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H-919-209 G/AE

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

CHANGES

B. Changes in Apparatus

B.1 Superseded

HA and HB diodes, 446F,
XV option

Superseded by

HA and HB diodes, 426H,
UI option

D. Description of Changes

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

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

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 3224-TEH-RVL

CIRCUIT DESCRIPTION

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

PBX SYSTEMS

No. 756A

LINE, LINK, AND MARKER CIRCUIT

CHANGES

B. CHANGES in Apparatus

B.1 Removed

RT14 Diodes, 446F, V W option

D. Description of Changes

D.1 On issue 43B, option VV was designated, ^{and} rated Mfr Disco and option V W was added as standard, but the contact; 8B of relays HMTA and HMTB used in options V W are not available as they were used in option VU on issue 42B.

D.2 Option V W is rated from standard to Mfrs Disco and option V V is rated from Mfrs Disco to standard.

D.3 Circuit note 904 is revised to reflect issue 49B.

BELL TELEPHONE LABORATORIES, INCORPORATED
DEPT 3221- WVS-KGP

CIRCUIT DESCRIPTION

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

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

CHANGES

B. Changes in Apparatus

B.1 Superseded

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

Superseded by

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

B.2 Added

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

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

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

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

D. Description of Changes

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

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DEPT 3221-TEH-RGP

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CIRCUIT DESCRIPTION

CD-65741-01
ISSUE 9D
APPENDIX 1D
DWG ISSUE 47D

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

CHANGES

D. Description of Changes

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

F. Changes in CD Section

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

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

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

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

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

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

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

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

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DEPT 3221-WVS-RGP

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

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SECTION I - GENERAL DESCRIPTION1. PURPOSE OF CIRCUIT

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

2. GENERAL DESCRIPTION OF OPERATIONA. Subcircuits and Arrangement

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

2.18 Arrangements are provided to prevent an auxiliary switchboard, which can be used in conjunction with the 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 or FS28) to find an idle link.

2.26 When an idle link has been found, the select magnet control circuit (FS13) operates the select magnets that correspond to that link, signaling the register control circuit and the line and trunk hunting circuit to operate the hold magnets associated with the selected dial pulse register and with the calling station. The station is thereby connected to a dial pulse register.

2.27 The line and trunk hunting circuit functions to check that the register is holding the connection to the station and then signals the route control circuit (FS9) to release the marker.

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

C. Call-Terminating ConnectionsGeneral

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

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

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

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

2.32 When an idle junctor has been found, its identity is stored on the junctor register relays (FS7) by the class-of-service circuit. The sequence control circuit advances to operate the register connector relays of the tens connector circuit and to signal the link test circuit to find an idle line (see Note 305).

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

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

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

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

Trunk to Station Line (See Note 309)

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

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

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

Trunk to Trunk

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

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

D. Called Station Line Busy

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

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

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

E. Paths Busy

All Links Busy

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

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

All Trunks Busy

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

Busy Tone Trunk Busy

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

F. Camp-On

Station Busy - No Trunk Camped-On

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

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

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

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

Line Busy - Trunk Already Camped-On

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

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

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

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

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

Line Busy - Remote Trunk Answer Operation

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

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

G. Abandoned Calls

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

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

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

H. Marker Time-Out

Second Trial

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

No Connection

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

Trouble Release

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

I. Checks

Downcheck

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

Time-Out Check

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

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

J. Permanent Signals

Before Dialing

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

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

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

After Dialing

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

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

K. Dial Back by Attendant - No Test

2.73 In order that a restricted line be able to make a call to a central office or to a distant 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 respect to the other will be detected. The marker is arranged so that it will continue to process calls with one of its dual paths not operating. However, the alarm relays and their associated lamps will function to assist in locating trouble conditions.

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

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

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

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

- (a) Provide a locking path for the operated tens relay.
- (b) Open the operating paths of all tens relays.
- (c) Operate the test disconnect relays TSDA,B and tens check relays TCK1, 2,3,4 whose functions are described later.
- (d) Start the marker timing.
- (e) Close paths for operating the preference relays shown on FS3.

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

1.05 Relays TACA,B and TACAA,BA operated:

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

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

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

Units Selection

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

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

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

Link Testing and Selection(Option 9) Mfr Dis

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

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

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

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

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

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

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

1.15 Any relay LTS2-9 operated:

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

1.16 Relays LEA,B and LEAA,BA operated:

- (a) Release relays LTA,B.

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

- (c) Operate select magnets SM0-9 on the appropriate switches.

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

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

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

Link Testing and Selection (Option 22)

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

- (a) Operates the link test connector relays LTCA,B (FS28).
- (b) Starts the link shift timing, which controls the shift of the link testing from one group to the other.
- (c) Pulses the link group sequence and link sequence control circuits.
- (d) Connects a portion of the link testing circuit to link test relays LT2-9 (FS28).
- (e) Prepares a locking path for relays LTP2-9 (FS28).

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

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

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

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

1.25 Any relay LT2-9 operated:

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

1.26 Relays LEA,B and LEAA,BA operated:

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

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

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

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

Register Selection

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

Hold Magnet Operation

1.31 The operation of relays SMTA,B will operate the select magnet register relays SMRA,B and SMRAA,BA (FS9), which provide a locking path for any operated S-relays. With relays SMTA,B and SMRAA,BA operated, ground from contacts of relays SMTA,B will operate the line hold magnet LHM-- of the calling station (or relay IN-- which, in turn, operates the line hold magnet) through the chain of relay S0-9 contacts in the line and trunk hunting circuit shown on FS6.

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

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

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

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

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

Hold Magnet Checks

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

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

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

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

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

Marker Release

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

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

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

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

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

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

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

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

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

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

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

1.46 Relays RGA,B and RGAA,BA, in releasing, release relays SMC0,1, RHKA,B, and LTAA,BA. The relays LTAA,BA in releasing, advance the link group sequence and link sequence control circuits and release any operated relays LT2-9 (option 22).

1.47 When relays TCK1,2,3,4, HMKA,B, RHKA,B, and HMTA,B are all released, relays DCKA,B reoperate and lock. The operation of relays DCKA,B release RLA,AA,AB,B,BA,BB and the marker is ready to process another call.

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

Originating Class of Service

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

General

1.60 To obtain a dial tone connection for a trunk, the attendant will operate the pickup key associated with the trunk and momentarily operate the common hold key of the console position or keyset. If the 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 leads TR- and U- corresponding to the trunk being used.

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

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

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

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

1.64 Relays TACA,B and TACAA,BA, in operating, will operate relays LUCA,B, ULA,B and RGA,B and RGAA,BA. Relays TRC- and TRU-, in operating, will operate relays SMCO and SMC8. Relays RGA,B and RGAA,BA, in operating, will operate the relay SMC1. Relays LUCA,B, in operating, will start the abandoned call timing.

Units Selection

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

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

Link Testing and Selection

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

Register Selection

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

Hold Magnet Operation

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

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

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

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

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

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

Hold Magnet Checks and Marker Release

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

Originating Class of Service

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

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

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

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

D. Attendant Trunk Dial Tone Connection

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

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

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

E. Busy Verification Trunk Dial Tone Connection

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

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

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

B. Register Requests Service

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

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

(b) Operate relays TSDA,B.

(c) Start the marker timing.

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

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

2.04 Relay RPA- operated:

(a) Operates the register units connector relays RUCA,B (FS5).

(b) Closes the path for operating the junctor terminating relays JTA,B (FS8) over leads JTA- and JTB- from the register.

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

C. Junctor Testing and Selection

2.06 The six junctors are associated with relays U-. Junctors 0,1,2,3,4 and 5 are associated with units relays UO,U1,U2, U5,U6 and U7, respectively. The operation of relays JTA,B and JTAA,BA and RUCA,B operates relays UO,U1,U2,U5,U6 and U7, thus connecting the primary windings of the corresponding relays S- to hold magnets THM11,THM13,THM15,THM17,THM82, and THM84, respectively. The hold magnets are associated with the terminating side of the junctors. Relays S- corresponding to the idle junctors will operate from battery through the terminating hold magnets. If a junctor is in use, the ground in the busy junctor holding the hold magnet operated will prevent the corresponding relay S- from operating.

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

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

2.09 Relay JR- operated will:

(a) Operate the junctor register end relays JREA,B (FS7).

(b) Operate relay SMC1 or SMC8 (FS13), whichever corresponds to the switch in which the selected junctor is located.

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

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

D. Terminating Link Selection

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

E. Called Station Selection and Testing

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

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

(b) Connect leads U- from the appropriate register to the units relays on FS5 and operate relay U- corresponding to the units digit of the called station number.

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

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

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

F. Connection of Called Station to Junctor

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

(a) Operate the select magnets in the involved switches corresponding to the selected link.

(b) Operate relays SMTA,B.

2.18 Relays SMTA,B, in operating, will:

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

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

(c) Operate the terminating hold magnet THM-- of the selected junctor through contacts of operated relay JR-.

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

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

2.21 When relays HMTAA,BA operate:

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

windings of relays HMKA,B connected in its place.

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

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

G. Connection of Calling Station to Junctor

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

(a) Lock to the operated relays SEA,B.

(b) Release relays HMKA,B, SMTA,B, and HMTA,B and HMTAA,BA.

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

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

2.26 Relays TRCA,B in operating:

(a) Provide a ground for holding the junctor terminating and called line hold magnets when relays SMTA,B release.

(b) Release relays RCTA,B and RCTAA,BA.

(c) Operate the select magnets associated with the link used for the dial tone connection, through the closed crosspoints of the register memory vertical on the switch in which the selected junctor is located.

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

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

2.29 The release of relays LTAA,BA:

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

(b) Advances the link sequence and link group sequence control circuits.

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

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

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

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

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

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

2.34 When relays HMTAA,BA operate, they will:

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

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

H. Marker and Register Release

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

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

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

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

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

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

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

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

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

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

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

2.44 If, during the called station line testing sequence, relay S- corresponding to the called station does not operate, the ground applied to relay SO-9 contact chain on FS6 will pass through the break contacts of all of relays SO-9 to operate the busy test relays BYA,B (FS6).

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

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

2.47 The operation of any relay S- will:

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

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

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

2.50 Relays BTA,B will release when relays RCTA,B release. If relays BSYAA,BA have operated, they will also release at this time.

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

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

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

2.52 When relays BSYA,B operate:

- (a) Relays HCA,B release, which, in turn, release relays U- associated with the station in the hunting group (if any).
- (b) The sleeve operate relays SOA,B (FS9) operate.

2.53 With relays SOA,B and relay U- associated with the called station operated, relay S- corresponding to the called station will operate over its secondary winding causing relays SEA,B and SEAA,B to operate.

2.54 Relays SEA,B and SEAA,BA, in operating

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

2.55 With relays SMRAA,BA and SOA,B and the relay S- corresponding to the called station operated, a path is complete between the line hold magnets of the called station and relays HMKA,B. The 100-ohm ground maintaining the called station line hold magnet (or relay IN--) operated will then operate relays HMKA,B which in turn will operate relays TRKA,B and TRKAA,BA.

2.56 With relays HMKA,B, SOA,B, SMRAA,BA, and SEAA,BA operated, relays BTTA,B (FS9) will operate, which, in turn, will:

- (a) Release the operated relay JR- and relays SOA,B which, in turn, cause relays HMKA,B to release.
- (b) Lock to the operated relay RPA- (option A) or relay RP- (option B).

2.57 Relay JR-, in releasing, will:

- (a) Release relays JREA,B.
- (b) Release the associated relay SMC- which, in turn, release the select magnets on the junctor switches corresponding to the selected terminating link.

2.58 Relays JREA,B, in releasing will:

- (a) Release relays LTAA,BA and LEA,B and LEAA,BA and the operated relay LTS- (option 9) or LT- (Option 22).
- (b) Release relays RCTA,B and RCTAA,BA.

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

- (a) Release relays RCA-, B-, C-, D-, E- which, in turn, release relays TCS-, THC-, TU-, TM- associated with the called station. Relay THC-, in releasing, releases the associated relay SMC-.
- (b) Release relays BYA, B, BSYA, B, and BSYAA,BA if option ZM is used or, if option ZL is used, release relays BYA,B which, in turn, release relays BSYA,B and BSYAA,BA.

2.60 The release of relays LTAA,BA will advance the link group sequence and the link sequence control circuits. The release of relays LEAA,BA, or relay LT- (opt. 22) or relay LTS- (option 9), will release the select magnets corresponding to the selected terminating link on the switch in which the called station line appears.

2.61 The operation of relays TRKAA,BA starts the slow release of relays SMTA,B which, in turn, release relays SMRA,B and SMRAA,BA, S-, and SEA,B and SEAA,BA in that sequence. The release of relays SEA,B will reoperate relays RUCA,B.

2.62 When relays SMTA,B and relays HMKAA,B release, a path is closed through contacts of the operated relays TRKA,B for operating relays TRCA,B and TRCAA,BA. The relays in operating, will:

- (a) Lock operated under control of relays BITA,B and RPA-.
- (b) In conjunction with relays SEA,B releases, release relays TRKA,B and TRKAA,BA.

2.63 With relays BITA,B and TRCA,B operated and relays TRKAA and TRKB released (and if option WZ is provided - relays BYA,B released), the busy tone trunk connector relays BTCA,B (FS9) will operate. Relays BTCA,B, in operating, will:

- (a) In conjunction with the operated relays RUCA,B, operate relay UO, which, in turn, operates relays UEA,B.
- (b) Operate relay SMC0.
- (c) Release the time-out lock relays TOLA,B (FS16), to prepare the time-out checking circuit.
- (d) With relay UO operated, close a path between relay SO primary winding and the busy tone trunk hold magnet.

2.64 If the busy tone trunk is idle, the battery through the busy tone trunk hold magnet THM07 (FS25) will operate the relay SO over its primary winding. Relay SO, in operating, will operate relays SEA,B and SEAA,BA.

2.65 Relay SMC0, in operating, will:

- (a) Operate relays SMTA,B.
- (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 relays TRCAA,BA through contacts of the released relays COA,B, operated relay RP-, and the crosspoints of the register memory hold magnet THM-9.

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

- (a) With relays SMTA,B operated, close paths for operating the slow operate relays HMTAA,BA and relays SMRA,B and SMRAA,BA.
- (b) Release relays RUCA,B, which release relays UO and UEA,B in that sequence.

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

2.68 The bridge on leads T and R will operate relay A in the busy tone trunk, which will:

- (a) Apply a 100-ohm ground on the link sleeve for holding the calling station line hold magnet (or relay IN-) operated after the register releases.
- (b) Connect ground to the busy tone trunk hold magnet to keep it operated after the marker removes the operating ground.

2.69 When relays HMTAA,BA operate, the operating path for the slow operate relays HMTA,B is closed, and the operating ground for the busy tone trunk hold magnet is removed. When the relays HMTA,B eventually operate, relays HMKAA,B are connected to the busy tone trunk hold magnet to check for the presence of the holding ground. Assuming the holding ground present, it will operate relays HMKAA,B, which, in turn, will release relays DCKA,B. Relays DCKA,B,

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

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

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

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

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

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

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

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

A. General

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

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

B. Register Requests Service

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

3.04 Relay RPA-, in operating, will:

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

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

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

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

C. Trunk Testing

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

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

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

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

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

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

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

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

- (b) Operate relays SNTA,B.

D. Trunk Selection and Hold Magnet Operation

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

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

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

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

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

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

E. Hold Magnet Check and Marker and Register Release

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

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

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

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

3.21 The release of relay RP-:

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

3.22 Relays TK9,A9,B9, in releasing, release the relays SMC0 and SMC8 and open the operating path for relays HMKA,B releasing them.

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

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

(a) Lock to relay ON in the register.

(b) Release relay DC in the register.

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

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

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

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

F. All Trunks Busy - Busy Tone Trunk Idle

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

3.30 When relays BSYA,B operate:

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

(b) Relays HCA,B release.

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

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

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

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

3.33 Relays BTTA,B, in operating, will:

(a) Operate relays TRKA,B and TRKAA,BA.

(b) Release relays SOA,B.

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

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

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

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

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

3.37 Relays RCA-,B-,C-,D-,E-, in releasing, will release relays TK9,A9,B9, which, in turn, release relays SMC0 and SMC8.

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

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

A. General

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

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

B. Register Requests Service

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

4.04 Relay RPA-, in operating, will:

- (a) Operate relays RUCA, B.
- (b) Close a path for operating relays RCTA, B and RCTAA, BA over leads RCTA, B from the register.
- (c) Close a path for operating the central office trunk relays COTA, B (PS9) over leads CTA-, B- from the register.

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

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

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

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

4.06 Relay MC in the trunk, in operating:

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

C. Called Station Testing and Select Magnet Operation

4.07 The operation of relays TM- and U-

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

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

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

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

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

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

D. Hold Magnet Operation

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

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

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

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

4.12 When relay HMTAA, BA operates:

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

- (b) Relay RV in the register is released.

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

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

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

E. Hold Magnet Check and Marker and Register Release

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

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

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

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

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

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

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

4.16 The release of relay RP-:

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

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

(c) Releases the operated select magnets.

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

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

4.19 Relays RRLA,B in the register, in operating, cause the register to restore to normal and relays R-, TEAO,A1,A2,A3,B0,B1,B2,B3, and TSDA,B in the marker to release.

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

F. Called Station Busy - Station in Hunting Group Idle

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

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

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

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

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

4.24 Any relay S-, in operating, will:

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

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

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

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

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

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

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

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

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

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

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

- (a) Lock operated to the operated relays RP- and released relay STAR,BR (option B) or the operated relay RPA- (option A) under control of relays COTA,B.
- (b) Operate relays SMC0 and SMC8.
- (c) Release the operated select magnets corresponding to the link used for the dial tone connection on the switch in which the called station appears.
- (d) Operate relay BY in the trunk.
- (e) Start the link shift timing.

(f) Pulse the link group sequence control circuit.

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

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

(i) Release relays SMTA,B.

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

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

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

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

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

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

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

4.37 If a link is idle, the associated sleeve lead will be open and the associated transistor in the detector circuit will not conduct. A busy link associated with other than the called station will have the 100-ohm holding ground and the battery connected line hold magnet (or relay IN--) connected to it resulting in a negative potential to ground of approximately 4.8 volts. This voltage will not drive the transistor into conduction.

4.38 The sleeve of the link used by the called station, however, will be at ground potential. This ground will drive the transistor into conduction. The conduction of the transistor extends the sleeve ground to the associated LT relay to operate it.

4.39 If no LT- relay operates during the testing of the first group of links, the link shift timing and link group control circuits will function and shift the link testing relays to the second group of links.

4.40 A relay LT-, in operating, will:

- (a) Prepare its own locking path.
- (b) Operate relays LEA,B and LEAA,BA.
- (c) Halt link shift timing.
- (d) Open the operate path of alarm relay COAL.

4.41 If the line, link, and marker circuit is equipped with options 9 and WS, the operation of relays LTCA,B and CONAA,BA connects the midpoint of a potential divider consisting of the grounded 200-ohm resistor LTB- in series with 1200-ohm resistor LTA- battery connected to the negative side of the primary winding to relays LT-. The positive side of the primary winding is normally connected to the link sleeves of the link group through contacts of relays TRLA,B. With relays LTCA,B operated, the battery connected 1000-ohm resistor L-- is also connected to this point. In this condition, the potential at the negative side of the primary winding will be approximately -8 volts.

4.42 An idle link will have only the potential due to resistor L-- on it, producing a voltage across the primary winding of approximately 2 volts of the wrong polarity. The voltage will not operate relay LT-. A busy link associated with other than the called station will have the 100-ohm holding ground and the battery connected line hold magnet (or relay IN--) connected to it in addition to the battery connected 1000-ohm resistor L--, resulting in a potential of somewhat

less than 1 volt of the correct polarity. This voltage is insufficient to operate the relay.

4.43 The link being used by the called station, however, will have a solid ground connected to it, producing a voltage of approximately 1.6 volts of the correct polarity, to operate relay LT-.

4.44 If no relay LT- operates during the testing of the first group of links, the link shift timing and link group control circuits will function and shift the link testing relays to the second group of links.

4.45 A relay LT-, in operating, will operate its associated relay LTS-, which, in operating, will:

- (a) Prepare a locking path for itself.
- (b) Provide a locking path for the corresponding relay LT-.
- (c) Operate relays LEA,B and LEAA,BA.
- (d) Halt link shift timing.

4.46 Relays LEA,B and LEAA,BA, 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 relay LT- (Options 22 and 41, or relay LTS- (Options 9 and WS) and the state of relays TRLA,B to operate in switches 0 and 8.

- (b) Release relays CONA,B and CONAA,BA.

4.47 The release of relays CONA,B and CONAA,BA:

- (a) Removes the ground from leads M- to the trunks, causing the trunk hold magnet THM-- and relay HM in the trunk to release.
- (b) Releases relays LTCA,B, which, in turn, release the operated relay LT- (options 9 and WS).
- (c) Releases relays SMRA,B and SMRAA,BA and SOA,B.

4.48 The release of either relays SMRAA,BA or SOA,B releases relays HMKA,B. The release of the relays SOA,B releases the operated relay S-, which, in turn, releases relays SEA,B and SEAA,BA.

4.49 With relays HMKA,B and SMTA,B released and relays TRKA,B operated, relay TRCA,B and TRCAA,BA will operate. These relays, in reoperating:

- (a) Lock under control of relays RP-.
- (b) Release relays TRKA,B and TRKAA,BA, which, in turn, reoperate relays SMTA,B.
- (c) Release relays RCTA,B and RCTAA,BA.

4.50 Relay RCTA,B and RCTAA,BA, in releasing:

- (a) Release relays RCA-, B-,C-,D-,E-, which in turn, release the operated relays TCS-, THC-, TU-, and TM- in the marker and relay RV in the register.
- (b) Release relays BYA,B, BSYA,B, and BSYAA,BA if option ZM is used, or, if option ZL is used, release relays BYA,B, which, in turn, release relays BSYA,B and BSYAA,BA. Relay THC-, in releasing, releases the associated relay SMC-.

4.51 Relays SMTA,B, in reoperating, will:

- (a) Reconnect ground to the leads M- to the trunk via contacts of the released relays HMTA,B, SOA,B and ALBA,BB and the operated relays COA,B, which will operate the trunk hold magnet and relay HM in the trunk.
- (b) Close the operating path for the slow operate relays HMTAA,BA.

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

4.53 When relays HMTAA,BA operate:

- (a) The operating paths for the slow operate relays HMTA,B are closed.
- (b) Leads RS- to the trunk are grounded, causing relay RS in the trunk to operate, which, in turn, releases relay HD in the trunk.

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

4.55 Relays DCKA,B, in releasing, will operate relays RLA,AA,AB,B,BA,EB, which will:

- (a) Release relays MTA,B, halting the marker timing.
- (b) Open the operate paths for the relays in the tens preference chain on FS3, causing relays TCK1,2,3,4 and RP- to release.
- (c) Release relays SMTA,B, which, in turn, release relays HMTA,B and HMTAA,BA.
- (d) Release relays LEA,B and LEAA,BA, which, in turn, release the operated relay LTS- (options 9 and WS) and select magnets.
- (e) Operate relays RRLA,B in the register circuit.
- (f) Remove ground from leads RLS- to the trunks to release the relay MC in the trunk.

(g) Diodes HE and HO provide a holding path for relay HM in the two-way tie trunk circuit to central office from operated relays RLA,B. A ground on leads ME and MO must be provided until relay MC in the central office trunk releases since the addition of option YC delays the release of relay MC.

4.56 Release of relay RP- releases relay RPA-, which, in turn, releases relays TRCA,B and TRCAA,BA, COTA,B, and RUCA,B. Relays COTA,B, in releasing, release relays COA,B and COAA,BA and HMKA,B. Relays COA,B and COAA,BA released:

- (a) Release relays SMC0 and SMC8.
- (b) Release the operated LT- relay (options 22 and WT).
- (c) Advance the link group sequence control circuit.

4.57 Operation of relays RRLA,B releases relay DC. Relay DC releases register relay L which, in turn, releases relay SR. The release of relay DC in the register also will release relays R-, TEAO,A1,A2,A3, BO,B1,B2,B3, and TSDA in the marker in that sequence.

4.58 Relay SR in the register released, releases relay ON in the register and the register hold magnets THM-8,-9. Relay ON in the register released will:

- (a) Release relay COT in the register
- (b) Reoperate the RA-A,-B in the register allotter circuit.
- (c) Release relays RRLA,B in the register provided register hold magnets THM-8,-9 have released.

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

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

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

- (a) Operate relay COS (FS12) in the marker (Options 9 and WS), or
- (b) Drive the Q5 transistors in the voltage reduction detector circuits VRDA,B (Options 22 and WT).

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

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

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

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

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

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

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

4.65 Relays COSA,B operated:

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

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

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

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

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

K. Called Station Busy - Message Registration Pulse on Sleeve

General

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

Marker Circuit Equipped With Option WV (SC33)

4.70 Relay COD operated:

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

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

4.72 Relay H operated:

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

4.73 Relays COA,B and COAA,BA operated:

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

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

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

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

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

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

Marker Circuit Equipped With Option XK (SC27)

4.77 Relay COD operated:

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

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

4.79 Relay H operated:

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

4.80 Relays COA,B and COAA,BA operated:

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

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

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

L. Called Station is Inward Restricted (SC25)

4.91 The marker in attempting to connect an inward restricted station to a central office trunk will function as in (SC5) to the point of operation of relay TCS5. Relays AUO-9 in the inward restriction circuit operate in parallel with relays UO-9.

4.92 Relays TCS5 and AU7 operated operate relay IR- in the inward restriction circuit performing the following functions:

(a) Prevents relay S7 from operating and so provides the marker with the necessary signals to consider the called line as unassigned.

(b) Locks operated via released marker relays RLA,B.

4.93 The marker proceeds to complete the call to an attendant trunk. When the call is completed, the marker releases by the operation of relays RLA,AA,AB,B,BA, BB, also releasing the inward restriction circuit.

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

A. General

5.01 In completing a call from a code 9 trunk to a code 8 trunk, the marker will make a busy test of the trunks in the code 8 trunk group dialed and complete the connection to an idle trunk in the group, via the link used for the dial tone connection. If all trunks in the dialed group are busy, the marker will return a camp-on busy indication to the code 9 trunk.

5.02 If the code 8 trunk is arranged for pad control, then options 19, 20 and 21 are provided for the trunk. In the course of completing the connection, the marker will signal the code 8 tie trunk to remove its switch pad.

B. Register Requests Service

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

C. Trunk Testing and Select Magnet Operation

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

D. Hold Magnet Operation

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

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

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

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

5.07 Relay OT2- in operating, will:

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

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

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

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

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

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

5.10 When relays HMTAA,BA operate:

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

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

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

E. Hold Magnet Check and Marker and Register Release

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

F. All Trunks Busy (SC15)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

7.06 The operated relay NT in the marker also:

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

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

8. CALLED LINE OR TRUNK UNASSIGNED (SC14)

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

8.02 A call to an unassigned line or trunk will be handled by the marker in the same way as a call to an assigned line or trunk as described up to the point when relays SOA,B operate, indicating that no stations or trunks in the groups related to the dialed number are idle. SC14 assumes that the call is from a station, Code 8, or attendant trunk (juncor class call) to an unassigned station line. For a call to an unassigned trunk, the sequence would be similar except that the junctor selection circuitry would not be involved.

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

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

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

(a) Release the junctor selection and link test portions of the circuit. (During the release of the junctor selection circuitry, relays JREA, B will release thereby releasing relays RCTA, B and RCTAA,BA.)

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

(c) Lock under control of relays RPA- or RP-.

8.06 Relays SMTA,B, in releasing:

(a) Operate relays TRCA,B and TRCAA,BA. (At this time, relays RCTA,B and RCTAA,BA will release if the call is to an unassigned trunk.)

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

8.07 Relays RCTA,B and RCTAA,BA, in releasing:

(a) Release relays RCA-,B-,C-,D-,E-, which release the operated tens connector and select magnet connector relays in sequence.

(b) Cause relays PYA,B, BSYA,B, and BSYAA,BA to release.

8.08 Relays BSYA,B, in releasing, cause relays SOA, B-,S-, and SEA,B and SEAA,BA to release in sequence. The release of the latter relays will:

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

(b) Operate relays RUCA,B.

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

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

8.11 Relay SMCO, in operating, will:

(a) Cause the select magnets corresponding to the link used in the dial tone connection in switch 0 to operate.

(b) Operate relay SMTA,B, which, in turn, operates relays SMRA,B and SMRAA,BA and closes the operating path for the slow operating relays HMTAA,BA.

8.12 Beyond this point in the call, the marker will function to connect the calling station or trunk to an idle attendant trunk, make the hold magnet check, and release itself and the register in much the same manner as described previously.

8.13 Because the attendant trunk was entered via its 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 relays TEAO,A1,A2,A3,BO,B1,B2,B3. Competing with these station groups for service are two trunk groups and two registers. Their associated relays TRO,1 and RO,1 perform the same functions as relays T2-7. Relays TEAO,A1,A2,A3,BO,B1,B2,B3 function as a gate in this

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

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

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

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

B. Tens Preference Control

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

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

10. ABANDONED CALLS (SC17)

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

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

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

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

11. ALLOTING AND SEQUENCE CONTROL

A. Register Allotter

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

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

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

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

these relays finally operate, relays RA1A,B will operate (if not already operated) and relays RAOA,B will release. On the next marker usage, register 1 will be preferred.

B. Link Group Sequence Control (SC24)

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

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

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

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

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

C. Link Sequence Control (SC23)

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

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

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

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

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

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

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

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

D. Units Sequence Control (SC25)

11.18 The state of relay ZU on PS6 will determine:

- (a) The preferential order with which stations and code 8 trunks within a tens group will be selected for dial tone calls.
- (b) The preferential order with which code 8 trunks or stations within a hunting group will be selected for the completion of calls to them.
- (c) The preferential order with which the junctors will be selected for the completion of station-to-station calls.
- (d) The preferential order with which code 9 trunks will be selected for outgoing calls by the marker.

11.19 The preceding preference orders change whenever the marker is seized for a dial tone call or whenever the marker progresses to second trial on any type of call.

11.20 The preference order of stations in a tens group is related to the units digit of a station. When relay ZU is operated, the order is 5-9, 0-4. When relay ZU is normal, the preference order is 0-9. The code 8 trunks take their preference order in the same manner from the units digit of their number assignment.

11.21 The preference order of junctor selection when relay ZU is operated is 3,4,5,0,1, and 2; when relay ZU is released, the order changes to 0,1,2,3,4, and 5.

11.22 The preference order for the outward selection of code 9 trunks when relay ZU is operated in accordance with trunk equipment numbers is 4,3,2,1, 0,9,8,7,6, and 5. With relay ZU normal the order changes to 9,8,7,6,5,4,3,2,1, and 0.

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

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

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

11.25 On the next operation of relays TACAA,BA on a subsequent marker usage, relay WU will be shunted down, but relay ZU will remain operated over a path

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

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

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

12. PATHS BUSYA. All Registers Busy

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

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

12.03 With relays RLA,B operated and relays RAOB and RA1B released, the all registers-busy relays ARBA,B (PS2) will operate. Relays ARBA,B lock through their own contacts independently of relays RLA,B, close an operating path for relays RO and RI independently of relays TEAO,A1,A2,A3, BO,B1,B2,B3, and open the operating circuit of relays TRP- and TP-.

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

B. All Links BusyStation-to-Station Call (SC11, SC22, or SC35)

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

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

12.06 Relays ALBA,B operated:

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

12.07 Relays BTAA,B operated:

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

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

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

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

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

Dial Tone Call

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

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

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

C. All Junctors Busy (SC12)

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

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

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

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

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

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

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

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

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

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

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

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

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

- (b) Operate relays SMTA,B.

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

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

D. Busy Tone Trunk Busy (SC13)

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

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

12.27 Relays BYA,B, in operating, will:

- (a) Release relays DCKA,B, which, in turn, will operate relays RLA,AA, AB,B,BA,BB, and start the sequence to release the marker.
- (b) Operate relays HCA,B, which have no function at this time.
- (c) Lock operated to the operated relays UEA,B.
- (d) Ground leads BY- to the register through contacts of the operated relays BTCA,B and RPA- as shown on FS10, which will operate relay BY in the register.
- (e) Open leads RRA-, B- from the marker to the register to prevent the release of the register during the marker release (option VM provided).

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

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

- (b) Release relay DC in the register.

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

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

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

- (a) Release relay RP-, which, in turn, will release relay RPA- and the operated select magnets on switch O.
- (b) Release relays TCK1,2,3,4.
- (c) Release relay MTA,B, which stops the marker timing.

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

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

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

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

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

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

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

13. LINK SHIFT TIMING

A. General

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

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

B. Link Shift Timing (Option 22 - SC34)

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

13.04 Relays LBA,B, in operating, will:

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

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

- (a) Reoperate relays LTCA,B.

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

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

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

C. Link Shift Timing (Option Z0 - SC21)

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

13.08 Relays LBA,B, in operating, will:

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

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

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

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

D. Link Shift Timing (Option ZN - SC10)

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

13.12 Relays LBA,B, in operating, will:

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

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

14. MARKER TIMING (SC16, SC36)

OPTION VQ

A. General

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

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

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

B. Second Trial

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

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

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

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

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

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

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

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

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

14.10 The subsequent operation of relays SAA,B will:

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

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

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

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

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

C. No Connection

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

14.16 Relays NAA,B, in operating, will:

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

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

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

D. Trouble Release

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

14.20 Relays TRA,B, in operating, will:

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

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

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

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

14.22 The trouble release relay, in operating, will:

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

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

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

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

(e) Release relays MTA,B.

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

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

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

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

OPTION VR

A. General

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

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 has released in the normal manner.

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

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

B. Second Trial

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

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

14.32 Relays STA,B operated:

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

14.33 Relays STAR,BR operated:

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

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

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

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

14.36 Relays SAA,B operated:

- (a) Lock to the operated relays MTA,B.
- (b) Release relays STAR,BR which restore the operating path for relays SMTA,B.
- (c) Restore the locking path for relays JR0-5. The sequential operation of relays SAA,B will also advance the link and units sequence control circuit.

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

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

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

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

C. No Connection

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

14.42 Relays NAA,B operated:

- (a) Release relays RCTA,B and

RCTAA,BA if operated.

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

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

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

D. Trouble Release

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

14.46 Relays TRA,B in operating:

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

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

14.48 The trouble release relay, in operating will:

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

(b) Stop the timer.

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

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

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

(f) Release relays MTA,B.

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

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

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

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

15. TIME-OUT CHECK (SC18)

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

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

15.02 When relays TOLA,B release, a path is prepared for operating the time-out check relays TOKA,B when the marker has finished processing all of the calls in the tens preference chain and relays TEA2,B0,B2 release.

15.03 Relays TOKA,B, in operating, will:

- (a) Operate relays MTA,B, which will start the timing circuit.
- (b) Lock operated under control of relays RLSA,B.
- (c) Open the operating path for relays TEAO,A1,A2,A3,B0,B1,B2,B3 and the tens preference chain on FS3.
- (d) Reoperate relays TOLA,B.

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

16. TRAFFIC REGISTER CONTROL

A. General

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

B. Peg Count Register Control

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

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

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

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

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

C. Overflow Register Control

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

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

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

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

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

D. Trouble Register Control

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

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

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

17. UNIVERSAL LINE GROUP 20-29

A. General

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

17.13 Diode L (option J - F335) in the battery supply lead for relays L20-29 prevents the transfer relays AT and ATA of the alarm, transfer, and test circuit from being held up falsely via a tie trunk as the distant end when the PBX power fails.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

17.24 Two line circuits are required to connect to one channel of the 3A code call circuit; one circuit is required for association with the calling end and the second circuit for association with the answering end. The line circuit assigned to the calling end should be provided with options ZD, ZG, WP, VC, and VE and leads T2, R2, and S2 connected to the code call circuit.

17.25 The line circuit assigned to the answering end should be provided with options ZE, WP, VC, and VE and leads T1, R1 A and S1A connected to the code call circuit. It is also required that leads HM, IT, and S2 be interconnected between the two line circuits and that the line hold magnet contacts in the line circuit assigned to the answering end be permanently insulated with a blocking tool to isolate the associated relay L windings from the circuit.

17.26 A calling party will originate a call to the 3A code call circuit by dialing the number in the 50 series corresponding to the line circuit to which the calling end is assigned. Assuming the answering end line circuit idle, the marker will process the call in the same manner as when connecting a call to a 2-way tie trunk.

17.27 The ground on lead IT originating in the marker will operate relay OT in the calling end line circuit through break contacts of relay IN and SL in the answering end line circuit and break contacts of relays L and IN in the calling end line circuit. When relay OT operates, operating the line hold magnet, the calling party bridge on the tip and ring of the link will function relays in the code call circuit, causing it to return a holding ground for relay OT on lead S2.

17.28 Ground on this lead will also operate relay SL in the line circuit associated with both the calling and answering ends. However, only relay SL associated with the calling end performs a useful function in this application. The answering end relay SL, in operating, will open the operating path of relay OT in the calling end line circuit and connect ground to lead IT as a busy indication to the marker.

17.29 After the connection to the calling end of the code call circuit is completed, the calling party will hear the code call circuit dial tone, indicating that the code of the desired party should be dialed.

17.30 When the code call circuit is idle, leads S and S1A to the answering end line circuit will be opened. Consequently, a station dialing the line number corresponding to the answering end will be intercepted in the same manner as a call to an

unassigned line. However, when a calling party has seized the calling end, a relay in the code call circuit will close a path between leads S and S1A, thus making the answering end line circuit available for seizure by the marker.

17.31 Also, when relay SL operates in the answering end line circuit due to a seizure of the calling end of the code call circuit, the tip and ring conductors from the answering end of the code call circuit will be extended to the crossbar switch crosspoints prepared for connection to the answering call.

17.32 A called party responding to the code signal broadcast by the code call circuit will originate a call to the answering end of the code call circuit from any station in the PEX. The called party will dial the number in the 20 series corresponding to the line circuit assigned to the answering end of the code call circuit. The marker will process this call as a station-to-station call, using a junctor in the connection. When the marker grounds lead S of the answering end line circuit, relay IN will operate.

17.33 Relay IN, in operating, will operate the line hold magnet, cutting through the tip and ring conductors of the answering end of the code call circuit to the terminating end of the junctor via the connected link. Relay IN will look over the sleeve lead of the link to a 100-ohm ground in the junctor.

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

17.35 When a calling party is connected to the code call circuit to the answering party for conversation, lead S to the marker in the answering end line circuit will be grounded by the same ground that holds relay IN operated. Thus, if a station tries to dial the number of the answering end line circuit during this period, it will receive a busy indication rather than be intercepted as an unassigned line.

17.36 If the calling party disconnects first, the removal of the station bridge from the calling end of the code call circuit will cause ground to be removed from lead S2. This will release relay OT in the calling end line circuit and release relay SL in the answering end line circuit. Relay OT, in releasing, will release the line hold magnet, restoring the calling end line circuit to normal, except that the operate path of relay OT is held open and ground is maintained on lead IT by the operated relay IN in the answering end line circuit.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

17.54 The attendant initiates conference connections by depressing the CONF key at the attendant position. Operated relays in the dial conference trunk circuit place a short circuit on the tip and ring of the trunk vertical assigned to conference port 1 as a signal to connect vertical 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 punchings IT and HM through the relays COTA,B operated to operate the associated relay OT.
- (b) Grounds lead IT as a busy indication.
- (c) Grounds lead central office to function relays in the dial conference trunk circuit to connect the central office trunk party to the conference amplifier.

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

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

General

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

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

Connections

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

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

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

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

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

Operation

Originating a Call to Recorded Message or Message Recorder COAM Equipment

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

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

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

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

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

Originating A Call to Called-Party-Answer COAM Equipment

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

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

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

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

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

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

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

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

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

Disconnection from Un-Manned Equipment

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

Disconnection form Called-Party-Answer COAM Equipment

17.79 Calling party disconnects first:

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

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

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

17.80 Called party disconnects first:

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

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

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

Allotted Time Exceeded

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

Taking Equipment Out of Service

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

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

18. STATION AND TRUNK HUNTING GROUPS

A. General

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

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

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

B. Two-Way Station Hunting Group

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

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

C. One-Way Station Hunting Group

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

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

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

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

18.09 In this case, if the marker is processing a call to station 47 but finds it busy, it will progress to the hunting sequence and operate relays U0 and U6; if both stations 40 and 46 are idle, relays S0 and S6 will operate. The marker will then complete the call to either station 40 or 46, depending upon the state of relay ZU.

18.10 However, if the marker is processing a call to station 46 and finds it busy, the marker, after progressing to its hunting sequence, will operate only relay U0; if station 40 is idle, relay S0 will also operate. The marker will then complete the call to station 40.

E. One-Way Sequential Station Hunting Group

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

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

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

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

18.14 If the marker is processing a call to station 52 but finds it busy, it will progress to the hunting sequence and operate relay U4 through diode H between terminals H52 and H54. Relay U0 will not operate, since diode H between terminal H50 and H52 is poled in the wrong direction to pass the ground on terminal H52. If station 54 is idle, relay S4 will operate, and the call will be completed to that station.

18.15 If the marker is processing a call to station 54 but finds it busy, it will progress to the hunting sequence. No relays U- will operate (other than relay U4 which is already operated), since diodes H between terminals H50, H52 and H54 are poled in the wrong direction to operate relays U0 and U2 from the ground on terminal H54. The marker will therefore attempt to connect the call to the busy tone trunk (or camp on to station 54 if the originating call is from a code 9 trunk).

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

19.01 On some installations, a cord switchboard will be required to supplement or replace the cordless attendant positions. If a 556A cord switchboard is used, options Y and ZT will be provided. These options will furnish jacks L20-79 and relays C020-79 and MON2-7 shown on FS1 and FS26. If a 608A or 608D cord switchboard is used, option XW will be provided for 40 line PBX and options XW and XX will be provided for 60 line PBX. Option ZW furnishes relays C020-59, and MONA,B shown on FS1 and FS26. Option XX furnishes relays C060-79 and MONC relays shown on FS1. This equipment is located in the switchboard when the 556A is used and in an apparatus cabinet when the 608A or 608D is used. The purposes of relays CO-- and MON- are to minimize interference from switchboard attendant to marker operation as well as provide an exchange of station busy indications between the switchboard and the marker.

19.02 When the marker is processing a call

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

19.03 Relay CO--, in operating, will:

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

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

19.05 Relay CO--, in operating, will:

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

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

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

20. ALARMS

A. General

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

multiplied (for example, relays TKO and TKA0) operate and release in unison. However, other marker operations are also checked as described in the following paragraphs.

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

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

B. Units Alarm

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

20.05 Relay UAL will operate if:

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

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

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

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

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

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

20.08 Relays UAL1 and UAL1A will operate if:

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

20.09 Relay UAL2 will operate if:

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

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

C. Release Alarms

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

20.12 Relay RLAL will operate if:

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

20.13 The operate path for relay RLAL is opened whenever relays ALBA or ALBB operate, since during an all-links-busy condition the marker will release and make repeated new attempts to complete calls, which under certain unfavorable conditions, can cause the alarm relay to operate falsely.

20.14 Relay TAAL will operate whenever the marker progresses to the trouble release stage. The operation of relays TRA,B will operate relays RLSA,B and RLSAA,BA, which, in turn, release relays MTA,B and the slow release relays TRA,B.

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

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

D. Tens Alarms

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

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

20.19 Relay TAL will operate if:

- (a) The following pairs of relays are not in the same state for a longer period than the operate time of relay TAL: relays TU2 and TCS2, TU3, and TCS3, TU4 and TCS4, TU5 and TCS5, TU6 and TCS6, TU7 and TCS7, RCC1 and RCD1, RCA1 and RCB1, RCA1 and RCC1, TACAA and TACBA, RCO and RCBO, RCO and RCCO, RCCO and RCDO, RCDO and RCEO, RCD1 and RCE1, ARBA and ARBB, TKO and TKAA, TK9 and TKA9, TK8 and TKA8, TRC1 and TRU1, TRCO and TRUO, TU2, and THC2, TU3 and THC3, TU4 and THC4, TU5 and THC5, TU6 and THC6, TU7 and THC7, TCK1 and TCK3, and TCK2 and TCK4.
- (b) A relay RP-, TRP-, or TP- is operated while relay RLAA or RLBA is operated for a longer period than the operate time of the alarm relay.
- (c) Relays TEAO, TEA1, TEA2, TEA3, TEBO, TEB1, TEB2, and TEB3 are not all operated whenever relays TA2-7, TRA0,1, or RO,1 are operated.
- (d) If option Y is provided and any one of the relays MON2-7 does not operate while any relay TP2-7, TRPO,1, or RPO,1 is operated (relays TEA1 and TEB1 are

assumed to be functioning properly and operated at this time).

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

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

E. Link Test Alarm

20.20 The link test alarm group shown on FS21 consists of relays LAL1, LAL2A, COAL (option WT), and XCAL (option WT). Each of these relays, in operating, will light their associated lamp on FS23 with the exception of relay LAL2A which will light lamp LAL2.

20.21 Relay LAL2A is connected in tandem with relay LAL2 to increase the effective operating time of the combination since this alarm relay is wired to detect the malfunctioning of some slow acting pairs of relays.

20.22 Relays LAL2 and LAL2A will operate in tandem if:

(a) The following pairs of relays do not operate and release in unison within the limits of the combined slow-operating characteristics of the tandem alarm relays: relays SMTA and SMTB, ALBA and ALBB, LBA and LBB (option ZN), and LSHA and LSHB (option ZO or 22).

(b) The link sequence control circuit functions improperly.

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

20.23 Relay LAL1 will operate if:

(a) The following pairs of relays are not in the same state for a longer period than the operate time of the alarm relay: relays LTAA and LTBA, COA and COB, CONA and CONB, LEAA and LEBA, TRLA and TRLB, LEA and LEAA, LEB and LEBA, CONA and CONAA, CONB and CONBA, COSA and COSB, WLL and WLLA, and WL and WLA.

(b) Relays LCK1 or LCK2 operate.

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

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

20.25 Relay XCAL (option WT) will operate if relay XC(option 22-FS28) operates.

Relay XC is a marginal relay which will operate only if two or more LT2-9 relays operate during the link testing sequence for a camp-on call termination.

20.26 Relay COAL (option WT) will operate if no LT2-9 relay operates during the link testing sequence for a camp-on call termination.

F. Time-Out Alarm

20.27 The time-out alarm group consists of relays TOAL and TOALA shown on FS22. Relay TOALA, in operating, will light lamp TOAL.

20.28 Relay TOALA is connected in tandem with relay TOAL to increase the effective operating time of the combination. Relays TOAL and TOALA will operate in tandem if the following pairs of relays are not in the same state for a longer period than the combined operate time of relays TOAL and TOALA: relays MTA and MTB, NAA and NAB, STA and STB, and TOLA and TOLB.

G. Alarm Control

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

20.30 If an alarm indication is received for two successive marker usages for terminating calls, the alarm locking relay in the alarm, transfer, and test circuit will operate and lock to the alarm release key and, in doing so, will activate the locking ground leads UA and JA on FS18, RA on FS19, TA and KA on FS20, LA and LAL on FS21, OA on FS22, and CA on FS11.

20.31 Relay TOALA, COAL (Option WT), or XCAL (Option WT), in operating, will ground lead TT to the alarm, transfer, and test circuit, which will cause it to disregard its alarm signal versus marker operation-counting circuitry and operate the alarm locking relay immediately.

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

21. MESSAGE WAITING SERVICE (OPTION ZQ)

21.01 When the PBX is arranged for message

waiting service, option XQ on FSL and FS26 will be provided and a Message Waiting Service Key, Interrupter, and Power Supply Circuit furnished as a connecting circuit. Also the station sets will be equipped with message waiting lamps.

21.02 The connecting circuit provides a diode across leads L and R poled to permit the line relay to operate from a switchhook operation.

21.03 If the message waiting lamp of a station is to be lit, the associated key in the connecting circuit will be operated, connecting -150 volts DC interrupted at 60 lpm to lead R. This voltage will flash the neon-type message waiting lamp in the station subset to the ground on the tip side of an idle line.

21.04 The back resistance of the diode in the connecting circuit between leads L and R is sufficiently high to prevent the line relay from operating from the message waiting signal voltage.

21.05 The message waiting lamp at the station will be extinguished:

(a) By the operation of the line hold magnet resulting from the station originating a call or a call being completed to the station.

(b) When the key in the connecting circuit is restored to normal.

22. DIRECT STATION SELECTION

A. Attendant Direct Station Selection (Options ZY and ZX)

22.01 With direct station selection, the attendant may enter a call into the PBX over an attendant trunk or complete a call into the PBX from a central office, long distance, or ringdown tie trunk.

22.02 When an attendant trunk, ringdown tie trunk, long distance, or central office trunk initiates a request for dial tone, one of the marker relays TRCO or TRC1 will be operated. Depending on which register is available to serve the call, ground from the operated relay TRCO or TRC1 is extended through the marker relays RGA and RAOA or RGB and RALA to operate relay AC in the connected register.

22.03 When the hold magnet operates for any station, ground via the off normal spring assembly and lead BL lights the station busy lamp in the attendant cordless position (612 type telephone set) or (4A or 4B console).

23. SINGLE-DIGIT DIALING

A. Make Busy and Lamp (Option YD)

23.01 When a station is arranged for selec-

tion by single digit dialing and a make busy key and lamp are required, the operation of key MB opens lead S and S1 and lights lamp MB as an indication to the station that key MB is operated. With leads S and S1 open, any call directed to this station will be intercepted.

B. Single-Digit Dialing 8 for Long Distance (Options YE, YF, YG and YP)

23.02 When the dial pulse register receives the necessary information for long distance by single-digit dialing 8, the register completes to the marker. The marker will make the connection to one of the central office trunk units No. 9,8,7, or 6.

24. PAD CONTROL CIRCUIT (OPTIONS WF, 19,20,21)

A. General

24.01 When a code 8 tie trunk facility specifies pad control, options 19, 20 and 21 are provided for that trunk. These options, when used with option WF constitute a pad control circuit to be associated with the trunk. Over a control lead designated as lead O, this circuit will perform two functions. The first and primary function is to control the switch pad of the associated trunk. The second function which is operative only if a manual switchboard is in use is to seize the switchboard applique circuit of the trunk whenever the trunk dials "0" into the PBX.

24.02 Two pad control arrangements are provided:

(a) Pad control of code 8 tie trunks on all code 8 to code 8 trunk calls as well as all code 8 to code 9 trunk calls and all code 9 to code 8 calls.

(b) Pad control of code 8 tie-trunk only on code 8 to code 8 calls.

24.03 Choice (a) is provided by options 19, 20, 21, WF and WK and dial pulse register circuit option XC. Choice (b) is provided by options 19, 20 and 21 and register option XD.

24.04 With option WK and register circuit option XC: when a code 8 trunk forms a tandem connection (that is: either a code 8 to code 8 trunk connection or a code 8 to code 9 or a code 9 to a code 8 trunk connection), a resistance ground is placed on control lead O to signal the trunk to remove its pad from the transmission path.

24.05 If the trunk forms a non-tandem connection or if the trunk forms a tandem connection from code 8 trunk to code 9 trunk - or vice versa - when marker

option WK is not used and register option XD is used, no signal is sent over control lead O and the switch pad of the trunk remains in the transmission path.

24.06 If a manual switchboard is used with the PBX, then upon dialing "0" through the trunk and into the PBX, a solid ground will be momentarily placed on control lead O. This will cause the switchboard applique circuit of the trunk to be seized which results in the call being diverted from an attendant trunk to the jack and line circuit of the trunk at the switchboard. The responsibility for pad control now rests in the hands of the switchboard attendant. The attendant must determine whether the manual connection to be made is tandem or non-tandem. If tandem, then the attendant removes the switch pad simply by using the "thru" jacks of the trunks. Otherwise, the standard connecting jacks are used. However, if instead the call is "intercepted", then the call will be routed through to an attendant trunk on a non-tandem basis and appear at the jack and line circuit of the attendant trunk.

24.07 If an attendant console is used with the PBX, then upon dialing "0" or being "intercepted", the call will be routed on a non-tandem basis through to an attendant trunk.

B. Incoming Calls (SC30)

24.08 A seized incoming trunk will be serviced by the marker first for a dial tone connection. When relay IN-- of the associated line circuit operates, either relay A or B of the associated pad control circuit will operate.

24.09 Ground passing on lead MS-- of the associated line circuit from a contact of relay IN-- operated, through a contact of relay MS released, and diodes A and B of the associated pad control circuit is available to both relays A and B. However, operating battery is available to only one of these relays. Battery passing on contacts of relays HMTA, B released and relays RGAA, BA operated can pass on either control lead RO or R1, but not on both, depending on the state of relays RAOB and RALB.

24.10 If allotment of register O had been made by the marker to process the call, then the register O allotment relay RAOB will be operated and battery will be available on control lead RO. However, if allotment of register 1 had been made, then the register 1 allotment relay RALB will be operated, relay RAOB will be released, and battery will be available on control lead R1.

24.11 Battery on control lead RO operates relay A and battery on control lead R1 operates relay B. In the following discussion it will be assumed that register O has been selected and consequently relay A has operated.

24.12 Relay A operated:

- (a) Provides a locking ground for itself and an operate ground for relay B subject to relay IN-- operated.
- (b) Transfers its operate battery from control lead RO to control lead RLO subject to relay RLO released.
- (c) Transfers operate battery for relay B from control lead R1 to control lead TDMO. Control lead TDMO supplies battery whenever a tandem connection is being completed through register O.
- (d) Prepares a locking battery for relay B.
- (e) Extends control lead TKOO to associated tie trunk control lead O. A solid ground is placed on control lead TKOO when the trunk dials "0" into register O.
- (f) Partially extends a 3000 ohm ground to control lead O.
- (g) Operates marker seizure relay MS.

24.13 Relay MS operated locks to relay IN-- operated and opens the operate ground for relay A.

Incoming Call: Tandem Connection (SC31)

24.14 Since the incoming call is through a code 8 tie trunk, trunk terminating relay TT in register O will have operated as soon as the register receives class of service information from the marker.

24.15 When the incoming trunk dials a code 8 or code 9 trunk, relay TKB8 or TKB9 will operate while the marker functions to complete the connection.

24.16 If option WK is omitted per paragraph 24.03, the path from the contact of TKB9 will not be complete, and any call to a code 9 trunk will result in pad control circuitry action as described below under "Incoming Call; Non-Tandem Connection".

24.17 If option WK is used or relay TKB8 is operated, circuit action will be as follows: when relays HMTAA, BA operate, relay B operates over control lead TDMO through contacts of operated relays HMTAA, BA, either relay TKB8 or TKB9 operated, register O relay TT operated, relay RAOB operated, and operated relay A.

24.18 Relay B operated:

- (a) Transfers its operate battery from control lead TDMO to locking battery provided by relay A operated.
- (b) Transfers holding battery of relay A from control lead RLO to locking battery.

(c) Opens the connection between control lead TK00 and control lead 0.

(d) Extends a 3000 ohm holding ground over control lead 0. This holding ground signals the associated tie trunk to remove its switch pad out of the transmission line.

24.19 However, if the dialed code 8 or code 9 trunk was busy with all other trunks in the same hunting group also busy, then the switch pad of the incoming trunk will not be removed. This is because relay RCA0 releases while the marker proceeds to direct the call to the busy-tone trunk and before relays HMTAA,BA operate. Consequently, the battery path over control lead TDNO is never completed and relay B remains normal. Since relay B remains normal, the pad control circuit will handle the call as if it were a non-tandem connection.

Incoming Call: Non-Tandem Connection:

Non-tandem Call - without manual switchboard or with switchboard and other than a dial "0" call (SC3):

24.20 When a code 8 or code 9 trunk is not dialed, relays TKB8 and TKB9 remain normal. Therefore, operate battery is not available over control lead TDNO and relay B remains normal.

24.21 When digit 0 is dialed into the PBX, relay TKA0 will operate and the register will pass ground on leads U5-7 to the marker. With relay A operated, a solid ground will pass from control lead TK00 to control lead 0 seizing the switchboard applique circuit of the trunk.

24.22 The switchboard applique circuit responding to this signal will:

- (a) Open the T and R loop between the tie trunk and the PBX.
- (b) Light the trunk lamp at the switchboard.
- (c) Ring for the switchboard attendant and extend audible ring tone to the tie trunk.

24.23 In the meantime, the marker proceeds to connect the tie trunk to an attendant trunk because the register continues to bridge leads T and R until the marker releases.

Release of the pad control circuit (SC3 or SC32)

24.24 When the down check relays DCKA,B release on a dial completed connection basis, ground will pass through contacts of relays DCKA,B released, relays HMTA,B operated, and relay RPO operated to operate relay RLO.

24.25 This would be the normal way in which relay RLO is operated. However, two important special cases exist that do not require relays HMTA,B to operate when the marker prepares for its release cycle on a completed connection basis.

24.26 One case is created when the busy tone trunk is busy and the marker therefore requests the register to give busy tone. For this case, when the busy test relays BYA,B operate, ground passes through on contacts of the busy tone trunk connector relays BTCA,B operated, relays BYA,B operated, and relay RPO operated operating relay RLO.

24.27 The second special case exists when the marker releases on a trouble release condition. With relay RPO operated diodes RLSA,B provide the operating ground for relay RLO when the trouble release relays RLSA,B, AA,BA are operated.

24.28 Relay RLO operated locks to relay DCKA,B released and with relay B normal, releases relay A over control lead RLO.

24.29 Relay A released opens operate ground for itself and relay B and opens the connection between control lead TK00 and control lead 0.

24.30 Relay MS remains operated while the trunk is busy to prevent the re-seizure of the associated pad control circuit. When the trunk releases relay MS will release.

24.31 When a switchboard applique circuit was seized by the pad control circuit as described in non-tandem call - dial 0 with a manual switchboard, then relay MS will release differently. When the register is dismissed by the marker during its release cycle, the T and R loop to the attendant trunk is left open. The attendant trunk then proceeds to return to normal.

24.32 When the attendant trunk releases its 100-ohm holding ground from the sleeve lead, relay IN-- of the associated line circuit will release. Thus, both the attendant trunk and line circuit return to normal. Relay IN-- released releases relay MS of the associated pad control circuit, returning the circuit to normal.

24.33 When the marker returns to normal, relays DCKA,B operate releasing relay RLO.

C. Outgoing Calls

24.34 An outgoing trunk will be seized by the marker on a dial completed connection basis. When relay OT-- of the associated line circuit operates, then as

with incoming calls either relay A or B will operate first.

24.35 When register 0 is processing the call, relay A will operate or when register 1 is processing the call, relay B will operate. Ground is available to both relays over control lead MS-- from a contact of relay OT--operated.

24.36 Assuming that register 0 processes the call, operating battery will be available over control lead RO through contacts of relay RAO operated and relay RLO released operating relay A.

24.37 Relay A operated performs the same functions as it did for the case of an incoming trunk being serviced by the marker in a dial tone connection basis.

Outgoing Calls: Tandem Connection (SC31)

24.38 With relay A operated, the pad control circuit functions for the outgoing trunk the same as described for incoming call - a tandem connection, except, a clarification will be made regarding the situation when the incoming call is from a code 9 trunk.

24.39 When the incoming trunk is a code 9 trunk, relay COT in register 0 will operate as soon as the register receives class-of-service information from the marker. When the attendant dials a code 8 trunk, relay TT in the register operates.

24.40 If, per paragraph 24.03, register option XD is used, register relay COT keeps the operate path of relay B from being complete; this prevents removal of the pad. Pad control circuit release is as described under "Incoming Call: Non-Tandem Connection". If, per paragraph 24.03, register option XC is used, relay B will operate from control lead TDMO and operation will proceed as in paragraph 24.18 above.

Outgoing Calls: Non-Tandem Connection (SC29)

24.41 When the incoming call is not from a code 8 or code 9 trunk, relay TT in the register will not operate. Consequently, operating battery for relay B will not be available over control lead TDMO and relay B will remain normal. With relay B normal, the pad control circuit will release in the same manner as described for release of the pad control circuit for an incoming call - non-tandem connection.

25. MAKE BUSY AND BUSY DISPLAY CIRCUIT

A. Function of Links with Make Busy and Busy Display Circuit

Link Key Normal

25.01 With the link key (LINK key) normal in the make busy and busy display circuit, the link busy lamp (LINK lamp) will light when a direct or resistance ground is applied to the associated S sleeve lead.

25.02 The marker, when the marker operates the LT relays associated with the idle links during the link testing sequence, those busy lamps associated with idle links will light momentarily. As the marker proceeds to select and busy one of the idle links during the link selection sequence, the busy lamp associated with the selected link will relight through the resistance ground applied to the sleeve of the selected link.

25.03 The re-lighting of the associated LINK lamp indicates that the link has been made busy to the marker through normal operations.

Link Made Busy

25.04 If it is desired to make a link busy to the marker, the associated LINK key in the make busy and busy display circuit is operated. Key LINK operated applies a 909-ohm resistor and 8 volt zener diode voltage divider circuit to the associated sleeve lead.

25.05 The zener diode connected to the sleeve:

- (a) Holds the sleeve to ground voltage at approximately -8 volts, thereby making the link busy to the marker.
- (b) Lights the associated LINK lamp in the make busy and busy display circuit indicating that the link has been made busy.

B. Function of Junctors with Make Busy and Busy Display Circuit

Junctor Key Normal

25.06 With the junctor key (JCTR key) normal in the make busy and busy display circuit, the junctor terminating lamps (JCTR TERM lamps) associated with the idle junctors will light momentarily during the junctor testing sequence. As the marker proceeds to select and busy one of the idle junctors, the JCTR TERM lamp associated with the selected junctor will re-light when relays SMTA and SMTB in the marker circuit operate the terminating hold magnet of the selected junctor. The junctor originating lamp (JCTR ORIG lamp) will light when the originating hold magnet is operated.

25.07 The lighting of lamps JCTR TERM and JCTR ORIG indicates that the junctor has been made busy through normal operations.

Junctor Made Busy

25.08 If it is desired to make a junctor busy, key JCTR is the make busy and busy display circuit is operated. Key JCTR operated grounds leads THM of the terminating hold magnet in the marker circuit. Grounding lead THM:

- (a) Operates the terminating hold magnet of the associated junctor in the marker circuit.
- (b) Makes the junctor appear busy to the marker on subsequent requests for service.
- (c) Lights the associated JCTR TERM lamp in the make busy and busy display circuit.

25.09 The lighting of lamp JCTR TERM indicates that the junctor has been made busy.

C. Function of Busy Tone Trunk with Make Busy and Busy Display Circuit

Busy Tone Trunk Key Normal

25.10 With the busy tone trunk key (BT key) normal in the make busy and busy display circuit, the busy tone trunk lamp (BT lamp) will light when the marker, in placing a busy test on the idle busy tone trunk, operates relay SO. As the marker proceeds to seize the idle busy tone trunk by operating the trunk hold magnet THM07, lamp BT will remain lit.

25.11 The lighting of lamp BT indicates that the busy tone trunk has been made busy by the marker through normal operations.

Busy Tone Trunk Made Busy

25.12 If it is desired to place the busy tone trunk in a busy condition, key BT is operated. Key BT operated grounds lead HM in the line, link, and marker circuit. Grounding lead HM in the marker circuit:

- (a) Operates the busy tone trunk hold magnet (THM07) in the marker circuit.
- (b) Makes the busy tone trunk busy to the marker on subsequent requests for service.
- (c) Lights lamp BT in the make busy and busy display circuit.

25.13 The lighting of lamp BT indicates that the busy tone trunk has been made busy. Under this condition, the marker directs the register to furnish the busy tone to the calling station on subsequent busy connections.

D. Function of Universal Lines with Make Busy and Busy Display Circuit (Option WQ)

Universal Line Key Normal

25.14 The make busy and busy display circuit is used in conjunction with a universal line circuit only when the universal line is assigned to a two-way tie trunk.

25.15 When a universal line circuit is assigned to a two-way tie trunk, the associated line busy lamp (LINE lamp) in the make busy and busy display circuit will light when direct or resistance ground is applied to the operate path of relay OT.

25.16 The lighting of the associated LINE lamp indicates that the line circuit assigned to the associated two-way tie trunk has been made busy through normal operations.

Universal Line Made Busy

25.17 If it is desired to make a universal line circuit busy to the marker for outgoing tie trunk calls, key LINE in the make busy and busy display circuit is operated. Key LINE operated:

- (a) Opens the operate path for relay OT in the marker circuit.
- (b) Applies ground to lamp LINE in the make busy and busy display circuit.

25.18 The lighting of lamp LINE indicates that the tie trunk has been made busy. Opening the operate path of relay OT prevents the operation of the associated S relay in the marker circuit. Grounding the operate path toward the S relay makes the line busy to the marker for outgoing tie trunk calls.

25.19 To prevent the use of the tie trunk for an incoming call, the tie trunk must be made busy at the distant PBX.

26. TRAFFIC MEASUREMENT SYSTEM NO. 1A
REMOTE SCANNER CIRCUIT

A. Function of Links with TMS Remote Scanner Circuit

26.01 When a link is requested, the marker operates relays LTA,B and LTCA,B in the line, link, and marker circuit. If a link is idle, the respective sleeve will be open. If a link is busy, the respective sleeve will have a potential of approximately -8 volts to ground. This ground signal will be extended over lead L-- to the TMS Remote Scanner to indicate a busy condition.

B. Function of Universal Lines with TMS Remote Scanner Circuit

Outgoing Call

26.02 When the marker applies a busy test on the line by applying battery through relay OT, the associated S relay operates. The resistance ground of relay S is extended over lead L8-- to the TMS Remote Scanner to indicate a busy condition. In the following sequences, the marker operates relay SMR-- to operate relay OT. After the marker completes and releases from the connection, relay OT is maintained by the ground applied on lead S2 from the tie trunk. The TMS Remote Scanner will receive a ground signal until relay OT releases.

Incoming Call

26.03 When the universal line circuit is seized and made busy to the marker by the operation of relay L in the line circuit, a ground signal is extended over lead L8-- to the TMS Remote Scanner. The marker operates relay IN which in turn releases relay L. After the marker completes and releases from the connection, relay IN is maintained by the ground applied on lead S2 from the Tie Trunk. The TMS Remote Scanner will receive a ground signal until relay IN releases.

C. Function of Busy Tone Trunk with TMS Remote Scanner Circuit

26.04 When a PBX line or trunk other than a two-way central office trunk originates a call to a PBX line or trunk which is found busy by the marker, the marker will attempt to establish a connection between the calling line or trunk and the busy tone trunk. Before seizing the busy tone trunk, the marker will proceed to place a busy test. If the trunk is busy relay S0 will be operated. With relay S0 operated a ground signal is extended over lead BT1 to the TMS Remote Scanner.

27. MISCELLANEOUS

27.01 A reported trouble of pretripping in the central office trunk on a call being completed by the attendant to a station is as described in the following paragraphs.

27.02 The first possibility of pretripping occurs when the marker releases relay MC in the trunk and operates relays RRLA and RRLB in the register. Both of these actions result from the operation of relays RLAB and RLBB in the marker.

27.03 The release of relay MC in the trunk connects ringing current to the ring side of the trunk, and the operation of relays RRLA and RRLB opens the tip and ring conductors in the register. If relay MC releases before relays RRLA and RRLB operate, the tip and ring bridge in the register can trip the trunk.

27.04 The first possibility is corrected by transferring control of the release of relay MC in the trunk from marker relays RLAB and RLBB to relays RLAA and RLBA. Relays RLAA and RLBA are slower to operate, thereby increasing the time of release of relay MC.

27.05 The second possibility of pretripping occurs when relays RRLA and RRLB in the register release. At the end of a call, relays RRLA and RRLB operate to:

- (a) Open the tip and ring conductor to the register.
- (b) Lock to relay ON.

27.06 As the register releases, relay ON releases, in turn releasing relays RRLA and RRLB, which reconnect the tip and ring conductors. Pretripping may occur if relays RRLA and RRLB release before the crosspoints are opened.

27.07 To eliminate this pretripping, the release of relays RRLA and RRLB are connected under control of the register memory hold magnets, thereby delaying the release of relays RRLA and RRLB until the crosspoints are open.

27.08 The elimination of pretripping in the register is covered by wiring option ZH on SD-65742-01 and by wiring option YC in this circuit.

27.09 Available break contacts of relays RLAA,B are added (options WM or YR) in leads RSE,0 to prevent false operation of trunk relay RS on dial 8 or dial 9 calls. Ground on leads RSE,0 must be removed before relay TKS or TK9 releases, since the addition of option YC has delayed the release of trunk relay MC. Option WM, in addition to preventing false operation of trunk relay RS from a ground in the marker circuit, prevents operation of trunk relay RS from trunk circuit off-normal ground over leads TLAE,0 through break contacts of marker circuit relays TSDA,B during marker release of toll-allowed dial 9 calls.

27.10 In option ZR, diodes H were formerly specified on the dial conference circuit. They are for hunting as described in the circuit descriptions for that circuit.

27.11 The difference between the switch 324AJ (options ZW and ZV) and the 324AK switch (options ZY and ZW) is in the hold magnet off-normal spring assembly. A 324AJ switch may be converted to a 324AK switch by changing out the hold magnet off-normal spring assembly to a P463604 spring assembly.

27.12 If relay TA- or TRA- fails and relay TRAL is operated, the marker advances to no-connection, at which time

a buzzing condition exists between relays TRC- and TRK-. This buzzing prevents the slow release timing relays TMA,B from releasing and the timing is disabled. The marker will now be locked up in this state until another station in the troublesome tens group goes off-hook. This condition is eliminated by option YL, which replaces option YK. This option opens, on dial tone connections, the operate path of relays TMA,B which is affected by the buzzing condition.

27.13 Option VR is added and rated Standard to provide for an improved advance, timeout, and release circuit. Option VQ is designated and rated Mfr Disc. Option VS is designated and rated Standard. Options A and YL are rated Mfr Disc.

27.14 Option 22 is designated on relay ZU to agree with the Western Electric manufacturing drawing.

27.15 On a dial tone connection, if both registers are idle and the marker experiences trouble in connecting to register 1, there exists a race condition in the advance, time-out, and release circuitry resulting in the failure of the marker to connect to register 0. Option VT is added and rated Mfr Disc. Option VU is added and rated Standard. Option VU adds #8-break contacts of relays HMTA and HMTB into the operate paths of relays SAA and SAB. This delays the start of second trial until the operate paths of the line hold magnet and register 0 hold magnet have been re-established.

27.16 This circuit is reissued to reduce voltage transients present on lead SL when this system is used with 608- manual switchboard. Option VZ is added and rated Standard.

27.17 When station C flashes for dial tone, and the PBX attendant subsequently depresses a DSS key during an incoming central office trunk call or an attendant trunk call, station C will be connected to the station the attendant is trying to direct station select. Investigation shows that when station C flashes for dial tone, relay AC- in the dial pulse register operates, permitting station C to be connected to the party the attendant is trying to direct station select. Option UA is added and rated Standard. Option UA adds a new TR lead to give a locking path for relays RCO and RCI (in the station dial transfer controller circuit) through contacts of marker relays RGA and RGB, thus assuring that relay AC- in the register does not operate when station C flashes for dial tone.

27.18 Option UC provides the equipment and wiring necessary for the switching of six additional outgoing one-way central office trunk circuits and the required wiring for the first trunk circuit.

27.19 Each trunk circuit is connected to a universal line circuit starting with 89 and descending to 84 depending upon the number of trunks added. Each trunk must be strapped for two-way hunting.

27.20 All stations must be either toll allowed or restricted.

27.21 The PBX must be arranged for single digit 9 selection of central office trunks.

22.22 The added outgoing trunks are connected to relay ATB which operates when all trunks are busy using a series ground circuit through each trunk.

27.23 The dialing of a single digit 9 into the dial pulse register operates register relay TD9 which connects ground to lead TD9 through the register connect relay contacts to the marker circuit. If the ATB relay is operated, this ground will operate marker relay TK9 resulting in the marker setting up a connection to a regular two-way central office trunk. If the ATB relay is normal the ground will operate marker relays TK8 and U9 resulting in the marker making a connection to universal line circuit 89, thus the originating station line is connected to an outgoing one-way trunk.

27.24 To prevent the improper seizure of the outgoing one-way trunk by dialing a 2-digit code, 89 through 84, an arrangement is made to intercept the call. The dialing of the code 89 will operate the TD8 and U9 relays in the register resulting in ground being connected to leads T8 and U9 toward the marker. The ground on lead T8 will operate marker relay INT when the register preference relays RPO or RPI and the register connector relays RECO or RECI operate. The ground on lead U9 will operate marker relay IN8 after relay INT operates. Relay IN8 operated opens the operating path for marker relay U9 and connects ground to operate relays U1 and U4. With relays U1 and U4 operated the marker will connect the call to an attendant trunk on an intercept basis.

27.25 Options UD, UE, UF, UG, and UH provide wiring and diodes for the additional five trunks.

SECTION III - REFERENCE DATA

1. WORKING LIMITS

1.01 Lines and Trunks

Maximum external circuit loop
resistance - 1500 ohms

Minimum insulation resistance -
10,000 ohms

1.02 Voltage Limits

Potential	Minimum	Maximum
-48	-45	-52
+48	+45	+52.6

2. FUNCTIONAL DESIGNATIONS

2.01 Relays

Designation	SD Location B Sheet Number	Meaning		
A	36	Pad Control A Sequence		
ACA,ACB	8	Abandoned Call		
ALBA,ALBB	22,40	All Links Busy		
ARBA,ARBB	2	All Registers Busy		
ATB	5B	All Trunks Busy		
B	36	Pad Control B Sequence		
BSYA,BSYAA	12	Circuits Busy		
BSYB,BSYBA		Circuits Busy		
BTCA,BTCB	15	Busy Tone Trunk Connector		
BTTA,BTTB,BTTC	16	Busy Tone		
BYA,BYB	12	Busy Test		
CCC	16	Cancel Camp-on		
CO20-29	35	Cut Off		
CO30-79	1	Cut Off		
COA,COAA	16	Camp On		
COB,COBA		Camp On		
COAL	32	Camp-On Alarm		
CONA,CONAA		Camp On		
CONB,CONBA		Camp On		
			COS	22
			CCSA,CCSB	22,40
			COTA,COTB	15
			DCKA,DCKB	26
			HCA,HCB	9
			HCKA,HCKB	9
			HMTA,HMTAA	15
			HMTB,HMTBA	
			ICTA,ICTB	16
			INT	5B
			IN8	8B
			IN20-29	35
			JRO-5	13
			JRAL	29
			JREA,JREB	13
			JTA,JTAA	14
			JTB,JTBA	
			L20-29	35
			L30-79	1
			LAL1,LAL2, LAL2A	32
			LBA,LBB	22,40
			LCK1,LCK2	24
			LEA,LEAA	23,38
			LEB,LEBA	
			LSHA,LSHB	23,40
			LT2-5	20,38
			LT6,7	20,39
			LT8,9	21,39
			LTA,LTAA	22,40
			LTB,LTBA	
			LTCA,LTCB	22,40
			LTS2-6	21
				Camp On
				Camp-On Stop
				Central Office Trunk
				Down Check
				Hunt Connector
				Hold Magnet Check
				Hold Magnet Timing
				Hold Magnet Timing
				Intercept
				Intercept
				Intercept 8
				In
				Junctor Register
				Junctor Register Alarm
				Junctor Register End
				Junctor Terminating
				Junctor Terminating
				Line
				Line
				Link Alarm
				Link Busy
				Link Check
				Link End
				Link End
				Link Shift
				Link Test
				Link Test
				Link Test
				Link Test
				Link Test Connector
				Link Test Slave

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LTS7-7	22	Link Test Slave	RUCA,RUCB	8	Register Units Connector
LUCA,LUCB	8	Line Units Connector	SO-4	10	Sleeve
MAL	30	Miscellaneous Alarm	S5-9	11	Sleeve
MONA,B MONC	1	Marker Off Normal	SAA,SAB	25	Second Trial Auxiliary
MON2-7	1	Marker Off Normal	SEA,SEAA	12	Sleeve End
MS	36	Marker Seizure	SEB,SEBA		Sleeve End
MTA,MTB	25	Marker Timing	SL20-29	35	Line Sleeve
NAA,NAB	25	No-Connection Auxiliary	SMCO-8	24	Select Magnet Connector
NCA,NCB	25	No Connection	SMRA,SMRAA	15	Select Magnet Register
NT	18	No Test	SMRB,SMRBA		Select Magnet Register
OT20-29	35	Out	SMTA,SMTB	23	Select Magnet Timing
RO,R1	2	Register	SOA,SOB	15	Sleeve Operate
RAOA,RAOB	17	Register Allotter	STA,STB	25	Second Trial
RA1A,RA1B		Register Allotter	STAR,STBR	25	Second Trial Register
RCAO,1,RCBO,1	5	Register Connector	T2-7	3	Line Tens
RCCO,1,RCDO,1		Register Connector	TA2-7	2	Line Tens Auxiliary
RCEO,1		Register Connector			
RCKA,RCKB	26	Release Check			
RCTA,RCTAA	14	Register Cut Through	TA,TB	25B	Timing
RCTB,RCTBA		Register Cut Through	TAA,TAB	25	Time-out Auxiliary
RGA,RGAA	17	Register Group	TAAL	30	Trouble Advance Alarm
RGB,RGBA		Register Group	TACA,TACAA, TACB,TACBA	4	Tens Auxiliary Connector
RHKA,RHKB	17	Register Hold Magnet Check	TAL	31	Tens Alarm
RLA,RLAA,RLAB	15	Release	TCK1-4	3	Tens Check
RLE,RLBA,RLBB		Release	TCS2-7	4	Tens Class
RLAL	30	Release Alarm	TEA0-3	2	Tens End
RLO,1	37	Release Register 0,1	TEB0-3		Tens End
RLSA,RLSAA	25	Trouble Release	THC2-7	4	Tens Hunt Connector
RLSB,RLSBA		Trouble Release	TK0,TK8,TK9	5	Trunk Connector
RPO,RPI	3	Register Preference	TKA0,TKA8,TKA9		Trunk Connector
RPAO,RPA1	5	Register Preference Auxiliary			

TKBO,TKB8,TKB9	5	Trunk Connector	WLG,ZLG	22,40	Link Sequence WZ
TM2-7,TMA,TMB	4	Tens Magnets	WU,ZU	12	Units Sequence WZ
TOA,TOB	25	Time Out	WILA,WLA	32	W Auxiliary
TOAL,TOALA	33	Time-Out Alarm	WLGA	22,40	W Auxiliary
TOKA,TOKE	26	Time-Out Check	WUA	29	W Auxiliary
TOLA,TOLB	26	Time-Out Lock	XC	38	Cross Check
TP2-7	3	Tens Preference	XCAL	32	Cross Check Alarm
TRO,TR1	2	Trunk Tens			
TRA,TRB	25	Trouble Relays			
TRAO,TRAl	2	Trunk Tens Auxiliary			
TRAL	31	Tens Release Alarm			
TRCO,TRCl	4	Trunk Class			
TRCA,TRCAA, TRCB,TRCBA	14	Terminating Route Complete			
TRKA,TRKAA, TRKB,TRKBA	14	Terminating Route Check			
TRLA,TRLB	22,40	Transfer Links			
TRMO,TRM1	4	Trunk Magnets			
TRPO,TRP1	3	Trunk Preference			
TRUO,TRU1	4	Trunk Units			
TS	19	Test			
TSDA,TSDB	18	Test Disconnect			
TT	18	Tie Trunk			
TU2-7	4	Tens Units			
U0-3	6	Units			
U4-7	7	Units			
U8,U9	8	Units			
UAL,UAl1	29	Units Alarm			
UAL1A,UAl2		Units Alarm			
UEA,UEB	8	Units End			
ULA,ULB	8	Units Lock			
WIL,WL,	24	Link Sequence WZ			
ZIL,ZL		Link Sequence WZ			

3. FUNCTIONS

- 3.01 Connects a calling station line or trunk to a dial pulse register
- 3.02 Connects a station line to a station line through a junctor.
- 3.03 Connects a station line to a trunk.
- 3.04 Connects a trunk to a station line.
- 3.05 Connects a trunk to a trunk.
- 3.06 Connects a station line or trunk to the busy-tone trunk if the called line or trunk group is busy.
- 3.07 Sets the dial pulse register to return busy tone if the busy-tone trunk is busy.
- 3.08 Connects a station line or a trunk to the intercept portion of the attendant trunk if the called line or trunk group is unassigned.
- 3.09 Sets a central office or ringdown tie trunk circuit to camp on the called station line if that line is busy and no other trunk is camped on that line.
- 3.10 Signals a central office or ringdown tie trunk and refuses to set up a camp-on if the called station line already has a trunk camped on.
- 3.11 Signals a central office trunk and refuses to set up a camp-on if the called station line is busy when the PBX is provided with an auxiliary position circuit and the attendant has placed the PBX on remote trunk answer operation.
- 3.12 Cancels camp-on if the marker encounters a busy station when attempting:
- (a) To add a station to either of the dial conference trunk circuits (attendant or station controlled).

