKA,B relays release the RLA,AA,AB,B,BA,BB relays, and the marker is ready to process another call.
- 1.38 If there are no other T-, TR-, or R- relays operated at this time, the TEAO,A1,A2,A3,BO,B1,B2,B3 relays will also release, releasing all operated TA- and TRA- relays and restoring the marker to normal.

#### Originating Class of Service

- 1.39 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.
- 1.40 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 CS-- terminal is strapped to the TLA terminal. A toll-denied class of service is provided by strapping the CS-- terminal to the TLD terminal. A station is restricted when both of the above straps are omitted.
- 1.41 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 the TLA- and TLD- leads. When the SEA,B relays operate at the completion of the units selection sequence, 48-volt battery through the CS resistance lamp is connected through contacts of the ZU, S-, and TCS- relays to the CS terminal.
- 1.42 If the station is strapped for toll-allowed service, the battery on the CS terminal will be connected through contacts of the RGA,B and RAOA,OB,1A,1B relays to the

TLA- lead 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 the TLD- leads in a similar manner.

B. Code 8 Tie Trunk Dial Tone Connections

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

1.44 A seizure of the trunk by the distant end will result in a bridge being connected across the T1 and R1 leads, which will operate the associated line L-- relay. The L-- relay will operate the tens preference T2 relay, 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.

1.45 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 a toll-allowed class of service by strapping the corresponding CS2- terminal to the TTLA terminal. A toll-denied classification is provided by strapping the CS2- terminal to the TTLD terminal. A tie trunk is restricted when the CS2- terminal is strapped to the RTT terminal.

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

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

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

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

General

1.49 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 PBX 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 the TR- and U- leads corresponding to the trunk being used.

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

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

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

1.52 The TRP- relay, in operating, will operate the TACA,B and TACAA,BA relays and the associated trunk tens connector relays TRM- and TRC- on FS4.

1.53 The TACA,B and TACAA,BA relays, in operating, will operate the LUCA,B, ULA,B, and RGA,B and RGAA,BA relays. The TRC- and TRU- relays, in operating, will operate the SMCO and SM08 relays. The RGA,B and RGAA,BA relays, in operating, will operate the SM01 relay. The LUCA,B relays, in operating, will start the abandoned call timing.

Units Selection

1.54 With the TRU- and LUCA,B relays operated, the U- relay corresponding to the trunk requesting service will operate and lock to the operated ULA,B relays. 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 U- relay will

operate. A U- relay, in operating, will operate the UEA,B relays, which, in turn, will release the LUCA,B relays and halt the abandoned call timing.

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

#### Link Testing and Selection

1.56 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

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

#### Hold Magnet Operation

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

(a) Provide a locking path for the operated S- relay.

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

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

1.60 The operation of the SMTA,B relays 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 the T,R, and S leads of the register to the other end of the selected link.

1.61 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 the T and R leads of the trunk, will operate the L relay in the register. Relay L, in turn, operates the SR relay in the register. The SR relay, in operating, connects a 100-ohm ground to the link sleeve and solid ground on the RHM- lead to the marker.

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

#### Hold Magnet Checks and Marker Release

1.63 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, the TRA- relay should be substituted for the T- relay, the TRP- relay for the TP- relay, and the TRM-, TRU-, and TRC- relays for the TCS-, THC-, TU-, and TM- relays.

#### Originating Class of Service

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

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

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

1.66 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

1.67 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 the TR- and U- leads corresponding to the trunk selected.

1.68 The three attendant trunks are distributed between the trunk tens preference groups, with trunks 1 and 2 associated with the TRO relay and trunk 0 with the TR1 relay. Therefore, a service request from trunks 1

or 2 will ground the TRO lead and one from trunk 0 will ground the TR1 lead. The correspondence between the U- leads 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.

1.69 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

1.70 The attendant may obtain dial tone over the busy verification trunk, YT option, by operating the DIAL BACK key after dial tone has been obtained over attendant trunk 2. This action will cause the TPO7 and U0 leads 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 DC relay in the register will operate, which, assuming no other requests for marker service, will operate the associated register R- relay (FS2). The R- relay, in operating,

will operate the TEAO,A1,A2,A3,B0,B1,B2,B3 relays. These relays operated:

- (a) Open the operating paths for the other register R- relay and the trunk tens TRO,1 and tens T2-7 relays.
- (b) Operate the TSDA,B relays.
- (c) Start the marker timing.
- (d) Close paths in the preference relay chain on FS3, causing the TCK1,2,3,4 relays and the register preference RP- relay to operate.

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

2.04 The RPA- relay operated:

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

#### C. Junctor Testing and Selection

2.06 The six junctors associated with U- relays, junctors 0,1,2,3,4, and 5 are associated with units relays U0,U1,U2,U5,U6, and U7, respectively. The operation of the JTA,B and JTAA,BA and the RUCA,B relays operates the U0,U1,U2,U5,U6, and U7 relays, thus connecting the primary windings of the corresponding S- relays to hold magnets THM11, THM13, THM15, THM17, THM82, and THM84, respectively. The hold magnets are associated with the terminating side of the junctors. The S- relays 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 S- relay from operating.

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

2.08 The idle junctor selected for use in this call is dependent upon the state of the ZU relay in the units sequence control

circuit. When the SEA,B relays operate, battery through the CS resistance lamp, contacts of the ZU relay, contacts of the first operated S- relay in the units sequence chain on FS11, and contacts of the operated JTA,B and released UEA,B relays will operate the junctor register JR- relay (FS7) corresponding to the junctor selected.

2.09 The JR- relay operated will:

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

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

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

#### D. Terminating Link Selection

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

#### E. Called Station Selection and Testing

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

- (a) Connect the T- leads from the appropriate register to the tens connector relays on FS4 and operate the TCS-, THC-, TU-, and TM- relays corresponding to the tens digit of the called station number.
- (b) Connect the U- leads from the appropriate register to the units relays on FS5 and operate the U- relay corresponding to the units digit of the called station number.

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

2.15 The U- relay operated will operate the UEA,B relays. With a U- relay and the

TM- relay both operated, the primary winding of the corresponding S- relay 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 IN-- relay) will operate the S- relay. If the station is busy, the 100-ohm ground maintaining the line hold magnet (or IN-- relay) operated will prevent the S- relay from operating.

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

#### F. Connection of Called Station to Junctor

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

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

2.18 The SMTA,B relays, in operating, will:

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

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

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

2.21 When the HMTAA,BA relays operate:

- (a) The ground from the SMTA,B relay contacts that operated the called station line hold magnet is removed and the windings of the HMKA,B relays connected in its place.

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

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

G. Connection of Calling Station to Junctor

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

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

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

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

2.26 The TRCA,B relays, in operating:

- (a) Provide a ground for holding the junctor terminating and called line hold magnets when the SMTA,B relays release.
- (b) Release the RCTA,B and RCTAA,BA relays.
- (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 SMC- relay has not released.

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

2.29 The release of the LTAA,BA relays:

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

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

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

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

2.32 The SMRA,B and SMRAA,BA relays also reoperate at this time but perform no useful function during this phase of the call.

2.33 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 the A relay of the junctor in parallel with the calling station telephone set and the tip and ring circuit of the register. The A relay in the junctor operates, which, in turn, operates the B relay in the junctor.

2.34 The B relay in the junctor, in operating, will provide:

- (a) A 100-ohm ground on the originating link sleeve to continue to hold the called 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.

2.35 When the HMTAA,BA relays operate, they will:

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

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

H. Marker and Register Release

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

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

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

2.40 The RRLA,B relays in the register, in operating:

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

2.41 The release of the L relay releases the SR relay in the register, which, when released, will release the ON relay in the register and the register hold THM-8,-9 magnets in the marker. When the ON relay releases, the RRLA,B relays release, restoring the register to normal.

2.42 The DC relay in the register, in releasing, releases the R- relay in the marker. If there are no other calls for the marker to serve, the R- relay will cause the TEAO,A1,A2,A3,B0,B1,B2,B3 relays to release, releasing the TSDA,B relays.

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

2.44 With the ON relay in the register released, the associated RA-A,-B relays 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)

2.45 If, during the called station line testing sequence, the S- relay corresponding to the called station does not operate, the ground applied to the SO-9 relay

contact chain on FS6 will pass through the break contacts of all of the SO-9 relays to operate the busy test BYA,B relays (FS6).

2.46 The BYA,B relays, in operating, lock to the operated RCTA,B relays and operate the hunt connector HCA,B relays (FS6). The HCA,B relays, in operating, close the operating path for the slow operate circuits busy BSYAA,BA relays (FS6) and extend the ground on the U- lead from the register corresponding to the called station units digit to the H terminal associated with the called station shown on FS1 or FS26. This ground will be extended through the hunting group straps (X option) or any properly poled H diodes (W or ZR option) to the H terminals associated with stations in the same hunting group, and operate the U- relays corresponding to those stations.

2.47 These U- relays, in operating, will connect the primary windings of the corresponding S- relays to the line hold magnets (or IN-- relays) of these stations. Battery through the line hold magnets (or IN-- relays) of the idle stations will operate the associated S- relays.

2.48 The operation of any S- relay will:

- (a) Open the operating ground for the BSYAA,BA relays.
- (b) Operate the SEA,B and SEAA,BA relays.

2.49 The operation of the SEA,B and SEAA,BA relays will permit the operated SMTA,B relays to operate the HMTAA,BA and SMRA,B and SMRAA,BA relays.

2.50 The calling station will be connected to the idle station in the hunting group corresponding to the first operate S- relay (relative to the state of the ZU relay) in the line hunting chain of S- relay contacts on FS6.

2.51 The BYA,B relays will release when the RCTA,B relays release. If the BSYAA,BA relays have operated, they will also release at this time.

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

2.52 If the called station is found to be busy, the BYA,B and HCA,B relays will operate. If there are no stations in the hunting group idle (or the called station is not part of a hunting group), no S- relays will operate, and the slow operate BSYAA,BA relays will operate from the SMTA,B relays ground on the line hunting S- relay contact chain on FS6. The BSYAA,BA relays, in operating, will close the operating path for the slow operate BSYA,B relays.