- (b) To transfer an incoming central office trunk call via station dial transfer trunk circuit.
- 3.13 Release and abandons a call under the following conditions:
 - (a) The calling party disconnects before receiving dial tone.
 - (b) The calling party disconnects after the dial pulse register seizes the marker and before the call is completed.
 - (c) The calling station line or trunk does not test idle.
- 3.14 Serves calls from register, trunk, and station lines in a predetermined order and prevents calls from interfering with each other.
- 3.15 Selects an idle link for a call.
- 3.16 Allots an idle dial pulse register for a call.
- 3.17 Selects an idle trunk from the group desired.
- 3.18 Hunts over lines strapped in a hunting group.
- 3.19 Recognizes an all-registers-busy condition and blocks until a busy register has been served and becomes idle.
- 3.20 Releases the dial pulse register when a call has been completed.
- 3.21 Goes to second trial if a call is not completed in a predetermined length of time.
- 3.22 Connects the calling party to the busy-tone trunk if the call is not completed on a second trial in a predetermined length of time.
- 3.23 Releases and gives an alarm if the call cannot be completed to the busy-tone trunk in a predetermined length of time.
- 3.24 Checks the time-out circuits every time the busy-tone trunk is used.
- 3.25 Operates an alarm relay whenever a faulty operation is detected, but otherwise completes most calls as if the faulty condition did not exist.
- 3.26 Signals the PBX alarm circuit when a marker alarm relay operates.
- 3.27 Provides a visual indication of a trouble.
- 3.28 Recognizes the class of service on a line or trunk when a call is originated and extends this to the register. Sends TLA and TT class of service indications from the register to the trunks.
- 3.29 Provides for operating internal or external traffic peg count, traffic overflow and trouble peg count registers.
- 3.30 Provides for the optional use of a manual switchboard as an attendant position.
- 3.31 Provides for message waiting service on an optional basis.
- 3.32 Cross-connect terminals are added to provide for operating external as well as internal traffic registers.
- 3.33 Provides for the optional use of the 756A attendant position when using a 608A or 608D switchboard.
- 3.34 Provides a jack appearance of port 5 of the station dial conference at 608A or 608D switchboard on an optional basis.
- 3.35 Provides pad control for code 8 tie trunks that use switchable pads.
- 3.36 To provide a link busy indication to the make busy and busy display circuit.
- 3.37 To provide a means for links to be made busy by the make busy and busy display circuit.
- 3.38 To provide a busy indication to the make busy and busy display circuit that the terminating side of the junctor is connected.
- 3.39 To provide a means for junctors to be made busy by the make busy and busy display circuit.
- 3.40 To provide a busy tone trunk busy indication to the make busy and busy display circuit.
- 3.41 To provide a means for a busy tone trunk to be made busy by the make busy and busy display circuit.
- 3.42 To provide a universal line (assigned to a two-way tie trunk) busy indication to the make busy and busy display circuit.
- 3.43 To provide a means for a universal line (assigned to a two-way tie trunk) to be made busy to outgoing tie trunk calls by the make busy and busy display circuit.

SECTION III

3.44 Provides a means of releasing relay SV in the telephone dictation trunk when the attendant plugs into a station line jack which is connected to a dictation machine (Option VF).

3.45 Provides a means of battery and ground reversal on leads T and R as a delay dial signal when the 756A is connected for delay dial tie trunk operation (Option VD).

3.46 To provide for operation of the Line, Link and Marker Circuit with the Traffic Measurement System No. 1A Remote Scanner.

4. CONNECTING CIRCUITS

4.01 When this circuit is listed on a key sheet, the information thereon is to be followed:

- (a) Dial Pulse Register Circuit - SD-65742-01.
- (b) Alarm, Transfer, and Test Circuit - SD-66796-01.
- (c) Traffic Register Circuit - For Internal Traffic and Trouble Registers - SD-65744-01.
- (d) Dial Conference Circuit - SD-65745-01.
- (e) Junctor Circuit - SD-65750-01.
- (f) Two-Way Central Office Trunk Circuit - SD-65752-01.
- (g) Attendant Trunk Circuit - SD-65753-01.
- (h) Busy-Tone Trunk Circuit - SD-65754-01.
- (i) Dial Repeating Type Tie Trunk Circuits - SD-65755-01, SD-65718-01. SD-65535-01 (typical).
- (j) Dial Long Line Circuit - SD-66060-01 (typical).
- (k) Loudspeaker Paging Trunk Circuit - SD-65747-01.
- (l) Cordless Position Circuit - SD-65751-01, SD-65757-01.
- (m) Ringdown Tie Trunk Circuit - SD-65756-01.
- (n) 3A Code Call Circuit - SD-66610-01.
- (o) Recorded Telephone Dictation Trunk - SD-65788-01.
- (p) Message Waiting Service Key, Interrupter, and Power Supply Circuit - SD-65784-01.
- (q) Busy Verification Auxiliary Trunk Circuit - SD-66911-01.

- (r) Station Dial Transfer Trunk Circuit with Add-On Conference - SD-66921-01.
- (s) Station Dial Transfer Controller Circuit - SD-66909-01.
- (t) Auxiliary Position Circuit - SD-66910-01.
- (u) Dial Conference Trunk Circuit - Station Controlled - SD-66902-01.
- (v) Dial Conference Trunk Circuit - Attendant Controlled - SD-66908-01.
- (w) Traffic Register Circuit - For External Traffic and Trouble Registers - SD-5E010-01.
- (x) Station Message Register Pulse and Surcharge Circuit - SD-5E021-01.
- (y) Message Register Circuit - SD-65852-01.
- (z) Inward Restriction Circuit - SD-5E003-01.
- (aa) Interface Trunk Circuit - SD-66926-01.
- (ab) Tie Trunk Access Circuit - SD-1E052-01 or SD-1E034-01.
- (ac) 608D Jack and Lamp Circuit - SD-65997-01.
- (ad) 552A, 552B, 552D, 552E, 605A, 607A, 607B, or 608A Jack Circuit - SD-65778-01.
- (ae) Line or Trunk Access Circuit (ground start) - SD-1E045-01.
- (af) Make Busy and Busy Display Circuit - SD-5E029-01.
- (ag) Voltage Reduction Detector Circuit - SD-5E037-01.
- (ah) Traffic Measurement System No. 1A Remote Scanner and Encoder Circuit Portable Type - SD-3B200-01.
- (ai) Relay Delay Timer - SD-99361-01
- (aj) Trunk Circuit to Central Office - SD-5E001-01

5. MANUFACTURING TEST REQUIREMENTS

5.01 The line, link, and marker circuit shall be capable of performing all the functions specified in this circuit description and meeting all the requirements of the Circuit Requirements Table.

6. TAKING EQUIPMENT OUT OF SERVICE

6.01 Station Lines: A station line may be removed from service by disconnecting lead S from the line hold magnet to the marker. All calls directed to that station

line then will be intercepted. If that station line tries to make a call, the marker will not find the idle verification and will abandon the call.

6.02 Links: A link may be removed from service by insulating the contacts of relays LTCA and LTCB, which connect the battery through resistor L- to lead S of the link.

6.03 Marker: There is no way in which the marker can be taken out of service without disrupting all traffic through the PBX. Individual relays, however, may be tested for adjustment by observing the preparation information in the Circuit Requirements Table. The effect of the marker operation is noted in those tables.

6.04 Trunks: Instructions for taking trunks out of service are given in the circuit description applying to the specific trunk circuit.

7. ALARM INFORMATION

A. Indication

7.01 A marker alarm relay, in operating, will transmit information to the alarm, transfer, and test circuit and light the associated alarm lamp in the marker circuit. Except for the time-out alarm condition, the alarm relay will normally not remain operated (unless the trouble condition remains when the marker releases). However, if the same or any other marker

alarm relay operates within the time of the next two register usages of the marker, the alarm, transfer, and test circuit will close a locking path for the marker alarm relay. This locking path will remain closed until it is opened manually. Any marker alarm relay that operates on subsequent marker operations before the alarm release key is operated will also lock operated. In the case of relays TOLA and TOALA, COAL (option WT), and XCAL (option WT), the alarm, transfer, and test circuit will close the locking path immediately, and those relays will remain operated. All operated marker alarm relays keep their associated alarm lamps lit to indicate the part of the marker in which trouble was encountered. If on the next marker usage after an alarm condition was encountered, no marker alarm relays operate, the alarm, transfer, and test circuit will release the alarm memory and restore to normal.

B. Action Required

7.02 When an alarm has been locked in, it is not possible to remove the marker from service for maintenance purposes. In general, the lighted alarm lamps should be noted and then the alarm released manually. If the trouble has cleared itself, no alarm lamps will relight on subsequent calls. If the alarm lamp or lamps do relight, the circuits of the marker involved as indicated by the lighted lamps should be observed to see if any relay or relays are out of step with the other of a pair. The faulty relays can be tested in accordance with the Circuit Requirements Table.

SECTION IV - REASONS FOR REISSUE

A. Changed and Added Functions

A.1 Provision is made to add up to six additional outgoing one-way central office trunks.

B. Changes in Apparatus

B.1 Added

INT relay, AK6, UC option, FS4, App Fig. 4

ATB relay, 1/2 AK6, UC option, FS4, App Fig. 4.

IN8 relay, AP515, UC option, FS5, App Fig. 4

U1 diode, 446F, UC option, FS5, App Fig. 4

U4A diode, 446F, UC option, FS5, App Fig. 4

U9 diode, 446F, UC option, FS5, App Fig. 4

INT1 diode, 446F, UC option, FS4, App Fig. 4

INT2 diode, 446F, UC option, FS4, App Fig. 4

TK8 diode, 446F, UC option, FS4, App Fig. 4

ATB1 diode, 446F, UC option, FS4, App Fig. 4

ASB1 diode, 446F, UC option, FS4, App Fig. 4

U8 diode, 446F, UC option, FS5, App Fig. 4

U7 diode, 446F, UC option, FS5, App Fig. 4

U6 diode, 446F, UF option, FS5, App Fig. 4

U5 diode, 446F, UG option, FS5, App Fig. 4

U4 diode, 446F, UH option, FS5, App Fig. 4

D. Description of Changes

D.1 The apparatus and option indexes are changed.

D.2 Options UB, UI, UJ, UK, UL, and UM are designated and rated Standard.

D.3 Options UC, UD, UE, UF, UG, and UH are added and rated A&M Only.

D.4 The connecting information for leads T2, K2, and S2 of the universal line circuit is changed to add reference to outgoing central office trunks.

D.5 Circuit Notes 102 and 104 are revised to reflect Issue 46D.

D.6 Circuit Note 131, 132, 324, 325, and 326 are added.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 3221-WVS-RCP

PBX SYSTEMS
NO. 756A
DIAL PULSE REGISTER CIRCUITCHANGESA. Changed and Added Functions

A.1 The dial pulse register circuit is modified to function with the Traffic Measurement System No. 1A Remote Scanner Circuit.

D. Description of Changes

D.1 Option XZ is added and rated Standard to provide a new TU(R-) lead for connection to the TMS Remote Scanner.

D.2 On sheet A1, the Sheet Index is brought up-to-date.

D.3 On sheet A2, the TMS Remote Scanner lead TU(R-) is added to the Lead Index and option XZ is added to the Option Index.

D.4 On sheet B3, contacts 1,10 and windings 1L,U of relay SW are interchanged to read 10,1 and U, 1L respectively, to indicate proper coordination with options XL and XM.

D.5 On sheet D1, Circuit Note 104 is revised to reflect changes in this issue.

D.6 On the E sheets the sequence charts are modified to reflect the addition of option XZ.

F. Changes in CD Sections

F.1 In SECTION II - DETAILED DESCRIPTION change 1.07 to read as follows:

Relay SR operated:
(g) extends ground over lead TU(R-) to the TMS Remote Scanner.

F.2 In SECTION II - DETAILED DESCRIPTION change 7.02 to read as follows:

Relay SR released:
(g) removes ground from lead TU(R-) to the TMS Remote Scanner.

F.3 In SECTION II - DETAILED DESCRIPTION change 7.06 to read as follows:

Relay DC releases relay L. Relay L releases relay SR. Relay SR releases relay ON, both register hold magnets in the marker and removes ground from lead TU(R-) to the TMS Remote Scanner.

F.4 In SECTION III - REFERENCE DATA 3. FUNCTIONS, add:

3.23 To provide for operation of the register with the Traffic Measurement System No. 1A Remote Scanner.

F.5 In SECTION III - REFERENCE DATA 4. CONNECTING CIRCUITS, add the following to paragraph 4.01:

(m) Traffic Measurement System No. 1A Remote Scanner and Encoder Circuit Portable Type - SD-3B200-01.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5122HW-SHA-WEA
DEPT 5331-SGS

PBX SYSTEMS
NO. 756A
DIAL PULSE REGISTER CIRCUIT

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SECTION I - GENERAL DESCRIPTION1. PURPOSE OF CIRCUIT

1.01 The dial pulse register functions as a dial pulse counter and digit and class information store on all calls passing within the PBX. It is not operative on outgoing central office calls after the central office has been engaged.

1.02 When either a station or a trunk originates a call into the PBX, the marker selects and connects an idle dial pulse register to it. The register receives and stores the originating line or trunk class information from the marker and then transmits dial tone to the line or trunk. After dialing is completed, the register engages the marker to terminate the call and transmits the information needed to establish a connection to the called station or trunk to the marker. When the connection has been established, the marker releases the register.

1.03 If the marker finds the busy tone trunk busy when trying to complete a call to it, it notifies the register to return the busy tone to the calling line.

1.04 The register allows from 8 to 16 seconds after seizure during which dialing must be completed. If dialing is not completed in this time, the register signals the marker to route this call to an attendant trunk.

1.05 The register is arranged to receive either dial pulses, direct station selection key signals, or the output of a TOUCH-TONE calling receiving circuit.

1.06 The dial pulse register functions to receive units and tens information from a direct station selection console key and transmit this information to the marker in the regular manner.

1.07 When a station is provided with the necessary auxiliary equipment, the dial pulse register functions to receive units and tens information from a direct station selection key in the telset. This information is transmitted to the marker in the regular manner.

1.08 The dial pulse register may be arranged for connecting to certain station lines by dialing a single digit. The proper tens digit is dialed, and after a timed interval of 3 seconds, the digit 0 is automatically set up in the register with a 2-digit code being transmitted to the marker in the regular manner.

1.09 A single digit code may be used for a trunk to the toll operator. When the single digit is dialed and a timer operates, the register functions to set

up a 2-digit code, which when transmitted to the marker, causes the marker to connect to a central office trunk that has been connected to the toll switchboard.

1.10 The dial pulse register circuit is arranged to function with the make busy and busy display circuit.

2. GENERAL METHOD OF OPERATION

2.01 When the receiver is lifted off-hook at a station, or a trunk circuit requests inward PBX service, the respective line or trunk tens relay in the marker operates. This operation sets off a train of events that result in the marker connecting the line through an idle link to an idle register.

2.02 As soon as the class identity of the calling circuit is known, after the register has been allotted, the marker transmits originating class information which is stored in the register for use when dialing is completed. The following classes of service exist:

(a) Restricted Line or Dial Repeating Tie Trunk: All restricted lines are restricted from central office trunks, and may or may not be restricted from dial repeating tie trunks.

(b) Restricted Central Office Trunks and Ringdown Tie Trunks: All central office and ringdown tie trunks are restricted from other central office and ringdown tie trunks and may or may not be restricted from dial repeating tie trunks.

(c) Nonrestricted Central Office Trunks and Ringdown Tie Trunks: All central office and ringdown tie trunks are permitted access to other central office trunks, ringdown tie trunks, and dial repeating tie trunks.

(d) Toll Denied Line or Dial Repeating Tie Trunks: The line or trunk can dial intralocal central office and extended area central office calls but not toll calls.

(e) Toll Allowed Line or Dial Repeating Tie Trunk: The line or trunk can dial all calls.

2.03 When the register hold magnet closes the tip, ring, and sleeve of the line through to the register, the register off-normal relay operates. The off-normal relay furnishes holding battery and ground for most of the register and closes the dial tone path to the calling line. This connection is known as the dial tone connection and is an indication that dialing may proceed.

2.04 The dial pulse register is arranged to receive 1- or 2-digit codes for station lines, ringdown tie trunks, miscellaneous trunks, or central office trunks, and a 1-digit code for attendant trunks or long distance trunks.

2.05 Access to trunk code 8- may be restricted or nonrestricted without regard to the access to the central office code. Thus, a line may be restricted from both codes 8- and 9-, or it may be restricted from code 9- only.

2.06 After the calling line dials the one or two digits required for identification of the called line, the register recognizes dial completion and engages the marker for termination of the call.

2.07 The digit steering relays determine when the tens and units digits have been registered; the tens digit being stored in the TD register relays and the units digit in the pulse counter and the UD register relays.

2.08 If a 1-digit central office trunk code is provided and a 9 or 0 is dialed, the steering circuit recognizes that only one digit will be dialed, and therefore engages the marker to either a central office or attendant trunk to complete the call. If a restricted line dials codes 8- or 9- (code 8- being restricted) or should an unequipped code be dialed, the call will be diverted to an attendant trunk. If code 8 is used for long distance, a code 8 will be translated into a 2-digit code 90. With single digit dialing, any tens digit so arranged will be translated into a 2-digit code by the addition of a zero.

2.09 The number dialed determines the terminating class of call, which directs the marker in its method of call completion. There are two terminating classes of calls:

- (a) Junctor Class - Calls which require a junctor.
- (b) Trunk Class - Calls which do not require a junctor.

2.10 When the digit registration is completed and the marker engaged, the register transmits the class information and the called number data to the marker.

2.11 When a dial tone call is established, the register memory hold magnet in the marker remembers which link was used for the connection from the calling line to the register, so that the same link can be reused when the call is later terminated via a junctor or a trunk.

2.12 After the marker performs its functions in terminating the call, it transmits a release signal to the register. The register then opens the tip, ring, and sleeve connections to the link, restores to normal, makes itself available to the marker for reseizure, and releases the register work and memory hold magnets.

2.13 If the marker encounters a busy condition and the busy tone trunk is also busy, it signals the register to transmit busy tone to the calling line.

DETAILED DESCRIPTION

1. REGISTER SEIZURE

A. Register Selection

1.01 When a register is idle, battery ground through break contacts of relay SN operate the associated register allotter relay in the marker. Operation of the allotter relay prepares an operating path for the register hold magnets and the class relays. In the process of link selection, the marker operates the register hold magnets.

B. Registration of Class

1.02 As soon as the class and originating line selection circuits have operated in the marker, an operate path for the class relays in the register is established through the make contacts of the register allotter relay in the marker. The following is a tabulation of class conditions that can exist for incoming calls to the register.

<u>Class Relays Operated</u>	<u>Originating Class of Service</u>
None	Restricted Station, or an Attendant Trunk
TT	Restricted Dial Repeating Tie Trunk
TLD	Toll Denied Station
TP & TLD	Toll Denied Dial Repeating Tie Trunk
TLA & TLD	Toll Allowed Station
TT, TLA & TLD	Toll Allowed Dial Repeating Tie Trunk
COT	Restricted Incoming Central Office or Ring-down Tie Trunk
COT, TLA & TLD	Nonrestricted Incoming Central Office or Ring-down Tie Trunk

1.03 These class relays operate on signals from the marker and hold through their own contacts to off-normal battery.

C. Dial Tone Connection Established (SC1)

1.04 While the originating class information is being transmitted to the register from the marker, the marker is selecting an idle link. When the select magnet timing relays operate in the marker, the register work and memory hold magnets THM-8 and THM-9 operate.

1.05 Operation of hold magnet THM-9 prepares paths in the marker that are used when the marker terminates the call, and also prepares a holding path for relays RRL (A, B).

1.06 Operation of hold magnet THM-8 closes register leads T, R and S to the calling line circuit via a link in the marker. The tip and ring closure operates relay L in series with the tone coil (FS1). Relay L operated, operates relay SR.

1.07 Relay SR operated:

- Operates relay ON.
- Connects resistance ground (resistor S) to lead S toward the marker to hold the station hold magnet operated.
- Grounds lead RHM toward the marker to provide a holding ground for hold magnets THM-8 and THM-9.
- Removes ground from lead RHM toward the make busy and busy display circuit, lighting the register busy lamp.
- Prepares an operating path for pulse counting relay Pl.
- Prepares an operating path for relay AC-
- Lights the all registers busy lamp at the attendants console (if direct station selection by the attendant feature is provided and if the other register is in use).

1.08 Relay ON operated:

- Completes a path to supply dial tone to the calling station via transformer TN.
- Prepares operate and holding paths for relays DC, PU, RRL (A, B), STR, UD and pulse counting relays.
- Connects battery to lead PR (option ZE)
- Provides an operating path for relay RA.
- Prepares operate and holding paths for relays TD- and UD-.
- Prepares holding paths for relays BY, OT, OTA, TMO & TR.
- Opens the operate path of the register allotter relay in the marker by removing battery and ground from leads ONB and ONG respectively, thus preventing the marker from selecting the same register for the next call.

1.09 NOTE: Relays operated: L, SR and ON.

2. DIAL PULSE COUNTING AND REGISTRATION

A. General

2.01 For any digit, a train of pulses consisting of one to ten equally spaced momentary line openings is generated by the dial on the calling line. The number of opens corresponds to the number dialed, one for the number 1, two for the number 2, etc. Between these trains of pulses there is an interdigital interval during which the line remains closed.

2.02 The pulsing relay L responds to these pulses and the counting circuit counts the number of pulses in each digit. In the interdigital time, the tens digits information is transferred to the tens digit register and the counting relays are released preparing the circuit for receipt of the units digit. The units digit is counted and registered by the pulse counter relays.

B. Pulsing Relay (FS1)

2.03 Relay L is a magnetically biased polarized mercury contact relay with three windings. The primary winding is in series with the customers line and dial contacts and operates the relay on line closure.

2.04 When relay L operates, its contact furnishes ground to the secondary winding which is poled oppositely to the primary winding. This opposition of ampere turns, when the relay is operated, tends to aid the release of the relay when the primary winding is opened.

2.05 The tertiary winding acts as a pulse aiding winding. The winding is wired in series with the pulse helping capacitor PH and a make contact of relay L. When relay L operates, its operated contact closes ground to capacitor PH which charges through the tertiary winding, causing an instantaneous current in a direction to hold relay L operated. As the capacitor charges, the current is reducing until, when fully charged, it is zero at which time the other windings have full control.

2.06 Relay L releases when the circuit of the primary winding is opened. Capacitor PH discharges through the winding of relay SR. This discharge current flows through the tertiary winding and is such a direction as to hold relay L released.

2.07 The tertiary winding and capacitor PH thus act to insure that once relay L operates it will remain operated for a definite minimum time, and that once it releases it will remain released for a definite minimum time. This pulse correcting

action permits longer maximum loops to be used than would otherwise be possible.

2.08 Capacitor LW and resistor LW are connected to the line side of the primary winding of relay L to prevent the premature release of the relay when dialing over a line which has high capacity ringing bridges. On each open pulse on these lines, the line current momentarily dips and then increases as the bridged capacitor charges in series with the inductive ringer. Capacitor LW holds relay L over the dip in line current.

2.09 Capacitor LW and resistor LW also prevent a false momentary release of relay L which may otherwise occur if a retard coil holding bridge in the attendants console is reinserted in loop at the end of each dialed digit.

C. Supervisory Control (FS1)

2.10 Relay SR is under control of relay L. Relay SR remains operated when relay L releases during dial pulses. Relay SR will release when the calling line disconnects before completion of dialing, when register time out occurs, or when the register is dismissed by the marker after completion of dialing.

2.11 Relay RA operates when relay L releases. It is made slow release by short circuiting its secondary winding through its own make contact. It operates on the first dial pulse open and remains operated until the interdigital interval at which time relay L is held operated and relay RA releases. When it releases, it causes the digit register relays and the digit steering relays to function.

D. Dial Pulse Counting (FS2)

2.12 The pulse counting circuit consists of relays P1 to P5 and P2A. Relays P1 to P5 count the number of dial pulses received for each digit. The sequence of operation of these relays is shown in SC26. The table below shows which of these relays remain operated after each digit.

<u>Digit Dialed</u>	<u>Relays Remaining Operated</u>
1	P1, P2
2	P3
3	P1, P2, P3, P4
4	P3, P4
5	P1, P2, P4
6	P4, P5
7	P1, P2, P4, P5
8	P3, P4, P5
9	P1, P2, P3, P5
0	P3, P5

SECTION II

Page 2

2.13 The auxiliary counting relay P2A operates at the start of the second pulse of the first digit. Its functions include removing dial tone from the calling line, and preventing the registration of preliminary digits which may be caused by rumberling the switchhook dialing a one as the first digit.

E. Digit Steering and Registration

2.14 The digit steering circuit functions to connect the output of the pulse counting relays to the proper digit register relays. It advances successively as each digit is recorded. The steering relays are under control of the register advance relay RA.

2.15 At the end of the last pulse of the tens digit, relay RA releases and causes the operation of relays SW and TD3. Relay TD3 operated locks to off-normal ground under control of relays TMO, ON and RRL-, and grounds lead T3 to the line, link and marker circuit.

2.16 Relay SW operated:

- (a) Releases relays P1, P2, P3 and P4.
- (b) Operates relay STR.

2.17 Relay STR operated:

- (a) Locks under control of relay ON
- (b) Prepares the operating paths for relays UD-.

2.18 Relay L follows the dial pulses of the units digit and, when at normal, operates relays P1 and RA. Relays P1 and RA operate on the first pulse.

2.19 Relay RA operated:

- (a) Operates relay UD.
- (b) Releases relay SW (if relay PU is not operated).

2.20 Relay UD operated:

- (a) Locks under control of relay ON.
- (b) Prepares an operating path for relay DC.
- (c) Prepares a holding paths for relays P- when relay RA releases.

2.21 At the end of the last pulse of the units digit, relay L reoperates. Relay L operated, operates relay P-, and slow releases relay RA.

2.22 Relay RA released:

- (a) Operates relay UD-.

(b) Operates relay DC.

2.23 Relay DC operated:

- (a) Releases relay PU (if operated).
- (b) Connects battery to leads JTA, JTB and DC (2, 4) toward the marker.
- (c) Grounds lead DC (1, 3) toward the marker.

2.24 The marker now functions to terminate the call.

F. Intercept of Tens Digit 6 and 7 or 8 Calls - Options Z, W (SC 9)

2.25 Option Z provides for routing tens digit 6 and 7 calls to the attendant on an intercept basis and is furnished when the PBX is equipped with only 40 lines.

2.26 Option W provides for routing tens digit 8 calls to the attendant on an intercept basis and is furnished when the PBX is not equipped with circuits using codes beginning with 8.

2.27 At the end of the last pulse of the tens digit 6, 7 or 8, relay L re-operates, slow releasing relay RA, and operating or/and releasing the appropriate P- relay(s).

2.28 Relay RA released:

- (a) Operates relay TD (6,7,8).
- (b) Operates relay SW.

2.29 Relay SW operated, operates relay STR, and releases relays P-. Relay TD- operated, starts the timer, operates relay OT, grounds its associated tens lead T- to the marker, and extends ground over lead T0 toward the marker.

2.30 Relay OT operated:

- (a) Locks under control of relay ON.
- (b) Operates relay UD.
- (c) Operates relays UD1 and UD4.
- (d) Transfers lead DC (2,4) from leads JTA and JTB to leads RCTA and RCTB.
- (e) Releases relay SW (if relay PU is not operated).

2.31 Relays UD1 and UD4 operated:

- (a) Connect ground to their associated units leads U1 and U4 toward the marker.
- (b) Operate relay SW.

2.32 Relay UD operated:

- (a) Locks under control of relay ON.
- (b) Operates relay DC.

2.33 Relay DC operated:

- (a) Releases relay PU (if operated).
- (b) Releases relay SW (if relay PU is not operated).
- (c) Stops PS & PD timing.
- (d) Grounds lead DC (1,3) toward the marker.
- (e) Connects battery to leads RCTA, RCTB and DC (2,4) toward the marker.

2.34 The marker functions to complete the call to an attendant trunk on an intercept basis, and releases the register.

G. Restricted Station or Dial Repeating Tie Trunk Denied Access to Code 8 or 9 Calls (SC 30)

Code 8 Trunk Call - Option Y

2.35 Option Y provides for routing tens digit 8 calls to the attendant on an intercept basis for a call originated by a restricted station or a restricted dial repeating tie trunk.

2.36 At the end of the last pulse of the tens digit 8, relay L re-operates, slow releasing relay RA, and releasing relay P2. Following operation is the same as described in sections 2.28 through 2.34.

Code 9 Trunk Call

2.37 At the end of the last pulse of the tens digit 9, relay L re-operates, slow releasing relay RA, and operating relay P2. Relay P2 operated, releases relay P4. Following operation is similar to that described for intercept of tens digit 8 except when relay RA releases it operates relay TD9 instead of relay TD8 since digit 9 is dialed. Relay TD9 operated, operates relay OT and extends ground over lead T9 to the marker. Register action proceeds as described for intercept of tens digit 6, 7 and 8 calls as described in section 2F.

2.38 NOTE: Relay TLD is not operated when a restricted station or a restricted dial repeating tie trunk seizes the register.

H. Restricted Station or Dial Repeating Tie Trunk Provided Access to Code 8 - Option X (SC 8, SC 15)

2.39 Option X is furnished when a restricted station or a restricted dial repeating

tie trunk ~~is~~ allowed access to codes beginning with 8. Stations and dial repeating tie trunk ~~that~~ are not restricted are allowed ~~access~~ at all times. Option X provides a ~~path~~ through relay TD8 operated to operate relay TR and extends ground to the marker over lead T8.

2.40 Relay TR locks operated and prepares a path to signal the marker over leads RCTA and RCTB to establish a trunk class call connection in place of a junctor class call connection. The units digit is counted and registered; and the register functions to complete to the marker.

I. Toll Denied Station to Central Office or Ringdown Tie Trunk Call - Option V or T provided (SC 7)

2.41 The register may be arranged for one digit (option V) or two digit (option T) access to code 9 central office trunks or code 9 incoming ringdown tie trunks.

2.42 Option V provides one digit access to code 9 trunks. When a nonrestricted station or dial repeating tie trunk dials 9, the register functions to operate relay TD9. With relay TLD operated, relay TD9 operates relay OTA, and extends a ground over lead T9 toward the marker. Relay OTA operated, locks under control of relay SR, and operates relay OT.

2.43 Relay OT operated:

- (a) Locks under control of relay ON.
- (b) Operates relays UD, and UD4.
- (c) Prepares a path to connect battery to leads RCTA and RCTB to signal the marker for establishing a trunk class call connection.
- (d) Opens the paths to the marker via leads JTA and JTR that are used to signal the marker to establish a junctor class call connection.

2.44 Relay UD operated locks under control of relay ON, and operates relay DC. Relay UD4 operated, grounds its associated lead U4 toward the marker, and prepares paths used to signal the marker to function and seize an idle central office trunk.

2.45 Relay DC operated:

- (a) Releases relay PU (if operated).
- (b) Releases relay SW (if relay PU is not operated).
- (c) Stops PS & PD timing.
- (d) Grounds lead DC(1,3) toward the marker.
- (e) Connects battery to leads RCTA, RCTB and DC(2,4) toward the marker.

2.46 The marker functions to complete the call to a central office trunk and releases the register.

2.47 Option T provides two digit access to code 9 trunks. With option T, relay TD9 operates relay TR in place of relay OTA. Relay TR locks operated under control of relay ON, and prepares a path to signal the marker to establish a trunk class call connection in place of a junctor class call connection. The units digit is counted and registered; and the register functions to complete to the marker. The marker functions to complete the call to a central office or ringdown tie trunk, and releases the register.

J. Attendant Trunk Dialed (SC23)

2.48 When the attendant trunk code 0 is dialed, the slow release of relay RA at the end of the tenth dial pulse operates relays TDO and SW. Relay TDO operated, operates relay TR.

2.49 Relay TR operated:

- (a) Locks operated under control of relay ON.
- (b) Extends ground over lead TO toward the marker.
- (c) Operates relay OT.
- (d) Prepares operating paths for relays UD5 and UD9.

2.50 Relay OT operated:

- (a) Locks under control of relay ON.
- (b) Operates relays UD5 and UD9.
- (c) Operates relay UD.
- (d) Releases relay SW (if relay PU is not operated).

2.51 Relays UD5 and UD9 operated, extend ground over their associated leads U5 and U9 toward the marker, and operate relay SW. Relay UD operated, operates relay DC. Relay DC operated functions as described in section 2.33 to complete to the marker.

2.52 The marker functions to complete the call to an attendant trunk (as a service appearance), and releases the register.

K. Central Office or Ringdown Tie Trunk Class of Service (SC12, SC13)

2.53 Option J provides for nonrestricted incoming central office trunk calls or incoming ringdown tie trunk calls. With this option, incoming call can be

completed to central office trunks on a toll allowed basis and to ringdown tie trunks. Incoming calls from central office trunks or ringdown tie trunks can also be completed to code 8 trunks. The marker operates relay COT when establishing a dial tone connection to the central office or ringdown tie trunk. Relay COT operates relay TLA. Relay TLA operates relay TLD. Relays TLA and TLD operated provide the above class of service.

2.54 When option J is not provided, central office trunks and ringdown tie trunks are restricted in regard to the completion of incoming calls by the attendant. Code 9 calls are routed to intercept. Code 8 calls are completed if option X is provided, or routed to intercept if option Y is provided. The register functions as previously described for restricted and non-restricted stations.

2.55 Option YP prevents the transient current generated by the battery and ground reversal signal sent via lead T and R to the central office trunk circuit from causing an error in the units digit stored in the register when the attendant extends in incoming central office call to a PEK station.

L. Tens and Units Digit Register (SC1)

2.56 Register relay units TD and UD consist of five dry reed relays each enclosed in a sealed container. Each relay consists of an operating coil surrounding two dry reed switches. One of these switches performs the function of holding the relay operated and the other acts as a load contact. One side of each coil is wired internally to one side of its respective holding contact. The load contact pair, one side of the holding contact, and the winding pairs are all brought out on individual terminals which have appearances on both front and back sides of the container. For ease of wiring, three sets of these terminals are strapped internally.

M. Preliminary Pulses

2.57 Since the number 1 is not assigned as a tens digit and since means for eliminating single pulses due to accidental momentary line opens must be provided, the pulsing circuit is designed to refuse registration of the tens digit 1. Relay P2A accomplishes this task by keeping the information ground path for relay TD open until it operates, and by not providing the locking ground path for relays P1 and P2 when relay RA restores to normal. Relay P2A remaining inoperative also maintains the dial tone output to the calling line.

3. DIRECT STATION SELECTION**A. Attendant Direct Station Selection**
ISC27

3.01 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.

3.02 The attendants direct station selection keys are located at the attendants console. A maximum of two consoles may be provided, but at any time only one may be in use. Relays POS1 and POS2 prevent interference if the direct station selection keys at the console not in use are operated. The cordless position circuit operates only relay POS1 or POS2 corresponding to the console in use.

3.03 When the attendant depresses a direct station selection key, ground is connected to lead H1. Relay POS1 or POS2 operated completes a path between leads H1 and HA to signal the cordless position circuit that the attendant has operated a direct station selection key. Ground on lead HA results in the same function as when the hold key at the attendants console is momentarily operated to initiate a request for a dial tone connection to a central office or ringdown tie trunk.

3.04 Marker relay TRCO or TRC1 operates when an attendant trunk, ringdown tie trunk, long distance trunk, or central office trunk initiates a request for dial tone. The marker register allotter relays RAO- or RAL- determine the register to be used for the dial tone connection, operate relay COT, and possibly operate relays TLA & TLD. Marker relays RG(A,B) operate when the marker functions to establish the dial tone connection, and with relay TRC- and RA-- prepares a path to operate relay AC in the register the marker selects. The marker completes the connection through a link and relay L operates over the path completed by leads T and R. Relay L operated, operates relay SR.

3.05 Relay SR operated:

- (a) Operates relays ON and AC-.
- (b) Removes ground from lead RHM toward the make busy and busy display circuit.
- (c) Extends ground over lead RHM toward the marker.
- (d) Connects resistance ground (resistor S) to lead S toward the marker.
- (e) Lights the all registers lamp at the attendants console via lead ARB (if the other register is in use).

3.06 Relay ON operated:

- (a) Prepares operate and holding paths for relays PU, UD, TD-, UD-, DC, RRLA, and RRLB.
- (b) Opens the operate path of the register allotter relays in the marker by removing battery and ground from leads ONB and ONG, respectively.
- (c) Starts PS & PD timing.

3.07 Relay AC- operated:

- (a) Operates relay UD via lead HA1.
- (b) Operates one of the TD2 to TD8 relays.
- (c) Operates one of the UDO to UD9 relays.

3.08 Relay UD operated:

- (a) Locks under control of relay ON.
- (b) Operates relay DC.

3.09 Relay TD- and UD- operate and ground their associated leads T- and U- to the marker.

3.10 Relay DC operated:

- (a) Locks operated under control of relays RRLA and RRLB.
- (b) Holds relay L operated over its tertiary winding.
- (c) Connects battery to leads RCTA, RCTB and DC(2,4) toward the marker.
- (d) Grounds lead DC(1,3) to the marker.
- (e) Releases relay AC-.

3.11 **NOTE:** Relays operated: COT, ON, SR, DC, UD, POS-, L, TD- and UD-; and possibly TLA and TLD.

3.12 The marker functions to connect the trunk to the called party and releases the register.

3.13 When the attendant originates a call via an attendant trunk or uses an attendant trunk for busy verification, the action is as described above except that relay AC- is operated when the attendant depresses a direct station selection key. Relay AC- operates at the time the attendant seizes the trunk and the dial tone connection is automatically established.

**B. Station Direct Station Selection -
Option 28**

3.14 Station direct station selection feature requires that the auxiliary relay circuit for direct station selection from stations be provided. A station arranged to select other stations by direct station selection obtains a dial tone connection in the normal manner.

3.15 A DSS key is operated and the auxiliary relay circuit function to connect ground to one of leads T0 to T9, one of leads U0 to U9, and completes a path between leads UD1 and UD2.

3.16 The tens digit is registered by operating a TD- relay and the units digit by operating a UD- relay.

3.17 Relay UD operates from ground supplied by relay ON over the path completed by leads UD1 and UD2. Relay UD operates relay DC, and the register functions to complete to the marker.

4. SINGLE DIGIT DIALING

**A. Single Digit Dialing for Stations -
SC28 (MD), SC31**

App. Figs. 10, 11 & 12

4.01 The register may be arranged so that stations 20, 30, 40, 50, 60 and 70 may be called by dialing only the tens digit. Dialing the normal tens digit results in operating relay SW, and the corresponding TD- relay as previously described.

4.02 Relay TD- operated:

- (a) Locks operated under control of relays RRLA and RRLB.
- (b) Grounds its associated lead T- to the marker.

4.03 Relay SW operated:

- (a) Locks under control of relays ON and PU (if operated).
- (b) Releases relay(s) P-.
- (c) Operates relay STR.
- (d) Starts the timer.

4.04 After a delayed time, the timer extends ground over lead SD-, operating relay SD.

4.05 Relay SD operated:

- (a) Locks under control of relay ON.
- (b) Operates relay UDO.

(c) Operates relay UD.

4.06 Relay UDO operated, locks under control of relay ON, and extends ground over lead U0 toward the marker. Relay UD operated, locks under control of relay ON, and operates relay DC.

4.07 Relay DC operated:

- (a) Holds relay L operated over its tertiary winding.
- (b) Connects battery to leads RCTA, RCTB and DC(2,4) toward the marker.
- (c) Grounds lead DC(1,3) to the marker.
- (d) Releases relay PU (if operated).
- (e) Releases relay SW (if PU is not operated).
- (f) Stops PS & PD timing (if SW is operated).

4.08 NOTE: Relays operated: L, SR, ON, PZA, TD-, SW, STR, SD, UD, UDO and DC; and possibly TLA and TLD.

4.09 The marker functions to complete the call and releases the register.

APP. FIG. 5 & ZC OPTION (MD)

4.10 The register may be arranged so that stations 20, 30, 40, 50, 60 and 70 may be called by dialing only the tens digit. Dialing the normal tens digit results in the corresponding TD- relay operating as previously described. Relay TD- locks operated and connects ground via isolating diode SD- to relay SD. Relay SD does not operate since transistor T is not conducting.

4.11 Transistor T is a PNP transistor that requires a current of a specific amount in the base for turn on. Transistor T is off since Zener diode Z is prevented from conducting due to the negative bias supplied by resistor RB and relay STR normal. Negative battery supplied through resistor RB holds capacitor C charged to full battery voltage.

4.12 The release of relay RA at the end of the tens digit causes the register to function to operate relay STR. Relay STR removes negative battery from resistor RB. The voltage across capacitor C decreases as the capacitor discharges through resistor RE and potentiometer R. Zener diode Z starts to conduct when the difference between battery voltage and capacitor voltage exceeds the breakdown voltage of the zener diode.

4.13 The base potential starts to rise. Resistor RC drains off a fixed amount of current and thereby sets the minimum amount of current required to turn on

transistor T over the range of base turn on currents encountered in this type of transistor. The base becomes forward-biased turning on transistor T which operates relay SD.

4.14 The difference in time between the operation of relay STR and the operation of relay SD may be adjusted to 3 seconds using potentiometer R. Capacitor C remains charged to full battery voltage during the idle state so that it will remain properly formed. Resistor RF limits the current through diode Z and transistor T to a safe value when battery is applied to the single digit dialing timing and control circuit.

4.15 Relay SD operates relay UDO and relay UD. Relay UD operates relay DC, and the register functions to complete to the marker. Relay DC reconnects battery to resistor RB. Relay SD remains operated since the battery is insufficient to cause transistor T to cease conducting. Relay SD remains operated until relay TD releases removing the operating ground. The early make-break relay contacts in series with the winding of relay SD are for test purposes.

B. Single Digit Dialing 8 for Long Distance - Option ZK

4.16 Option ZK provides access to the long distance operator by dialing the single digit 8. Relay TD8 operated connects ground to the timer (App. Fig. 10 & 11 used) or, connects ground to relay SD (App. Fig. 5 used). After a delayed time relay SD operates in the same manner as occurs for single digit dialing for stations.

4.17 Relay SD operates:

- (a) Operates relay OT.
- (b) Connects ground to the marker via lead T9.
- (c) Removes the ground that had been applied to the marker via lead T8.
- (d) Operates relay UDO.
- (e) Prevents the operation of other UD-relays by opening the operate paths provided when relay OT operates.
- (f) Extends the LD leads from central office trunks 8 and 9 to the marker.
- (g) With option XT, extends the LD leads from central office trunks 6 and 7 to the marker.
- (h) Operates relay UD.

4.18 Relay UD operates relay DC, and the register functions to complete to

the marker. The marker establishes a connection to one of the trunks in the group 6, 7, 8 and 9. Trunks 6, 7, 8 and 9 are connected to a toll subscriber line circuit. They are removed from the regular hunting arrangement used for one or two digit code 9 dialing and are placed in their own hunting group. The trunks are arranged so that the only access to them is by dialing 8.

5. OPERATION WITH "TOUCH-TONE" CALLING RECEIVING CIRCUIT (SC 29)

A. Type A3 Receiver

5.01 Options YJ and YL provide a TOUCH-TONE calling translation circuit to arrange the register for use with a type A3 TOUCH-TONE calling receiving circuit.

5.02 The station or attendant obtains dial tone in the usual manner when making a TOUCH-TONE call. To place the call, the pushbuttons are depressed in a sequence corresponding to the digits of the called number. Depressing the button causes a two frequency tone to be generated within the station set or attendants console.

5.03 The receiving circuit responds to the TOUCH-TONE signals by operating relay STR1 and delivers output signals via the digital leads, one lead for each of the signaling frequencies. The output signals one of the relays in the L1 to L4 relay group and one of the relays in the H1 to H3 relay group.

5.04 Relays L- and H- operated complete a path to operate one of the ten TD- relays. Relay TD- locks operated and connects ground to the corresponding T-lead to provide the marker with tens digit information.

5.05 Relay STR1 operates relay KRA. Relay KRA operates relay P2A. Relay P2A locks operated under control of relay ON, opens the path supplying dial tone, and prepares the operate path for relay SW.

5.06 Releasing the pushbutton causes the receiving circuit to release relays STR1, L-, and H-. Relay STR1 releases relay KRA. Relay KRA releasing operates relay SW. Relay SW operates relay STR. Relay STR locks under control of relay ON, prepares an operate path for relay UD, and prepares the operate paths of the ten UD- relays.

5.07 Depressing the pushbutton corresponding to the second digit of the called stations code causes the receiving circuit to again operate relay STR1 and one relay in both the L1 to L4 relay group and the H1 to H3 relay group. Relays L- and H- complete a path to operate one of the ten

UD- relays. Relay UD- locks operated and connects ground to the corresponding U-lead to provide the marker with units digit information.

5.08 Relay STR1 operates relay KRA. Relay KRA operates relay UD and opens the operate path for relay DC. Relay UD locks under control of relay ON and prepares the operate path for relay DC.

5.09 Releasing the pushbutton causes the receiving circuit to release relays STR1, L-, and H-. Relay STR1 releases relay KRA. Relay KRA releasing operates relay DC. The register functions to complete to the marker.

B. Type C1 Receiver

5.10 Option 9 provides a connector to arrange the register for use with a type C1 TOUCH-TONE calling receiving circuit.

5. Register circuit action is the same as described for operation with a type A3 receiver except that relay KRA, relay TD-, and relay UD are operated directly from the type C1 receiver.

6. REGISTER COMPLETES TO THE MARKER

A. Dial Completion

6.01 Relay DC operates indicating that the register is ready to transmit its stored information to the marker.

6.02 Relay DC operated:

- (a) Locks under control of relay RRLA, RRLB and BY normal, and relay ON operated.
- (b) Holds relay L operated through its tertiary winding.
- (c) Connects battery and ground to leads DC(2,4) and DC(1,3), respectively to signal the marker that the register is requesting service.
- (d) Connects battery via leads JT(A,B) or RCT(A,B) to signal the marker that a junctor should or should not be used by the marker in terminating the call.
- (e) Connects resistor H across leads T and R. This is required by the junctor in the establishment of junctor class calls.
- (f) Releases relay AC- (if operated).
- (g) Releases relay SW (if relay PU is not operated) or, releases relay PU which in turn releases relay SW. This prepares the register for dial completion time-out.

(h) Prevents operating relay OT and connecting ground to marker lead TO should dial completion time-out occur.

(i) Prepares to operate relays RRLA and RRLB should dial completion occur.

(j) Completes a path between leads RT and RT1 to the alarm, transfer and test circuit.

B. Transfer of Registered Digits and Class Information

6.03 Relay DC operated signals the marker that the register is requesting service. The marker when ready to function with the register connects to the register information leads. The marker accepts the digit information and functions to terminate the call.

6.04 A junctor class of call exists when the call is from a station to a station or from a code 8 tie trunk to a station. This is indicated to the marker by a battery signal on leads JT- when relays COT, OT, TR, and TMO are normal.

6.05 A trunk class of call exists for all other types of calls. This is indicated to the marker by a battery signal on leads RCT when relays COT, OT, and TR are operated alone or in combination.

6.06 Relay COT is operated when the call originates in a central office trunk or ringdown tie trunk.

6.07 Relay COT operated:

- (a) Locks under control of relay ON.
- (b) Operates relay TLA, when option J is provided, to store in the register the information central office trunks and ringdown tie trunks are not restricted.
- (c) Signals the marker that a trunk class of call exists.
- (d) Prepares a path to operate marker relays COT- via leads CT-.
- (e) Prepares an operating path for relay RV.
- (f) Prepares an operating path for relay TT.
- (g) Completes a path between marker leads PCG and CPC to operate originating peg count traffic registers.
- (h) Prevents relay DC from connecting resistor H across leads T and R.

6.08 The marker operates relay RV when it is processing the call stored in the register. Relay RV operated connects bat-

tery through resistor T to lead T and ground through transformer TN to lead R. This battery and ground reversal on leads R and T is a signal to the trunk that the marker is engaged in terminating the call that the trunk originated.

6.09 Battery is supplied through resistor T in place of the winding of relay L to insure that transient currents generated by the reversal will not release and reoperate relay L causing an error in the digit stored.

6.10 When a central office trunk or ring-down tie trunk dials a trunk code, relay TR operates relay TT.

6.11 Relay TT operated:

- (a) Locks under control of relay ON.
- (b) Signals the marker via leads TR- to cause the marker to operate the pad control relays in the originating ring-down tie trunk, the terminating ringdown tie trunk, or in both ringdown tie trunks.
- (c) Signals the marker via leads TR- to cause the marker to extend the signal to the originating central office trunk or the originating ringdown tie trunk.
- (d) Completes a path between marker leads PCG and TPC to operate originating peg count traffic registers.

6.12 Incoming calls originating in code 8 tie trunks cause the marker to operate relay TT.

C. Register Returns Busy Tone To Calling Line (SC 20)

6.13 When a calling station or dial repeating tie trunk dials a busy line, the marker routes the call to the busy tone trunk to supply busy tone to the calling line. If the busy tone trunk is engaged when the marker finds the called line busy, the marker signals the register to return busy tone to the calling line by operating relay BY.

6.14 Relay BY operated:

- (a) Locks under control of relay ON.
- (b) Supplies busy tone to the calling station or trunk through transformer TN.
- (c) Releases relay DC which places relay L under control of the calling line.
- (d) Opens the marker leads RR- to prevent releasing the register when the marker releases.

(e) Prepares operating paths for relays RRL- to allow the register to release if time-out occurs.

(f) Opens marker lead DC1 or DC3 to prevent the register from seizing the marker if time-out occurs.

6.15 The register releases when the calling station disconnects or when time-out occurs, whichever occurs first.

7. RELEASE OF REGISTER

A. Abandoned Call (SC 2)

7.01 Relay L releases when the calling line disconnects before relay DC operates. Relay L slow- releases relay SR.

7.02 Relay SR released:

- (a) Releases relay ON.
- (b) Removes the 100 ohm ground from lead S, releasing the calling line hold magnet or causing the originating circuit to release.
- (c) Removes ground from marker lead RHM, releasing both register hold magnets in the marker.
- (d) Extinguishes the all registers busy lamp at the attendants console if the other register is in use.
- (e) Releases relay AC- if the call was originated by the attendant.
- (f) Opens the operate path for relay Pl.

7.03 Relay ON released restores the register to normal, removes dial tone, and provides a signal via leads ONG and ONB that is used by the marker as it allocates calls to the two registers.

B. Normal Release

7.04 The marker operates relays RRLA and RRLB when it has completed its function of terminating the call.

7.05 Relay RRLA or RRLB operated:

- (a) Locks under control of relay ON and the marker.
- (b) Releases relays DC, TD-, and UD-.
- (c) Opens the relay L operate path over leads T and R.

7.06 Relay DC releases relay L. Relay L releases relay SR. Relay SR releases relay ON and both register hold magnets in the marker. Relay ON released restores the register to normal and sends a signal that is used by the marker as it allocates calls to the two registers.

7.07 Relays RRLA and RRLB release when both relay ON and the crosspoints in the marker release.

C. Time-Out Release

7.08 The marker operates relays RRLA and RRLB when it completes its function of terminating the call to an attendant trunk after register permanent signal or partial dial time-out occurs. Relays RRLA and RRLB lock under control of relay ON and the marker, release relay TMO, and release relay L. Further register action is as described under normal release.

7.09 Relay TMO operates if the marker after being seized by the register completes its functions and fails to release the register or if the register is supplying busy tone to the calling line and the calling line does not disconnect. Relay TMO operates RRLA and RRLB. Further register action is as described under normal release.

8. REGISTER TIME-OUT (SC 10, SC 11, SC 24, SC 25)

A. General

8.01 To be sure that the register will not be permanently engaged by a receiver off-hook or by incomplete dialing, a timing circuit operates on every register seizure to insure that suitable terminating action occurs to release it within a nominal period of time. This timing circuit consists of relays PU and TMO, which operate from timed pulses originating in the power plant.

8.02 The power plant furnishes two timing pulses, TM and PU, which are of 1/4 second duration and are separated in time by approximately 1/5 second, each of which has cyclic rate of one pulse every 8 seconds. Sequence Chart SC-25 diagrams this grounded timing pulse action.

8.03 Because of the pulse stagger, two timing extremes are possible. The first condition, for minimum time-out, occurs when the PU pulse coincides with the seizure of the register. The PU pulse duration is long enough for the slow operate relay PU to function. Relay PU prepares the operate path for relay TMO. Eight seconds later, the TM pulse occurs, operating relay TMO.

8.04 The second condition, for maximum time-out, occurs when the tail end of the PU pulse is just passing as the register is seized. Under these conditions, the register has to wait approximately 7.5 seconds before the next PU pulse arrives. When the PU pulse does arrive, relay PU operates preparing the operate path for relay TMO. Eight seconds later the TM pulse occurs, operating relay TMO. The time-out extremes are approximately 8.0 and 15.5 seconds.

B. Permanent Signal Time-Out

8.05 Relay ON operates when the register is seized and prepares the operate path for relay PU. The ground pulse over lead PU operates relay PU. Relay PU locks under control of relay ON and prepares the operate path for relay TMO. The ground pulse over lead TM operates relay TMO.

8.06 Relay TMO operated:

- (a) Locks under control of relay ON.
- (b) Operates relay OT and connects ground to the marker via lead TC.
- (c) Operates relay UDL.
- (d) Prevents relay UD from operating when relay OT operates.
- (e) Connects resistor H across leads T and R to insure the operation of attendant trunk relay A.
- (f) Signals the marker via leads DC- that the register is requesting service.

8.07 The marker routes the call to the attendant as an intercept call.

C. Partial Dial Time-Out

8.08 The first dialed digit of a directing code is registered by the operation of a TD- relay. If the second digit is not dialed, relay TMO operates and functions as described for permanent signal time-out. Relay TMO also releases any operated TD- or UD- relays and opens the normal ground supply for the marker T- leads to insure the only leads grounded are leads TO and UO.

8.09 The marker routes the call to the attendant as an intercept call.

D. Time-Out After Dial Completion

8.10 If the marker fails to release the register after being called to complete a call, or if the calling line does not disconnect when receiving busy tone from the register, the register times itself out and releases.

8.11 If relay PU is operated at the end of the last digit dialed, relay SW is locked operated under control of relay PU. Relay DC operates to call in the marker. Relay DC releases relay PU. Relay PU releases relay SW. Relay SW prepares the operate path for relay PU, thus starting another complete timing cycle for the PU and TMO relay combination.

8.12 The ground pulse on lead PU operates relay PU. Relay PU locks under control of relay ON and prepares the operate

path for relay TMO. The ground pulse over lead TM operates relay TMO. Relay TMO operates relays RRLA and RRLB. Relays RRLA and RRLB cause the register to restore to normal.

9. REGISTER TESTING

9.01 The number 310 plug of the test cord is inserted into jack TST when the register is to be tested. The action operates relay RT, opens the tip and ring towards the marker, and closes the tip and ring toward the register through to the test cord.

9.02 Relay RT operated:

- (a) Prevents marker hold magnets THM-8 and THM-9 from operating.
- (b) Prevents relay DC from holding relay L operated.
- (c) Prepares a path to light the ARB lamp at the attendant position when the other register is in use.
- (d) Lights lamp RT.
- (e) Lights lamps TR in the cordless position circuit and alarm circuit to indicate that there is an off normal condition in the PEX.
- (f) Prevents marker seizure by opening the ground to lead DC1 or DC3.
- (g) Makes the register busy to the marker by opening lead ONG ground.

9.03 Caution: When testing the 293A (TD- or UD-) relays, avoid the use of any testing equipment which might permit currents over 0.5 ampere to pass through

the reeds. Do not use headsets with low resistance receivers, such as the 56-ohm 528 receiver or the 1011G hand set, unless a 1000-ohm resistor is put in series with the unit. Such a resistor has been made available in SD-66796-01, the alarm, transfer, and test circuit, as the RB resistor (terminal HRB) located on slide 6 of the PBX. When using a lamp as the testing device, take particular care that tungsten filament lamps are not used.

10. FUNCTION OF MAKE BUSY AND BUSY DISPLAY CIRCUIT

A. Register key Normal

10.01 With the register key (REG- key) normal in the make busy and busy display circuit, the register busy lamp (REG- lamp) will light when the marker operates relay SR in the dial pulse register circuit. This indicates that the register has been made busy by the marker through normal operations.

B. Register Made Busy

10.02 If it is desired to make a register busy to the marker, key REG- in the make busy and busy display circuit is operated. Key REG- operated, operates register relay RT. Relay RT operated makes the register busy to the marker by removing ground from leads ONG and RHM in the register circuit.

10.03 Removing the ground from lead RHM lights lamp REG- in the make busy and busy display circuit, indicating that the register has been made busy. Removing the ground from lead ONG prevents the operation of register allotter relays (RA-) in the marker circuit thereby preventing the use of the register by the marker.

SECTION III - REFERENCE DATA1. WORKING LIMITS

1.01 Maximum External Loop Resistance - 2000 ohms.

1.02 Voltage Limits

<u>Voltage</u>	<u>Minimum</u>	<u>Maximum</u>
-48	-45	-52

2. FUNCTIONAL DESIGNATIONS

2.01 Relays

<u>Designation</u>	<u>Meaning</u>
AC(0,1)	Attendant Connector
BY	Busy
COT	Central Office Terminating
DC	Dial Completion
H1-H3	High Tone
KFA	Register Advance
L	Line
L1-L4	Low Tone
ON	Off-Normal
OT	Only Tens
OTA	Only Tens Auxiliary
PI-P5	Pulse Counter
P2A	Pulse Counter Auxiliary
POS (1, 2)	Position
PU	Pick Up
RA	Register Advance
RRL (A,B)	Register Release
RT	Register Test
RV	Reversing
SD	Single Digit
SR	Supervisory
STR	Steering
STR1	Translator Steering
SW	Switching
TD (0-9)	Tens Digit Register
TLA	Toll Allowed
TLD	Toll Denied
TMO	Time-Out
TR	Two-Digit Trunk
TT	Trunk Terminating
UD	Units Digit
UD (0-9)	Units Digit Register

3. FUNCTIONS

3.01 Make itself busy either with the register engaged on a service call, or with the register under test, by means of a plug in the test jack.

3.02 Time and then generate a units digit 0 when single digit dialing is received.

3.03 Hold the register work and memory hold magnets in the marker under control of a slow release supervisory relay when the marker releases.

3.04 Register originating class of service and/or class of call when seized by the marker. This data may be retrans-

mitted to the marker on completion of the call for terminating circuit usage.

3.05 Transmit dial tone to the calling line when the register has been connected to the line and is ready to receive dial pulses.

3.06 Disconnect dial tone after the second pulse of the tens digit has been received.

3.07 Count the number of pulses in each digit.

3.08 Register the units digit count on a group of 10 tens register relays on a 1 out of 10 basis.

3.09 Register the units digit count on a group of 10 units register relays on a 1 out of 10 basis.

3.10 Recognize that only one digit is to be received on calls to the attendant.

3.11 Recognize that one or two digits are to be received on calls to a central office or ringdown tie trunk depending upon the option provided.

3.12 Engage the marker after the units digit has been dialed or after a single digit central office or attendant code has been dialed.

3.13 Hold the register after dial completion so that the calling subscriber cannot release the connection while the marker is engaged.

3.14 Transfer the class of call and class of service indication to the marker.

3.15 Reverse battery and ground to the link connection upon receiving a signal from the marker on a call to be terminated from a central office or ringdown tie trunk.

3.16 Release when the marker grounds the RR- leads and return to normal.

3.17 Measure time, 8 seconds nominal, while waiting for the two digits to be dialed. If the digits are not dialed, or are only partially dialed, when the register times out, the line is connected to intercept.

3.18 Measure the time between dial completion and release of the register, 8 seconds nominal. If the register does not release in this time due to release ground signals from the marker, the register releases itself and is reallocated for subsequent usage.

3.19 Route unequipped number codes to intercept.

- 3.20 Supply busy tone to the calling line when the busy tone trunk is engaged.
- 3.21 Operate a traffic register to record the originating trunk traffic.
- 3.22 Translate a single digit 8 into 90 when long distance dialing is required.
- 3.23 To provide for a busy indication to the make busy and busy display circuit.
- 3.24 To provide for being made busy by the make busy and busy display circuit.

4. CONNECTING CIRCUITS

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

- (a) Line, Link and Marker Circuit - SD-65741-01.
- (b) PBX Cabling Diagram - SD-65746-01.
- (c) Two-Way Trunk Circuit to Central Office - SD-65752-01.
- (d) Cordless Position Circuit - SD-65757-01.
- (e) Auxiliary Relay Circuit for Direct Station Selection by Stations - SD-65942-01.
- (f) Alarm, Transfer, and Test Circuit - SD-66796-01.
- (g) TOUCH-TONE Calling Receiving Circuit - Type C1 - SD-67027-01.
- (h) Power Supply Circuit - SD-81326-01.
- (i) Power Supply Circuit - SD-81600-01.
- (j) Signaling Circuit - Tone Generator for PBX TOUCH-TONE Calling - SD-81719-01.
- (k) TOUCH-TONE Calling Receiving Circuit-Type A2 - SD-95287-01.
- (l) TOUCH-TONE Calling Receiving Circuit-Type A3 - SD-98148-01.
- (m) Make Busy and Busy Display Circuit - SD-98029-01.
- (n) Relay Delay Timer Circuit - SD-99361-01.

5. MANUFACTURING TEST REQUIREMENTS

5.01 The dial pulse register shall be capable of performing all the service functions specified in this circuit

description and meeting all the requirements of the Circuit Requirements table and also shall be capable of functioning under test conditions listed below.

(a) The pulsing and counting functions of the register shall be checked with the following conditions: A precision pulse generating circuit such as SD-25680-0113 or equivalent capable of generating dial pulses within the limits of accuracy given in Fig. 1 in the Information Note 301 on the SD.

(b) Nominal circuit conditions may be employed in these tests except as specified in (d) and (e).

(c) The pulsing and counting features of the register circuit under test shall be checked using the pulsing and loop conditions covered in Note 301 on the drawing. Two digits, a digit of less than five pulses (preferably a 2 or 3) followed by a digit of more than five pulses (preferably a 9 or 0), shall be dialed under each condition and all digits dialed shall be correctly registered.

(d) The test circuit shall provide an interdigital interval of 183 ~~113~~ msec for the pulsing conditions of Fig. 1C. For other pulsing conditions this time may be exceeded.

(e) All timing and operation tests shall be performed with the test voltages within the limits of 45 to 52 volts.

6. TAKING EQUIPMENT OUT OF SERVICE

Register Circuit

6.01 When the make busy and busy display circuit is not provided, the register can be taken out of service by inserting a No. 258 plug in jack TST.

NOTE: Make sure that the register is not in use before inserting the No. 258 plug.

6.02 When the make busy and busy display circuit is provided, the register can be taken out of service by operating the register busy key (REG key) in the make busy and busy display circuit.

NOTE: Make sure that the register busy lamp (REG lamp) is not lit in the make busy and busy display circuit before operating key REG.

SECTION IV - REASONS FOR REISSUE**B. Changes in Apparatus****B.1 Added**

Diode L, 446F, option XO, App. Fig. 3
 Relay AC(0,1), AJ202, option XP, App. Fig. 4
 Relay SD, AJ83, App. Fig. 10
 Diode SD, 458A, App. Fig. 10
 Capacitors SDO & SD1, 535EA, App. Fig. 11
 Connector J2, 910A, App. Fig. 11
 Resistors SDO & SD1, 221A, App. Fig. 11
 Time Delay Unit T, ED-9555-(), App. Fig. 12
 Diodes ST-, 458A, App. Fig. 13
 Relay OTA, 1/2AK30, Option XW, App. Fig. 1

B.2 Removed

Relay AC, AJ202, option ZB, App. Fig. 2
 Relay SD, AJ83, App. Fig. 5
 Capacitor C, KS-14105, option YA, App. Fig. 5
 Capacitor T, KS-16742, L1, App. Fig. 5
 Diode SDA, 446F, option YW, App. Fig. 5
 Diode Z, 446N, Option YW, App. Fig. 5
 Potentiometer R, KS-13790, L30, App. Fig. 5
 Resistor RB, 146C, App. Fig. 5
 Resistors RC & RE, 145C, App. Fig. 5
 Resistor RF, KS-13490, L1, option YN, App. Fig. 5
 Transistor T, 27A, App. Fig. 6
 Diodes SD-, 446F, option YY, App. Fig. 7

B.3 Superseded**Superseded By**

Relay KRA AF16, Option ZB, App. Fig. 2	Relay KRA, AF20, Option XP, App. Fig. 2
Relay RT, AF63, Option XL, App. Fig. 2	Relay RT, 1/2AK7, Option XM, App. Fig. 2
Relay TLD, AF52, Option XL, App. Fig. 2	Relay TLD, 1/2AK7, Option XM, App. Fig. 2
Relay SW, AF114, Option XL, App. Fig. 3	Relay SW, 1/2AK6, Option XM, App. Fig. 3
Relay UD, AF57, Option XL, App. Fig. 3	Relay UD, 1/2AK6, Option XM, App. Fig. 3
Capacitor LW, 542G, Option XN, App. Fig. 1	Capacitor LW, 705G, Option XY App. Fig. 1

C. Changes in Circuit Requirements Other Than Those Caused by Changes in Apparatus

C.1 On sheet PB, Test Note 4 is added.

D. Description of Changes

D.1 Option XL is designated and rated Manufacture Discontinued. Option XM is added and rated Standard to show recoding of relays RT, TLD, SW & UD on a cost reduction basis.

D.2 Relay L tends to produce oscillating transients and split pulses when combined with 24V4 repeaters. Option KN is designated and rated Standard. Option XO is added and rated Standard. Option XO adds diode L (App. Fig. 3) in series with the primary (10-11) winding of relay L to prevent pulse splitting when the dial pulse register circuit is being used with 24V4 repeaters.

D.3 Option ZB is rated Manufacture Discontinued. Option XP is added and rated Standard to show recoding of relay KRA from AF16 to AF20. Option XP also transfers relay AC- from App. Fig. 2 to App. Fig. 4. This places all the attendant direct station selection relays in one App. Fig. instead of two App. Figs.

D.4 Option XQ is designated and rated Manufacture Discontinued. Option XR is added and rated Standard to prevent a buzzing condition of relay TR when the register circuit is strapped for two digit code 9 operation (option T provided). Option XR insures that the lock path of the TR relay on two digit code 9 operation is present before the operate path is removed.

D.5 Options XK, YA, YN, YW, YY, ZC, ZS, and App. Figs. 5, 6 & 7 are rated Manufacture Discontinued. Option XS, XT, and App. Figs. 10, 11, 12 & 13 are added and rated Standard. Option XU is added and rated Manufacture Discontinued. App. Fig. 10, 11 & 12 replace App. Fig. 5 & 6. App. Fig. 13 replaces App. Fig. 7.

Option XS is provided when only one of the tens group is arranged for single digit dialing. If more than one of tens group is arranged for single digit dialing, App. Fig. 13 must be provided. App. Fig. 13 adds ST- diodes (type 458A). Option XT provides single digit dialing for central office trunk units 6 & 7.

D.6 A misdirected call condition exists when the PEX is arranged for single digit 8 & 9. The call may be routed to the attendant on an intercept basis under an all-trunks-busy condition.

Option XV is designated and rated Manufacture Discontinued. Option XW is added and rated Standard. Option XX is designated and rated Standard. Option XW adds a new relay OTA(1/2AK30) and associated wiring to prevent the call from being routed to the attendant and is returned busy tone under an all-trunks-busy condition. Option XX must be specified where ZI

option has been provided. (Single digit code 8 not used or used for reaching station tie trunk or miscellaneous trunk).

D.7 The pigtail leads of capacitor LW(542G) tend to break during shipment of 756A PBX system. Vibrations occurring during shipment causes the mass of capacitor to bend the pigtail leads to the point of fatigue. Option ZN is rated Manufacture Discontinued. Option XY is added and rated Standard to recode capacitor LW from 542G to 705G, thus eliminating lead breakage during shipment of 756A PBX system.

D.8 On sheet D1, under Circuit Note 104, option XK is added under the Standard column to correct a drafting error.

D.9 On sheet D1, under Circuit Note 102, option XX is added.

D.10 On sheet D1, Circuit Note 106 is rated Manufacture Discontinued; and Circuit Notes 119, 120, 121 & 122 are added. On sheet D2, Information Notes 302 & 303 are rated Manufacture Discontinued; and 304 & 305 are added and rated Standard.

D.11 Sheet G1 is added to show CAD Fig. for Miscellaneous Terminal Strip.

D.12 Sheet G1 is added to show CAD 1 for App. Figs. 1, 2, 3 & 10.

D.13 Circuit Notes 101, 102 & 104; App. Figs; Sequence Charts; Circuit Requirements Table; Sheet Apparatus, Lead & Option Indices have been changed to reflect the added options.

BELL TELEPHONE LABORATORIES, INCORPORATED

(WECO 5120HW-SHA-RHP)
DEPT 5337-RVL

PBX SYSTEMS
NO. 756A
TRAFFIC REGISTER CIRCUIT
FOR INTERNAL TRAFFIC
AND TROUBLE REGISTERSCHANGESA. Changed and Added Functions

A.1 External traffic registers may be provided on an optional basis in a cabinet located near the PBX attendant. When used in conjunction with ten external traffic registers, the six internal registers may be used to record the same data or additional data or they may be temporarily removed from the circuit.

D. Description of Changes

- D.1 On sheet 1, the sheet index is changed to show revised FS headings.
- D.2 On sheet 1, Circuit Note 102 is corrected to indicate one App. Fig. 1 per PBX.
- D.3 On sheet 1, supporting information is added for external traffic registers.
- D.4 On sheet 1, the title of the circuit is changed to add sub-title "For Internal Traffic and Trouble Registers" to distinguish from external traffic and trouble registers.
- D.5 On sheet 2, titles of FS1 and FS2 are changed to differentiate traffic and trouble registers and cross-connections added along with explanatory sheet note 2.
- D.6 On sheet 2, App. Fig. 1 is corrected to indicate six message registers designated REG1-6 with sheet note 1 added to clarify use of internal and external traffic registers.

F. Changes in CD Sections

- F.1 Under GENERAL DESCRIPTION, SECTION I, paragraph 3.1, change first sentence to read: "A maximum of four internal and four external message registers may be connected as trouble peg count registers to record the number of times that troubles cause abnormal behavior of the marker."
- F.2 Under CONNECTING CIRCUITS, SECTION III, Part 4, add:
- 4.2 Traffic Register Circuit for External Traffic and Trouble Registers - SD-5E010-01.

BELL TELEPHONE LABORATORIES, INCORPORATED

(WECO 7760HW-RHB-JGW)
DEPT 5337-RAV

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PBX SYSTEMS
NO. 736A
TRAFFIC AND TROUBLE REGISTER CIRCUIT

SECTION I - GENERAL DESCRIPTION

1. TRAFFIC OVERFLOW REGISTERS

1.1 This circuit provides means to register the number of calls which overflow from an "all busy" condition on dial pulse registers, links, busy tone trunk, junctors and trunk codes 8, 9 and 0. An overflow register may be provided for each group of dial pulse registers, links, junctors and trunk. For example, when a call requires a junctor and all junctors are busy, the junctor overflow register JOF will be operated. The operation of these registers is controlled by the marker.

2. TRAFFIC PEG COUNT REGISTERS

2.1 Means are also provided by this circuit to register the number of calls handled by the junctors, the busy tone trunk and the 8, 9 and 0 trunk groups. The terminating peg count TPC8, TPC9 and TPC0 registers are operated each time a call is terminated from the PBX to the associated trunk group. The originating peg count OPC register is operated on each call originated by station lines on the PBX. The terminating peg count TPC- register is operated on each call terminated to the PBX from trunks. The operation of these registers is controlled by the marker except for the OPC8 and OPC9 registers which are controlled by the marker and the dial pulse register.

3. TROUBLE PEG COUNT REGISTERS

3.1 Four trouble peg count registers are provided to record the number of times that troubles cause abnormal behavior of the marker. These registers are: (1) marker second trial peg count register STPC, (2) marker no connection peg count register MCPC, (3) marker trouble release peg count register TRPC, and (4) marker time out peg count register TOPC. If a marker cannot complete a call on a first trial because of trouble, a second trial is automatically made. If the marker cannot complete the call on the second trial, it is automatically released from this call and allowed to proceed to other calls before returning to this call. After a call has been served and no other calls are waiting, the marker automatically checks its time-out circuits that control the second trials and trouble releasing. These circuits will again be checked following any call which is terminated to the Busy Tone Trunk and no

other calls are waiting. The TOPC register records the number of times that the marker checks these time-out circuits. Each of the trouble registers is advanced once each time that the marker checks its time-out circuits. Therefore, the number of second trials, no connections, and trouble releases experienced is determined by subtracting the reading of the TOPC register from each of the readings of the STPC, MCPC and TRPC registers. These registers are controlled by the marker.

SECTION II - DETAILED DESCRIPTION

1. OVERFLOW REGISTERS

1.1 Register Overflow

When a station line or a trunk originates a call and operates marker relays TR0, TR1, or T2, T3, T4, T5, T6 or T7 and all dial pulse registers are busy, ground is connected from the TR0 and TR80 relays, which operate from the TR- or T-relays, through contacts of the marker ARBA and ARBB relays to lead ROP. This ground operates register ROP.

1.2 Link Overflow

When a call requires a link and all links are busy, marker relays ALBA and ALBB operate. Ground from the ALB- relays is connected to the LOP lead and operates register LOP.

1.3 Busy Tone Overflow

When a call is routed to the busy tone trunk and the busy tone trunk is already busy, marker relays BYA and BYB will operate. Ground from contacts of the BY- relays through contacts of the marker BTCA and BTCB relays is connected to lead BTOP operating the BTOP register.

1.4 Junctor Overflow

When a call requires a junctor and all junctors are busy, the marker JYA and JYB relays operate. Ground from contacts of the JY- relays through contacts of the marker JTAA and JTBA relays is connected to lead JOF operating register JOF.

1.5 Trunk Group Overflow

When a call is directed to a trunk group and all trunks in that group are busy, marker relays BYA and BYB operate.

Ground from contacts of the BY- relays through contacts of marker relays TDB8, TKB9 or TKB0 is connected to lead OF8, OF9 or OF0 respectively. This ground operates register OF8, OF9 or OF0. If more than one trunk group is designated by tens digit 8, all overflows from all groups designated 8 will be recorded on register OF8.

2. PEG COUNT REGISTERS

2.1 Junctor Peg Count

When a call requires a junctor, the marker JTAA and JTBA relays operate. These relays connect ground to lead JPC to operate register JPC. This register records all calls for which a junctor is required including those which go to overflow.

2.2 Busy Tone Trunk Peg Count

When a call cannot be completed, it is routed to the busy tone trunk. Marker relays BTCA and BTCB operate and connect ground to lead BTPC operating register BTPC. This register records all calls which require busy tone including those overflow calls on which a dial pulse register must supply busy tone.

2.3 Trunk Terminating Peg Count

When a call is directed to a trunk by dialing 8, 9 or 0 marker relays TKB8, TKB9 or TKB0 operate. The operation of these relays connects ground to lead TPC8, TPC9 or TPC0. These registers record all calls directed to these trunk groups including those calls which go to overflow. If there is more than one trunk group having a tens digit 8, all calls directed to these trunk groups will be recorded on register TPC8.

2.4 Trunk Originating Peg Count

When a call in this PBX is originated by a trunk, marker relays RGAA, RGBA and RAOA or RALA operate when the trunk is connected to a dial pulse register. The dial pulse register class relay COT, or TT will operate depending on whether the call is from a central office trunk or a tie trunk. Ground is connected from relay RAOA or RALA, through contacts of the dial pulse register class relay and contacts of the RGAA and RGBA relays to lead OPC8 or OPC9, operating register OPC8 or OPC9. Calls originated by attendant trunks will not be registered. Register OPC8 will record all calls from all trunks designated by tens digit 8.

2.5 Total Originating Peg Count

When a station line originates a call one of marker relays TP2 to TP7 operates, grounding lead OPC. Ground on lead OPC operates register OPC.

2.6 Total Terminating Peg Count

When a trunk initiates a call to the PBX, one of marker relays TRP0 or TRP1 operates, grounding lead TPC. Ground on lead TPC operates register TPC.

3. TROUBLE PEG COUNT REGISTERS

3.1 Second Trial Peg Count

When the marker is unable to complete a call before its shortest timeout circuit functions, the marker advances to second trial and tries again. At the time the marker advances to second trial, marker relays STAR and STBR operate connecting ground to lead STPC operating register STPC.

3.2 No Connection Peg Count

If the marker is unable to complete a call on its second trial before its longer timeout circuit functions, the marker advances to a "no connection" condition and tries to complete the calling party to the busy tone trunk. At the time the marker advances to the "no connection" condition, marker relays NAA and NAB operate grounding lead NCPC to operate register NCPC.

3.3 Trouble Release Peg Count

If the marker is unable to complete a call to busy tone after it has advanced to "no connection", before its longest timeout circuit functions, the marker will release and try to serve another call. When the marker releases, marker relays TRA and TRB operate, grounding lead TRPC to operate register TRPC.

3.4 Timeout Peg Count

When the marker becomes idle and no calls are waiting to be served and the preceding call was routed to the Busy Tone Trunk, the timeout check circuit functions to check the marker advance, timeout and release circuit. When the timeout check circuit functions, marker relays TOLA and TOLB release and connect ground to lead TOPC to operate register TOPC. As the marker advance circuit functions, registers STPC, NCPC and TRPC will operate.

SECTION III - REFERENCE DATA

1. WORKING LIMITS

1.1 None

2. FUNCTIONAL DESIGNATIONS

BTOP - Busy Tone Trunk Overflow
BTPC - Busy Tone Trunk Peg Count
JOF - Junctor Overflow
JPC - Junctor Peg Count
LOF - Link Overflow

NCPC - No Connection Peg Count
 OFO - Trunk Group 0 Overflow
 OF8 - Trunk Group 8 Overflow
 OF9 - Trunk Group 9 Overflow
 OPC - Originating Peg Count
 OPC8 - Trunk Group 8 Originating
 Peg Count
 OPC9 - Trunk Group 9 Originating
 Peg Count
 ROF - Dial Pulse Register Overflow
 STPC - Second Trial Peg Count
 TOPC - Time Out Peg Count
 TPC - Terminating Peg Count
 TPCO - Trunk Group 0 Terminating
 Peg Count
 TPC8 - Trunk Group 8 Terminating
 Peg Count
 TPC9 - Trunk Group 9 Terminating
 Peg Count
 TRPC - Trouble Release Peg Count

3. FUNCTIONS

- 3.01 To record overflows on registers.
- 3.02 To record overflows on links.
- 3.03 To record overflows on the busy tone trunk.
- 3.04 To record overflows on junctors.
- 3.05 To record overflows on trunk groups.
- 3.06 To record peg counts on junctors.
- 3.07 To record peg counts on the busy tone trunk.
- 3.08 To record originating peg counts on trunk group 8 and 9.

- 3.09 To record terminating peg counts on trunk groups 0, 8 and 9.
- 3.10 To record originating peg counts from station lines.
- 3.11 To record terminating peg counts from trunks.
- 3.12 To record marker second trials, no connections and trouble releases.
- 3.13 To record marker timeout checks.

4. CONNECTING CIRCUITS

When this circuit is listed on a keysheet the information thereon is to be followed.

- 4.1 Line, Link and Marker Circuit - SD-65741-01.

5. MANUFACTURING TEST REQUIREMENTS

- 5.1 The traffic register circuit shall be capable of meeting all the requirements of the Circuit Requirements Table.

6. TAKING EQUIPMENT OUT OF SERVICE

- 6.1 Any register in this circuit may be removed from service by disconnecting its associated strap on the unit terminal strip.

7. ALARM INFORMATION

- 7.1 There are no alarms associated with or actuated by this circuit.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT. 2714-RDW-RCD-C4

CIRCUIT DESCRIPTION

CD-65745-01
ISSUE 5AC
APPENDIX 1D
DWG ISSUE 6D

3

PBX SYSTEMS
NO. 756A
DIAL CONFERENCE CIRCUIT
ARRANGED FOR A
MAXIMUM OF 5
SIMULTANEOUS CONNECTIONS

CHANGES

D. Description of Changes

D.1 Contacts 4 and 5 of relay RVD and
contacts 8 and 9 of relay RVE are
redesignated EMB to correct an error
in the drawing.

D.2 The circuit is rerated A&M Only.

F. Changes in CD Section

F.1 None.

BELL TELEPHONE LABORATORIES, INCORPORATED

(WECO 2120HW-RRS-WHK)
DEPT 5337-LAH

2

PEX SYSTEMS
NO. 756A
DIAL CONFERENCE CIRCUIT
ARRANGED FOR A
MAXIMUM OF 5
SIMULTANEOUS CONNECTIONS

SECTION I - GENERAL DESCRIPTION

1. GENERAL METHOD OF OPERATION

This circuit provides a means for connecting three stations and two trunks, four stations and one trunk or five stations together in a conference connection. This circuit may be reached from any station or tie trunk assigned to a station line circuit by dialing the conference circuit station code. A central office trunk or tie trunk which is incoming only to the attendant may be connected to this circuit by the attendant dialing the conference circuit trunk code. In response to the dialed number, the dial pulse register and the marker circuit function to connect each station and trunk to a different appearance of the conference circuit. As each calling party is connected to this circuit, a talking path is established to all others already connected.

A conference circuit may be connected in the PEX to terminal groups 80-84 or 85-89. Terminals 80, 81 and 82 or 85, 86, and 87 are for stations only. Terminals 83 and 84 or 88 and 89 are for trunks or stations. To reach this circuit a station only has to dial 80 or 85 and the attendant dials 83 or 88 for trunk connections. If more than three stations dial 80 or 85, the fourth and fifth stations will be connected to the trunk appearances of the conference circuit and all others will receive busy tone. If the attendant connects more than two trunks by dialing 83 or 88, only two trunks will be connected and the others will receive busy tone. If the attendant connects a trunk by dialing a station code 80 or 85 instead of the trunk code 83 or 88, the trunk will be connected to a station appearance and the most favorable transmission will not be obtained. The transmission circuits for station lines are in series and those for trunks are in parallel to equalize the transmission. As each station or trunk disconnects, it will be released from the conference circuit.

SECTION II - DETAILED DESCRIPTION

1. STATION LINE TO CONFERENCE CIRCUIT

When a station line desires to be connected to the conference circuit, the user dials 80 or 85 depending on which code is assigned to the conference circuit. The

dial pulse register recognizes the dialed code as a tie trunk code and signals the marker to connect the station line to the appropriate trunk. The marker circuit tests the terminals of the conference circuit and connects the station to terminal 80, 81, 82, 83, or 84 or to terminal 85, 86, 87, 88, or 89 in that order of preference. If terminal 80 is busy the connection will be made to 81 and so on. (Hunting feature FS2.)

When the marker operates the hold magnet associated with the conference circuit terminal, the station loop is closed to relay A, B, C, D, or E. Relays A, B, and C are arranged to operate reversing relay RV thus reverse the battery and ground on trunk terminals 83, 84, 88, or 89, which provides reverse battery supervision to connected trunks.

If "W" option is provided, operation of reverse relays RVD and RVE is delayed until corresponding D and E relays operate over the closed loop of the connecting trunk.

When any of relays A, B, C, D, or E are operated, ground is closed to the sleeve lead to hold the connection and the shunt is removed from across the talking path. All connected stations or trunks, talk together through coils A, B, and C. Relays A, B, C, D, and E supply talking battery to the calling circuits.

2. TRUNK TO CONFERENCE CIRCUIT

When a trunk is to be connected to the conference circuit, the attendant dials 83 or 88 depending on which code is assigned to the conference circuit. The dial pulse register and marker operate as in 1. to connect the trunk to the conference circuit. The marker strapping (FS2) allows a call directed to terminal 83 to be connected to either 83 or 84, but not to 80, 81, or 82. Likewise a call directed to terminal 88 may be connected to either 88 or 89, but not to terminals 85, 86, or 87. Varistors DCA and DCB block the current flow so that when either relay U3 or U4 is energized, relays U0, U1, and U2 cannot operate. The same thing is true of relays U5, U6, U7, U8, and U9.

When the marker operates the hold magnet associated with the conference circuit terminal, a loop is closed to relay D or E which operates. Relay D or E closes

ground to the sleeve lead to hold the connection and opens the shunt across the talking circuit. Later when any station terminal A, B, or C is seized, relay RV will operate and reverse the battery and ground on both trunk terminals to give answered supervision to the connected trunk.

3. DISCONNECTION

When a station line or a trunk disconnects after being connected to the conference circuit, relay A, B, C, D, or E releases. Relay A, B, and C releasing release relay RV which takes the reverse battery condition from trunk terminals D and E to give disconnect supervision to the connected trunk. The relay released also removes ground from the "S" lead allowing the connection to release and restoring the shunt across the conference appearance.

SECTION III - REFERENCE DATA

1. WORKING LIMITS

None.

2. FUNCTIONAL DESIGNATIONS

None.

3. FUNCTIONS

The functions of this circuit are:

- (a) To supply talking battery to the calling station line or trunk.
- (b) To hold the connection under control of the calling party.
- (c) To release the connection when the calling party disconnects.
- (d) To provide a conference transmission circuit.
- (e) To provide reverse battery supervision to connected trunks.

4. CONNECTING CIRCUITS

When this circuit is listed on a key-sheet the information thereon is to be followed.

- (a) Line, Link and Marker Circuit - SD-65741-01.

5. MANUFACTURING TESTING REQUIREMENTS

The dial conference circuit shall be capable of performing all of the functions specified in this circuit description, and meeting all the requirements of the circuit requirements table.

6. TAKING EQUIPMENT OUT OF SERVICE

This circuit may be taken out of service by shorting the No. 8 make and insulating the No. 8 break of the L- relay associated with the branch to be taken out of service.

SECTION IV - REASONS FOR REISSUE

B. CHANGES IN APPARATUS

<u>B.1 Superseded</u>	<u>Superseded By</u>
RV	RVD,E
AF-120	AK-30
Relay	Relay

B.2 Added:

RVD,E	RVD,E
420G	185A
Diode	Network

D. DESCRIPTION OF CHANGES

D.1 Option "W" has been provided in this issue to delay the reversal to a connecting trunk until the D or E relays have operated. This option is necessary to make the conference circuit compatible with Line, Link and Marker Circuit (SD-65741-01) in which "YC" option is provided.

D.2 Option "X" is rated Mfr Disc. and is replaced by option "W".

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DEPT 5332-JDS-HFH

CIRCUIT DESCRIPTION

CD-65746-01
ISSUE 3D
APPENDIX 12D
DWG ISSUE 53D

PBX SYSTEMS
NO. 756A
PBX CABLING DIAGRAM

CHANGES

D. Description of Changes

- D.1 Index sheets A1, A4, A5, and A7 are updated.
- D.2 On Index sheet A6, option designations ZP, ZQ, and ZR are added to the Option Index. Connector AW2 is added to the Connector Location Index.
- D.3 On sheet D3, option letter Z is changed to XL in Table A.
- D.4 On sheet D5, options ZP, ZQ, and ZR are added to Circuit Note 104, Note 108 is renumbered as 109, and Notes 108 and 110 are added.
- D.5 On sheet G4, slide 3, plug D wiring is clarified at pins 2 and 3.
- D.6 On sheet G5, slide 5, plug E, pin 4 wiring for option T is added.
- D.7 On sheet G10, slide 6, plug H, pins 12 and 3 wiring for option WM is added and the designation for option XA is changed to WL.
- D.8 On sheet G14, slide 6, plug J, pins 5 and 8, option YC wiring is added and leads to relays RLBB and RLAB are designated as option YB.
- D.9 On sheet G19, the termination of slide 5, plug L, pins 1, 4, 10, and 18 is changed from BY relay spring 8 to spring 6.
- D.10 On sheet G20, the termination of slide 5, plug M, pins 1 and 10 is changed from BY relay spring 8 to 6.
- D.11 On sheet G22, Sheet Note 1, "option 9..." is changed to read "option 22...".
- D.12 On sheet G26:
- (a) On slide 3, option letter S is changed to S, VY.
- (b) On slide 4, option letter S, V is changed to S, V, VY.
- D.13 On sheet G28, Sheet Note 2, "...SD-65743-01..." is changed to read "...SD-66796-01...".
- D.14 On sheet G38, slide 2, plug S:
- (a) The note "F stitch" is deleted from pins 2, 12, and 14.
- (b) The termination of pin 13 is changed from 6(TU3) to 8(TU3).
- D.15 On sheet G40, slide 3, plug H, the termination of pin 13 is changed from 6(TU5) to 8(TU5).
- D.16 On sheet G44, a new lead is added between slide 1, plug A, pin 11 and slide 5, plug A, pin 11 as option ZP wiring.
- D.17 On sheet G48, option ZQ is assigned to leads going to connector AY1, pins 4 and 5, from plug M, pins 3 and 14 in slide 1.
- D.18 On sheet G50, slide 1, plug Y, pins 0 and 1, the PLT LOCATION designation is changed from X to Y.
- D.19 On sheet G53, a new Note 18 is added.
- D.20 On sheet G54, connector A, pin 33, option designation XN is added to a lead terminated at the 7(MC) relay, and a new lead, terminated at the 4B(N) relay, as option XC is added. Reference to option XN is added to Sheet Note 2. Option A is changed to "A, WA" for the lead from pin 25 of connector B.
- D.21 On sheet G57, phrase "or CAD 37" is deleted from the brackets at slides 2, 3, and 4 which read "to CAD 14 or CAD 37".
- D.22 On sheets G63, G64, and G65, to CAD TITLE BLOCK:
- (a) On sheet G63, add "(See Sheet 387)".

- (b) On sheet G64, add "(See Sheet G86)".
- (c) On sheet G65, add "(See Sheet G87)".
- D.23 On sheet G90, Sheet Note 3 and references are added.
- D.24 On sheet G92, the termination on connecting block C1 for lead T-(A) is changed to 2CR, and lead R-(A) to 20T.
- D.25 On sheet G105:
 - (a) At slide 3, option designation S is changed to S, SY.
 - (b) At slide 4, option designation S, V is changed to S, V, VY.
 - (c) In Sheet Note 3, option designation S, V is changed to S, V, VY.
- D.26 A new sheet G109B is added. Sheet G109 is renumbered as G109A.
- D.27 On sheet G110, the designation of the note to slide 2, plug 2 pins 0, 1, and 12 is changed from "shown on CAD1" to "shown on CAD38".

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DEPT 3224-JRV-RVL

PBX SYSTEMS
NO. 756A
PBX CABLING DIAGRAM

CHANGES

D. Description of Changes

D.1 Index Sheets A1, A4, A5, and A7 are updated.

D.2 On sheet G74, the lead to connector BE3, pin 17, is removed from plug AE3, pin 12.

D.3 On sheet G96:

- (a) Lead to connector BE3, pin 17, is added to plug AJ3, pin 1, and designated as option ZN.
- (b) The termination of the lead from plug AJ3, pin 3, to connector BE3 is changed from pin 7 to pin 18.
- (c) The termination of the lead from plug AJ3, pin 5, to connector BE3 is changed from pin 8 to pin 19.
- (d) Option ZM is assigned to the leads from plug AJ3, pins 1, 3, and 5, terminated respectively at S40, S41, and S42.

D.4 On sheet G120:

- (a) Termination of the lead from plug BE3, pin 17, is changed to connector AJ3, pin 1.
- (b) Termination of the lead from plug BE3, pin 7, is changed to S41.
- (c) Termination of the lead from plug BE3, pin 18, is changed to connector AJ3, pin 3.
- (d) Termination of the lead from plug BE3, pin 8, is changed to S42.
- (e) Termination of the lead from plug BE3, pin 19, is changed to connector AJ3, pin 5.

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PBX SYSTEM
NO. 756A
~~PBX~~ CABLING DIAGRAM

CHANGES

D. Description of Changes

- D.1 Indexes on sheets A1 through A7 are updated.
- D.2 On sheet D5, options ZM, ZN, ZO, and Notes 107 and 108 are added.
- D.3 On sheets G11 and 105, options ZM and ZN are added.
- D.4 On sheet G36, options ZN, ZM, and XO (from SD-65752-01) are added.
- D.5 On sheets G45, 74, and 96, option ZN is added.
- D.6 On sheet G48, option ZO is added.
- D.7 On sheet G53, options XX and XW (CAD 6) and Note 17 are added.
- D.8 On sheet G60, add Note 4 and revise CAD 35.
- D.9 Add sheets G119 and 120 per option ZN.

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DEPT 3224-RHO-RVL

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PBX SYSTEMS
NO. 756A
PBX CABLING DIAGRAM

CHANGES

D. Description of Changes

- D.1 On sheets A1, A4, A5, and A7, the Sheet Index is brought up to date.
- D.2 On sheet A3, the Lead Index is brought up to date.
- D.3 On sheet A6, the Option Index is brought up to date.
- D.4 On sheet G24, under slide 4, the termination of leads TU(TT0) and (TT1) is changed from pin E to pins 5 and 4, respectively.
- D.5 On sheets G28, G31 through G37, G76, G77, G79, and G110, the following sheet note is added. "When local test console cable is provided, leads are shown on SD-66920-01, CAD 15. On sheet G33, lead RA, a reference to cord switchboard is added on a no-record basis."
- D.6 On sheet G54 and G117, option XV is changed to option XS on a no-record basis.
- D.7 On sheet G62, TS(D), option H is added on a no-record basis.
- D.8 On sheet G80, slide 2, lead terminations change from connector AU to different pins on connector AJ on a no-record basis.
- D.9 On sheet G96, slide 2, option ZL is added on a no-record basis.
- D.10 On sheet G109, slide 2, option ZL is removed on a no-record basis.
- D.11 On sheet G118, plug 2AC, change 2L OT(20-29) to read 5M OT(20-29).
- D.12 All changes which are made on a D no-record basis are in agreement with WECO standards.

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DEPT 5334-RHO-RVL

PRX SYSTEM
NO. 700A
PRX CABLING DIAGRAM

CHANGES

D. Description of Changes

- D.1 On sheets A1, 4, 5 and 7, the Sheet Index is brought up to date.
- D.2 On sheet A3, the Lead Index is brought up to date.
- D.3 On sheet A6, the Connector Location Index is brought up to date.
- D.4 On sheet D5: Under Circuit Note 104, option ZL is added and rated standard; Under Circuit Note 102, Traffic Measurement System feature and option ZL are added.
- D.5 On sheet G1, 2, 4, 8, 22, 24, 25, 80 and 109; option ZL leads TU() and Sheet Notes are added.
- D.6 On sheets G3, and 17, reference information is added.
- D.7 On sheets G16, 31 and 32, leads TU() and option ZD which is shown on SD-65753-01 are added.
- D.8 On sheet G54: CAD 8, leads TU() and option XV (from SD-65752-01) are added; and on CAD 9, lead TU() and options ZA and ZD are added.
- D.9 On sheet G111; leads TU(), option ZD (from SD-65753-01), option ZL and Notes are added.
- D.10 Sheets G117 and 118 are added.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5334DR-RHO-
DEPT 5334-RVL

PBX SYSTEMS
NO. 756A
PBX CABLING DIAGRAM

CHANGES

D. Description of Changes

- D.1 On sheets A1, 4, 5, and 7, the Sheet Index is brought up to date.
- D.2 On sheet A2, the Lead Index is brought up to date.
- D.3 On sheets G34-37 and 72, color of slide leads is removed.
- D.4 On sheet G34, reference to transmission facilities is added.
- D.5 On sheet G36, 53 and 54 option XO is added.
- D.6 On sheet G53, Note 3 is rated "Manufacture Discontinued" and Note 15 is added.
- D.7 On sheet G72, Note 2 is added to refer to Dial Pulse Register Circuit.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5334DR-RHO
DEPT 5334-RVL

PBX SYSTEMS
NO. 756A
PBX CABLING DIAGRAMCHANGESD. Description of Changes

- D.1 On sheets A1, 4, 5 and 7 the Sheet Index is brought up to date
- D.2 On sheet A2, the lead index is brought up to date.
- D.3 On sheet A6, the option index is brought up to date.
- D.4 On sheet D5, option ZK is added in Note 104.
- D.5 On sheet G1, under slide 6, change plate position of LD lead from G to C:
- D.6 On sheet G14, under slide 6 and LD lead, add plate position C.
- D.7 On sheet G15, 72, 81, 82 and 111, add options XL and XM to change termination of register leads PL, UD, T, R, RC, (GRD) and MB in slide 6. On sheet G111 Note 5 is added.
- D.8 On sheet G28; option ZK is added to slide 1, plug P, pin 3, and sheet note 8 is added.
- D.9 On sheet G49, option ZK is added to slide 1, plug W, pin 5.
- D.10 On sheet G53, rate CAD 5 "MFR DISC" and add Notes 14 and 15.
- D.11 On sheet G62, TSD; add ZS option to ZF option, add CO lead on pin HM-2 and remove ZE and ZF option from shop wiring side of IT-2 and HM-3 terminals. (D no-record change per agreement with WECO).
- D.12 On sheet G80, add Note 1 and options EB and XP to change termination of register lead in slide 6.
- D.13 On sheet G92, under slide 1, plug P, add R BAT lead to 608D SWBD MISC CKT.

BELL TELEPHONE LABORATORIES, INCORPORATED

(WECO 5123HW-RHO-RHP)
DEPT 5337-RVL

CIRCUIT DESCRIPTION

CD-65746-01
ISSUE 3D
APPENDIX 5B
DWG ISSUE 46B

PBX SYSTEMS
NO. 756A
PBX CABLING DIAGRAM

CHANGES

D. Description of Changes

D.1 On sheets A1, 4, 5 and 7, the
Sheet Index is brought up to
date.

D.2 On sheet G53, CAD 6; change XM
option to XK, change XK option to
XL and on terminal 22 change lead
termination from (SD) capacitor to
4B (P) relay on a no-record change per
agreement with WECO standards.

BELL TELEPHONE LABORATORIES, INCORPORATED

(WECO 5120HW-RHO-RHP)
DEPT 5337-RVL

PBX SYSTEMS
NO. 756A
PBX CABLING DIAGRAM

CHANGES

D. Description of Changes

- D.1 On sheets A1, 4, 5, 6 and 7 the sheet and connector location index are brought up to date.
- D.2 On sheets G3 and G12, reference information is added to reflect added pins shown on G49.
- D.3 On sheet G45; under slide 2, plug C, pin 17, change termination of MBD lead from S (PWR-96) to 5 (PWR KEY).
- D.4 On sheet G49; add G and H Grd leads in slide 2 (plug C-pin 12), slide 4 (plug J-pin 12) and slide 2 (plug C-pin 10), slide 4 (plug J-pin 10) respectively.
- D.5 On sheet G54; add option XH in CAD 6, and add note 13.
- D.6 On the above G sheets, color code of leads is removed.

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(WECO 5120HW-RHO-RHP)
DEPT 5337-RVL

Y
PBX SYSTEMS
NO. 756A
PBX CABLING DIAGRAM

CHANGES

D. Description of Changes

- D.1 On sheets A1, 4, 5, and 7, the Sheet Index is brought up to date.
- D.2 On sheet G22, 24, 25 and 112 under slide 2, terminal designations of the 490C keys on the make busy and busy display unit are changed from "R" to "T".
- D.3 On sheet G62; TS (D), pin MD1, terminal designation of the 490C key on the make busy and busy display unit is changed from "R" to "T".
- D.4 On the above G sheets, color code of leads is removed.

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DEPT 5337-RVL

PBX SYSTEMS
NO. 756A
PBX CABLING DIAGRAMCHANGESD. Description of Changes

- D.1 On sheets A1, 4, 5, 6 and 7, the sheet and option index is brought up to date.
- D.2 On sheet D2, option ZH is designated Manufacture Discontinued and option ZJ is designated Standard.
- D.3 On sheet G53, the following changes are made on a D no-record basis per agreement with WECO. DT resistor is removed from CAD 5 and options ZA, ZB, YL and YM are added.
- D.4 On sheet 53, CAD 6, the following options are added: XE, XF, XK, XL, XM, ZJ and ZH. Only options ZJ and ZH are added on this circuit. Option XF provides ease in field addition of Attendant Restriction feature (restricts attendant from placing outgoing CO calls), and prevents the attendant from entering a connection when lock-out is provided. Options XK and XL are added to provide audible ringing tone on trunk to toll calls. Option XM replaces option Z to free pin 22. Option ZH and ZJ rearrange the terminal strip to free pin 22.
- D.5 On sheet G54, options ZA, ZB, ZJ and YM are added, termination of BZ lead on pin 18 of CAD 8 is changed from 11 of (FF) relay to 1M of (R1) relay, sheet notes 2 and 3 are combined and new note 3 added. These changes are made on a D no-record basis per agreement with WECO.
- D.6 On sheet G86, CAD 30, option ZG is added to provide a locking path for the SEO-9 relay when lock-out is required.

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PBX SYSTEMS
NO. 756A
PBX CABLING DIAGRAM

CHANGES

D. Description of Changes

- D.1 On sheets A1, A4, A5 and A7 the sheet index is brought up to date.
- D.2 On sheets A2 and A3 the lead index is brought up to date.
- D.3 On sheet A6 the connector index is brought up to date.
- D.4 On sheets G81, G82, G83, G84, and G85 lead GN per SD-65742-01 option XH is added for TOUCH-TONE calling feature.
- D.5 On sheets G92 and G93 information is added for 608A and D Cord Switchboard.
- D.6 On sheets G28, G58, G95, G105 and G106 reference to CAD 43 is added.
- D.7 On sheets G100 and G101, CAD 37, is rated MANUFACTURE DISCONTINUED.
- D.8 On sheet G114, CAD 1, leads TPA and TPB per SD-65741-01 options VH and VJ are added.
- D.9 Sheets G115 and G116, CADS 43 and 44, are added for 3 Wire Jack 608A or D Cord Switchboard.
- D.10 On sheet G116, CAD 45, is added for the station controlled conference feature when used with a 608A or D Cord Switchboard.
- D.11 Other minor miscellaneous corrections made in CAD figures.

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DEPT. 5337-RVL

PBX SYSTEMS
NO. 756A
PBX CABLING DIAGRAMSECTION I - GENERAL DESCRIPTION1. PURPOSE OF CIRCUIT

1.01 This PBX Cabling Drawing shows the interconnection of the crown cable for the six equipment slides, the interconnection of the house and feeder cables and unit terminal strip cross connection information where required for 756A PBX circuits.

SECTION II - DETAILED DESCRIPTION

1.01 None.

SECTION III - REFERENCE DATA1. WORKING LIMITS

1.01 None.

2. CONNECTING CIRCUITS

2.01 When this circuit is listed on a keysheet, the connecting information thereon is to be followed.

(a) Line, Link, and Marker Circuit - SD-65741-01.

(b) Dial Pulse Register Circuit - SD-65742-01.

(c) Traffic Register Circuit - SD-65744-01.

(d) Loud Speaker Paging Trunk Circuit - SD-65747-01.

(e) Junctor Circuit - SD-65750-01.

(f) 2-Way Trunk Circuit to Central Office - 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) Ringdown Tie Trunk Circuit - SD-65756-01.

(k) Cordless Position Circuit - SD-65757-01.

(l) Auxiliary Relay Circuit For Direct Station Selection By Stations - SD-65942-01.

(m) Message Waiting Service Key, Interrupter, And Power Supply Circuit - SD-65784-01.

(n) Feature Cabling Diagram - SD-66920-01.

(o) Traffic Register Circuit - External Traffic And Trouble Registers - SD-5E010-01.

(p) Station Message Register Pulse And Surcharge Circuit - SD-5E021-01.

(q) Inward Restriction Circuit - SD-5E003-01.

(r) Make Busy And Busy Display Circuit - SD-5E029-01.

(s) TOUCH-TONE Calling Receiver Circuit Type A3 - SD-98148-01.

(t) TOUCH-TONE Calling Receiver Circuit Type C1 - SD-67027-01.

(u) Telephone Console Circuit Type 3 and 4 - SD-66907-01.

- (v) Dial Conference Trunk Circuit
Station Controlled - SD-66908-01.
- (w) Dial Conference Trunk Circuit
Attendant Controlled - SD-66908-01.
- (x) Alarm, Transfer, and Test Circuit -
SD-66796-01.
- (y) Recorded Telephone Dictation Trunk -
SD-65788-01.
- (z) 3A Code Call Circuit - SD-66610-01.
- (aa) Power Supply Circuit - SD-81326-02.
- (ab) Power Supply Circuit - SD-81600-01.
- (ac) 556A PBX Cord, Telephone, Dial,
Battery, Buzzer and Ringing -
SD-65658-01.
- (ad) 608D Jack and Lamp Circuit -
SD-65997-01.
- (ae) 552A, 552B, 552D, 552E, 605A, 607A,
607B, or 608A Jack Circuit -
SD-65778-01.
- (af) 608A Auxiliary Signal, Fuse Alarm,
Battery Cut Off and Miscellaneous
Circuit - SD-66772-01.
- (ag) 608D Auxiliary Signal, Fuse Alarm,
Battery Cut Off and Miscellaneous
Circuit - SD-67039-01.

SECTION IV - REASONS FOR REISSUE

D. Description of Changes

- D.1 Option ZF is designated and rated
Manufacture Discontinued. Option ZG
is added and rated Standard to arrange
the cabling so the station message register
feature will function with the transistor-
ized link test circuit designed for the
marker.
- D.2 On sheet G10, termination of lead LG
is modified per SD-65741-01,
option 22.
- D.3 On sheets G22, 24 and 25, termination of
leads S02-S09 and S12-S19 are mod-
ified per SD-65741-01, option 22.
- D.4 On sheet G43, termination of lead
FB is modified per SD-65757-01,
option ZZ.
- D.5 On sheet G114, leads COA and XCA
are added per SD-65741-01, option WT.
- D.6 Minor correction for the make busy
and busy display and battery reserve
features are made per agreement with WECO
Standards Engineering.

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(WECO 2120HW-RLL-WHK)
DEPT 5337-LAH

PBX SYSTEMS
NO. 558A SYSTEM, 756A,
800A, 801A, 802A PBX
OR
SWITCHING SYSTEM NO. 400
LOUDSPEAKER PAGING TRUNK
CIRCUIT

TABLE OF CONTENTS	PAGE	SECTION II - DETAILED DESCRIPTION
<u>SECTION I - GENERAL DESCRIPTION</u>	1	<u>1. SEIZURE OF LOUDSPEAKER PAGING TRUNK</u>
<u>1. PURPOSE OF CIRCUIT</u>	1	SEIZURE BY 756A STATION (DIAL SELECTED)
<u>SECTION II - DETAILED DESCRIPTION</u>	1	1.01 If a station desires to be connected to the paging trunk, it originates a call and dials the code assigned to the paging trunk (80 through 89). The marker functions to connect the calling station to the paging trunk on a trunk class basis (without a junctor). The paging trunk provides talking battery for the calling station and a connection to the input of the paging amplifier. A busy lamp is provided at the 756A attendant position equipment and is lighted whenever the trunk is busy.
<u>1. SEIZURE OF LOUDSPEAKER PAGING TRUNK</u>	1	1.02 The paging trunk is connected to a converted station line circuit (stations 20 through 29 converted to 80 through 89) so it can be used for dial selected calls. This provides the necessary path for the marker to connect any calling station to the paging trunk via a link circuit.
SEIZURE BY 756A STATION (DIAL SELECTED)	1	1.03 When this circuit is seized, the loop of the calling station is extended through a link and a converted station line circuit via leads T2 and R2, operating relay A.
SEIZURE BY ATTENDANT.	2	1.04 Relay A operated:
SEIZURE BY 2-WAY AUXILIARY TRUNK.	2	(a) Extends ground to lead S2.
<u>2. RELEASE OF LOUDSPEAKER PAGING TRUNK</u>	2	(b) Lights the lamp associated with the paging trunk at the 6-button key telephone set, console, or 608D cord switchboard.
<u>3. MISCELLANEOUS</u>	2	(c) Supplies battery to the isolation amplifier (if provided).
<u>SECTION III - REFERENCE DATA</u>	3	(d) With option G, disconnects lead COE1 from lead R, switching off the external input.
<u>1. WORKING LIMITS</u>	3	(e) With option J, removes the idle line termination from the input of the paging amplifier.
<u>2. FUNCTIONAL DESIGNATIONS</u>	3	
<u>3. FUNCTIONS</u>	3	
<u>4. CONNECTING CIRCUITS</u>	3	
<u>5. MANUFACTURING TESTING REQUIREMENTS</u>	3	
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<u>7. TAKING EQUIPMENT OUT OF SERVICE</u>	3	
<u>SECTION IV - REASONS FOR REISSUE</u>	3	
<u>SECTION I - GENERAL DESCRIPTION</u>		
<u>1. PURPOSE OF CIRCUIT</u>		
1.01 The purpose of this circuit is to provide a paging trunk circuit that may be dial selected by a 756A station line circuit. It may also be manually selected by a PBX attendant using a console equipped with a paging trunk pickup key, a cord switchboard arranged with a jack appearance, or an attendant being seized by a 2-way auxiliary trunk circuit.		

(f) With option E, connects the ring conductor of the paging amplifier to lead R1 of the isolation amplifier (App Fig. 3).

(g) With option F, connects the ring conductor of the paging amplifier input to lead R2 via capacitor R.

(h) Connects lead COE3 to lead COE4, switching on the paging amplifier.

1.05 The calling station now is connected to the input of the paging amplifier through capacitors T and R.

SEIZURE BY ATTENDANT

1.06 When a console or 6-button key telephone set is used as an attendant position, the circuit is seized by operating the pickup key associated with the paging trunk. (The pickup key must have the tip and ring leads cabled.)

1.07 The pickup key operated:

- (a) Provides a direct connection to the paging trunk.
- (b) Connects the attendant's telephone circuit to the tip and ring of the paging trunk causing the A relay to operate.

1.08 The functions of relay A operated work similarly to those described in 1.04 except that no station line is connected (through a link) to the circuit.

1.09 An attendant may override a busy condition when a station or another attendant is connected to the paging trunk by operating the associated pickup key.

1.10 When a 608D cord switchboard is used as an attendant position, this circuit is seized by either operating a paging key, or by inserting a cord into the jack associated with the loudspeaker paging trunk.

1.11 Operating the pickup key, or insertion of the plug into the jack assigned to loudspeaker paging, connects the attendant's telephone circuit to the trunk and causes the operation of relay A as described in 1.04.

Note: The paging key must be depressed and held by the attendant while using the paging trunk.

SEIZURE BY 2-WAY AUXILIARY TRUNK

1.12 The seizure of this circuit by the 2-way auxiliary trunk circuit connects or loops to leads T2 and R2 to operate

relay A. Relay A operated connects ground to lead S2 to hold the supervision of the trunk circuit.

2. RELEASE OF LOUDSPEAKER PAGING TRUNK

2.01 If the trunk is dial selected by a station and the calling party hangs up, the loop is opened thereby releasing relay A.

2.02 Relay A released:

- (a) Removes ground from lead S2.
- (b) Removes battery from leads SL1, SL2, SL3, and BL1 to extinguish the lamp associated with the paging trunk at the 6-button key telephone set, console, and 608D cord switchboard.
- (c) Removes battery from the isolation amplifier (if provided).
- (d) With option G, connects lead COE1 to lead R switching on the external input source.
- (e) With option J, connects the idle line termination (A resistor) across leads T and R to the input of the paging amplifier.
- (f) With option E, disconnects the ring conductor of the paging amplifier from lead R1 of the isolation amplifier (App Fig. 3).
- (g) Disconnects the ring conductor of the calling station from the input of the paging amplifier.
- (h) Disconnects lead COE3 from COE4, switching off the paging amplifier.

2.03 The circuit is now at normal.

2.04 Relay A, releasing on disconnect when the trunk is manually selected or selected by a 2-way auxiliary trunk performs all the functions described above except that release of the station line circuit is not involved.

3. MISCELLANEOUS

3.01 A 33L varistor (option T) is connected across the paging amplifier input to reduce a click on disconnect.

3.02 The isolation amplifier is provided optionally to prevent 2-way transmission through the paging trunk. Operation of relay A supplies battery to operate the amplifier. Resistor FB is set at 30 ohms to limit the amplifier gain to unity.

SECTION III - REFERENCE DATA

1. WORKING LIMITS

1.01 Maximum circuit loop is 1885 ohms.

1.02 Voltage limits are 45 to 52 volts.

2. FUNCTIONAL DESIGNATIONS

None.

3. FUNCTIONS

3.01 To recognize seizure when either dial or manually selected.

3.02 If dial selected, to provide a holding ground for the associated line circuit.

3.03 To light a busy lamp at the attendant position(s) when seized.

3.04 To remove an idle line termination from the amplifier input terminals or, to remove external source from amplifier input terminals.

3.05 To make itself busy to the marker when seized.

3.06 To couple the calling station and/or attendant into the paging amplifier.

3.07 To release on disconnect and to remove the busy condition when it releases.

3.08 To provide for the attendant to override a busy condition.

3.09 To switch off paging amplifier on disconnection.

4. CONNECTING CIRCUITS

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

- (a) No. 756A PBX Line, Link, and Marker Circuit - SD-65741-01.
- (b) No. 800A PBX 2-Way Auxiliary Trunk Circuit - SD-1E027-01.
- (c) No. 400 Switching System Line, Link, and Connector Circuit - SD-69469-01.

(d) Any paging amplifier circuit.

(e) Any tape, tuner, or other audio source.

(f) No. 558A System Circuit Schematic - SD-5E060-01.

(g) No. 800A PBX 2-Way Auxiliary Trunk Circuit - SD-1E319-01.

(h) No. 801A PBX Attendant Console Circuit - SD-1E322-01.

(i) No. 802A PBX Attendant Console Circuit - SD-1E274-01.

5. MANUFACTURING TESTING REQUIREMENTS

5.01 The loudspeaker paging trunk shall be capable of performing all the service functions specified in this circuit description, and meeting all the requirements of the Circuit Requirement tables.

6. ALARM INFORMATION

6.01 An operated fuse alarm is indicated by a major alarm at the plant service center (if alarm transmitting features are provided). In any case, a visual signal at the attendant's position and in the alarm transfer and test circuit are indicated. Replace the fuse to restore the circuit, extinguish the alarm lamp, and silence the alarm at the plant service center.

7. TAKING EQUIPMENT OUT OF SERVICE

7.01 In order to take a loudspeaker paging trunk out of service it is necessary to block the A relay unoperated.

SECTION IV - REASONS FOR REISSUE

D. Description of Changes

D.1 Circuit Note 102 is revised to add reference to the No. 558A, 801A, and 802A PBXs.

D.2 In FS1, connecting information is added for the 558A, 801A, and 802A PBXs.

D.3 The title is changed to add the 558A, 801A, and 802A PBXs.

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DEPT 3221-WVS-MAF

PBX SYSTEMS
NO. 756A
JUNCTOR CIRCUITCHANGESA. Changed and Added Functions

A.1 The junctor circuit is modified to function with the Traffic Measurement System No. 1A.

D. Description of Changes

D.1 Option R is added and rated Standard to provide a ground to give a busy signal to the Traffic Measurement Remote Scanner.

D.2 On sheet 1, Lead Index is added.

D.3 On sheet 2, option R is added and the connections for the Traffic Measurement System Remote Scanner are shown.

D.4 Circuit Note 103; sequence charts; sheet and option indices; and the supporting information have been changed to reflect the added option.

F. Changes in CD Sections

F.1 In SECTION II - DETAILED DESCRIPTION under 1.1 change the last sentence to read:

Relay B...line hold magnets (2) close holding ground...after the marker releases and (3) extends busy ground over lead TU(J-) toward the Traffic Measurement System Remote Scanner.

F.2 In SECTION II - DETAILED DESCRIPTION, Part 2, change second sentence of second paragraph to read:

Relay D operated reverses the originating "T and R" leads, and provides a

holding ground on lead TU(J-) for the Traffic Measurement System Remote Scanner.

F.3 In SECTION II - DETAILED DESCRIPTION, Part 3.1, change third sentence to read:

The release of relay B removes ground from lead TU(J-) toward the Traffic Measurement System Remote Scanner, and from leads SO, ST, OHM, and THM which releases the originating and terminating hold magnets of the junctor and the associated line hold magnets.

F.4 In SECTION II - DETAILED DESCRIPTION, under 3.21, change the second sentence to read as follows:

This condition...ST lead, removes ground from lead TU(J-), and also opens, restoring the junctor to normal.

F.5 In SECTION II - DETAILED DESCRIPTION, under 3.22, change the last sentence to read:

Relay D released removes ground from lead TU(J-), and releases the line and trunk hold magnets, restoring the trunk to normal.

F.6 In SECTION III - REFERENCE DATA, under Part 2, add:

(h) To provide a busy ground condition for the Traffic Measurement System Remote Scanner.

F.7 In SECTION III - REFERENCE DATA, under Part 3, add:

(d) Traffic Measurement System No. 1A Remote Scanner - SD-3B200-01.

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Page 1
1 Page

PBX SYSTEMS
NO. 756A
JUNCTOR CIRCUITCHANGESA. Changed and Added Functions

A.1 The junctor circuit is modified to function with the make busy and busy display circuit.

D. Description of Changes

D.1 Option S is added and rated Standard to provide an indication to the make busy and busy display circuit of a connection to the originating side of the junctor.

D.2 On sheet 1, the option index and note 103 are revised to reflect the changes in this issue.

D.3 On sheet 2, option S is added and the connections for the make busy and busy display circuit are shown in the line, link, and marker circuit.

D.4 On sheet 3, the sequence charts are modified to show the lighting of the originating and terminating make busy lamps (JCTR ORIG and JCTR TERM).

F. Changes in CD Sections

F.1 In SECTION II - DETAILED DESCRIPTION, add:

4. FUNCTION OF MAKE BUSY AND BUSY DISPLAY CIRCUIT

4.1 Junctor Key Normal

With the junctor key (JCTR key) normal in the make busy and busy display circuit, the junctor terminating lamp (JCTR TERM lamp) will light when relay SMT- in the line, link, and marker circuit operates the

terminating hold magnet for the junctor. The junctor originating lamp (JCTR ORIG lamp) will light when the originating hold magnet is operated. This indicates that the junctor has been made busy through normal operations.

4.2 Junctor Made Busy

If it is desired to make a junctor busy, key JCTR is operated. Key JCTR operated, grounds lead THM of the terminating hold magnet in the line, link, and marker circuit. The grounding of lead THM:

(a) Operates the junctor's terminating hold magnet in the marker circuit.

(b) Makes the junctor busy to the marker on subsequent requests for service.

(c) Lights lamp JCTR TERM in the make busy and busy display circuit.

The lighting of lamp JCTR TERM indicates that the junctor has been made busy.

F.2 In SECTION III - REFERENCE DATA, 2. FUNCTIONS, add:

(g) To provide an indication to the make busy and busy display circuit that the originating side of the junctor is connected.

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

(c) Make Busy and Busy Display Circuit - SD-5E029-01

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(WECO 2120HW-JJM-WHK)
DEPT 5337-LAH

PBX SYSTEMS
NO. 756A
JUNCTOR CIRCUIT

CHANGES

D. DESCRIPTION OF CHANGES

D.1 On Sheet 2, contacts 1 and 12 of the B relay were added
(T option) to prevent reoperation of relay A when relay
D releases.

D.2 Prior to issue 6B, option V was a part of FS1.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5332-HGS-HFH

PBX SYSTEMS
NO. 756A
JUNCTOR CIRCUITSECTION I - GENERAL DESCRIPTION

1. PURPOSE OF CIRCUIT

The Junctor Circuit is used to supply talking battery, and provide supervision on station-to-station and dial repeating tie trunk-to-station calls.

When the marker is signaled by the register to set up a connection from a PBX line or incoming dial repeating tie trunk to another PBX line, it does so by connecting a link from the terminating end of the junctor to the called line, and another link from the calling PBX line or tie trunk to the originating end of the junctor. The junctor continues to supervise the connection, supplying transmission battery both ways.

2. GENERAL DESCRIPTION OF OPERATION

When the register circuit into which the number of the called station has been dialed signals the marker to establish a connection to that line, it does so by connecting a link from the called station line hold magnet to the terminating end of a junctor. The marker also establishes a connection to the calling line or trunk over a link from the originating end of the junctor.

Upon seizure, the junctor supplies a holding ground to hold the originating and terminating line hold magnets, as well as the originating and terminating junctor hold magnets in the Line, Link, and Marker Circuit. The junctor also connects ringing current to the called line via the terminating link. When the called line answers, the junctor trips the ringing and cuts through the transmission path. With X option when the calling line disconnects, the junctor releases the originating link and calling line hold magnet, and subsequently when the called line disconnects, the junctor releases the terminating link and terminating line hold magnet. With W option, disconnection by the calling line will release both the calling and terminating line hold magnets.

If the originating line disconnects but the terminating line fails to disconnect with X option, the junctor will remain busy to the marker, even though the originating end of the connection is released. This feature is provided because the marker tests the terminating end of the junctor for a busy condition.

SECTION II - DETAILED DESCRIPTION

1. SEIZURE OF JUNCTOR CIRCUIT (STATION-TO-STATION OR TIE TRUNK-TO-STATION CALL)

1.1 Operation of a Relay and Holding Cross-points

The marker, having received information from the register as to the called line number for a station-to-station or tie trunk-to-station call, proceeds to set up a connection to that line on a "junctor class" basis. A "junctor class" call requires a Junctor Circuit to supply transmission battery to both parties.

The marker tests the terminating hold magnets of the junctors. Having found an idle junctor, the marker SMTA and SMTB relays operate the terminating hold magnet for the junctor and the line hold magnet of the called line to connect them together over an idle link which has already been selected. The marker continues to hold the hold magnets operated.

Having established a connection to the called line, the marker recycles to operate the originating hold magnet of the junctor which connects the junctor to the same link which is being used to connect the originating line hold magnet to the register. The register then drops off the link. When the junctor originating hold magnet operates to connect the calling line to the junctor, the calling station loop is extended through crosspoints to the winding of relay A to battery and ground, and relay A operates. Relay A operates relay B, which is slow releasing in order to guard against momentary opens in the loop that would falsely drop the connection. Relay B operated (1) closes ground through both sections of resistance A to the terminating link sleeve and to the originating link sleeve to hold the calling and called line hold magnets and (2) closes holding ground to the originating and terminating junctor hold magnets over leads "OHM" and "THM", respectively, to hold these operated after the marker releases.

1.2 Start of Ringing

Ringing current, over lead "R1", through a make contact of A, through the primary winding and a break contact of tripping relay TP is applied to the ring conductor of the junctor toward the called line. Ringing ground is connected extended over lead "ring G" through a break contact of TP to the tip conductor of the junctor

toward the called line. Condenser A is provided to furnish audible ringing tone to the calling line.

2. RINGING TRIP AND CUT THROUGH

When the called party answers, the terminating loop operates relay TP.

Relay TP operated locks to ground through a make contact of the B relay and transfers the terminating "T&R" leads from the Power Supply Circuit (removes ringing current) to the windings of relay D, which operates. Relay D operated reverses the originating "T&R" leads. This battery and ground reversal is used on calls to PBX lines from tie trunks which require reversed battery-type supervision. Relay D operated provides supplementary holding ground for the terminating link sleeve, the junctor terminating hold magnets, and (with X option) relay TP. The junctor supplies talking battery through relay A to the calling line or tie trunk, and through relay D to the called line. The voice current path is complete through capacitors T&R.

3. RELEASE

3.1 Called Line Did Not Answer

When the calling line or tie trunk disconnects, relay A releases. Relay A released, removes ringing current from the terminating "R" lead and releases relay B. The release of relay B removes ground from leads "SO", "ST", "OHM", and "THM" which releases the originating and terminating hold magnets of the junctor and the associated line hold magnets. The slow release of relay B insures that no current is flowing in the crosspoint circuits at the time the hold magnets are released.

3.2 Calling Party Disconnects First

3.2.1 With X Option

Relays A and B release as described in 3.1, but relay D is held operated over the called station loop, and only the originating end of the junctor will release. This condition will prevail until the called party hangs up, at which time the release of relay D releases relay TP, opens up the terminating "ST" lead, and also opens up the "THM" leads, thereby releasing the terminating hold magnet and restoring the junctor to normal.

3.2.2 With W Option (SC4)

When the calling line or tie trunk disconnects, relay A releases which opens the "R1" lead to relay TP and releases relay B. Relay B released, releases the originating trunk and line hold magnets and relay TP. Relay TP released opens the loop to the terminating end of the junctor causing relay D

to release. Relay D released releases the terminating line and trunk hold magnets, restoring the trunk to normal.

3.3 Called Party Disconnects First

Relay D releases as described in 3.2 but the junctor terminating hold magnet, the terminating line hold magnet, and relay TP cannot release until the supplementary holding grounds supplied by operated relay B are removed. When the calling party hangs up relays A and B release and the junctor restores to normal as described in 3.1.

SECTION III - REFERENCE DATA

1. WORKING LIMITS

Maximum external circuit loop is 14100

Voltage Limits are: 45 to 52 volts dc
75 to 110 volts ac.

2. FUNCTIONS

(a) To respond to seizure and supply holding ground for the originating line hold magnet and the terminating line hold magnet under control of the calling station loop.

(b) To supply ringing to the called station and audible ringing tone to the calling station.

(c) To recognize that the called station has answered the ringing signal - to cut through the transmission path supplying transmission battery to both lines.

(d) To reverse the battery and ground toward the calling end as an answered signal to tie trunks requiring reverse battery supervision.

(e) To recognize when either party disconnects, and with X option to hold itself busy until both parties hang up.

(f) To release the entire connection when the calling party hangs up, whether or not the answering party has disconnected, if W option is supplied.

3. CONNECTING CIRCUITS

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

(a) Line, Link, and Marker Circuit - SD-65741-01.

(b) Power Supply Circuit - SD-81326-01.

4. MANUFACTURING TESTING REQUIREMENTS

The Junctor Circuit shall be capable of performing all the service functions

specified in this circuit description and meeting all the requirements in the Circuit Requirements Tables.

5. TAKING EQUIPMENT OUT OF SERVICE

To make the junctor busy, it is necessary to ground to "THM" lead toward the Line, Link, and Marker Circuit. This can be accomplished as follows: ascertain that no select magnet is operated and block the D relay operated.

6. ALARM INFORMATION

6.1 Fuse Alarm

An operated fuse supplying the Junctor Circuit is indicated by a major alarm at the plant service center if alarm transmitting features are provided, and in any case by a visual signal at the attendant position, and in the alarm transfer and test circuit in the equipment cabinet. Replace the operated fuse to silence the alarm and extinguish the visual alarm signal.

SECTION IV - REASONS FOR REISSUE

D. DESCRIPTION OF CHANGES

D.1 On Sheet 2, ground to the 10 contact of the D relay was made optional so that it may be removed when a 3A code call circuit is provided with a 756A PBX.

D.2 Option W was designated and not shown on drawing issues preceding 5B. Prior to issue 5B, option W was a part of FSL.

D.3 Option X was designated and not shown on drawing issues preceding 5B and provides the feature listed as D.1.

D.4 On Sheet 1, references to options W and X were entered in Circuit Notes 102 and 103 and Equipment Note 202 was added.

D.5 On Sheet 3, Sequence Chart 4 was added.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5332-LET-HFH

CIRCUIT DESCRIPTION

CD-65752-01
ISSUE 13B
APPENDIX 4B
DWG ISSUE 39B

PBX SYSTEMS
NO. 756A
TWO-WAY TRUNK CIRCUIT
TO CENTRAL OFFICE

CHANGES

D. Description of Changes

- D.1 Option WD is designated and option WE is added.
- D.2 Circuit Note 102 is revised to change the central office information for trunks.
- D.3 Circuit Note 104 is revised to reflect Issue 39B.
- D.4 Circuit Notes 120 and 121 are added.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 3224-WVS-RVL

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Page 1
1 Page

CIRCUIT DESCRIPTION

CD-65752-01
ISSUE 13B
APPENDIX 3B
DWG ISSUE 38B

PBX SYSTEMS
NO. 756A
TWO-WAY TRUNK CIRCUIT
TO CENTRAL OFFICE

CHANGES

D. Description of Changes

- D.1 Diode S1 is added to the Apparatus Index.
- D.2 Options WB and WC are added to the Option Index.
- D.3 Option WB is designated and rated Standard.
- D.4 Option WC is added as standard.
- D.5 Circuit Note 102 is revised to include reference to option WC.
- D.6 Circuit Note 104 is revised to reflect Issue 38B.
- D.7 Information Note 303 is expanded.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 3221-WVS-RGP

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Page 1
1 Page

CIRCUIT DESCRIPTION

CD-65752-01
ISSUE 13B
APPENDIX 2B
DWG ISSUE 37B

PBX SYSTEMS
NO. 756A
TWO-WAY TRUNK CIRCUIT
TO CENTRAL OFFICE

CHANGES

D. Description of Changes

- D.1 Option XZ is added as standard to provide cut-through of the trunk on night connections when working into a step-by-step central office.
- D.2 Option XY is added as standard to provide power failure transfer for trunks 5, 6, and 7.
- D.3 Option WS is added as standard to permit the attendant to reenter a trunk after making an error in dialing an outgoing central office call to a station.
- D.4 Options WA, XZ, and XY are added to the Option Index.
- D.5 Reference to the 402C tone generator is added to the cordless position circuit as shown in FS7.
- D.6 Circuit Notes 102 and 104 are revised to reflect Issue 37B.
- D.7 Circuit Note 107 is changed from Mfr Disc. to Standard and now includes reference to option WA.
- D.8 Information Note 303 is added.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 3221-WVS-RGP

TELEPHONE SYSTEMS
NO. 756A
TWO-WAY TRUNK CIRCUIT
TO CENTRAL OFFICE

CHANGES

D. Description of Changes

D.1 This circuit is reissued to upgrade the transmission on night connections. On Issue 32B, the introduction of option X0 inadvertently removes the S capacitor from across the winding of relay S, thus degrading the transmission. This is corrected by placing the S capacitor directly across the winding of relay S.

D.2 On sheets A1 and A2, the Sheet Index is brought up to date.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 3221-SHA-RGP

PBX SYSTEMS
NO. 756A
TWO-WAY TRUNK CIRCUIT
TO CENTRAL OFFICE

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SECTION I - GENERAL DESCRIPTION

1. PURPOSE OF CIRCUIT

1.01 This trunk circuit provides the supervisory, control, and transmission features required for originating and terminating calls in either direction between PBX and central office switching systems.

2. GENERAL METHOD OF OPERATION

A. General Functions

2.01 When the trunk is seized from the central office, the attendant is alerted by a flashing visual signal and an audible signal that an incoming call is awaiting answer.

2.02 After answering the call and determining what line is desired, the attendant steers into the PBX and dials the line number.

2.03 The attendant may remain on the line to announce the incoming call or may release immediately after receiving ringing induction.

2.04 If the called line is engaged, the central office trunk camps on the connection until the called line becomes idle; then it automatically cuts through and rings the line.

2.05 If the called line is already camped on and a second incoming central office trunk tries to establish connection to it, the trunk circuit returns a camp-on stop visual and audible indication to the attendant who then disconnects the initiated call and notifies the calling party of the busy line condition.

2.06 When a line within the PBX originates a call to the central office, the central office trunk circuit acts as a screening device either to allow or to deny toll calls.

2.07 As soon as a toll-denied line connects to a toll circuit, the central office trunk circuit disconnects the line from the toll connection and diverts it to busy tone.

2.08 A restricted line wanting an outgoing central office connection has to dial the attendant trunk code rather than the central office code.

2.09 After receiving the required information, the attendant places a hold on the attendant trunk circuit and calls the desired number over a central office trunk.

2.10 When the called party answers, the attendant holds the central office connection and steers into the PBX for local dial tone by operating the hold key.

2.11 When local dial tone is heard, the dial-back key is operated; then the attendant dials the calling restricted line number.

2.12 Under this condition, the central office trunk circuit cuts through to the line and causes the line connection held by the attendant trunk to be released.

2.13 Night service connections are established by the attendant between any idle central office trunk circuit and any PBX station.

2.14 Incoming calls can be answered from any PBX station when the PBX is provided with an auxiliary position circuit as a special service circuit and the attendant places the PBX on remote trunk answer operation. The central office trunk functions in a manner similar to that which occurs when the attendant answers and completes an incoming trunk call.

B. Options Applying to the Attendant

2.15 Optional features are provided to permit or prevent the attendant from entering the trunk circuit:

(a) Lockout or nonlockout.

(b) Restriction or without restriction.

2.16 The nonlockout option permits the attendant to reenter, at any time, any connection which the attendant has previously established.

2.17 Lockout prevents reentering an attendant established connection. However, the attendant may reenter the trunk circuit on a recall, camp-on, or camp-on busy condition.

2.18 With restriction, the attendant is prevented from gaining access to the trunk in order to originate a call. The attendant, however, is not prevented from gaining access to the trunk on an incoming call.

2.19 When an attendant reenters the trunk circuit (after having completed a connection) on a recall or with nonlockout, the condition of reentry is determined by the secrecy option.

2.20 The secrecy option splits the connection between the central office and the PBX. The attendant is able to talk to the PBX line but the central office is prevented from hearing the conversation between the attendant and the PBX line.

C. Incoming Call to Idle Line

2.21 An incoming call from the central office alerts the attendant with a 120-IPM flashing visual signal on the trunk lamp and an audible signal. The call is answered by operating the pickup key associated with the incoming trunk signal.

2.22 When the trunk is answered, the trunk lamp lights steadily, the audible is silenced, and the attendant is connected to the central office connection.

2.23 After obtaining the number of the line wanted, the attendant operates the hold key. This changes the trunk lamp indication to a 30-IPM visual signal and steers the attendant into the PBX for local dial tone.

2.24 When the attendant completes dialing, if the called line is idle, the trunk lamp changes to a steady signal and the station lamp starts flashing at 30 IPM, indicating that the called line is being rung.

2.25 The attendant hears ringing induction and operates the release key to release the pickup key, which disconnects her from the connection. When the called line answers, the station lamp changes to a steady visual signal and the central office cuts through to the line.

D. Camp-On

2.26 If the called line is busy, the central office trunk will camp on it (provided the line is not already camped on or the PBX is not on remote trunk answer operation), transmit a 60-IPM visual signal to the station lamp, and transmit busy tone to the attendant.

2.27 The attendant then releases the pickup key which removes the tone and connects the called line to the central office. At this time, the attendant may reenter the trunk by operating the pickup key to notify the calling party of the camp-on condition.

2.28 At calling party request, the attendant may discharge the connection by operating the hold key and then releasing the pickup key or may establish a new connection by operating the hold key twice in succession to steer into the PBX for dial tone.

2.29 If the calling party wishes to remain camped on, the attendant simply releases. When a camped-on line becomes idle, the trunk cuts through and starts ringing, changing the station lamp signal from 60 IPM to 30 IPM. The answering station trips the ringing and changes the station lamp to a steady signal.

E. Camp-On Busy

2.30 If the called line is already camped on, the central office trunk circuit returns a 120-IPM station lamp signal and tone interrupted at 120 IPM to the attendant.

2.31 The attendant then operates the hold key to discharge the connection. This action steers her back to the central office trunk and she announces the camp-on busy condition to the calling party. The attendant either disconnects or establishes a connection to another line (initiated by reoperating the hold key) at calling party request.

2.32 If a busy line is encountered when the PBX is on remote trunk answer operation, the central office trunk circuit returns busy tone interrupted at 120 IPM to the PBX station that answered the call.

F. Recall

2.33 Having once established a connection, the attendant plays no further role in the call unless recalled. If the called line depresses the switchhook momentarily, the central office trunk transmits a 120-IPM station lamp signal and a steady audible signal to the attendant.

2.34 After answering the recall signal, if the central office party is to be transferred to another line, the attendant operates the hold key which disconnects the original connection. On reoperation of the hold key, the attendant once again is steered back into the PBX for dial tone and the trunk lamp flashes at 30 IPM.

G. Automatic Disconnection

2.35 At the termination of an established call, when both parties disconnect, both trunk and station lamps are extinguished and the trunk circuit is again idle.

H. Dial Back Call

2.36 The attendant is called if a restricted line desires an outgoing central office call or a toll-denied line wishes to reach the toll office. After answering the call, the attendant instructs the calling station to remain off-hook until the connection is established.

2.37 The attendant trunk is then held and an idle central office trunk is selected. The attendant operates the central office trunk pickup key, which causes the trunk lamp to light steadily, and then dials the requested number.

2.38 Having reached the requested number, the attendant operates the hold key which changes the trunk lamp signal to 30 IPM and steers the connection into the PBX for local dial tone.

2.39 The dial back key is operated; then the number of the calling station is dialed. The central office trunk circuit connects to the held calling station, causes the attendant trunk to disconnect, and causes the trunk and station lamps to light steadily.

2.40 The attendant announces the established connection to the calling station and then disconnects, connecting the central office through to the station line.

I. Outgoing Trunk Call

2.41 The trunk circuit supervises the call to see that only toll-allowed lines are permitted to gain access to toll circuits. If a toll-denied station calls for a toll connection, the central office trunk circuit functions to divert the calling line to local busy tone and the toll trunk is freed.

2.42 Nonrestricted (toll-denied or toll-allowed) stations may dial the central office directly without the aid of the attendant. When the central office trunk circuit is seized on such calls, both trunk and calling station lamps light steadily and central office dial tone is transmitted back to the calling line.

J. Power Failure and Night Connection

2.43 When the PBX has four of the permanently wired central office trunks

connected to the alarm, transfer, and test circuit the central office cable pairs of these four trunks are connected to four predetermined station line circuits whenever a power failure occurs or they may be connected as night connections by action of the attendant.

2.44 When the PBX has three of the permanently wired central office trunks connected to the alarm, transfer, and test circuit, the attendant may establish a night connection between any idle central office and any station that is idle or busy.

2.45 The attendant operates the night service key to the night service position, operates the pickup key associated with the central office trunk to be night connected, and operates the hold key which steers the connection into the PBX.

2.46 Upon receiving dial tone, the station number that is to be connected for night service is dialed and the release key is operated. The trunk will be either connected directly to the station if the station is idle, or will camp on if the station is busy. As soon as the station becomes idle, the trunk is directly connected.

2.47 In the case of a power failure, the night connections established by the attendant are disconnected, and the three central office cable pairs of the first three central office trunks are connected to three predetermined stations.

2.48 When the PBX is provided with an auxiliary position circuit (for trunk answering from any station), the attendant should establish any night service connections required before placing the PBX on remote trunk answer operation.

SECTION II - DETAILED DESCRIPTION1. OPTIONSA. Options Applying to or Affecting the Central Office Trunk

1.01 Optional wiring and apparatus arrangements to provide certain basic operating features of the trunk are shown in Table A.

Restricted Access

1.02 Central office trunks may be arranged for restricted or unrestricted service by the omission or addition of an option in the dial pulse register.

(a) Restricted central office trunks are denied access to other central office trunks or ringdown tie trunks but are allowed access to dial repeating tie trunks.

(b) Unrestricted central office trunks are permitted access to other central office trunks, ringdown tie trunks, or dial repeating tie trunks.

B. Options Applying to the Attendant

1.03 Options related to lockout, secrecy, and restrictions are shown in Table B. These options determine the conditions under which the attendant may gain access to the trunk; they may be provided singly or in combination.

Basic Attendant Functions

1.04 Regardless of the option furnished, the attendant may do the following:

- (a) Answer incoming calls.
- (b) Reconnect to a trunk previously placed on hold.
- (c) Reconnect to a trunk any time before the called party answers.
- (d) Reconnect in response to a recall signal on any connection previously established.

1.05 In addition, regardless of the options provided, the attendant is denied access to any outgoing trunk (dial 9) connection.

TABLE A

OPTIONS APPLYING TO BASIC OPERATING CONDITIONS

OPTION	FEATURE
T	Provides for wiring certain trunks to certain station line circuits via the alarm, transfer, and test circuit.
V	Provides wiring for trunks not wired to the station line circuit via the alarm, transfer, and test circuit.
S	Arranges relay H to function with central offices having a battery voltage of 40 or more volts.
R	Arranges relay H to function with central offices having a battery voltage of 39 or less volts. (With 39 or less volts, relay H bridged across the trunk with both windings will not get enough current to operate.)
J(MD), YP, YQ	Arrange(s) the trunk for two-way assigned service (allows the trunk to be seized by the marker).
K	Arranges the trunk for unassigned or one-way incoming service (prevents the trunk from being seized by the marker).
F(MD)	Arranges the trunk in conjunction with option T for a fixed night connection.
E(MD), ZJ(MD), YM	Arranges the trunk so that the attendant may connect any station to any trunk for a night connection.

TABLE A (CON'T)	
OPTIONS APPLYING TO BASIC OPERATING CONDITIONS	
OPTION	FEATURE
8	Improves station telephone set transmission characteristics whenever 72-volt central office battery is provided.
XP	Arranges the trunk for 48-volt central office battery operation.

TABLE B

OPTIONS APPLYING TO ATTENDANT FEATURES
OF LOCKOUT, RESTRICTION AND SECRECY

OPTION	FEATURE
Z(MD), XK	<u>Without Lockout</u> - Attendant may reenter a trunk connection previously established.
Omit Z(MD), XK	<u>With Lockout</u> - Attendant may reenter the trunk before the called party answers or in response to a recall signal.
X(MD) Omit Y	<u>With Restriction</u> - Attendant is prevented from originating outgoing calls over the trunk.
Y	<u>Without Restriction</u> - Attendant may originate outgoing calls over the trunk
W	<u>With Secrecy</u> - The trunk is split when the attendant reenters; the central office end is on hold and the attendant is connected to the station. <u>Note:</u> When secrecy is specified, lockout must also be provided.
Omit W	<u>Without Secrecy</u> - The attendant reenters the trunk on a bridging basis and may converse with both the calling and the called parties.

2. INCOMING CALL TO IDLE STATION (SC1)A. Central Office Seizes and Rings
Central Office TrunkSeizure During Silent Interval

2.01 If the trunk is seized during the silent interval of machine ringing, relay H (option R or S provided) operates on tripping battery and ringing ground, and operates relay CT (with option YB or YC).

2.02 Relay CT operated:

(a) Operates relay SR.

(b) Closes part of its locking path.

(c) Connects the central office end of the trunk to the link end of the trunk (cut-through).

(d) Operates the operating path for relay MC via lead IT(90-99) to prevent the trunk from being seized by the marker.

2.03 Relay SR operated:

(a) Lights lamp TL(CDLS POS) or L(6 BUT KEY TEL SET).

(b) Connects ground to lead IT(90-99) to busy the trunk to the marker.

(c) Transfers the ring side of the trunk through the A and B diodes for future trunk-to-marker identification.

(d) Prepares a path for holding relay CT.

(e) Connects off-normal ground to the trunk.

(f) Lights lamp TRK BY in the make busy and busy display circuit to indicate that the central office trunk has been made busy to the marker by a central office trunk call.

2.04 Subsequently ringing signal from the central office operates relay R and relay R operated:

(a) Holds relay CT operated.

(b) Grounds lead LO to the auxiliary position circuit (if option ZZ is provided - see Note 109).

(c) Operates relay R1 (option YD or YE provided).

(d) Provides ground via lead NA (option YE) to 608A or 608D cord switchboard auxiliary signal, fuse alarm, battery cut-off, and miscellaneous circuit to operate audible signal.

2.05 Relay R1 operated:

- (a) Prepares an operating path for relay ACA.
- (b) Locks operated to off-normal ground under control of relay S1.
- (c) Transfers lamp TL(CDLS POS) or L(6 BUT KEY TEL SET) from steady to 120 IPM.
- (d) Extends the continuous ringing (with option ZS) or interrupted ringing at central office rate (with option ZR) via lead BZ(0-9) to operate the audible signal.
- (e) Opens an operating path for relay HM.

2.06 Relay R follows central office ringing which causes the audible signal also to follow the ringing.

2.07 Note: Relays operated: H, CT, SR and R1. Relay R following central office ringing. Lamps L(6 BUT KEY TEL SET) or TL(CDLS POS) flashing at 120 IPM.

Seizure During Ringing Interval

2.08 If the trunk is seized during the ringing interval of machine ringing, relay R operates on the rectified voltage of the ring-up circuit and causes the operation of relay CT. The following operation is the same as that described in 2.01 through 2.07.

Ring-Up Circuit

2.09 The ring-up circuit consists of relay R and associated network of varistor E, diode D, thermistor R, and capacitor R, which serves to rectify the 20-Hz ringing voltage and prevent false line signals from operating relay R.

2.10 When ringing voltage is applied to the tip and ring of this trunk at the central office, one-half cycle of ringing current will flow through capacitor R, thermistor R and diode D, bypassing relay R; but the other half cycle will be blocked by diode D, causing the current to flow through the secondary winding of relay R, thermistor R, and capacitor R to operate relay R.

2.11 Thermistor R normally has a high resistance (over 50,000 ohms), but when ringing current is applied for about one-half second or longer, its resistance is reduced. This provides an operating path for relay R.

2.12 Varistor E has two functions:

- (a) To shunt thermistor R and thus reduce heating current through it during dialing transients. This prevents false relay operation.
- (b) To protect diode D and thermistor R by providing a shunt path which has low resistance to transient voltage peaks. The varistor has a very high resistance to normal ringing and dialing voltages.

2.13 At the end of the ring cycle, relay R releases.

B. Attendant Answers Incoming Call (SC2)

2.14 The attendant answers an incoming trunk call by operating the pick-up key associated with the flashing (120 IPM) L(6 BUT KEY TEL SET) or TL(CDLS POS) lamp. With relay R1 and the pick-up key operated and relays SP and NT in the cordless position circuit normal, relay ACA operates.

2.15 Relay ACA operated:

- (a) Operates relay AC.
- (b) Prepares a holding path under control relays AC and S1.
- (c) Connects both the line and central office end of the trunk circuit to the cordless position circuit.
- (d) Connects the attendant telephone circuit across the central office end of the trunk to trip the ringing and operate relay S.
- (e) Connects, in part, leads T and U from the cordless position circuit to the marker, and leads H, HG, HM, FB, and SP from the cordless position circuit to the trunk.
- (f) Operates relay TLA. Relay TLA operated locks operated to off-normal ground under control of relay SR.

2.16 Relay AC operated transfers the pick-up key control from relay ACA to AC and splits the trunk into a line and trunk end.

2.17 Relay S operated causes relay S1 to operate and perform the following functions:

- (a) Connects a hold circuit for relays CT and ACA.

(b) Releases relay R1.

(c) Connects off-normal ground to the trunk in parallel with relay SR.

(d) Releases relay H.

(e) Transfers lamp L(6 BUT KEY TEL SET) from 120 IPM to steady battery.

(f) Removes ground from lead NA (option YE).

2.18 Relay R1 released transfers lamp TL(CDLS POS) from 120 IPM to steady battery, and silences the audible signal.

2.19 Note: Relays operated: ACA, AC, S, SI, CT, SR, and TLA. Lamp L(6 BUT KEY TEL SET) or TL(CDLS POS) steady.

C. Attendant Establishes PBX Dial Tone
(SC5)

2.20 If the incoming trunk call requires connection from the trunk to a line within the PBX, the attendant operates the hold key (nonlocking), causing relay H in the cordless position circuit to operate momentarily which in turn operates relay HD.

2.21 Relay HD operated:

(a) Connects relay SL to the sleeve lead.

(b) Prepares a path for operating relay TT.

(c) Locks to off-normal ground.

(d) Operates relay SP in the cordless position circuit.

(e) Connects one section of inductor H1 across the tip and ring to hold the central office end of the trunk.

(f) Disconnects the attendant from the trunk end.

(g) Transfers lamp L(6 BUT KEY TEL SET) or TL(CDLS POS) from steady battery to 30 IPM.

2.22 Cordless position circuit relay SP operated:

(a) Connects a short circuit across leads TT and TR toward the trunk end.

(b) Leaves the attendant telephone circuit across lead LT and LR toward the line end of the trunk.

(c) Locks to off-normal ground.

2.23 On release of the hold key, relay H in the cordless position circuit releases and performs the following functions:

(a) Prepares a locking path for relays RS and TT via leads H and HG.

(b) Extends ground to leads T and U, starting the marker.

2.24 Thus, when called by the central office trunk circuit, the marker functions to connect the trunk circuit to a dial pulse register. When the selector magnet timing relay in the marker operates, ground is transmitted through the operated trunk magnet relay in the marker to operate relay HM over lead ST(90-99). The marker has thus received a bid from the trunk for connection to a dial pulse register; it proceeds to operate the trunk hold magnet to establish the connection.

2.25 Relay HM and the trunk hold magnet in the marker operate in parallel. The trunk hold magnet operated:

(a) Closes the crosspoints which connect the loop of the attendant telephone circuit to the dial pulse register via the T and R leads. This gives the attendant PBX dial tone and connects the 100-ohm sleeve ground in the register to the sleeve lead to operate relay SL.

(b) Locks operated with relay HM. The marker having verified that the trunk hold magnet is operated, proceeds to release.

2.26 Relay HM operated:

(a) Holds operated to off-normal ground through operated relays HD and SL and released relay MC.

(b) Transfers holding of relay HD from lead HD to lead H.

- (c) Opens the tens and units start lead to the marker.
- (d) Opens the operating path for relay MC.
- (e) Prepares an alternate path to hold itself and the trunk hold magnet when relays AC and ACA release.
- (f) Opens an operating path for relay ACA.
- (g) Grounds lead RTK to the auxiliary position circuit (if option ZZ is provided - see Note 109).

Note: The number 6 contact of relay HM is a test point.

2.27 Note: Relays operated: CT, HD, AC, SR, HM, TLA, SL, ACA, SL, and S. Lamp L (6 BUT KEY TEL SET) or TL(CDLS POS) flashing at 30 IPM. Cordless position relay SP operated.

2.28 When the attendant has completed dialing into the PBX, the dial pulse register receives and stores the dialed information. This completes the originating function of the call. The register then engages the marker to terminate the call. When the marker functions to terminate the call, the central office trunk circuit identifies itself to the marker as the originating circuit so that the proper connections are made.

Note: This use of the term "terminate" refers to completing the connection between the trunk and the desired (terminal) PBX station.