2.53 When the BSYA,B relays operate:

- (a) The HCA,B relays release, which, in turn, release the U- relays associated with the station in the hunting group (if any).
- (b) The sleeve operate SOA,B relays (FS9) operate.
- 2.54 With the SOA,B relays and the U- relay associated with the called station operated, the S- relay corresponding to the called station will operate over its secondary winding causing the SEA,B and SEAA,BA relays to operate.
- 2.55 The SEA,B and SEAA,BA relays, in operating:
- (a) Operate the SMRA,B and SMRAA,BA relays.
- (b) Release the RUCA,B relays, which cause the operated U- and UEA,B relays to release in sequence.
- 2.56 With the SMRAA,BA and SOA,B relays and the S- relay corresponding to the called station operated, a path is completed between the line hold magnet (or IN-- relay) of the called station and the HMKA,B relays. The 100-ohm ground maintaining the called station line hold magnet (or IN-- relay) operated will then operate the HMKA,B relays.
- 2.57 With the HMKA,B, SOA,B, SMRAA,BA, and the SEAA,BA relays operated, the busy tone BTTA,B,C relays (FS9) will operate, which, in turn, will:
- (a) Operate the TRKA,B and TRKAA,BA relays.
- (b) Release the SOA,B relays and the operated JR- relay.
- (c) Lock to the operated RPA- relay (A option) or RP- relay (B option).
- 2.58 The JR- relay, in releasing, will:
- (a) Release the JREA,B relays, which will in sequence release the LTAA,BA and LEA,B and LEAA,BA relays and the operated LTS- relay.
- (b) Release the associated SMC- relay, which, in turn, releases the select magnets on the junctor switches corresponding to the selected terminating link.
- 2.59 The release of the LTAA,BA relays will advance the link group sequence and the link sequence control circuits, and the release of the LTS- or LEAA,BA relays will release the select magnets corresponding to the selected terminating link on the switch in which the called station line appears.
- 2.60 The release of the SOA,B relays:
- (a) Causes the HMKA,B relays to release.
- (b) Releases the operated S- relay, which, in turn, releases the SEA,B and SEAA,BA relays.
- 2.61 The release of the SEA,B relays will reoperate the RUCA,B relays.
- 2.62 When the SMTA,B relays and the HMKA,B relays release, a path is closed through contacts of the operated TRKA,B relays for operating the TRCA,B and TRCAA,BA relays. The relays, in operating, will:
- (a) Lock operated under control of the BTTA,B,C and RPA- relays.
- (b) Release the TRKA,B and TRKAA,BA and RCTA,B and RCTAA,BA relays.
- 2.63 The RCTA,B and RCTAA,BA relays, in releasing:
- (a) Release the RCA-,B-,C-,D-,E- relays, which, in turn, release the TCS-, THC-, TU-, TM- relays associated with the called station.
- (b) Release the BYA,B, BSYA,B and BSYAA,BA relays if ZM option is used or, if ZL option is used, release the BYA,B relays, which, in turn, release the BSYA,B and BSYAA,BA relays. The THC- relay, in releasing, releases the associated SMC- relay.
- 2.64 With the BTTA,B,C and TRCA,B relays operated and the TRKA,B and TRKAA,BA relays released, the busy tone trunk connector BTCA,B relays (FS9) will operate, which:
- (a) In conjunction with the operated RUCA,B relays, operate the UO relay, which, in turn, operates the UEA,B relays.
- (b) Operate the SMCO relay.
- (c) Release the time-out lock TOLA,B relays (FS16), to prepare the time-out checking circuit.
- (d) With the UO relay operated, close a path between the SO relay primary winding and the busy tone trunk hold magnet.
- 2.65 If the busy tone trunk is idle, the battery through the busy tone trunk hold THM07 magnet (FS25) will operate the SO relay over its primary winding. The SO relay, in operating, will operate the SEA,B and SEAA,BA relays.
- 2.66 The SMCO relay, in operating, will:
- (a) Operate the SMTA,B relays.
- (b) Operate the select magnets on switch 0 corresponding to the link used for the

dial tone connection from ground at the contacts of the operated TRCAA,BA relays, through contacts of the released COA,B relays, operated RP- relay, and the crosspoints of the register memory hold magnet THM-9.

2.67 The SEA,B and SEAA,BA relays, in operating, will:

(a) With the SMTA,B relays operated, close paths for operating the slow operate HMTAA,BA relays and the SMRA,B and SMRAA,BA relays.

(b) Release the RUCA,B relays, which release the UO and UEA,B relays, in that sequence.

2.68 At this point in the call, ground from contacts of the operated SMTA,B relays passing through contacts of the released HMTA,B, TRKA,B, and SOA,B relays; the operated SEA,B, SO, SMRAA,BA, and BTCA,B relays; and the ZU relay either operated or released will operate the busy tone trunk hold THM07 magnet. The hold magnet, in operating, will close the crosspoints in the vertical associated with the operated select magnets, thereby connecting the T,R, and S leads 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.

2.69 The bridge on the T and R leads will operate the A relay 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 IN-- relay) 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.

2.70 When the HMTAA,BA relays operate, the operating path for the slow operate HMTA,B relays is closed, and the operating ground for the busy tone trunk hold magnet is removed. When the HMTA,B relays eventually operate, the HMKA,B relays 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 the HMKA,B relays, which, in turn, will release the DCKA,B relays. The DCKA,B relays, in releasing, will operate the RLA,AA,AB,B,BA,BB relays, which release the marker.

2.71 The RLA,AA,AB,B,BA,BB relays, in operating, will:

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

(b) Open the operate paths for the relays in the tens preference chain on FS3,

causing the TCK1,2,3,4 and RP- relays to release.

(c) Release the SMTA,B relays.

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

2.72 The release of the RP- relay releases the RPA- relay and the operated select magnets on switch O. The RPA- relay, in releasing, releases the BTCA,B,C relays, which, in turn, release the BTCA,B and TRCA,B and TRCAA,BA relays. The BTCA,B relays, in releasing, release the SMCO relay.

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

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

2.75 When the TCK1,2,3,4, TRCA,B, HMTA,B, and HMKA,B relays release, the DCKA,B relays will reoperate. The DCKA,B relays, in turn, release the RLA,AA,AB,B,BA,BB relays, 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, the DC relay in the register will operate. When the marker is ready to serve the request, the R-, TEAO,A1,A2,A3,B0,B1,B2,B3, MTA,B, TSDA,B, TCK1,2,3,4, RP-, and RPA- relays will operate.

3.04 The RPA- relay, in operating, will:

(a) Operate the RUCA,B relays.

(b) Close a path for operating the RCTA,B and RCTAA,BA relays over the RCTA,B leads 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 The RCTA,B relays, in operating, will operate the RCA-,B-,C-,D-,E- relays, which connect the tens and units leads from the involved register to the marker.

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

### C. Trunk Testing

3.08 If the register is arranged for one-digit code 9 operation, the T9, U1, and U4 leads 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 H-- terminals associated with each group will be strapped together.

3.09 When the RCA-,B-,C-,D-,E- relays operate, the ground on the T9 lead from the register will operate the trunk connector TK9,A9,R9 relays. The grounds on the U- leads will operate the U- relays associated with the trunks in the group either directly or through the strapping of the H-- terminals. Any U- relay, in operating, will operate the UEA,B relays.

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

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

(a) Release the RUCA,B relays.

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

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

3.13 The TK9 relay, 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 JREA,B and COA,B relays, the operated RCTA,B and RP- relays, and the crosspoints of the register memory vertical THM-9.

(b) Operate the SMTA,B relays.

### D. Trunk Selection and Hold Magnet Operation

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

(a) Close the operating circuit for the HMTAA,BA relays.

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

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

3.16 The MC relay in the trunk, in operating, will:

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

(b) Lock operated to the RLS- lead from the marker to the trunk.

3.17 The THM-- hold magnet, in operating, will close the crosspoints in the trunk vertical associated with the operated select magnets and connect the T,R, and S leads of the trunk to the calling station line circuit in parallel with the register via a link. The bridge on the T and R leads will cause a central office trunk to cut through to the central office and a 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 IN-- relay) operated after the register is released from the connection.

### E. Hold Magnet Check and Marker and Register Release

3.18 When the HMTAA,BA relays operate, the operating path for the slow operate HMTA,B relays is closed and the operating ground for the MC relay in the trunk is removed. When the HMTA,B relays operate, the HMKA,B relays are connected to the IT-- lead 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 a ringdown tie trunk, only the supervisory relays in the trunk have operated, a ground will be present on the IT-- lead. This ground will operate the HMKA,B relays. The HMKA,B relays, in operating, will release the DCKA,B relays, which, in turn, will operate the RLA,AA,AB,B,BA,BB relays.
- 3.20 The RLA,AA,AB,B,BA,BB relays, in operating:
- (a) Release the MTA,B relays, thus halting the marker timing.
  - (b) Open the operate paths for the relays in the tens preference chain on FS3, causing the TCK1,2,3,4 and RP- relays to release.
  - (c) Release the SMTA,B relays, which, in turn, release the HMTA,B and HMTAA,BA and SMRA,B and SMRAA,BA relays.
  - (d) Operate the RRLA,B relays in the register circuit.
  - (e) Remove the ground on the RLS- lead to the trunk circuit, thereby releasing the MC relay in the trunk.
- 3.21 The release of the RP- relay:
- (a) Releases the RPA- relay, which, in turn, releases the RCTA,B and RCTAA,BA relays.
  - (b) Releases the RCA-,B-,C-,D-,E- relays, which, in turn, release the TK9,A9,B9 relays.
  - (c) Releases the operated select magnets.
- 3.22 The TK9,A9,B9 relays, in releasing, release the SMC0 and SMC8 relays and open the operating path for the HMKA,B relays, releasing them.
- 3.23 The SMRA,B and SMRAA,BA relays, in releasing, release all operated S- relays, which, in turn, release the SEA,B and SEAA,BA relays.
- 3.24 The RRLA,B relays in the register, in operating:
- (a) Lock to the ON relay in the register.
  - (b) Release the L and DC relays in the register.
- 3.25 The release of the L relay in the register releases the slow release SR relay in the register, which, in turn, releases the ON relay in the register and the register hold THM-8,-9 magnets in the marker. When the ON relay in the register releases, it releases the RRLA,B relays in

the register, restoring the register to normal.