2.29 If the call is to a station line, the marker directs the trunk to take the following actions:

- (a) Start ringing if the line is idle.
- (b) Return camp-on information if the line is already engaged.
- (c) Return camp-on-busy indication if the line is already camped on.

2.30 If the call is to a tie trunk, the marker directs the central office trunk circuit to couple inductively to the called trunk. The tie trunk furnishes talking battery to the line side of the central office trunk circuit under this condition. If all tie trunks are busy, the marker directs the central office trunk circuit to return camp-on-busy indications.

D. Trunk to Marker Identification (SC6)

2.31 When the dial pulse register has received the dialed information from the central office trunk circuit, the register engages the marker to terminate the call and reverses battery and ground over the tip and ring of the link connection to the trunk circuit. This causes current to flow through diode A and operates relay P.

2.32 Relay P operated transfers lamp L (6 BUT KEY TEL SET) from 30 IPM to steady battery and operates relay MC.

2.33 By operating relay MC, the central office trunk circuit identifies itself to the marker as the circuit requesting information.

2.34 Relay MC operated:

- (a) Releases relay P.
- (b) Locks via lead RLS(E,O) under control of the marker.
- (c) Transfers holding of relay HM and the trunk hold magnet in the marker to lead M(E,O). Relay HM and the trunk hold magnet are controlled by the marker via lead M(E,O) while the marker is engaged in termination of the call.
- (d) Connects leads for termination information as follows:
 - (1) Connects fast flash relay FF to lead FF(E,O).
 - (2) Connects busy relay BY to lead BY(E,O).
 - (3) Connects ring start relay RS to lead RS(E,O).
 - (4) Connects trunk terminating relay TT to lead TT(E,O).
 - (5) Connects no-test relay NT to lead NT.

2.35 Relay P released transfers lamp L(6 BUT KEY TEL SET) from steady battery to 30 IPM.

E. Ring Start (SC6)

2.36 If the marker finds the called station line idle, it transmits a ground on lead RS(E,O) to operate relay RS.

2.37 Relay RS operated:

- (a) Locks to off-normal ground under control of relay RT.
- (b) Prepares the trunk to transmit ringing current to called station line.

- (c) Maintains the holding bridge across the central office line.
 - (d) Releases relay HD.
 - (e) Maintains a holding path for relay SP in the cordless position circuit.
 - (f) Prepares a path for holding relay HM and the trunk hold magnet in the marker after relays HD and MC release.
 - (g) Provides an alternate operating or holding path for relay ACA.
 - (h) Operates relay FB in the cordless position circuit.
- 2.38 Relay HD released:
- (a) Releases relay SL.
 - (b) Connects resistance ground (resistor SH) to the sleeve lead to hold the station line hold magnet.
 - (c) Maintains a holding path for relays SP and FB in the cordless position circuit.
 - (d) Opens one of the holding paths for the trunk end of the trunk.
 - (e) Provides an alternate path for holding relay HM and the trunk hold magnet when the marker releases.
 - (f) Disconnects relay P from the ring side of the trunk.
 - (g) Disconnects relay TT from lead TT(E,O).
 - (h) Flashes lamp SL(CDLS POS) at 30 IPM.
 - (i) Transfers lamp TL(CDLS POS) from 30 IPM to steady.
- 2.39 After the marker has transmitted its terminating data, it releases itself and the dial pulse register from the connection. Release of the marker releases relay MC.
- 2.40 Relay MC released:
- (a) Connects R1 ringing current through the primary winding of relay RT to the ring side of the trunk to ring the called station.
 - (b) Transfers the holding circuit to relay HM and the trunk hold magnet from the marker to the trunk.
 - (c) Disconnects relays BY, RS, NT, and TLA from their respective leads.

- 2.41 Relay FB in the cordless position circuit operated:
- (a) Provides audible ringing feedback to the attendant as an indication that the called line is being rung.
 - (b) Provides transmission batteries to the called station as long as the trunk is split.

2.42 As long as the attendant remains on the connection during the establishment of the call, the transmission path between the central office and the station line remains split.

2.43 Note: Relays operated: RS, CT, HM, TLA, ACA, AC, SR, SL, and S. Lamp TL (CDLS POS) steady, lamp L(6 BUT KEY TEL SET) or SL(CDLS POS) flashing at 30 IPM. Cordless position circuit relays SP and FB operated.

F. Attendant Releases (SC7)

2.44 When the attendant releases from the connection, operation of the release key releases the trunk pick-up key causing relay AC to release.

2.45 Relay AC released:

- (a) Connects the trunk side of the circuit to the line side.
- (b) Releases relay ACA.
- (c) Maintains the holding circuit for relay HM and the trunk hold magnet.

2.46 Relay ACA released releases relays FB and SP in the cordless position circuit and disconnects the attendant telephone circuit from the trunk.

2.47 Disconnection of the attendant telephone circuit removes the short circuit bridge from the trunk side, allowing the central office to hear ringing induction through capacitor FB.

2.48 Note: Relays operated: RS, CT, HM, TLA, SR, SL, and S. Lamp TL(CDLS POS) steady, lamp L(6 BUT KEY TEL SET) or SL(CDLS POS) flashing at 30 IPM.

G. Station Answers (SC8)

2.49 When the station answers, relay RT operates on the primary winding (after its slow-operate interval) and performs the following functions:

- (a) Locks operated through the secondary winding to off-normal ground.
- (b) Closes the operating path for relay ACA (if option Z is furnished).

- (c) Releases relay RS.
 - (d) Maintains a holding circuit for relay HM and the trunk hold magnet.
 - (e) Connects a high resistance bridge across the trunk. This bridge consists of one section of inductor H1 and 1200-ohm resistor HS; it provides non-through supervision to the central office.
 - (f) Lights lamp TRK BY INC in the make busy and busy display circuit.
- 2.50 Relay RS released (after its slow-release interval):
- (a) Removes the low holding bridge from the trunk.
 - (b) Transfers lamp L(6 BUT KEY TEL SET) or SL(CDLS POS) from 30 IPM to steady battery.
 - (c) Transfers the line end of the trunk from ringing to the central office end.
 - (d) Opens an operating circuit for relay ACA.

2.51 The call is now extended from the attendant or from the central office if the attendant has disconnected prior to answer by the station.

2.52 **Note:** Relays operated: RT, CT, HM, TLA, SR, SL, and S. Lamp L(6 BUT KEY TEL SET) or SL(CDLS POS), and TL(CDLS POS) steady.

H. Remote Trunk Answer from Any Station

2.53 Relay LO- in the auxiliary position circuit is connected in parallel with relay RI when the attendant places the PBX on remote trunk answer operation. Relay LO- operates when the central office seizes and rings the central office, and the auxiliary position circuit signals the PBX that a call is waiting.

2.54 The call is answered by dialing the remote trunk answer code from any station. The marker completes a connection between the answering station and the auxiliary position circuit.

2.55 When the auxiliary position circuit is seized by the station, the auxiliary position circuit functions to close the loop to the cordless position circuit that replaces the attendant telephone circuit and to operate relay ACA.

2.56 Relay ACA operated connects the auxiliary position circuit loop across the central office end of the trunk to trip the ringing and operate relay S. This

completes a talking path between the answering station and the central office end to the trunk via the auxiliary position circuit.

2.57 To complete the trunk call to another station, the auxiliary position circuit functions to steer the line end of the central office trunk into the PBX to establish a PBX dial tone.

2.58 The answering station dials the desired code. Trunk to marker identification and ring start proceed as described. Relay RT operates when the called station answers.

2.59 Relay RT operated opens the ground path to lead RTK- to prevent the auxiliary position circuit from releasing the connection between the called station and the line end of the trunk when the auxiliary position circuit releases.

2.60 The station that answered the trunk call disconnects to extend the call from the central office to the called station. The central office trunk functions in the same manner as when the attendant releases after the called station answers.

3. OUTGOING TRUNK CALL

A. Outgoing Dial Selected Trunk Call (SC22)

3.01 When a station, tie trunk (other than a ringdown tie trunk), or the attendant using a central office trunk or ringdown trunk dials the central office directing code, the marker tests for an idle central office trunk circuit by testing lead IT (90-99) for battery. When the select magnet test relays operate in the marker, ground is connected to lead IT(90-99) to operate relay MC.

3.02 Relay MC operated:

- (a) Locks to the marker via lead RLS(E,O).
- (b) Connects relays BY, RS, IT, TLA, NT, RT, and FF to the marker circuit via their respective leads.
- (c) Opens the primary winding of relays P and RT.
- (d) Operates relay HM and the trunk hold magnet.
- (e) Connects lead M(E,O) to lead ST (90-99).

3.03 If the station originating the call is a toll-allowed line, relay TLA operates when relay MC operates.

3.04 Relay TLA operated:

- (a) Locks operated to off-normal ground.
- (b) Connects a shunt path across diode A to prevent the operation of relay P if a toll code is dialed.

3.05 The trunk hold magnet closes the tip, ring, and sleeve of the calling line to the central office trunk circuit in parallel with the dial pulse register on the same link. Connections to and from the central office are made on a trunk class-of-call basis: that is, connections are made over a single link from the central office trunk circuit to the calling or called line.

3.06 Closure of the crosspoints performs the following functions:

- (a) Connects resistance ground (resistor SH) to sleeve lead S to hold the calling line or tie trunk.
- (b) Connects the station loop to operate relay S. The operating path for relay S is from battery at resistor BF to ground at contact 6 of relay SR.

3.07 Relay S operated operates relay SL which performs the following functions:

- (a) Lights lamps L(6 BUT KEY TEL SET), SL(CDLS POS), and TL(CDLS POS).
- (b) Connects off-normal ground to the trunk circuit.
- (c) Opens lead IT(90-99) toward the trunk and connects ground toward the marker as a busy.
- (d) Connects ground to the ring side of the trunk toward the central office as a start ground for the line circuit.
- (e) Prepares a circuit to operate relay H when the line circuit in the central office has functioned.

3.08 After the marker tests to see that the trunk hold magnet is operated, it operates the marker release relays to release relay MC and the dial pulse register. Relay HM and the trunk hold magnet are held by off-normal ground.

3.09 When start ground is furnished to the central office, the central office line circuit operates and returns dial tone to the PEK; or, if a manual central office, the operator answers. In either case, relay H operates and in turn operates relay CT.

3.10 Relay CT operated:

- (a) Operates relay SR.

(b) Connects the trunk tip and ring to the central office for second dial tone.

(c) Prepares a holding circuit under control of relays SR and SL.

3.11 Relay SR operated:

- (a) Connects off-normal ground in parallel with relay SL.
- (b) Replaces the ground on lead IT(90-99) provided by relay SL.
- (c) Releases relay H.
- (d) Removes start ground from the ring side of the trunk.
- (e) Completes the holding circuit for relay CT.
- (f) Closes the P relay circuit (toll diversion) in the ring side of the trunk if relay TLA is unoperated. The calling station may now complete the call into the central office.

3.12 Note: Relays operated: CT, HM, SR, SL, S, TLA (if toll-allowed station). Lamps L(6 BUT KEY TEL SET), SL(CDLS POS), and TL(CDLS POS) steady.

B. Toll-Allowed Service

3.13 If a station or tie trunk (other than a ringdown tie trunk) originating a call through the central office trunk circuit is equipped for toll-allowed service, the TLA relay operates when the trunk circuit is seized.

3.14 Relay TLA operated shunts diode A and opens the P relay circuit used to sense battery reversal from the toll office. Under this condition, the P relay does not operate and the call can progress to a toll circuit.

C. Toll-Denied Service (SC23)

3.15 When a toll-denied line or tie trunk (other than a ringdown tie trunk) connects to a central office trunk circuit for outward dialing, relay TLA does not operate. On a local call, battery from the central office flows through diode A and does not operate relay P. If a toll code is dialed, the reversal of battery from the toll office causes current to flow through diode B and the primary winding of relay P which operates.

3.16 Relay P operated:

- (a) Locks operated to off-normal ground on its secondary winding.

- (b) Releases relay CT.
 - (c) Connects busy tone to the ring side of the trunk toward the calling station.
 - (d) Connects ground to the tip side of the trunk.
 - (e) Prevents the connection of start ground to the ring side of the trunk when relay SR releases.
- 3.17 Relay CT releases after its slow release interval, releases relay SR, and disconnects the trunk from the central office. The calling line is thus denied access to toll and can proceed no further.
- 3.18 If the central office trunk is seized at the central office during the time that the diverted station line is connected to the busy tone signal, relay R operates as soon as ringing current is transmitted.
- 3.19 Relay R operated:
- (a) Operates relay Rl.
 - (b) Grounds lead LO to the auxiliary position circuit (if option ZZ is provided - see Note 109).
- 3.20 Relay Rl operated:
- (a) Releases relay HM.
 - (b) Removes ground from lead ST(90-99) to the marker, causing the release of the trunk hold magnet and permitting the crosspoints to open.
 - (c) Connects continuous ringing (option ZS) or interrupted ringing (option ZR) to lead BZ(0-9) for audible signal.
 - (d) Transfers lamp TL(CDLS POS) from steady to 120 IPM.
- 3.21 Relay HM released:
- (a) Removes resistance ground (resistor SH) from lead S.
 - (b) Removes ground from lead RTK to the auxiliary position circuit.
 - (c) Extinguishes lamp SL(CDLS POS).
- 3.22 The local toll denied station will be returned to PBX dial tone, and the trunk will restore to normal. During the next ringing period, relay R and the trunk circuit function as under incoming calls.
- D. Attendant Originates Trunk Call - Not Restricted - Option Y (SC18)
- 3.23 If the attendant is not restricted, operation of a pick-up key associated with an idle trunk operates relay ACA.
- 3.24 Relay ACA operated:
- (a) Prepares locking circuits under control of relays AC and Sl.
 - (b) Operates relay AC.
 - (c) Connects the attendant telephone circuit across the trunk.
- 3.25 Relay AC operated locks relay ACA and splits the trunk. Relay S operates via the loop through the attendant telephone circuit and operates relay Sl.
- 3.26 Relay Sl operated:
- (a) Holds relay ACA.
 - (b) Prepares an operating circuit for relay H.
 - (c) Connects start ground to the ring side of the trunk.
 - (d) Connects off-normal ground to the trunk.
 - (e) Lights lamp TRK BY in the make busy and busy display circuit.
 - (f) Lights lamp L(6 BUT KEY TEL SET) or TL(CDLS POS).
 - (g) Connects ground to lead IT(90-99) to busy the trunk to the marker.
- 3.27 The line circuit at the central office functions in response to the start ground to return dial tone or to bring in the central office operator and also operates relay H. Relay H operates relay CT.
- 3.28 Relay CT operated:
- (a) Operates relay SR.

(b) **Locks** under control of relays **SI** and **SR**.

(c) **Cuts** the trunk through to the attendant.

3.29 Relay **SR** operated:

(a) **Releases** relay **H**.

(b) **Locks** relay **CT**.

(c) **Transfers** ground on lead **IT(90-99)** from relay **SI** to relay **SR**.

(d) **Removes** the start ground from the ring side of the trunk.

3.30 **The attendant** is now connected to the **central** office and may complete the call.

3.31 Note: Relays operated: **CT, ACA, AC, SR, SI, S**. Lamp **L(6 BUT KEY TEL SET)** or **TL(CDLS POS)** steady.

4. CAMP-ON

A. Camp-On Call Station Busy (SC12, 13)

4.01 When the attendant has **completed** dialing into the **PBX**, the dial pulse register receives and stores the dialed information completing the originating function on the call. The register then engages the marker to terminate the call.

4.02 When the marker functions to terminate the call, the central office trunk circuit identifies itself to the marker as the originating circuit so that the proper connections can be made.

4.03 When the dial pulse register has received the dialed information from the central office trunk circuit, it reverses battery and ground over the tip and ring of the link connection to the trunk circuit. This causes current to flow through diode A and operate relay P.

4.04 Relay P operated transfers lamp L (6 BUT KEY TEL SET) from 30 IPM to steady battery and operates relay MC.

4.05 By operating relay MC, the central office trunk circuit identifies itself to the marker as the circuit requesting termination. If the called station line is busy when the marker tests, the camp-on relays in the marker operate.

4.06 Relay MC operated:

(a) **Releases** relay P.

(b) **Locks** to lead **RLS(E,O)** under control of the marker.

(c) **Transfers** the holding of relay HM and the trunk hold magnet to lead M(E,O) (only while the marker is terminating the call).

(d) **Connects** relays **FF, RS, BY, TT, TLA**, and **NT** to their respective leads.

4.07 Relay P released transfers lamp L (6 BUT KEY TEL SET) from steady battery to 30 IPM. The marker in terminating the call grounds lead BY(E,O) which operates relay BY.

4.08 Relay BY operated:

(a) **Disconnects** the trunk tip and ring leads to the link so that ringing current will not be transmitted to the station line as long as the trunk is camped on.

(b) **Operates** relays **DR** and **DRA** which have no functions at this time.

(c) **Releases** relay **SL**.

(d) **Partially** connects a sensing circuit to lead S consisting of resistor SH and relay SL which will operate when the called station line becomes idle.

(e) **Connects** busy tone to the cordless position circuit.

(f) **Opens** the CR leau.

(g) **Flashes** lamp **SL(CDLS POS)** at 60 IPM.

(h) **Locks** operated under control of relays **SL** and **HM**.

4.09 During the process of marker functioning for a camp-on call, the camp-on relays in the marker release which removes ground from lead M(E,O) allowing relay HM and the trunk hold magnet to release. Relay HM released extinguishes lamp SL (CDLS POS).

4.10 The trunk is now free from its originating link on which the dial pulse register is still connected. The marker then functions to operate the select magnet for the link to which the busy station line is connected.

4.11 When the select magnet timing relay in the marker operates, ground is connected to lead M(E,0) which operates relay HM and the trunk hold magnet. Relay HM operated connects lamp SL(CDLS POS) to 60 IPM.

4.12 The trunk is now connected to the busy link. When the hold magnet timing relay in the marker operates, ground is connected to lead RS(E,0) to operate relay RS.

4.13 Relay RS operated:

- (a) Releases relay HD.
- (b) Locks operated to the fundamental ground under control of relay RT.
- (c) Connects an alternate hold path for relay HM and the trunk hold magnet when relays MC and HD release.
- (d) Completes the sensing circuit to relay SL.
- (e) Maintains a holding circuit across the central office end of the trunk.
- (f) Prepares the trunk to ring the station when relay BY releases.
- (g) Prepares a circuit for the attendant to operate relay ACA.
- (h) Maintains the holding circuit for relay SP in the cordless position circuit when relay HD releases.
- (i) Operates relay FB in the cordless position circuit to provide busy tone to the attendant.

4.14 Relay HD released:

- (a) Transfers lamp L(6 BUT KEY TEL SET) from 30 IPM to 60 IPM.
- (b) Transfers lamp TL(CDLS POS) from 30 IPM to steady battery.
- (c) Changes the holding circuit for relays HM, the trunk hold magnet, and relay SP in the cordless position circuit.
- (d) Connects leads TT and TR from the cordless position to the central office end of the trunk.

4.15 Having completed the connecting functions, the marker releases relay MC which restores the hold magnet control to

the trunk circuit. The attendant is visually alerted with 60 IPM flashing lamp L(6 BUT KEY TEL SET) or SL(CDLS POS) and audibly alerted by busy tone in the telephone circuit.

4.16 Note: Relays RS, DR, DRA, CT, BY, HM, TLA, ACA, AC, SR, SL, S are operated. Relays SP and FB are operated in the cordless position circuit. Lamp TL(CDLS POS) is steady. Lamp SL(CDLS POS) or L(6 BUT KEY TEL SET) is flashing at 60 IPM.

4.17 Having received the camp-on indications, the attendant operates the release key in the cordless position circuit which mechanically releases the pickup key. When the pickup key releases, relays AC and ACA restore to normal releasing relays SP and FB in the cordless position circuit. Relay ACA released removes the busy tone from the attendant telephone circuit.

4.18 When the attendant reoperates the pickup key to notify the calling party of the camp-on condition, relay ACA operates in turn operating relay AC (and relay IC- if provided when option YK is specified).

4.19 Relay IC- operated, operates relay CS in the cordless position circuit and prepares to connect tone generator IT of the cordless position circuit to the tip and ring of the line side of the trunk.

4.20 Relay CS operated in the cordless position circuit:

- (a) Completes the locking path for relays IC- and CS.
- (b) Connects ground to tone generator IT.
- (c) Prepares an operating path for relay SS in the cordless position circuit.
- (d) Operates relay CO in the cordless position circuit.

4.21 Relay CO operated, locks under control of relay IC- and opens the operating paths of all relays IC-.

4.22 After notifying the calling party of the camp-on condition, the attendant releases, mechanically releasing the trunk pick-up key. The pick-up key released, releases relay AC which releases relay ACA and operated relay SS in the cordless position circuit.

4.23 Relay SS operated:

- (a) Slow releases relay CS.
- (b) Connects a second ground to tone generator IT in the cordless position circuit.
- (c) Provides a holding path for relay IC upon the release of relay CS.
- (d) Connects tone to the tip and ring of the line side of the trunk for approximately 1/2 second.

4.24 Relay CS released, slow releases relay SS which removes ground from tone generator IT turning it off and removes tone from the tip and ring leads. Relay SS released, also releases relay IC which, in turn, releases relay CO in the cordless position circuit.

4.25 Relays operated during camp-on are: RS, DR, DRA, CT, BY, HM, TLA, SR, S1, and S. Lamp TL(CDLS POS) is steady and lamp SL (CDLS POS) or L(6 BUT KEY TEL SET) is flashing at 60 IPM.

B. Camp-On Station Becomes Idle (SC8, 14)

4.26 With relays BY and RS operated, a sensing circuit is established on the sleeve of the connection to determine when the station line becomes idle.

4.27 Relay SL is connected in a bridge circuit consisting of resistors PD and SH in the central office trunk circuit, the line hold magnet in the marker, and the 100-ohm sleeve resistance in the circuit that is engaged with the busy station line.

4.28 During camp-on, the potential across relay SL is insufficient to operate it. soon as the engaged connection releases the 100-ohm ground on the sleeve is removed, relay SL is placed in series with the line hold magnet. Relay SL operates releasing relay BY.

4.29 Relay BY released:

- (a) Releases relays DR and DRA if the station is on-hook.
- (b) Connects the trunk tip and ring to the link toward the station for ringing.
- (c) Releases relay SL.

- (d) Connects resistor SH to the sleeve lead to hold the line hold magnet.
- (e) Transfers lamp L(6 BUT KEY TEL SET) or SL(CDLS POS) from 60 IPM to 30 IPM.

4.30 Relay DR remains operated after relay BY releases if the called station is still off-hook. This action prevents the ringing current from being applied to the station line which would cause a premature ring trip condition.

4.31 When the station goes on-hook, relays DR and DRA release to establish a ringing path through the primary winding of relay RT to the ring side of the trunk.

4.32 Note: Relays RS, CT, HM, TLA, SR, S1, and S are operated. Lamp TL(CDLS POS) is steady; lamp L(6 BUT KEY TEL SET) or TL(CDLS POS) is flashing at 30 IPM.

4.33 When the station answers, relay RT operates after its slow-operate interval and:

- (a) Locks to the fundamental ground via the secondary winding.
- (b) Prepares an operating circuit for relay ACA (if option Z is provided).
- (c) Connects a high-resistance bridge (resistor HS and inductor H1) across the trunk to hold the central office.
- (d) Prepares an operating path for relay FF.

(e) Releases relay RS.

4.34 Relay RS released:

- (a) Opens the low-resistance bridge (inductor H) across the trunk.
- (b) Transfers lamp L(6 BUT KEY TEL SET) or SL(CDLS POS) from 30 IPM to steady battery.
- (c) Disconnects ringing from the line.
- (d) Connects the trunk to the link. The central office and the station may now converse.

4.35 Note: Relays RT, CT, HM, TLA, SR, S1, and S are operated. Lamps L(6 BUT KEY TEL SET), SL(CDLS POS), and TL(CDLS POS) are steady.

C. Camp-On Discharge (SC16)

4.36 If the calling party elects to be connected to another line or to hang up after being notified of the camp-on condition, the attendant does not release but instead operates the hold key.

4.37 When the attendant operates the hold key (nonlocking), relay H operates in the cordless position circuit. Relay H operated:

- (a) Releases relay RS by opening the lead to the fundamental ground.
- (b) Maintains a holding path for the trunk hold magnet and relay HM when relay RS releases.

4.38 Relay RS releases after its slow-release interval and:

- (a) Removes the H1 inductive bridge from across the trunk.
- (b) Removes the ringing leads to the PBX end of the trunk.
- (c) Disconnects the sensing circuit to relay SL.
- (d) Partially restores the operating path for relay HD.
- (e) Removes a holding path for the trunk hold magnet and relay HM.

4.39 When the hold key is released, relay H releases. This releases the trunk hold magnet and relay HM by removing ground via lead HM from the position circuit.

4.40 When the trunk hold magnet releases, the PBX link drops but the central office end of the trunk is held by the loop provided by the attendant telephone circuit leads TT and TR and relay SP normal in the position circuit.

4.41 Relay HM released releases relay BY and extinguishes lamp SL(CDLS POS).

4.42 Relay BY releases after its slow-release interval and:

- (a) Releases relay DR.
- (b) Opens the busy tone lead BT.
- (c) Transfers lamp L(6 BUT KEY TEL SET) from 60 IPM to steady battery.

4.43 Note: Relays ACA, AC, CT, TLA, SR, SL, and S are operated. Lamp TL (CDLS POS) or L(6 BUT KEY TEL SET) is steady.

4.44 If the call is to be rerouted, the attendant operates the hold key again for PBX dial tone and the action is the same as for a new incoming call.

4.45 If the call is to be disconnected, the attendant operates the release key. The trunk restores to normal when the central office disconnects.

D. Camp-On Busy (SC15,16)

4.46 The action of the trunk, marker, and register are the same as described in 4.01 through 4.25 except for the following considerations: The marker in terminating the call grounds lead BY(E,0) to operate relay BY and in the process of link testing connects a solid ground on sleeve lead S.

4.47 When this test ground is connected to the sleeve lead S, there is a path through the trunk that has camp-on priority via contacts of operated relays BY, RS, and DR, diode F, and lead CW to operate the camp-on stop relay in the marker.

4.48 The G diode prevents the SL relay from operating in the trunk with camp-on priority. With the camp-on stop relay operated in the marker, relay FF operates.

4.49 Relay BY operated prepares a lockup circuit for relay FF. Relay FF operated:

- (a) Connects an operating path for relay ACA.
- (b) Connects in part a low shunt across the trunk.
- (c) Bridges the cut-through contacts of relay CT.
- (d) Parallels the operating path of relay DR.
- (e) Locks operated under control of relays BY and SR.
- (f) Transfers lamp L(6 BUT KEY TEL SET) from 30 IPM to 120 IPM.

4.50 Relays BY and FF jointly connect 120-IPM busy tone to the attendant telephone circuit, and relays FF and DR jointly connect lamp SL(CDLS POS) to 120 IPM.

4.51 The operation of relay FF prevents relay SL from operating regardless of whether the camp-on line becomes idle. The sensing circuit is, therefore, functionless and only the trunk that was originally camped-on will cut through and provide ringing when the line becomes idle.

4.52 When relay HM reoperates over the M(E,O) lead with relay FF operated, the SL(CDLS POS) lamp changes to 120 IPM. When relay HD releases due to the operation of relay RS, the L(6 BUT KEY TEL SET) lamp remains flashing at 120 IPM with FF operated.

4.53 Having completed the connecting functions, the marker releases relay MC which restores the hold magnet control to the trunk circuit. The attendant is visually alerted with 120-IPM flashing lamp L(6 BUT KEY TEL SET) or SL(CDLS POS) and audibly alerted by busy tone interrupted at 120 IPM.

4.54 Note: Relays ACA, AC, RS, DR, DRA, CT, BY, HM, TLA, SR, S1, S, and FF and relays SP and FB in the cordless position circuit are operated. Lamp TL(CDLS POS) is steady and lamp L(6 BUT KEY TEL SET) or SL(CDLS POS) is flashing at 120 IPM.

4.55 Having received the camp-on busy indication, the attendant operates the hold key which operates relay H in the cordless position circuit.

4.56 Relay H follows the action of the hold key (nonlocking). When relay H in the cordless position circuit operates, relay RS releases, in turn releasing relay SP in the cordless position circuit. Relay SP releases relay FB in the cordless position circuit.

4.57 When the hold key is released, relay H in the cordless position circuit releases releasing the trunk hold magnet and relay HM. This causes relay BY to release and in turn release relays DR and DRA.

4.58 Relay SP in the cordless position circuit released removes the short circuit from the trunk and relay FB released disconnects the 120-IPM tone. The attendant now advises the calling party of the progress of the call.

4.59 Note: Relays CT, TLA, ACA, AC, SR, S1, and S are operated. Lamp L(6 BUT KEY TEL SET) or TL(CDLS POS) is steady.

4.60 Make contact on relay DR is provided in the CW to isolate the CW lead to the marker. This prevents a faulty diode in some other trunk circuit from "feeding-out" to the CW lead and falsely operating relay SL.

4.61 At calling party request, the attendant may reroute the call to another station or many disconnect. The action is the same as described in the preceding section for rerouting or disconnection.

E. PBX On Remote Trunk Answer Operation

4.62 When the PBX has been conditioned for remote trunk answering, the action of the trunk, marker, and register is the same as described for camp-on busy except for the following considerations.

4.63 The marker in terminating the call grounds leads BY and FF to operate relays BY and FF when the called station line is busy.

4.64 Relays ACA, BY, and FF operated and relays FB in the cordless position circuit operated complete a path to return busy tone, interrupted at 120 IPM, to the answering station via the auxiliary position circuit.

4.65 The auxiliary position circuit functions to operate and release relay H in the cordless position circuit to discharge the busy condition. The PBX functions to reconnect the answering station to the central office so that the calling party can be advised of the progress of the call.

5. RECALL

A. Station Recall - Option ZW (SC11)

5.01 Once a station has answered on an incoming central office call or a dial back call, the station may recall the attendant by momentarily depressing the switchhook. Relay S follows the operation of the switchhook and when released removes ground to release relay S1 and connects ground to operate relay FF.

5.02 Relay FF operated:

- (a) Prepares a circuit so the attendant may operate relay ACA.
- (b) Connects a low resistance bridge (resistor LS and inductor H1) across the central office end of the trunk.
- (c) Bridges the cut-through contacts of relay CT.
- (d) Locks under control of relays AC and SR.
- (e) Prepares circuits to transfer lamp L(6 BUT KEY TEL SET) or SL(CDLS POS) to 120 IPM and to operate the audible signal.
- (f) Extinguishes lamp L(6 BUT KEY TEL SET) or SL(CDLS POS).

5.03 When the switchhook is released, relay S reoperates. Relay S operated:

- (a) Holds relay S1 if it has not released.

(b) Operates relay S1 if it did release.

(c) Operates relays DR and DRA.

5.04 Relay DR operated flashes lamp L (6 BUT KEY TEL SET) or SL(CDLS POS) at 120 IPM, and connects continuous ringing to the audible signal. Relay DRA operated connects audible ringing to the station line.

5.05 Note: Relays DR, DRA, CT, RT, HM, TLA, SR, S1, FF, and S are operated. Lamp TL(CDLS POS) is steady; lamp L(6 BUT KEY TEL SET) or SL(CDLS POS) is at 120 IPM.

5.06 The attendant recognizes the 120 IPM flashing lamps and the continuous audible signal as a station recall. When the attendant answers the recall by operating the pick-up key, relay AC operates.

5.07 Relay AC operated releases relay FF and, with option W, operates relay SP in the cordless position which splits the trunk to provide secrecy.

5.08 Relay FF released:

(a) Disconnects the low-resistance bridge from the trunk.

(b) Silences the audible signal.

(c) Releases relay DR.

(d) Transfers lamp L(6 BUT KEY TEL SET) or SL(CDLS POS) from 120 IPM to steady battery.

(e) Opens the operating path of relay ACA to prevent the attendant from re-entering for any reason other than recall (if option Z(MD) or XK is not provided).

5.09 Note: Relays CT, RT, HM, TLA, ACA, AC, SR, S1, and S are operated. Lamps L(6 BUT KEY TEL SET), SL(CDLS POS), and TL(CDLS POS) are steady.

5.10 If the switchhook is depressed until relay S1 releases, relay CT releases allowing relay SR to start to release. When relay S1 reoperates, relay CT operates through the make contact of relay FF.

5.11 Relay CT operated reestablishes the operate path for relay SR. Thus as long as relay CT can be reoperated before relay SR releases, the switchhook signal actuates a recall condition.

5.12 If the switchhook signal is of such duration that relay SR releases before relay CT is reoperated, the central office disconnects.

5.13 If the trunk is connected to a panel central office, a false recall situation occurs when the panel office disconnects. In the process of disconnect, the

potential on lead R from the panel office is removed and replaced before being finally removed. This causes relay S to release and operate relay FF as described previously.

5.14 To prevent this false recall, a detector circuit per FS7 (App Fig. 4) recognizes whether or not there is a potential on lead R. As long as the potential remains on lead R, transistor Q1 is "switched on" allowing the station to recall in the normal way. However, when the potential is removed, transistor Q1 is "switched off" which prevents relay FF from operating when relay S releases, eliminating the false recall condition.

B. Station Dial Transfer - Option ZX(SC39)

5.15 After a station has answered an incoming central office call or dial back call, the station may transfer this call to another station by momentarily depressing the switchhook.

5.16 Relay S follows the operation of the switchhook and when released removes ground to release relay S1 and connects ground to operate relay FF.

5.17 Relay FF operated:

(a) Prepares a circuit so the attendant may operate relay ACA.

(b) Connects a low-resistance bridge (resistor LS and inductor H1) across the central office end of the trunk.

(c) Bridges the cut-through contacts of relay CT.

(d) Locks under control of relays AC and SR.

(e) Prepares circuits to transfer lamp L(6 BUT KEY TEL SET) or SL(CDLS POS) to 120 IPM.

5.18 When the switchhook is released, relay S reoperates.

5.19 Relay S operated:

(a) Holds relay S1 if it has not released.

(b) Operates relay S1 if it did release.

(c) Operates relays DR and DRA.

5.20 Relay DR operated grounds lead TP- to the station dial transfer controller circuit operating relay TP- in the controller circuit to start a station dial transfer.

C. Trunk Recall

5.21 When the central office trunk is terminated by a tie trunk other than a ringdown tie trunk, the station terminating the tie trunk may recall the attendant by momentarily depressing the switchhook. If the tie trunk is terminated by a cord switchboard, recall is accomplished by momentarily removing the cord.

5.22 In either case, relay P releases and reoperates. Relay P released:

- (a) Releases relay S by opening the bridge across the central office end of the trunk.
- (b) Transfers lamp L(6 BUT KEY TEL SET) from steady to 30 IPM.

5.23 Relay S released operates relay FF.

5.24 Relay FF operated:

- (a) Provides a path for the attendant to operate relay ACA.
- (b) Connects low-resistance shunt (resistor LS and one winding of inductor H) across the central office end of the trunk.
- (c) Bridges the cut-through contacts of relay CT.
- (d) Locks operated under control of relay AC.
- (e) Prepares a circuit to operate relay DR.
- (f) Transfers lamp L(6 BUT KEY TEL SET) from 30 IPM to the contacts of relay DR.

5.25 When relay P reoperates, it operates relay S which in turn operates relays DR and DRA. Relay DRA operated connects audible ringing to the station line. Relay DR operated connects continuous ringing to lead BZ(0-9) to activate the audible signal and connects lamp L(6 BUT KEY TEL SET) or SL(CDLS POS) to 120 IPM. The attendant is now alerted for a tie trunk recall.

5.26 Note: Relays P, DR, DRA, CT, TT, RT, HD, HM, TLA, SL, SR, S1, FF, and S are operated. Lamp TL(CDLS POS) is steady, and lamp L(6 BUT KEY TEL SET) or SL(CDLS POS) is at 120 IPM.

5.27 When the attendant answers the recall, the trunk action is the same as described in 5.01 through 5.14 except that relays P, HD, TT, and SL remain operated.

6. RERING

A. Toll-Allowed Station (SC28)

6.01 If a toll-allowed station originates a call to the toll office and elects to hang up while the toll operator holds the connection, relay S releases causing relay S1 to release.

6.02 Relay S1 released:

- (a) Causes relay H to operate from the hold connection.
- (b) Removes the holding circuit for relay CT.
- (c) Removes one of the parallel fundamental grounds.
- (d) Restores the locking path for relay R1.
- (e) Extinguishes lamp SL(CDLS POS) leaving lamp L(6 BUT KEY TEL SET) or TL(CDLS POS) lighted steady.

6.03 Relay H operated holds relay CT. When the toll operator rerings on the circuit, only the station is rung. Relay R operates on the ringing current but since relay TLA is operated, relay R1 is prevented from operating.

6.04 With relay R1 normal, the attendant is bypassed. When the station answers, relay S operates, in turn operating relay S1. Relay S1 operated:

- (a) Releases relay H.
- (b) Holds relay CT.
- (c) Connects a parallel off-normal ground.
- (d) Lights lamp SL(CDLS POS).

6.05 If the toll operator had disconnected instead of reringing, relay H would have released, in turn releasing relay CT. Relay CT released releases relay SR which removes the fundamental ground, releases relay HM and the trunk hold magnet, and extinguishes lamp L(6 BUT KEY TEL SET) or TL(CDLS POS).

B. Toll-Denied or Restricted Station (SC38)

6.06 If a toll-denied or a restricted station has been connected to a toll office by the attendant using the no-test key and the station elects to hang up, relay S releases, in turn releasing relay S1 and operating relay FF.

6.07 Relay FF operated:

- (a) Provides a path for the attendant to operate relay ACA.
- (b) Connects a low-resistance bridge (resistor LS and inductor H1) across the trunk toward the trunk office.
- (c) Bridges the cut-through contacts of relay CT.
- (d) Locks operated under control of relays AC and SR.
- (e) Extinguishes lamp SL(CDLS POS). Relay SL released connects relay H to the trunk circuit and releases relay CT which in turn releases relay SR.

6.08 Relay SR released:

- (a) Releases relay FF.
- (b) Removes ground from lead IT(90-99).
- (c) Removes the fundamental ground which releases relay HM and the trunk hold magnet.

6.09 The station is now disconnected since the crosspoints are open. As long as the toll operator holds, the circuit relay H remains operated. When relay FF restores to normal, relay CT operates in turn operating relay SR.

6.10 Relay SR operated connects the fundamental ground to the trunk and connects ground to lead IT(90-99) to busy the trunk. The trunk circuit is now in the same condition as if it were seized at the central office during the silent interval of the ringing cycle. When the toll operator rerings, the attendant receives the signal as an incoming call.

C. Attendant Originated Call to Toll Office

6.11 With option A, if the attendant disconnects, the toll operator may rering. The rering operates relay R in turn operating relay R1 (relay TLA normal). Relay R1 operated locks to the fundamental ground under control of relay S1 and changes lamp TL(CDLS POS) to 120 IPM.

6.12 Relays R and R1 operated jointly connect ringing current to the audible signal in the cordless position circuit. (The audible signal follows the rering.)

6.13 With option A, if the attendant holds instead of releasing, the toll operator may rering. The rering operates relay R in turn operating relay R1. Relay R1 operated flashes lamp TL(CDLS POS) at 120 IPM

and relays R and R1 operated jointly connect ringing current to the audible signal. (The audible signal and 120-IPM flashing lamp TL(CDLS POS) follow the rering.)

7. HOLDING

A. Attendant Holds Incoming Call (SC19)

Register Seized Before Attendant Releases

7.01 If a register is seized and a dial tone connection is established, the course of events is as described in 2.20 through 2.30. The operation of the release key in the cordless position circuit releases the pick-up key which in turn releases relay AC.

7.02 Relay AC released:

- (a) With relay HD operated, connects inductor H in series with diode C across the line side of the trunk.
- (b) Releases relay ACA.
- (c) Maintains a holding circuit for relay HD.

7.03 Relay ACA released:

- (a) Disconnects the attendant telephone circuit from the trunk.
- (b) Releases relay SP.
- (c) Opens leads H, HG, HD, HM, SP, SR, BT, NT, T, U, and FB.

7.04 The disconnection of the attendant telephone circuit removes the loop causing relay L in the dial pulse register to release. (Diode C presents an open circuit to relay L.)

7.05 Relay L released causes the dial pulse register to release which removes the 100-ohm ground from the sleeve of the link. The removal of this ground releases the register hold magnet and relay SL.

7.06 Relay SL released releases relay HM (relay TLA operated has opened an alternate holding path) and releases the trunk hold magnet. Relay HD remains operated to keep lamp L(6 BUT KEY TEL SET) or TL(CDLS POS) flashing at 30 IPM, and maintains the holding bridge (inductor H1) across the trunk toward the central office.

Attendant Releases Before Register is Seized

7.07 If the attendant holds a trunk and a register is not seized due possibly to heavy traffic, the operation of the hold key (nonlocking) operates relay H in the cordless position circuit.

7.08 Relay H follows the action of the hold key to operate relay HD and prepares a circuit to operate relay SP in the cordless position circuit.

7.09 Relay HD operated:

- (a) Locks to off-normal ground.
- (b) Operates relay SP in the cordless position circuit.
- (c) Connects inductor H1 across the trunk to hold the central office.
- (d) Disconnects the attendant from the central office end of the trunk.
- (e) Transfers lamp L(6 BUT KEY TEL SET) or TL(CDLS POS) from steady battery to 30 IPM.

7.10 The operation of the release key releases the pick-up key which releases relay AC. Relay AC released releases relay ACA. Since the dial pulse register was not seized, the release of relays AC and ACA simply disconnects the attendant telephone circuit from the trunk. Relay HD remains operated to hold the central office and to keep lamp L(6 BUT KEY TEL SET) or TL(CDLS POS) flashing at 30 IPM.

7.11 Note: Relays CT, HD, TLA, SR, S1, S are operated. Lamp L(6 BUT KEY TEL SET) or TL(CDLS POS) is flashing at 30 IPM.

B. Attendant Reenters Held Incoming Trunk (SC20)

7.12 The attendant reenters a held trunk by operating the pick-up key associated with the held call. Relay ACA operates through relay HM normal and Y option, or through relay HM normal, relay S1 operated.

7.13 Relay ACA operated:

- (a) Connects the attendant telephone circuit to the trunk.
- (b) Extends leads FB, HD, SP, H, HM, HG, T, U, NT, and BT to the cordless position circuit.
- (c) Operates relay AC.
- (d) Prepares a locking circuit for relay HM.
- (e) Locks up under control of relay AC.

7.14 Relay AC operated:

- (a) Splits the trunk.
- (b) Releases relay HD.

(c) Locks relay ACA.

7.15 When relay HD releases, it connects the attendant to the central office end of the trunk, and transfers lamp L(6 BUT KEY TEL SET) or TL(CDLS POS) from 30 IPM to steady battery.

7.16 Note: Relays ACA, AC, CT, S, S1, SR, and TLA are operated. Lamp L(6 BUT KEY TEL SET) or TL(CDLS POS) is steady.

7.17 If the attendant wishes to complete the incoming call, the hold key must be operated to establish PBX dial tone. The action is the same as described in 2.20 through 2.30 except that relay TLA is already operated (if option A is provided).

8. MISCELLANEOUS

A. Dial-Back Call (SC21)

8.01 When a station line dials the attendant trunk code for assistance in establishing a central or toll office connection, the attendant instructs the calling line to remain off-hook until the connection is established.

8.02 The attendant then:

- (a) Holds the attendant trunk circuit.
- (b) Completes a call to the central office as described in 3.23 through 3.31.
- (c) Requests the called central office party to remain on the line.
- (d) Holds the central office trunk to establish PBX dial tone as described in 7.01 through 7.11.
- (e) Operates the no-test key in the cordless position circuit.
- (f) Dials the station that is being held on the attendant trunk circuit, operating relay P over its secondary winding.

8.03 Relay P operates after its slow-operate interval and:

- (a) Operates relay MC.
- (b) Transfers lamp L(6 BUT KEY TEL SET) from 30 IPM to steady battery.

8.04 Relay MC operated:

- (a) Locks under control of the marker.
- (b) Operates relay NT in the marker.
- (c) Operates relay TLA.
- (d) Releases relay P.

- 8.05 Relay NT in the marker operated:
- (a) Operates relay RT over its secondary winding.
 - (b) Lights lamp TRK BY INC in the make busy and busy display circuit.
- 8.06 Relay P released, transfers lamp L(6 BUT KEY TEL SET) from steady to 30 IPM.
- 8.07 Relay RT operates after its slow-operate interval and:
- (a) Opens the locking path for relay RS.
 - (b) Locks to the off-normal ground.
 - (c) Connects a high-resistance bridge across the trunk.
 - (d) Provides alternate holding paths for relay HM and SP(in the cordless position circuit).
 - (e) Lights lamp SL(CDLS POS).
- 8.08 The marker in terminating the call extends ground over lead RS(E,O) to operate relay RS.
- 8.09 Relay RS operated:
- (a) Releases relay HD.
 - (b) Operates relay FB in the cordless position circuit.
- 8.10 Relay HD released:
- (a) Removes the holding bridge from the trunk but relay SP in the cordless position still has the trunk end short circuited.
 - (b) Extends the trunk to the attendant telephone circuit.
 - (c) Releases relay SL.
 - (d) Provides a holding path for relay HM and the trunk hold magnet.
 - (e) Lights lamp SL(CDLS POS).
 - (f) Transfers lamp L(6 BUT KEY TEL SET) or TL(CDLS POS) from 30 IPM to steady battery.
 - (g) Connects the 100-ohm resistor SH to lead S to hold the line hold magnet.
- 8.11 Since the marker performs as if the call were going to camp-on, the central office trunk circuit is transferred from its originating link, on which the dial tone connection was established, to the link on which the calling station is waiting.

- 8.12 Relay NT operated in the marker also connects ground to the KO (kick-off) lead to the attendant trunk circuit operating relay TN which in turn releases relay B in that circuit.
- 8.13 Relay B released releases the attendant trunk hold magnet which opens the crosspoints allowing the attendant trunk to release.
- 8.14 After the marker has transmitted its terminating data, it releases itself and the dial pulse register from the connection. The release of the marker causes relay MC to release.
- 8.15 Relay MC released transfers the holding path for relay HM and the trunk hold magnet from marker control to trunk control and disconnects relays BY, RS, NT, and TLA from their respective leads.
- 8.16 Relays FB and SP in the cordless position circuit remain operated as long as the attendant remains on the connection. Relay FB provides transmission battery for the called station and relay SP keeps the short circuit across the central office end of the trunk.
- 8.17 When the attendant releases, the station and central office are connected, the station receiving transmission battery from the central office.
- 8.18 Note: Relays CT, RT, HM, TLA, SR, SL, S are operated. Lamp L(6 BUT KEY TEL SET) or SL(CDLS POS) and TL(CDLS POS) is/are steady.
- 8.19 If the trunk is connected to any busy station other than the station awaiting service on a dial-back basis, the attendant may discharge the connection by operating the hold key.

B. Disconnection - Called Station Remains Unanswered

- 8.20 The condition of the trunk prior to the operation of the release key is the same as for ring start, dial-back call, or trunk terminating as described in 2.36 through 2.43, 8.01 through 8.19, and 8.40 through 8.50, respectively. If the attendant has not released after dialing is completed, the call may be discharged and the attendant may reconnect to the central office end of the trunk by operating the hold key.
- 8.21 The operation of the hold key, which is nonlocking, causes relay H to operate in the cordless position circuit. Relay H operated opens the locking path over leads H and HG to release relays TT and HD or RS depending upon the type of connection.

8.22 Relays SP and SL or FB in the cordless position circuit subsequently release in sequence due to the elimination of holding paths previously supplied by relay HD or RS.

8.23 When the hold key is released, relay HM and the trunk hold magnet in the marker release since there is no longer a holding path to the fundamental ground.

8.24 The attendant is now connected to the central office end of the trunk. Relays ACA, AC, CT, S, SL, SR, and TLA are operated; and lamp L(6 BUT KEY TEL SET) or TL(CDLS POS) is steady.

8.25 If the attendant had released from the connection after dialing was completed, the condition of the trunk would be the same as described above prior to the operation of the release key except that relays ACA, AC, SP, and FB would release when the key is operated.

8.26 It is therefore necessary that the attendant operate the pick-up key to operate relays ACA and AC. The action of the trunk when the attendant subsequently operates the hold key is the same as described above.

8.27 Should the attendant wish to reroute the call, the hold key must be re-operated for PBX dial tone.

8.28 If the attendant wishes to disconnect the trunk, the release key is operated. Relays AC and ACA release in sequence which removes the attendant telephone circuit from the trunk allowing relay S to release and release relay SL.

8.29 Relay SL released releases relays CT, SR, and TLA in sequence restoring the trunk to normal.

8.30 If the central office does not disconnect immediately, relay H operates when relay SL releases to hold relay CT operated. When the central office disconnects, relay H releases releasing relays CT, SR, and TLA and restoring the trunk to normal.

8.31 When the PBX is on remote trunk answer operation, the answering station remains on the line after dialing is completed. The auxiliary position circuit holds relays AC and ACA operated.

8.32 The answering station causes the auxiliary position to operate and release relay H in the cordless position circuit to discharge the call. The PBX functions to discharge the call and reconnect the answering station to the central office as previously described.

8.33 Should the answering station wish to reroute the call, the auxiliary position circuit functions to operate and release relay H in the cordless position circuit and the PBX functions to return dial tone.

8.34 If the answering station wishes to disconnect the trunk, the handset is placed on the switchhook. The auxiliary position circuit functions to release relays AC and S and disconnection proceeds as previously described.

C. Emergency Trunk Service - Options V, T, (MD), ZJ(MD), YM, and F(MD)

8.35 Central office trunks 0, 1, 2, and 5 (option F) or central office trunks 0, 1, and 2 (option E or ZJ or YM) are wired to station line circuits 30, 31, 32, and 33 or to line circuits 30, 31, and 32, respectively, through the alarm transfer and test circuit (per option T).

8.36 When there is a power failure, relays AT and ATA release in the alarm transfer and test circuit to transfer the above central office cable pairs from the central office end of the trunk units directly to the station instruments, effectively bypassing the trunks. These stations will receive incoming central office calls.

8.37 To make outgoing central office calls, a start key which is provided with each of these stations must be operated to connect start ground to the ring side of the cable pair and cause the central office line circuit to function.

8.38 When power is restored, relays AT and ATA reoperate to transfer the trunk circuits to the cable pairs and the station instruments to their respective line circuits. If one of these stations is busy when power is restored, the central office connection is broken.

8.39 The remainder of the central office trunk circuits are wired per option V and do not have the transfer feature.

D. Trunk Terminating

Other Than Ringdown Tie Trunk

8.40 If the incoming call requests a connection to a tie trunk other than a ringdown tie trunk, the initial action is the same as when the attendant establishes PBX dial tone and trunk-to-marker identification as described in 2.20 through 2.35.

8.41 The marker in terminating the call connects a ground from the dial pulse register to lead TT(E,O) causing relay TT to operate. Since relay TK8 in the marker is operated, there is no ground connected to lead RS.

8.42 Relay TT operated:

- (a) Locks to off-normal ground.
- (b) Transfers lamp TL(CDLS POS) from 30 IPM to steady battery.
- (c) Connects lamp SL(CDLS POS) to 30 IPM.
- (d) Prepares a path for the attendant to reoperate relay ACA.
- (e) Connects inductor H into the trunk circuit. This inductively couples the PBX and central office ends of the trunk circuit.

8.43 If the attendant remains on the line, the loop through the attendant telephone circuit or, if the attendant disconnects, the loop through one winding of inductor H, causes the tie trunk to function.

8.44 When the tie trunk answers, battery is reversed to provide supervision. The reversed battery operates relay P through its primary winding.

8.45 Relay P operated:

- (a) Transfers lamp L(6 BUT KEY TEL SET) from 30 IPM to steady battery.
- (b) Operates relay RT over its secondary winding.
- (c) Opens the operating path (via relay TT) for relay ACA.
- (d) Provides a holding circuit for relay S when relay RT operates.

8.46 Relay RT operates after its slow-operate interval and:

- (a) Locks to off-normal ground.
- (b) Provides a path for the attendant to operate relay ACA (if option Z is used).
- (c) Connects resistor HS in parallel with relay S as a high-resistance bridge across the trunk.
- (d) Transfers lamp SL(CDLS POS) from 30 IPM to steady battery.
- (e) Prepares a path to operate relay FF if relay S releases.

8.47 The central office trunk and tie trunk (other than a ringdown tie trunk) are now connected.

8.48 Note: Relays P, CT, TT, RT, HD, HM, TLA, SL, SR, SI, and S are operated. Lamps L(6 BUT KEY TEL SET), SL(CDLS POS), and TL(CDLS POS) are steady.

Ringdown Tie Trunk

8.49 If a ringdown tie trunk code is dialed by the attendant, the action is the same as described above except that in answering, the ringdown tie trunk will not reverse battery and ground to operate relay P.

8.50 Under this condition, relay RT does not operate and lamp L(6 BUT KEY TEL SET) or SL(CDLS POS) remain at 30 IPM. There is no supervision to the attendant other than a steady TL(CDLS POS) lamp and a flashing L(6 BUT KEY TEL SET) or SL(CDLS POS) lamp; hence, the attendant must challenge this connection periodically.

E. Cord Switchboard Used as Attendant Equipment - App Fig. 2

8.51 When the central office trunk has an appearance on the cord switchboard, an incoming call from the central office causes the trunk circuit to:

- (a) Connect battery to lead C.
- (b) Connect continuous ringing to the audible signal when 556A switchboard is used; provides ground to 608A or 608D auxiliary signal, fuse alarm, battery cut-off, and miscellaneous circuit to operate audible signal when 608A or 608D switchboard is used.
- (c) Connect 120-IPM battery via lead L to flash the switchboard L lamp.

8.52 The attendant inserts a cord into the trunk jack T associated with the flashing lamp. Relay SEO-9 is operated via lead SL to ground at the answering jack. Relay SL operated completes the tip and ring paths to connect the attendant to the trunk.

8.53 Battery through resistance lamp SLO-9 (option ZE) or ground through resistor SLO-9(option ZF) causes the cord sleeve relays to function.

8.54 To make an outgoing call, the attendant inserts a cord into trunk jack T. If the central office trunk circuit is idle, battery via lead C and Y option operates relay SEO-9. Relay SEO-9 operated connects the tip and ring leads to the cord circuit. The loop of the cord circuit operates relay S from ground to the tip via relay SR operated to battery via resistor BF.

8.55 Relay SEO-9 operated connects the tip and ring leads to the cord circuit. The loop of the cord circuit operates relay S from ground to the tip via relay SR operated to battery via the BF resistor.

H. Traffic Measurement System Remote Scanner

Trunk Seizure to Trunk Answer

8.76 When the central office trunk is seized, relay R follows central office ringing. Relay R in operating operates relay CT which in turn operates relay SR. Relay SR operated operates

relay R1. Relay R1 operated extends a busy ground signal over lead TU(T-A) to the TMS remote scanner.

Trunk Answer to Trunk Release

8.77 Each operation of relay SR in the central office trunk circuit extends a busy ground signal over lead TU(T-) to indicate a busy condition to the TMS remote scanner circuit.

8.56 Relay S operated operates relay S1 which operates lamp L (FS5) and activates the trunk in a manner similar to the action described for cordless operation.

8.57 If the central office trunk circuit had been busy, lamp L would have been lighted as a busy lamp.

8.58 Note: Attendant options X(MD), Y, Z(MD), and XK apply to the cord switchboard attendant the same as for a cordless operation.

8.59 Night connections may be established by using the cord circuit with the night and through dialing key operated. When the plug is inserted into trunk jack T, relay SEO-9 operates on battery via lead C and option Y. Relay SEO-9 operated connects the tip and ring leads to the plug of the cord. Outgoing calls function as described for cordless operation.

F. Direct Station Selection

Incoming Central Office Call

8.60 The attendant operates the pickup key and, after determining that the calling party wishes to be connected to a station, momentarily depresses the push button key associated with the station to be called if the particular station busy lamp is dark.

8.61 This key, when depressed, results in the same functions as operating the hold key, receiving dial tone, and dialing the station.

8.62 If the central office calling party wishes to be completed to a busy line (indicated by a lighted station busy lamp), the attendant immediately informs the calling party of the busy condition of the station.

8.63 If the central office party wishes to wait, the attendant depresses the station key. This causes the central office trunk to camp on the busy line.

8.64 The operation of the station key operates relays H, HA, and DS in the cordless position circuit.

8.65 Relay DS operated prepares a path to operate relay CS in the cordless circuit position and prevents cordless position relay SS from operating.

8.66 The marker in terminating the call grounds lead BY(E,O) which operates relays BY and IC- (with option YK).

8.67 Relay IC- operated performs the same function as described in 4.01 through 4.25.

8.68 The attendant receives audible and visual indications of camp-on at the end of register and marker action.

8.69 With the camp-on connection completed, the attendant releases the station key which releases relay HA in the cordless position circuit.

8.70 The attendant then operates the release key which mechanically releases the pick-up key. When the pick-up key releases, relays AC and ACA release. Relay AC released, operates relay SS in the cordless position circuit.

8.71 Relay SS operated performs the same functions as described in 4.01 through 4.25 except relay SPA released, releases relay DS.

Dial Back

8.72 To complete outgoing calls on a dial back basis, the no-test key in the cordless position circuit is operated after the attendant has been connected to the central office party. The attendant then depresses the station key which starts register and marker action to complete the connection between the station and central office.

G. Station Message Registration

Message Register Pulsing

8.73 Each operation of relay SX in the station message register pulse and surcharge circuit applies positive 48 volts to the sleeve via lead SS1, operating the station message register in multiple with the line hold magnet. The positive voltage holds the line hold magnet during message registration.

Message Register Surcharging

8.74 When the calling station goes on-hook relay S releases, releasing relay S1. Relay S1 released slowly releases relay P (furnished for panel only) and removes a shunting ground from lead S1 which operates relay DS in the station message register pulse and surcharge circuit.

8.75 Station message register pulse and surcharge circuit relay DS operated prevents new calls from ringing until all surcharge pulses have been registered. When surcharge pulsing is completed, relay MS in the station message register pulse and surcharge circuit will release releasing the trunk. The release of relay SR will release station message register pulse and surcharge circuit relay DS.

9. NIGHT CONNECTIONS

A. Fixed Night Connections - Option F (ML)

9.01 When the attendant operates the night service key, relays AT and ATA release in the alarm, transfer and test circuit.

9.02 Relay AT released transfers the tip and ring of stations 30, 31, 32, and 33 from their associated line relays to back contacts of relay ATA.

9.03 Relay ATA released transfers the central office cable pairs from central office trunks 0, 1, 2, and 5 to stations 30-33. The stations are now connected directly to the central office.

9.04 Calls are completed as described for emergency trunk service except that, relays AT and ATA are under control of the night service key.

B. Flexible Night Connections - Options Y, E(MD), YM(MD), and XO

Idle Trunk to Idle Station (SC33, 34)

9.05 When the attendant operates the night service key, relay NS releases in the alarm, transfer, and test circuit. This connects ground to leads NSO and NSE and connects leads NC(0-9) to leads CN(0-9).

9.06 The attendant then operates the pick-up key associated with a central office trunk to be night connected. Relays ACA, AC, S, and S1 operate; lamp TL(CDLS POS) or L(6 BUT KEY TEL SET) lights as described for an attendant-originated call with the following exceptions and additions:

9.07 When the pick-up key is operated, relay N1 operates in parallel with relay ACA.

9.08 If the PBX is provided with an auxiliary position circuit, relay NC- in the auxiliary position circuit operates in parallel with relays N1 and ACA.

9.09 Since relay BN in the auxiliary position circuit is operated when the PBX is on remote trunk answer operation and thus opens the operate path for relay N1 and relay NC- in the auxiliary position circuit, the attendant cannot set up night connections after placing the PBX on remote trunk answer operation.

9.10 Relay N1 operated:

- (a) Disconnects the trunk circuit from the central office conductors with the exception of the ringing bridge.
- (b) Connects battery and ground to the tip and ring to operate relay H.

(c) Locks operated under the control of relays ACA and S1 (via lead J).

(d) Prepares the operate path for relay H (with option ZZ).

9.11 Relay ACA operated provides holding ground for relay N1 and operates relay H.

9.12 Relay H operated:

- (a) Connects ground to the trunk.
- (b) Lights lamp TRK BY in the make busy and busy display circuit.
- (c) Locks operated under control of relay NS in the alarm, transfer, and test circuit.
- (d) Opens ringing lead R1.
- (e) Partially completes a path to prevent the connection of two trunks to one station.
- (f) Prepares a lockup path for relay RS.

9.13 After relay H operates, relays CT and SR operate, and relay H releases.

9.14 **Note:** Relays ACA, AC, CT, N, N1, S, S1, SR, and TLA are operated. Lamp L(6 BUT KEY TEL SET) or TL(CDLS POS) is steady.

9.15 The attendant operates the hold key for PBX dial tone, and operates relay TLA (with option A). Upon receiving dial tone, the attendant dials the number of the station to be night connected and the action is the same as trunk to marker identification.

9.16 **Note:** Relays ACA, AC, CT, HD, HM, N, N1, S, S1, SL, SR, and TLA are operated. Lamp L(6 BUT KEY TEL SET) or TL(CDLS POS) is flashing at 30 IPM. Relay SP is operated in the cordless-position circuit.

9.17 If the marker finds the called station line idle, the marker, register, and trunk function as described for ring start except that ringing is not applied to the called station since operated relay H had opened ringing lead R1.

9.18 **Note:** Relays ACA, AC, CT, HM, N, N1, RS, S, S1, SR, and TLA are operated. Lamp TL is steady. Lamp L(6 BUT KEY TEL SET) or SL(CDLS POS) is flashing at 30 IPM. Relays SP and PB are operated in the cordless position circuit.

9.19 Lamp SL(CDLS POS), flashing at 30 IPM is an indication to the attendant that the station and trunk are connected.

9.20 The attendant operates the release key which releases, in sequence, relays AC, ACA, and relays FB and SP in the cordless position circuit.

9.21 In addition, relay ACA released releases relay RS. Relay RS released removes the holding bridge from the trunk allowing relay S to release in turn releasing relay SL.

9.22 Relay SL released:

- (a) Releases relay CT.
- (b) Releases relay N1 by removing ground from diode J.
- (c) Extinguishes lamp SL(CDLS POS).

9.23 Relay CT released releases relay SR and extinguishes lamp TL(CDLS POS) or L(6 BUT KEY TEL SET).

9.24 Relay N1 released removes battery and ground from the trunk and connects the trunk conductors to the central office.

9.25 Note: Relays TLA, N, and HM will remain operated as long as the night service key remains operated.

C. Camp-On (SC33-36)

9.26 If the attendant sets up a night connection and the station to be connected is busy, the sequence of events up to the time the register responds to the attendant dial is the same as described above. The action from this point on is the same as for a camp-on call, including the operation of the release key by the attendant after receiving visual and audible indication of the connection.

9.27 Preparation of a night connection to a busy station is now complete. The night connection will be established without further attendant action.

9.28 Note: Relays RS, DR, DRA, CT, BY, HM, TLA, N1, N, SR, SL, and S are operated. Lamp TL(CDLS POS) is steady. Lamp L(6 BUT KEY TEL SET) or SL(CDLS POS) are flashing at 60 IPM.

D. Camped-On Station Becomes Idle (SC36)

9.29 Relay SL operates and releases; relays BY and DR release when the camp-on station becomes idle. However, when relay DR releases during a night connected camp-on condition, relay RS releases since, with relay N operated, there is no locking path via lead CL.

9.30 Relay N operated also prevents ringing via the R1 lead when the camped on station becomes idle.

9.31 Relay RS released removes the holding bridge from the trunk allowing relay S to release.

9.32 Relay S released releases, in sequence, relays SL, N1, CT, and SR which extinguish lamps L(6 BUT KEY TEL SET), SL(CDLS POS), and TL(CDLS POS) as explained for attendant release. The trunk and station are now connected for night service.

9.33 Note: Relays TLA, N, and HM remain operated as long as the night service key remains operated.

9.34 The path between sleeve lead S and lead CW is provided to prevent two trunks from being connected to one station.

9.35 If the attendant attempts to connect a second trunk to an existing night-connected trunk, which is either idle or camped on, a camp-on busy condition will exist; 120-IPM busy tone will be connected to the attendant and lamp SL(CDLS POS) will flash at 120 IPM.

9.36 The attendant must remove this condition by the following (sequential) procedure:

- (a) Restore the night service key. This releases all night connections.
- (b) Operate the pick-up key associated with the flashing SL lamp.
- (c) Operate the hold key.
- (d) Operate the release key.
- (e) Reestablish all night service connections.

9.37 When the attendant releases the night connections at the start of business, any busy connection will not be disturbed; upon becoming idle, the trunks will restore to normal.

E. Incoming Central Office Call to Night Connected Stations

9.38 If the trunk is seized by the central office during the silent interval, relay H operates.

9.39 When the central office applies ringing current, relay R operates but does not operate relay R1 since relay TLA remains operated during night service connections.

9.40 Relay R operated, operates relay RS. Relay RS follows relay R to repeat central office ringing, and continuous ringing is applied to the station through contacts of relays RS and N.

9.41 If the trunk is seized during the ringing intervals, relay R operates causing relay RS to operate. Relay RS operated functions as described above; ringing current operates the station ringer.

9.42 Note: Relays HM, TLA, and N are operated with R and RS following central office ringing. Lamp SL (CDLS POS) flashes intermittently with ringing.

9.43 If the station answers during the silent interval, the loop trips ringing and operates relay S which in turn operates relay S1. Relay S1 operated, lights lamp SL(CDLS POS) of L(6 BUT KEY TEL SET) steadily, and operates relay CT through a contact of relay H. Relay CT operated, operates relay SR, and the central office ringing is tripped. The station is now cut through to the central office.

9.44 If the station answers during the ringing interval, a dc path is closed, operating relay RT. Relay RT operated, releases relay RS which disconnects ringing from the station. With relays RS and R released, relay RT releases. The operation of relays S, S1, CT, and SR is the same as station answering during the silent interval.

9.45 When the station hangs up, relays S, S1, CT, and SR release, lamps SL(CDLS POS) and TL(CDLS POS) are extinguished, lamp L(6 BUT KEY TEL SET) is extinguished, and relay H is operated. When the central office disconnects, relay H releases.

F. Outgoing Call from a Station on Night Connection

9.46 When the station goes off-hook, relay S operates from battery through resistor BF, the station loop, and to ground.

9.47 Relay S operated operates relay S1 which furnishes a start ground to the ring side of the central office line circuit, and lights lamp(s) TL(CDLS POS) and SL(CDLS POS) or L(6 BUT KEY TEL SET).

9.48 Once the start ground is furnished to the central office, the central office line circuit functions to return dial tone or if a manual central office, the operator answers.

9.49 This action causes relay H to operate in turn operating relay CT.

9.50 Relay CT operated:

- (a) Operates relay SR.

- (b) Locks operated through the operated S1 and SR contacts.

- (c) Closes the tip and ring of the trunk through to the central office which gives the station central office dial tone.

9.51 Relay SR operated releases relay H and removes the start ground from the ring side of the trunk.

9.52 Disconnection is the same as for an incoming central office call to a night-connected station.

10. DISCONNECTION (SC9-10)

A. Incoming Central Office Trunk Call Connected to a Station

10.01 If the station disconnects first, the removal of the station loop releases relay S which operates relay FF and releases relay S1. Relay FF operated extinguishes lamp L(6 BUT KEY TEL SET) or lamp SL(CDLS POS).

10.02 Relay S1 released connects relay H across the tip and ring toward the central office, releases relay CT, and lights lamp L(6 BUT KEY TEL SET). Relay H operates on central office battery.

10.03 Relay CT releases relay SR which removes the off-normal ground to release relays RT, HM, TLA, FF, and the trunk hold magnet, extinguishes lamps TRK BY and TRK BY INC in the make busy and busy display circuit, and extinguishes lamp L(6 BUT KEY TEL SET) or TL(CDLS POS).

10.04 Relay FF released operates relay CT which operates relay SR.

10.05 Relay SR operated lights lamp L(6 BUT KEY TEL SET) or TL(CDLS POS), connects the fundamental ground to the trunk, and lights lamp TRK BY in the make busy and busy display circuit.

10.06 When the central office disconnects, relay H releases in turn releasing relay CT which releases relay SR. Relay SR released, extinguishes lamp TRK BY in the make busy and busy display circuit, and extinguishes lamp L(6 BUT KEY TEL SET) or TL(CDLS POS).

10.07 If a central office arranged for calling party control disconnects first, all relays release, all lamps are extinguished, and the station is returned to local PBX dial tone.

10.08 If a central office arranged for joint control disconnects first, no action occurs until the central office times out; then the action is as above.

B. Incoming Central Office Trunk Call
Connected to the Attendant

10.09 If the attendant disconnects first
(SC3 and 4), operation of the
release key causes relay AC to release in
turn releasing relay ACA.

- 10.10 Relay ACA released disconnects the attendant telephone set from the trunk causing relay S to release in turn releasing relay S1.
- 10.11 Relay S1, released with S or R option, connects relay H in the trunk which operates from the central office.
- 10.12 Relay H operated holds relay CT in turn holding SR and holds lamp L (6 BUT KEY TEL SET) or TL(CDLS POS) steady.
- 10.13 When the central office times out or disconnects, relay H releases in turn releasing relay CT which releases relay SR. Relay SR released extinguishes lamp L(6 BUT KEY TEL SET) or TL(CDLS POS).
- 10.14 If a central office arranged for calling party control releases first, relay S releases in turn releasing relay S1.
- 10.15 Relay S1 released releases relays ACA and CT.
- 10.16 Relay ACA released releases relay AC.
- 10.17 Relay CT released releases relay SR which removes the fundamental ground and extinguishes lamp L(6 BUT KEY TEL SET) or TL(CDLS POS) restoring the trunk to normal.
- 10.18 If option Y is provided and the attendant has not disconnected when relay SR releases, the action is the same as if the attendant initiates an outgoing call.
- 10.19 When the attendant disconnects, all relays release and all lamps are extinguished.
- 10.20 If a central office arranged for joint control disconnects first, no action occurs until the central office times out at which time the action is as above.
- C. Incoming Central Office Trunk Call Held by the Attendant
- 10.21 If a central office arranged for calling party control disconnects from a hold condition after the attendant has released and the call was originated at the central office, the trunk relays release in the following order: S, S1, CT, SR, TLA, and HD. Lamp L(6 BUT KEY TEL SET) or TL(CDLS POS) is extinguished when relay SR releases.
- 10.22 If the attendant has not restored the pick-up key with option Y furnished, all operated relays release; but when the HM relay and SR relay release, relays ACA and S reoperate causing the trunk to function as for an attendant originated call.

When the attendant disconnects, all reoperated relays release and all lamps are extinguished.

- 10.23 If the central office disconnects from a hold condition before the attendant restores the pick-up key and option X is furnished, relay S releases releasing relays ACA and S1.
- 10.24 Relay ACA released releases relays HD, AC, and SP in cordless position circuit.
- 10.25 Relay HD released releases relay S1. Relay S1 released releases relay CT which releases relay SR removing the off-normal ground.
- 10.26 Relays HM and TLA release and all lamps are extinguished.
- 10.27 If the central office is arranged for joint control and the central office disconnects, the holding bridge in the trunk holds the connection until the central office times out at which time disconnection is the same as above.

D. Outgoing Call from Station to Central Office

- 10.28 If the central office disconnects first, no action takes place in the trunk circuit and when the station disconnects, all trunk relays release in order as follows: relay S, S1, CT, SR, TLA, and HM. (RT releases if call was completed on a dial back basis.)
- 10.29 Relay SR released extinguishes lamp(s) L(6 BUT KEY TEL SET), or SL(CDLS POS) and TL(CDLS POS).
- 10.30 If the station disconnects first, all relays release as above and the trunk is restored to normal.

E. Trunk Camped On Busy Station

- 10.31 If the central office is arranged for calling party control and the central office disconnects before the camped on trunk cuts through to the station, relay S releases in turn releasing relays S1 and DR.
- 10.32 Relay S1 released releases relay CT which releases relay SR. Relay SR removes the off-normal ground causing relays TLA, HM, and RS to release and extinguishes lamp L(6 BUT KEY TEL SET) or TL(CDLS POS). Relay HM released releases relay BY and extinguishes lamp SL(CDLS POS).
- 10.33 If the central office is arranged for joint control and the calling party disconnects before the trunk cuts through to the station, the bridge in the trunk holds the connection until such time that the office times out. After time out, the trunk releases as above.

F. Trunk in a Camped On Busy Condition

- 10.34 If a central office arranged for calling party control disconnects first after the attendant has advised the calling party of the progress of the call, relay S releases causing relays DR and SL to release.
- 10.35 Relay SL released releases relay CT in turn releasing relay SR.
- 10.36 Relay SR released removes the off-normal ground to release relays SP and FB in the cordless position circuit, releases relays RS, HM, TLA, and FF, and extinguishes lamp L(6 BUT KEY TEL SET) or TL(CDLS POS).
- 10.37 Relay HM released extinguishes lamp SL(CDLS POS) and releases relay BY.
- 10.38 If option Y is not provided, relay ACA releases when FF and RS release releasing relay AC.
- 10.39 If option Y is furnished, relay ACA remains operated or reoperates when relay HM releases causing the trunk to function as for an attendant originated outgoing call.
- 10.40 When the attendant disconnects, all relays release and all lamps are extinguished.
- 10.41 If the attendant disconnects first relay AC releases in turn releasing relay ACA which releases relays SP and FB in the cordless position circuit. When the central office disconnects, the trunk releases as described above.
- 10.42 If the central office is arranged for joint control, the bridge in the attendant telephone circuit holds the connection until the office times out which causes the trunk to disconnect as described for calling party control. Otherwise when the attendant disconnects, the bridge is removed from the trunk causing the central office to release.

G. Tie Trunk (Other than Ringdown) to Central Office

- 10.43 If a tie trunk is connected to a central office trunk circuit and the central office disconnects first, no action takes place in the central office trunk circuit. When the tie trunks disconnect, the action is the same as for a station.

H. Incoming Central Office Trunk to Tie Trunk (Other than Ringdown)

- 10.44 When a central office trunk is connected to a tie trunk and the central office arranged for calling party control disconnects first, relay S releases causing relays SL, CT, and SR to release in turn.
- 10.45 Relay SR released releases relays HD, HM, TLA, TT, RT, and extinguishes lamp L(6 BUT KEY TEL SET) or TL(CDLS POS).
- 10.46 Relay HM released extinguishes lamp SL and relay HD released releases relays P and SL. The central office trunk is now normal.
- 10.47 If the tie trunk disconnects first, relay P releases causing relays S, SL, CT, and SR to release in turn.
- 10.48 Relay SR released functions as above to release the trunk.
- 10.49 If the central office still has not disconnected, the action is the same as a seizure from the central office during the silent period.
- 10.50 If a central office arranged for joint control disconnects first, no action occurs until the central office times out; then the action is as above.

I. Ringdown Tie Trunk to Central Office

- 10.51 When a ringdown tie trunk is connected to a central office arranged for calling party control and the tie trunk disconnects first or last, nothing happens.
- 10.52 When the central office disconnects, relays S, SL, CT, and SR release in turn.
- 10.53 Relay SR released releases relays TLA and HM and extinguishes lamp L(6 BUT KEY TEL SET) or TL(CDLS POS). Relay SL released extinguishes lamp SL(CDLS POS).
- 10.54 If a central office is arranged for joint control, no action occurs until the central office times out; then the action is as above.

J. Central Office Trunk to Ringdown Tie Trunk

- 10.55 The only difference between this type call and a ringdown tie trunk call to a central office is that relay TT is operated when the central office trunk is connected.

K. Incoming Central Office Trunk Call
Connected to a Station Via the
Auxiliary Position Circuit

10.56 When the PBX is on remote trunk answer operation and the answering station disconnects, the auxiliary position circuit opens the loop to the central office through which relay S is held operated and opens the path holding relay AC operated.

10.57 Relays S and AC released function as described under disconnection for an incoming central office trunk call connected to the attendant.

11. EXPLANATION OF OPTIONS

A. Option A

11.01 When the attendant places a call to a toll office and disconnects for any reason, the toll operator is unable to rering on the central office trunk circuit unless option A is provided.

11.02 The inability to rering on the trunk circuit is due to the operation of relay TLA which opens the operating path of relay R1 which is required to operate the audible signal and flash the trunk lamp.

11.03 Wiring option A prevents relay TLA from operating unless the attendant operates the hold key in the cordless position circuit. With this wiring option, the toll operator may rering the PBX attendant as follows.

11.04 If the attendant disconnects, the rering locks in a flashing trunk lamp and the audible signal follows the ringing current.

11.05 If the attendant holds, the flashing trunk lamp and audible signal both follow the ringing current.

11.06 Diode A prevents the locking of relay H after the toll-allowed relay in the trunk circuit has operated.

B. Option ZB

11.07 When the secrecy feature is provided and the central office trunk camps on a busy station, the attendant is prevented from reporting back to the calling central office party unless the trunk is removed from the camp-on condition.

11.08 Option ZB adds a contact of the ring start relay in the control path of splitting relay of the cordless position circuit; therefore, the connection will not be split until the ring start relay has operated.

C. Option ZH (MD)

11.09 If a trunk is camped on a busy station and the party connected to the busy station disconnects while the busy station remains in the off-hook condition it is possible for the busy station and the party connected to the camped on trunk to talk with reduced transmission through the FB capacitor.

11.10 To prevent this, option ZH is added in conjunction with one of options ZL or ZJ. With option ZH, the path through the FB capacitor is opened when relay DR operates.

D. Option ZD

11.11 When the attendant operation of a 756A PBX is transferred to a 6-button key telephone set, the common ringer continues to ring on calls over central office and attendant trunks which do not appear on the 6-button key telephone set unless option ZD is provided.

11.12 Option ZD provides for each BZ (buzzer) lead to be separate and to connect to relay contacts in the cordless position circuit.

11.13 Straps are added across the make and break contact of each BZ lead associated with a trunk appearance on the 6-button key telephone set. When the operations are transferred, the added relays in the cordless position circuit operate and the BZ leads not strapped are opened. Only those BZ leads strapped will cause the common ringer to operate.

E. Option ZN (MD)

11.14 With option ZN, trunk units 8 and 9 are used as single-digit, dial-8 long distance trunks. On incoming calls from the toll office, the trunks function as a regular central office trunk; outgoing they are not available unless a single-digit 8 is dialed and converted to 90.

11.15 When the SD relay in the dial pulse register operated, the IT(90-99) lead is connected toward the marker circuit and the trunk is selected.

F. Option Z0

11.16 Option Z0 prevents preliminary pulse emission upon seizure of the central office trunk.

G. Option ZP (MD)

11.17 Option ZP extends delay single-digit dialing to trunks 6 and 7. Option ZP and ZN are the same otherwise.

H. Option ZQ (MD)

11.18 Option ZQ makes the trunk busy to the marker when the trunk is being used for a night connection with a cord switchboard.

I. Option ZS

11.19 Option ZS provides steady audible signal to a switchboard attendant when the central office trunk is seized by an incoming call.

J. Option ZV

11.20 Option ZV isolates a trunk ground from the central office ground on the ring side of the line when the attendant reconnects after camp-on.

K. Option ZZ

11.21 Option ZZ enables the trunk to function with the auxiliary position circuit for remote trunk answering.

L. Options YA(MD) and YI

11.22 Option YA or YI provides wiring associated with App Fig. 6 to provide indication of camp-on.

M. Options YQ, YS, and XL

11.23 With options YQ, YS, and XL trunk units 6, 7, 8, and 9 are used as single-digit dial and long distance trunks.

N. Options YP and YR

11.24 Options YP and YR make the trunk busy to the marker when the trunk is being used for a night connection with a cord switchboard.

O. Options J(MD), YP, and YQ

11.25 Option J, or options YP and YQ is/are arranged for 2-way assigned service.

P. App Fig. 5

11.26 App Fig. 5 prevents false flashing signals (false recall) when the trunk is wired to a panel central office.

Q. App Fig. 6

11.27 App Fig. 6 connects a warning tone of approximately one-half second from the cordless position circuit to the tip and ring as an indication of a central office trunk camped on a busy station.

R. Option XP

11.28 Option XP arranges the trunk for 48-volt central office battery operation.

S. App Fig. 8

11.29 App Fig. 8 improves station telephone set transmission characteristics whenever 72-volt central office battery is supplied.

12. FUNCTION OF MAKE BUSY AND BUSY DISPLAY CIRCUIT

A. Central Office Trunk Key Normal

12.01 With the central office trunk key (CO TRK key) normal in the make busy and busy display circuit, the trunk busy lamp (TRK BY lamp) will light when ground is applied to lead IT9- directly or through relay S- in the line, link, and marker circuit. The lighting of lamp TRK BY indicates that the central office trunk has been made busy to the marker by a central office trunk call.

12.02 The trunk busy incoming lamp (TRK BY INC lamp) in the make busy and busy display circuit is an additional busy lamp to indicate an incoming central office trunk call. Lamp TRK BY INC will light whenever ground is applied to the secondary winding of the ring trip (RT) relay in the trunk circuit. The lighting of lamp TRK BY INC indicates the central office trunk has been made busy to the marker by an incoming central office trunk call.

B. Central Office Trunk Made Busy

12.03 If it is desired to make a central office trunk busy to the marker for outgoing central office trunk calls, key CO TRK in the make busy and busy display circuit is operated. Key CO TRK operated:

- (a) Opens the associated IT9- lead to the line, link, and marker circuit.
- (b) Applies ground to lamp TRK BY in the make busy and busy display circuit.

12.04 The lighting of lamp TRK BY indicates that the central office trunk has been made busy. Opening lead IT9- prevents the operation of the associated S relay in the marker circuit. The ground applied to lead IT9- makes the trunk appear busy to the marker for outgoing central office trunk calls.

12.05 To prevent the use of the central office trunk circuit by an incoming call, the central office trunk must be made busy at the central office.

SECTION III - REFERENCE DATA

1. WORKING LIMITS

- 1.01 Maximum external loop resistance for tripping during the silent interval - 1400.
- 1.02 Maximum external loop resistance for tripping during the ringing interval - 2000.
- 1.03 The trunk conductor loop resistance plus the maximum station loop resistance of the S relay shall not exceed the central office subscriber range of the connecting central office less 65 ohms.

2. FUNCTIONAL DESIGNATIONS

2.01 The functional meanings of the designations of the relays of the central office trunk circuit are listed below.

<u>Designation</u>	<u>Meaning</u>
AC,ACA	Attendant Connector
BY	Busy
CT	Cut Through
DR	Delayed Ring
DRA	Delayed Ringing Auxiliary
FF	Fast Flash
H	Historical Designation (Monitors Tip and Ring Toward Central Office)
HD	Hold
HM	Hold Magnet Slave
IC	Indicate Camp-On
MC	Marker Connector
N	Night Service
N1	Auxiliary Night Service
P	Polarized
R	Ringup
R1	Ringup Auxiliary
RS	Ring Start
RT	Ring Trip
S	Supervisory
S1	Supervisory Auxiliary
SE	Sleeve of Answer Jack
SL	Sleeve
SR	Slow Release
TLA	Toll Allowed
TT	Trunk Terminating

3. FUNCTIONS

A. Incoming Calls

- 3.01 To make the link end of the trunk busy to the marker when the central office end is seized.
- 3.02 To light the trunk lamp steadily when the central office trunk is seized during the silent interval of the ringing cycle.
- 3.03 To flash the trunk lamp at 120 IPM and operate the cordless position audible signal when central office ringing is received.

- 3.04 To trip ringing, light the trunk lamp steadily, silence the cordless position audible signal, and complete the transmission path to the cordless position circuit when the attendant answers.
- 3.05 To hold and split the central office end of the trunk from the attendant, flash the trunk lamp at 30 IPM, and complete the transmission and dialing path from the cordless position to the line end of the trunk (thereby furnishing local dial tone) when the hold key is momentarily depressed.
- 3.06 To provide for tandem operation from a tie trunk which is arranged for tandem dial operation.
- 3.07 To flash the station lamp at 30 IPM when dialing is completed until the called line answers.
- 3.08 To exclude the central office from the talking circuit until the attendant releases after dialing into the PBX.
- 3.09 To light the trunk and station lamps steadily when the talking circuit is completed.
- 3.10 To camp on a busy station line and give a warning tone to the station user as an indication of camp-on.
- 3.11 To flash the station lamp at 60 IPM and transmit busy tone to the attendant when the trunk circuit camps-on a busy line.
- 3.12 To flash the station lamp at 120 IPM and transmit 120-IPM busy tone to the attendant when the trunk circuit encounters a camp-on busy.
- 3.13 To provide camp-on busy indications in response to an all called trunks busy condition.
- 3.14 To remove the splitting feature and disconnect the attendant when the release key is operated, preparatory to reporting a busy to the calling party.
- 3.15 To reconnect the transmission path between the central office and the attendant when the pick-up key is reoperated to report a busy to the calling party.
- 3.16 To release the called line, extinguish the station lamp, and steer the attendant to the central office when the hold key is momentarily operated to discharge a camp-on, camp-on busy, or line does not answer call.
- 3.17 To flash the station lamp at 120 IPM and operate the cordless position ringer steadily when the called line recalls the attendant.

3.18 To light the station lamp steadily, silence the ringer, and bridge the attendant on the talking circuit when the pickup key is operated to answer a recall.

3.19 To exclude the central office from the talking circuit when the attendant answers a recall if the secrecy option is provided.

3.20 To release the calling line and extinguish the station lamp when the attendant momentarily operates the hold key to transfer a call.

3.21 To flash the trunk lamp at 30 IPM, hold the central office, and re-engage the PBX equipment to provide local dial tone when the hold key is momentarily reoperated to transfer a call.

3.22 To release and extinguish the station and trunk lamps on disconnect.

3.23 To provide delay-through supervision.

3.24 To provide a busy indication to the TMS remote scanner.

B. Outgoing Calls from Stations or Trunks

3.25 To light the trunk and station lamps steadily and make the circuit test busy to the marker after seizure.

3.26 To signal the central office.

3.27 To connect the calling line to the central office when the operator answers in the case of a manual central office or when the dial equipment functions and is ready to receive dial pulses in the case of a dial central office.

3.28 To disconnect toll-denied lines from the central office and divert them to busy tone when a toll trunk is called.

3.29 To provide for reringing a toll-allowed station from the toll office when toll delays are experienced.

3.30 To provide outgoing central office connections from restricted stations on a dial-back basis.

3.31 To rering the cordless position circuit when the toll operator rerings on a delayed toll call to a restricted station.

3.32 To release the station line, extinguish the station lamp, flash the trunk lamp at 120 IPM, and operate the cordless position ringer if the trunk circuit is seized by an incoming call after the station has been diverted to busy tone due to being denied access to toll.

3.33 To hold the PBX end of the trunk busy until the central office end of the trunk is released.

3.34 To provide a disconnect signal to the central office when the PBX station disconnects.

3.35 To extinguish both station and trunk lamps when both the PBX line and central office finally disconnect from the trunk circuit.

3.36 To provide a busy indication to the TMS remote scanner.

C. Outgoing Calls Originated by the Attendant

3.37 To light the trunk lamp steadily and make the circuit test busy to the marker when the attendant originates an outward call.

3.38 To signal the central office.

3.39 To connect the attendant telephone circuit through to the central office when the operator answers in a manual office or when the dial central office is ready to receive dial pulses.

3.40 To flash the trunk lamp at 30 IPM and place a holding bridge across the central office end of the trunk when the attendant momentarily operates the hold key and then the release key to hold the trunk.

3.41 To light the trunk lamp steadily and remove the holding bridge when the trunk circuit is reentered again by the attendant.

3.42 To permit rering from the central office into the holding bridge, to flash the trunk lamp at 120 IPM, and operate the cordless position ringer.

3.43 To provide a disconnect signal to the central office when the attendant disconnects.

3.44 To extinguish the trunk lamp when the attendant disconnects.

3.45 To provide a busy indication to the TMS remote scanner.

D. Functions With Key Telephone Set Used as Attendant Position

3.46 To provide only the moving lamp signal when moving signals are present.

3.47 To operate exactly the same as the cordless position does except that the switchhook replaces the pickup and release keys and no no-test key is provided.

3.48 To provide the attendant a means of establishing night connections between any central office trunk and any station.

3.49 To provide a busy indication to the TMS remote scanner.

E. Functions When Trunk is Used With A Cord Switchboard

3.50 To provide a trunk appearance at a cord switchboard.

3.51 To make the trunk busy to the marker when being used for night connections.

3.52 To provide a steady audible signal to a switchboard attendant on incoming calls.

3.53 To provide a busy indication to the TMS remote scanner.

F. Functions With Auxiliary Position Circuit When PBX is on Remote Trunk Answer Operation

3.54 To signal the auxiliary position circuit to activate the remote answer signal when an incoming call is received.

3.55 To trip ringing and complete the transmission path to the cordless position circuit when the call is answered by a PBX station.

3.56 To hold and split the central office end of the trunk from the answering station and complete the dialing path from the auxiliary position circuit to the line end of the trunk (thereby furnishing local dial tone) when the call is to be completed to another station.

3.57 To exclude the central office from the talking circuit until the trunk answering station disconnects after dialing into the PBX and answer by the called station.

3.58 To provide camp-on busy indication in response to a called station busy condition.

3.59 To release the called line and steer the trunk answering station to the central office under control of a signal from the trunk answering station.

3.60 To release the called line and then release if the trunk answering station disconnects without discharging a called station busy or called line does not answer call.

3.61 To release on disconnect.

3.62 To provide delay-through supervision.

3.63 To provide a busy indication to the TMS remote scanner.

G. Functions With Station Dial Transfer Trunk Circuit and Controller Circuit When PBX is Arranged for Station Dial Transfer Operation

3.64 To signal the station dial transfer controller circuit on station recall

3.65 To light the trunk and station lamp steadily while transferring occurs.

3.66 To activate the marker in calling a dial pulse register when a station has been attached to the transfer trunk circuit.

3.67 To transmit dial tone to a transferring station when a dial pulse register has been attached to a transfer trunk circuit.

3.68 To transmit pulses into the register when pulsing starts after a register is attached to the line end of the trunk circuit.

3.69 To trip ringing and complete the transmission path through the station dial transfer circuits when a transfer call is answered by a PBX station

3.70 To flash the station lamp at 120 IPM and operate the cordless position audible signal when a PBX station dials zero when transferring.

3.71 To hold and split the central office end of the trunk and complete the transmission and dialing path when a PBX station momentarily operates his switch-hook to transfer a call.

3.72 To make the trunk busy to the marker when being used in transferring a call.

3.73 To return a transferring station to the attendant without going through an attendant trunk.

3.74 To release a PBX station attached to the line end of the trunk after the transfer has taken place.

3.75 To release the transferring and transferred lines when the trunk end station disconnects.

3.76 To release or disconnect.

3.77 To provide delay-through supervision.

3.78 To provide a busy indication to the TMS remote scanner.

H. Functions With Make Busy and Busy Display Circuit

3.79 To provide a trunk busy indication to the make busy and busy display circuit on all trunk calls.

3.80 To provide an additional trunk busy indication to the make busy and busy display circuit on all incoming trunk calls.

3.81 To provide for being made busy by the make busy and busy display circuit for outgoing calls only.

3.82 To provide a busy indication to the TMS remote scanner.

4. CONNECTING CIRCUITS

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

- (a) 756A PBX Line, Link, and Marker Circuit - SD-65740-01.
- (b) 756A PBX Alarm, Transfer, and Test Circuit - SD-66796-01.
- (c) 756A PBX Cabling Diagrams - SD-65746-01.
- (d) 756A PBX Cordless Position Circuit - SD-65757-01.
- (e) Subscriber Line Circuit Arranged for Ground Signaling on the Ring Conductor - SD-25553-01(typical).
- (f) Long Trunk Circuit - SD-66192-01 (typical).
- (g) SXS Toll Diverting Trunk Circuit - SD-32067-01.
- (h) Ringing Circuit - SD-81288-01.
- (i) Power Supply Circuit - SD-81326-01.
- (j) No. 556A Cord, Telephone, Dial, Battery, Buzzer and Ringing Circuit - SD-65658-01.
- (k) No. 608A Auxiliary Signal, Fuse Alarm, Battery Cut-Off, and Miscellaneous Circuit - SD-66722-01.
- (l) Toll Subscribers Line Circuit - SD-56501-01.
- (m) 756A Station Dial Transfer Controller Circuit - SD-66909-01.
- (n) 756A Auxiliary Position Circuit - SD-66910-01.
- (o) 756A PBX Feature Cabling Diagram - SD-66920-01.

- (p) Station Message Register Pulse and Surcharge Circuit - SD-5E021-01.
- (q) Line or Trunk Access Circuit - SD-1E045-01.
- (r) 552A, 552B, 552D, 552E, 605A, 607A, 607B, or 608A Jack Circuit - SD-65778-01.
- (s) 608D Jack and Lamp Circuit - SD-65997-01.
- (t) 608A or 608B Auxiliary Signal, Fuse Alarm, Battery Cut-Off, and Miscellaneous Circuit - SD-66722-01.
- (u) 608D Auxiliary Signal, Fuse Alarm, Battery Cut-Off, and Miscellaneous Circuit - SD-67039-01.
- (v) Make Busy and Busy Display Circuit - SD-5E029-01.
- (w) Traffic Measuring System No. 1A Remote Scanner and Encoder Circuit Portable Type - SD-3B200-01.

5. MANUFACTURING TESTING REQUIREMENTS

5.01 The 2-way central office trunk shall be capable of performing all the service functions specified in this circuit description and of meeting all the requirements of the Circuit Requirements Table.

6. TAKING EQUIPMENT OUT OF SERVICE

6.01 When the make busy and busy display circuit is not provided, the central office trunk circuit can be taken out of service by removing the strap between terminals 18 and 28 on the unit terminal strip and connecting a strap between terminals 18 and 17. This busies the trunk toward the marker. To prevent incoming calls, the central office trunk should be made busy at the central office.

6.02 When the make busy and busy display circuit is provided, the central office trunk may be taken out of service as follows: make sure that the central office trunk busy lamp (TRK BY lamp) in the make busy and busy display circuit is not lighted and operate key CO TRK. This busies the trunk toward the marker, thereby preventing outgoing trunk calls. To prevent incoming trunk calls, the central office trunk should be made busy at the central office.

7. ALARM INFORMATIONA. Fuse Alarm

7.01 An operated fuse supplying the 2-way central office trunk circuit will result in a major alarm being transmitted to the plant service center if alarm sending is provided and in any case by a visual signal at the attendant position and in the alarm transfer and test circuit.

SECTION III

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SECTION IV - REASONS FOR REISSUE

D. Description of Changes

D.1 Contact 2EBM of relay N1 is added per option XX to prevent audible ringing tone to the attendant position circuit when establishing flexible night connections. This change must be coordinated with Issue 51B of SD-65746-01.

D.2 Apply the application to prevent ringing pretrip for the 103A data set as well as for the other circuits mentioned in Circuit Note 116.

D.3 Circuit Notes 104 and 116, App Fig. 1, and the Sheet and Option Indexes are revised to reflect the change in this issue.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 3221-SHA-RGP

CIRCUIT DESCRIPTION

CD-65753-01
ISSUE 8D
APPENDIX 1D
DWG ISSUE 19D

PBX SYSTEMS
NO. 756A
ATTENDANT TRUNK CIRCUIT

CHANGES

D. Description of Changes

- D.1 Option ZG is designated and rated Mfr. Disc.
- D.2 Options ZH and ZI are added as Standard.
- D.3 Circuit Note 104 is revised to reflect Issue 19D.
- D.4 Circuit Note 105 is added.

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DEPT 3221-WVS-RGP

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PBX SYSTEMS
NO. 756A
ATTENDANT TRUNK CIRCUIT

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C. Attendant Re-enters Held Call	4	1.01 When a PBX station or tie trunk dials 0, the marker will complete this call on a trunk class basis which means that no junctor circuit is required for the call and only a single link path is completed from the calling line or tie trunk to the attendant trunk circuit. When the calling station or tie trunk loop is extended through the link crosspoints to the attendant's trunk, that trunk functions to provide a holding ground for both the calling line or tie trunk hold magnet and for the attendant trunk hold magnet.	
D. Attendant Holds Before Dialing	4	1.02 When the attendant trunk is seized by a cordless operation, a visual and audible signal is operated at the attendant's equipment. The attendant operates the pickup key associated with the incoming lamp signal and connects the attendant's telephone to the attendant trunk. Once connected to the trunk, the attendant has the option of dis-	
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connecting or of placing the attendant trunk on hold. If the call is a request for a central office or outside telephone number the attendant puts the hold condition on the attendant trunk, and the calling line remains off-hook. The attendant disconnects from the attendant trunk and dials the desired outside telephone number over an idle 2-way CO trunk. Having reached the desired outside telephone, the attendant then dials the number of the PBX line, which is being held by the attendant trunk, on the "in" end of the 2-way CO trunk, on a dial-back basis. The marker proceeds to set up a link from the "in" end of the CO trunk to the PBX station disregarding the busy condition. The attendant trunk recognizes this double connection and responds by releasing. The connection is now complete from the calling PBX line through the 2-way CO trunk to the outside telephone number, and the attendant trunk is restored to normal.

1.03 When the attendant trunk is seized by a cord switchboard operation, an audible and visual signal is operated at the cord switchboard. The attendant plugs a station cord into the jack associated with the visual signal and operates the talk key to connect the switchboard telephone circuit to the trunk.

2. GENERAL FUNCTIONS

2.01 This circuit functions:

- (a) To provide for terminating calls to the attendant, and to provide talking battery for the connection of the calling PBX line or trunk after the attendant disconnects, if desired.
- (b) To hold the connection under control of the calling PBX line or trunk after the attendant disconnects, if desired.
- (c) To release automatically when the calling line is dialed back from a 2-way CO trunk.
- (d) To provide for answering only incoming calls at a cord switchboard.
- (e) To provide supervision on incoming calls via dial repeating tie trunks.

SECTION II - DETAILED DESCRIPTION

1. INCOMING CALL (DIAL 01)

A. Seizure of Trunk (Options AW and Y1)

1.01 When the calling line or tie trunk dials 0, the marker is signaled to set up a connection from the calling line or tie trunk to the attendant trunk over a link. When the SMTA relay in the marker operates, it grounds one of the IT05 through 07 leads toward the attendant trunk circuit. This ground is carried back to the line, link, and marker

circuit where it operates the trunk hold magnet (THM) of the attendant trunk. The trunk hold magnet operated closes the cross-points which extend the loop of the calling line or trunk to relay A. The loop operates relay A which: (a) operates relay B; (b) closes a circuit from lead FF of the power plant to lamp SL which flashes at 120 IPM; (c) with Z option, operates relay NC in the attendant cord switchboard; (d) with R option, prepares a path to operate relay RV; (e) extends ground over lead TU(AT-A) toward the TMS remote scanner.

1.02 Relay B operated:

- (a) Bridges the contacts of relay AC in both the T and R leads to keep relay A operated when relay AC operates.
- (b) Completes a path for ringing tone from capacitor RT to the ring side of the trunk for audible ringing tone.
- (c) Connects ground to one of the IT00 through 02 and IT05 through 07 leads to make the trunk busy to the marker.
- (d) Closes machine ringing from lead R1 through break contacts on relays ON and HD to lead BZ to operate the audible signal in the attendant equipment.
- (e) Prepares a locking path for relays ON and HD.
- (f) Connects ground to lead HM to hold the trunk hold magnet THM.
- (g) Operates relay SL (relay SL is connected as a 100-ohm holding ground to lead S which holds the hold magnet of the calling line or trunk operated after the marker releases).

B. Attendant Answers Call

1.03 The attendant, in response to an audible signal and flashing SL lamp, operates the pickup key associated with the trunk. The pickup key operated connects ground to lead ACA to operate relay AC. Relay AC will remain operated as long as the pickup key is operated. Relay AC operated: (a) connects the attendant equipment to the trunk via leads TT and TR; (b) with S option, prepares a path to operate relay SP in the attendant equipment; (c) prepares a path to operate relay HD; (d) connects ground to leads U and TR- toward the marker; (e) operates relay ON; (f) with R option, operates relay RV to give reverse battery supervision on calls from dial tie trunks.

1.04 Relay ON operated: (a) locks operated to ground through its own contacts and under control of relays HD and B; (b) opens the tone path from the RT capacitor to the ring of the trunk; (c) opens the R1 lead to silence the audible signal at the attendant's equipment; (d) transfers lamp SL from

120 IPM to steady battery; and (e) removes ground from lead TU(AT-A) to the TMS remote scanner. The calling station and the attendant are now connected, and transmission battery for the calling party is from the A relay.

G. Attendant Holds Call

1.05 If it is desired to place a hold condition on an attendant trunk, the attendant must momentarily operate the hold key in the attendant equipment prior to releasing the pickup key. The hold key operated operates relay H in the attendant equipment which grounds lead HD to operate relay HD through relay AC operated. Relay HD operated:

- (a) With S option, operates relay SP in the attendant's equipment.
- (b) With R option, operates relay D.
- (c) Releases relay ON.
- (d) Opens one of the operating paths of relay B.
- (e) Prepares a path to operate relay TN over lead KO from the marker.
- (f) Prepares a locking path for itself to remain locked to the sleeve through contacts of relay TN normal after relay AC releases.
- (g) Transfers the busy ground on one of leads IT00 through 02 from relay B to relay HD.
- (h) Transfers the SL lamp from steady battery to 30 IPM to indicate a holding condition.
- (i) Opens lead R1 or BZ to prevent reoperation of the audible signal at the attendant equipment when relay ON releases.
- (j) Opens the tone lead to the ring side of the trunk.

1.06 With S option, relay SP operated in the attendant equipment locks operated to ground over lead SP and holds relay HD operated until relay AC releases.

1.07 With R option, relay D holds relay HD operated until relay AC releases.

1.08 The attendant operates the release key which mechanically releases the pickup key. The pickup key released in turn releases relay AC. Relay AC released: (a) removes ground from leads U- and TR-; (b) with S option, releases relay SP in the attendant's equipment; (c) with R option, releases relay D; (d) transfers relay HD from an operating path to a holding path to the sleeve lead; and (e) disconnects the attendant equipment via leads TT and TR from the

trunk and leaves the calling line connected to relay A. Relay ON released prepares a locking path for relay TN which operates at a later time.

D. Attendant Re-enters Held Call

1.09 With the hold condition established on an incoming call, relays A, B, HD, SL, and if R option is furnished, relay RV is operated in the attendant trunk circuit. To re-enter the trunk the attendant again operates the pickup key, and relay AC operates as described in 1.03 and 1.04. Relay AC operated bridges the attendant telephone set on to the T and R leads over leads TT and RT for a talking path. Relay AC operated releases relay HD. Relay HD released: (a) operates relay ON from ground through operated relay AC; (b) transfers lamps SL from 30 IPM to 120 IPM; and (c) disconnects the holding of relay RV. Relay ON operates to transfer lamps SL from 120 IPM to steady battery.

2. INTERCEPTION

A. Call Intercepted

2.01 If a station dials: (a) an unassigned station; (b) a trunk code 8 which is not equipped; (c) a restricted station; (d) a restricted dial repeating tie trunk which is denied access to 2-digit codes beginning with 8 and 1- or 2-digit codes beginning with 9; (e) a restricted station or a restricted dial repeating tie trunk which is denied access to 1- or 2- digit codes beginning with 9 but which is allowed access to codes beginning with code 8; (f) a register times out or a permanent signal condition exists, the marker will direct the call to an attendant trunk circuit over a link. When the SMTA relay in the marker operates, ground is connected to one of the IT00 through 02 leads causing relay TN to operate. Relay TN operated (a) prepares a path to flash lamps TL, and (b) grounds lead HM to operate the attendant trunk hold magnet THM in the line, link, and marker circuit. With the trunk hold magnet operated the loop is extended to operate relay A, and the trunk functions as described in 1.01 and 1.02 except that lamp TL flashes at 120 IPM and relay TN locks operated under control of relays B and ON.

B. Attendant Answers Intercepted Call

2.02 The attendant, in response to an audible signal and flashing SL and TL lamps, operates the pickup key associated with the trunk. Relays AC and ON operate as described in 1.03 and 1.04 except that relay ON transfers the ring of the trunk from ringing tone through capacitor RT to low tone through capacitor TN and opens the locking path of relay TN which starts to release. During the interval in which relay ON is operated and before relay TN releases, the low tone heard by the attendant is a signal to the attendant that this is other than a dial call. The

low tone is removed when relay TN releases. Relay TN released extinguishes lamp TL.

C. Attendant Holds Intercepted Call

2.03 Holding an intercepted call is the same as described in 1.05 through 1.08.

D. Attendant Re-enters Held Call

2.04 Re-entering a hold intercepted call is the same as described in 1.09.

1. ATTENDANT ORIGINATED CALL

A. Outgoing Call by Attendant

3.01 When the attendant originates a call over the attendant trunk circuit, an idle trunk is selected from the lamp indication. The attendant operates a pickup key in the attendant equipment associated with the idle trunk. The pickup key operated grounds lead ACA to operate relay AC. Relay AC operated: (a) operates relay ON; (b) prepares a path to operate relay OUT through relay B normal when the marker operates the trunk hold magnet; (c) connects the attendant's equipment to the trunk circuit via leads TT and TR; (d) prepares a path to operate relay HD; and (e) grounds leads U- and TR- to the line, link, and marker circuit as a signal to connect the attendant trunk to a register via a link.

3.02 Relay ON operated: (a) connects battery to lead SL- to light the SL lamps steadily; (b) connects ground to one of leads IT00 through 02 to make the trunk busy to the marker on subsequent calls; (c) opens the BZ lead to prevent the audible signal from sounding; and (d) opens the audible ringing lead to the ring side of the trunk.

3.03 In the process of connecting the trunk to a register, relay SMTA in the marker grounds one of leads IT05 through 07 to operate the trunk hold magnet THM, relay OUT, and extends ground over lead TU(AT-) toward the TMS remote scanner. Relay OUT operated: (a) connects the sleeve lead to the HM lead so that the sleeve holding ground furnished by the register will hold the attendant trunk hold magnet operated after the marker removes ground from one of the IT05 through 07 leads; (b) locks operated to the sleeve ground; (c) connects battery to lamps SL in place of relay ON; and (d) opens the T and R leads to relay A to prevent its operation.

3.04 The attendant now hears PBX dial tone from the register and can dial the desired PBX station line. The marker will set up a connection to the line on a junctor class basis. When finally connected the junctor will supply holding ground on the sleeve and supply transmission battery to the called station.

B. Attendant Holds Call

3.05 To hold an attendant originated call, the attendant operates the hold key, in turn operating relays H and HD as described in 3.01 through 3.04. In addition, relay HD connects a short circuit across the T and R leads of the trunk to hold the junctor when relay AC releases and also prepares a path to lock to lead HM when relay AC releases. Lead HM is connected to the sleeve lead by relay OUT which is grounded via the link by the junctor.

3.06 The attendant operates the release key which mechanically releases the pickup key, in turn releasing relay AC. Relay AC released transfers the tip and ring from the attendant telephone circuit to the short prepared by relays OUT and HD operated. This short circuit is extended to the junctor or tie trunk to which the attendant trunk is connected. Under control of this short, the connecting circuit supplies holding ground on the sleeve to hold the attendant trunk hold magnet in the line, link, and marker circuit and relay HD over lead HM which is connected to the sleeve through relay OUT operated.

C. Attendant Re-enters Held Call

3.07 With the hold condition established on a call originated by the attendant, relays HD and OUT are operated in the trunk. To re-enter the trunk, the attendant operates the pickup key associated with the trunk to operate relay AC as described in 3.01 through 3.04. Relay AC operated (a) transfers the trunk T and R leads from the holding short formed by relays HD and OUT to the attendant equipment via leads TT and RT, and (b) releases relay HD. Relay HD released operates relay ON and transfers lamp SL from 30 IPM to 120 IPM. Relay ON operated transfers lamp SL from 120 IPM to steady battery.

D. Attendant Holds Before Dialing

3.08 When the attendant depresses the pickup key associated with an idle trunk, a dial tone connection will be established as explained in 3.01 through 3.04. Should the attendant depress the hold key, the H relay in the attendant circuit and the HD relay in the trunk circuit will operate as explained in 1.05 through 1.08. With J option, relay HD in operating will place the C diode in series with make contacts of the OUT relay and its own make contact across the tip and ring of the line as a holding bridge. Since this connection is to a DP register there will be battery on the ring side and ground on the tip. When the attendant releases from the circuit the polarity of the C diode will prevent current flow, releasing the L relay in the register circuit which will function to restore both circuits to normal.

E. Attendant Holds Call Before Called Party Answers

3.09 When the attendant depresses the pickup key of an idle trunk and receives dial tone as explained in 3.01 through 3.04, the desired line may be called. After dialing, the marker will set up the call on a junctor type basis. While the called station is on-hook there is ground on the tip and battery on the ring from the junctor circuit. Should the attendant place the trunk on hold and release from the connection, the C diode will prevent current flow causing the A relay in the junctor to release which will function to restore both circuits to normal.

4. DISCONNECTIONA. Calling Party Disconnects First (Incoming Call)

4.01 If the calling party disconnects before the attendant and the hold condition has not been established, no circuit action occurs in the trunk circuit because an inductor in the attendant equipment is connected across leads TT and TR to hold relay A operated.

B. Attendant Disconnects First (Incoming Call)

4.02 If the attendant disconnects first and the hold condition has not been established, relay AC releases when the pickup key is released by operating the release key. Relay AC releasing (a) operates relay HD, and (b) releases relay RV which reverses battery and ground to give disconnect supervision on a tie trunk.

4.03 Relay HD is forced operated on disconnect to insure that the trunk will respond to "kick off" if the attendant fails to operate the hold key before disconnecting on calls where dialing back from a 2-way central office trunk is required. Relay HD operated: (a) transfers the ground on one of the IT00 through 02 leads from relay B to relay HD; (b) opens the BZ lead to keep the AND audible signal from sounding when relay ON releases; (c) connects 30 IPM to the SL lamps; (d) opens the tone lead to the ring of the trunk to prevent sending tone to the calling party when relay ON releases; (e) opens the TL lamp lead; (f) prepares its own locking circuit under control of relay B; and (g) releases relay ON.

C. Calling Party Disconnects After Attendant (Incoming Call)

4.04 When the calling party disconnects after the attendant has disconnected, the loop is opened and relay A releases in turn releasing relay B. Slow-release relay B (a) opens the sleeve lead to release relay SL and removes the 100-ohm holding ground from the sleeve to release the calling line hold magnet, (b) releases relay HD, (c) removes

ground from lead HM to release the trunk hold magnet, (d) removes ground from lead IT05 through 07, and (e) removes ground from lead TU(AT-) to the TMS remote scanner. Relay HD releases to extinguish the SL lamp and remove ground from one of the IT00 through 02 leads to remove the busy condition on the trunk.

D. Disconnection of Attendant Originated Call

4.05 If the called party disconnects first on a call originated by the attendant, no circuit action takes place in the trunk because the junctor circuit originating end is being held under control of the attendant telephone circuit which is bridged across the T and R leads over leads TT and RT through make contacts of AC. When the attendant disconnects by restoring the pickup key, ground is removed from lead ACA and relay AC releases. Relay AC released releases relay ON and relay OUT is held locked up to the sleeve. Relay AC released removes the loop from the A relay in the connected junctor circuit which is a signal to the junctor to release. When the junctor releases, sleeve ground is removed and relay OUT releases. The trunk hold magnet is also released. Relay OUT released removes ground from the IT leads to remove the busy condition from the trunk. Relay OUT released also removes battery from lead SL to extinguish the lamp at the attendant position.

5. KICKOFF

5.01 If a PBX line which needs to be connected to a CO subscriber is routed to an attendant trunk circuit either by that line dialing 0 or by a restricted line attempting to dial 9, the attendant must ascertain the identity of the calling line as well as the outside telephone number desired. When the attendant has the necessary information, the attendant places a hold condition on the attendant trunk. The attendant now selects an idle 2-way CO trunk and dials the desired outside telephone number. When the called CO line answers, the attendant informs the party of the call and asks them to wait. The attendant then puts a hold on the 2-way CO trunk (central office end) and receives PBX dial tone from the PBX end of the 2-way CO trunk. After operating the dial-back key momentarily, the attendant proceeds to dial the number of the PBX line that requested the outside connection.

5.02 The marker proceeds to set up a connection from the PBX end of the 2-way CO trunk to the calling PBX line, and in response to the dial-back key operation, will set up this connection disregarding the busy condition of the line being held on the attendant trunk.

5.03 The camp-on relay in the marker connects ground to the sleeve lead of the calling line, and this ground via the link shuts down relay SL. Relay SL released

completes the path via lead KO to operate relay TN from ground in the marker from the no-test relay. Relay TN operated locks operated and releases relay B. Relay B released releases the trunk hold magnet and relay TN. Relay TN released releases relay HD and removes ground from lead TU(AT-) to the TMS remote scanner. When the trunk hold magnet released, the loop to relay A was opened which caused relay A to release. With relays A and HD released, the SL lamp is extinguished. The attendant trunk now is released and restored to normal.

6. OPERATION WITHOUT PBX ATTENDANT, INTERCOMMUNICATING SYSTEM ONLY (X OPTION)

6.01 If the PBX is used for intercommunicating purposes only, the attendant trunks are used only as holding trunks for calls to unassigned numbers or permanent signal calls.

6.02 Seizure of the attendant trunk for this condition is as described in 2.01 except that X option provides busy tone instead of audible ringing tone to the ring of the trunk.

7. OPERATION WITH CORD SWITCHBOARD (Z OR A OPTION)

A. Seizure of Trunk

7.01 Seizure of the trunk when a cord switchboard is provided is the same as described in 1.01, 1.02, and 2.01 except that a call originated by dialing 0 results in a 120-IPM flashing busy lamp at the cord switchboard. A call which is intercepted results in both the busy and trunk lamps flashing at 120 IPM at the cord switchboard.

B. Attendant Originated Call

7.02 No provision is made for the attendant to originate calls over the attendant trunk from the cord switchboard.

C. Attendant Answers Incoming Call

7.03 The attendant, in response to the flashing busy lamp, inserts a station cord into the attendant trunk jack. A make contact on the tip jack spring closes ground over a lead to operate relay OUT.

7.04 Relay OUT transfers the trunk T and R leads from the winding of relay A to the switchboard. Relay A releases.

7.05 Relay OUT operated also operates relay ON and transfers the busy lamp lead BL from 120-IPM flashing battery to solid battery, resulting in a steadily lighted busy lamp.

7.06 T option causes the trunk to return supervision when answering a tie trunk.

7.07 Relay ON operated (a) opens the A or NA lead to silence the audible signal and close a circuit in order to hold itself independent of relay OUT, and (b) removes ground from lead TU(AT-A) to the TMS remote scanner.

D. Attendant Answers Intercepted Call

7.08 The attendant responds to the flashing busy and trunk lamp signal by inserting a trunk cord into the attendant trunk jack. Circuit action is as described in the preceding paragraphs except that in addition to relay A releasing, relay TN is also released when relay ON operates. Relay TN released removes flashing battery from lead TL or L, resulting in a dark trunk lamp. The busy lamp remains steadily lighted from the solid battery through contacts of relay OUT operated.

E. Disconnection

7.09 If the calling line or trunk disconnects before the attendant removes the plug from the trunk jack, no circuit action occurs in the trunk because relay OUT is still held from the operated jack spring ground.

7.10 If the attendant removes the plug from the trunk jack before the calling party disconnects, relay OUT will release returning the tip and ring of the trunk to the winding of relay A. Relay A reoperates to continue holding slow-release relay B.

7.11 Relay B held operated holds the trunk and calling line hold magnets operated. Relay ON holds the busy lamp steadily lighted and the audible signal silenced.

8. OPERATION WITH 6-BUTTON KEY TELEPHONE SET

8.01 When a 6-button key telephone set is used as an attendant equipment, the attendant trunk circuit functions as described in 1.01 through 5.03 with the following exceptions:

- (a) The line lamp (L) in the 6-button set serves the same purpose as does the station lamp (SL).
- (b) On a dial 0 or intercepted call, relay A furnishes transmission battery for the 6-button set.
- (c) On intercepted calls there will be no trunk lamp (TL) and only the burst of tone will identify the call.
- (d) On an attendant originated call the junctor furnishes the transmission battery for the 6-button set.
- (e) There is no release key on the 6-button set but a switchhook contact will open the circuit to the AC relay causing it to release when the handset is replaced.

9. MISCELLANEOUS

9.01 When the attendant's operation of a 756A PBX is transferred to a 6-button key telephone set, the common ringer continues to ring on calls over central office and attendant trunks which do not appear on the 6-button key telephone set.

9.02 To prevent this, option N is added which provides for each buzzer (BZ) lead to be separate and to connect to relay contacts in the cordless position circuit.

9.03 Straps are added across the make and break contacts of each BZ lead associated with a trunk appearance on the 6-button key telephone set. When the operations are transferred, the added relays in the cordless position circuit operate and the BZ leads not strapped are opened. Only those strapped BZ leads will cause the common ringer to operate.

9.04 When direct station selection is provided for the attendant, option M is required in the attendant trunk circuit.

9.05 Relay AC operated opens lead HL to prevent the operation of relay H in the cordless position circuit when any of the keys in the direct station selection set are operated.

10. FUNCTION OF MAKE BUSY AND BUSY DISPLAY CIRCUIT**A. Attendant Trunk Key Normal**

10.01 With the attendant trunk key (ATND TRK) normal in the make busy and busy display circuit, the attendant trunk busy lamp (ATND TRK) will light (a) when the marker, in placing a busy test on the attendant trunk for either an attendant originated trunk call or an incoming attendant trunk call, applies resistance ground to the associated IT05 through 07 lead in the line, link, and marker circuit, or (b) when the marker, in selecting the attendant trunk for an intercepted call, applies direct ground to the associated HM lead by operating relay TN in the attendant trunk circuit. In either case, the lighting of lamp ATND TRK indicates that the attendant trunk has been called on by the marker through normal operations.

B. Attendant Trunk Made Busy

10.02 If it is desired to place the attendant trunk in a busy condition, key ATND TRK is operated. The ATND TRK key operated operates relay B in the attendant trunk circuit. Relay B operated, grounds the associated IT00 through 02 and HM0 through 2 leads to the line, link, and marker circuit. The ground applied to lead HM by the operation of relay B: (a) operates the trunk hold magnet (THM) in the marker circuit; (b) makes the attendant trunk busy to the marker for incoming calls; (c) makes the trunk inaccess-

ible to the attendant for an attendant originated call; and (d) lights lamp ATND TRK in the make busy and busy display circuit. The ground applied to the associated IT00 through 02 lead makes the attendant trunks busy to the marker for intercepted calls.

SECTION III - REFERENCE DATA**1. WORKING LIMITS****A. Lines**

1.01 The maximum external circuit loop for relay A is 2370 ohms; minimum insulation resistance is 20,000 ohms.

B. Voltage Limits

1.02 45-52 volts dc

2. FUNCTIONAL DESIGNATIONS**2.01 Relays**

DESIGNATION	B LOCATION	FUNCTIONAL MEANING
A	2A9	Line
AC	2E9	Attendant Connector
B	2G4	Slow-Release Guard
HD	2E4	Hold
ON	2B2	Off-Normal
OUT	2C2	Outgoing Call
SL	2E2	Sleeve
TN	2F4	Tone

3. FUNCTIONS

3.01 To recognize seizure by the calling line or tie trunk and to supply holding ground for the calling line or the trunk hold magnet under control of the calling party.

3.02 To make itself busy to the marker or subsequent calls.

3.03 To supply holding ground for the attendant trunk hold magnet under control of the calling party.

3.04 To cause an audible and visual signal to sound at the attendant position as a signal that the trunk has been seized.

3.05 To provide a means for the attendant to connect the cordless position circuit to the trunk.

3.06 To silence the audible signal and change the visual signal from a fast flash to

a steadily lighted lamp when the attendant is connected to the trunk.

3.07 To signal the attendant with a short spurt of tone and a distinctive lamp signal if the call is other than a dial 0 call from a calling line or the trunk.

3.08 To supply audible ringing tone to the calling party until the attendant answers.

3.09 To remove the audible ringing tone when the attendant answers.

3.10 To supply transmission battery to the calling party.

3.11 To supervise the connection and recognize whether the calling party disconnects when the attendant is not connected and no hold has been established, and to signal this disconnection to the attendant.

3.12 To hold the connection at the discretion of the attendant after disconnect and to signal this hold condition to the attendant.

3.13 To release itself (kick off) and extinguish the trunk lamp when the attendant dials back over a 2-way CO trunk to complete a call from an outside line to the line initiating the request on the attendant trunk.

3.14 To enable the attendant to originate a call to a PBX line and to hold this line after the connection is established, if desired.

3.15 To return to normal when both the calling line and PBX attendant have disconnected, and to free the calling line.

3.16 To hold itself busy as long as either the calling party remains off-hook or the attendant remains connected.

3.17 To provide for operation with a cord switchboard.

3.18 To disconnect if the attendant places a call on hold and releases from the circuit before dialing (J option).

3.19 To disconnect if the attendant dials an extension and places the call on hold but releases before called party answers (J option).

3.20 To provide for being made busy by the make busy and busy display circuit.

3.21 To provide for a busy indication to the make busy and busy display circuit.

3.22 To provide for operation with the traffic measurement system No. 1A remote scanner.

4. CONNECTING CIRCUITS

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

4.02 This circuit connects with the following circuits:

- (a) Attendant Modular Console and Position Cordless Positions Circuit - SD-65757-01
- (b) Cordless Position Circuit - SD-65751-01
- (c) Line, Link, and Marker Circuit - SD-65741-01
- (d) Alarm, Transfer, and Test Circuit - SD-65743-01
- (e) Power Supply Circuit - SD-81288-01
- (f) Busy Verification Auxiliary Trunk Circuit - SD-66911-01
- (g) Traffic Measurement System No. 1A Remote Scanner and Encoder Circuit - Portable Type - SD-3B200-01
- (h) Make Busy and Busy Display Circuit - SD-5E029-01
- (i) 552A, 522B, 552D, 552E, 605A, 607A, 607B, or 608A Jack Circuit - SD-65778-01
- (j) 608A Auxiliary Signal, Fuse Alarm, Battery Cutoff and Miscellaneous Circuit - SD-66722-01
- (k) 608D Jack and Lamp Circuit - SD-65997-01
- (l) 608D Auxiliary Signal, Fuse Alarm, Battery Cutoff and Miscellaneous Circuit - SD-67039-01

5. MANUFACTURING TESTING REQUIREMENTS

5.01 The attendant trunks shall be capable of performing all the service functions listed herein, and meeting the requirements shown in the Circuit Requirement table.

6. ALARM INFORMATION

6.01 An operated fuse supplying an attendant trunk will cause a major alarm to be transmitted to the plant service center if alarm sending is provided, and in any case, it will produce a visual signal at the attendant position and in the alarm transfer and test circuit.

6.02 To silence the alarm and extinguish the alarm lamp, replace the operated fuse.

7. TAKING EQUIPMENT OUT OF SERVICE

7.01 In order to make an attendant trunk busy it is necessary to ground the IT leads toward the line, link, and marker circuit. This can be accomplished as follows: Ascertain that no select magnet is operated, then insulate 11M of relay B and block relay B operated.

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DEPT 3221-WVS-RGP

SECTION IV - REASONS FOR REISSUE

D. Description of Changes

D.1 Option ZE is designated and rated Mfr Disc.

D.2 Option ZF is added as Standard.

D.3 Options ZE and ZF are added to the Option Index.

D.4 Circuit Note 104 is revised to reflect Issue 18D.

PBX SYSTEMS
NO. 756A
BUSY TONE TRUNK CIRCUITCHANGESD. Description of Changes

D.1 On sheet 2, the connections for the make busy and busy display circuit are shown in the line, link, and marker circuit.

F. Changes in CD Sections

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

3. FUNCTION OF BUSY TONE TRUNK WITH MAKE BUSY AND BUSY DISPLAY CIRCUIT

3.1 Busy Tone Trunk Key Normal

3.2 Busy Tone Trunk Made Busy

F.2 In SECTION II - DETAILED DESCRIPTION, add:

3. FUNCTION OF BUSY TONE TRUNK WITH MAKE BUSY AND BUSY DISPLAY CIRCUIT

3.1 Busy Tone Trunk Key Normal

With the busy tone trunk key (BT key) normal in the make busy and busy display circuit, the busy tone trunk lamp (BT lamp) will light when the marker, in placing a busy test on the busy tone trunk, applies a resistance ground to lead HM in the line, link, and marker circuit. The lighting of lamp BT indicates that the busy tone trunk has been called on by the marker under normal operations.

3.2 Busy Tone Trunk Made Busy

If it is desired to place the busy tone trunk in a busy condition, key BT in the make busy and busy display circuit is operated. Key BT operated, grounds lead HM in the line, link, and marker circuit. Grounding lead HM in the marker circuit:

(a) Operates the trunk hold magnet THM in the marker circuit.

(b) Makes the busy tone trunk busy to the marker.

(c) Lights lamp BT in the make busy and busy display circuit. The lighting of lamp BT indicates that the busy tone trunk has been made busy.

Under this condition, the marker directs the register to furnish the busy tone to the calling station on subsequent busy connections.

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

3.3 Make Busy and Busy Display Circuit - SD-5E029-01.

BELL TELEPHONE LABORATORIES, INCORPORATED

(WECO 2120HW-JJM-WHK)
DEPT 5337-WHK

PBX SYSTEMS
NO. 756A
BUSY TONE TRUNK CIRCUIT

TABLE OF CONTENTS	PAGE	SECTION I - GENERAL DESCRIPTION
<u>SECTION I - GENERAL DESCRIPTION</u>		1. GENERAL METHOD OF OPERATION
1. GENERAL METHOD OF OPERATION	1	1.1 When a PBX line or trunk originates a call to another PBX line or trunk, and the called line or trunk is found busy, the marker will then route the call to this Busy Tone Trunk Circuit. Routing the call to the Busy Tone Trunk permits release of the Register to handle subsequent calls instead of being held to return tone to the calling line.
2. GENERAL FUNCTIONS	1	2. GENERAL FUNCTIONS
<u>SECTION II - DETAILED DESCRIPTION</u>		2.1 When the Busy Tone Trunk is seized, it provides a ground to hold the cross-points under control of the calling station loop.
1. SEIZURE OF BUSY TONE TRUNK	1	<u>SECTION II - DETAILED DESCRIPTION</u>
1.1 Operation of A Relay and Holding Cross Points	1	1. SEIZURE OF BUSY TONE TRUNK
1.2 Returning Tone to Calling Line	1	1.1 Operation of A Relay and Holding Cross-points
2. RELEASE OF BUSY TONE TRUNK	2	When a PBX line or trunk other than a 2 WAY CO. Trunk originates a call to another PBX line or trunk which is found busy by the Marker, the Marker will function to establish a connection between the calling line or trunk and the Busy Tone Trunk. The A relay operates from the calling line loop via the link crosspoints. Without "W" option relay A operated, closes ground from 100 ohm resistor A over the link sleeve to hold the originating line hold magnet, and provides direct ground to the Busy Tone Trunk hold magnet HM in the Line Link & Marker Circuit. With "W" option relay A operated operates relay RA which connects ground from resistor A (100 ohms) over the link sleeve to hold the originating line hold magnet and provides direct ground to the Busy Tone Trunk hold magnet HM in the line link and marker circuit.
<u>SECTION III - REFERENCE DATA</u>		Relay RA is slow release to prevent releasing of the connection should the calling line continue to dial.
1. WORKING LIMITS	2	1.2 Returning Tone to Calling Line
1.1 Lines	2	The tone Generator in the Power Supply Circuit supplies Busy Tone over lead BT to condenser A of this trunk. Busy Tone is extended through condenser A to the Ring Conductor of the trunk.
1.2 Voltage Limits	2	
2. FUNCTIONS	2	
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5. TAKING EQUIPMENT OUT OF SERVICE	2	
6. ALARM INFORMATION	2	
6.1 Fuse Alarm	2	
<u>SECTION IV - REASONS FOR REISSUE</u>	2	

2. RELEASE OF BUSY TONE TRUNK**2.1 Release of Relay A and Restore to Normal**

When the calling line goes "on-hook" in response to the busy tone signal, the originating station loop is opened and relay A releases. Without "W" option relay A released removes the 100 ohm locking ground from the link sleeve to release the Line Hold Magnet of the calling line in the Line Link and Marker Circuit, and removes direct ground from the Busy Tone Trunk hold magnet in the Line Link and Marker Circuit.

With "W" option relay A released causes relay RA to release which removes the 100 ohm locking ground from the link sleeve to release the Line Hold Magnet of the calling line and removes direct ground from the Busy Tone Trunk hold magnet.

SECTION III - REFERENCE DATA**1. WORKING LIMITS**

1.1 Maximum external circuit loop is 2370 ohms.

1.2 Voltage Limits are 45 to 52 Volts.

2. FUNCTIONS

2.1 To respond to a seizure and provide a holding ground for the calling station Line Hold Magnet and the Busy Tone Trunk Hold Magnet.

2.2 To extend busy tone to the calling line.

2.3 To cause release of calling line hold magnet and Busy Tone Trunk Hold Magnet when calling line goes "On Hook", and to return to normal.

3. CONNECTING CIRCUITS

When this circuit is listed on a key-sheet, the following connecting information is to be followed.

3.1 Line Link and Marker Circuit - SD-65741-01.

3.2 Power Supply Circuit - SD-81296-01 or SD-81297-01.

4. MANUFACTURING TEST INFORMATION

4.1 The Busy Tone Trunk shall be capable of performing all the service functions specified in this circuit description, and meeting all the requirements of the Circuit Requirement tables.

5. TAKING EQUIPMENT OUT OF SERVICE

5.1 In order to take a Busy Tone Trunk out of service it is necessary to ground the HM lead toward the marker circuit. The following procedure shall be followed. Ascertain that no select magnet is operated then block A relay operated.

6. ALARM INFORMATION**6.1 Fuse Alarm**

An operated fuse supplying the Busy Tone Trunk is indicated by a major alarm at the Plant Service Center if alarm transmitting features are provided and in any case a visual signal at the attendant equipment and in the Alarm Transfer & Test Circuit. Replace the operated fuse to restore the circuit, put out the alarm lamp, and silence the alarm at the Plant Service Center.

SECTION IV - REASONS FOR REISSUE**CHANGES****D. DESCRIPTION OF CIRCUIT CHANGES**

D.1 Option "W" is added to prevent the disconnection of the trunk should the calling line continue to dial.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT. 2242 -WVS-RDW-AP

PBX SYSTEMS
NO. 756A
TIE TRUNK CIRCUIT
OUTGOING MANUAL AND DIAL SELECTED
WITH 2 SECOND RINGING SIGNAL
INCOMING RINGDOWN

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OUTGOING CALL (SC6)	8	PBX. It is arranged for 2-way operation and	
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B. Call Completed to Dial		for the completion of tandem calls through	
Repeating Type Tie Trunk	9	the PBX.	
2. DISCONNECT	9		

2.02 Incoming calls are answered and completed by the attendant. The attendant is alerted by a 120-IPM flashing trunk lamp and audible signal.

2.03 After answering the incoming call and determining which station of the trunk is desired, the attendant steers into the PBX and dials the number.

2.04 While the trunk is ringing a called station, the station lamp flashes at 30 IPM. When the station answers, the lamp stops flashing and becomes steadily lighted.

2.05 If the called station is busy, the trunk will camp on the busy line and indicate this to the attendant by flashing the station lamp at the 60-IPM rate and connecting busy tone to the attendant telephone set.

2.06 When the camped-on busy station becomes idle, the trunk will start ringing on the station lamp at 30 IPM. If the called station is busy and another trunk is already camped on, the station lamp will be flashed at 120 IPM, and an interrupted 120-IPM tone will be connected to the attendant telephone set.

2.07 When an incoming call is directed to a dial repeating tie trunk, the station lamp will flash at 30 IPM until the tie trunk answers at which time the lamp will become steadily lighted.

2.08 When an incoming call is directed to a central office trunk or another ringdown trunk, the station lamp flashes at 30 IPM as an indication to the attendant that the call should be supervised periodically.

2.09 If an all trunks busy condition is encountered on an attempt to complete an incoming call to a trunk, the ringdown trunk will flash the station lamp at 120 IPM and connect interrupted 120-IPM tone to the attendant telephone set.

2.10 When this trunk is dial selected for an outgoing call, a 2-second ringing signal will be transmitted to the distant PBX and both the trunk and station lamps will light steadily.

2.11 The trunk will disconnect automatically when the called party hangs up on incoming calls completed to stations or dial repeating type tie trunks, and when the calling party hangs up on outgoing calls from stations and dial repeating tie trunks.

2.12 On calls completed to or from central office trunks or other ringdown tie trunks the attendant will have to disconnect by re-entering the connection at the originating trunk. However, if the distant PBX attendant originates a new call before the previous connection at the 756A PBX is released, the ringing signal for the new call will release the previous connection.

2.13 When an incoming call to the trunk is completed to a station or a dial repeating type tie trunk, the called party may recall the attendant. After receiving a recall signal the trunk will flash the station lamp at 120 IPM and with an option will connect audible ringing tone to the station.

2.14 An adjustable transmission pad is provided in the trunk to equalize the transmission on tandem calls and calls terminated at the PBX. The pad is normally in the circuit but is cut out on all trunk-to-trunk connections.

2.15 Line termination is provided toward the distant PBX to prevent a repeater from singing should one be employed on the trunk facility.

2.16 The trunk is arranged to prevent the attendant from entering the trunk when it is being used for an outgoing call. When the attendant connects to the trunk to answer an incoming call the attendant telephone set is connected through to the distant PBX, but when the attendant steers inward to complete the call, the connection is split.

2.17 In the split condition the attendant telephone set is connected inward toward the called end and a termination is connected across the distant PBX side of the split. When the attendant leaves the connection the called end is cut through to the calling PBX. The attendant telephone set will be bridged across the connection on any subsequent re-entry of the attendant.

2.18 The trunk can be arranged on an optional basis to function with a code ringing multiparty ringdown trunk line. When the option is provided the rering release feature is disabled and incoming ringing signals are not locked in.

2.19 An auxiliary subset is provided at the attendant location for receiving incoming signals; outgoing ringing signals are controlled manually with the dial back key in the cordless position circuit.

2.20 When the trunk is arranged for code ringing operation, both incoming and outgoing calls must be completed by the attendant. If a station dials the trunk code, the station will be directed to the intercept termination of an attendant trunk.

2.21 In general, connections between central office trunks and ringdown tie trunks can be set up by the attendant using either trunk as the originating trunk. However, if the central office is arranged for toll diversion, toll calls will have to be set up using a central office trunk as the originating trunk. Otherwise, since the originating class of service of the ringdown tie trunk is toll denied, the dialing of a toll code will cause the central office trunk to disconnect from the central office and return busy tone to the attendant via the ringdown tie trunk.

2.22 It should be noted that in cases which involve a step-by-step central office that is not arranged for toll diversion, the polarity of the battery and ground on the tip and ring will be reversed when the called party answers. This also causes the central office trunk to disconnect from the central office and return busy tone to the attendant via the ringdown tie trunk.

2.23 In such cases all connections between central office and ringdown tie trunks should also be set up using a central office trunk as the originating trunk.

SECTION II - DETAILED DESCRIPTION

1. INCOMING CALL FROM DISTANT PBX COMPLETED TO STATION LINE

A. Seizure of Idle Trunk (SC1)

1.01 The distant PBX will seize this trunk by ringing over the tip and ring conductors. The ringing current is rectified by the rectifier bridge network consisting of varistors D1, D2, D3, and D4 and causes relay R to operate in step with the ringing.

1.02 Relay R in operating:

- (a) Operates relay R1 which locks operated with option ZD to a break contact of relay S1 or with option ZE which locks under control of the battery cutoff relay in the alarm, transfer, and test circuit via lead S1.
- (b) Extends ground over lead TU (T-A) to the TMS remote scanner.

1.03 Relay R1 operated:

- (a) Connects 120-IPM battery to lead TL to the cordless position circuit to flash the associated trunk lamp TL in the attendant position.
- (b) With option U connects machine ringing (R code), or with option ZC connects continuous ringing to lead BZ to the cordless position circuit to sound the ringer in the attendant console or 6-button key telephone set.
- (c) Connects 120-IPM battery to lead L to the cordless position circuit to flash the associated lamp L in the attendant 6-button key telephone set.
- (d) Operates relay LO.

1.04 Relay LO operated (a) grounds lead IT-- to the marker as a busy indication to prevent seizure of the trunk for an outgoing call, (b) opens the operate path for relay T to prevent it from operating when the attendant answers, and (c) extends ground over lead TU (T-) to the TMS remote scanner.

B. Call Answered By Attendant (SC2)

1.05 In response to flashing lamps TL or L and the ringing signal, the attendant will operate the associated pickup key in the attendant console or 6-button key telephone set causing relays ACA and AC to operate in that sequence. Relays AC and ACA function as connector relays to associate common equipment in the cordless position circuit with the trunk.

1.06 Relay ACA operates from ground in the cordless position circuit through the associated pickup key over lead ACA and through a back contact of the released relay AC. When relay ACA operates it closes a path for operating relay AC from the ground on lead ACA. When the AC relay operates it opens the initial operating path for relay ACA but relay ACA remains operated to ground on its own front contact under control of relay AC.

1.07 Relay ACA operated closes a supervisory bridge across leads TT1 and TR in the cordless position circuit which operates relay S.

1.08 Relay S operated closes a locking path for relay LO and operates relay S1.

1.09 Relay S1 operated:

- (a) Releases relay R1.
- (b) Changes flashing lamp TL in the attendant console and lamp L in the 6-button key telephone set to steadily lighted lamps.
- (c) Silences the audible signals at the attendant equipment.
- (d) Removes ground from lead TU (T-A) to the TMS remote scanner (if option U is provided).

1.10 Relay AC operated connects the transmission leads of the trunk to the attendant telephone equipment allowing the attendant to converse with the calling end. If the call is answered from the 6-button key telephone set, talking battery for the attendant equipment is provided by the trunk through the windings of relay S.

C. Attendant Steers Inward and Dials Called Station (SC3)

1.11 After questioning the calling party to obtain the called number, the attendant will operate the hold key momentarily in the console or the 6-button key telephone set. This causes relay H in the cordless position circuit to operate thereby grounding leads HD and HM to the trunk. Ground on lead HD operates relay HD and ground on lead HM operates relay AO. Relay AO locks to ground through operated contacts of relay S1.

1.12 Relay HD operated:

- (a) Causes relay SP in the cordless position circuit to operate from ground through the operated contacts of relay S1 in the trunk which, with the operated relay AC, splits the incoming end from the outgoing end of the trunk and prepares the cordless position circuit for dialing.
- (b) Causes the lighted TL and L lamps in the cordless position circuit to change from steadily lighted to flashing at 30 IPM.
- (c) Connects resistor H (1000 ohms) across the windings of relay S to keep it operated while the trunk is in the split condition.
- (d) Prepares a dialing path in the trunk through varistor B on the ring side of the line.
- (e) Disconnects the normal ground through resistor SL (100 ohms) from the sleeve replacing it with 945-ohm battery obtained by the series connected resistor PD and relay SL.
- (f) Connects resistor ITT (200 ohms) across the inside terminals of the coil which at this time has no useful function.

1.13 When the hold key is released relay H in the cordless position circuit releases. However, relay SP in the cordless position circuit remains operated to off-normal ground in the trunk while relay HD in the trunk holds operated to the operated relay SP.

1.14 With relay H released and relay SP operated in the cordless position circuit, ground from the cordless position circuit through relay ACA operated and relay HM released in the trunk starts the marker over leads TR and U. After receiving these start indications the marker proceeds to connect the trunk to a dial pulse register circuit.

1.15 While in the process of serving the trunk the marker will operate the associated trunk hold magnet and return ground over lead ST to operate relay HM. When the marker closes the switch crosspoints establishing a connection between the dial pulse register circuit and the trunk, dial tone originating from the register circuit will be heard by the attendant.

1.16 A 100-ohm ground on the sleeve lead from the dial pulse register circuit will operate relay SL through operated relay HD. After checking that the connection is established and holding, the marker will release itself.

1.17 After hearing dial tone the attendant will dial the station number. When

dialing is completed, the dial pulse register circuit will function to recall the marker.

1.18 When the marker is seized the dial pulse register circuit will reverse the battery and ground on the tip and ring causing relay P to operate through diodes A and B.

1.19 With relay HD operated and relay TT released, relay P in operating will operate relay MC from off-normal ground in the trunk. The operation of relay MC releases relay P but relay MC holds operated to lead RLS from the marker.

1.20 Relay MC is a connector relay which when operated connects various information leads from the marker to the trunk. While the marker is processing the call, information will be passed over these leads to the trunk to indicate on this type of call whether:

- (a) The called line is idle and the trunk should start ringing.
- (b) The line is busy and a camp-on condition has been established.
- (c) The line is busy but is already camped on by another trunk.

D. Completing the Call (SC9)Called Station Idle

1.21 If the marker finds the called stations line idle, a ground will be returned over lead RS operating relay RS.

1.22 Relay RS operated:

- (a) Locks to off-normal ground in the trunk under control of relay RT.
- (b) Disconnects the tip and ring connectors from the PBX side of the trunk and prepares a path for connecting machine ringing through the primary winding of relay RT toward the called PBX station line.
- (c) Releases relay HD.
- (d) Connects 30-IPM battery over an alternate path through back contacts of released relay HD to keep lamp SL in the attendant console and lamp L in the 6-button key telephone set flashing at 30 IPM.
- (e) Provides holding paths for relay HD and for keeping relay SP in the cordless position circuit operated after relay HD releases.
- (f) Closes a supplementary path for bridging resistor H across the windings of relay S to maintain it operated should the attendant release from the trunk before the called station answers.

1.23 Relay HD released:

- (a) Disconnects the ring conductor from relay P and diodes A and B to disconnect the pulsing path and restore a link in the talking path over the tip and ring conductors.
- (b) Disconnects resistor ITT and restores relay S to its normal position across the inside terminals of the coil.
- (c) Changes the condition of lamp TL from 30 IPM flashing to steadily lighted.
- (d) Operates relay FB in the cordless position circuit to provide talking battery for the station while the attendant maintains the split condition.
- (e) Disconnects the sleeve from relay SL thus releasing it and connecting the sleeve to ground through resistor SL providing 100-ohm ground for holding the station line hold magnet operated.

1.24 After transmitting the terminating information to the trunk and connecting the trunk via a link to the station line, the marker will release itself and the dial pulse register from the connection. When the marker releases, ground is removed from lead RLS and relay MC releases. Relay HM in this circuit and the associated trunk hold magnet in the marker remain operated to off-normal ground in the trunk.

1.25 Relay MC released causes ringing current to be transmitted toward the station line. Audible ringing tone is transmitted to the attendant through capacitor FB.

1.26 When the station line answers, relay RT will operate on its primary winding and lock on its secondary windings to off-normal ground. Relay RT in operating releases relay RS and closes additional locking paths for maintaining operated relay HM in this circuit and relay SP in the cordless position circuit if the attendant has not disconnected before relay RS releases.

1.27 Relay RS released disconnects the ringing supply from the line and restores the connection of the tip and ring conductors from the station to the calling party or to the cordless position circuit if the attendant is still connected. It also changes the condition of lamps SL and L in the cordless position circuit from 30 IPM flashing to steadily lighted.

1.28 The call is not completed between the called station and the distant PBX until the attendant releases from the connection. The attendant releases from the connection by operating the RELEASE key in the attendant console which mechanically releases all operated pickup keys. If the incoming call was served from the 5-button key telephone set, the attendant may release by either

restoring the handset to its cradle or operating a different pickup key.

1.29 When the attendant disconnects, relay AC will release which in turn releases relay ACA. When relay AC releases, the station line is cut through to the distant PBX. The release of relay ACA disconnects the cordless position circuit from the trunk causing relays SP and FB in that circuit to restore to normal. Relay S in the trunk will hold operated to the station loop.

Called Station Busy - Camp-On Established

1.30 When a call is directed to a busy station, the marker will return ground over lead BY operating relay BY when relay MC operates.

1.31 Relay BY operated:

- (a) Opens the tip and ring conductors of the trunk towards the station.
- (b) Operates relay DR.
- (c) Releases relay SL.
- (d) Locks under control of operated relay HM and releases relay SL.
- (e) Prepares a sensing circuit for reoperating relay SL when the called line becomes idle.
- (f) Connects busy tone over lead BT to the cordless position circuit.
- (g) Connects 60-IPM battery to lamps SL and L in the cordless position circuit flashing these lamps as visual busy indication.

1.32 Relay DR operated opens a link in the ringing supply to the ring side of the line and prepares a link in a camp-on checking path to enable the marker to identify an existing camp-on condition if it attempts to complete a call over another trunk to the same station line as explained in 1.37 through 1.41.

1.33 The marker will also release the trunk connection to the dial pulse register but connect the trunk to the link that the busy called station line is presently using and apply ground over lead RS. The ground on lead RS operates relay RS which prepares the circuit to ring the called station when it becomes idle as explained in 1.21 through 1.29.

1.34 While the circuit is in the camp-on condition, one side of relay SL is connected to the link sleeve of the called station line and the other side to the center of a voltage divider consisting of resistors SD and PD. While the called line is busy, the voltage on the sleeve lead is approximately -4.8 volts. The resulting voltage across the relay SL winding is approximately one half of the

voltage necessary to operate it. When the called line becomes idle, the voltage across relay SL rises to approximately 5.2 volts and the relay operates.

1.35 Relay SL operated releases relay BY. With relay RS operated, the release of relay BY connects ringing ground to the tip side of the line toward the station while connecting the ring side of the line to the contacts of relay DR. It also changes lamps SL and L in the cordless position circuit from 60 IPM flashing to 30 IPM flashing.

1.36 As a safeguard against ringing while the station is still off-hook from the previous call, the circuit is arranged so that relay DR will be kept operated by the ringing ground on the tip side of the line through the station loop and a contact of relay DR. When the station goes on-hook, relay DR releases allowing ringing current through relay RT to be extended to the ring side of the line. Beyond this point, the circuit behaves as described in 1.21 through 1.29.

Called Station Busy with Another Trunk Camped On

1.37 When a call is directed to a busy station which already has a trunk camped on, the marker will return ground over leads BY and RS operating relays BY and RS as before.

1.38 The marker, in performing its testing functions, will connect a ground to the sleeve of the busy called line which will find a path through the contacts of operated relays BY, RS, and DR and diode F in a camped-on trunk back into the marker over lead CW to operate a camp-on-stop relay in the marker. Diode G prevents relay SL in a camped-on trunk from operating when the marker makes this test. The operated camp-on-stop relay in the marker will connect ground to lead FF operating relay FF in the trunk seeking to terminate a call.

1.39 Relay FF operates when relay MC operates and locks operated under control of relay BY.

1.40 Relay BY operated operates relay DR, releases relay SL, and locks under control of released relay SL and operated relay HM. Relay RS locks to the trunk off-normal ground and releases relay HD.

1.41 With relays FF and BY operated, 120-IPM interrupted busy tone is transmitted over lead BT to the cordless position circuit, and with relays DR and FF operated, lamps SL and L will flash at 120 IPM thus providing audible and visual indications to the attendant that a camp-on busy condition exists.

2. INCOMING CALL FROM DISTANT PBX DIRECTED TO OUTGOING TRUNK

A. Seizure of Idle Trunk (SC1)

2.01 Same as described in 1.01 through 1.41.

B. Call Answered by Attendant (SC2)

2.02 Same as described in 1.01 through 1.41.

C. Attendant Steers Inward and Dials Trunk Code (SC3)

2.03 The circuit functions generally in the same manner as described in C. Attendant Steers Inward and Dials Called Station under 1. of this section. However, in this case the marker, informed by the dial pulse register circuit that a trunk code was dialed, connects ground to lead TT to the trunk but omits grounding lead RS. If the desired trunk is busy, the marker will also connect ground to leads BY and FF.

D. Completing the Call (SC5)

Call Completed to an Outgoing Ringdown Tie Trunk

2.04 When the dial pulse register circuit reverses the polarity of the battery and ground on the tip and ring conductors, relay P operates which in turn causes relay MC to operate as described in 1.01 through 1.41. The ground on lead TT operates relay PC through the contacts of operated relay MC and operates relay TT through contacts of relay MC and operated relay HD. Since relay RS does not operate on this type of call, relay HD will remain operated for the duration of the call.

2.05 Relay TT operated:

- (a) Locks off-normal ground to the trunk.
- (b) Connects resistor ITT (200 ohms) across the inside of repeating coil A to present a dry bridge toward the outgoing trunk when the attendant leaves the connection.
- (c) Connects 30-IPM battery to lamp SL flashing it at 30 IPM.
- (d) Changes lamp TL from 30 IPM flashing to steadily lighted.

2.06 Relay PC in operating will lock to the trunk off-normal ground and remove pad PR from the circuit as described in pad control.

2.07 The ringdown tie trunk to which the call is completed will function on the outgoing call as described in 5.01.

Call Completed to a Central Office Trunk

2.08 The circuit will function for this type of connection in the same manner as described in 2.04 through 2.07. If the central office involved is a dial office, dial tone will be heard by the attendant when the line equipment in the central office is seized. After hearing dial tone, the attendant will dial the central office number before leaving the connection.

Call Completed to a Dial Repeating Type Tie Trunk

2.09 The circuit will function for this type of connection in the same manner as described in 2.04 through 2.07 except that when the distant operator or attendant answers, the outgoing tie trunk will reverse the polarity of the battery and ground on the tip and ring conductors operating relay P in this circuit.

2.10 Relay P operated operates relay RT from the trunk off-normal ground through a contact of the operated relay TT and provides a supplementary path to hold relay S operated after relay RT has operated.

2.11 Relay RT in operating at this time changes lamp SL from 30 IPM flashing to steadily lighted.

E. Called Trunk Busy (SC5)

2.12 If the called trunk is busy, the marker will operate relays FF, BY, and RS in the trunk in addition to relays TT and PC when relay MC operates.

2.13 Relay FF operated locks under control of operated relays BY and S1 and releases relay PC.

2.14 Relay BY operated releases relay SL, completing a locking path for itself through the contacts of released relay SL and operated relays HM and DR. Relay RS operated releases relay HD.

2.15 Relays FF and DR operated change lamps SL and L from 30 IPM flashing to 120 IPM flashing. Relays FF and BY operated cause low tone interrupted at 120 IPM to be transmitted to the attendant over lead BT.

J. TRUNK DIAL SELECTED BY STATION FOR OUTGOING CALL (SC6)

3.01 An unrestricted station can place an outgoing call to this trunk by dialing the ringdown tie trunk code. In processing this call, the marker will test for an idle trunk in the group by searching for battery (through the winding of relay MC) on lead IT. A ground connected to lead IT-- of an idle trunk by the marker operates relay MC in the idle trunk selected, and extends ground over lead TU(T-) toward the TMS remote scanner.

3.02 Relay MC operated locks to marker lead RLS and extends the ground on lead IT to the winding of relay HM, operating it and the associated trunk hold magnet which extends the calling station loop to relay S causing it to operate. Relay S operated operates relay S1 through a break contact of relay TC. Relay S1 operated extends ground over lead TU(T-) to the TMS remote scanner. With relays S and S1 operated and relay LO normal, relay T operates operating relay T1.

3.04 Relay T1 operated operates relay TC which in turn operates relay SR. When relay SR operates, relay S1 releases thus releasing relays T, T1, TC, and SR in tandem.

3.05 Relays T, S1, T1, and SR have slow-release characteristics and their chain release takes approximately one to two seconds. Relay SR remains operated during this interval causing a spurt of ringing current to be sent out over the tip and ring conductors toward the distant PBX. Audible ringing tone is returned to the calling station through capacitor BR.

3.06 During the interval when relay T1 is released and relay SR operated, relay LO will operate. Relay LO operated locks under control of relay S and prevents a recycle of relays T, T1, TC, and SR. Relay TC released reoperates relay S1.

3.07 After relay HM has operated, the marker releases releasing relay MC. However, relay HM locks operated to the trunk off-normal ground maintained by relay S1. While relay S1 is released during the ringing interval, the trunk off-normal ground is maintained by relay SR.

3.08 When the trunk is seized as described above, lamps TL, SL, and L are steadily lighted. Steady battery is connected to lamp TL through the break contacts of the normal relays HD and R1 in series with the parallel make contacts of relays S1 and SR.

3.09 Lamp SL is lighted by battery connected through break contacts of the normal relays RS, HD, BY, and FF in series with the make contacts of the operated relays S1 and HM. Lamp L has battery connected to it through break contacts of relays RS, HD, BY, and FF in series with make contacts of operated relay S1.

4. TRUNK DIAL SELECTED FOR OUTGOING CALL BY DIAL REPEATING TYPE TIE TRUNK (SC6)

4.01 The circuit responds to a seizure for an outgoing call by a dial type tie trunk in generally the same manner as for a seizure by a station except that in this case the marker, when processing the call, will connect ground to lead TT causing relay PC to operate when relay MC operates. Also, relay S operates from battery and ground, adding

polarity on the tip and ring conductors from the dial repeating tie trunk.

4.02 Relay PC in operating locks to the trunk off-normal ground and functions to short circuit pad PR as described in pad control.

5. TRUNK SELECTED BY ATTENDANT FOR OUTGOING CALL (SC6)

A. Dial Selected by Attendant

5.01 A ringdown tie trunk may be dial selected by the attendant to complete a call which has originated over either a central office trunk or another ringdown tie trunk. In this type of connection, the outgoing ringdown tie trunk functions in the same manner as described in 4.01 and 4.02.

B. Manually Selected by Attendant

5.02 The ringdown tie trunk can be manually selected by the attendant for an outgoing call in order to complete a call between the attendant and the distant PBX, or in preparation to complete a call from a station or trunk being held by an attendant trunk using the dial back method described in 6. DIAL BACK.