- 3.26 When the HMTA,B, TCK1,2,3,4 and HMKA,B relays are all released, the DCKA,B relays will release, causing the RLA,AA,AB,B,BA,BB relays to reoperate.
- 3.27 The DC relay in the register, in releasing, will release the R- relay in the marker. If there are no other calls to be processed by the marker, the release of the R- relay will release the TEAO,A1,A2,A3,B0,B1,B2,B3 relays, which, in turn, release the TSDA,B relays, restoring the marker to normal.
- 3.28 When the ON relay in the register releases, the associated RA-A,-B relays 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 S- relays will operate when the trunks are tested. The ground from the contacts of the SMTA,B relays will pass through the break contacts of the released S- relay trunk hunting contact chain shown on FS6 and operate the BYA,B relays, which will cause the HCA,B, BSYAA,BA, and the BSYA,B relays to operate in sequence.
- 3.30 When the BSYA,B relays operate:
- (a) The SOA,B relays will operate, which will, in turn, cause all of the S- relays corresponding to the trunks in the group (as determined by the operated U- relays) to operate.
  - (b) The HCA,B relays will release.
- 3.31 The S- relays, in operating, operate the SEA,B and SEAA,BA relays, which:
- (a) Operate the SMRA,B and SMRAA,BA relays.
  - (b) Release the RUCA,B relays, which, in turn, release the operated U- relays and the UEA,B relays, in sequence.
- 3.32 When the SMRAA,BA relays operate, ground on the IT-- leads of the busy trunks will operate the HMKA,B relays, which, with the SOA,B, SMRAA,BA, and SEA,B relays operated, will cause the BTTA,B,C relays to operate.
- 3.33 The BTTA,B,C relays, in operating, will:
- (a) Operate the TRKA,B and TRKAA,BA relays.
  - (b) Release the SOA,B relays.
- 3.34 The TRKAA,BA relays, in operating at this time, will release the SMTA,B

relays. The SOA,B relays, in releasing, will release the HMKA,B relays and operated S- relays. The S- relays, in releasing, will release the SEA,B and SEAA,BA relays, which, in turn, will cause the RUCA,B relays to reoperate.

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

3.36 The RCTA,B and RCTAA,BA relays, in releasing, will:

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

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

3.37 The RCA-,B-,C-,D-,E- relays, in releasing, will release the TK9,A9,B9 relays, which, in turn, release the SMC0 and SMCB relays.

3.38 With the TRCA,B and BTTA,B,C relays operated and the TRKA,B and TRKAA,BA relays released, the BTCA,B relays 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 The DC relay in the register will operate when dialing is completed. When the marker is ready to admit the request for service, the R-, TEAO,A1,A2,A3, BO,B1,B2,B3, MTA,B, TSDA,B, TCK1,2,3,4, RP-, and RPA- relays will operate.

4.04 The RPA- relay, in operating, will:

(a) Operate the RUCA,B relays.

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

(c) Close a path for operating the central office trunk COTA,B relays (FS9) over the CTA-,B- leads from the register.

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

(a) Connect the tens leads from the register to operate the TCS-, THC-, TU5, and TM5 relays corresponding to the tens digit of the called station number.

(b) Connect the units leads from the register to operate with the RUCA,B relays operated and the U- relays corresponding to the units digit of the called station number, which, in turn, operate the UEA,B relays.

(c) Operate the RV relay in the register, which, in turn, causes the P and MC relays in the trunk to operate in sequence.

4.06 The MC relay in the trunk, in operating:

(a) Locks operated to the RLS- leads from the marker.

(b) Connects the trunk to the common M, RS, BY, FF, TT, TLA, and NT leads from the marker.

##### C. Called Station Testing and Select Magnet Operation

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

4.08 The SEA,B and SEAA,BA relays, in operating, will:

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

(b) Prepare paths for operating the HMTAA, BA and SMRA,B and SMRAA,BA relays.

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

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

#### D. Hold Magnet Operation

- 4.10 The operation of the SMTA,B and SEA,B relays will:
- (a) Close the operating path for the slow operate HMTAA,BA relays.
  - (b) Operate the SMRA,B and SMRAA,BA relays, which will extend ground from contacts of the SMTA,B relays through contacts of the released HMTA,B, SOA,B, and TRKA,B relays, the ZU relay, and the operated S- and TM- relays to operate the line hold LHM-- magnet (or an IN-- relay which, in turn, operates the line hold magnet) associated with the called station.
- 4.11 The operation of the hold magnet connects the T,R, and S leads of the line circuit to the trunk in parallel with the register, via the link used in the dial tone connection.
- 4.12 When the HMTAA,BA relay operates:
- (a) The operating paths for the slow operate HMTA,B relays are closed.
  - (b) The RV relay in the register releases, causing the P relay in the trunk to restore to normal.
  - (c) The original operating path for the called station line hold magnet (or IN-- relay) is opened.
  - (d) Ground is connected to the RS- leads to the trunk, causing the RS relay in the trunk to operate and lock to the trunk off-normal ground.
- 4.13 The RS relay in the trunk, in operating, causes the HD relay 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 IN-- relay) operated when the register is eventually released from the connection. The trunk hold THM-- magnet will be maintained operated by off-normal ground in the trunk.

#### E. Hold Magnet Check and Marker and Register Release

- 4.14 When the HMTA,B relays operate, the HMKA,B relays are connected to the line hold magnet of the called station, and the

link sleeve ground present at the point will operate them. The HMKA,B relays, in operating, will release the DCKA,B relays, which, in turn, will operate the RLA,AA,AB,B,BA,BB relays.

- 4.15 The RLA,AA,AB,B,BA,BB relays, in operating:

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

- 4.16 The release of the RP- relay:

- (a) Releases the RPA- relay, which, in turn, releases the COTA,B and RCTA,B and RCTAA,BA relays.
- (b) Releases the RCA-,B-,C-,D-,E- relays, which, in turn, cause the TCS-, THC-, TU-, and TM- relays to release.
- (c) Releases the operated select magnets.

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

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

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

- 4.20 When the HMTA,B, TCK1,2,3,4, and HMKA,B relays are all released, the DCKA,B relays will reoperate, releasing the RLA,AA,AB,B,BA,BB relays, 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 S- relay will not operate when the line test is made. When the SMTA,B relays operate, the grounds from its contacts will pass through the break contacts of the SO-9 relay contact chain on FS6 and operate the BYA,B relays.

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

- (a) Close the operating path for the slow operate BSYAA,BA relays.
- (b) Extend the ground on the U- lead from the register corresponding to the called station units digit to the H terminal associated with the called station.

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

4.24 Any S- relay, in operating, will:

- (a) Open the operating ground for the BSYAA,BA relays.
- (b) Operate the SEA,B and SEAA,BA relays.

4.25 Once the SEA,B and SEAA,BA relays operate, the marker will continue in the sequence described previously and connect the trunk to an idle station in the hunting group. The BYA,B and HCA,B relays will release when the RCTA,B relays 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 S- relays will operate after the HCA,B relays operate. The slow operating BSYAA,BA and BSYA,B relays will eventually operate in sequence.

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

4.28 The S- relay, in operating, will:

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

the UEA,B relays to release in sequence.

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

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

4.31 The COA,B and COAA,BA relays, in operating:

- (a) Lock operated to the operated RP- and released STAR,BR relays (B option) or the operated RPA- relay (A option) under control of the COTA,B relays.
- (b) Operate the SMCO and SMC8 relays.
- (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 the BY relay 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 COS relay (FS12).
- (h) Prepare locking paths for the LTS2-9 relays.

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

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

4.33 The L relay in the register, in releasing, opens the operate path for the slow release SR relay in the register to start its release.

4.34 The CONA,B and CONAA,BA relays, in operating:

- (a) Operate the LTCA,B relays.
- (b) Operate the TRKA,B and TRKAA,BA relays, which, in turn, release the SMTA,B relays.

- (c) Provide a holding path for the SMRA,B and SMRAA,BA relays.
  - (d) Connect solid ground to the called station line hold magnet (or IN-- relay) through contacts of the operated SEA,B, SMRAA,BA, S-, and TM- relays and the ZU relay.
- 4.35 The ground extends over the sleeve of the link serving the busy called station.
- 4.36 The operation of the CONA,B and COA,B relays transfers the control of the ground on the M- leads to the trunks to the CONA,B relays.
- 4.37 The operation of the LTCA,B and CONAA,BA relays connects the midpoint of a potential divider consisting of the grounded 200-ohm LTB- resistor in series with the 1200-ohm LTA- battery connected resistor to the negative side of the primary winding to the LT- relays. The positive side of the primary winding is normally connected to the link sleeves of the link group through contacts of the TRLA,B relays. With the LTCA,B relays operated, the battery connected 1000-ohm L-- resistor is also connected to this point. In this condition, the potential at the negative side of the primary winding will be approximately -8 volts.
- 4.38 An idle link will have only the potential due to the L-- resistor on it, producing a voltage across the primary winding of approximately 2 volts of the wrong polarity. The voltage will not operate the LT- relay. 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 IN-- relay) connected to it in addition to the battery connected 1000-ohm L-- resistor, resulting in a potential of somewhat less than 1 volt of the correct polarity. This voltage is insufficient to operate the relay.
- 4.39 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 the LT- relay.
- 4.40 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.
- 4.41 An LT- relay, in operating, will operate its associated LTS- relay, which, in operating, will:
- (a) Prepare a locking path for itself.
  - (b) Provide a locking path for the corresponding LT- relay.
- (c) Operate the LEA,B and LEAA,BA relays.
  - (d) Halt link shift timing.
- 4.42 The LEA,B and LEAA,BA relays, in operating, at this time:
- (a) Cause the select magnets corresponding to the link being used by the busy called station (as determined by the operated LTS- relay and the state of the TRLA,B relays) to operate in switches 0 and 8.
  - (b) Release the CONA,B and CONAA,BA relays.
- 4.43 The release of the CONA,B and CONAA,BA relays:
- (a) Removes the ground from the M- leads to the trunks, causing the trunk hold THM-- magnet and the HM relay in the trunk to release.
  - (b) Releases the LTCA,B relays, which, in turn, release the operated LT- relay.
  - (c) Releases the SMRA,B and SMRAA,BA and SOA,B relays.
- 4.44 The release of either the SMRAA,BA or SOA,B relays releases the HMKA,B relays. The release of the SOA,B relays releases the operated S- relay, which, in turn, releases the SEA,B and SEAA,BA relays.
- 4.45 With the HMKA,B and SMTA,B relays released and the TRKA,B relays operated, the TRCA,B and TRCAA,BA relays will operate. These relays, in reoperating:
- (a) Lock under control of the RP- relays.
  - (b) Release the TRKA,B and TRKAA,BA relays, which, in turn, release the RCTA,B and RCTAA,BA relays and reoperate the SMTA,B relays.
- 4.46 The RCTA,B and RCTAA,BA relays, in releasing:
- (a) Release the RCA-,B-,C-,D-,E- relays, which, in turn, release the operated TCS-, THC-, TU-, and TM- relays in the marker and the RV relay in the register.
  - (b) Release the BYA,B, BSYA,B, and BSYAA,BA relays if ZM option is used, or, if ZL option is used, release the BYA,B relays, which, in turn, release the BSYA,B and BSYAA,BA relays. The THC- relay, in releasing, releases the associated SMC- relay.
- 4.47 The SMTA,B relays, in reoperating will:
- (a) Reconnect ground to the M- leads to the trunk via contacts of the released HMTA,B, SOA,B and ALBA,BA and the operated COA,B relays, which will operate the

trunk hold magnet and the HM relay in the trunk.