5.03 The trunk is manually selected by operating an associated pickup key in the cordless position circuit which will operate relays ACA and AC in the trunk. When relay ACA operates, relay S will operate from a bridge across the tip and ring in the cordless position circuit.

5.04 Relay S operates relay S1 which extends ground over lead TU(T-) to the TMS remote scanner, causing relays T, T1, TC, and SR to function as they would for a dial selected outgoing call, and sends out a 2-second spurt of ringing toward the distant PBX.

5.05 Relay S1 in operating causes lamp TL in the attendant console and lamp L in the 6-button key telephone set to light steadily. When relay T1 releases while relay SR is operated, relay LO will operate and lock to the operated relay S. Relay LO in operating will open the operating path for relay T and thus prevent a recycle of relays T1, TC, and SR.

5.06 When relay SR releases, the connection is completed between the attendant and the distant PBX.

6. DIAL BACK

6.01 If a restricted station attempts to call this trunk, the call will be routed to the attendant over an attendant trunk circuit. To complete the call to the ringdown tie trunk, the attendant obtains the number of the calling station, instructs the calling

party to remain on the line, and places the attendant trunk in the hold condition.

6.02 The attendant then originates an outgoing call as described in 5.02 through 5.05. After notifying the distant PBX attendant of the incoming call, the attendant steers inward for dial tone as described in 1.11 through 1.20, momentarily operates the dial back key in the cordless position circuit, and dials the number of the calling station.

6.03 The operation of the dial back key operates relay NT in the cordless position circuit which locks to the ground in the ringdown tie trunk through the contacts of operated relay ACA and then releases relays MC and RT. When relay MC in the ringdown tie trunk operates after the completion of dialing as described in 2.04 through 2.15, the locking path for relay NT in the cordless position circuit is transferred over lead NT into the marker causing relay NT in the marker circuit to operate.

6.04 Relay NL operated in the marker circuit will cause that circuit to override the busy condition of the called line. The operation of relay NT in the marker circuit will also operate relay RT in the ringdown tie trunk over lead RT through the operated relay MC.

6.05 Relay RT operated will prevent relay RS from locking operated and thus prevent ringing the called station.

6.06 The attendant trunk circuit will be released by the marker when the ringdown tie trunk is connected to the line which is being held, leaving the calling line connected only to the ringdown tie trunk.

7. SUPERVISION (SC2, SC3, SC10, AND SC11)

A. Incoming Calls

7.01 When the trunk is seized on an incoming call, lamp TL in the attendant console and lamp L in the 6-button key telephone set will flash at 120 IPM. When the call is answered, lamps TL and L light steadily. When the attendant places the trunk in the hold condition, lamps TL and L flash at 30 IPM.

7.02 When dialing is completed, lamp TL lights steadily but lamp L follows the SL lamp in the console. Up to this point, lamp L functioned like the trunk lamp in the console.

7.03 If the call is being completed to a station line which is found to be idle, lamps SL and L will flash at 30 IPM while the line is being rung and light steadily after the station has answered. If the station line is busy and the trunk camps on, lamps SL and L will flash at 60 IPM. If the station line is busy but another trunk is already camped on

the line, lamps SL and L will flash at 120 IPM.

7.04 If the call is being completed to a trunk, lamps SL and L will flash at 30 IPM throughout the call unless the called trunk is busy in which case the lamps will flash at 120 IPM. However, if the call is completed to a dial repeating type tie trunk, the 30-IPM flashing lamps SL and L will change to steadily lighted lamps when answer supervision is returned from the distant end.

B. Outgoing Calls

7.05 When the trunk is dial selected for an outgoing call, lamps SL, TL, and L light steadily and remain lighted for the duration of the call. If the trunk is manually selected, only lamps TL and L will light steadily and lamp SL will be extinguished.

2. RECALL (SC14)

A. Call Completed to Station

8.01 When an incoming call is completed to a station, the called station can recall the attendant by momentarily depressing the switchhook.

8.02 Relay S will release when the switchhook is depressed. Relay S when released with relays RT and S1 operated will cause relay FF to operate.

8.03 Relay FF operated:

- (a) Locks operated under control of operated relay S1 and released relay AC.
- (b) Prepares a path for operating relay DR when relay S reoperates.
- (c) Disconnects steady battery from lamps SL and L in the cordless position circuit and prepares a path for connecting 120-IPM battery to these lamps when relay DR operates.
- (d) Prepares a path for operating the ringer in the cordless position circuit when relay DR operates.
- (e) Operates relay T.

8.04 Relay T operated operates relay T1 which in turn operates relay TC. Relay TC operated releases relay T which in turn releases relay T1. Relay T1 released releases relay S1 if the switchhook is depressed too long.

8.05 When the switchhook is reoperated, relay S reoperates. Relay S operated releases relay TC, holds relay S1, and operates relay DR. When relay DR operates, lamps SL and L flash at 120 IPM and continuous ringing is connected to the ringer lead BZ as a recall signal to the attendant.

With option ZB, relay DR operated connects audible ringing to the station.

8.06 In response to the recall signal, the attendant will re-enter the connection by operating the associated pickup key in the cordless position circuit causing relays ACA and AC to operate. Relay AC operated will release relay FF which in turn releases relay DR thus restoring the circuit to its condition before the recall signal was originated.

B. Call Completed to Dial Repeating Type Tie Trunk

8.07 When an incoming call is completed to a dial repeating tie trunk, a recall signal from the distant end will cause a momentary reversal of the battery and ground on the tip and ring conductors which in turn cause relay P to release and reoperate. Relay S will follow the actions of relay P and generate a recall condition in the same way as described in 8.01 through 8.06.

2. DISCONNECT

A. Incoming Calls

Trunk to Station Connections (SC12)

9.01 When the station disconnects, relay S releases. This operates relay FF which operates the relays T, T1, and TC in sequence. Thus relay S1 is held operated for a longer interval of time.

9.02 When relay TC operates, it slow-releases relay T. Relay T released slow-releases relay S1 which in turn slow-releases relay S1. Relay S1 released releases relays RT, LO, HM, and FF and extinguishes lamps SL, TL, and L thus restoring the trunk to normal. The release of relay LO removes ground from lead TU(T-) to the TMS remote scanner. Relay FF released releases relay TC.

Trunk to Trunk Connections (SC12)

9.03 If the connections had been originated by the ringdown tie trunk for the completion of an incoming call, relays AO and RT would have operated.

9.04 If the call was completed from this trunk to a dial repeating tie trunk, relays HD, TT, AO, RT, PC, and P will remain operated for the duration of call as described in 8.07. When the distant end disconnects the battery and ground from the dial repeating tie trunk, it will return to its normal polarity thus releasing relay P. When relay P releases, relay S releases, relay FF operates, and the circuit functions as described in 9.01 and 9.02 except that relays PC and TT also release.

B. OutgoingTrunk to Station Connections (SC13)

9.05 On a trunk-to-station call, the connection is held by the operated S relay which is under control of the station switchhook. When the station hangs up, relay S releases causing relays LO and S1 to release.

9.06 Relay S1 in releasing removes ground from lead TU(T-) to the TMS remote scanner and from the off-normal ground lead releasing the trunk hold magnet and relay HM. When the switch crosspoints open, ground through resistor SL is disconnected from the link sleeve causing the line hold magnet associated with the calling line to release. The release of relay S1 also extinguishes lamps SL, TL, and L, thus restoring the trunk to normal.

Trunk to Trunk Connections (SC13)

9.07 On calls originated by a dial repeating type tie trunk to this trunk, relays AO, RT, HD, and TT will not be operated but relay PC would have been operated. Relay S will be held operated by battery and ground aiding polarity from the tie trunk. When the dial repeating type tie trunk receives a disconnect signal from its distant end, it will reverse battery and ground polarity thereby releasing relay P. Relay P releases relay S which will release relays LO and S1. When relay S1 releases, the circuit functions as described in 9.01 and 9.02, but also releases relay PC.

C. Connections to Central Office Trunk or Another Ringdown Tie Trunk

9.08 Calls of this type have to be disconnected manually by the attendant. As explained in 7.01 through 7.04, the attendant lamps SL and L associated with the originating ringdown tie trunk or central office trunk will be flashing at 30 IPM during conversation as an indication to the attendant that manual supervision is required.

9.09 When the attendant re-enters the connections by operating the trunk pickup key associated with 30-IPM flashing lamps and finds conversation completed, the attendant will operate the hold key momentarily to break down the connection.

9.10 The operation of the hold key will operate relay H in the cordless position circuit which, while operated, will open the holding path for relays TT, PC, AO, and HD causing them to release.

9.11 Relay HD in releasing opens a holding path for relay HM and the trunk hold magnet but these remain operated from a ground at the operated H relay in the cordless position circuit. When the hold key is released, relay H in the cordless position circuit releases and in turn releases relay HM and the trunk hold magnet.

9.12 The release of relay HD causes the release of relay SL, but this has no consequence in this type of connection.

9.13 When relays HM and HD release, lamp SL is extinguished and lamps TL and L change from slow flashing to steadily lighted. When the attendant operates the release key (or another pickup key), relays AC and ACA release, followed by the release of relays S, LO, T, and S1. When relay S1 releases, lamps TL and L are extinguished and ground is removed from lead TU(T-) to the TMS remote scanner. The trunk is now restored to normal.

9.14 A ringdown tie trunk at the terminating end of a central office trunk to a ringdown tie trunk connection, or a ringdown tie trunk to ringdown tie trunk connection is held by the bridge across the tip and ring conductors in the originating trunk. When the attendant releases the originating trunk as described above, the terminating trunk releases automatically when the bridge is removed from across the tip and ring conductors. The removal of the bridge releases relay S which in turn releases relays PC, HM, LO, and S1. Relay S1 released removes ground from lead TU(T-) to the TMS remote scanner. The trunk is now restored to normal.

D. Ringing Release

9.15 If the distant PBX operator originates a new call before the trunk is disconnected from the previous call, the existing connection will be broken down and the new incoming call signal locked in.

9.16 When relay R1 operates, the ground on the off-normal ground lead being maintained by the operated relay S1 is opened. This will release relay HM and any other relays locked operated to the off-normal ground lead. When the trunk hold magnet releases releasing the crosspoints, relays S and S1 release. Relay LO will not release when relay S releases. It will be held operated by the operated relay R1. When relay S1 releases, relay R1 will lock operated thus locking in audible and visual signals as described in 1.01 through 1.04.

9.17 The purpose of thermistor R1 is to slow up the operation of relay R1. This is necessary to prevent kicks of relay R, such as might occur after sending out a ringing signal, from falsely operating relay R1, or from breaking down a connection.

10. PAD CONTROL

10.01 Pad PR is provided to equalize the transmission on calls which terminate locally and calls which tandem through the PBX. The pad is normally in the circuit but is removed by the operation of relay PC which operates on calls to or from dial repeating type tie trunks, central office trunks, and other ringdown tie trunks.

10.02 The marker circuit will connect ground to lead TT only when setting up trunk to trunk calls. Ground on this lead will operate relay PC which locks operated to the trunk off-normal ground. Relay PC when operated will short circuit the series legs and open the shunt leg of the H-type pad thereby improving the transmission on tandem calls.

10.03 The locking path for relay PC is through a break contact of relay FF to provide for the reconnection the pad in the circuit if the attendant encounters an all trunks busy condition.

11. IDLE LINE TERMINATION

11.01 When the circuit is idle, termination is provided by the ITT resistor connected across a quadrant of the repeating coil A at the PBX side of the coil. When an attendant answers an incoming call or seizes the trunk for an outgoing call, or the trunk is seized through the switches for an outgoing call, relay S1 operates removing the ITT resistor termination.

11.02 When the attendant places the trunk in the hold condition, termination is provided by resistor IL which is connected across the tip and ring conductors at the PBX side of repeating coil A through the contacts of relay ACA in the trunk and relay SP in the cordless position circuit.

11.03 If after placing the trunk in the hold condition the attendant disconnects before dialing to attend to other calls, resistor ITT is reconnected in a terminating position through contacts of the operated HD relay and released relays TT and AC.

11.04 If the attendant in completing an incoming call dials a number and disconnects before the called party answers, resistor ITT is reconnected in a termination position through the contacts of the operated RS relay and released relays AC and TT. This also serves to provide termination if the attendant is removed from the connection while the trunk is camped on a busy line or while the trunk is reflecting the camp-on busy condition.

11.05 If the attendant in completing an incoming call to a trunk should dial the number and leave the connection, after which the trunk meets an all trunks busy condition, a termination will be provided by resistor ITT connected in its terminating position across a quadrant of repeating coil A through the contacts of the released relay AC and the operated relays HD and FF.

12. HOLD CONTROL

12.01 The attendant answers an incoming call by operating the associated pickup key in the attendant telephone equipment after

which the attendant steers inward by operating the hold key. This places the trunk in the hold condition as described in 1.11 through 1.20. If at this time the attendant should decide to release the pickup key before dialing the call in order to attend to other business, relays AC and ACA will release and the following action will occur.

12.02 If the attendant released after a dial tone connection was established, the release of relay AC connects resistor ITT in series with diode C across the tip and ring conductors toward the dial pulse register circuit. Diode C is poled in order to present a high resistance to the bridged relay in the register circuit, causing the dial pulse register to release. When the register releases, the ground is removed from the link sleeve causing relay SL to release. Relay SL in releasing removes the holding ground for relay HM and the trunk hold magnet, causing them to release. The release of relay HM transfers the holding path for relay HD through a break contact of relay AC.

12.03 If the attendant releases before the dial tone connection is completed, relay HM will not have been operated and relay HD, which was operated from ground over lead HD from the cordless position circuit, is held through a break contact of relay AC when relay AC releases.

12.04 When the attendant re-enters a held connection, the operation of relay AC following the operation of the trunk pickup key opens the holding path for relay HD thus releasing it. When relay HD releases, lamp TL changes from 30 IPM flashing to steady and the circuit is restored to the condition it was in when the incoming call was originally answered.

13. CODE RINGING (SC15)

13.01 When the trunk is to be used as a trunk party on a code ringing multi-party ringdown trunk line, V option should be provided and Y option omitted.

13.02 V option: (a) opens the lock circuit for relay R1; (b) disables the rering release circuit; (c) opens the operating circuit for relay T1; (d) operates relay SR from the dial back key in the attendant equipment when relay HM is normal; (e) prevents relay R1 from operating the auxiliary signal in the attendant equipment; and (f) provides a subset for receiving incoming ringing signals.

13.03 The omission of Y option prevents a station or trunk from seizing the code ringing trunk for an outgoing call. A station or trunk dialing the code ringing tie trunk code is intercepted by the attendant. Note that as a consequence of this tandem connection between two code ringing tie trunks cannot be established. However, tandem connections between a code ringing tie trunk and a

central office trunk, a dial repeating type tie trunk, or a noncode ringing ringdown tie trunk can be established provided the attendant uses the code ringing tie trunk as the originating trunk.

13.04 To originate a call over the trunk, the attendant operates the associated trunk pickup key and listens to determine whether the trunk line is in use. If the line is not busy, the attendant manually rings the code of the desired party with the dial back key in the cordless position circuit. Relay SR follows the operations of the dial back key. When the called party is reached, the attendant steers inward as described in previous paragraphs. Once the attendant has steered inward and relay HM has operated, the dial back key is disconnected from relay SR and connected into the dial back portion of the circuit.

13.05 When a ringing signal of the proper ringing code is heard on the auxiliary subset, the operator operates the trunk pickup key and answers the incoming call. After obtaining the call details, the attendant steers inward and completes the connection.

13.06 The code ringing trunk responds to recall signals and disconnects in the same manner as the noncode ringing trunk described in previous paragraphs.

14. MISCELLANEOUS

14.01 When the attendant's operation of a 756A PIX is transferred to a 6-button key telephone set, the common ringer continues to ring on calls over the central office and attendant trunks which do not appear on the 6-button key telephone set. To prevent this, option S is added which provides that each lead BZ is separate and connects to relay contacts in the cordless position circuit. Straps are added across the make and break contact of each lead BZ associated with a trunk appearance on the 6-button key telephone set. When the operations are transferred, the added relays in the cordless position circuit operate and leads BZ which are not strapped are opened. Only BZ leads strapped cause the common ringer to operate.

SECTION III - REFERENCE DATA

1. WORKING LIMITS

1.01 Relay S:

Maximum external circuit loop resistance - 2260 ohms

1.02 Relay RT:

Maximum external circuit loop resistance for silent interval tripping - 1400 ohms.

Maximum external circuit loop resistance for ringing interval tripping - 2000 ohms.

RINGING

1.03 Maximum external circuit loop resistance when a connecting circuit rings directly through repeating coil or through bypassing capacitors:

For 95 volts ringing source - 8300 ohms

For 75 volts ringing source - 7500 ohms

1.04 Maximum external circuit loop resistance when a connecting circuit rings through blocking capacitors:

For 95 volts ringing source - 13,000 ohms

For 75 volts ringing source - 10,000 ohms

2. FUNCTIONAL DESIGNATIONS

2.01 The functional meanings of the designations of the relays in this circuit are as follows:

Designation	Meaning
AC	Attendant Connector
ACA	Attendant Connector Auxiliary
AO	Attendant Originated
BY	Busy
DR	Delay Ringing
FF	Fast Flash
HD	Hold
HM	Hold Magnet
LO	Lockout
MC	Marker Connector
P	Polarized
PC	Pad Control
R	Ringing
R1	Ringing Auxiliary
RS	Ringing Start
RT	Ringing Trip
S	Supervisory
S1	Supervisory Auxiliary
SL	Sleeve
SR	Send Ringing
T	Timing
T1	Timing Auxiliary

TC Timing Control
 TT Trunk Terminating

3. FUNCTIONS

3.01 To provide a termination for the line to the distant PBX when the trunk is idle.

3.02 To lock in a ringing signal from the distant PBX and cause the trunk lamp to flash at 120 IPM and the audible signal to operate.

3.03 To change the trunk lamp to steadily lighted, silence the audible signal, and to establish a talking path between the attendant and the distant PBX when the attendant answers the incoming signal.

3.04 To change the trunk lamp to 30-IPM flashing; signal the marker for a connection to a dial pulse register; prepare a dialing path between the attendant and the dial pulse register; split off the distant PBX from the connection; and restore a termination to the line when the attendant momentarily operates the hold key.

3.05 To flash the station lamp at 30 IPM while the trunk is ringing the called station for the completion of an incoming call.

3.06 To return ringing induction to the attendant when the trunk is ringing a called station while the attendant remains with the connection. It also returns ringing induction to the distant PBX if the attendant leaves the connection before the called station answers.

3.07 To maintain the split condition of the trunk until the attendant leaves the connection.

3.08 To trip ringing and change the station lamp to light steadily when the called station answers.

3.09 To provide talking battery from the cordless position circuit for the station while the attendant remains with the connection and to provide the battery from the trunk after the attendant leaves the connection.

3.10 To flash the station lamp at 60 IPM and return busy tone to the attendant if the marker camps the trunk on a busy called station.

3.11 To recognize that a camped on station has become idle and to prepare to ring the station.

3.12 To delay ringing the camped station that has become idle until the station switchhook is restored to the normally operated condition.

3.13 To flash the station lamp at 120 IPM and return interrupted busy tone to the attendant if the called station is found to be busy and another trunk is already camped on.

3.14 To flash the station lamp at 30 IPM while awaiting answer on a call completed to a dial repeating type tie trunk and to change the station lamp to steadily lighted when the called end answers.

3.15 To flash the station lamp at 30 IPM while the trunk is connected to a central office trunk or another ringdown tie trunk.

3.16 To permit the attendant to re-enter a connection, which was originated by the attendant, on a bridged basis.

3.17 To release the dial pulse register but maintain the trunk lamp flashing at 30 IPM if the attendant leaves the connection before dialing but after placing the trunk in the hold condition.

3.18 To respond to a recall signal from a called station or dial repeating type tie trunk by flashing the station lamp at 120 IPM and operating the attendant audible signal.

3.19 To provide a dry supervisory bridge across the tip and ring on calls completed to trunks.

3.20 To maintain a busy indication to the marker while the trunk is off-normal.

3.21 To release on inward calls to stations or dial repeating type tie trunks when the called end disconnects, unless the attendant is also connected to the trunk.

3.22 To release on all inward calls if the attendant is connected to the trunk and to operate the hold key momentarily.

3.23 To release on all types of calls should the distant PBX ring to originate a new incoming call.

3.24 To provide for completing an inward call on a no-test basis under control of the attendant dial back key.

3.25 To permit the trunk to be manually selected by the attendant or dial selected for an outgoing call.

3.26 To automatically send a 1- to 2-second ring toward the distant PBX and to light the trunk lamp when the trunk is seized for an outgoing call.

3.27 To prevent the attendant from entering a dial selected outgoing call.

3.28 To provide for the removal of a transmission pad on calls completed to or from trunks.

3.29 To provide for operation of the trunk on a code ringing basis.

3.30 To operate the trunk with the TMS No. 1A Remote Scanner.

4. CONNECTING CIRCUITS

4.01 When this circuit is listed on a keysheet, the information thereon is to be followed. This circuit connects with the following circuits.

- (a) Line, Link, and Marker Circuit - SD-65741-01
- (b) Cordless Position Circuit - SD-65757-01, SD-65751-01
- (c) PBX Cabling Diagram - SD-65746-01
- (d) Ringing Circuit - SD-81288-01
- (e) Ringdown Tie Trunk Circuits - SD-66522-01*, SD-66898-01*, SD-66578-01*, SD-66401-01*
- (f) Traffic Measurement System No. 1A Remote Scanner and Encoder Circuit Portable Type - SD-JB200-01

* Typical

5. MANUFACTURING TESTING REQUIREMENTS

5.01 The trunk shall be capable of performing all of the functions listed and described herein and shall meet all of the requirements in the Circuit Requirements table.

6. ALARM INFORMATION

6.01 An operated fuse supplying the trunk will result in a lighted trouble lamp in the attendant equipment and a fuse alarm lamp in the alarm, transfer, and test circuit equipment located in slide 1 of the PBX. If alarm sending arrangements are provided, a major alarm will also be transmitted to the plant service center.

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DEPT 3221-WVS-RGP

6.02 The alarm indications are restored to normal by replacing the fuse.

7. TAKING EQUIPMENT OUT OF SERVICE

7.01 When the trunk is taken out of service, it should be made busy to outgoing calls at both the marker and attendant equipment appearances and made busy to incoming calls at the distant PBX.

7.02 The trunk is made busy to the marker by opening lead IT between the marker and the trunk and by grounding the end toward the marker. This may be accomplished by removing the strap between terminals 18 and 28 on the trunk terminal strip (not provided when trunk is arranged for code ringing) and adding a strap between terminals 17 and 18.

SECTION IV - REASONS FOR REISSUE

D. Description of Changes

D.1 A lead index is added for the alarm, transfer, and test circuit.

D.2 Options ZA, ZB, ZC, ZD, ZE, and ZF are added to the option index.

D.3 Options ZA and ZD are designated and rated Mfr Disc.

D.4 Options ZB is added as Standard to provide audible ringing to the station when the attendant is recalled.

D.5 Option ZE is added as Standard to place the locking of relay R1 under control of the battery cutoff relay in the alarm transfer, and test circuit so that when the PBX is on night connections an unanswered tie trunk call will not flash the trunk lamp and ring the console ringer continuously.

D.5 Option ZF is designated and rated Mfr Disc., and option ZC is added as Standard to prevent the ringing supply from short circuiting when the tie trunk and an attendant trunk on a central office trunk is signaling the attendant over the BZ lead.

PBX SYSTEMS
NO. 756A
CORDLESS POSITION CIRCUIT

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telephone consoles, a key telephone set, or a combination of one or two telephone consoles and a key telephone set. The telephone console or the key telephone set provides the necessary apparatus such as a handset for talking, a dial, keys for connections to trunks or lines, lamps for supervision, an audible signal, and keys for attendant functions such as holding and dial back. The telephone console may also be provided with

pushbutton keys for direct station selection. The cordless position circuit also provides the relay equipment necessary to complete the attendant functions.

B. General Functions

2.02 The operating and supervisory equipment of the control apparatus units which may be used is shown in Table A.

TABLE A - 3- AND 4-TYPE TELEPHONE CONSOLES

CONTROL OR SIGNAL	FUNCTION OR USE
PICKUP KEY	Provides access to trunks and lines for the purpose of answering incoming calls, originating outgoing calls, and completing calls to either the central office or to the PBX.
HOLD KEY	Provides for the holding of a trunk.
DIAL BACK KEY	Used in completing calls from a PBX station via the attendant to the central office while the station remains off-hook and in verification of a busy station.
RELEASE KEY	Functions only as a mechanical means to release an operated pickup key.
AUDIBLE SIGNAL CUTOFF KEY	Used to silence the audible signal.
NIGHT SERVICE KEY	Arranges the central office trunks so that night connections may be established.
LOUDNESS CONTROL	A mechanical device to control the loudness of the audible signal.
TRUNK AND STATION LAMPS	Provided as supervisory signals.
DIAL	Used to actuate the PBX switching equipment on calls into the PBX, central office, and tie trunks.
DIRECT STATION SELECTION PUSH-BUTTON KEYS (4-TYPE ONLY)	Used to actuate PBX switching equipment on a call into a PBX only.
JACKS A AND B	Provided as a means to switch attendant functions from one console position to the other or to a key telephone set.
ALARM LAMP	Provided to alert the attendant that there is some malfunction within the PBX or as an indication that established night connections have been disconnected due to a power failure.
REGISTERS BUSY LAMP (4-TYPE ONLY)	Green lamp indicates an all-registers-busy condition.

SECTION II - DETAILED DESCRIPTION

1. DESCRIPTION AND USE OF CORDLESS POSITION CIRCUIT AND KEY TELEPHONE SET

A. Cordless Position Circuit

1.01 The cordless position circuit consists of inductor A (battery feed for stations), inductors TB1 and TB2 (battery feed for two 3A or 4A telephone consoles), and relays BZ, BZ1, PB, H, HA, NT, and SP. Relays CS, DS, SPA, and SS and tone generator IT are provided for the indication of a camped-on call to the busy line feature.

1.02 The 3-type telephone console consists of:

- (a) Local battery telephone circuit with a transistor amplifier.
- (b) Jacks for use with either a handset or a head telephone set.
- (c) Rotary or TOUCH-TONE[®] dial.
- (d) Audible signal with cutoff key and loudness control.
- (e) Night service key.
- (f) One plug-in right key and trunk lamp unit with three trunk pickup keys.
- (g) One hold key.
- (h) One dial back and one release key.
- (i) One right plug-in station lamp unit with three station lamps.
- (j) One center plug-in key and trunk lamp unit with six pickup keys.
- (k) One center plug-in station lamp unit with six station lamps.
- (l) One optional left plug-in key and trunk lamp unit with six trunk or line pickup keys (the T and R leads of each key is extended to the cross-connection box for connection to line circuits).
- (m) One optional left plug-in station lamp unit with six station lamps.

1.03 The 4-type telephone console has the same items as the 3-type with the addition of 70 combination direct station selection keys and busy lamps and an all-registers-busy lamp.

B. Key Telephone Set

1.04 A standard key telephone set may be used if pickup of five or fewer trunks is required. The set is modified to use the sixth key as a hold key. Externally mounted keys are required for night service and dial back functions. The fifth key is arranged

for connection to either a trunk or line circuit. The exclusion key is used as an audible signal cutoff key.

C. Operation with Two Telephone Consoles and One Key Telephone Set

1.05 In general practice, two telephone consoles and one key telephone set are connected to one PBX through the cordless position circuit. The operating grounds for relay AC or ACA in the trunk circuits, relay POS1 or POS2 in the dial pulse register circuit (the position relays POS1 and POS2 in turn provide ground for the operation of relays H, HA, and NT and the audible signal), and the TT and TR leads are chained through jacks A and B.

1.06 If the attendant at the first console has the plug of the handset or headset in jacks A and B, the succeeding console and 6-button key telephone set are inoperative and cannot establish connections to a trunk; however, they have access to lines.

1.07 When the plug is removed from jacks A and B, the operating grounds and the talking leads are extended toward the second console or key telephone set. Regardless of which attendant unit is controlling, the supervisory lamps L, SL, and TL will light at all locations.

2. OPERATION WITH ATTENDANT TRUNK

A. Incoming Call to Console

2.01 When a PBX station dials 0, when a restricted PBX station dials 9, or when a PBX station line is in a permanent signal condition, the marker upon a signal from the register completes a connection from the station line to an attendant trunk.

2.02 The attendant trunk (FS5) functions to supply 120-ipm battery over lead SL to flash the SL lamp associated with the trunk, connects ringing current to lead BZ to operate the audible signal (through capacitor BZ, audible signal to ground at relay POS1 or POS2), and connects 120-ipm battery over lead TL to flash lamp TL on permanent signals or intercepted calls.

2.03 In response to the flashing lamps and audible signal, the attendant operates the associated pickup key. The pickup key operated (FS1) connects ground from relays SP and NT normal, through jack A springs operated, over lead ACA to operate relay AC in the attendant trunk.

2.04 Relay AC operated connects the attendant telephone circuit to the trunk over leads TT and TR, through the normal contacts of relays SP and PB, the 100-ohm tip and ring resistors, and the make contacts of jacks A and B.

2.05 The attendant trunk supplies talking battery for the PBX station and the attendant telephone circuit for the 3C or 4B telephone console. The attendant telephone circuit for the 3A or 4A telephone console is supplied talking battery from inductor TB over leads AT and BT.

2.06 Relay AC operated operates relay ON in the trunk circuit which opens lead BZ to silence the audible signal and transfers lamp SL from 120 ipm (fast flash) to battery, resulting in a steady lamp indication. On permanent signals or intercepted calls relay TN releases to extinguish lamp TL.

B. Incoming Call to Key Telephone Set

2.07 When a 6-button key telephone set is used, the attendant trunk functions as described in 2.01 to light the line lamp and sound the audible signal. The path for the audible signal is lead BZ, the ringer and exclusion key of key telephone set, and contacts of jack B normal or options around jack B to ground.

2.08 With option B, when the attendant function is transferred to the 6-button key telephone set, relays BZ and BZ1 operate. These relays operate open the individual BZ leads from each attendant trunk, ringdown tie trunk, and central office trunk. Only those BZ leads which are strapped around the relay contacts will cause the common ringer to operate.

2.09 The attendant operates a pickup key associated with the flashing lamp and removes the handset from the switchhook. Relay AC in the attendant trunk is operated over lead ACA, the operated pickup key and switchhook of the key telephone set, lead ACG, jack A normal, through the cord switchboard BCO key operated or through the options around the jacks and cord switchboard, and through relays SP and NT normal to ground.

2.10 Relay AC operated in the attendant trunk connects the key telephone set to the trunk over leads TT and TR, contacts of relays SP and FB, and options Q and S or the normal springs of jacks A and B. The trunk supplies talking battery to the PBX line and the key telephone set.

2.11 Relay AC operated operates relay ON in the trunk which opens lead BZ to silence the audible signal and transfers the line lamp from 120 ipm (fast flash) to a steady lamp indication.

C. PBX Call from Console Via Attendant Trunk

2.12 If the attendant desires to originate a call over the attendant trunk, the attendant operates a pickup key associated with the trunk (dark lamp). The pickup key operated connects ground from relays SP and NT normal, through the contacts of jack A operated, and over lead ACA to operate relay AC in the trunk circuit.

2.13 Relay AC functions to connect the attendant telephone set to the trunk and operates relay OUT which connects battery to lead SL causing lamp SL to light. The attendant hears dial tone and may dial the desired line or trunk code.

D. PBX Call from Key Telephone Set Via Attendant Trunk

2.14 If the attendant desires to originate a call over the attendant trunk, the attendant operates a pickup key associated with the trunk (dark lamp) and removes the handset from the switchhook. Relay AC in the attendant trunk operates to connect the key telephone set to the trunk and operates relay OUT which connects battery to lead SL causing the L lamp to light. The attendant hears dial tone and may dial the desired line or trunk code.

E. Attendant Hold Key Operation

2.15 When the hold key is operated in the console in connection with an attendant trunk, relay H operates over lead H, through the hold key operated, to ground at relay POS1 or POS2. When a hold key of a key telephone set is operated (sixth pickup key modified for holding), relay H operates over lead H, through the pickup key operated, and through the springs of jack B normal or the option around the B jack to ground.

2.16 Relay H operated connects ground to lead HD through contacts of relay AC operated to operate relay HD in the trunk. Relay HD operated causes the attendant trunk to function to hold a connection after the attendant releases the pickup key and disconnects from the trunk. Relay HD also connects slow flash (30-ipm battery) to lead SL which flashes lamp SL or L at 30 ipm as a hold identification.

F. Attendant Re-Enters Held Trunk

2.17 If the attendant trunk has been held and the attendant wishes to reconnect the console or the key telephone set to this trunk, the pickup key associated with the trunk (slow flashing lamp) is operated.

2.18 Relay AC in the attendant trunk operates. Relay AC operated releases relay HD in the trunk and connects the attendant telephone set over leads TT and TR to the trunk. If after re-entering a held trunk it is desired to hold the trunk again, the hold key must be operated.

1. OPERATION WITH LINE PICKUP

A. Connection to Console or Key Telephone Set

3.01 If the attendant is provided with a regular line circuit, the tip and ring of this line is connected to one of the six pickup keys in the left key unit or to the

fifth pickup key (option V) in the key telephone set. (These keys have the tip and ring brought out separately and are not multiplied to the common TR and TR leads.) A separate audible signal must be provided and connected externally. No lamp signals are provided.

B. Line Pickup Operation

3.02 On an incoming call, the audible signal sounds as an indication to the attendant. The attendant operates the pickup key in the console or operates the pickup key and removes the handset from the switchhook on the key telephone set. The ringing will be tripped and a talking path established.

3.03 To originate a call, the attendant operates the pickup key associated with the line and removes the handset from the switchhook if a key telephone set is used. This operation connects the attendant to the line.

4. OPERATION WITH CENTRAL OFFICE TRUNK

A. Incoming Call to Console

4.01 On an incoming call from the central office to the central office trunk circuit, if the connection to the trunk is made during the silent interval in the central office the trunk circuit functions to connect battery to leads TL and L which lights lamp TL in the console and lamp L in the key telephone set.

4.02 At the end of a silent interval and at the start of the ringing interval the trunk circuit functions to change battery on leads TL and L to 120 ipm which causes lamps TL and L to flash.

4.03 If the connection in the central office is made during the ringing interval at the central office the trunk functions to flash lamps TL and L. The trunk also functions to connect continuous ringing current controlled by relay R1 in the trunk circuit to lead BZ which operates the ringer through the audible signal key to ground at relay POS1 or POS2.

4.04 The attendant answers by operating the pickup key associated with the trunk. Relay ACA in the trunk circuit operates over lead ACA, the pickup key operated, and springs of jack A operated to ground. Relay ACA operated connects the attendant telephone circuit to the central office trunk over leads TT and TR, through contacts of relays SP and PB normal, and the made contacts of jacks A and B to trip the ringing on the trunk.

4.05 As soon as the ringing is tripped, relay R1 in the trunk releases to silence the audible signal and transfers the flashing lamps from 120-ipm battery (fast flash) to a steady lamp indication.

B. Incoming Call to Key Telephone Set

4.06 On an incoming call from the central office to the central office trunk, the trunk circuit functions to flash lamp L as described in 4.01. The trunk circuit also connects continuous ringing controlled by relay R1 in the trunk to lead BZ which operates the audible signal in the key telephone set through the exclusion key and the normal springs of jack B or through the option which shunts jack B.

4.07 The attendant answers by operating the pickup key associated with the flashing lamp L and removing the handset from the switchhook. Relay ACA in the trunk operates over lead ACA, through the pickup key and switchhook operated, and through the normal springs of jack A or through the options which shunt jack A to ground.

4.08 Relay ACA operated connects the attendant to the trunk over leads TT and TR, through the normal contacts or relays SP and PB, and through the normal springs of jacks A and B or the option that shunts jacks A and B to trip the ringing.

4.09 As soon as the ringing is tripped, relay R1 in the trunk releases to silence the audible signal and transfers lamp L from 120 ipm (fast flash) to a steady lamp indication.

C. Trunk Holding by Console

4.10 The hold key functions as both a holding and a steering key when it is used with a central office trunk. If the incoming call requests connection to a line within the PBX, the attendant operates the nonlocking hold key and in turn operates relay H over lead H, through the hold key, and to ground at relay POS1 or POS2.

4.11 Relay H follows the action of the hold key and operates relay HD in the trunk. Relay HD operated transfers the TL or L lamp from a steady lamp indication to 30 ipm (slow flash) as a holding signal.

4.12 The operation of relay H and relays HD and ACA in the trunk cause relay SP to operate. Relay SP operated:

- (a) Places a holding short across the trunk side of the circuit (leads TT and TR).
- (b) Leaves the attendant telephone circuit across the line side of the circuit (leads LT and LR).
- (c) With the hold key released, ground is connected to leads T and U through the trunk to the marker as a signal for the marker to connect a dial pulse register to the trunk.

D. Trunk Holding by Key Telephone Set

4.13 The holding of an incoming call on a central office trunk at a key telephone set is the same as described in the preceding section except that the hold key in the key telephone set is pickup key No. 6 modified and that relay H operates through the hold key operated, the normal contacts of jack B, or the option that shunts jack B to ground.

E. Completion of Incoming Calls to PBX

4.14 After the attendant has answered an incoming call and has held the trunk, dial tone will be returned by the dial pulse register. The attendant dials the desired PBX line and if the marker finds the called station line idle it transmits a ring start ground to operate relay RS in the central office trunk.

4.15 Relay RS operated prepares the trunk to transmit ringing current to the called station line, operates relay FB, and releases relay HD in the trunk. Relay HD released changes lamps TL and L from 30 ipm (slow flash) to a steady lamp indication and connects 30 ipm to lamps SL and L.

4.16 If the attendant releases from the connection immediately after dialing, ringing induction is returned to the central office when the station line is rung. The operation of the RLS key by the attendant mechanically releases the pickup key which releases relays AC and ACA in the central office trunk.

4.17 The release of relay AC connects the central office trunk side to the line side of the central office trunk, but the holding short across the TT and TR leads due to relay SP operated remains until relay ACA in the SP operated releases.

4.18 Relay ACA released releases relay SP and disconnects leads TT, TR, LT, and LR from the attendant telephone circuit. When relay ACA releases, the holding short is removed and the central office hears ringing inductions.

4.19 If the attendant remains on the connection until the station answers, relay RT operates in the central office trunk to release relay RS, also in the central office trunk. Relay RS released changes lamps SL and L from 30 ipm (slow flash) to a steady lamp indication and provides a supplementary holding path for relay FB. Relay FB supplies talking battery for the called station while it is connected to the attendant.

F. Outgoing Call from Console

4.20 The attendant may originate an outgoing call to the central office by operating a pickup key associated with an idle central office trunk (dark SL and TL lamp) provided certain options are wired in the trunk.

4.21 Relay ACA operates from ground through the contacts of relays SP and NT normal, contacts of relay BCO operated if M option is furnished, and the contacts of jack A and the pickup key operated.

4.22 Relays ACA and AC operated in the central office trunk connect the tip and ring of the central office trunk to the attendant telephone circuitry via leads TT and TR. The attendant now receives central office dial tone and may dial out. Relays S1 and SR in the central office trunk function to light lamps L and TL steady.

G. Outgoing Call from Key Telephone Set

4.23 A call may be originated from the key telephone set by operating the pickup key associated with an idle central office trunk (dark L lamp) and removing the handset from the switchhook. The central office trunk functions as described in the preceding section except that the ground for the operation of relay ACA is through jack A normal or options shunting jack A and the contacts of the switchhook of the key telephone set.

H. Recall by Station

4.24 If the PBX line connected to a central office trunk or a station dial transfer trunk recalls the attendant (fast flash 120 ipm on station lamp), the attendant reoperates the trunk pickup key associated with the 120-ipm fast-flashing lamp which reoperates the ACA relay in the trunk to connect the attendant telephone circuit to the LT and LR leads of the trunk toward the PBX.

4.25 When the attendant has received the number of the PBX line to which the call is to be transferred, the hold key is operated grounding lead H to operate relay H.

4.26 Relay H operated:

- (a) Grounds lead HD toward the central office trunk to operate relay HD in the central office trunk.
- (b) Grounds lead HM toward the central office trunk to supply a supplementary holding ground for relay HM in the central office trunk.
- (c) Removes ground from lead H to cause a series of relays to release in the central office trunk which removes holding ground from relay HM in the central office trunk.

4.27 Relay HM is prevented from releasing until the hold key is released because relay H operated also grounds lead HM to hold relay HM in the central office trunk operated.

4.28 When the hold key is released relay HM in the central office trunk releases. Relay HM released causes the established call to disconnect, and leaves the attendant tele-

phone set connected toward the central office.

4.29 The attendant then reoperates the hold key which will reoperate relay H over lead H. Relay H operated grounds lead HD to operate relay HD in the central office trunk. Relay HD in the trunk operated grounds lead SP to operate relay SP in the cordless position circuit.

4.30 Relay SP operated and relay H released (when the hold key is released) provides ground over leads T and U, and with relay ACA operated in the central office trunk gives a signal for the marker to connect a register to this trunk. When the register is attached the attendant hears PBX dial tone and can dial the desired PBX line number.

I. Attendant Re-Enters Held Central Office Trunk

4.31 If the attendant desires to re-enter a central office trunk which has been held, the trunk pickup key associated with the slow-flashing lamp is operated which operates relays AC and ACA in the central office trunk.

4.32 Relay AC operated in the central office trunk removes the hold condition and the attendant telephone circuit is connected to the central office. After re-entering the central office trunk if the attendant desires to again hold the central office trunk the hold key is reoperated to re-establish the hold.

5. POSITION CIRCUIT NORMAL CHECK

5.01 Ground to operate an AC relay in any trunk circuit is supplied over lead ACA through relays SP and NT normal. This path is provided to guard against operation of an AC relay if either the NT or SP relay is operated which would cause a false signal to be sent to the connected trunk. Resistance H is provided to furnish holding ground for AC relays after relay SP or NT has been operated.

6. COMPLETING OUTWARD CALLS FROM RESTRICTED LINES

6.01 If a restricted line desires to place an outward call to the central office and dials either 9 or 0, the call will be routed to the attendant via an attendant trunk circuit.

6.02 The attendant answers this incoming signal as described in a preceding section and having determined both the telephone number desired and the number of the PBX line originating the call puts a hold on the attendant trunk.

6.03 The attendant now seizes an idle central office trunk and dials the central office number. When the party at the central office telephone answers, the attendant asks him to wait. The attendant then puts a hold condition on the central office trunk but does not restore the trunk pickup key. The attendant will now hear PBX dial tone, and before dialing operates the dial back key.

6.04 The dial back key operated operates relay NT with a ground from relay POS1 or POS2 over lead NTG. Relay NT operated locks over lead N to relay MC normal in the central office trunk.

6.05 When dialing is completed, the MC relay in the central office trunk operates and connects relay NT in the position circuit, in series with the NT relay in the marker. Relay NT operated in the marker is an indication that the marker shall disregard the busy condition of the called line and connect to it.

6.06 When the marker connects this central office trunk to the PBX line which is being held on the attendant trunk, the attendant trunk is released or kicked off and returns to normal.

6.07 The connection to the central office trunk remains complete, and the attendant restores the trunk pickup key for the central office trunk.

6.08 For the key telephone set, operation is identical to the above except operating ground for relay NT is through jack B normal or through the option which shunts the jack.

7. NIGHT CONNECTIONS

7.01 If the PBX is arranged for flexible night connections, the operation of the night key to the night service position causes relay NS to release in the alarm, transfer, and test circuit. The attendant now may establish a night connection between any idle central office trunk and any station (idle or busy) by the following sequential procedures:

- (a) Operating the pickup key associated with the idle trunk to connect the attendant to the trunk.
- (b) Operating the hold key to obtain PBX dial tone.
- (c) Dialing the number of the desired station.
- (d) Operating the release key to disconnect the attendant from the trunk.

The central office trunk will be directly connected to an idle station or will camp on if the station is busy.

7.02 If a power failure occurs after night connections have been established, all

night connections are disconnected and emergency connections are established by the release of relays AT and ATA in the alarm, test, and transfer circuit.

7.03 Relays AT and ATA released transfer lines (STA, 30, 31, and 32) directly to central office trunk conductors and make these lines busy to the PBX switching system.

8. DIRECT STATION SELECTION

A. Busy Lamp Field

8.01 A busy lamp is associated with each station. Whenever a hold magnet associated with a station line is operated, ground is connected via a BL- lead to one side of the busy lamp.

8.02 The other side of all busy lamps within a tens group is strapped common and is connected via a B- lead, through the BCO relay in the alarm, transfer, and test circuit operated, to one side of a 10-volt ac supply. The other side of the supply is grounded. Therefore, whenever a station hold magnet operates, the associated busy lamp is lighted.

B. All Registers Busy Lamp

8.03 When both of the dial pulse registers are busy, battery through contacts of both of the SR relays light a lamp (ARB) in the attendant 4-type telephone console. This lamp lighted serves as a warning to the attendant that direct station selection is inoperative.

C. Direct Station Selection (Option A)

8.04 When the attendant wishes to complete an incoming trunk call to a station, the pushbutton key associated with the called station is momentarily depressed if the busy lamp is dark. This causes the same functions as if the attendant had operated the hold key, received dial tone, and dialed two digits.

8.05 Ground from contacts of relay POS- via lead SG3 is connected to the contacts of the pushbutton key. With the key depressed this:

- (a) Operates relay HA (ground via lead H1, contacts of POS- relay, and lead HA).
- (b) Operates relay H (ground via lead H1, contacts of relay POS-, lead HA, and lead H1 via the attendant trunks).
- (c) Connects ground to a units U- lead corresponding to the units digit of the key.
- (d) Connects ground to a tens T- lead corresponding to the tens digit of the key.

8.06 Relay H operated operates relay HD in the trunk. Relay HD operated transfers the TL or L lamp from a steady lamp indication to 30 ipm (slow flash) as a holding signal.

8.07 The operation of relays H and ACA in the trunk causes relay SP to operate.

8.08 Relay SP operated:

- (a) Places a holding short across the trunk side of the circuit (leads TT and TR).
- (b) Leaves the attendant telephone circuit across the line side of the circuit (leads LT and LR).
- (c) With the H relay released, ground is connected to leads T and U through the trunk to the marker as a signal for the marker to connect a dial pulse register to the trunk.

8.09 Leads T- and U- are extended to the attached register via relays AC and POS- in the register circuit. Ground on these leads results in the operation of register relays TD- and UD-. Relay HA operated operates register relay UD via leads HA1 and HA2 and releases relay H. Register relay UD causes the register to complete to the marker.

8.10 If the marker finds the called station idle it operates the station hold magnet to light the busy lamp and transmits a ring start ground to operate relay RS in the central office trunk.

8.11 Relay RS operated prepares the trunk to transmit ringing current to the called station line, operates relay PB, and releases relay HD in the trunk.

8.12 Relay HD released changes lamps TL and L from 30 ipm (slow flash) to a steady lamp indication and connects 30 ipm to lamps SL and L.

8.13 If the attendant releases from the connection immediately after dialing, ringing induction is returned to the central office when the station line is rung.

8.14 The operation of the RLS key by the attendant mechanically releases the pickup key which releases relays AC and ACA in the central office trunk.

8.15 The release of relay AC connects the central office trunk side to the line side of the central office trunk, but the holding short across the TT and TR leads remains until relay ACA in the trunk releases due to relay SP operated.

8.16 Relay ACA released releases relay SP and disconnects leads TT, TR, LT, and LR from the attendant telephone circuit. When relay ACA releases, the holding short is removed

and the central office hears ringing inductions.

8.17 If the attendant remains on the connection until the station answers, relay RT operates in the central office trunk to release relay RS, also in the central office trunk. Relay RS released changes lamps SL and L from 30 ipm (slow flash) to a steady lamp indication and provides a supplementary holding path for relay PB. Relay PB supplies talking battery for the called station while it is connected to the attendant.

8.18 If the attendant desires to originate a call over an attendant trunk, the attendant operates a pickup key associated with the trunk (dark lamp). The pickup key operated connects ground from relays SP and NT normal, through the contacts of jack A operated, and over lead ACA to operate relay AC in the trunk circuit.

8.19 Relay AC functions to connect the attendant telephone console to the trunk and operates relay OUT which connects battery to lead SL causing lamp SL to light. The attendant hears dial tone.

8.20 The called station may be directly selected by momentarily depressing a pushbutton key associated with the station. When the key is depressed ground is connected to units lead U-, tens lead T-, and lead H1 which operates relay HA.

8.21 The ground on the U- and T- leads will operate a units digit UD- and tens digit TD- relay in the register. Relay HA operated causes the register to complete to the marker. The marker will set up the connection between the attendant and station on a junction basis.

9. OPERATION WITH CORD SWITCHBOARD

9.01 When a cord switchboard is provided for the attendant position equipment, the cordless position circuit functions only with the night attendant key telephone equipment.

9.02 Circuit action for transferring from the day attendant cord switchboard is the same as previously described for transfer from one console to another or from one console to the key telephone set, except that instead of the telephone set jacks in the console providing the transfer, the transfer is accomplished by the battery cutoff relay in the switchboard.

10. INDICATION OF CAMPED-ON CALL TO BUSY LINE

A. Without Direct Station Selection

10.01 The attendant after receiving an indication of a camped-on condition (busy tone), operates the release key dropping the connections. The attendant then reoperates

the pickup key associated with the central office trunk which operates trunk relay ACA. Relay ACA operated operates trunk relays AC and IC-.

10.02 Relay IC- operated:

- (a) Operates relay CS in the cordless position circuit via lead IC1.
- (b) Partially prepares the path to connect the tip and ring of the busy line to the tone generator.

10.03 Relay CS operated:

- (a) Completes a locking path for relays IC- and CS.
- (b) Prepares an operating path for relay SS.
- (c) Connects ground to start tone generator IT.
- (d) Operates relay CO.

10.04 Relay CO operated:

- (a) Locks operated under control of trunk relay IC-.
- (b) Opens the operating paths of the IC-relays of all central office trunks.

10.05 The attendant notifies the central office party of the camped-on condition and releases, mechanically releasing the trunk pickup key. The pickup key released releases trunk relay AC. Trunk relay AC released releases trunk relay ACA and operates relay SS.

10.06 Relay SS operated:

- (a) Connects a second ground to tone generator IT.
- (b) Applies tone to the tip and ring of the busy line.
- (c) Slow releases relay CS.

10.07 Relay CS released removes one ground from tone generator IT and slow release relay SS.

10.08 Relay SS released removes ground from tone generator IT turning it off and opens the tip and ring leads.

B. With Direct Station Selection

10.09 When the attendant console is equipped with a station busy lamp field, the attendant may confirm a desired camp-on condition before connecting the central office party by direct station selection. When the attendant depresses the pushbutton key, relay DS operates in parallel with relays H and HA.

10.10 Relay DS operated:

- (a) Prepares an operating path for relay CS.
- (b) Locks under control of relay SPA.
- (c) Opens the operating path of relay SS.

10.11 In the process of completing a camp-on connection, the marker operates trunk relays RY and IC.

10.12 Relay IC operated performs the same functions as described in 10.02.

10.13 Relay CS operated performs the same functions as described in 10.03.

10.14 Relay CO operated performs the same functions as described in 10.04.

10.15 At the completion of the camp-on connection, the attendant will receive audible and visual indications of camp on. The attendant release of the DSS key will release relay RA.

10.16 Having completed the camp-on connection, the attendant then disconnects from the loop by operating the release key, mechanically releasing the trunk pickup key. The pickup key released releases trunk relay AC. Trunk relay AC released releases trunk relay ACA and operates relay SS.

10.17 Relay SS operated performs the same functions as described in 10.06 except relay SPA released releases relay DS.

11. MISCELLANEOUS

11.01 When this circuit is used the 700-type cordless position or with a 756A PBX that does not have the POS1 or POS2 relays, option G is furnished. The ground normally furnished by the position relay on lead SG3 is replaced by the AP ground through jack B.

11.02 When the attendant operation of a 756A PBX is transferred to a 6-button key telephone set, the common ringer continues to ring on calls over central office and attendant trunks which do not appear on the 6-button key telephone set.

11.03 To prevent this, options are added in the attendant trunk and the central office trunk which separate the buzzer leads of each trunk and connect the leads to contacts of relays provided by this circuit (option B).

11.04 Straps are added across the make and break contacts of each BZ lead associated with a trunk appearance on the 6-button key telephone set. When the operations are transferred, the added relays in the cordless position circuit operate and the buzzer leads not strapped are opened. Only those BZ leads strapped will cause the common ringer to operate.

11.05 When a 556A switchboard with jack appearances of the two-way trunk circuit to the central office is used as an attendant position, lead BZ is connected to the cord buzzer circuit to cause an audible signal on incoming trunk calls.

11.06 When the attendant holds a two-way trunk circuit to the central office and lead W is provided, ground from the hold key causes relay TLA in the trunk circuit to operate.

11.07 Option ZE provides a make contact of the BZ1 relay in the BZ lead to the 6-button key telephone set ringer. This prevents the buzzing of the BZ relay due to ringing current associated with incoming calls to an attendant position.

SECTION III - REFERENCE DATA

1. WORKING LIMITS

1.01 Voltages: 45 to 52 volts dc.

2. FUNCTIONAL DESIGNATIONS

2.01 The functional designations and meanings of the relays used in the cordless position are listed as follows:

Designation	Meaning
BZ	Buzzer
BZ1	Buzzer Auxiliary
CO	Cutout
CS	Control Signal
DS	Direct Station Selection
FB	Battery Feed
H	Hold
HA	Hold Auxiliary
NT	No Test
SP	Split
SPA	Split Auxiliary

3. FUNCTIONS

3.01 To provide for connecting the attendant telephone to any central office trunk or attendant trunk or line circuit under control of the attendant.

3.02 To provide lamp signals for trunks.

3.03 To provide transmitter battery for the attendant telephone when 3A or 4A telephone consoles are provided.

3.04 To provide an audible signal in conjunction with trunk and line lamp signals.

3.05 To provide for cutting off the audible signal under control of a key.

3.06 To provide a start signal to the marker on outgoing calls to PBX lines or trunks from the attendant position.

3.07 To provide for holding a trunk after the attendant disconnects, if desired.

3.08 To provide talking battery for the attendant on calls to PBX lines or trunks connected to the line end of central office trunks.

3.09 To provide for splitting a central office trunk when required.

3.10 To signal the marker to connect to a line disregarding the busy condition on dial back completion of outward calls to the central office.

3.11 To provide for operation with more than one attendant key telephone unit at different times.

3.12 When used with more than one attendant key telephone unit, to render other key units inoperative except to lines when a particular key unit is attended.

3.13 To provide a visual trouble signal which is common to all alarm conditions for the PBX.

3.14 To provide a visual signal when a power failure has disconnected the flexible night connections.

3.15 To provide for operation of the cordless position circuit with the auxiliary position circuit during remote trunk answer operation of the PBX.

3.16 To provide at only one attendant position (a console or the 6-button key telephone set) a means for placing the PBX on remote trunk answer operation.

3.17 To provide for disabling the 6-button key telephone set when the attendant at the key telephone set position places the PBX on remote trunk answer operation.

4. CONNECTING CIRCUITS

4.01 When this circuit is listed on a keysheet, the connecting information thereon is to be followed. This circuit connects with the following:

- (a) Line, Link, and Marker Circuit - SD-65741-01
- (b) Dial Pulse Register Circuit - SD-65742-01

- (c) Two-Way Central Office Trunk - SD-65752-01
- (d) Attendant Trunk Circuit - SD-65753-01
- (e) Tie Trunk Circuit - Outgoing Manual and Dial Selected - Incoming Ringdown - SD-65756-01
- (f) Alarm, Transfer, and Test Circuit - SD-66796-01
- (g) Busy Verification Auxiliary Trunk Circuit - SD-66911-01
- (h) Power Supply Circuit - SD-81326-01
- (i) Power Supply Circuit - SD-81600-01
- (j) No. 556A PBX Cord, Telephone, Dial, Battery, Buzzer, and Ringing Circuits - SD-65658-01 (typical)
- (k) Telephone Consoles - 3- and 4-Type Telephone Console Circuit - SD-66907-01
- (l) Station Dial Transfer Controller Circuit - SD-66909-01
- (m) Auxiliary Position Circuit - SD-66910-01
- (n) 608D Cord Switchboard Auxiliary Signal, Fuse Alarm, Battery Cut-Off, and Miscellaneous Circuit - SD-67039-01

5. MANUFACTURING TESTING REQUIREMENTS

5.01 The cordless position circuit shall be capable of performing all the service functions listed herein, and meeting the requirements shown in the Circuit Requirements Tables.

6. TAKING EQUIPMENT OUT OF SERVICE

6.01 No provision is made to take this equipment out of service.

7. ALARM INFORMATION

7.01 An operated fuse supplying the cordless position circuit will result in a major alarm. This alarm is transmitted to the plant service center if alarm sending is provided, by a visual signal at the attendant position, and in the alarm transfer and test circuit. Replacing the operated fuse silences the alarm and extinguishes the lamp.

SECTION IV - REASONS FOR REISSUE

D. Description of Changes

D.1 The code of the H relay in App Fig. 1 is corrected from AF6A to AF6J.

D.2 Reference is added for the 402C tone generator.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 3221-WVS-RGP

PEX SYSTEMS
NO. 756A
CURRENT DRAIN DATA

1. PURPOSE OF CIRCUIT

1.01 This drawing gives the Current
Drains for circuits in PEX Systems,
No. 756A KEY SHEET, SD-65910-01.

2. REASON FOR REISSUE

2.01 Current Drain values are revised
to update Current Drain Data
Sheet.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5122HW-WEK-RHP
DEPT 5337-RVL

PBX SYSTEMS
AUXILIARY RELAY CIRCUIT
FOR DIRECT STATION SELECTION
FROM STATIONSCHANGESB. Changes in Apparatus

B.1 Superseded Superseded By
K- Relay AK⁴, K- Relay AK⁴⁹,
Fig. 3, X Option Fig. 3, W Option

D. Description of Changes

D.1 On sheets 2, 3, 5, 7 and 8, Option X is designated and rated Manufacture Discontinued. Option W is added to provide a new relay code for relay K- whereby all of the contacts in the operate and holding paths to line relay L in the register are EMB. This change eliminates the possibility of momentarily opening the circuit path long enough to falsely release relay L in the register under marginal conditions.

D.2 On sheets 2 and 3, wiring option V is added to provide lead K as a locking path to ground for operated K- relays. This change reduces the probability of call blocking and contact arcing when the DSS key is operated momentarily and restored to normal before the call is completed.

D.3 On sheet 2, the working limits information is clarified by adding a reference to relay SC and equipment note 201 is removed.

D.4 On sheet 1, the title is changed to delete references to No. 759A Dial Communications System which was re-designated Switching System No. 400.

D.5 On sheet 6, SC1 and SC2 are revised to indicate that the DSS key should be held operated until dial tone is removed and to make minor additions and corrections.

D.6 On sheets 8, 9 and 10, CAD Figs. 8 and 9 for 759A are deleted, CAD Figs. 3 and 4 are rated "A&M Only" and replaced

by new CAD Figs. 8 and 9 respectively. Wiring of diodes is revised to eliminate criss-crossing.

D.7 On sheets 8, 9 and 10, CAD Figs. 1, 5, 6 and 7, option V is added.

F. Changes in CD Section

F.1 Under SECTION I - GENERAL DESCRIPTION,
1. GENERAL METHOD OF OPERATION,
change paragraph 1.01 to read:

1.01 The purpose of this circuit is to provide a means whereby a station arranged for direct station selection may originate a call by lifting the handset, listening for dial tone and operating a key corresponding to the number of the station being called until dial tone is removed.

F.2 Under SECTION II - DETAILED DESCRIPTION,
1. ESTABLISHING A DIRECT STATION SELECTION CALL, change paragraph 1.04 to read:

1.04 (d) Prepares its own locking path to ground under control of relay PRO,1.

F.3 Change paragraph 1.06 to add:

1.06 (e) Completes the locking path to ground for operated K- relays.

F.4 Change paragraph 1.10 to read:

1.10 When relay PRO,1 releases, the locking path for operated K- relays is opened, the associated relays DSCO,1 and SC- release which removes ground from leads T- and U- to the register.

F.5 Add paragraph 1.14 as follows:

1.14 When dial tone is removed, the DSS key is restored to normal which releases the K- relay.

F.6 Under SECTION III - REFERENCE DATA,
1. WORKING LIMITS, change paragraph
1.01 to read:

1.01 Lines

The maximum resistance of the circuit
path for satisfactory operation of relay
SC- is 125 ohms.

F.7 Under SECTION IV - CONNECTING CIRCUITS,
change paragraph 4.01 to delete:

4.01 (a) No. 759A Line, Link and Connector
Circuit - SD-66744-01.

(b) No. 759A Dial Pulse Register
Circuit - SD-66775-01.

BELL TELEPHONE LABORATORIES, INCORPORATED

(WECO 2120HW-RHB-WHK)
DEPT 5337-LAH

PBX SYSTEMS
NO. 759A DIAL COMMUNICATION SYSTEM
AND NO. 756A
AUXILIARY RELAY CIRCUIT
FOR DIRECT STATION SELECTION
FROM STATIONS

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SECTION I - GENERAL DESCRIPTION

1. GENERAL METHOD OF OPERATION

1.01 The purpose of this circuit is to provide a means whereby a station arranged for direct station selection may originate a call by lifting the handset, listening for dial tone, and momentarily operating a key corresponding to the number of the station or trunk being called.

1.02 Each line arranged for direct station selection will have a relay K and a relay SC associated with it.

1.03 The telephone set, in addition to the usual dial, will be equipped with a DSS key for each station or trunk it is desired to reach by this method. Each key will be wired to reach a particular two digit directory number by appropriate connections of diodes T and U.

1.04 The PBX switching equipment is arranged for direct station selection by stations by associating relays RC, PR, and DSC with each dial pulse register.

1.05 To originate a call by direct station selection, the handset should be lifted from its cradle and the PBX switching equipment will connect a dial pulse register to the line in the usual manner.

1.06 After dial tone is heard, a DSS key should be operated. The key, in operating, will operate relay K which, in operating, will signal the register over the tip conductor that a DSS call is being originated.

1.07 The register will then operate relay SC over the tip conductor. Relay SC, in operating, will connect through the tens and units digit leads to the register.

1.08 The tens and units digit leads corresponding to the operated key will be grounded and operate the appropriate tens and units digit register relays in the register.

1.09 Relay SC, in operating, will also signal the register that the digit information is being passed and it should call the marker to complete the connection in the usual manner.

1.10 When relay K operates, relay RC, associated with the connected register, will release allowing relay PR to operate which operates relay SC over the tip conductor and relay DSC in the local circuit.

1.11 Relays PR and DSC for both registers are interwired so that only relays PR and DSC associated with one register may be operated at one time. The purpose of this is to prevent interference between two simultaneous DSS calls.

SECTION II - DETAILED DESCRIPTION

1. ESTABLISHING A DIRECT STATION SELECTION CALL

1.01 When a station equipped for DSS removes the handset to originate a call, the station switchhook contacts complete the operate path of the associated line relay in the line circuit and the marker sets up a dial tone connection to the register.

reference is called for the 4020 tone generator.

1.02 When the marker functions to operate register hold magnets HM8 and HM9, both relay L in the register and relay RCO,1 will operate under the control of relays K and PRO,1.

DSC 3221-WVS-PGF

1.03 After hearing dial tone the associated DSS key for the called station should be depressed. This key in operating grounds the associated lead T and U for the called station and operates relay K.

1.04 Relay K operated:

(a) Transfers the winding of relay L in the register to the tip side of the station telephone set to provide a holding path for relay K.

(b) Removes battery from relay RCO,1 thus releasing it.

(c) Prepares the operate path for relay SC.

1.05 With relay RCO,1 released and relay ON in the register operated battery on lead PR operates relay PRO,1.

1.06 Relay PRO,1 operated:

(a) Connects positive 48 volt battery to the tip side of the line under control of relay K and diode SC which operates relay SC.

(b) Opens the operating path of relay RCO,1.

(c) Extends register ground under control of relay PRO,1 to operate relay

(d) Opens the operating path of relay PRO,1 associated with the other register to prevent both relays DSCO,1 from operating simultaneously, thus allowing only one call to be processed by the register if two stations originate a call at the same time.

1.07 Relay SC, in operating, extends the ground on the tens and units leads to contacts of relay DSCO,1.

1.08 Relay DSCO,1 operated:

12

(a) Ground leads T- and U- to operate the associated relays TD- and UD- in the register.

(b) Under control of relays DSCO,1 and SC extends ground over lead UD2 to operate relay UD in the register.

(c) Under the control of relay DSCO,1 prevents the operation of relay PRO,1 associated with the other register.

1.09 Relay UD, in the register, operated, operates relay DC in the register and opens the operating circuit of relay PRO,1 thus releasing it.

1.10 When relay PRO,1 releases, the associated relays DSCO,1 and SC release which removes ground from leads T- and U- to the register.

1.11 When relays PRO,1 and DSCO,1 release they prepare an operating path for the associated PRO,1 in the other register.

1.12 Relay PRO,1 released, restores the operating path for relay RCO,1.

1.13 When relay DC in the register operates, the marker is called to complete the call in the regular manner.

2. MISCELLANEOUS

2.01 When relay K operates, relay L in the register will be held operated under control of relay K.

2.02 Holding ground for relay L is from relay K on lead R, through the telephone set, to lead T, and crosses to lead E towards the register which will confine unbalance on tip and ring conductors and minimizes crosstalk between relay K and switching equipment.

2.03 If negative battery was used in operating relay SC, station interference would occur. Accidental operation of a DSS key or a legitimate call being made at the same time would result in incorrect tens and units recorded in the register giving the wrong number; therefore positive battery is used.

SECTION III - REFERENCE DATA

1. WORKING LIMITS

1.01 Lines

The maximum external loop resistance for satisfactory operation of relay SC is 125 ohms.

1.00 Voltage Limits

<u>Minimum</u>	<u>Maximum</u>
-45	-52
+40	+60

2. FUNCTIONAL DESIGNATIONS

2.01 The functional meaning for the relays of the auxiliary relay circuit are given in the following table.

<u>Designation</u>	<u>Meaning</u>
DSCO,1	Direct Station Connector
K	Key
PRO,1	Priority
RCO,1	Register Control
SC	Station Connector

3. FUNCTIONS

3.01 The auxiliary relay circuit is designed to perform the following functions:

- (a) To connect a calling station line to a dial pulse register and permit a station to complete a call by direct station selection.
- (b) To extend ground over the units dialed leads to operate the units dialed relay UD in the register.
- (c) To extend a ground on the tens and units leads to the register circuit to operate associated tens dialed and units digit dialed relays.
- (d) To give priority to a register and allow only one direct station selection type of call to be processed in the PBX at one time.
- (e) To prevent interference between stations originating direct station selection calls simultaneously.

4. CONNECTING CIRCUITS

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

- (a) No. 759A Line, Link and Connector Circuit - SD-66744-01.
- (b) No. 759A Dial Pulse Register Circuit - SD-66775-01.
- (c) No. 756A Line, Link and Marker Circuit - SD-65741-01.
- (d) No. 756A Dial Pulse Register Circuit - SD-65742-01.

5. MANUFACTURING TEST REQUIREMENTS

5.01 The auxiliary relay 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. ALARM INFORMATION

6.01 Fuse Alarm:

- (a) An operated fuse supplying the auxiliary relay circuit is indicated by an alarm at the plant service center, if alarm transmitting features are provided, and in any case, by a visual signal locally. Replace the operated fuse to silence the alarm and extinguish the visual alarm signal.

SECTION IV - REASONS FOR REISSUEB. Changes in ApparatusB.1 Added

Resistance lamp 13N, App. Fig. 1, Option Y

D. Description of Changes

- D.1 Option Z is designated and rated Manufacture Discontinued. Option Y is added to limit the excessive current from the +48 volt supply caused by a trouble ground on the tip side of a station line when connected to a register when using Station D.S.S.
- D.2 The +48 volt fuse shown in the 756A PBX Alarm Transfer and Test Circuit is changed from a 70E type to a 70P type (slow blow) concurrent with this issue.
- D.3 Circuit Notes 101 and 104 are changed to reflect the added options.

BELL TELEPHONE LABORATORIES, INCORPORATED

(WESG 2120HW-WED-WHK)
DEPT 5337-LAH

CIRCUIT DESCRIPTION

CD-66796-01
ISSUE 4B
APPENDIX 1D
DWG ISSUE 15D

PBX SYSTEMS
NO. 756A
ALARM, TRANSFER AND TEST CIRCUIT

CHANGES

D. Description of Changes

- D.1 The 12 break contact of relay ATA1 is removed from the AP ground supply to the dial tone start keys for stations 40, 41, and 42.
- D.2 This change is made on a D no-record basis as agreed to by the WE Standards Engineer.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 3221-WVS-RGP

Printed in U.S.A.

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PBX SYSTEMS
NO. 756A
ALARM, TRANSFER & TEST CIRCUIT

TABLE OF CONTENTS	Page	2. GENERAL METHOD OF OPERATION
<u>SECTION I - GENERAL DESCRIPTION</u>	1	2.01 Normally, relays AT, ATA, TR, and if App Fig. 11 is provided, relays AT1 and ATA1 are operated. They release only under trouble conditions. When a fuse operates in any of the PBX or power circuits, and indicating lamp lights within the PBX and in the attendant equipment. Also the central office is alerted via the WCT and WCR lead.
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<u>SECTION II - DETAILED DESCRIPTION</u> ...	2	
1. <u>ALARMS</u>	2	2.02 In the event of commercial power failure where the power plant does not include a battery, all relays release and three central office trunks are automatically transferred directly to stations 30, 31, and 32. When App Fig. 11 is provided, any three stations (40, 41, and 42) are transferred to CO trunks 5, 6, and 7. The central office also receives an alarm signal when the trouble relay releases. The PBX is therefore not isolated when all power fails.
A. <u>General</u>	2	
B. <u>Local Distribution Fuse Alarm</u>	2	
C. <u>Power Plant Fuse Failure</u>	2	
D. <u>Fuse Failure or Trouble Alarm at an Externally Mounted Unit</u>	2	
E. <u>Marker Alarm</u>	2	
2. <u>CENTRAL OFFICE TRUNK TRANSFER AND FLEXIBLE NIGHT CONNECTIONS</u> ..	4	2.03 The operation of the night service key releases a relay which prepares the central office trunk circuits for night connections to be established by the attendant. If a power failure occurs after the attendant has established the night connections and disconnected, central office trunks 0, 1, and 2 will be directly connected to stations 30, 31, and 32. When App Fig. 11 is provided, any three stations (40, 41, and 42) are transferred to CO trunks 5, 6, and 7.
A. <u>Power Failure and Restoration</u>	4	
B. <u>Attendant Establishes Flexible Night Connections</u> ..	4	
C. <u>Power Failure and Restoration During Night Service</u>	4	
3. <u>TEST CIRCUIT</u>	4	
4. <u>DIRECT STATIONS SELECTION BUSY LAMP BATTERY CUTOFF</u>	5	
<u>SECTION III - REFERENCE DATA</u>	5	
1. <u>WORKING LIMITS</u>	5	2.04 A dial tone start key must be provided at each of these stations. To bring in dial tone to the station line, the dial tone start key is depressed until dial tone is heard and then it is released so that dialing may proceed.
2. <u>FUNCTIONAL DESIGNATIONS</u>	5	
3. <u>FUNCTIONS</u>	5	
4. <u>CONNECTING CIRCUITS</u>	5	
5. <u>MANUFACTURING TESTING REQUIREMENTS</u>	6	2.05 When the marker encounters a trouble of the type that operates the marker alarm relays, a trouble signal is transmitted to the alarm circuit. If the trouble persists, successive trouble signals will occur. The alarm circuit counts these trouble indications and weighs them against the number of marker seizures. An alarm is operated only if two trouble signals are transmitted to the alarm circuit before two calls have been completed from a dial pulse register. This latter conditional requirements may mean a maximum of five marker functions.
<u>SECTION IV - REASONS FOR REISSUE</u>	6	
<u>SECTION I - GENERAL DESCRIPTION</u>		
1. <u>PURPOSE OF CIRCUIT</u>		
1.01 The alarm, transfer and test circuit provides alarm indications to the attendant and/or central office when troubles arise in the PBX, automatically transfers three station lines directly to the central office in the event of power failure, provides test line tip and ring leads, and provides test ground, regular battery and high-resistance test battery.		2.06 When the alarm operates, the marker trouble lamps lock in as a permanent indication of the trouble location. To extinguish the alarm, the trouble has to be

cleared and the alarm reset key operated manually.

2.07 The operation of the night service key releases relay BCO to disconnect the 10 volt ac from the busy lamps in the attendant consoles.

SECTION II - DETAILED DESCRIPTION

1. ALARMS

A. General

1.01 Under normal operating conditions, relay TR is operated.

1.02 Whenever a local distribution fuse, marker or power alarm occurs, the operate path for relay TR opens and relay TR releases causing an alarm signal to be transmitted to the attendant equipment and to the central office.

B. Local Distribution Fuse Failure

1.03 When a -48 volt local distribution fuse fails, relay FA operates.

1.04 If the +48 volt fuse fails, relay R operates.

1.05 Either relay in operating causes the FA lamp to light and the TR relay to release.

1.06 Relay TR released:

- (a) Lights the TR lamp in the unit equipment.
- (b) Lights the TR lamps in the attendant equipment.
- (c) Transmits an alarm to the central office via the WCT and WCR leads.

1.07 The alarm is retired by replacing the blown fuse which releases the FA or R relay.

1.08 Relay FA or R released extinguishes the FA lamp and permits relay TR to reoperate.

1.09 Relay TR operated extinguishes the TR lamps and retires the alarm indication to the central office.

C. Power Plant Fuse Failure

1.10 When a -48 volt fuse in the power plant fails, relay RB operates.

1.11 If the 10 volt ac fuse fails in the power plant, relay S operates. The S relay operates from 10 volts ac rectified by the S varistor.

1.12 Relay RB or S operated lights the PA lamp and releases relay TR.

1.13 Relay TR released:

- (a) Lights the TR lamp in the unit equipment.
- (b) Lights the TR lamps in the attendant equipment.
- (c) Transmits an alarm to the central office via the WCT and WCR leads.

1.14 The alarm is retired by replacing the blown fuse in the power plant.

1.15 When this is done, the RB or S relay releases and the TR relay reoperates restoring the circuit to normal.

D. Fuse Failure or Trouble Alarm at an Externally Mounted Unit

1.16 When a fuse fails or a trouble alarm occurs in an externally mounted unit, relay EXT operates from ground via lead EXT.

1.17 Relay EXT operated lights the EXT lamp and releases relay TR.

1.18 Relay TR released:

- (a) Lights the TR lamp in the unit equipment of the alarm, transfer and test circuit.
- (b) Lights the TR lamps in the attendant equipment.
- (c) Transmits an alarm to the central office via the WCT and WCR leads.

1.19 Lamps at the location of the externally mounted unit indicate the type of trouble condition that occurred.

1.20 The alarm is retired by correcting the trouble condition. When this is done, ground is removed from lead EXT and relay EXT releases.

1.21 Relay EXT released allows relay TR to reoperate thus restoring the circuit to normal.

E. Marker Alarm

1.22 Every time the marker is seized, the marker timing relays MTA and MTB operate and connect ground to lead MT. Relay HO operates from the ground supplied to lead MT.

1.23 If the marker encounters trouble in establishing a connection, one or more of the marker relays listed in Table

A may operate.

TABLE A
MARKER ALARM FUNCTIONS

Function	MARKER RELAY DESIGNATIONS
Tens Alarm	TAL
Units Alarm	UAL
	UAL1 & UAL1A
	UAL2
Junction Register Alarm	JRAL
Test	TS
Miscellaneous Alarm	MAL
Release Alarm	RIAL
Tens Release Alarm	TRAL
Trouble Advance Alarm	TAAL
Link Alarm	LAL1
	LAL2 & LAL2A
	LCK1
	LCK2
Time Out	TAOL & TOALA
Comp-On Alarm	COAL
Cross Check Alarm	XCAL

- 1.24 The operation of any of the marker alarm relays (TAL through LAL2 & LAL2A) listed in Table A, grounds lead AT to operate relay A1.
- 1.25 Relay A1 locks operated and prepares the operate path for relay A2. Relay A2 remains shunted down by ground supplied through the contacts of relay H0 operated.
- 1.26 When the marker completes its function, marker relays MTA and MTB release causing relay H0 to release.
- 1.27 Relay H0 released removes the shunt from relay A2 and relay A2 operates in series with relay A1.
- 1.28 Relay A2 operated connects relay AL to lead AT.
- 1.29 The alarm circuit has thus counted the first marker trouble and has prepared itself to transmit an alarm if another marker trouble occurs within the next four or five marker operations.
- 1.30 The slow release of relay H0 insures that any trouble arising at the end of the marker operation will result in relay A1 locking operated.
- 1.31 If during the second seizure, the same or any other marker alarm relay operates due to a trouble, ground is connected to lead AT to operate relay AL.
- 1.32 Relay AL operated:
- (a) Locks operated under control of the alarm release key.
 - (b) Connects ground to leads CA, JA, KA, LAL (ZE Option), LA, OA, RA, TA, and UA to hold the marker alarm relay operated.
- (c) Releases relay TR which functions as described under local distribution fuse failure.
- (d) Provides an additional open in the relay A1 operate path.
- 1.33 Relay AL can be released only by manually operating the alarm reset key.
- 1.34 The marker alarm relay operated lights its associated alarm trouble lamp.
- 1.35 Once the AL relay operates, any marker alarm relay which operates is held operated and any subsequent troubles will not register in the alarm sequence relays.
- 1.36 Assuming that a register is in terminating condition and has seized the marker for the third marker operation, relay A3 operates from ground supplied by relay A2 and register relay DC operated via lead RT1. Relay A3 locks operated and prepares the operate path for relay A4. When the marker and register release, the ground on the RT1 lead is removed and relay A4 operates. Relay A4 operated holds relay A2 operated and releases relay A1.
- 1.37 Assuming that neither register is in terminating condition during the fourth marker operation, relay H0 operates and releases but performs no useful function.
- 1.38 Assuming that a register is in a terminating condition and has seized the marker for the fifth marker operation, ground on lead RT1 will shunt down relay A3. When the marker and register release, the ground on lead RT1 is removed and relay A4 releases. Relay A4 released releases relay A2 and the marker alarm sequence relays are again normal.