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

4.48 When the trunk hold magnet operates, the crosspoints corresponding to the link being used by the called station will close. Although this connects the T,R, and S leads of the trunk to the busy link, there will be no interference with the call in progress, since the operated BY relay in the trunk keeps the T and R leads open.

4.49 When the HMTAA,BA relays operate:

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

(b) The RS- leads to the trunk are grounded, causing the RS relay in the trunk to operate, which, in turn, releases the HD relay in the trunk.

4.50 When the HMTA,B relays operate, the ground at contacts of the operated SMTA,B relays through contacts of the operated COTA,B and COAA,BA relays will operate the HMKA,B relays. The HMKA,B relays, in turn, release the DCKA,B relays.

4.51 The DCKA,B relays, in releasing, will operate the RLA,AA,AB,B,BA,BB relays, which will:

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

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

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

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

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

(f) Remove ground from the RLS- leads to the trunks to release the MC relay in the trunk.

4.52 The release of the RP- relay will release the RPA- relay, which, in turn, will release the TRCA,B and TRCAA,BA and COTA,B relays. The COTA,B relays, in releasing, will release the COA,B and COAA,BA and HMKA,B relays. The COA,B and COAA,BA relays, in releasing, will release the SMC0 and SMC8 relays and advance the link group sequence control circuit.

4.53 Although the SR relay in the register starts to release when the BY relay in

the trunk released the L relay, it can be assumed that the SR relay is sufficiently slow in releasing so that it will not have released before the RRLA,B relays in the register have operated. Therefore, the RRLA,B relays in the register, in operating, will release the DC relay in the register, which, in turn, will release the R-, TEAO,A1, A2,A3,B0,B1,B2,B3, and TSDA,B relays in the marker, in that sequence.

4.54 When the SR relay in the register does finally release, it will release the ON relay in the register and the register hold THM-8,-9 magnets. The ON relay in the register, in releasing, will:

(a) Release the COT relay in the register.

(b) Reoperate the RA-A,-B in the register allotter circuit.

(c) Release the RRLA,B relays in the register.

4.55 When the HMTA,B, HMKA,B, TCK1,2,3,4, and TRCA,B relays are all released, the DCKA,B relays will reoperate. The DCKA,B relays, in turn, will release the RLA,AA, AB,B,BA,BB relays, 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)

4.56 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 the CONA,B relays 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 BY, RS, and DR relays. The released FF relay in the trunk already camped on backs into the marker over the CW lead (which is multiplied through all the code 9 trunks) to operate the camp-on stop COS relay (FS12) in the marker.

4.57 The COS relay, in operating, will operate the COSA,B relays (FS12), which will:

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

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

4.58 The operation of the FF relay along with the BY and RS relays 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 FF relay.

4.59 The COS relay will release when the CONA,B relays release; the COSA,B relays will release when the LEA,B relays release.

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

4.60 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 the CONAA,BA relays operate, battery supplied through the Auxiliary Position Circuit will operate the COSA,B relays (FS12).

4.61 The COSA,B relays operated:

- (a) Lock operated through contacts of the operated LEA,B and COAA,BA relays.
- (b) Ground the FF- leads to the trunk through break contacts of the HMTAA,BA relays to operate the FF relay in the trunk.

4.62 The operation of the FF relay along with the BY and RS relays 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 FF relay.

4.63 The COSA,B relays will release when the LEA,B relays 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)

4.64 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. The CCC relay 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.

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.

B. Register Requests Service

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

C. Trunk Testing and Select Magnet Operation

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

D. Hold Magnet Operation

5.04 The SMTA,B relays will operate when the SMC2 relay operates; the SEA,B and SEAA,BA relays will operate when an S- relay operates. The SMTA,B and SEA,B and SEAA,BA relays, in operating:

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

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

5.06 The OT2- relay, in operating, will:

- (a) Operate the corresponding line hold magnet LHM2-.
- (b) Close the operating ground for the OT relay through to the slow operating SL2- relay.
- (c) Connect ground through the 100-ohm S2- resistor to the sleeve of the link.
- (d) Transfer the T and R leads to the links from its normal connection to the T1 and R1 leads associated with the code 8 trunk to the T2 and R2 leads of the code 8 trunk.

5.07 The operation of the hold magnet will close the crosspoints and thus connect the T2 and R2 leads of the code 8 trunk to the T and R leads of the code 9 trunk in parallel with the T and R leads 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 the S2 lead from the code 8 trunk to the line circuit to maintain the OT2 and SL2- relays operated.

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

5.09 When the HMTAA,BA relays operate:

- (a) The operating paths for the slow operate HMTA,B relays are closed.
- (b) The RV relay in the register releases, causing the P relay in the trunk to release.
- (c) The original operating path for the OT2- and SL2- relays is opened.

E. Hold Magnet Check and Marker and Register Release

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

F. All Trunks Busy (SC15)

5.11 If all trunks in the code 8 group dialed are busy, none of the corresponding S- relays on FS6 will operate, and the BYA,B relays 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 the CONA,B and CONAA,BA and COA,B and COAA,BA relays operate.

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

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

6.03 If all trunks in the group are busy, no S- relay will operate, the BYA,B relays 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 the NT relay 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 the MC relay in the trunk operates, the no test NT relay (FS11) in the marker will operate in series with the NT relay in the Cordless Position Circuit.

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

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

7.06 The operated NT relay in the marker also:

- (a) Grounds the RT- leads (FS11) to the trunks, which will operate the RT relay in the trunk to prevent ringing the calling station.
- (b) Grounds the KO lead (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 the S and S1 terminals shown on FS1 and FS26 will be omitted. An unassigned code 8 trunk termination will have no optional connection wired to the IT8- lead 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 the IT9- lead 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 the SOA,B relays operate, indicating that no stations or trunks in the groups related to the dialed number are idle.

8.03 When the SOA,B relays operate, the S-relay corresponding to the dialed units digit will operate over its secondary winding, which, in turn, causes the SEA,B and SEAA,BA and SMRA,B and SMRAA,BA relays to operate, in that sequence. The SEA,B relays, in operating, release the RUCA,B, U-, and UEA,B relays in sequence.

8.04 With the SOA,B, S-, SMRAA,BA, and a tens connector relay operated, the HMKA,B relays are connected to the S or IT-- lead of the dialed trunk or station. Since no ground will be present on these leads, the HMKA,B relays will not operate.

8.05 With the SOA,B, SMRAA,BA and SEAA,BA relays operated and the HMKA,B relays released, the intercept ICTA,B relays (FS9) will operate. These relays will:

- (a) Release the junctor selection and link test portions of the circuit (if involved).
- (b) Operate the TRKA,B and TRKAA,BA relays, which, in turn, release the SMTA,B relays.
- (c) Lock under control of the RPA- or RP-relays.

8.06 The SMTA,B relays, in releasing:

- (a) Operate the TRCA,B and TRCAA,BA relays, which, in turn, release the RCTA,B and RCTAA,BA relays.
- (b) Release the SMRA,B and SMRAA,BA relays.

8.07 The RCTA,B and RCTAA,BA relays, in releasing:

- (a) Release the RCA-,B-,C-,D-,E- relays, which release the operated tens connector and select magnet connector relays in sequence.
- (b) Cause the BYA,B, BSYA,B, and BSYAA,BA relays to release.

8.08 The BSYA,B relays, in releasing, cause the SOA,B, S-, and SEA,B and SEAA,BA relays to release in sequence. The release of the latter relays causes the TRKA,B and TRKAA,BA relays to release and the RUCA,B relays to operate.

8.09 The release of the TRKAA,BA relays will cause the TKO,AO,BO relays to operate at this time, which, in turn, will operate the SMCO relay.

8.10 With the TKO and RUCA,B relays operated, the operated ICTA,B relays will operate the UO,U1, and U2 relays. These relays, in turn, will operate the UEA,B relays and complete a path between the primary windings of the SO,S1, and S2 relays and the IT00,IT01, and IT02 leads, respectively, from the attendant trunks. Battery through the TN relays in the idle attendant trunks will operate the respective S-relays. Any S- relay, in operating, will operate the SEA,B and SEAA,BA relays.

8.11 The SMCO relay, 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 the SMTA,B relay, which, in turn, operates the SMRA,B and SMRAA,BA relays and closes the operating path for the slow operating HMTAA,BA relays.

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 IT00,01, or 02 appearance instead of the IT05,06, 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 TEAO,A1,A2,A3,B0,B1,B2,B3 relays. 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 the T2-7 relays. The TEAO,A1,A2,A3,B0,B1,B2,B3 relays 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 the T2-7, TRO-1, and RO-1 relays with break contacts on the TEAO,A1,A2,A3,B0,B1,B2,B3 relays. Furthermore, the TEAO,A1,A2,A3,B0,B1,B2,B3 relays will lock operated to any operated T2-7, TRO,1, and RO,1 relays.

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

9.04 The release of all of the T2-7, TRO-1, or RO-1 relays allows the TEAO,A1,A2,A3,B0,B1,B2,B3 relays 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 The RO,1, TRO,1, and T2-7 relays 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 RO,1, TRO,1, or T2-7 relays are operated. The register circuits have the highest preference, the trunk circuits have 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. The TCK1 and TCK2 relays operate in series with the primary winding path, the TCK3 and TCK4 relays 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 the TACA,B and LUCA,B relays operate during the units selection sequence, the operating path for the slow operate abandon call ACA,B relays (FS5) is closed. If the station or trunk abandons the call before the LUCA,B relays release (indicating that a U- relay and the UEA,B relays have operated), the ACA,B relays will eventually operate.

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

10.03 If the abandonment occurs after the LUCA,B relay has released (the AC,A,B relays 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 a holding bridge on the T and R leads.

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 register 0 and 1, RAOA,B, and RALA,B, respectively, operate when the associated register becomes idle. However, the operate path of the RAOA,B relays is through break contacts of the RALA,B relays. Consequently, once released, the RAOA,B relays cannot reoperate until a call is served by register 1. The RALA,B relays 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 the STA,B relays will operate and release the RALA,B relays. 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 the STA,B relays will release the RALA,B relays and, assuming that register 0 is idle, the RAOA,B relays 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 the NAA,B relays operate. These relays, in operating, will operate the BTTA,B,C relays, which, in turn, cause the TRKA,B and TRKAA,BA relays to operate. The TRKAA,BA relays, in operating, release the SMTA,B relays, which, in turn, operate the TRCA,B and TRCAA,BA relays.

11.04 These relays, in operating, will release the BTTA,B,C and TRKA,B and TRKAA,BA relays and close the operating path for the slow operate ACA,B relays. When these relays finally operate, the RALA,B relays will operate (if not already operated) and the RAOA,B relays 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 the TRLA,B relays (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 the TRLA,B relays is dependent, in turn, upon the state of the ZLG relay. The ZLG relay functions in combination with the WLG and WLGA relays.

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

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

11.09 The LBA,B relays can also step the WLG, ZLG, WLGA relay combination by interrupting the operating grounds from the contacts of the operated LTAA,BA or COAA,BA relays. The LBA,B relays 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 the LBA,B relays will thereby cause the TRLA,B relays 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 the WL, ZL, WIL, and ZIL relays on FS13. If during link selection the ZL and WIL relays are operated, the link preference order will be -2 through -9. When the ZL relay is released and the ZIL relay operated, the preference order is -4 through -9,-2,-3. With the ZL relay operated and WIL relay released, the preference order is -6 through -9, -2 through -5. Finally, with both the ZL and ZIL relays 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 the WL, ZL, WIL, and ZIL relays are initially released, the LTAA,BA relays, in operating, will operate the WL relay. With the LTAA,BA and WL relays operated, the ZL relay is shunted down. The WL relay, in operating, will also operate the WIL relay. With the WL and WIL relays operated, the ZIL relay is shunted down. Thus, on this first marker operation, the link preference order will be that associated with the ZL and ZIL relays, both released. The release of the LTAA,BA relays removes the shunt from the ZL relay, which will then operate.

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

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

11.15 The fourth operation of the LTAA,BA relays will shunt down the WL relay but maintain the ZL relay operated. The WL relay, in releasing, will release the ZIL relay. Thus, on the fourth marker operation, the link preference order will be that associated with the ZL relay operated and the WIL relay released. When the LTAA,BA relays release, the ZL relay 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, the STA,B relays will operate, followed after a short interval by the operation of the SAA,B relays. Referring to FS13, it can be seen that the operation of these relays interrupts the ground from the contacts of the operated LTAA,BA relays to the WL and ZL relays, which will advance the link sequence control circuit in the same manner as if the LTAA,BA relays were released and reoperated.

D. Units Sequence Control (SC25)

11.18 The state of the ZU relay 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 the ZU relay is operated, the order is 5-9, 0-4. When the ZU relay 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 the ZU relay is operated is 3,4,5,0,1, and 2; when the ZU relay

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 the ZU relay is operated in accordance with trunk equipment numbers is 4,3,2,1,0,9,8,7, 6, and 5. With the ZU relay normal, the order changes to 9,8,7,6,5,4,3,2,1, and 0.

11.23 Assuming the WU and ZU relays to be normal, the operation of the TACAA,BA relays on a dial tone call will:

- (a) Operate the WU relay, which locks to its own contacts.
- (b) Shunt the winding of the ZU relay to prevent it from operating.

11.24 When the TACAA,BA relays release, the shunt is removed from the ZU relay, and it operates from ground at the contacts of the operated WU relay.

11.25 On the next operation of the TACAA,BA relays on a subsequent marker usage, the WU relay will be shunted down, but the ZU relay will remain operated over a path to ground through a break contact of the released WU relay. When the TACAA,BA relay releases, the ZU relay releases, restoring the circuit to the state prior to the first TACAA,BA relay operation.

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

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

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 the RLAA and RLBA relays 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 ARBA,B relays (FS2) will operate. The ARBA,B relays lock through their own contacts independently of the RLA,B relays, close an operating path for relays RO and R1 independently of the TEAO,A1,A2,A3,B0,B1,B2,B3 relays, and open the operating circuit of the TRP- and TP- relays.

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

#### B. All Links Busy

##### Station-to-Station Call (SC11 or SC22)

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 ALBA,B relays (FS12) will operate.

12.06 The ALBA,B relays, in operating, will operate the BTTA,B,C relays, which:

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

12.07 The release of the JR- relay will release the JREA,B relays. The JREA,B relays, in releasing, will release the LTA,B and LTAA,BA relays, which, in turn, cause the release of the IBA,B, LTCA,B, and ALBA,B relays. If ZO option is provided, the LSHA,B relays will also release at this time.

12.08 After the TRKA,B and TRKAA,BA relays 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

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

12.10 When the ACA,B relays operate, the DCKA,B relays release, which, with

the ACA,B relays operated, cause the RLA,AA, AB,B,BA,BB relays to operate, releasing the marker.

12.11 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)

12.12 When the 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.

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

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

12.15 With the SMRAA,BA, SEA,B, SO, SOA,B, and JTA relays operated, the HMKA,B relays are connected to the hold magnet of junctor O. The ground at that point will operate the HMKA,B relays. Meanwhile, the RUCA,B relays, in releasing, cause a sequence releasing the UO-2, U5-7, UEA,B, BYA,B, BSYAA,BA, and BSYA,B relays.

12.16 With the SOA,B, SMRAA,BA, and HMKA,B relays operated, the BTTA,B,C relays will operate and lock to the operated RP- or RPA- relays. The BTTA,B,C relays operated will:

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

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

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

- (a) Release the TRKA,B and TRKAA,BA relays.
- (b) Reoperate the RUCA,B relays.

12.19 With the BTTA,B,C and TRCA,B relays operated and the TRKAA and TRKB relays

released, the BTCA,B relays operate, which, in turn, operate the SMCO relay and release the TOLA,B relays. The SMCO relay, in operating, will:

(a) Provide a path for operating the select magnets on switch 0 used for the dial tone connection from grounds at the contacts of the operated TRCAA,BA relays passing through the RP- relay and the register memory hold magnet THM(-9).

(b) Operate the SMTA,B relays.

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

12.21 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)

12.22 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 the SO relay primary winding to the hold magnet of the trunk.

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

12.24 The BYA,B relays, in operating, will:

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

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

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

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

12.25 The BY relay in the register, in operating, will:

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

(b) Release the DC relay in the register.

(c) Open the RRA-,B- leads from the register to the marker to prevent the release of the register when the marker releases.

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

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

(a) Release the RP- relay, which, in turn, will release the RPA- relay and the operated select magnets on switch 0.

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

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

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

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

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

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

12.30 If a call has been intercepted but all attendant trunks are busy, the BYA and BYB and the BSYA and BSYB relays will operate when no S- relay 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, the LTA,B or COA,B relays will operate at

the start of the link hunting sequence. These relays operated will close the operating path of the slow operate LBA,B relays to the chain of break contacts of the LTS2-9 relays as shown on FS12.

13.02 If an LTS- relay does not operate before the LBA,B relays operate, the link group sequence control circuit will advance and change the state of the TRLA,B relays. The TRLA,B relays, in operating or releasing, will shift the link testing circuitry from one group of links to the other.

#### B. Link Shift Timing (ZO Option) (SC21)

13.03 The operation of the LTA,B or COA,B relays will connect ground to one side of the winding of the slow operate LBA,B relays. The other side of the winding is connected through break contacts of the released LSHA,B relays to the break contact chain of LTS2-9 contacts to battery, as shown on FS12. If no LTS- relays 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), the LBA,B relays will operate.

13.04 The LBA,B relays, in operating, will:

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

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

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

13.06 The LBA,B relays will release when the COA,B or LTA,B relays release. The LBA,B relays, in releasing, will release the LSHA,B relays.

#### C. Link Shift Timing (ZN Option) (SC10)

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

13.08 The LBA,B relays, in operating, will:

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

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

#### 14. MARKER TIMING (SC16)

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

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

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

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

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

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

14.09 The operation of the STA,BR relays will release the MSTA,B relays and also release the RPA- relay, if operated. The STA,B relays, in operating, will:

- (a) Release any operated JR- relay.
- (b) Release the RA1A,B relays, if operated.

14.10 The subsequent operation of the SAA,B relays will:

- (a) Release the STA,BR relays, which will restore the operating path for the SMTA,B relays.
- (b) Restore the locking path for the JRO-6 relays. The sequential operation of the STA,B and SAA,B relays will also advance the link and units sequence control circuit.

14.11 On a dial tone call the release of the SMTA,B relays will cause the release of the SMRA,B and SMRAA,BA, HMTA,B, and HMTAA,BA relays. 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 the RA1A,B relay will cause the marker to attempt to connect to register 0 (if idle) on the second trial.

14.13 If the marker preferred register 0 on the first trial, the release of the RA1A,B relay 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 the ZU relay. When the SMTA,B relays reoperate, the grounds from their contacts will pass through the S- relay contact chain on FS6 by the alternate route.

14.14 If the marker is processing a terminating call, the release of the RPA-, JR-, and SMTA,B relays 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 the TOA,B relays release on the second cycle, the NCA,B relays will operate and release the JTA,B, ICTA,B, and TRCA,B and TRCAA,BA relays, if operated. When the TAA,B relays release, the TMA,B relays will operate to start the timing circuit on its next cycle and operate the NAA,B relays.