1.39 If during the second marker seizure and the subsequent marker operations described above, no marker alarm relays operate, the action is as described except that when relay A2 releases the sequence alarm relays are ready for another trouble indication.

1.40 If marker relay TS operates instead of one of the marker alarm relays, the alarm circuit functions described above will be performed.

1.41 The operation of any of the marker alarm relays (TOALA, COAL or XCAL) listed in Table A grounds lead TT, causing the alarm, transfer, and test circuit to disregard its alarm signal versus marker operation - counting circuitry and operate relay AL immediately.

2. CENTRAL OFFICE TRUNK TRANSFER AND FLEXIBLE NIGHT CONNECTIONS

A. Power Failure and Restoration

2.01 When a power failure occurs, relays TR, NS, AT, and ATA release. Relay TR released transmits an alarm signal to the central office via the WCT and WCR leads. Relays AT and ATA released connect central office trunks 0, 1, and 2 directly to station lines 30, 31, and 32. When App Fig. 10 is provided, relay ATA released restores relays AT1 and ATA1 to normal. These relays transfer three station lines (40, 41, and 42) to central office trunks 5, 6, and 7.

2.02 A ST pushbutton (FS4) is provided at each of these three stations for a manual ground start to the central office. In order to get dial tone or raise the operator after the station lifts the receiver, the ST pushbutton is operated until dial tone is heard or the operator answers and then it is released.

2.03 When power is restored, relays TR and NS reoperate. Relay TR operated retires the alarm to the central office. Relay NS operated reoperates relays AT and ATA. This restores central office trunks 0, 1, and 2 and station lines 30, 31, and 32 to normal. When App Fig. 10 is provided, relay ATA operates operating relays AT1 and ATA1. Relays AT1 and ATA1 operated restore central office trunks 5, 6, and 7 and the three station lines 40, 41, and 42 to normal.

B. Attendant Establishes Flexible Night Connections

2.04 Relays AT and ATA remain operated until a power failure occurs. The operation of the night service key releases relay NS.

2.05 Relay NS released:

- (a) Connects ground to the even and odd central office trunk circuits over leads NSE and NSO.
- (b) Removes ground to lead NSA to release auxiliary position circuit relay NSA when remote trunk answering is provided.
- (c) Connects leads NCO-9 to CNO-9 to prepare the central office trunk circuits for flexible night connections that are to be set up by the attendant.
- (d) Removes the operating ground for relays AT and ATA leaving them locked up under control of relay AT.

2.06 The attendant may disconnect flexible night connections by releasing the night service key. The night service key released operates relay NS. Relay NS operated causes the central office trunk circuits to disconnect from the connected stations unless they are busy.

C. Power Failure and Restoration During Night Service

2.07 If a power failure occurs after the attendant has established flexible night connections, relays AT and ATA release and remain released until the attendant operates relay NS by restoring the night service key. Relays AT and ATA released connect central office trunks 0, 1, and 2 directly to station lines 30, 31, and 32. When App Fig. 10 is provided, relay ATA released restores relays AT1 and ATA1 to normal. These relays transfer three station lines (40, 41, and 42) to central office trunks 5, 6, and 7.

2.08 When power is restored, relays AT and ATA remain released. The TR lamps light as an indication to the attendant that a power failure has occurred and that the flexible night connections as established have been disconnected. Station lines 30, 31, and 32 remain connected to the central office trunks 0, 1, and 2. When App Fig. 10 is provided, three station lines (40, 41, and 42) remain connected to central office trunks 5, 6, and 7. These station lines and central office trunk circuits are made busy by applying ground through relays AT, ATA, AT1, and ATA1 released to the associated S and IT- leads to the marker.

3. TEST CIRCUIT

3.01 A -48 volt test battery termination is provided on two slides to facilitate maintenance work. In addition, a -48 volt termination with 1000 ohms series resistance is provided on slide 6. The high re-

istance termination is used for testing apparatus such as dry reed relays, which would be damaged by excessive current flow.

3.02 Line circuit 29 is a regularly assigned test line circuit; a pair of test terminals, T and R, are brought out on slide 2 for connection to this test line.

4. DIRECT STATION SELECTION BUSY LAMP BATTERY CUTOFF

4.01 The operation of the night service key releases relays BCO and NS.

4.02 Relay BCO released removes ground from lead S1 to the tie trunk circuit, and disconnects the 10-volt ac supply from the busy lamps in the attendant consoles. This prevents the busy lamps associated with night connected stations or with stations busy due to a call in progress from lighting.

SECTION III - REFERENCE DATA

1. WORKING LIMITS

1.01 None.

2. FUNCTIONAL DESIGNATIONS

<u>Designation</u>	<u>Meaning</u>
A1 A2 A3 A4	Marker Alarm Sequence Relays
AL	
AR	
AT,ATA, AT1,ATA1	
BCO	Battery Cutoff Relay
EXT	Alarm Relay for Externally Mounted Units
FA	Fuse Alarm Relay
HO	Hold-Over Relay
NS	Night Service Relay
R	+48V Supply Alarm Relay
RB	Ringing Battery Alarm Relay
S	10V AC Supply Alarm Relay
TR	Trouble Relay

3. FUNCTIONS

- (a) To cause an alarm signal when any of the fuses in the PBX operates.
- (b) To cause an alarm signal when two or more troubles occur in the marker during two successive operations or within two successive marker operations in which the register is terminating a call.
- (c) To cause an alarm signal when a fuse operates or a trouble occurs in an externally mounted unit.

(d) To extend to the central office all of the above alarms and to function with either a marginal or reverse-battery alarm system at the central office.

(e) To extend an alarm to the central office in the event of a commercial power failure.

(f) To automatically transfer a maximum of six station lines directly to the central office in the event of a power failure.

(g) To provide test ground, regular battery, and high resistance test battery for test purpose.

(h) To provide T and R terminals for a test line.

(i) To provide the attendant a means of establishing night connections between any central office trunk and any station.

4. CONNECTING CIRCUITS

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

- (a) Line, Link, and Marker Circuit - SD-65741-01.
- (b) Dial Pulse Register Circuit - SD-65742-01.
- (c) Two-Way Trunk Circuit to Central Office - SD-65752-01.
- (d) Cordless Position Circuit - SD-65757-01.
- (e) Auxiliary Relay Circuit - SD-65942-01.
- (f) Auxiliary Position Circuit - SD-66910-01.
- (g) Station Message Register Pulse and Surcharge Circuit - SD-5E021-01.
- (h) No. 556A PBX Cord, Telephone, Dial, Battery, Buzzer, and Ringing Circuits - SD-65658-01.
- (i) Power Supply Circuits - SD-81326-01 or SD-81640-01, or SD-81599-01.
- (j) Extension Alarm Circuit - SD-65484-1.
- (k) 608A or 608B Auxiliary Signal, Fuse Alarm, Battery Cut-off and Miscellaneous Circuit - SD-66722-01.

(1) 608D Auxiliary Signal, Fuse Alarm, Battery Cut-Off and Miscellaneous Circuit - SD-67039-01.

(m) Make Busy and Busy Display Circuit - SD-58029-01.

(n) Tie Trunk Circuit - SD-65756-01.

(o) Trunk Finder Circuit - SD-1E050-01.

5. MANUFACTURING TESTING REQUIREMENTS

5.01 This circuit shall be capable of performing all the service functions specified in this circuit description and of meeting all the requirements of the Circuit Requirement tables.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 3221-WVS-RGP

SECTION IV - REASONS FOR REISSUE

D. Description of Changes

- D.1 Diodes A and B are added to the Apparatus Index.
- D.2 Options ZL and ZK are added to the Option Index.
- D.3 Option ZK is designated and rated Mfr Disc.
- D.4 Option ZL is added as Standard to light the FA lamp when fuse FA operates.
- D.5 On sheet B4, the option shown for central office trunks 5, 6, and 7 is corrected to read XY.
- D.6 Circuit Note 104 is revised to reflect Issue 14B.

CIRCUIT DESCRIPTION

CD-66902-01
ISSUE 2D
APPENDIX 4B
DWG ISSUE 9B

PBX SYSTEMS
NO. 756A
DIAL CONFERENCE TRUNK CIRCUIT
STATION CONTROLLED

CHANGES

B. Changes in Apparatus

B.1 Superseded

S1, 2 and S3, 4 resistors,
19LC, App Fig. 1, option K

S5 resistor, 18BW, option K

Superseded by

S1, 2 and S3, 4 resistors,
19LG, App Fig. 1, option J

S5 resistor, 18EB, option J

D. Description of Changes

D.1 Option J is added and rated Standard to recode resistors S1 through S5 from 100 (option K) to 84 ohms. The 84-ohm resistor provides the proper voltage level on the sleeve to prevent a link test failure when conference equipment is used.

D.2 Option F is added and rated Standard to improve the transmission between the control station and the attendant (dial 0) or a called station (second to fifth conferee).

D.3 These changes are reflected in the Sheet Index, Option Index, FS3, FS4, App Fig. 1, and Circuit Note 104.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 3224-TEH-RVL

CIRCUIT DESCRIPTION

CD-66902-01
ISSUE 2D
APPENDIX 3D
DWG ISSUE 8D

PBX SYSTEMS
NO. 756A
DIAL CONFERENCE TRUNK CIRCUIT
STATION CONTROLLED

CHANGES

D. Description of Changes

- D.1 The code of resistors R0 through R5, R8, and RD is shown as 145A or 221A types.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 3221-WVS-RGP

PBX SYSTEMS
NO. 756A
DIAL CONFERENCE TRUNK CIRCUIT
STATION CONTROLLED

CHANGES

D. Description of Changes

D.1 A break contact of relay RT is added in the operate path of relay D1 when private consultation is provided. This change prevents the possibility of a false bid for the marker when the controller flashes to include the controller and the called party in the conference, SC 24.

BELL TELEPHONE LABORATORIES, INCORPORATED

(WECO 2120-HW-RRS-WHK)
DEPT 5337-LAH

PBX SYSTEMS
NO. 756A
DIAL CONFERENCE TRUNK CIRCUIT
STATION CONTROLLED

CHANGES

D. Description of Changes

- D.1 On sheets B3B and C2, contact 5B is substituted for contact 6B of relay CO.
- D.2 On sheet B1, terminals of relay DOA coil are corrected.
- D.3 On sheet B2, contact 8M of relay S5 is designated option V and contact 10M is added and designated option 3 to agree with App. Fig. 1.
- D.4 On sheet G1, S load ~~from cord~~ switch-board is relocated from pin 8 to pin 9 of connector C1.

BELL TELEPHONE LABORATORIES, INCORPORATED

(WECO 2120HW-RHB-WHK)
DEPT 5337-LAH

PBX SYSTEMS
NO. 756A
DIAL CONFERENCE
TRUNK CIRCUIT
STATION CONTROLLED

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SECTION I - GENERAL DESCRIPTION1. PURPOSE OF CIRCUIT

1.01 This circuit provides control arrangements which permit any station to set up a conference connection with any five other stations or with any four other stations and a central office trunk. The private consultation feature permits the originating station to confer privately with each new conferee prior to both joining the conference.

2. GENERAL DESCRIPTION OF OPERATIONA. Definitions

2.01 Table A defines terms used in this description and in the operation charts of drawing information notes which outline the station and switching actions involved in setting up and controlling a conference.

B. Assignment of Switch Verticals

2.02 The six conference ports may be assigned to any six tie trunk verticals of the link. The number of the vertical assigned to conference port 0 is the calling code for originating a conference. For descriptive purposes, it is assumed the verticals 80-85 are assigned to ports 0-5,

respectively. It should be noted, however, that a consecutive sequence of numbers is not required.

C. Originating a Conference

2.03 When any station calls 80, normal switching action of the PBX terminates the calling station on conference port 0.

2.04 When a call is first terminated on the conference calling code, the conference circuit performs the following functions:

- (a) Makes verticals 80 and 81 busy.
- (b) Calls for the attachment of a dial pulse register at vertical 81.
- (c) Returns dial tone to the conference originator.
- (d) Prepares to repeat the dialing of the originating station into the dial pulse register. The conference originator may now dial the code of the first conferee station.

2.05 The conferee station, when called, is terminated on port 1 of the conference circuit via vertical 81 and conference circuit port 1 is connected to conference bridge port 1.

TABLE A

Term	Definition
CONFERENCE ORIGINATOR	Station which dials conference code and seizes the conference control circuit.
CONFERENCE CONTROLLER	Conference originator or a conferee station which has assumed control after originator has gone on-hook.
CONFEREE	Station which has been called into a conference by the originator or controller.
CONFERENCE PORT	One of six interfaces between tie trunk switch verticals and the conference control circuit. The first vertical is the conference calling code used by the originator. Other verticals are occupied by conferees on a first-idle basis.
CALLING PORT	A conference port in group 1-5 through which a conferee station is being called.
CONFERENCE VERTICAL	A switch vertical in the tie trunk group which is cross-connected to a conference port.
CONFERENCE BRIDGE	A six-port conference bridge which provides multiway communication between all conferees (including originator).
CONFERENCE BRIDGE PORT	One of six interfaces between the conference control circuit and the conference bridge circuit.
PRIVATE CONSULTATION	Feature which allows the conference originator or controller to privately confer with a new station before both parties join the multiway voice communication conference.
SWITCHHOOK FLASH	Operation of switchhook and release in not fewer than 75 ms nor more than 1.5 seconds.

2.06 When the switching and control circuit actions are completed, the conference originator is connected to conference bridge port 0 and may communicate with the conferee station just added.

2.07 The originating station prepares for calling the second station by a momentary operation of the switchhook. This action disconnects the originator from the conference bridge and transfers the originating line to vertical 82 for calling the next conferee. By normal switching action the dial pulse register is connected to vertical 82 and dial tone is returned to the conference originator.

Without Private Consultation Feature

2.08 The conference originator dials the number of the second desired conferee station and, by normal switching action, the station is rung. When the called station answers, it is terminated on the conference bridge. At this time, the originator is reconnected to the conference bridge and multiway voice communication may take place between the

originating station and both conferee stations.

With Private Consultation Feature

2.09 The conference originator dials the number of the second desired conferee station and, by normal switching action, the station is rung. At this point, the private consultation circuits are operated. When the called station answers, it is connected to the conference originator for private consultation via a repeat coil.

2.10 After private consultation, the originator switchhook flashes and both he and the called station are transferred to the conference buss. At this time, the originator is reconnected to the conference bridge and multiway voice communications may take place between the originating station and all conferee stations.

2.11 Assuming that all desired conference stations are idle and answer when rung, setup of the conference proceeds until five stations have been connected to the conference

bridge circuit. If the originator attempts to add a sixth station, busy tone rather than dial tone is returned to the originator as an indication that the conference is "full".

2.12 If at any time during the process of buildup of a conference the called station is busy or does not answer when rung, the conference originator cancels the call to this station by a switchhook operation. This dismisses the PBX switching circuits and returns the originator to the conference bridge for communication with the stations already connected.

2.13 The action of canceling by operation of the switchhook, including canceling after partial dialing, may be taken at any time prior to answer by the called station.

D. Disconnections

2.14 If a station leaves the conference by going on-hook, it is dismissed from the conference circuit and may make or receive other calls in a normal manner. The conference port vacated by the disconnected station is available for calling in any other station or for recall of any station which previously has left the conference.

2.15 If the station which originated the conference goes on-hook, it is disconnected from the conference and may make or receive other calls in a normal manner. In this case, however, the originating station cannot be replaced by another station since the master conference number must remain busy to the marker.

E. Transfer of Control

2.16 If the conference originator has left the conference by going on-hook and there is at least one other vacant port, any one of the remaining conferee stations may become conference controller by a momentary operation of the station switchhook. This signal transfers control of the conference to the station at which the switchhook was operated and calls for attachment of a dial pulse register at the lowest numbered unused conference port other than port 0. The station which has assumed control may now connect stations to vacant conference ports by the same procedure used in originating the conference.

2.17 If a station which has assumed control goes on-hook, any remaining station may assume control by a switchhook operation and may proceed with the connection of other conference stations to unused conference ports.

2.18 Throughout the conference, the station which is in control may call for connection of stations to conference ports (except port 0) which becomes available as stations leave the conference.

F. Connection of Central Office Trunk

2.19 A central office trunk may be connected to the conference by the PBX attendant if such a connection is requested by the conference controller.

Without Private Consultation Feature

2.20 When the conference controller dials 0 to request a trunk connection, port 5 is automatically reserved for the trunk and is no longer available for a station connection.

2.21 After dialing 0 and passing information to the attendant, the conference controller may proceed with the addition of stations at conference ports other than port 5. The switch vertical used in the process of reaching the attendant becomes vacant so that the conference may include the originator and four stations in addition to the central office trunk.

2.22 When the trunk call is completed to the desired distant station, the PBX attendant connects the trunk to the conference via port 5, using normal dial-back procedures if a console is used for attendant position. If a cord switchboard is used, the attendant connects to port 5 by plugging into the jack appearance of port 5.

With Private Consultation Feature

2.23 To add a central office party, the controller dials 0 to reach the attendant. After requesting a CO party, the controller waits on the attendant trunk until the attendant completes the connection. If the controller dials 0 with only the last port idle, busy tone will be returned as an indication that a central office party cannot be added. The controller flashes his switchhook to dispose of the busy tone and returns to the conference. If a central office party must be added, the controller must request a station to disconnect. The central office party may then be added and the disconnected station can then be reconnected in the normal manner.

2.24 When the trunk call is completed to the desired distant station, the PBX attendant connects the trunk into the conference circuit by:

- (a) Normal dial-back procedure if a console is used for the attendant position, or by
- (b) Plugging into the switchboard jack appearance if a cord switchboard is used for the attendant position.

2.25 When the attendant makes the above connection, the controller will automatically be disconnected from the attendant trunk and connected to the central office trunk. After the attendant releases, the controller and the central office party will be connected via a repeat coil unless the central office

party is the first added to the conference in which case the controller and central office party will be connected via the conference bridge.

2.26 After the controller and the central office ~~party~~ are connected for private consultation a switchhook flash by the controller will connect both parties into the conference bus.

SECTION II - DETAILED DESCRIPTION

1. GENERAL

1.01 Any six tie trunk switch verticals may be used as entry ports to the conference control circuit. In the following description, use of the group 80-85 is assumed but a consecutive sequence is not a requirement.

1.02 It is also assumed that vertical 80 is given a ringdown tie trunk (RTT) class of service and that verticals 81-85 are given a central office trunk (COT) class of service by suitable strapping at PBX terminal strips. Verticals 81-85 are on a "service denied" basis with the exception that code 85 may be used for a "dial-back" connection by the attendant if the controller has called the attendant for connection of a central office trunk.

2. ORIGINATING A CONFERENCE - SC1

A. Control Circuit Seized

2.01 Any station may seize the conference control circuit by dialing the conference control code (for descriptive purposes assumed to be 80). The marker functions in its normal manner for handling a tie trunk code and connects the calling station to vertical 80. Operation of the crosspoints closes the tip and ring of conference port 0 through the link to the calling line circuit. The tip and ring closure operates relay L.

2.02 Relay L operated operates relay SRC which operates off-normal relays ON and ONA and prepares a holding path for relays CR1-5.

2.03 Relay ONA operated provides a holding ground for the calling party hold magnet and prepares a locking ground for relays BC1-5.

2.04 Relay ON operated:

- (a) Prepares a holding path for relays CR1-5.
- (b) Prepares operating paths for relays D1 and RRL and a locking path for relay RS.
- (c) Provides a holding path for relay ONA.
- (d) Operates relay CRDK via break contacts on relays 2 and CR1-5.
- (e) Prepares a locking path for relay PM.
- (f) Locks under control of relay ONRL.
- (g) Provides off-normal ground to the private consultation circuitry.

B. Dial Tone Returned

2.05 Relay CRDK operated operates relay CR1 through thermistor A. The thermistor

delays the operation of relay CR1 approximately 400 ms.

2.06 Relay CR1 operated:

- (a) Releases relay CRDK which in turn operates relay RRL after 1 second.
- (b) Disconnects thermistor A from its winding and locks to ground under control of relays S1, D1, PM, ER1, and SRC.
- (c) Prepares an operating path for relay BC1.
- (d) Places a short circuit (if option V is used), through the 5-6 and 1-2 windings of repeat coil T1 and the polarized operating circuit of relay P, on the tip and ring of tie trunk vertical 81.
- (e) If option 3 is used, applies approximately 2000 ohms across the tie trunk vertical 81. This 2000 ohms is the sum of resistance of the 5-6 and 1-2 windings of repeat coil T1, the 1920-ohm P resistor, and the forward resistance of the B diode.
- (f) Connects a 100-ohm holding ground to the sleeve of vertical 81.

C. Register Attached

2.07 The bridged tip and ring of vertical 81 signals the marker to connect to a register and return dial tone.

1. ORIGINATOR ADDS FIRST CONFEREE STATION - SC2 OR SC22

A. Calling Conferee Station

3.01 After receiving dial tone from the register, the control station dials the code of the first conferee station. Relay L follows the dial pulses; make contacts on relay L are in series with the bridge across tip and ring and pulse the register.

3.02 After the register has received the proper number of digits, it reverses the tip and ring. This operates relay P which is polarized by diodes A and B. At the same time the register calls the marker.

3.03 Relay P operated operates relay MC which performs the following functions:

- (a) Operates marker relay CCC which cancels the camp-on function if the called line is busy.
- (b) Operates relay PM.
- (c) Closes a path from the marker, operating relay RS.

- (d) Opens its operating path and locks under control of marker relay RLAA.

3.04 Relay PM operated opens one of the locking paths for relays CR1-5 and prepares a path for operating relay D1 when relay L is released.

3.05 Relay RS operated:

- (a) Locks to ground at relay OM under control of relays RT and D1.
- (b) Releases relay P by opening the bridge across tip and ring via coil T1.
- (c) Prepares a path for applying ringing supply to tip and ring of vertical 81.
- (d) Opens the termination via coil T1 across tip and ring of vertical 80.
- (e) Prepares a path via capacitor H for audible ringing feedback from vertical 81 to vertical 80.
- (f) Operates relay RS1 (option 3).

3.06 After the marker has completed its functions, it releases itself and the dial pulse register from the connection. Release of the marker causes relay MC to release. Relay MC released with relay RS operated connects ringing supply through the primary winding of relay RT to the ring side of vertical 81 and connects ringing ground to the tip side. This rings the called station; audible ringing feedback is transmitted through capacitor H to port 0 (vertical 80).

B. Called Station Answers

3.07 When the called station answers, relay RT operates on its primary winding and performs the following functions:

- (a) Locks through its secondary winding to ground at relay OM under control of relay CRDK.
- (b) Operates relay BC1.
- (c) Releases relay RS which in turn releases relay RS1 with option 3.

3.08 Relay BC1 operated:

- (a) Operates relay S1 by closing the tip and ring of vertical 81 to the primary and secondary windings; relay S1 remains operated under control of the called party.
- (b) Removes the idle port terminating network from port 1 of the conference bridge and connects tip and ring of the called station to this port.
- (c) Supplements the path via relay CR1 for holding 100-ohm ground on the sleeve of vertical 81.

- (d) Prepares a holding path which is completed when relay BCH1 operates.

- (e) Operates relay RV which in turn operates relay TPDE.

3.09 Relay S1 operated:

- (a) Releases relay CR1.
- (b) Prepares an operating path for relay CR2.
- (c) Operates relay BCH1 to provide a holding path for relay BC1.

3.10 Relay CR1 released opens one path to 100-ohm holding ground from the sleeve of vertical 81 and operates relay CRDK. Sleeve ground is maintained by operated relay BC1.

3.11 Relay CRDK operated:

- (a) Releases relays RT, PM, and RRL.
- (b) Disconnects the idle port terminating network from port 0 of the conference bridge and connects tip and ring of the conference originator to this port.

3.12 The conference originator and the conferee station are now connected via the conference bridge and may communicate.

4. ORIGINATOR ADDS SECOND CONFEREE STATION

4.1 Originator Resumes Control Function - SC3

4.01 To add another station to the conference, the originator flashes his switchhook. This transfers the originating station from the conference bus to a dial pulse register.

4.02 Depressing the switchhook at the originating station opens the tip and ring loop connected to vertical 80 and thus releases relay L.

4.03 Relay L released operates relay D1 which in turn operates relay CR2. Relay SRC may release if the switchhook is held operated more than about 100 ms but performs no functions of interest in this sequence.

4.04 Relay CR2 operated:

- (a) Releases relay CRDK.
- (b) Prepares an operating path for relay BC2.
- (c) Prepares to bridge the tip and ring of the trunk vertical 82 via windings of repeat coil T1, resistor P, and diode B.
- (d) Supplies a 100-ohm holding ground for the sleeve of vertical 82.

4.05 Relay CRDK released:

- (a) Operates relay RRL through thermistor C (which delays its operation approximately 1 second) if relay SRC has not released or prepares the operating path for doing so if relay SRC has released.
- (b) Disconnects tip and ring of vertical 80 from the conference bridge with idle port termination.
- (c) Prepares a holding path for relay PM and a locking path for relay RT.
- (d) Releases relay D1.

4.06 When the switchhook is released at the originating station, relay L operates and performs the following functions:

- (a) Operates relay SRC if it has released.
- (b) Places a bridge on tip and ring of vertical 82 through the windings of repeat coil T1 and the operating circuit for relay P. This calls for attachment of a register at vertical 82.

4.07 Relay SRC operated (if released during switchhook flash):

- (a) Operates relay RRL through thermistor C which delays its operation approximately 1 second. If relay SRC does not release during switchhook flash, operation of relay RRL starts when relay CRDK is released.
- (b) Re-establishes the operating path for relay ON. Relay ON is held operated by its locking path via relay ONRL unless the switchhook is depressed longer than the disconnect time of 1.5 seconds.

B. Register Attached

4.08 Register seizure is the same as in adding the first conferee station except that vertical 82 is used instead of 81. At this point, dial tone is returned to the originating station.

5. ORIGINATOR ADDS ADDITIONAL STATIONS

A. Calling Conferee Station - No Private Consultation (Option V)

5.01 Dial tone is returned to the originating station and circuit functions during subsequent dialing and called party answering are the same as in adding the first station except that relays BCH2, BC2, and S2 are operated instead of relays BCH1, PC1, and S1.

B. Calling Conferee Station - Private Consultation (Option J1 - SC23)

5.02 After receiving dial tone from the register, the control station dials the code of the desired conferee station. Relay L follows the dial pulses; make contacts on relay L are in series with the bridge across tip and ring and pulse the register.

5.03 After the register has received the proper number of digits, it reverses the tip and ring. This operates relay P which is polarized by diodes A and B. At the same time, the register calls the marker.

5.04 Relay P operated operates relay MC which performs the following functions:

- (a) Operates marker relay CCC which cancels the camp-on function if the called line is busy.
- (b) Operates relay PM.
- (c) Closes a path from the marker operating relay RS.
- (d) Opens its operating path and locks under control of marker relay RLAA.

5.05 Relay PM operated opens one of the locking paths for relays CR1-5 and prepares a path for operating relay D1 when relay L is released.

5.06 Relay RS operated:

- (a) Locks to ground at relay ON under control of relays RT and D1.
- (b) Releases relay P by opening the bridge across tip and ring via coil T1.
- (c) Prepares a path for applying ringing to tip and ring of the called vertical.
- (d) Opens the termination via coil T1 across tip and ring of vertical 80.
- (e) Prepares a path via capacitor H for audible ringing feedback from vertical 80 to the called vertical.
- (f) Operates relay RS1.

5.07 Relay RS1 operated:

- (a) Operates relays BP1 and BR2 which lock under control of relay CF.
- (b) Prepares the connection to talking battery for private consultation when the called station answers.
- (c) Operates relay PMR which causes relay PM to release and provides a holding ground for relays CR1-5.

5.08 After the marker has completed its functions, it releases itself and the dial

pulse register from the connection. Release of the marker causes relay MC to release. Relay MC released with relay RS operated connects ringing supply through the primary winding of relay RT to the ring side of vertical 82 and connects ringing ground to the tip side. This rings the called station; audible ringing feedback is transmitted through capacitor H to port 0 (vertical 80).

5.09 When the called station answers, relay RT operates on its primary winding and performs the following functions:

- (a) Locks through its secondary winding to ground at relay ON under control of relay CRDK.
- (b) Releases relays RS and PMR.

5.10 Relay RS released releases relay RS1 which provides talking battery for private consultation.

5.11 The control station and called station are now in private consultation. All previously connected conferees are on the multiway conference bridge and are free to talk to each other at all times.

6. ORIGINATOR OR CONTROLLER SWITCHHOOK FLASHES WITH ALL PORTS BUSY - SC17

6.01 When all conference ports are occupied by stations, a busy tone is returned to the controller as an indication that all conference ports have been used.

6.02 When all conference ports are occupied by stations or dial repeating tie trunks, relays BC1-5 are operated and relay DOM is released. Under this condition, operation of relay D1 resulting from depression of the switchhook at the control station operates relay D9W. This connects busy tone via capacitor G and coil T1 to the control station line. When the switchhook is released, relay D1 is released and relay Z operates. Operation of relay Z releases relay CRDK so that busy tone is heard only by the conference controller.

6.03 After receiving the all-ports-busy signal, the controller returns to the conference bridge by a second flash of the switchhook. This releases relays D9W and Z. Release of relay D9W removes busy tone and release of relay Z operates relay CRDK to return the control station to the conference bridge.

7. CONTROLLER AND CALLED STATION ENTER CONFERENCE (OPTION 3) - SC24

7.01 After private consultation with a called station and both parties wish to join the multiway conference, the control station flashes his switchhook.

7.02 Depressing the switchhook at the originating station opens the tip and ring loop connected to vertical 80 which releases relay L.

7.03 Relay L released operates relay CF.

7.04 Relay CF operated releases relays BR1 and BR2. Relay BR1 released allows relay BC- of the called station to operate.

7.05 Relay BC- operated:

- (a) Operates relay 8- by closing the tip and ring of vertical 8- to the primary and secondary windings; relay 8- remains operated under control of the called party.
- (b) Removes the idle port terminating network from the port of the conference bridge and connects tip and ring of the called station to this port.
- (c) Supplements the path via relay CR- for holding 100-ohm ground on the sleeve of vertical 8-.
- (d) Prepares a holding path which is completed when relay BCH- operates.
- (e) Operates relay RV which in turn operates relay TPDK.

7.06 Relay 8- operated:

- (a) Releases relay CR-.
- (b) Prepares an operating path for the succeeding relay CR-.
- (c) Operates relay BCH- to provide a holding path for relay BC-.

7.07 Relay CR- released opens one path to 100-ohm holding ground from the sleeve of vertical 8- and operates relay CRDK. Sleeve ground is maintained by operated relay BC-.

7.08 Relay CRDK operated:

- (a) Releases relays RT, PM, and PRL.
- (b) Disconnects the idle port terminating network from port 0 of the conference bridge and connects tip and ring of the conference originator to this port.

7.09 Release of relay RT releases relay CF.

7.10 The conference originator and the conferee station are now connected via the conference bridge and may communicate. The private consultation circuits are restored to normal and are ready to operate on the next call.

8. ORIGINATOR DISPOSES OF LINE BUSY OR NO ANSWER - SC5

8.01 If the called station is busy or does not answer, the originator may return to the conference bus by flashing his switchhook.

8.02 When the originator depresses his switchhook, relay L releases and performs the following functions:

- (a) Immediately removes the bridge from tip and ring of the conference port connected to the called station. This action is supplemented by the later release of the operated CR- relay.
- (b) Operates relay D1.
- (c) Provides a holding path for relay RRL.
- (d) Starts the slow release of relay SRC.
- (e) Operates relay CF which in turn releases relays BR1 and BR2 (option 3).

8.03 Relay D1 operated releases relay RS and relay CR- which has just been operated. Relay RS releases relay RS1 with option 3.

8.04 Relay CR- released:

- (a) Operates relay CRDK.
- (b) Opens tip and ring of the calling port so that subsequent operation of relay L will not place a bridge on the port.
- (c) Removes 100-ohm holding ground from the calling port sleeve.

8.05 Relay CRDK operated returns the conference originator to the conference bus.

8.06 When the originator releases his switchhook relay L operates. Relay L operated operates relay SRC if it has released and releases relays D1, RRL, and with option 3, relay CF. Relay D1 in releasing releases relay PM.

8.07 At this time, the port last used is cleared and made available for adding the next conferee and the originator is on the conference bridge. The private consultation circuits are back to normal ready for the next operation (option 3).

9. ORIGINATOR DISPOSES OF DIAL TONE OR PARTIAL DIAL - SC6

9.01 If the conference originator has received dial tone or has partially dialed, he may cancel the call and return to the conference bus by flashing his switchhook. In this case the switchhook must be depressed long enough to release slow-release relay SRC.

9.02 When the originator depresses his switchhook, relay L releases and performs the following functions:

- (a) Immediately removes the bridge from tip and ring of the port connected to the dial pulse register. This action is supplemented by the later release of operated relay CR-.
- (b) Releases slow-release relay SRC which releases relay CR- just operated.

9.03 Relay CR- released:

- (a) Operates relay CRDK.
- (b) Opens tip and ring of the calling port so that subsequent operation of relay L will not place a bridge on the port.
- (c) Removes the 100-ohm holding ground from the calling port sleeve.

9.04 Relay CRDK operated:

- (a) Returns the conference originator to the conference bus.
- (b) Operates relay D1. This serves no purpose at this time.

9.05 When the originator releases his switchhook, relay L is operated. Operation of relay L operates relay SRC and releases relays D1 and RRL.

9.06 At this time, the originator is connected to the conference bridge, the register is released, and the port used to call in the register is cleared and made available for adding the next conferee.

10. CENTRAL OFFICE TRUNK ADDED TO CONFERENCE

A. Without Private Consultation Feature (Option V)

Originator Dials 0 to Call Attendant - SC6

10.01 The conference circuit is so arranged that the conference controller may add one central office trunk with the assistance of the PBX attendant. The action of dialing 0 reserves port 5 for later addition of a central office trunk.

10.02 When the controller dials 0, the register and marker function to connect the calling port to an attendant trunk. Relay P operates operating relay MC. When relay TK0 in the marker operates, relays D0 and PM are operated via contacts on relay MC. Relay D0 locks to off-normal ground under control of relay D0R.

10.03 Relay D0 operated:

- (a) Prepares a path between the IT-1 (25) and HM-2 (25) punchings of terminal strip D so that the "service denied"

restriction will be removed (from vertical 85 only) when relay MC is released by the marker.

- (b) Operates relay DOM.
- (c) Prepares an operating path for relay BC5 and a locking path for relay S5.
- (d) Opens the operating path of relay CR5 to reserve conference port 5 for the central office trunk.
- (e) Prepares an operate path for relay C0 if option 2 is furnished.

10.04 Relay DOM operated prepares operating paths for relays D0R and D9W. Relay P releases due to relay operation in the register.

Attendant Connects Central Office Trunk to Conference - SC6 - Console Used as Attendant Position

10.05 When the conference originator or controller calls the attendant by dialing 0, the conference circuit is primed so that the attendant may later place a central office trunk on the conference bus by dialing code 85.

10.06 Relay P operates when the attendant answers. The attendant calls the distant station over the central office trunk, then operates the HOLD key and receives PBX dial tone. When the attendant dials 85, the marker functions in the normal manner for connecting a central office trunk to a tie trunk. When a relay OT 25 in the line, link, and marker circuit operates, relay BC5 is operated.

10.07 Relay BC5 operated:

- (a) Operates relay S5 through the closed tip and ring loop of port 5. Relay S5 locks under control of relay D0R.
- (b) Connects vertical 85 to the conference bridge.
- (c) Supplies a 100-ohm holding ground to the sleeve of port 5.

10.08 Relay S5 operated operates relay BCH5 which performs the following functions:

- (a) Operates relay D0R (in series with thermistor B) in approximately 400 ms. Relay D0R locks to off-normal ground via relay BCH5.
- (b) Supplies an off-normal holding ground for relay DOM.

10.09 Relay D0R operated releases relay D0 which performs the following functions:

- (a) Opens the lead between terminal strip punchings IT-1 (25) and HM-2 (25).

- (b) Removes the temporary holding ground from relay S5.

10.10 After making a trunk connection, the attendant should release the holding condition by operating key RLS. After operating the release key, the attendant is released from the conference circuit and cannot re-enter. However, the attendant may be recalled by the conference controller as described in a following section.

Attendant Connects Central Office Trunk to Conference - SC6 - Cord Switchboard Used as Attendant Position - SC19

10.11 When the conference controller calls the attendant by dialing 0, the conference circuit is primed so that the attendant may later place a central office trunk on the conference by plugging into the conference circuit jack appearance.

10.12 Relay P operates when the attendant answers. The attendant calls the distant party over the central office trunk:

10.13 After informing the central office party that he is to be included in a conference, the attendant plugs into the conference circuit jack appearance with the other cord of the pair used in the central office trunk jack. Plugging in the cord grounds lead SL. Ground on lead SL operates relay C0 through a relay DC make contact, diode C0(0-4), and a normal break contact of relay MONA in the line, link, and marker circuit.

10.14 Relay C0 operated:

- (a) Locks operated under control of the switchboard and relays S1-4 and ON.
- (b) Operates relay S5; relay S5 operates relay BCH5.
- (c) Operates relay BC5.
- (d) Operates the line hold magnet in the marker associated with conference port 5.
- (e) Provides dc path across tip and ring of port 5 switchboard jack through inductor L1 and the break contact of released relay F0.
- (f) Grounds sleeve of port 5 jack.
- (g) Sets up flash attendant circuitry for longer (750 ms) flash interval needed for recall at the 608A or D attendant position by bridging relay F0 break contact 7. Also, relay F0 is made fast release so that the timing variation is minimized.

10.15 The cord switchboard attendant releases from the conference by depressing either another talk key or the release key. The attendant may re-enter at any time.

Controller Releases From Attendant Trunk -
All Ports Not Busy - SC5

10.16 When the conference controller has reached the attendant via a conference port other than number 5, he may return to the conference bridge by a single switchhook flash. The circuit functions in this case are similar to those involved when a called station is busy or does not answer.

Controller Releases From Attendant Trunk -
All Ports Busy - SC7

10.17 When conference ports 1-4 are in use, dialing 0 to reach the attendant sets up an all-ports-busy condition by reserving port 5 for later connection of a central office trunk. In this case, a switchhook flash at the controlling station results in return of busy tone to the conference controller.

10.18 When the switchhook at the controlling station is depressed, relay L releases. Relay L released operates relay D1 and releases relay P.

10.19 Relay D1 operated:

- (a) Releases relay CR5. Relay CR5 releasing operates relay CRDK.
- (b) Operates relay D9W via a path through operated relays D0M and BC1-4.

10.20 Operation of relay D9W connects busy tone via coil T1 to the tip and ring of the control port.

10.21 When the switchhook at the controlling station is released, relay L operates and relay D1 releases. This opens the shunt path across relay Z which operates, releasing relay CRDK. Under this condition, busy tone is heard at the controlling station only.

10.22 To dispose of busy tone, the controller again flashes his switchhook.

10.23 When the switchhook is depressed, relay L releases and shunts relay D9W via operated relay Z. Release of relay L also operates relay D1 which supplements the shunt path across relay D9W via operated relay Z.

10.24 When the switchhook is released, relay L operates and releases relay D1. This removes operating ground from relay Z which releases. Release of relay Z operates relay CRDK which returns the conference controller to the conference bridge.

B. With Private Consultation Feature (Option
31)Originator Dials 0 to Call Attendant - SC28 -
Attendant Called on Port 5

10.25 When the controller dials 0, the register and marker function to connect the calling port to an attendant trunk. Relay P operates operating relay MC. When relay TK0

in the marker operates, relays D0, D0A, and PM are operated via contacts of relay MC. Relay D0 locks operated under control of relay BCH5 or a switchhook flash.

10.26 Relay D0 operated:

- (a) Prepares a path between the IT-1 (25) and HM-2 (25) punchings of terminal strip D so that the "service-denied" restriction will be removed (from vertical 85 only) when relay MC is released by the marker.
- (b) Operates relay D0M which prepares an operate path for relay D9W.
- (c) Prepares an operate path for relays BR1, BR2, RT, and BC5.
- (d) Transfers control of relay CR5 so that it may be operated by a ground on lead OTG via relay BR1 make contact.

10.27 If the call to the attendant was made on port 5, the transfer of control of relay CR5 will cause relay CR5 to release. This will remove the bridge from port 5 tip and ring and the call will be disconnected.

10.28 Ground via relay BC1,2,3,4 make contact, relay BC5S break contact, relay D0M make contact, and relay D9W break contact operates relay D9W which locks operated under control of relay ON and relay Z.

10.29 Relay D9W operated causes busy tone to be returned to the controller as an indication that a central office party cannot be added with only one part idle. To dispose of busy tone, the controller flashes his switchhook and returns to the conference.

Originator Dials 0 to Call Attendant - SC28 -
Attendant Called on Port Other Than Port 5

10.30 When the controller dials 0, the register and marker function to connect the calling port to an attendant trunk. Relay P operates operating relay MC. When relay TK0 in the marker operates, relays D0, D0A, and PM are operated via contacts of relay MC. Relay D0 locks operated under control of relay BCH5 or a switchhook flash.

10.31 Relay D0 operated:

- (a) Prepares a path between the IT-1 (25) and HM-2 (25) punchings of terminal strip D so that the "service-denied" restriction will be removed (from vertical 85 only) when relay MC is released by the marker.
- (b) Operates relay D0M which prepares an operate path for relay D9W.
- (c) Prepares an operate path for relays BR1, BR2, RT, and BC5.

- (d) Transfers control of relay CR5 so that it may be operated by a ground on lead OTG via relay BR1 make contact.

10.32 When the attendant answers, relay P operates. The attendant calls the distant party via a central office trunk while the controller waits on the attendant trunk connection.

With Console Used as Attendant Position and No One Yet on Conference Bridge

10.33 After reaching the central office party, the attendant connects the central office trunk into the conference by operating the hold key and dialing 85. When the attendant dials 85, the marker functions in the normal manner for connecting a central office trunk to a tie trunk. When relay OT25 in the line, link, and marker circuit operates, relay BC5 operates through a normal break contact of relay BR1 which does not operate because no BCH- relay is operated. Relay RT also operates through diode RT.

10.34 Relay BC5 and its slave BC5S operated:

- (a) Operates relay S5 through the closed tip and ring loop of port 5.
- (b) Releases relay CR1, releasing the attendant trunk.
- (c) Connects vertical 85 to the conference bridge and removes idle port termination from bridge port 5.
- (d) Supplies a 100-ohm holding ground to the sleeve of conference circuit port 5.

10.35 Relay S5 operated operates relay BCH5 which performs the following functions:

- (a) Supplies an off-normal holding ground for relay DOM.
- (b) Shunts down relay D0 causing relay D0A to release.

10.36 Relay CRDK operates with relay D0 released and releases relays PM and RT. With relay CRDK operated, the controller is again connected to the conference bridge.

10.37 After the attendant releases, the controller and the central office party are alone on the conference bridge.

With Console Used as Attendant Position and at Least One Party Waiting on Conference Bridge

10.38 After reaching the central office party, the attendant connects the central office trunk into the conference circuit by operating the hold key and dialing 85. When the attendant dials 85, the marker functions in the normal manner for connecting a central office trunk to a tie trunk. When relay OT25

in the line, link, and marker circuit operates, fast-operate relay BP1 operates from ground on lead OTG through relay D0 make contact and diode BR1 and relay BCH- make contact and relay CF break contact. Relay BR2 operates over the same path as BP1. Relay RT also operates from the ground on lead OTG via relay D0 make contact and diode RT.

10.39 Relay BR1 operated:

- (a) Opens the operate path of relay BC5 before it has a chance to operate.
- (b) Operates relay CR5 via relay D0 make contact.

10.40 Relay BR2 operated:

- (a) Releases the CR- relay which was used to establish connection to the attendant.
- (b) Disconnects resistor P, relay P, and diodes A and B, and transfers connection of capacitors P so as to permit transmission through repeat coil T1 while direct current is blocked.

10.41 Relay CR- released opens the loop to the attendant and releases the attendant trunk.

10.42 Relay CR5 operated connects the controller to the central office trunk through repeat coil T1. After the attendant releases, the controller and central office party may consult privately via repeat coil T1.

Controller Flashes to Include Central Office Party and Self in Conference - SC31

10.43 A switchhook flash by the controller will release relay L.

10.44 Relay L released:

- (a) Operates relay CF via relay BR1 make contact. Relay CF locks operated under control of relay RT.
- (b) Starts the slow release of relay SRC.

10.45 Relay CF operated:

- (a) Releases relays BR1 and BP2.
- (b) Establishes a temporary path so that the loop to central office trunk circuit will not be opened during the transfer of the loop. This temporary path prevents the release of relay P in the central office trunk circuit.
- (c) Maintains ground on lead S1 of conference circuit port 5 during the transfer of the loop.

10.46 Relay BP1 released:

- (a) Operates relay BC5 from lead OTG via relay D0 make contact and diode BC5. Relay BC5 operates relay BC5S.
- (b) Releases relay CR5.
- (c) Operates relay D1 which performs no useful function at this time.

10.47 Relays BC5 and BC5S operated:

- (a) Complete the loop to relay S5 which operates through relay P in the central office trunk circuit even though there exists a parallel path from inductor L2 via normal break contacts of relay RS1, relay CF make contacts, resistors T2R and T2T, and relay D0A make contacts.
- (b) Connects port 5 to the conference bridge.

10.48 Relay S5 operated operates relay BCH5 which releases relay D0.

10.49 Relay D0 released:

- (a) Releases relay D0A which opens the temporary holding path for central trunk circuit P relay.
- (b) Supplies battery to relay CRDK operating it.

10.50 Relay D0A released:

- (a) Opens the path which temporarily held central office trunk circuit P relay.
- (b) Re-establishes direct current paths to the conference circuit P relay.
- (c) Removes direct ground from lead S1 of port 5; 100-ohm ground remains on lead S1 via relay BC5 make contact.

10.51 Relay CRDK operated:

- (a) Releases relay RT which releases relay CF.
- (b) Releases relay PM.
- (c) Returns the controller to the conference bridge.
- (d) Removes idle port termination from bridge port 0.

With Cord Switchboard Used as Attendant Position and No One Yet on Conference Bridge

10.52 After reaching the central office party, the attendant connects the central office trunk into the conference by plugging into the conference circuit jack appearance. Plugging the cord into the port 5 jack appearance grounds lead SL. Ground on lead SL operates relay CO via diode CO (0-4), relay D0 make contact, and line, link, and marker circuit relay MONA break contact.

10.53 Relay CO operated:

- (a) Locks operated under control of the switchboard and relays S1-4 and DN.
- (b) Grounds the switchboard jack sleeve to give answer supervision to the switchboard.
- (c) Closes a direct current path through inductor L1.
- (d) Operates LHM 25 in the line, link, and marker circuit.
- (e) Operates relays RS1 and RT which perform no useful function at this time.
- (f) Operates relay BC5 via relay D0 make contact, diode BC5, and relay BR1 break contact.

10.54 Relay BC5 operated:

- (a) Closes the transmission path to conference bridge port 5.
- (b) Removes idle port terminations from bridge port 5.
- (c) Operates relay BC5S.

10.55 Relay BC5S operated:

- (a) Operates relay S5 by shorting terminal 1L to terminal 2U. Relay S5 operated operates relay BCH5.
- (b) Releases relays RS1 and CR1.

10.56 Relay BCH5 operated shunts down relay D0.

10.57 Relay D0 released:

- (a) Releases relay D0A.
- (b) Supplies battery to relay CRDK operating it.

10.58 Relay CRDK operated:

- (a) Releases relays PM and RT.
- (b) Removes the idle port termination from bridge port 0 and connects the controller to the bridge.

10.59 After the attendant releases, the controller and the central office party are alone on the conference bridge.

With Cord Switchboard Used as Attendant Position and at Least One Party Waiting on Conference Bridge

10.60 After reaching the central office party, the attendant connects the central office trunk into the conference circuit by plugging into the conference circuit jack appearance. Plugging into the port 5 jack appearance grounds lead SL. Ground on lead

SL operates relay CO via diode CO (0-4), relay D0 make contact, and line, link, and marker circuit relay MONA break contact.

10.61 Relay CO operated:

- (a) Locks operated under control of the switchboard and relays S1-4 and ON.
- (b) Grounds the switchboard jack sleeve to give answer supervision to the switchboard.
- (c) Closes a direct current path through inductor L1.
- (d) Operates LHM 25 in the line, link, and marker circuit.
- (e) Operates relay BR2 and fast-operate relay BR1 through relay D0 make contact and diode BR1 and relay BCH- make contact and relay CF break contact.
- (f) Operates relay RT via relay D0 make contact and diode RT. Relay RT prepares a hold path for relay CF.
- (g) Operates relay RS1 so that the consult bus operates dry.

10.62 Relay BR1 operated:

- (a) Opens the operate path of relay BC5 before it has a chance to operate.
- (b) Operates relay CR5 from lead OTG via relay D0 make contact and relay S5 break contact.

10.63 Relay BR2 operated:

- (a) Releases the CR- relay used to establish the connection to the attendant, releasing the attendant trunk.
- (b) Disconnects resistor P, relay P, and diodes A and B, and transfers connection of capacitor P so as to permit transmission via repeat coil T1 while direct current is blocked.

10.64 Relay CR5 operated connects the controller to the central office trunk through repeat coil T1. After the attendant releases, the controller and central office party may consult privately via repeat coil T1.

Controller Flashes to Include Central Office and Self in Conference - SC3

10.65 A switchhook flash by the controller will release relay L.

10.66 Relay L released:

- (a) Operates relay CF via relay BR1 make contact.
- (b) Starts the slow release of relay SRC.

10.67 Relay CF operated:

- (a) Locks operated under control of RT.
- (b) Releases relays BR1 and BR2.
- (c) Opens the operate path of relay D9W so that busy tone is not returned if the added party is the sixth party to the conference.
- (d) Opens the operate path of relay FOM so that relay FOM does not operate when the sixth party is added to the conference.
- (e) Shorts out relay D1 break contact in the hold path of relay D0 to prevent release of D0 when relay D1 operates.

10.68 Relay BR1 released:

- (a) Operates relay BC5 through diode BC5 and relay D0 make contact and relay CO make contact.
- (b) Operates relay D1 which performs no useful function at this time.

10.69 Relay BC5 operated:

- (a) Cuts a transmission path through to conference bridge port 5.
- (b) Removes the idle port termination from bridge port 5.
- (c) Operates relay S5 by shorting terminal 1L to terminal 2L. Relay S5 operated operates relay BCH5.
- (d) Operates relay BC5S.

10.70 Relay BC5S operated releases relay RS1.

10.71 Relay BCH5 operated:

- (a) Provides a hold path for relays D0A and BC5.
- (b) Shunts relay D0, releasing it.

10.72 Relay D0 released:

- (a) Releases relay D0A, re-establishing direct current paths to the conference circuit P relay.
- (b) Supplies battery to relay CRDK, operating it.

10.73 Relay CRDK operated:

- (a) Releases relay RT which releases relay CF.
- (b) Releases relay PM.
- (c) Returns the controller to the conference bridge.

- (d) Removes the idle port termination from bridge port 0.

Attendant Recall After CO Trunk Has Been Added - All Ports Not Busy

10.74 When a CO trunk is connected at port 5 but one or more ports in group 1-4 are unoccupied, a switchhook flash at the controlling station results in dial tone instead of operator recall to the CO trunk. Under this condition, the controller dials 0 to reach the attendant via an attendant trunk.

10.75 After giving the attendant instructions via the attendant trunk, the controller returns to the conference by another switchhook flash. The attendant takes appropriate action to release the attendant trunk and disconnects the CO trunk if this is required.

Attendant Recall After CO Trunk Has Been Added - All Ports Busy; Console Used as Attendant Position - SRC

10.76 When all conference ports are busy and a CO trunk has been connected at port 5, a switchhook flash at the conference control station results in a flashing recall signal on the CO trunk of the attendant console.

10.77 Depressing the switchhook at the controlling station releases relay L which starts the slow release of relay SRC. Relay D1 is operated by the release of relay L but performs no functions of interest in this sequence.

10.78 When relay SRC has released, relay FOM operates and prepares a path for operating relay FO. Release of relay SRC also starts disconnect timing action which will end in operation of relay ONRL if the switchhook is held operated longer than about 1.5 seconds.

10.79 If the switchhook is released within 1.5 seconds, disconnect timing action is stopped and relay SRC is reoperated. This operates relay FO via the path prepared by operation of relay ROM.

10.80 Relay FO operated starts the slow release of relay FOM and also reverses battery and ground on the tip and ring toward the CO trunk. This locks in a flashing recall signal associated with the CO trunk at the attendant console.

10.81 Release of relay FOM starts the slow release of relay FO. The combined slow release of relays FO and FOM allows sufficient time to lock in the recall condition at the attendant position circuit.

10.82 The recall signal is an indication to the attendant that the CO trunk should be released.

10.83 Disconnection of the CO trunk releases relays S5, BCH5, BC5, BC5S, and DOM if option 3 is used or relays S5, BCH5, BC5,

DOM, and DOB if option V is used. This clears conference port 5 for use in adding a conferee station or another CO trunk connection.

10.84 If another CO trunk connection is desired, the conference controller dials 0 and reaches the attendant via an attendant trunk. The dial 0 conditions mark port 5 for addition of a trunk after the controller and attendant have released the connection via the attendant trunk.

Attendant Recall After CO Trunk Has Been Added - All Ports Busy; Cord Switchboard Used as Attendant Position

10.85 When all conference ports are busy and port 5 is connected through the switchboard, a switchhook flash by the controller results in a flashing recall signal at the attendant position on the cord lamp associated with the cord plugged into the conference circuit jack appearance.

10.86 Depressing the switchhook at the controlling station releases relay L which starts the slow release of relay SRC. Relay D1 is operated by the release of relay L but performs no functions of interest in this sequence.

10.87 When relay SRC has released, relay FOM operates through varistors FO1 and FO2 and resistor FO; relay FOM prepares a path for operating relay FO. Release of relay SRC also starts disconnect timing action which will end in operation of relay ONRL if the switchhook is held operated longer than about 1.5 seconds.

10.88 If the switchhook is released within 1.5 seconds, disconnect timing action is stopped and relay SRC is reoperated. This operates relay FO via the path prepared by operation of relay FOM; reoperation of SRC also initiates timing of timer FO.

10.89 Relay FO operated opens the DC path to the switchboard. Relay FO also places an idle port termination across bridge port 5 to prevent howling.

10.90 After about 750 ms, timer FO completes timing; timer FO1 (option V) or FO7 (option M) lead is effectively connected to timer FO4 (option V) or FO5 (option M) lead and relay FOM is shunted down. Relay FOM released releases relay FO. Release of relay FO restores the dc path to switchboard. This 750-ms open of the dc path locks in a 120-imp flashing recall signal at the switchboard.

10.91 The recall signal is an indication to the attendant that the conference should be re-entered. The attendant re-enters and receives instructions on the action desired.

10.92 If the attendant is instructed to disconnect the party on port 5, the cord is pulled down from the jack appearance of port 5. Disconnection results in release of

relays CO, BC5, BCH5, DOM, and DOR if option 7 is used or relays CO, BC5, BC5S, BCH5, and DOM if option 3 is used. This clears conference circuit port 5 for addition of another party.

10.93 If another connection via the switchboard is desired, the conference controller dials 0 and reaches the attendant via an attendant trunk. This will set up the conference circuit so that a party may again be added via the switchboard jack appearance.

11. DIAL 9 TRUNK ACCESS DENIED - SC9

11.01 The conference circuit is arranged to deny access to central office trunks and to return busy tone if trunk access code 9 is dialed by the conference controller.

11.02 When the conference originator dials 9, the register and marker function in a normal manner for connecting a dial 9 call. Relay P operates which operates relay MC. Relay MC in turn operates relay PM. When the marker relay TKB9 operates, it operates relays D9W and Z via operated relay MC.

11.03 Relay D9W operated:

- (a) Locks to off-normal ground and, independently, to ground via operated relay PM.
- (b) Removes the bridge from the tip and ring of the calling port.
- (c) Through capacitor G, connects busy tone to a winding of repeat coil T1. Tone is induced on the tip and ring of the port which is controlling the conference.

11.04 Relay Z operated prepares a path for shunt-down release of relay D9W when relay L is released by a switchhook flash.

11.05 The controller disposes of the busy tone and returns to the conference bus by a switchhook flash.

11.06 When the switchhook is depressed, relay L releases. This operates relay D1 which removes locking ground from the CR1-5 relays and releases the one just operated.

11.07 Relay CR- released:

- (a) Removes 100-ohm holding ground from the sleeve of the calling port.
- (b) Opens a possible tip and ring bridge on the calling port when relay D9W releases.

11.08 Release of relay L completes a shunt path across the winding of relay D9W via operated relay Z. This releases relay D9W but relay Z remains operated as long as the switchhook is depressed. Release of

relay D9W removes busy tone from the tip and ring of the control station.

11.09 When the switchhook is released, relay L operates and relays D1 and PM, release. This opens both paths for holding relay Z operated so that it releases.

11.10 Release of relay Z operates relay CRDK. This reconnects tip and ring of the control port to bridge port 0 and also releases relay PM.

11.11 At this time, the conference connection is restored to the condition which existed before the controller attempted to add a central office trunk by dialing the trunk access code.

12. DIAL REPEATING TIE TRUNK ADDED TO CONFERENCE - SC18, SC26

12.01 Dial repeating tie trunks with reverse battery supervision may be added to the conference without help from the PBX attendant. With option 3, the originator may also have a private consultation with the tie trunk party.

12.02 When a tie trunk (say 86) has been dialed by the conference controller, the register calls the marker and reverses battery toward the calling port. This operates relay P which in turn operates relay MC.

12.03 Relay MC operated:

- (a) Prepares a path for operation of relay D8 via the marker.
- (b) Grounds marker lead CCC to cancel the camp-on function.
- (c) Operates relay PM.

12.04 The marker when connected operates relay D8, connects the called port to the tie line, and then releases.

12.05 With private consultation (option 3) provided, relay D8 operates relay RS1 which in turn operates relays BR1 and BR2. When the called station answers with relay BR1 operated, the control station and called station will be in private consultation.

12.06 Relay BR1 operated operates relay PMR which releases relay PM to keep holding ground on relays CR1-5 (option 3).

12.07 Release of the marker releases relay MC and connection of the tie line releases relay P. The controller may now dial the number of the station at the distant PBX.

12.08 If a supervisory signal received from the distant PBX indicates the called station is busy or does not answer, the controller may cancel the call and return to the conference by a switchhook flash (SC27).

12.09 If the distant station answers, reverse battery supervision provided by the trunk operates relay P. This operates relay RT on its secondary winding via operated relay D8 and released relay MC.

12.10 With private consultation (option 3), operation of relay RT releases relays PMR and RS1. Relay RS1 released releases relay P by removing battery previously available through inductor L2. Relay P released releases relay D8.

12.11 Without private consultation (option V), the operation of relay RT operates relay BC- and releases relay D8. Relay BC- operated completes a path via the switch vertical by operating relay S-. This releases relay CR- and operates relay BCH-. Release of relay CR- operates relay CRDK which releases relays RT, PM, and RRL. Relay CRDK operated also returns the conference controller to the conference bridge.

13. TRANSFER OF CONTROL

A. Conference Originator Disconnects

13.01 When the conference originator depresses his switchhook longer than 1.5 seconds, he is disconnected from the conference and cannot re-enter unless he is recalled by a conference station which has assumed control of the conference as described in a following section. Circuit action involved in disconnecting an originating station is described in a following section.

Note: The originating station, if recalled, will be connected at a port in group 1-5 and not at port 0.

B. Conferee Station Assumes Control - SC15

13.02 After the conference originator hangs up and is disconnected, a conferee station may gain control of the conference and add additional stations. The conferee station gains control by flashing his switchhook.

13.03 Assume that a conference port (other than port 0) is available, the originator has been disconnected, and the station on port 3 wishes to assume control of the conference.

13.04 When the conferee on port 3 depresses his switchhook, relay S3 releases. Relays BC3 and BCH3 are slow to release and hold up over a switchhook flash to maintain the sleeve ground at port 3.

13.05 Relay S3 released operates relay TP3 which locks to ground via operated relay BY.

13.06 Relay TP3 operated releases relay TPDK and prepares operating paths for relays

L, TE, and TEA which temporarily lock under control of released relay TPDK and operated relay RV.

13.07 Relays TE and TEA operated:

- (a) Open the operate paths for relays TP1-5.
- (b) Close the loop of port 3 across the windings of relay L operating it.
- (c) Supply a holding ground for relay S3.
- (d) Prepare a locking ground for relay TPDK.
- (e) Prepare an operating path for relay D1.

13.08 Relay L operated:

- (a) Operates relay SRC.
- (b) Opens one operating path for relay D1.

13.09 Relay SRC operated operates relays ON and ONA.

13.10 Relay ON operated:

- (a) Provides a holding ground for relays ONA, TE, and TEA.
- (b) Prepares a holding ground for relays Z, D9W, CR1-5, RRL, RS, and D0.
- (c) Indirectly prepares an operating path for relays DOR, BC1-5, and CR1-5.
- (d) Operates relay CRDK.
- (e) Prepares an operating path for relay D1.

13.11 Relay ONA operated:

- (a) Opens the operating path for relays TE and TEA.
- (b) Supplies a locking path for relays TP1-5.
- (c) Releases relay BY.
- (d) Provides a make-busy ground for the sleeve of vertical 80.

13.12 Relay CRDK operated:

- (a) Operates relay D1.
- (b) Removes off-normal ground from the operating path of relay RRL.

13.13 Relay D1 operated operates relay CR- (for the lowest numbered available port) which performs the following functions:

- (a) Releases relay CRDK.

- (b) Prepares an operating path for relay BC-.
- (c) Places a bridge, through the windings of repeat coil T1 and the operating circuit for relay P, on the tip and ring of the switch vertical connected to the lowest numbered available port.

13.14 A bridge on tip and ring of the switch vertical is a bid for connection of a dial pulse register.

13.15 Relay CRDK released:

- (a) Operates relay RRL (via thermistor C) after a delay of approximately 1 second.
- (b) Provides an off-normal holding ground for relays PM and RT.
- (c) Releases relay D1.

13.16 Relay RRL operated:

- (a) Operates relay TPDK which locks under control of relay TE.
- (b) Transfers holding ground for relays CR1-5 from relay ON to relay SRC.

13.17 At this point in the control sequence, the following conditions exist:

- (a) The station line connected via vertical 83 is transferred from its normal line relay S3 to the controlling line relay L.
- (b) Connection between conference bridge port 3 and switch vertical 83 is open.
- (c) Line relay S3 is held operated.
- (d) A register is connected to the lowest numbered available port and is returning dial tone to port 3 via coil T1 and a bridging connection at the tip and ring of vertical 80.
- (e) Switch linkage to vertical 80 has been dropped by the previous disconnect of the originator, but the conference control circuit number is held busy by ground on the sleeve of vertical 80.

13.18 Under these conditions, the station at port 3 may control the conference circuit in the same manner as the originator. The necessary action at this time is dialing the number of a station to be added or disposing of the dial tone and releasing the register by a switchhook flash.

14. DISCONNECT

A. An Added Station Disconnects - SC12

Originator Still in Control - Three or More Stations in Conference

14.01 When a called conferee station

hangs up, the S- relay associated with his conference port is released. This starts the slow release of relay BCH-. Release of relay BCH- starts the slow release of relay BC- which when released removes the holding ground from the sleeve of the switch vertical to release the corresponding holding magnet.

14.02 When a conferee port is cleared by disconnection of the called station, it becomes available for a new call by the conference controller. A new call is directed to the lowest number conference port having a released S- relay.

Added Station, Not in Control, Disconnects With Originator Disconnected - Three or More Stations in Conference - SC13

14.03 If the conference originator has been disconnected before an added station hangs up, the added station releases relays S-, BCH-, BC-, and the link hold magnet in the sequence which occurs when the originator is still in control. With the originator disconnected, however, there is an additional circuit action of operating and releasing relay TP- and releasing and reoperating relay TPDK during the disconnect sequence.

Originator Disconnects First - Only Two Stations Left in Conference - SC14

14.04 If the conference originator has been disconnected and only two stations are left in the conference, a hangup at either station releases the conference control circuit. For discussion purposes, assume that the stations on conference ports 2 and 3 remain in the conference and that the station on port 2 hangs up.

14.05 A hangup at the station connected to port 2 releases, in sequence, relays S2, BCH2, BC2, and link hold magnet 82. Also during this sequence relay TP2 is operated and released and relay TPDK is released and reoperated.

14.06 Since the originator is disconnected, relay ONA is released so that the holding path for relay BC3 is opened when relay BC2 releases. Release of relay BC2 thus releases relay BC3.

14.07 Relay BC3 released:

- (a) Releases holding magnet 83.
- (b) Releases relay S3.
- (c) Releases relay RV.

14.08 Release of relay S3 releases relay BCH3 and release of relay RV releases relay BY.

14.09 Release of relay BY releases relay TPDK and removes ground from the sleeve of the switch vertical used by the originator. This restores the conference control circuit to a normal idle condition and thus makes it available for a new conference originator.

Called Station Disconnects During Private Consultation With Originator (Option 3) - SC25

14.10 The called station disconnects during private consultation by hanging up. The control station switchhook flashes to reconnect to the multiway conference as described in 7., except the disconnected station does not go to the conference and is free to make and receive other calls.

B. Originator Disconnects

With Register Attached - SC10

14.11 When the conference originator hangs up, relay L is released and starts the slow release of SRC. Release of relay SRC releases relay CR- associated with the conference port at which the register is attached. This removes the bridge from the tip and ring of the switch vertical and thus dismisses the register. Release of relay CR- operates relay CRDK which in turn operates relay D1.

14.12 Release of relay SRC also activates the disconnect timing circuit by grounding the start terminal. After the disconnect interval of about 1.5 seconds, relay ONRL operates. This opens the locking path for relay ON, releasing it.

14.13 Release of relay ON releases relays ONA, CRDK, D1, and RRL. Release of relay ONA releases relay TPDK and hold magnet 80 and stops disconnect timing. Relay ONRL releases.

14.14 Release of relay TPDK operates relay BY which reconnects ground to the sleeve of vertical 80 to hold the conference number busy. Operation of relay BY also operates relay TPDK via a series of break contacts on relays TP1-5.

While Connected to Conference Bridge - SC11

14.15 If the conference originator hangs up while connected to the conference bridge, the main disconnect sequence is the same as for disconnection when attached to a register. However, there is additional circuit action which depends on the busy condition of the conference ports.

14.16 If all ports are busy with stations, operation of relay D1 operates D9W in preparation for applying an all-ports-busy tone. The all-ports-busy tone is not applied to the conference, however, since repeat coil winding 4-3, 7-8 is open at break contacts of relay L. Relays D9W and D1 are released when relay ON releases.

14.17 An additional circuit action in the all-ports-busy case is the operation of relay FOM when relay SRC releases. This is preparatory to flashing the trunk recall lamp at the attendant console if a central office trunk is connected at port 5.

While on Consultation Bus With Another Station - SC34

14.18 If the originator disconnects while on the consultation bus, the circuit operation is as described in 7. and in 14.15 through 14.17.

C. Station in Control Disconnects - SC16

14.19 When a station which is in control of the conference (say the station on port 3) hangs up, relay L is released. This operates relay D1 and starts the slow release of relay SRC. If a conference port is idle, operation of relay D1 operates relay CR- in preparation for adding a station. Operation of relay CR- releases relay CRDK which in turn releases relay D1. However, the on-hook condition at the controlling station allows the disconnect sequence to continue through the operation of relay ONRL, release of relays ON and ONA, and release of relay ONR1.

14.20 Release of relay ON in addition to releasing relay ONA releases the operated relay CR- and relays TE and TEA.

14.21 Release of relay TE opens the locking path for relay TPDK which releases since relay TP3 was operated when the station assumed control. Release of relay TEA removes holding ground from relay S3 releasing it.

14.22 Release of relay ONA, in addition to recycling the timer, releases relay TP3 and operates relay BY via released relay TPDK. With relay TP3 released, operation of relay BY applies ground via break contacts on relay TP1-5 for operating relay TPDK.

14.23 If at least one port is idle, operation of relay BY completes a path via relay TPDK operated and relays TEA and BCH-released for reoperating TP3. This is a momentary operation since relay TP3 is released when relay BC3 is released following release of relay BCH3.

14.24 At the end of a disconnect sequence for a station which has assumed control, the conference circuit is in the same condition as that following disconnection of the original controller. Any station still connected to the conference may assume control by flashing his switchhook.

D. Disconnects When Port 5 is Connected Through Cord Switchboard - SC21

14.25 The following describes the action resulting when all stations except a station (or trunk) connected through a cord switchboard appearance hang up. Assume that port 2

is the next-to-last port to be disconnected; assume further that port 2 is associated with directory number 82 and port 5 is associated with directory number 85.

14.26 A hangup at the station connected to port 2 releases S2 which releases relay CO, operates relay TP2 releasing relay TPDK, and, in sequence, releases relays BCH2, BC2, and TP2. Release of BC2 also releases line hold magnet 82.

14.27 Relay CO released releases line hold magnet 85 and relay S5. Relay CO released removes ground from the sleeve of the switchboard jack causing the back cord lamp to light.

14.28 Relay S5 released releases relays TP5 and BCH5. BCH5 released releases relays BC5 and DOM and in conjunction with released BC2 releases relay RV. Release of relay RV releases relay BY making the conference circuit available for another conference. Relay BC5 released releases relays TP5 and BC5S.

14.29 If a central office party connected through a cord switchboard disconnects while the conference is in progress, central office timeout will result in a momentary open of the trunk loop which will lock in a flashing recall at the switchboard. A moment later, dial tone will be returned from the central office into the conference. This dial tone will persist until the attendant takes the appropriate action.

SECTION III - REFERENCE DATA1. WORKING LIMITSLines and Trunks

1.01 Maximum external loop resistance is 1500 ohms. Minimum insulation resistance is 16,000 ohms.

Voltage Limits

1.02	Minimum	Maximum
	-45	-52

2. FUNCTIONAL DESIGNATIONS2.01 Relays

<u>Designation</u>	<u>Meaning</u>
BC1-5	Bus Connect
BC5S	Bus Connect 5 Slave
BCH1-5	BC Hold
BR1	Block Relay 1
BR2	Block Relay 2
BY	Busy
CF	Conference Return
CO	Cut Over
CR1-5	Connect Register
CRDK	CR Down Check
D0	Dial 0
D0A	Dial 0 Auxiliary
D0M	Dial 0 Memory
D0R	D0 Release
D1	Dial 1
D8	Dial 8
D9W	Dial 9 and All-Ports-Busy Sequence W
FO	Flash Attendant
FOM	Flash Attendant Memory
L	Line Relay
MC	Marker Connect
ON	Off Normal
ONA	Off-Normal Auxiliary
ONRL	Off-Normal Release

P	Polarized
PM	P Relay Memory
PMR	PM Release
RRL	Register Release
RS	Ring Start
R81	Ring Start Slave
RT	Ring Trip
RV	Reverse
S1-5	Supervisory - Station Line
SRC	Slow Release
TE	Transfer Control Execute
TEA	TE Auxiliary
TP1-5	Transfer Control Prepare
TPDK	TP Down Check
Z	All-Ports-Busy Sequence Z

3. FUNCTIONS

3.01 To provide means for initiating and controlling, from any PBX station, a conference connection of PBX stations and dial repeating tie trunks.

3.02 To disconnect any conference station which goes on-hook and make the station available for incoming or outgoing nonconference calls.

3.03 To make a conference port from which a station has disconnected available to the conference controller for adding another station.

3.04 To return busy tone if the controller attempts to add a station when all ports are in use.

3.05 To return busy tone if the controller attempts to add a central office trunk by dial 9 procedure.

3.06 To transfer conference control to any conferee station which flashes a switchhook after the conference originator is disconnected.

3.07 To release the conference controller from a partially completed call if the switchhook is flashed at any time prior to answer by the called station.

3.08 To provide for addition, by the PBX attendant, of a central office trunk to the conference.

3.09 To recall the attendant to a central office trunk if the switchhook is flashed by

the controller when all conference ports are in use.

3.10 To provide private consultation between the control station and newly added conferee. The private consultation is canceled by a switchhook flash by the controller, and both the control station and the called station are connected into the multi-way conference.

3.11 To return busy tone if the controller dials 0 over conference port 5.

4. CONNECTING CIRCUITS

FBX Circuits

4.01 The station controlled conference circuit is connected to the following circuits.

- (a) Line, Link, and Marker Circuit - SD-65741-01.
- (b) Ringing Circuit - SD-81288-01 and Power Supply Circuit - SD-81326-01 or Power Supply Circuit - SD-81577-01 alone or Power Supply Circuit - SD-81600-01 alone.
- (c) Tie Trunk Circuit - SD-65535-01.
- (d) 552A, 552B, 552D, 552E, 605A, 607A, 607B, or 608A Jack Circuit - SD-65778-01.
- (e) 608D Jack and Lamp Circuit - SD-65997-01.

Plug-In Units

4.02 The station controlled conference circuit includes timing circuit SD-66793-01

or SD-99361-01 (CP5) or SD-99361-01 (CP4). The station controlled conference circuit also includes six-port conference bridge circuit SD-96595-01, Fig. 1.

5. ALARM INFORMATION

5.01 Operation of a fuse supplying power to the station controlled conference circuit results in a visual and audible alarm at the attendant position and at the alarm, transfer, and test circuit. If alarm sending is provided, a fuse alarm results in a major alarm at the plant service center.

6. MANUFACTURING TESTING REQUIREMENTS

6.01 The station controlled conference circuit shall be capable of performing all of the functions given in this circuit description; the relays with which it is equipped shall meet all requirements of the Circuit Requirements Table.

7. TAKING EQUIPMENT OUT OF SERVICE

7.01 The station controlled conference circuit may be taken out of service by the following procedures:

- (a) Determine that the circuit is not in use by observing that all relays are released.
- (b) Block relay BY operated.
- (c) Remove all battery supply fuses.

SECTION IV - REASONS FOR REISSUEA. Changed and Added Functions

A.1 To provide a private consultation between the controller and newly added conferee. The private consultation is canceled with a switchhook flash by the controller and both the controller and the called station are connected into the multiway conference.

A.2 To return busy tone if the controller dials 0 over conference port 5.

B. Changes in ApparatusB.1 Added

Relay	BC5S	1/2AK4	App Fig. 3
Relay	BR1	AF88	App Fig. 3
Relay	CF	AJ15	App Fig. 3
Relay	D0A	1/2AK4	App Fig. 3
Relay	RS1	1/2AK4	App Fig. 3
Relay	PMR	1/2AK4	App Fig. 3
Inductor	L2	274L	App Fig. 3
Capacitor	P	437A	App Fig. 3
Diode	BC5	446F	App Fig. 3
Diode	BR1	446F	App Fig. 3
Diode	D8	446F	App Fig. 3
Diode	RT	446F	App Fig. 3
Resistor	D0	18U	App Fig. 3
Resistor	MC	KS-13492, L1, 200 Ohms	App Fig. 3
Resistor	P	18JU	App Fig. 3
Resistor	T2R	144A, 1500 Ohms	App Fig. 3
Resistor	T2T	144A, 1500 Ohms	App Fig. 3

B.2 SupersededSuperseded By

A Capacitor, 542F, T Option	A Capacitor, 705G, S Option
B Capacitor, 542F, T Option	B Capacitor, 705G, S Option
C Capacitor, 542F, T Option	C Capacitor, 705G, S Option
D Capacitor, 542F, T Option	D Capacitor, 705G, T Option
E Capacitor, 542F, T Option	E Capacitor, 705G, T Option

F Capacitor, 542F,
T Option

F Capacitor, 705G,
T Option

L Capacitor, 437QA,
V Option

Wiring, M Option

RD Connector,
KS-19198, L1,
App Fig. 1,
V Option

RD Connector,
910A, M Option

RD Plug-In Unit,
ED-66715, App
Fig. 1, V Option

RD Plug-In Unit,
ED-99556, App
Fig. 1,
Q Option or

FO Plug-In Unit,
ED-99541, App
Fig. 2, V Option

RD-FO Plug-In
Unit, ED-99555,
App Fig. 1,
R Option

DOR Relay, 1/2AK4,
App Fig. 1,
V Option

BR2 Relay, 1/2AK4,
App Fig. 1,
M Option

L Relay, AJ52,
App Fig. 1,
V Option

L Relay, AJ138,
App Fig. 1,
M Option

R0-5 Resistors,
145A, 900 Ohms,
App Fig. 1,
T Option

R0-5 Resistors,
145A, 600 Ohms,
App Fig. 1,
S Option

B.3 Removed

B Thermistor, 1F,
App Fig. 1, V Option

D. Description of Changes

D.1 Option T is designated and rated Mfr Disc. and option S is added to change the idle bridge-port termination to improve balance on partially loaded conferences.