14.16 The NAA,B relays, in operating, will:

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

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

14.18 When the BTCA,B relays 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 the TOA,B relay releases on the third cycle of the timing circuit, the TRA,B relays will operate over a path through contacts of the released TOA,B relays and the operated TAA,B and MTA,B relays.

14.20 The TRA,B relays, in operating, will:

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

- (b) Release the normally operated release check RCKA,B relays (FS15).
- (c) Release the TAA,B relays, which, in turn, reoperate the TMA,B relays.

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

14.22 The trouble release relay, in operating, will:

- (a) Release the TEAO,A1,A2,A3,BO,B1,B2,B3 and TCK1,2,3,4 relays.
- (b) Release any operated RP-, TRP-, TP-, TACA,B and TACAA,BA, SEEA,B and SEAA,BA, LEA,B and LEAA,BA, and SMTA,B relays.
- (c) Release the MC relay in a trunk, if operated.
- (d) Operate the RRLA,B relays in a register if a register is connected.
- (e) Release the MTA,B relays.

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

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

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

#### 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 TOLA,B relays (FS16) release, due to a power failure, or the BTCA,B relays operate when the marker connects a call to the busy tone trunk.

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

15.03 The TOKA,B relays, in operating, will:

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

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

### 16. TRAFFIC REGISTER CONTROL

#### A. General

16.01 Contacts on relays in the marker are provided for operating registers in the traffic register circuit as shown on FS24. These leads may be grouped as peg count, overflow, and trouble register control leads.

#### B. Peg Count Register Control

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

16.03 Whenever the marker attempts to complete a call to a code 9 trunk, the TKB9 relay will operate, grounding the TPC9

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

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

#### C. Overflow Register Control

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

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

16.08 When the marker attempts to complete a call to a code 9 trunk, the TKB9 relay will operate. If all trunks in the group are busy, the BYA,B relays will also operate and ground the OF9 lead, 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, the OF8 lead 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, the OFO lead 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, the BTCA,B and BYA,B relays will be operated, causing the BTOF lead 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, the JTAA,BA and BYA,B relays will be operated, causing the JOF lead 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 the STA,BR relays operate, indicating that the marker has progressed to the second trial stage, the STPC lead is grounded and the corresponding register scored. If the marker progresses to the no-connection state, the NAA,B relays will operate, grounding the NCPC lead and causing the corresponding register to operate. When the RLSAA,BA relays operate, indicating that the marker has progressed to the trouble release stage, the TRPC lead 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 and ZD)

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

#### C. Two-Way Tie Trunk (Options ZD and ZF)

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

ZD and ZF options are used. With some trunks the S1 lead may also be required.

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 the L relay over the T1 and R1 leads and the marker will process the call as if it were a station. The L relay, in operating, will close a path between the S lead to the marker and the winding of the IN relay. This path is maintained by make contacts of the IN relay after the marker operates the IN relay over the S lead. The IN relay operated operates the line hold magnet LHM, which causes the L relay to release.

17.06 After the connection has been established, the IN relay 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 the S1 lead) that will return ground to the line circuit over the S2 lead operating the SL relay. In other trunks the ground on the S2 lead is present immediately upon seizure.

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

17.08 When the marker seizes the circuit for an outgoing call by grounding the IT lead, the OT relay operates. The OT relay, 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 (T1 and R1 leads) to the outgoing leads of the trunk (T2 and R2 leads).
- (c) Disconnects the link sleeve from its normal connection to the S1 lead of the trunk and connects 100-ohm ground to it.
- (d) Prepares a path for locking itself to the S2 lead of the trunk.
- (e) Starts the operation of SL relay.

17.09 If the trunk is of the type that requires a forward ground on the S2 lead for seizure on an outgoing call, this requirement is satisfied by the operation of the OT relay since the ground from the marker which operates it is extended to the S2 lead 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 the S2 lead to keep the OT relay operated when the marker removes ground from the IT lead. This ground on the S2 lead also operates checking relays in the marker and completes the operation of the SL relay.

17.11 The SL relay, in operating, opens the operate path for the OT relay and grounds the IT lead to the marker as a busy indication. The SL relay is made slow in operating to allow sufficient time for the trunk to return locking ground on the S2 lead to hold the OT operated before the operating path for the OT relay is opened. When the SL relay operates, the T thermistor is short-circuited by contacts of the SL relay to allow it to start cooling immediately, thus ensuring that the SL relay 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 the S2 lead 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 the S2 lead. Ground on the S2 lead will operate the SL relay, grounding the IT lead to the marker and preventing its selection for an outgoing call at the PBX.

17.13 The L diode (FS35; option J) in the battery supply lead for the L20-29 relays 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 (Options N and ZD)

17.14 When a line circuit is assigned to a terminal of the dial conference circuit, N and ZD options are provided, and the T2, R2, and S2 leads 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 the IT lead, operating the OT relay in the same manner as when setting up a connection to a 2-way tie trunk. When the crossbar switch crosspoints 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 the S2 lead.

17.16 Ground on the S2 lead locks the OT relay operated and grounds the IT lead as the busy indication. The SL relay will operate whenever the S2 lead is grounded and replaces the S2 lead on the IT lead with a ground from its own contacts.

E. Recorded Telephone Dictation Trunk (Options ZD and ZF)

- 17.17 When a line circuit is assigned to a Recorded Telephone Dictation Trunk, the T2, R2, and S2 leads are connected to the trunk, and ZD and ZF options are used.
- 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 the S2 lead to complete operating the SL relay and lock the OT relay operated.
- 17.19 When the calling station hangs up, the trunk normally removes the ground on the S2 lead, causing the OT and SL relays to release. The OT relay, 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 the S2 lead for an instant, after which the ground is restored.
- 17.20 During the momentary removal of the S2 lead ground, the SL and OT relays 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 the S2 lead will reoperate the SL relay and ground the IT lead 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, the S2 lead will be grounded, which will operate the SL relay and connect a busying ground to the IT lead.

F. Loudspeaker Paging Trunk (Options ZD and ZS)

- 17.21 When a line circuit is assigned to the loudspeaker paging trunk, ZD and ZS options are used, and the T2, R2, and S2 leads 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 the S2 lead, which will operate the SL relay. The SL relay, in operating, will ground the IT lead to the marker, thus preventing its selection for an outgoing call at the PBX.

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

- 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 ZD and ZG options and the T2, R2, and S2 leads connected to the code call circuit.

17.25 The line circuit assigned to the answering end should be provided with ZE option and the T1, R1, S and S1A leads connected to the code call circuit. It is also required that the HM, IT, and S2 leads 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 L relay 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 the IT lead originating in the marker will operate the OT relay in the calling end line circuit through break contacts of the IN and SL relays in the answering end line circuit and break contacts of the L and IN relays in the calling end line circuit. When the OT relay 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 the OT relay on the S2 lead.

17.28 Ground on this lead will also operate the SL relays in the line circuit associated with both the calling and answering ends. However, only the SL relay associated with the calling end performs a useful function in this application. The answering end SL relay, in operating, will open the operating path of the OT relay in the calling end line circuit and connect ground to the IT lead 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, the S and S1A leads 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 the S and S1A leads, thus making the answering end line circuit available for seizure by the marker.

17.31 Also, when the SL relay 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 the S lead of the answering end line circuit, the IN relay will operate.

17.33 The IN relay, 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. The IN relay will lock over the sleeve lead of the link to a 100-ohm ground in the junctor.

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

17.35 When a calling party is connected to the code call circuit to the answering party for conversation, the S lead to the marker in the answering end line circuit will be grounded by the same ground that holds the IN relay 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 the S2 lead. This will release the OT relay in the calling end line circuit and release the SL relay in the answering end line circuit. The OT relay, in releasing, will release the line hold magnet, restoring the calling end line circuit to normal, except that the operate path of the OT relay is held open and ground is maintained on the IT lead by the operated IN relay in the answering end line circuit.

17.37 In the answering end line circuit the IN relay is held operated by the junctor that is under control of the answering party. The answering end SL relay, 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 the IN relay. The IN relay, in releasing, releases the line hold magnet in the answering end line circuit, restoring that circuit to normal. In the calling end line circuit, the IN relay, in releasing, removes the ground from the IT lead and closes the operating path of the OT relay, 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 the S2 lead to the calling end line circuit, releasing the OT relay in that line circuit and the SL relay in the answering end line circuit. The OT relay, in releasing, will release its associated line hold magnet.

17.41 The answering end SL relay, in releasing, will remove the bridge towards the terminating end of the junctor, allowing the junctor to release. The junctor, in releasing, will release the IN relay 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 the S2 lead. This ground will operate the SL relay in the answering end line circuit, which will ground the IT lead to the marker at the calling end line circuit as a busy indication.

#### H. Auxiliary Position Circuit for Remote Trunk Answering (Options ZD and ZF)

17.43 When a line circuit is assigned to the Auxiliary Position Circuit, ZD and ZF options are provided and the T2, R2, and S2 leads 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 the S2 lead to complete operating the SL relay and lock the OT relay operated.

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

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

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 ZD and ZF options and the T2, R2, and S2 leads connected to the dial conference trunk circuit. The line circuits assigned as conference ports 1-5 should be provided with ZD option and the T1, R1, and S1 leads connected to the dial conference trunk circuit. In addition, the line circuit assigned as conference port 5 should be provided with XD option.

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 the IT lead originating in the marker will operate the OT relay in the control port line circuit.

17.48 When the OT relay 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 the OT relay on the S2 lead. Ground on this lead also operates the checking relays in the marker and the SL relay. Operation of the SL relay opens the operating path for the OT relay and grounds the IT lead to the marker as a busy indication.

17.49 Functioned relays in the dial conference trunk circuit short-circuit the tip and ring of the tie 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 the IT and HM punchings through the relays COTA, B operated to operate the associated relay OT and ground the IT lead 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 and XC)

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 ZD and XC options and the T1, R1, and S1 leads connected to the dial conference trunk circuit. However, only the line circuit assigned as conference port 5 should be provided with the wiring of the IT and HM terminals and the strapping of the T1 and R2, R1 and T2, and S1 and S2 leads.

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 her position. Functioned relays in the dial conference trunk circuit place a short circuit on the tip and ring of the tie trunk vertical assigned to conference port 1 as a signal to connect vertical 81 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 the IT and HM punchings through the relays COTA,B operated to operate the associated relay OT.
- (b) Grounds the IT lead 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.

## 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 H-- terminal shown on FS1 and FS26. A hunting group is formed by connecting X or ZR option 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 the H8- terminals shown on FS5 as desired. Likewise, code 9 trunks are grouped by strapping the H9- terminals 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 groups. In completing a call to trunks, 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 X option straps between the H-- terminals 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 the U-relays corresponding to stations in the hunting group, and the S- relays corresponding to the idle stations in the group will operate. The marker will then connect to the station associated with the first operated S- relay in the line hunting chain circuit on FS6. It should be noted that if the

ZU relay is operated, the preference order of selection is S5-S9, S0-S4. If the ZU relay 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 the H diode (ZR option) between pairs of H-- terminals 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 the U-relays corresponding to the stations beyond the dialed station in the H-- terminal strapping order will operate. The marker will connect the call to an idle station corresponding to the operated U-relays in a preference determined by the state of the ZU relay and the position of the S- relays corresponding to the operated U-relays 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 X option between pairs of H-- terminals and ZR option 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, X option 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, ZR option 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 the U0 and U6 relays; if both stations 40 and 46 are idle, the S0 and S6 relays will operate. The marker will then complete the call to either station 40 or 46, depending upon the state of the ZU relay.

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 the U0 relay; if station 40 is idle, the S0 relay 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 ZR option between pairs of H-- terminals corresponding to the stations involved,

with the diode arrows always pointed in the direction of the higher numbered H-- terminal.

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). Furthermore, 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, ZR option 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 the U2 and U4 relays, which, in turn, will cause the S2 and S4 relays to operate if stations 52 and 54 are idle. Regardless of the state of the ZU relay, the S2 relay will be ahead of the S4 relay 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, the S2 relay 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 the U4 relay through the H diode between terminals H52 and H54. The U0 relay will not operate, since the H diode between terminal H50 and H52 is poled in the wrong direction to pass the ground on terminal H52. If station 54 is idle, the S4 relay 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 U-relays will operate (other than the U4 relay which is already operated), since the H diodes between terminals H50, H52 and H54 are poled in the wrong direction to operate the U0 and U2 relays from 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. MANUAL SWITCHBOARD (Y OPTION AND ZU OR ZT OPTION)

19.01 On some installations a manual switchboard will be required to supplement or take the place of the cordless attendant positions. In such cases, Y option and ZU or ZT option will be provided in the circuit, which will furnish the L20-79 jacks and the C020-79 and MON2-7 relays shown on the FS1 and FS26. This equipment is located at the switchboard location and is intended to minimize interference with the marker operation from the switchboard attendant 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, the ground furnished by the marker over the S lead, which will operate the line hold magnet LHM-- or IN-- relay, will also operate the associated CO-- relay.

19.03 The CO-- relay, 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 the CO-- relay and the line hold magnet LHM-- or IN-- relay 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 CO-- relay and LHM-- line hold magnet from ground at the jack contact.

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

19.07 The MON2-7 relays 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 the CO-- relay during a marker usage by opening the operate path of all CO-- relays. This will prevent the associated line hold magnet from operating while select magnets may be operated and thus connect the station to a link and 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, SMTA and SMTB) and multiplied relays (for example, TKO and TKAO) operate and release in unison. However, other marker operations are also checked as described in following paragraphs.

20.02 The alarm relays are provided with locking paths to the Alarm, Transfer, and Test Circuit, which functions to lock up an alarm relay only after alarm conditions have been encountered on several successive marker usages. The one exception to this is the timeout alarm TOALA relay (FS22), which will cause the Alarm, Transfer, and Test Circuit to activate the locking path for all the alarm relays on its initial operation. Once locked up, 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 the UAL, UALLA, UAL2 and JRAL alarm relays shown on FS18. Each of these relays, in operating, will light the similarly designated lamp on FS23, except for the UALLA relay, which will light the UALL lamp.

20.05 The UAL relay 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 UAL relay: UEA and UEB, JREA and JREB, ULA and ULB, RUCA and RUCB, SEAA and SEBA, HCA and HCB, TRKA and TRKAA, TRBK and TRKBA, and TRKA and TRKB.
- (b) The TRCA,B and TRCAA,BA relays are not all in the same state for longer period than the operate time of the UAL relay.
- (c) If more than one JR- relay is operated at one time during a marker usage.
- (d) The WU and ZU relay combination in the units sequence control circuit is not functioning properly.

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

20.07 The UALLA relay is connected in tandem with the UALL relay 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 The UALL and UALLA relays 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: 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 The UAL2 relay 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 UAL2 relay: 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) The SMRA,B and SMRAA,BA relays are not all in the same state for a longer period than the operate time of the UAL2 relay.

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

#### C. Release Alarms

20.11 The release alarm group consists of the RLAL, TAAL, and MAL alarm relays shown on FS19.

20.12 The RLAL relay 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 RLAL relay: RLSA and RLSAA, RLSB and RLSBA, RLA and RLB, RLSA and RLSB, and TSDA and TSDB.
- (b) The RLA, RLAA, and RLAB relays are not all in the same state for a longer period than the operate time of the RLAL relay.
- (c) The RLB, RLBA, and RLBB relays are not all in the same state for a longer period than the operate time of the RLAL relay.

20.13 The operate path for the RLAL relay is opened whenever the ALBA or ALBB relays 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 The TAAL relay will operate whenever the marker progresses to the trouble release stage. The operation of the TRA,B relays will operate the RLSA,B and RLSAA,B relays, which, in turn, release the MTA,B and the slow release TRA,B relays.

20.15 While the RLSAA,BA and TRA,B relays are operated, the TAAL relay will operate unless the TOKA,B relays are operated, indicating that the marker timing circuit is being exercised on a time-out check. The TOKA,B relays operated open the battery supply for the TAAL relay.

20.16 The MAL relays check that the following miscellaneous fast-acting relays pairs are not in the same state for a longer period than the operate time of the MAL relay: LUCA and LUCB, BTCA and BTCB, HMKA and HMKB, and LTA and LTB.

#### D. Tens Alarms

20.17 The tens alarm group consists of the TRAL and TAL alarm relays shown on FS20.

20.18 The TRAL relays check that the marker, having completed a dial tone connection request, will properly operate the TA- or TRA- relay associated with the tens group that was just served. The TRAL relay will operate if, while the RLA,B or RLAA,BA relays, the TRP- or TP- relays, and the TR- or T- relays are operated, the TRA- or TA- relays associated with the tens group just served operate within the operate time of the alarm relay.

20.19 The TAL relay 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 TAL relay: 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 RCBO, RCO and RCCO, RCCO and RCDO, RCDO and RCEO, RCD1 and RCE1, ARBA and ARBB, TKO and TKAO, 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) An RP-, TRP-, or TP- relay is operated while the RLAA or RLBA relay is operated for a longer period than the operate time of the alarm relay.

(c) The TEAO, TEA1, TEA2, TEA3, TEBO, TEB1, TEB2, and TEB3 are not all operated whenever the TA2-7, TRAO,1, or RO,1 relays are operated.

(d) If Y option is provided and any one of the MON2-7 relays does not operate

while any TP2-7, TRPO,1, or RPO,1 relay is operated (the TEA1 and TEB1 relays are assumed to be functioning properly and operated at this time).

(e) On a dial tone call, more than one of the TRMO,1 and TM2-7 relays are operated while one of the TRO,1 or T2-7 relays are operated.

(f) On a terminating call when the RCEO,1 relays will be operated, more than one of the TKB8, TKB9, TKBO, and TM2-7 relays are operated.

#### E. Link Test Alarms

20.20 The link test alarm group consists of the LAL1 and LAL2A alarm relays shown on FS21. The LAL1 relays, in operating, will light the LAL1 lamp on FS23; the LAL2A relay, in operating, will light the LAL2 lamp.

20.21 The LAL2A relay is connected in tandem with the LAL2 relay 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.

20.21 The LAL2 and LAL2A relays 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: SMTA and SMTB, ALBA and ALBB, LBA and LBB (ZN option), and LSHA and LSHB (ZO option).

(b) The link sequence control circuit functions improperly.

(c) The link group sequence control circuit functions improperly.

20.23 The LAL1 relays 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: 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) The LCK1 or LCK2 relays operate.

(c) The WLG and WLGA relays operate for a longer period than the operate time of the alarm relay.

20.24 The LCK1 and LCK2 relays shown on FS13 operate if false grounds appear on the leads that operate the select magnets.

#### F. Time-Out Alarms

20.25 The time-out alarm group consists of the TOAL and TOALA alarm relays shown

on FS22. The TOALA relay, in operating, will light the TOAL lamp.

20.26 The TOALA relay is connected in tandem with the TOAL relay to increase the effective operating time of the combination. The TOAL and TOALA relays 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 the TOAL and TOALA relays: MTA and MTB, NAA and NAB, STA and STB, and TOLA and TOLB.

#### G. Alarm Control

20.27 The alarm control circuit is also shown on FS22. The MTA,B relays operate whenever the marker is in use and furnish a ground over the MT lead to the Alarm, Transfer and Test circuit. The TS relay or any of the alarm relays, when operated, will ground the AT lead to the Alarm, Transfer, and Test circuit. The Alarm, Transfer, and Test circuit will relate the number of times ground is received over the AT lead with respect to marker usages.

20.28 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 on FS21, OA on FS22, and CA on FS11.

20.29 The TOALA relay, in operating, will ground the TT lead 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.

20.30 The TS relay is an alarm relay shown on FS11 that will detect false standing grounds on the TT, TLA, RS, BY, and FF leads to the central office and ringdown tie trunks. The TS relay is connected to these leads through break contacts of the TSDA,B relays, which operate during every marker usage.

#### 21. MESSAGE WAITING SERVICE (OPTION ZQ)

21.01 When the PBX is arranged for message waiting service, ZQ option 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 the L and R leads 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 lighted, the associated key in the connecting circuit will be

operated, connecting -150 volts dc interrupted at 60 ipm to the R lead. 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 the L and R lead 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 TRCO or TRC1 relays will be operated. Depending on which register is available to serve the call, ground from the operated TRCO or TRC1 relay is extended through the marker RGA and RAOA or RGB and RALA relays 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 Key and Lamp (Option YD)

23.01 When a station is arranged for selection by single digit dialing and a make busy key and lamp may be required, the operation of the MB key opens lead S and S1 and lights the MB lamp as an indication to the station that MB key 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. MISCELLANEOUS

- 24.01 A reported trouble of pretripping in the central office trunk on a call being completed by the attendant to a station is as follows:
- 24.02 The first possibility of pretripping occurs when the marker releases the MC relay in the trunk and operates the RRLA and RRLB relays in the register. Both of these actions result from the operation of the RLAB and RLBB relays in the marker.
- 24.03 The release of the MC relay in the trunk connects ringing current to the ring side of the trunk, and the operation of the RRLA and RRLB relays opens the tip and ring conductors in the register. If the MC relay releases before RRLA and RRLB relays operate, the tip and ring bridge in the register can trip the trunk.
- 24.04 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 RLBB. The RLAA and RLBB relays are slower to operate, thereby increasing the time of release of relay MC.
- 24.05 The second possibility of pretripping occurs when the RRLA and RRLB relays 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) Locks to relay ON.
- 24.06 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 the RRLA and RRLB relays release before the crosspoints are opened.
- 24.07 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 RRLA and RRLB until the crosspoints are open.
- 24.08 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.
- 24.09 Available break contacts of RLCA,B relays are added (option YR) in RSCE,0 leads to prevent false operation of trunk RS relay on dial 8 and dial 9 calls. Ground on the RSE,0 leads must be removed before the TK8 or TK9 relays release, since the addition of YC option has delayed the release of the trunk MC relay.
- 24.10 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.
- 24.11 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.
- 24.12 If a TA- or TRA- relay fails and the TRAL relay is operated, the marker advances to no-connection, at which time a buzzing condition exists between the TRC- and TRK- relays. 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 YL option, which replaces YK option. This option opens, on dial tone connections, the operate path of the TMA,B relays, which is affected by the buzzing condition.

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      Min      Max  
    -45      -52

2. FUNCTIONAL DESIGNATIONS

2.01 Relays

<u>Designation</u>	<u>SD Loca- tion B Sheet No.</u>	<u>Meaning</u>	<u>Designation</u>	<u>SD Loca- tion B Sheet No.</u>	<u>Meaning</u>
ACA, ACB	8	Abandoned Call	NCA, NCB	25	No Connection
ALBA, ALBB	22	All Links Busy	NT	18	No Test
ARBA, ARBB	2	All Registers Busy	OT20-29	35	Out
BSYA, BSYAA	12	Circuits Busy	RO, RI	2	Register
BSYB, BSYBA	12	Circuits Busy	RAOA, RAOB	17	Register Allotter
BTCA, BTCB	15	Busy Tone Trunk Connector	RALA, RALB	17	Register Allotter
BTTA, BTTB, BTTC	16	Busy Tone	RCAO, 1, RCBO, 1,	5	Register Connector
BYA, BYB	12	Busy Test	RCCO, 1, RCDO, 1,	5	Register Connector
CCC	16	Cancel Camp-on	RCEO, 1	26	Register Connector
CO20-29	35	Cut Off	RCKA, RCKB	26	Release Check
CO30-79	1	Cut Off	RCTA, RCTAA,	14	Register Cut Through
COA, COAA,	16	Camp On	RCTB, RCTBA	14	Register Cut Through
COB, COBA,	16	Camp On	RGA, RGAA,	17	Register Group
CONA, CONAA,	16	Camp On	RGB, RGBA	17	Register Group
CONB, CONBA	16	Camp On	RHKA, RHKB	17	Register Hold
COS, COSA, COSB	22	Camp-on Stop	RLA, RLAA, RLAB,	15	Magnet Check
COTA, COTB	15	Central Office Trunk	RLB, RLBA, RLBB	15	Release
DCKA, DCKB	26	Down Check	RLAL	30	Release Alarm
HCA, HCB	9	Hunt Connector	RLSA, RLSAA,	25	Trouble Release
HMKA, HMKB	9	Hold Magnet Check	RLSB, RLSBA	25	Trouble Release
HMTA, HMTAA,	15	Hold Magnet Timing	RPO, RP1	3	Register Preference
HMTB, HMTBA	15	Hold Magnet Timing	RPAO, RPA1	5	Register Preference
ICTA, ICTB	16	Intercept	RUCA, RUCE	8	Auxiliary Register Units Connector
IN20-29	35	In	SO-4	10	Sleeve
JRO-5	13	Junctor Register	S5-9	11	Sleeve
JRAL	29	Junctor Register Alarm	SAA, SAB	25	Second Trial
JREA, JREB	13	Junctor Register End	SEA, SEAA,	12	Auxiliary Sleeve End
JTA, JTAA,	14	Junctor Terminating	SEB, SEBA	12	Sleeve End
JTB, JTBA	14	Junctor Terminating	SL20-29	35	Line Sleeve
L20-29	35	Line	SMCO-8	24	Select Magnet Connector
L30-79	1	Line	SMRA, SMRAA,	15	Select Magnet Register
LAL1, LAL2, LAL2A	32	Link Alarm	SMRB, SMRBA	15	Select Magnet Register
LBA, LBB	22	Link Busy	SMTA, SMTB	23	Select Magnet Timing
LCK1, LCK2	24	Link Check	SOA, SOB	15	Sleeve Operate
LEA, LEAA,	23	Link End	STA, STB	25	Second Trial
LEB, LEBA	23	Link End	STAR, STBR	25	Second Trial Register
LSHA, LSHB	23	Link Shift	T2-7	3	Line Tens
LT2-9	20	Link Test	TA2-7	2	Line Tens Auxiliary
LTA, LTAA,	22	Link Test	TAA, TAB	25	Time-out Auxiliary
LTB, LTBA	22	Link Test	TAAL	30	Trouble Advance Alarm
LTCa, LTCB	22	Link Test Connector	TACA, TACAA,	4	Tens Auxiliary Connector
LTS2-6	21	Link Test Slave	TACB, TACBA	4	Tens Auxiliary Connector
LTS7-9	22	Link Test Slave	TAL	31	Tens Alarm
LUCA, LUCB	8	Line Units Connector	TCK1-4	3	Tens Check
MAL	30	Miscellaneous Alarm	TCS2-7	4	Tens Class
MON2-7	1	Marker Off Normal	TEAO-3, TEBO-3	2	Tens End
MTA, MTB	25	Marker Timing	TEBO-3	2	Tens End
NAA, NAB	25	No-Connection Auxiliary	THC2-7	4	Tens End
			TKO, TK8, TK9,	5	Tens Hunt Connector
			TKA0, TKA8, TKA9,	5	Trunk Connector
			TKB0, TKB8, TKB9,	5	Trunk Connector
			TM2-7, TMA, TMB	4	Trunk Connector
			TOA, TOB	4	Tens Magnets
			TOAL, TOALA	25	Time Out
			TOKA, TOKB	33	Time-out Alarm
			TOLA, TOLB	26	Time-out Check
			TP2-7	26	Time-out Lock
			TRO, TR1	3	Tens Preference
			TRA, TRB	2	Trunk Tens
			TRAO, TRAI	25	Trouble Relays
			TRAL	2	Trunk Tens Auxiliary
			TRCO, TRC1	31	Tens Release Alarm
			TRCA, TRCAA,	4	Trunk Class
			TRCB, TRCBA,	14	Terminating Route
			TRKA, TRKAA,	14	Complete
			TRKB, TRKBA	14	Terminating Route Check

<u>Designation</u>	<u>SD Loca- tion B Sheet No.</u>	<u>Meaning</u>
TRLA, TRLB	22	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
WLG, ZLG	22	Link Sequence WZ
WU, ZU	12	Units Sequence WZ
W1LA, WLA	32	W Auxiliary
W1GA	22	W Auxiliary
WUA	29	W Auxiliary

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 Releases 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 huntin 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 peg count, overflow, and trouble traffic 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.

#### 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 - 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.

#### 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 Requirement table.

#### 6. TAKING EQUIPMENT OUT OF SERVICE

6.01 Station Lines: A station line may be removed from service by disconnecting the S lead from the line hold magnet to the marker. All calls directed to that station line will then 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 the LTCA and LTCB relays, which connect the battery through the L- resistor to the S lead 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 tables. The effect on 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 the TOLA and TOALA, time-out alarm relays, 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 lighted 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 Requirement table.

SECTION IV - REASONS FOR REISSUE

A. Changed and Added Functions

A.1 XA option is provided to cancel camp-on if the marker encounters a busy station when attempting to:

- (a) Add a station to either of the dial conference trunk circuits.
- (b) To transfer an incoming central office trunk call via the Auxiliary Position Circuit or station dial transfer trunk circuit.

B. Changes in Apparatus

B.1 ADDED

CCC Relay 1/2 AK7 - App. Fig. 8  
 BTTC Relay 1/2 AK7 - App. Fig. 8  
 Diodes 446F - App. Fig. 8  
 Option XA

D. Description of Changes

- D.1 On Sheets A1, A2, A3, A4, A5, and A6, various indexes are revised and Sheet A7 added to reflect changes associated with this drawing issue.
- D.2 On Sheets B6, B7, B19, and B34, YT option is added.
- D.3 On Sheets B7 and B34, YS option is added.
- D.4 On Sheets B2, B8, B11, B18, B23, and B24, YV option is added.
- D.5 On Sheets B2, B11, and B18, YW option is added.

- D.6 On Sheets B5 and B8, YX option is added.
- D.7 On Sheets B16 and B19, XA and XB options are added.
- D.8 On Sheets B5 and B35, option XC is added.
- D.9 On Sheets B5 and B35, option XD is added.
- D.10 On Sheet B35, option XE is added.
- D.11 On Sheet B35, sheet Notes 3 and 4 are added.
- D.12 On Sheets C1, C5, and C7, App. Fig. changes are added to reflect the addition of circuit options.
- D.13 On Sheet D1, references to options YS, YT, YV, YW, YX, XA, XB, XC, XD, and XE are added to Notes 102 and 104.
- D.14 On Sheet D1, Notes 113 to 117 are added.
- D.15 On Sheet D5, Notes 315 to 318 are added.
- D.16 On Sheets E6, E7, E10, E11, E12, E15, E17, and E18, minor changes are made to show the operation of relays CCC and BTTC.
- D.17 Sheet E21 is added to show SC26, Cancel Camp-On.
- D.18 On Sheet F2, circuit requirement information for relays CCC and BTTC is added.

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