D.2 Option V is designated and rated Mfr Disc. and options 3, N, Q, R, and M are added to provide private consultation and to permit the use of one double relay time delay circuit in place of the previous two single relay time delay circuits.

D.3 On sheet C1, use of contacts of relays BCH1-4, L, ON, RS, RT, D8, and S are shown for use with option 3. Options M and V are also shown.

D.4 On sheet C2, App Fig. 3 is added.

D.5 On sheet D1:

(a) Options 3, N, Q, R, and M are included in Note 102.

(b) Options 3, N, Q, R, S, T, M, and V are included in Note 104.

(c) Notes 107 and 303 are added.

(d) Minimum insulation resistance is

raised from 10,000 ohms to 16,000 ohms to insure release of relays S- on disconnects.

D.6 Sheets D2 and D3 are added; Information Note 302 is added on sheets D1, D2, and D3.

D.7 Sheets E1 through E8 and SC1 through SC21 are modified and sheets SC22 through SC34 are added.

D.8 On sheet F1, circuit requirement information for relays BC5S, BR1, BR2, CF, D0A, RS1, and PMR is added. Information on relays D0 and L is also made to agree with changes in this issue.

BELL TELEPHONE LABORATORIES, INCORPORATED

(WECO 7120HW-RRS-JGW)

DEPT 5337-LAH

PBX SYSTEMS
NO. 756A
DIAL CONFERENCE
TRUNK CIRCUIT
ATTENDANT CONTROLLED

CHANGES

B. Changes in Apparatus

B.1 Superseded

S1, 2 and S3, 4 re-
sistors (two), 19LC,
App Fig. 1, option S

S5 resistor, 18BW,
App Fig. 1, option S

Superseded by

S1, 2 and S3, 4 re-
sistors (two), 19LG,
App Fig. 1, option R

S5 resistor, 18EB,
App Fig. 1, option R

D. Description of Changes

D.1 Option R is added and rated Standard to recode the conference sleeve resistors from 100 to 84 ohms. This provides the proper potential on the sleeve lead to prevent a link test failure. Option S is rated Mfr Disc.

D.2 This change is reflected in the Sheet Index, Option Index, FS2, App Fig. 1, and Circuit Note 104.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 3224-TEH-RVL

CIRCUIT DESCRIPTION

CD-66908 1
ISSUE 2
APPENDIX 2A
DUG ISSUE 617

PBX SYSTEMS
NO. 556A
DIAL CONFERENCE
TRUNK CIRCUIT
ATTENDANT CONTROLLED

CHANGES

D. Description of Changes

D.1 On sheets B1 and B3, option U is designated and rated Manufacture Discontinued. Option T is added to revise the operate paths of relays BCH1-5 and CR1-5.

D.2 On sheet B3, relays BC1-5 are designated as "SR".

D.3 Option index, App. Fig. 1 and circuit note 104 are revised to reflect the aforementioned changes.

BELL TELEPHONE LABORATORIES, INCORPORATED

(WECO 2120HW-SHA-WHK)
DEPT 5337-LAH

Page 1
1 Page

FBI SYSTEM
NO. 756A
DIAM CONFERENCE
TRUNK CIRCUIT
ATTENDANT CONTROLLEDCHANGESB. Changes in ApparatusB.1 SUPERSEDEDSUPERSEDED BY(6) A,B,C,D,E,F
5427 Capacitors

App. Fig. 1, Option W.

(6) A,B,C,D,E,F
705G Capacitors

App. Fig. 1, Option V.

(6) R0, R1, R2, R3, R4, R5
145A, 898 ohm Resistors

App. Fig. 1, Option W.

(6) R0, R1, R2, R3, R4, R5
145A, 600 ohm Resistors

App. Fig. 1, Option V.

D. Description of Changes

D.1 For description of operation see CD,
Issue 2A.

D.2 Option W is designated and option V is
added. Option V provides improved idle
line termination for the conference bridge
circuit and provides for disconnecting the
battery supply from the conference bridge
circuit when the trunk circuit is idle.

D.3 In FS1 and FS2, references to options V
and W are added at the location of capacitors
A,B,C,D,E and F and resistors R0, R1, R2, R3, R4
and R5.

D.4 In FS4, option W provides battery supply
to CA connector terminal 20 at all times
and option V places connection of the battery
supply under control of contacts 3 make of
relay ON and the BC-relays.

D.5 Circuit note 104 is changed to indicate
that the use in the circuit of option W
is manufacture discontinued and that the use
of option V is standard.

D.6 The title conference bridge circuit was
conference amplifier circuit prior to
this issue.

BELL TELEPHONE LABORATORIES, INCORPORATED

(WECO 2120HW-WES-JGW)
DEPT. 5337-LAH

PBX SYSTEMS
NO. 756A
DIAL CONFERENCE
TRUNK CIRCUIT
ATTENDANT CONTROLLED

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SECTION I - GENERAL DESCRIPTION**1. PURPOSE OF CIRCUIT**

1.01 To provide control arrangements which permit an attendant to set up a conference connection with any five stations or tie trunks or with any four stations or tie trunks and a central office trunk.

2. GENERAL DESCRIPTION OF OPERATION**A. Definitions and Operation Charts**

2.01 Table A defines terms used in this circuit description and Charts A-D of the schematic drawing outline the control and switching actions involved in setting up a conference.

B. Assignment of Switch Verticals

2.02 The five conference ports may be assigned to any five tie trunk verticals of the switch. For descriptive purposes it is assumed that verticals 81-85 are assigned to ports 1-5, respectively. It should be noted, however, that a consecutive sequence of numbers is not required.

C. Originating a Conference

2.03 A conference is originated by a request to the attendant over an attendant trunk or a central office trunk. ~~ATTN~~ station or tie trunk party must release this connection to permit the attendant to set up the conference connections including recall of the originating station or tie trunk party.

2.04 The attendant may seize the conference control circuit by depressing the CONF key. The conference circuit performs the following functions:

- (a) Makes vertical 81 busy.
- (b) Calls for the attachment of a dial pulse register at vertical 81.
- (c) Returns dial tone to the attendant.
- (d) Prepares to repeat the dialing of the attendant into the dial pulse register. The attendant may now dial the code of the first conferee station.
- (e) Provides a steady visual signal on the TL lamps associated with the CONF and ST/RC keys.

2.05 The conferee station, when called, is terminated on port 1 of the conference circuit via vertical 81 and conference port 1 is connected to conference bridge port 1.

2.06 When the switching and control circuit actions are completed, the attendant is connected to conference bridge circuit port 0 and may communicate with the conferee station just added.

TABLE A

Term	Definition
CONFEREE	Station which has been called into a conference by the attendant.
CONFERENCE PORT	One of five interfaces between tie trunk switch verticals and the conference control circuit. The verticals are occupied by conferees on a first idle basis.
CALLING PORT	A conference port in group 1-5 through which a conferee station is being called.
CONFERENCE VERTICAL	A switch vertical in the tie trunk group which is cross connected to a conference port.
CONFERENCE BRIDGE	A six port conference bridge which provides multiway communication between all conferees (including attendant).
CONFERENCE BRIDGE PORT	One of six interfaces between the conference control circuit and the conference bridge circuit.
SWITCHHOOK FLASH	Operation of switchhook and release in not less than 75 milliseconds nor more than 250 milliseconds.

2.07 The attendant prepares for calling the second station by momentarily depressing the ST/RC key. This action disconnects the attendant from the conference bridge and transfers the attendant to vertical 82 for calling the next conferee. By normal switching action the dial pulse register is connected to vertical 82 and dial tone is returned to the attendant.

2.08 The attendant dials the number of the second desired conferee station and, by normal switching action, the station is rung. When the called station answers, it is terminated on the conference bridge. At this time the attendant is reconnected to the conference bridge and multiway voice communication may take place between the attendant and both conference stations.

2.09 Assuming that all desired conference stations are idle and answer when rung, set up of the conference proceeds until five stations have been connected to the conference bridge circuit. A 60-ipm signal is connected to the SL lamp of ST/RC key when all ports are in use.

2.10 If at any time during the process of build up of a conference the called station is busy or does not answer when rung, the attendant cancels the call to this station by operating the ST/RC key momentarily. This dismisses the PBX switching circuits and returns the attendant to the conference bridge for communication with the stations already connected.

2.11 The action of cancelling by operation of the ST/RC key, including cancelling after partial dialing, may be taken at any time prior to answer by the called station.

D. Disconnections

2.12 If a station leaves the conference by going on hook it is dismissed from the conference circuit and may make or receive other calls in a normal manner. The conference port vacated by the disconnected station is available for calling other

stations or for recall of any station which previously has left the conference.

2.13 After releasing from the conference the attendant may be recalled by a switchhook flash at any station.

2.14 Each member of the conference is disconnected three to five hundred milliseconds after hanging up. If all parties disconnect except one, the remaining party is disconnected automatically. After the last station is disconnected, the TL lamps associated with the CONF and ST/RC keys are extinguished.

E. Connection of Central Office Trunk

2.15 A central office trunk may be connected to the conference by the PBX attendant via port 5 using normal dialing procedure.

F. Optional Features

2.16 An optional feature is available to provide for lock out of the attendant from the conference control circuit after her release. However, any member of the conference may recall the attendant by a switchhook flash. As a result of this action the SL lamp associated with the CONF key will flash at 120 ipm. The attendant answers by depressing the CONF key and is connected to the conference bridge. The request is received and another party can be connected provided there is an idle port.

2.17 An optional feature is available to provide for attendant release of a conference in progress by depressing and holding the ST/RC key down for a period in excess of five seconds. By this action the holding sleeve grounds of the conferee circuits are opened.

SECTION II - DETAILED DESCRIPTION1. GENERAL

1.01 Any five tie trunk switch verticals may be used as entry ports to the conference control circuit. In the following description, use of the group 81-85 is assumed but a consecutive sequence is not a requirements.

1.02 It is assumed that verticals 81-85 are given a central office trunk (COT) class of service by suitable strapping at PBX terminal strips. Verticals 81-85 are on a "service denied" basis with the exception that code 85 may be used for a "dial back" connection by the attendant for connection of a central office trunk.

2. ORIGINATING A CONFERENCE - SC1

2.01 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. Then the attendant can connect the originator through 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.

A. Control Circuit Seized

2.02 The attendant may seize the conference control circuit, if idle, by depressing the CONF key. Operation of the key connects the tip and ring of the attendant circuit to relay L, operating it.

2.03 Ground from the associated ACA lead in the cordless position circuit operates relay ON.

2.04 Relay ON operated:

- (a) Operates relay ONA.
- (b) Operates relay CR1 and closes a holding path for relays CR1-5.
- (c) Prepares locking path for relays RS and D8.
- (d) Operates relay CRDK via break contacts on relays CR1-5.
- (e) Prepares a locking path for relays PM and RT.
- (f) Connects the battery supply through to the conference bridge circuit.

2.05 Relay ONA operated:

- (a) Prepares a locking ground for relays BC1-5.

(b) Opens the operating path of relay LO.

(c) Lights the TL lamps (steady) associated with the CONF and ST/RC keys.

B. Dial Tone Returned

2.06 When relay CR1 operates (through break contacts of relays BC1-5 and relay RRL), the attendant receives dial tone.

2.07 Relay CR1 operated:

- (a) Releases relay CRDK which disconnects the attendant from the conference bridge.
- (b) Locks to ground under control of relays S1, ST, PM, RRL and ON.
- (c) Prepares an operating path for relay BC1.
- (d) Places a short circuit, through the 5-6 and 1-2 windings of repeat coil T1 and the polarized operating circuit of relay P, on the tip and ring of the tie trunk vertical assigned to conference port 1. (Assumed to be vertical 81.)
- (e) Connects a 100-ohm holding ground to the sleeve of vertical 81.

C. Register Attached

2.08 The shorted tip and ring of vertical 81 signals the marker to connect vertical 81 to a register and return dial tone to the attendant.

3. ATTENDANT ADDS FIRST CONFERENCE STATION - SC2A. Calling Conferee Station

3.01 After receiving dial tone from the register, the attendant dials the code of the first conferee station. Relay L follows the dial pulses; make contacts on relay L are in series with the bridge across tip and ring and pulse the register.

3.02 After the register has connected to marker it reverses the tip and ring. This operates relay P which is polarized by diodes A and B. At the same time the register calls the marker.

3.03 Relay P operated, operates relay MC which performs the following functions:

- (a) Operates marker relay CCC which cancels the camp-on function if the called line is busy.

- (b) Operates relay PM.
 - (c) Closes a path to the marker and operates relay RS.
 - (d) Open its operating path and locks under control of marker relay RLAB.
- 3.04 Relay PM, operated, opens one of the locking paths for relays CRL-5.
- 3.05 Relay RS operated:
- (a) Locks to ground at relay ON under control of relays RT and ST.
 - (b) Releases relay P by opening the bridge across tip and ring via coil T1.
 - (c) Prepares a path for applying ringing supply to tip and ring of vertical 81.
 - (d) Opens the termination via coil T1 across tip and ring of the attendant's connection.
 - (e) Prepares a path via capacitor H for audible ringing feedback from vertical 81 to attendant.
- 3.06 After the marker has completed its functions, it releases itself and the dial pulse register from the connection. Release of the marker causes relay MC to release. Relay MC released with relay RS operated, connects ringing supply through the primary winding of relay RT to the ring side of vertical 81, and connects ringing ground to the tip side. This rings the called station; audible ringing feedback is transmitted through capacitor H to the attendant.
- B. Called Station Answers
- 3.07 When the called station answers, relay RT operates on its primary winding and performs the following functions:
- (a) Locks through its secondary winding to ground at relay ON under control of relay CPDK.
 - (b) Operates relay BCL.
 - (c) Releases relay RS.
 - (d) Provides an open in lead OT1 to prevent the operation of line circuit relay OT- when relay BCL operates.
- 3.08 Relay BCL operated:
- (a) Operates relay S1 by closing the tip and ring of vertical 81 to the primary and secondary winding; relay S1 remains operated under control of the called party.
 - (b) Removes the idle port terminating network from port 1 of the conference bridge and connects tip and ring of the called station to this port.
 - (c) Supplements the path via relay CRL for holding 100-ohm ground on the sleeve of vertical 81.
 - (d) Prepares a holding path which is completed when relay BCH1 operates.
 - (e) Completes a path to supply battery to the conference bridge circuit when the attendant disconnects.
- 3.09 Relay S1 operated:
- (a) Releases relay CRL.
 - (b) Prepares an operating path for relay CR2.
 - (c) Operates relay BCH1 to provide a holding path for relay BCL.
- 3.10 Relay CRL, released, opens one path to 100-ohm holding ground from the sleeve of vertical 81 and operates relay CRDK. Sleeve ground is maintained by operated relay BCL.
- 3.11 Relay CRDK operated:
- (a) Releases relays RT and PM.
 - (b) Disconnects the idle port terminating network from port 0 of the conference bridge and connects tip and ring of the attendant to this port.
- 3.12 The attendant and the conferee station are now connected via the conference bridge and may communicate.

4. ATTENDANT CONNECTS REMAINING PARTIES TO CONFERENCE - SC3

A. Attendant Control Function

- 4.01 To add another station to the conference, the attendant momentarily depresses the ST/RC key. This transfers the attendant from the conference to the dial pulse register.
- 4.02 The ST/RC key operates relay ST; relay ST operates relay CR2.
- 4.03 Relay CR2 operated:
- (a) Releases relay CRDK.
 - (b) Prepares an operating path for relay BC2.

(c) Places a short circuit on the tip and ring of tie trunk vertical 82 via the windings of repeat coil T1, make contacts of relay L and the operating circuit for relay P.

(d) Supplies a 100-ohm holding ground for the sleeve of vertical 82.

4.04 Relay CRDK released:

(a) Disconnects tip and ring of attendant position circuit from conference port 0 and terminates the port with the idle port terminating network.

(b) Prepares a holding path for relay PM and a locking path for relay RT.

4.05 The short circuit on tip and ring of vertical 82 calls for attachment of a register at vertical 82.

B. Register Attached

4.06 Register seizure is the same as in adding the first conferee station except that vertical 82 is used instead of 81. At this point dial tone is returned to the attendant and circuit functions during subsequent dialing and called party answer are the same as in adding the first station except that BC2, S2 and BCH2 are operated instead of BC1, S1 and BCH1.

4.07 Additional stations are added to the conference by the same procedure used to add the second station; that is, by momentarily depressing the ST/RC key and receiving dial tone, followed by dialing the number of the desired station. When all conference ports are occupied, a 60-ipm flashing visual signal on the S lamp associated with the ST/RC key alerts the attendant.

4.08 When all ports are busy and the attendant is connected to the conference bridge, a 60-ipm flashing signal is applied to the ST/RC SL lamp through make contacts BCH1-5.

5. ATTENDANT DISPOSES OF LINE BUSY OR NO ANSWER - SC4

5.01 If the called station is busy or does not answer, the attendant may return to the conference bridge by momentarily depressing the ST/RC key. This operates the ST relay which opens the operating path of the associated relay CR-.

5.02 Relay CR- released:

(a) Operates relay CRDK.

(b) Opens tip and ring of the calling port.

(c) Removes 100-ohm holding ground from the calling port sleeve.

5.03 Relay CRDK operated, returns the attendant to the conference buss.

5.04 At this time the port last used is cleared and made available for adding the next conferee.

6. ATTENDANT DISPOSES OF DIAL TONE OR PARTIAL DIAL - SC5

6.01 If the attendant has received dial tone or has partially dialed, the call may be cancelled by depressing key ST/RC. In this case key ST/RC must be depressed long enough to operate relay RRL via thermistor A. Relay RRL operated opens the holding path of operated relay CR-.

7. CENTRAL OFFICE TRUNK PARTY ADDED TO CONFERENCE - SC6

A. Conference Setup Requested Over Central Office Trunk

7.01 A central office trunk may be connected to the conference circuit whenever port 5 is unoccupied. If the central office trunk requests a conference, the attendant can attach the central office trunk directly to port 5 by normal dial back procedure. A visual indication on the TL lamps of the CONF and ST/RC key indicates that the trunk is connected to the conference. Also provided is a 120-ipm flashing of lamp SL associated with CONF key.

7.02 The action of terminating the call on the switch vertical assigned to port 5 grounds lead CO from the line link and marker circuit. This operates relay BC5 via released relays ON and CO.

7.03 During termination of the trunk call on port 5, relay S5 is operated. This operates relay AR5 which locks under control of relays BC5, S5, ON and ONA. Operation of relay S5 results in operation of relays CO and BCH5. Relay BCH5 operated results in operation of relay LO. Relay LO operated closes the circuit for lighting the TL lamps associated with the CONF and ST/RC keys.

7.04 Relay AR5 operated, operates relay FO through thermistor B which closes the circuit for 120-ipm flashing of lamp SL associated with the CONF key. This is an additional indication to the attendant that the central office trunk is terminated on conference port 5.

7.05 When the central office trunk has been terminated on port 5 the attendant operates the CONF key. This mechanically releases the attendant circuits from the trunk used in the dial-back procedure, and electrically operates relays L, ON, and ONA.

7.06 Operation of relays ON and ONA release relay AR5 which releases relay FO. Release of relay FO stops the 120-ipm flashing of lamp SL associated with the CONF key.

7.07 With relays L, ON, and ONA operated, the conference circuit is prepared for action by the attendant to call in the first conferee station requested by the central office trunk party. Four stations or dial repeating tie trunks may be called in by the attendant as described in a preceding section. When four stations have been connected, the SL lamp associated with the ST/RC key flashes at a 60-ipm rate to indicate the all-ports-busy condition.

B. Central Office Trunk Added to Conference

7.08 The attendant may add a central office trunk to an established conference (if port 5 is unoccupied) by the following sequential procedure:

- (a) Operate central office trunk key and call distant station.
- (b) Terminate trunk on port 5 by normal dial-back procedure.
- (c) Operate key CONF and proceed with the addition of stations as requested.

7.09 Connection of the trunk results in operation of relay FO as previously described. Relay FO operated starts 120-ipm flashing of lamp SL as previously described and also short circuits break contacts on relay LO to defeat attendant lock-out if provided.

7.10 Where lock-out (option X) is provided the attendant must wait for the 120-ipm flashing signal before operating the CONF key. Premature operation of the CONF key operates relay L and may release relay AR5 before relay FO can operate. Under this condition the attendant, if locked out, cannot operate relay ON and is thus denied access to the conference circuit unless recalled by a switchhook flash by one of the conferee stations.

8. ATTENDANT RECALL - SC8

8.01 A switchhook flash by any station results in a 120-ipm flashing recall signal on the SL lamp associated with the CONF key of the attendant console.

8.02 Depressing the switchhook at any station releases relay S-. The associated relay AR- operates through the break contact of relay S- and the make contact of the slow release relay BCH-.

8.03 Relay AR- operated:

- (a) Locks under control of relays ON, ONA and BC-.
- (b) Operates relay FO through thermistor B.

8.04 Operation of relay FO is delayed by thermistor B to prevent flashing recall when a station hangs up.

8.05 When the attendant depressed the CONF key relays L, ON and ONA are operated. Operation of relays ON and ONA release any operated relays AR which release relay FO. Release of relay FO stops the 120-ipm flashing of lamp SL associated with the CONF key.

9. DIAL REPEATING TIE TRUNK ADDED TO CONFERENCE - SC7

9.01 Dial repeating tie trunks with reverse battery supervision may be added to the conference by the attendant.

9.02 When a tie trunk number (assume 89) has been dialed by the attendant, the register calls the marker and reverses battery toward the dialing port. This operates relay P which in turn operates relay MC.

9.03 Relay MC operated:

- (a) Prepares a path for operation of relay D8 via the marker.
- (b) Grounds marker lead CCC to cancel the camp-on function.
- (c) Operates relay PM.

9.04 The marker, when connected, operates relay D8, connects the calling port to the tie line and then releases.

9.05 Relay D8 operated operates relay D8M when port 5 is idle through a break contact of relay BC5. A break contact of D8M prevents the operation of the associated relay OT in the marker during connection and disconnection of a tie trunk (code 8) on port 5.

9.06 Release of the marker releases relay MC and connection of the tie line releases relay P. The attendant may now dial the number of the station at the distant PBX.

9.07 If a supervisory signal received from the distant PBX indicates the called station is busy or does not answer, the attendant may cancel the call and return to the conference by momentarily depressing the ST/RC key (SC4).

9.08 If the distant station answers, reverse battery supervision provided by the trunk operates relay P. This operates relay RT on its secondary winding via operated relay D8 and released relay MC.

9.09 Operation of relay RT operates relay BC and releases relay D8. Relay D8M will be held operated by relay RT. Relay BC- operated completes a path via the switch vertical for operating relay S-. This releases operated relay CR- and operates relay BCH.

9.10 Release of relay CR- operates relay CRDK which releases relay RT and PM. Relay D8M will remain operated on the release of relay RT is a tie trunk (code 8) is connected to port 5. Operation of relay CRDK also returns the attendant to the conference bridge. The attendant and tie trunk station are now connected via the conference bridge.

10. DISCONNECTS

A. Attendant Disconnects From Conference Bridge Circuit - SC9

10.01 The attendant may release at any time by operating the RELEASE key of the console. This mechanically releases key CONF.

10.02 Release of key CONF releases relays L, ON and except for the case of only one station on the conference bridge, releases relay ONA.

10.03 If no stations have been called into the conference, release of key CONF restores the conference circuit to the normal idle condition.

10.04 If the attendant has connected only one conferee to the conference bridge via port 1, relay ONA will not release when the attendant leaves the conference bridge. Relay ONA operated provides holding ground for relay BC1 to allow the attendant to connect a central office trunk after adding the single conferee.

10.05 If the attendant has connected a minimum of two parties, the attendant may release from the conference by depressing the RELEASE key of the console. This action results in mechanical release of key CONF. The release of key CONF releases relays ON, ONA, and L. Relay ON released opens the ground path for relay CRDK which releases. Relay CRDK released results in the operation of relay LO and removes the attendant from the conference bridge.

B. Conference Station Disconnects Minimum of Two Parties Remaining in Conference - SC10

10.06 When a conferee goes on hook relay S- associated with the conference port is released. This starts the slow release of relay BCH-. The associated relay OT- in marker is operated momentarily through break contacts of relays S- and BCH- (also D8M on port 5 only) and a make contact of relay BC-. Relay OT- operated opens the sleeve from the station sleeve ground in the case of a camped-on conferee. Released relay BCH- starts the slow release of relay BC-. The associated switch vertical is then released.

10.07 When a conferee port is cleared by disconnection of the called station, it becomes available for a reuse by the attendant. A new call is directed to the lowest number conference port having a released relay S-.

C. Next to Last Conferee Station Disconnects With Attendant Disconnected - SC11

10.08 If the attendant has disconnected and only two stations are left in the conference, either station going on hook releases the conference control circuit. For discussion purposes, assume that the stations on conference ports 1 and 2 remain in the conference, and that the station on port 1 hangs up.

10.09 A hang up at the station connected to port 1 releases, in sequence, S1, BCH1, LO, and line hold magnets 81. Relay OT21 in marker is operated during the release of relay BC1 to open the sleeve ground of the switch vertical on the station side. Release of relay LO removes battery from trunk lamps CONF and ST/RC, extinguishing them.

10.10 Since the attendant is disconnected, relay ONA is released so that the holding path for relay BC2 is opened when relay BC1 releases. Release of relay BC1 thus releases relay BC2.

10.11 Relay BC2 released:

- (a) Opens the holding sleeve ground for vertical 82.
- (b) Releases relay S2.
- (c) Disconnects the battery supply from the conference bridge circuit.

10.12 Relay OT22 will operate momentarily through break contacts of relays BC2 and S2 and a make contact of relay BCH2. Relay OT22 operated opens the sleeve from the station sleeve ground in the case of a camped-on conferee.

10.13 Release of relay S2 releases relay BCH2. The conference circuit is then clear for reuse.

11. OPTIONAL FEATURES

A. Lockout of Attendant from Conference (X Option)

11.01 When the lock-out feature (X option) is provided, break contacts on relay LO are in series with control leads from the attendant console to the conference control circuit. If the attendant releases from the control circuit after two or more conferees have been connected, relay LO operates and opens leads by which the attendant normally controls the conference. Under this condition, the attendant may not reconnect to the conference bridge or control the conference except to effect its complete release as described in a following paragraph.

11.02 When the attendant is recalled to the conference, the control lead is reclosed by operation of relay FO. When the attendant re-enters the conference by operation of key CONF, relay ON operates. Relay ON operated operates relay ONA which releases relay LO. This re-establishes attendant control of the conference.

11.03 It should be noted that relay FO is operated when a central office

trunk is added so that a locked-out attendant may re-enter the conference after adding a central office trunk.

B. Release Conference (Z Option)

11.04 When the release-conference feature (Z option) is provided the attendant may release the entire conference by holding key ST/RC operated for about 5 seconds. Option Z is provided by plugging the optional timer circuit RD into the RD socket.

11.05 With Z option provided and key CONF operated, operation of key ST/RC grounds lead ON4 of the timer circuit.

11.06 Relay RC operated:

(a) Operates relays OT- in marker that are associated with ports in use. This opens all sleeve grounds associated with conferee stations.

(b) Removes 100-ohm holding ground from all conference ports. This releases the operated holding magnets and results in release of all switch links to the conference circuit.

(c) Opens the operating path for relay ONA.

11.07 Relay ON operates either immediately (lockout not provided) or when relay LO is released. Under this condition, release of the conference circuit is indicated by return of dial tone to the attendant. The attendant may either release from the conference circuit or proceed with another conference setup.

SECTION III - REFERENCE DATA

1. WORKING LIMITS

LINES AND TRUNKS

1.01 Maximum external loop resistance
1,500 ohms. Minimum insulation
resistance 10,000 ohms.

VOLTAGE LIMITS

1.02	<u>Minimum</u>	<u>Maximum</u>
	-45	-52

2. FUNCTIONAL DESIGNATIONS

<u>Designation</u>	<u>Meaning</u>
AR1-5	Attendant Recall
BC1-5	Buss Connect
BCH1-5	Buss Connect Hold
CO	Central Office
CR1-5	Connect Register
CRDK	Connect Register Down Check
D8	Dial 8
D8M	Dial 8 Memory
FO	Flash Attendant
L	Line Relay
LO	Lock Out
MC	Marker Connect
ON	Off Normal
ONA	Off Normal Aux
P	Polarized
PM	P Relay Memory
RC	Release Conference
RRL	Register Release
RS	Ring Start
RT	Ring Trip
SL-5	Supervisory - Station Line

3. FUNCTIONS

- 3.01 To provide means for the attendant to initiate and control a conference connection with PBX stations, dial repeating tie trunks and one central office trunk.
- 3.02 To disconnect any conference station which goes on hook and make the station available for incoming or outgoing nonconference calls.
- 3.03 To make a conference port from which a station has disconnected available to the attendant for adding another station.
- 3.04 To return a flashing signal if all ports are busy.

- 3.05 To provide for release of the attendant from a partially completed call.
- 3.06 To provide for the addition of a central office trunk to the conference by attendant.
- 3.07 To provide recall of the attendant by a flashing signal if the switch-hook is flashed by any PBX station conferee.
- 3.08 To prevent (by lock-out option) attendant reconnection to the conference amplifier when two or more stations are in conference.
- 3.09 To permit a locked-out attendant to reconnect to the conference amplifier when recalled by any conferee station.
- 3.10 To provide (optionally) for release of all conferee stations by the attendant.

4. CONNECTING CIRCUITS

- 4.01 The attendant controlled conference is connected to the following circuits which are part of the 756A PBX system:
- (a) Line, Link and Marker Circuit - SD-65741-01.
 - (b) Ringing Circuit SD-81288-01 and Power Supply Circuit SD-81326-01 or Power Supply Circuit SD-81577-01 alone, or Power Supply Circuit SD-81600-01 alone.
 - (c) Tie Trunk Circuit - SD-65535-01.
 - (d) Cordless Position Circuit - SD-65757-01.

PLUG-IN UNITS

- 4.02 The attendant controlled conference circuit includes the six port conference bridge circuit per SD-96595-01, Fig. 1, and when option Z is specified, the timing circuit SD-66793-01.

5. ALARM INFORMATION

- 5.01 Operation of a fuse supplying power to the attendant controlled conference circuit results in a visual alarm at the attendant position and alarm, transfer, and test circuit. If alarm sending is provided, a fuse alarm results in a major alarm at the plant service center.

6. MANUFACTURING TESTING REQUIREMENTS

6.01 The attendant controlled conference circuit shall be capable of performing all of the functions given in this circuit description, and relays with which it is equipped shall meet all requirements of the circuit requirements table.

7. TAKING EQUIPMENT OUT OF SERVICE

7.01 The attendant controlled conference

may be taken out of service by the following procedure (in sequence):

- (a) Determine that the circuit is not in use by observing that all relays are released.
- (b) Block relay CO operated.
- (c) Remove all battery supply fuses.

SECTION IV - REASONS FOR REISSUE

D. Description of Changes

D.1 This circuit is reissued to correct a trouble condition that at times occurred when the called station answered after being rung by this circuit. Instead of being connected into the conference bridge circuit, the called station was released by this circuit and the marker established a dial tone connection to the station.

D.2 This trouble occurred when relay CR released faster than relay OT in the

line, link and marker circuit. Relay OT operated prevented relay S from holding operated over the station loop when relay CR released. Relay S normal prevented the operation of relay BCH which allowed relays BC and OT to release. Relay BC normal removed the 100 ohm ground from lead S1 causing the connection between this circuit and the station to release.

D.3 FS3 is changed to correct this trouble condition by adding contact 9 break of relay RT in series with contact 8 break of the S relays to prevent the operation of relay OT in the line, link and marker circuit.

BELL TELEPHONE LABORATORIES, INCORPORATED

(WECO 7120HW-WES-JGW)
DEPT 5337-LAH

CIRCUIT DESCRIPTION--

CD-66909-01
ISSUE 2D
APPENDIX 1B
DWG ISSUE 7B

PBX SYSTEMS
NO. 756A
STATION DIAL TRANSFER
CONTROLLER CIRCUIT

CHANGES

B. Changes in Apparatus

B.1 Added

RCA and RCB diodes, 446F, App Fig. 1, option V

D. Description of Changes

- D.1 Option X is designated and rated Mfr Disc. to remove a locking path for relay AR-.
- D.2 Option W is designated and rated Mfr Disc.
- D.3 Option V is added as Standard to prevent a station that flashes for dial tone from being connected to a station that the attendant direct station selects at the same time.
- D.4 Circuit Note 104 is revised to reflect Issue 7B.

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DEPT 3224-WVS-RVL

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PBX SYSTEMS
NO. 756A
STATION DIAL TRANSFER
-CONTROLLER CIRCUIT

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<u>E. Marker Starting and Register Attached</u>	5	1.01 The station dial transfer controller circuit working with the station dial transfer trunk circuit with add-on conference allows any PBX station to transfer an incoming call to any other PBX station (including a station reached by a tie trunk) without the assistance of the attendant.	
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TABLE A - DEFINITIONS OF TERMS

TEPM	DEFINITION
PARTY A	An outside party connected to a PBX station through a central office trunk.
STATION B	A PBX station connected to an outside party A through a central office trunk.
STATION C	A PBX station to which party A requests transfer.
STATION D	A PBX station to which an incoming call is transferred by station C.
CONTROLLER CIRCUIT	Station dial transfer controller circuit. Working with the station dial transfer trunk circuits with add-on conference and associated with the 10 central office trunks.
TRANSFER TRUNK CIRCUIT	Two identical trunk circuits (No. 0 and No. 1) associated with a station C by switching circuits.
SWITCHHOOK FLASH	Operation of switchhook and release in not less than 75 ms nor more than 850 ms.

B. Association of the Controller Circuit With Central Office and Transfer Trunk Circuits

2.02 The station dial transfer controller circuit gives every central office trunk circuit access to both transfer trunk circuits.

2.07 The transfer trunk circuit, when called, obtains control of the transfer call performing all supervisory actions according to the requests made by station B.

2.08 At this point, the controller circuit acts as a connecting means between the central office trunk involved in the transfer call and the transfer trunk circuit.

C. Assignment of Switch Verticals

2.03 The two transfer trunk circuits are permanently assigned to the first two verticals of crossbar switch No. 9. The horizontal of crossbar switch No. 9 are connected in series with the other crossbar switches of the 756A PBX.

2.04 Transfer trunk No. 0 is used as a first choice. If a second station requests transfer, transfer trunk No. 1 is used. In case a third station requests service when both trunks are busy, the controller will direct this call to the attendant.

2.09 Station C is attached at the transfer trunk end and when it hangs up performs the following functions:

- (a) Releases itself from the connection.
- (b) Releases the transfer trunk circuit involved in the operation.
- (c) Releases part of the controller circuit associated with the particular central office trunk circuit.
- (d) Restores the central office trunk circuit to the state which existed before transfer took place.
- (e) Station B and party A are now connected together as they were originally through the central office trunk circuit.

D. Transferring Party A to Another Station

2.05 When station B flashes, the central office trunk involved in this connection activates the controller circuit.

2.06 When the controller is activated, it performs the following functions:

- (a) Obtains a transfer trunk circuit according to the preference circuit, unless both transfer trunks are busy.
- (b) Puts party A on hold at the central office trunk.

2.10 If station B hangs up, it performs the following functions:

- (a) Releases itself from the connection.
- (b) Releases part of the transfer trunk circuit involved in the connection.

- (c) Prepares the transfer trunk circuit for further transferring.
- (d) Releases part of the central office trunk.
- (e) Transfers control of the circuit to station C for further transferring.

E. Second Transfer of Party A

2.11 Assuming party C has hung up, station B and party A are connected through the central office trunk as previously described. Operation of the switchhook by station B will have the same effect as described for the first transfer to a station C.

2.12 Assuming party B has hung up, operation of the switchhook by station C causes the following operations:

- (a) Activates part of the transfer trunk which in turn activates part of the controller circuit.
- (b) Prepares the transfer trunk circuit for subsequent operations.

2.13 When the part of the controller associated with the central office trunk is activated, it performs the following functions:

- (a) Prepares the central office trunk for calling the marker.
- (b) Activates the marker through the central office trunk circuit to connect station C to a dial pulse register.
- (c) Returns dial tone to station C.
- (d) Prepares to repeat the dialing of station C into the dial pulse register. Station C may now dial the number of station D.

2.14 When dialing is completed, the marker functions to connect station D to station C through the central office trunk, part of the controller circuit, and through the transfer trunk circuit.

2.15 If station D hangs up, it performs the following functions:

- (a) Releases itself from the connection.
- (b) Releases part of the transfer trunk circuit involved in connecting itself.
- (c) Releases part of the controller circuit, which in turn restores the central office trunk circuit to the state which existed before station C flashed the switchhook.
- (d) After station D hangs up, operation of the switchhook by station C will have

the same effect as described for the second transfer to a station D.

2.16 When station C hangs up the following release actions are performed:

- (a) Releases itself from the connection.
- (b) Releases the transfer trunk circuit.
- (c) Releases part of the controller circuit associated with the particular central office trunk circuit.
- (d) Restores the central office trunk circuit to the state which existed before transferring took place.

2.17 Calling the attendant from any PBX station during transfer is done by dialing zero. The transfer trunk circuit activates the marker which in turn abandons the call to an attendant trunk setting up a station recall condition to the attendant. The red lamp associated with the particular central office trunk circuit flashes at 120 ipm and continuous ringing is applied.

SECTION II - DETAILED DESCRIPTION

1. GENERAL

1.01 When the dial transfer feature is provided, an incoming trunk call is first terminated on the called PBX station or tie line by the PBX attendant using normal procedure.

1.02 If the terminating station is reached by tie line, a switchhook flash at the distant PBX station results in a flashing recall signal at the attendant position.

1.03 When the trunk call is terminated on a local PBX station, a switchhook flash results in dial tone to the station. Transfer to another station or tie line is effected without recalling the attendant.

1.04 When necessary, the PBX attendant may be recalled to a trunk terminated on a local PBX station by dialing 0. This results in a flashing recall signal to the attendant.

2. FIRST TRANSFER OF PARTY A - STATION B TRANSFERS TO STATION C (SC11)

A. Controller Circuit Attached to Central Office Trunk No. 0

2.01 Assume an established talking connection between party A and station B through the central office trunk No. 0. Also assume that transfer trunk circuit No. 0 is idle. Station B depresses the switchhook momentarily.

2.02 Relay S in the central office trunk follows the operation of the switchhook. The central office trunk functions identically as

in station recall, grounding the TPO lead and so operating relay TPO.

2.03 Relay TPO operated:

- (a) Locks through its own contact under control of relays FF and DR in the central office trunk.
- (b) Prepares operating paths for relays TOA and TOB.
- (c) Operates relay GP.

2.04 Relay GP operated:

- (a) Prevents starting other transfers while the controller is in the process of obtaining a transfer trunk circuit.
- (b) Operates relay TOA.

B. Transfer Trunk Circuit No. 0 Attached

2.05 Relay TOA operated:

- (a) Operates relay STB in transfer trunk circuit No. 0 through the contacts of relay CT7 in the transfer trunk circuit and TPO in the controller circuit.
- (b) Operates relay TRO through the same path.
- (c) Prepares operating paths for relays STO and ARO.
- (d) Prepares a path for transferring control of the central office trunk.
- (e) Prepares operating paths for relays RLBY, MCA, MCR, and RLD in the transfer trunk circuit.
- (f) Prepares paths for connecting station B to the transfer trunk circuit.
- (g) Prepares a path for calling in party A.

2.06 Relay STB operated in the transfer trunk circuit proceeds to activate the transfer trunk circuit and together with the controller circuit activates the marker for establishing dial tone.

2.07 Relay TFO operated:

- (a) Provides a holding path for party A.
- (b) Connects station B to the transfer trunk circuit and splits the central office trunk.
- (c) Releases relay FF in the central office trunk.
- (d) Transfers control of the central office trunk to the transfer trunk circuit.

- (e) Operates relay B in the transfer trunk circuit under control of relay MCR in the same circuit.

2.08 Relay FF released in the central office trunk:

- (a) Releases relay DR in the central office trunk.
- (b) Removes ground from the starting lead, releasing relay TPO.

2.09 Relay TPO released:

- (a) Permits other central office trunks to request transfer through station B when relay GP is released.
- (b) Releases relay GP.

C. Controller Circuit Attached to Central Office Trunk No. 1

2.10 Assume an established talking connection between party A and station B through another central office trunk No. 1. Also assume that transfer trunk No. 0 is busy through central office trunk No. 0. Party B depresses the switchhook momentarily.

2.11 Relay S in the central office trunk follows the operation of the switchhook. The central office trunk functions identically as in station recall grounding the TP1 lead and thereby operating relay TP1.

2.12 Relay TP1 operated:

- (a) Locks through its own contact under control of relays FF and DR in the central office trunk.
- (b) Prepares operating paths for relays T1A and T1B.
- (c) Operates relay GP.

2.13 Relay GP operated:

- (a) Prevents starting other transfers while the controller is in the process of obtaining a transfer trunk circuit.
- (b) Operates relay T1B.

D. Transfer Trunk Circuit No. 1 Attached

2.14 Relay T1B operated:

- (a) Operates relay STB in transfer trunk circuit No. 1 through the contacts of relay CT2 in the transfer trunk circuit and TP1 in the controller circuit.
- (b) Operates relay TR1 through the same path.
- (c) Prepares operating paths for relays ST1 and AR1.

- (d) Prepares a path for transferring control of the central office trunk.
- (e) Prepares operating paths for relays RLRY, RLDT, MCA, and MCB in the transfer trunk circuit.
- (f) Prepares paths for connecting station B to the transfer trunk circuit.
- (g) Prepares a path for calling in party A.

2.15 Relay STB operated in the transfer trunk circuit No. 1 proceeds to activate the transfer trunk circuit and together with the controller circuit activates the marker for establishing dial tone.

2.16 Relay TP1 operated:

- (a) Provides a holding path for party A.
- (b) Connects station B to the transfer trunk and splits central office trunk No. 1.
- (c) Releases relay FF in central office trunk No. 1.
- (d) Transfers control of the central office trunk to the transfer trunk circuit.
- (e) Operates relay B in transfer trunk No. 1 under control of relay MCB in the same circuit.

2.17 Relay FF released in central office trunk No. 1:

- (a) Releases relay DR in the central office trunk.
- (b) Removes ground from the starting lead, releasing relay TP1.

2.18 Relay TP1 released:

- (a) Permits other central office trunks to request transfer through station B when relay GP is released.
- (b) Releases relay GP.

E. Marker Starting and Register Attached

2.19 The transfer trunk circuit activates the marker by operating relay TP1 for the purpose of obtaining a dial pulse register. In the process of obtaining the register, relay TRP1 in the marker operates. This operates relay TRT1.

2.20 Controller relay TRT1 operated:

- (a) Prepares operating paths for marker relays U9 and U8.
- (b) Operates relay S4C9.

- (c) Prepares operating paths for relay HM in the transfer trunk circuits and hold magnets THM90 and THM91.
- (d) Prevents register relay AC from operating.

2.21 In the sequence of operation, marker relay SMPAB operates, operating relay HM in the transfer trunk circuit and hold magnet THM90. Relay HM operated in the transfer trunk circuit directs subsequent requests for transfer to station dial transfer trunk circuit No. 1.

3. STATION B DISPOSES OF DIAL TONE, PARTIAL DIAL, NO ANSWER, BUSY, OR 120-IPM TONE (SC2)

3.01 If station B has received dial tone or 120-ipm tone or the called station C is busy or does not answer, the call may be cancelled and station B may return to party A by flashing the switchhook.

3.02 When station B depresses the switchhook, the transfer trunk circuit proceeds to release the connection by operating relay RLS in the transfer trunk circuit.

3.03 Transfer trunk relay RLS operated releases transfer trunk relay STB performing the following functions:

- (a) Releases relays TOA and TRO.
- (b) Releases hold magnet TH90.
- (c) Releases the transfer trunk circuit and thereby makes it available for subsequent requests for transfer.

4. STATION B RECALLS THE ATTENDANT (SC3)

4.01 Station B may recall the attendant by dialing zero. The transfer trunk circuit activates the controller circuit which in turn flashes the red lamp associated with the particular central office trunk at 120 ipm signaling the attendant. Continuous ringing is also applied.

4.02 The marker circuit senses the dialing of zero by operating transfer trunk relay DBO through the contacts of marker relay TKBO. Relay DBO operated in the transfer trunk circuit operates controller relay ARO.

4.03 Relay ARO operated:

- (a) Locks under control of relays AC, FF, and SR in the central office trunk 0.
- (b) Flashes the red lamp associated with the central office trunk No. 0 at 120 ipm.
- (c) Prevents relays TPO and STO from operating.

- (d) Applies continuous ringing to signal the attendant.
- (e) Operates relay FF in the central office trunk No. 0. Relay FF operated operates relay DR also in the central office trunk which in turn causes the line lamp at the 6-button key telephone set (if provided) to flash at 120 ipm.

4.04 When the attendant answers the recall by operating the pickup key, central office trunk relay AC operates, releasing relay ARO, and relay FF in the central office trunk No. 0. Relay FF released in trunk No. 0 releases relay DR also in the trunk and transfers the line lamp at the 6-button key telephone set (if provided) from 120 ipm to steady battery.

5. SECOND TRANSFER OF PARTY A - STATION C TRANSFERS TO STATION D. (SC4)

5.01 Assume an established talking connection between party A and station C through transfer trunk No. 0. Also assume that central office trunk No. 0 is involved in this connection. Station C operates the switchhook momentarily.

5.02 The transfer trunk circuit senses the operation of the switchhook by releasing relay CTZ. Transfer trunk relay CTZ releasing operates relay STO in the controller circuit performing the following functions:

- (a) Operates relay HD in the central office trunk.
- (b) Starts the marker through the central office trunk by operating marker relay TRO.
- (c) Prepares an operating path for relays MCA and MCB in the transfer trunk circuit and relay CCC in the marker circuit.
- (d) Operates relay RCO which prevents relay AC in the register from operating.

5.03 Central office trunk relay HD operated prepares the central office trunk for obtaining a dial pulse register and performs the following functions:

- (a) Connects relay SL to the sleeve lead.
- (b) Prepares an operating path for relay TT.
- (c) Locks to off-normal ground.

5.04 Operation of relay TRO in the marker starts the marker for the purpose of obtaining a dial pulse register. In the sequence of operation, the marker obtains a dial pulse register and attaches it to the central office trunk.

5.05 When station C completes dialing the number of station D into the register, the register notifies the marker to connect station D to the central office trunk as it does on any other central office to station call.

5.06 When the called station D answers, stations C and D can talk to each other but not to party A. Station C or D can call in party A by flashing the switchhook.

6. STATION C DISPOSES OF DIAL TONE, PARTIAL DIAL, NO ANSWER, BUSY, OR 120-IPM TONE (SC5)

6.01 If station C has received dial tone or 120-ipm tone or the called station D is busy or does not answer, the call may be cancelled and station C may return to party A by flashing the switchhook.

6.02 When station C depresses the switchhook, the transfer trunk circuit releases the connection by operating relay DLBA in the transfer trunk circuit.

6.03 Transfer trunk relay DLBA operated releases central office trunk relays HM, RT, and TLA and hold magnet THM00 restoring central office trunk No. 0 to normal as it was before station C flashed for dial tone.

6.04 At this time, station C is connected to party A through the central office trunk and transfer trunk circuit. Also the dial pulse register is cleared and made available for subsequent calls.

7. STATION C RECALLS THE ATTENDANT. (SC3)

7.01 Station C may recall the attendant by dialing zero. The transfer trunk circuit activates the controller circuit which in turn flashes the red lamp associated with the particular central office trunk at 120 ipm signaling the attendant. Continuous ringing is also applied.

7.02 The marker circuit senses the dialing of zero by operating transfer trunk relay DCO through the contacts of marker relay TKBO. Relay DCO operated in the transfer trunk circuit operates controller relay APO.

7.03 Relay ARO operated:

- (a) Locks under control of relays AC, FF, and SP in the central office trunk No. 0.
- (b) Flashes the red lamp associated with the central office trunk No. 0 at 120 ipm.
- (c) Prevents relays TPO and STO from operating.
- (d) Applies continuous ringing to signal the attendant.

- (c) Operates relay FF in the central office trunk No. 0. Relay FF operated operates relay DR also in the central office trunk which in turn causes the line lamp at the 6-button key telephone set (if provided) to flash at 120 ipm.

7.04 When the attendant answers the recall by operating the pickup key, central office trunk relay AC operates releasing relay ARO, and relay FF in the central office trunk No. 0. Relay FF released in trunk No. 0 releases relay DR also in the trunk and transfers the line lamp at the 6-button key telephone set (if provided) from 120 ipm to steady battery.

8. ALL TRANSFER TRUNKS BUSY (SC6)

8.01 If both transfer trunk circuits are busy and another station requests transfer the call is routed to the attendant.

8.02 Relay GP operated in the controller circuit operates controller relay ATB which in turn operates relay ARO performing the following functions:

- (a) Locks to ground under control of the central office trunk.
- (b) Flashes the red central office trunk lamp at the attendant console at 120 ipm.
- (c) Applies continuous ringing to the attendant.
- (d) Releases controller relay TPO which in turn releases relays GP and ATB.

9. DISCONNECTS

A. After Dialing Zero Station B Disconnects Before Attendant Answers

9.01 If station B hangs up before the attendant answers, the central office trunk releases and the signals at the attendant console disappear.

B. Station C Hangs Up After Answering

9.02 Station C releases from the connection when it hangs up. This also releases the transfer trunk circuit by releasing transfer trunk relay STB.

9.03 When relay STB releases, it releases part of the controller circuit associated with central office trunk No. 0 by releasing relays TOA and TPO.

C. Station B Hangs Up After Station C Has Answered

9.04 When station C has answered station B may release from the connection by hanging up either before or after party A has been

called in. When station B releases, it frees the central office line end and therefore makes it available for subsequent transfers.

9.05 The transfer trunk circuit reacts to the disconnection of station B by operating transfer trunk relay DLBA. Transfer trunk relay DLBA operated releases central office trunk relays HM, RT, and TLA and hold magnet TM400 restoring central office trunk No. 0 to normal as it was after the attendant had answered the incoming call from party A.

D. After Dialing Zero Station C Disconnects Before Attendant Answers

9.06 Disconnection of station C before the attendant answers will cause part of the controller circuit associated with central office trunk No. 0 to release. The transfer trunk circuit will be released and available for subsequent requests for transfer.

9.07 The transfer trunk circuit reacts to disconnection of station C by operating transfer trunk relay DLC. Transfer trunk relay DLC operated releases relay STB in the same circuit. When relay STB releases, it releases the transfer trunk circuit and part of the controller circuit associated with central office trunk No. 0 by releasing relays TOA and TRO.

SECTION III - REFERENCE DATA

1. WORKING LIMITS

1.01 The maximum external loop resistance is 1500 ohms. The minimum insulation resistance is 10,000 ohms.

1.02 Voltage Limits

<u>Minimum</u>	<u>Maximum</u>
-45 volts	-52 volts

2. FUNCTIONAL DESIGNATIONS

<u>Designation</u>	<u>Meaning</u>
AR0-9	Attendant Recall
ATB	All Trunks Busy
GP	Group Preference
RC0, 1	Register Control
SMC9	Select Magnet Connector
T(0-9)A, B	Transfer Trunk Preference
TP0-9	Tens Preference
TR0-9	Transfer
TRT1	Transfer Trunk

SD0-9 Station Transfer

3. FUNCTIONS

3.01 To give every central office trunk access to both station dial transfer trunk circuits.

3.02 To attach a transfer trunk to that part of the controller circuit associated with the particular central office trunk circuit involved in the transfer.

3.03 To prevent interference between simultaneous requests for transfer.

3.04 To transmit dial tone to a transferring station B when a dial pulse register has been attached to a transfer trunk circuit.

3.05 To transmit pulses into the register when pulsing starts after a register is attached.

3.06 To activate the particular central office trunk involved in the transfer for calling a dial pulse register when station C has been attached to the transfer trunk.

3.07 To restore the central office trunk involved in the transfer to normal after station C has hung up.

3.08 To provide means for signaling the attendant when station B or C has dialed zero.

4. CONNECTING CIRCUITS

4.01 When this circuit is listed on a keysheet, the information thereon is to be followed.

4.02 This circuit is connected to the following circuits which are part of the 756A PBX system:

- (a) Line, Link, and Marker Circuit - SD-65741-01.
- (b) Two-Way Central Office Trunk Circuit - SD-65752-01.
- (c) Ringing Circuit - SD-81288-01 and Power Supply Circuit - SD-81326-01 or Power Supply Circuit - SD-81577-01 alone, or Power Supply Circuit - SD-81600-01 alone.
- (d) Station Dial Transfer Trunk Circuit with Add-On Conference - SD-66921-01.
- (e) Cordless Position Circuit - SD-65757-01.

5. MANUFACTURING TESTING REQUIREMENTS

5.01 The station dial transfer controller circuit shall be capable of performing all of

the functions given in this circuit description; the relays with which it is equipped shall meet all requirements of the Circuit Requirements table.

6. ALARM INFORMATION

6.01 An operated fuse supplying the dial transfer controller circuit results in visual and audible signals at the attendant position and in the alarm, transfer, and test circuit. If alarm sending is provided, a major alarm is transmitted to the plant service center.

6.02 Replacing the operated fuse silences the audible alarm and extinguishes the alarm lamps.

7. TAKING EQUIPMENT OUT OF SERVICE

7.01 The station dial transfer controller circuit may be taken out of service by the following procedures in sequence:

- (a) Determine that the circuit is not in use by observing that all relays are released.
- (b) Determine that all central office trunks in the PBX are not in use by observing that all relays are released.
- (c) Block relays TP0-9 released.
- (d) Remove all battery supply fuses.
- (e) Remove all crown plug assemblies associated with this circuit and replace them with connector plug assemblies.

SECTION IV - REASONS FOR REISSUED. Description of Changes

D.1 On sheet B1, the numbering of the off-normal break contacts of trunk hold magnets THM 90 and 91 is changed from 4 and 5 to 1 and 2 to agree with a 324AK switch.

D.2 The value of resistance for the windings of relays ST(0 through 9) is changed from 950 to 2450 ohms.

D.3 Circuit Note 101 is changed to replace fuse C with fuse SDT.

D.4 CAD 1 is changed to show SDT battery and ground in place of C battery and ground.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 3221-WVS-RGP

PBX SYSTEMS
NO. 756A
AUXILIARY POSITION CIRCUIT
FOR REMOTE ANSWERING OF TRUNKS AND
INWARD COMPLETION BY ANY STATION

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<u>SECTION I - GENERAL DESCRIPTION</u>	
1. <u>PURPOSE OF CIRCUIT</u>	
1.01 This circuit enables any PBX station to answer an incoming central office trunk call when the attendant places the PBX on remote trunk answer operation. It also enables the answering station to complete the trunk call to another PBX station.	
2. <u>GENERAL METHOD OF OPERATION</u>	
2.01 In the following general and detailed description the auxiliary position circuit is referred to as the auxiliary circuit.	
2.02 The attendant at a 6-button key telephone set position places the PBX on remote trunk answer operation by operating the remote answer key at the telephone set. If no key telephone set position is provided, the attendant at a console position places the PBX on remote trunk operation by removing the headset or handset cord plugs from the console jacks. Any PBX station can then answer an incoming central office trunk call in the following manner.	
2.03 An incoming trunk call causes the auxiliary circuit to activate externally mounted visual and/or audible signals to indicate that a call is waiting to be answered. Any PBX station may answer the call by dialing the universal line circuit trunk code assigned to the auxiliary circuit.	
2.04 The PBX establishes a connection between the answering station and the trunk call through the auxiliary circuit, and the externally mounted signals restore to normal.	
2.05 The answering station becomes the controlling station for subsequent progress	

of the trunk call. The control station may terminate the call or complete the call to another station.

2.06 To terminate the call the control station places the receiver on the switchhook. This action releases the auxiliary circuit which is ready to serve another trunk call.

2.07 To complete the call to another station, the control station flashes the switchhook once. This action causes the PBX to return dial tone to the control station. The control station dials the called station and the PBX rings the called station.

2.08 A connection is established between the two stations when the called station answers. The control station determines whether the trunk call is to be completed to the called station, and if it is, places the receiver on the switchhook.

2.09 This action causes the PBX to connect the called station to the trunk call and to release the auxiliary circuit. After a trunk call is answered through the auxiliary circuit and the control station hangs up, it is not possible to again gain access to that call through the auxiliary circuit.

2.10 The control station can return to the trunk call when call-blocked conditions are encountered (busy line, no answer, etc) by flashing the switchhook once. This action causes the PBX to release the destination to which the control station is connected and return the control station to the trunk call.

2.11 When using the flexible night connection feature of the trunks, the attendant must set up the night connections before placing the PBX on remote answer operation. Incoming calls to night-connected trunks will not activate the remote answer signal.

2.12 If the PBX establishes a connection between the auxiliary circuit and a station when the PBX is not on remote answer, busy tone is returned to the station.

SECTION II - DETAILED DESCRIPTION

1. ATTENDANT ESTABLISHES REMOTE ANSWER CONNECTIONS FOR CENTRAL OFFICE TRUNKS (SC1)

1.01 When the PBX is not provided with a 6-button key telephone set attendant position, the attendant at a console position places the PBX on remote answer by removing the headset or handset cord plugs from the console jacks. When the PBX is provided with a key telephone set position and attendant operation has been transferred to it, the attendant at the key telephone set position places the PBX on remote answer by operating the remote answer key.

1.02 Placing the PBX on remote answer operation causes the transfer of a group of position circuit leads to the auxiliary circuit and disables the flexible night connection feature of the trunks that the attendant has not placed on night connections.

1.03 The action of the attendant placing the PBX on remote answer connects ground to lead RA to operate relay RA.

1.04 Relay RA operated operates relay RAC and prepares the operate path for relay SIG.

1.05 Relay RAC operated:

- (a) Operates relay BN.
- (b) Transfers leads TT, TR, and ACG to the auxiliary circuit to transfer control of incoming trunk calls from the console to the auxiliary circuit.
- (c) Prepares the operate paths for the LO-relays by connecting battery to their windings.
- (d) Prepares the operate path for relay LOE.
- (e) Prepares a path to connect ground to lead H toward the console.
- (f) Opens one path between leads HD and HD1.
- (f) Opens one path between leads HD and HD1.
- (g) Prepares paths to operate the COSA and COSB relays in the marker.
- (h) Opens the paths that supply busy tone from lead BT to stations connected to the auxiliary circuit when the PBX is not on remote answer.
- (i) Prepares its own locking path so it will remain operated if a call is in progress through the auxiliary circuit when the attendant again takes control of incoming trunk calls and relay RA releases.

1.06 Relay BN operated opens the operate paths for relays NC and trunk relays N1. This disables the flexible night connection feature of the trunks that the attendant has not previously placed on night connections.

2. INCOMING CALL TO A CENTRAL OFFICE TRUNK (SC2)

2.01 When the central office trunk for an incoming call, the trunk signals the auxiliary circuit which operates externally mounted signals to notify the PBX that a call is waiting.

2.02 An incoming call causes trunk relays R and SR to operate. The operation of these

relays connects ground to the LO- lead associated with that trunk. Each LO- lead provides the operating path for the corresponding LO- relay. These relays determine which trunk will be served first and insure that only one trunk will be served at a time. Assuming that the only trunk requesting this circuit is trunk 0, the ground connected to lead LOO operates relay LOO.

2.03 Relay LOO operated:

- (a) Operates relay SIG.
- (b) Prepares a path to operate trunk relay ACA through lead ACAO.
- (c) Opens the path supplying battery to the windings of all other LO relays. Corresponding contacts on the other LO relays are so arranged that the operation of any LO relay will open the path supplying battery to the windings of all higher numbered LO relays.
- (d) Prepares its own locking path so it will remain operated after the call is answered; the trunk removes ground from lead LOO. Corresponding contacts on the other LO relays are so arranged that only the highest numbered LO relay operated will remain operated after the call is answered.
- (e) Prepares a locking path for relay ON.
- (f) Prepares the operate path for relay RTR.

2.04 Relay SIG in operating closes paths to operate externally mounted signals to notify the PBX that a call is waiting.

3. CALLING PARTY DISCONNECTS BEFORE CALL IS ANSWERED (SC3)

3.01 Trunk 0, relay SR, releases if the party calling the PBX disconnects before the call is answered. Relay SR released removes ground from the LOO lead allowing relay LOO to release. Relay LOO released releases relay SIG which restores the externally mounted signals to normal.

4. INCOMING CALL ANSWERED FROM A PBX STATION (SC4)

4.01 The universal line circuit trunk code assigned to the auxiliary circuit is dialed from any station in the PBX to answer a trunk call. After the marker establishes a connection between the PBX station and the auxiliary circuit, the auxiliary circuit signals the trunk to complete a connection between the trunk and the auxiliary circuit through the cordless position circuit. The auxiliary circuit completes a loop to trip central office ringing and completes the talking path between the answering station and the trunk call.

4.02 When the trunk answering code is dialed from a PBX station, the marker establishes the call in the normal manner and relay A operates through the loop from the station apparatus. Relay A supplies talking battery to the answering station.

4.03 Relay A operated:

- (a) Operates relay B.
- (b) Provides an additional open in the operate path for relay C.
- (c) Closes the dial pulse repeating contacts in the loop to leads TT and TR.

4.04 Relay B operated:

- (a) Closes the locking path through lead S2 for line relay OT-- to hold relay OT-- operated after the marker releases. Relay OT-- operates and maintains the connection to the answering station.
- (b) Operates relay ON.
- (c) Provides an additional open in the relay F operate path.
- (d) Prepares the operate path for relay H.
- (e) Opens the path across the relay A dial pulse repeating contacts in the loop to leads TT and TR.
- (f) Opens the operate path via thermistor RL for relay RL.

4.05 Relay ON operated:

- (a) Operates relay LOE.
- (b) Closes a locking path for relay LOO. The locking circuit of the LO- relays is so arranged that only the highest numbered LO- relay operated will be held operated.
- (c) Opens the operate path for relay SIG. Relay SIG releases and restores the externally mounted signals to normal.
- (d) Supplements the locking path for relay RAC.
- (e) Provides an additional ground path to lead S2 to hold the connection to the answering station when relay B releases during switchhook flashes.
- (f) Provides an off-normal ground for this circuit.
- (g) Prepares the operate path for relay C.
- (h) Prepares the path that supplies busy tone to a station connected to the auxiliary circuit when the PBX is not on remote answer operation.

4.06 Relay LOE operated:

- (a) Opens the operate paths of the LO-relays.
- (b) Closes through the path between leads AG and ACAO to operate trunk relay ACA.

4.07 Relay ACA operated completes the paths from the tip and ring of the central office end of the trunk to leads TT and TR of the auxiliary circuit through the cordless position circuit. Central office ringing is tripped through the loop formed by the A repeat coil across leads TT and TR. The A repeat coil completes the talking path between the answering station and the trunk call. The answering station becomes the controlling station for further progress of the call.

5. CONTROL STATION DISCONNECTS TO TERMINATE CALL WITHOUT TRANSFER (SC5)

5.01 If the control station determines that the call is not to be completed to another station, the control station can terminate the call by placing the receiver on hook. This action drops the connection to the control station and signals the trunk to release the connection to the cordless position circuit.

5.02 The operation of the switchhook when the control station hangs up opens the loop from the station and thus releases relay A.

5.03 Relay A released:

- (a) Starts the slow-release of relay B.
- (b) Opens the loop across leads TT and TR toward the central office end of the trunk.
- (c) Operates relay C.

5.04 Relay C operated:

- (a) Closes an additional locking path for relay LOO.
- (b) Closes a path across its secondary winding to increase its release time.
- (c) Prepares the operate path for relay F.
- (d) Closes a path across the A repeat coil windings and resistor A in loop toward leads TT and TR.
- (e) Prepares its own locking path.
- (f) Opens the discharge path of the A capacitor through the A relay.

Functions (c), (d), and (e) are not necessary to this sequence of operations.

5.05 Relay B released:

- (a) Starts slow-operation of relay RL via thermistor RL.
- (b) Closes the loop across leads TT and TR toward the central office end of the trunk.
- (c) Opens the operate path for relay ON. Relay ON remains locked operated under control of relay LOO.
- (d) Opens the original locking path for line relay OT--. Relay OT-- remains locked operated to lead S2 under control of relay ON.
- (e) Operates relay F.

5.06 Relay F operated performs no useful function in this sequence of operations. Relay RL operates after a time interval determined by thermistor RL.

5.07 Relay RL operated:

- (a) Starts the slow-release of relay C.
- (b) Provides an additional ground path to lead S2.
- (c) Closes a path across thermistor RL to allow it to cool.
- (d) Opens the loop across leads TT and TR toward the central office end of the trunk. This causes the trunk to release in a manner similar to that which occurs when the attendant disconnects after answering an incoming call signal.
- (e) Supplements the original operate path for relay LOE.
- (f) Opens the original locking path for relay LOO. Relay LOO remains locked operated under control of relay C.
- (g) Prepares the operate path for relay H.
- (h) Prepares the operate path for relay RTK.
- (i) Opens the path between leads HD and HD1.

Functions (g), (h), and (i) are not necessary to this sequence of operations.

5.08 Relay C released releases relays F and LOO. Relay LOO released releases relay ON and opens the path between leads ACG and ACAO, allowing trunk 0, relay AC to release.

5.09 Trunk relay AC released causes the trunk to disconnect the tip and ring of the central office end of the trunk from the cordless position circuit. Relay ON released releases relay RL.

5.10 Relay RL released:

- (a) Opens the ground path to lead S2 allowing line relay OT-- to release. This releases the connection to the control station.
- (b) Releases relay LOE.

5.11 Relay LOE released reconnects the LO relays to their corresponding trunks and the auxiliary circuit is again ready to receive an indication of another trunk call.

6. CONTROL STATION ESTABLISHES DIAL TONE CONNECTION (SC6)

6.01 After a trunk call has been answered through the auxiliary circuit and the control station has determined that the call is to be completed to another station, the control station obtains a dial tone connection by flashing the switchhook once. When this signal is received, the auxiliary circuit signals the cordless position circuit which seizes the marker through the trunk. The marker connects a register to the trunk, establishing a dial tone connection to the control station through the crossbar switches, the trunk, the cordless position circuit, and the auxiliary circuit.

6.02 Depressing the switchhook opens the station loop releasing relay A. Relay A released:

- (a) Starts the slow-release of relay B.
- (b) Operates relay C.
- (c) Opens the loop through leads TT and TR toward the central office end of the trunk.

6.03 Relay C operated prepares the operate path for relay F. Relay B is slow to release so that it will not release when relay A releases and operates during dial pulsing.

6.04 Relay B released:

- (a) Operates relay F.
- (b) Closes the loop through leads TT and TR toward the central office end of the trunk.
- (c) Starts the slow-operation of relay RL via thermistor RL.

6.05 Relay F operated:

- (a) Prepares the operate path for relay H.
- (b) Closes its own locking path to off-normal normal ground under control of relay C.

6.06 Releasing the switchhook closes the station loop, operating relay A.

6.07 Relay A operated:

- (a) Operates relay B.
- (b) Starts the slow-release of relay C.
- (c) Prepares a path to repeat dial pulses to the register in the loop to leads TT and TR.

6.08 Relay B operated:

- (a) Operates relay H.
- (b) Opens the operate path for relay RL via thermistor RL. Relay RL will not operate during the interval in which the relay B is released as the result of a switchhook flash.

6.09 Relay H operated:

- (a) Operates cordless position circuit relay H via lead H.
- (b) Provides an additional open in the locking path for relay C.
- (c) Provides an additional locking path for relay LOO.

Functions (b) and (c) are not necessary to this sequence of operations.

6.10 Cordless position circuit relay H operated causes the trunk to disconnect the loop across leads TT and TR from the central office end of the trunk and to hold the trunk call. Relay C is slow-released to allow time for relays in the trunk and cordless position circuit to operate.

6.11 Relay C released releases relay F; relay F released releases relay H; relay H released releases cordless position circuit relay H.

6.12 Cordless position circuit relay H released causes the trunk to seize the marker and the marker establishes a connection between the register and the line end of the trunk. Register relay L operates through the loop completed by the A repeat coil to leads TT and TR. Dial tone from the register is transmitted to the control station through the A repeat coil.

7. CONTROL STATION DIALS AN IDLE STATION (SC7)

7.01 The control station dials the called station after receiving dial tone as described in the preceding section. The auxiliary circuit repeats the dial pulses to the register. When dialing is completed, the register seizes the marker. The marker establishes a connection between the trunk and the called station and releases the register connection to the trunk. The trunk applies ringing current to the called station and audible ringing feedback is transmitted to

the control station as an indication that the called station is being rung.

7.02 Relay A releases and reoperates as the station loop is opened and closed by the control station dial. Relay A releasing and reoperating opens and closes the loop to leads TT and TR. This loop provides the operate path for register relay L which follows the dial pulses. Relay C operates when relay A releases at the start of the first dial pulse of the digit dialed. Slow-release relay C remains operated during the interval between further dial pulses of the digit dialed, short-circuits the windings of the A repeat coil and the A resistor in the pulsing loop, and opens the discharge path of the A capacitor through the A relay.

8. CALLED STATION ANSWERS AND CONTROL STATION TRANSFERS CALLED STATION TO TRUNK CALL (SC8)

8.01 When the called station answers, a talking path is completed between the called station and the control station through the auxiliary circuit. If the control station determines that the called station is to be transferred to the trunk call, the control station hangs up. This action causes the auxiliary circuit to signal the trunk which completes the trunk call to the called station through the trunk. The auxiliary circuit releases the connection to the control station and is ready to receive an indication of another incoming trunk call.

8.02 Trunk relay RT operates when the called station answers. Trunk relay RT operated opens the operate path for relay RTK to prevent the release of the called station connection when the control station hangs up. Trunk relay RT operated releases trunk relay RS. Trunk relay RS released completes the talking path between the called station and the control station through repeat coil A.

8.03 The control station hangs up if the trunk call is to be completed to the called station. This action opens the station loop, releasing relay A. Relay A released operates relay C and opens the operate path for slow-release relay B. Relay C operated closes an additional locking path for relay LOO and prepares the operate path for relay F.

8.04 Relay B released closes ground through to thermistor RL to start release timing.

8.05 Relay RL operates after a time interval determined by thermistor RL. Relay RL operated opens the operate path for slow-release relay C. Relay C released releases relay LOO.

8.06 Relay LOO released releases relay ON and opens the path between leads ACG and ACAO, allowing trunk 0, relay AC to release.

8.07 Trunk relay AC released connects the line end of the trunk (called station) to the central office end of the trunk (trunk call). The trunk functions to disconnect from and release the cordless position circuit.

8.08 Relays ON, RL, and LOE release and function as described in the section covering disconnect of control station without transfer.

9. CONTROL STATION RETURNS TO TRUNK CALL (SC9)

9.01 The control station returns to the trunk call by flashing the switchhook once if, while attempting to transfer to another station, a call-blocked condition (busy tone, no answer, etc) is encountered; or if, after the called station answers, it is determined that trunk call completion to that station is not required.

9.02 Relay A is released by depressing the switchhook. Relay A released starts the slow-release of relay B and operates relay C. Relay C operated prepares the operate path for relay F.

9.03 Relay B released operates relay F. Relay F prepares the operate path for relay H.

9.04 Releasing the switchhook reoperates relay A. Relay A operated starts the slow-release of relay C and operates relay B.

9.05 Relay B operates relay H. Relay H operates cordless position circuit relay F.

9.06 Relay C released releases relay F, relay H, and cordless position circuit relay H in that order.

9.07 The operation and release of cordless position circuit relay H causes the PBX to release the connection to the line end of the trunk and to again complete the talking path between the control station and the central office end of the trunk.

10. CONTROL STATION DISCONNECTS WITHOUT RELEASING LINE END TRUNK CONNECTION (SC10)

10.01 If the control station encounters a call-blocked condition while attempting to transfer the trunk call the control station should return to the trunk call to advise the calling party of the call-blocked condition. If in error the control station hangs up the auxiliary circuit functions to cause the release of the destination connected to the line end of the trunk, to disconnect from the trunk, and to release the connection to the control station. It is not possible to again gain access to this trunk call through the auxiliary circuit.

10.02 The release of the switchhook when the control station hangs up opens the loop from the station apparatus releasing relay A.

10.03 Relay A released starts the release of slow-release relay B and operates relay C.

10.04 Relay C operated:

- (a) Closes an additional locking path for relay LOO.
- (b) Prepares the operate path for relay F.
- (c) Prepares its own locking path.

10.05 Relay B released starts the operation of relay RL via thermistor RL and operates relay F.

10.06 Relay F operated prepares the operate path for relay H and locks operated to off-normal ground under control of relay C.

10.07 Relay RL operates after a time interval determined by thermistor RL and performs the following functions:

- (a) Operates relay RTK from ground supplied by trunk relay HM operated.
- (b) Prepares the operate path for relay H.
- (c) Opens the path between leads HD and HD1 to prevent the trunk from holding the trunk call when both registers are busy.

10.08 Relay RTK operated operates relay H and holds relay C operated.

10.09 Relay H operated:

- (a) Grounds lead H to operate cordless position circuit relay H.
- (b) Releases relay C.
- (c) Provides an additional locking path holding relay F operated. Relay F released opens the operate path for relay H.

10.10 Relay C released releases relay F which releases relay H.

10.11 Relay H released releases relay LOO and cordless position circuit relay H.

10.12 The operation and release of cordless position circuit relay H causes the trunk to release the connection that had been established to the line end of the trunk.

10.13 Relay LOO released:

- (a) Releases relay ON.
- (b) Opens the path between leads ACG and ACAO allowing trunk O, relay AC to release.

(c) Releases relay RTK.

10.14 Trunk relay AC released causes the trunk to disconnect the tip and ring of the central office end of the trunk from the cordless position circuit. Relay ON released opens the operate path for relay RL.

10.15 Relay RL released:

- (a) Opens the ground path to lead S2 causing the release of the connection to the control station.
- (b) Releases relay LOE.

10.16 The auxiliary circuit is again ready to receive an indication of another trunk call.

11. ATTENDANT RELEASES REMOTE ANSWER CONNECTIONS (SC11)

11.01 When the attendant takes the PBX off remote trunk answer operation, the cordless position circuit removes ground from lead RA releasing relay RA. The auxiliary circuit either releases at this time or, if a call is in progress, releases when the control station hangs up.

11.02 If no call is in progress through the auxiliary circuit, relay RA released releases relays RAC and BN in sequence.

11.03 If a call is in progress through the auxiliary circuit, relay RAC releases when relay ON releases after the control station hangs up. Relay RAC released releases relay BN.

12. ATTENDANT ESTABLISHES TRUNK FLEXIBLE NIGHT CONNECTION (SC12)

12.01 The attendant must establish any trunk flexible night connections that are required before placing the PBX on remote answer. The auxiliary circuit functions to open the incoming call signal path from the trunk to the auxiliary circuit as each night connection is set up. Incoming calls to night-connected trunks will not cause the auxiliary circuit to function to operate the associated signal equipment if the PBX is then placed on remote answer.

12.02 When the attendant places the PBX on night service, the PBX functions to open the ground path to lead NSA allowing relay NSA to release.

12.03 Relay NSA released prepares the operate paths for the NC0 through 9 relays. When the attendant establishes a night connection to a trunk, a ground path is closed to the ACA lead corresponding to that trunk. This path completes the operate path for trunk relay N1 and the corresponding NC relay in the auxiliary circuit.

12.04 Relay NC operated:

- (a) Closes its own locking path under control of relay NSA.
- (b) Opens the operate path of the correspondingly numbered LO- relay. This prevents the LO- relay from operating when the trunk is seized for an incoming call after the PBX is placed on remote answering.

BN	Block Night Connection
C	Historical
F	Flash
H	Hold
LO	Lockout
LOE	Lockout End
NC	Night Connection
NSA	Night Service Auxiliary
ON	Off-Normal
RA	Remote Answer
RAC	Remote Answer Connect
RL	Release
RTK	Release Trunk
SIG	Signal

13. CONTROL STATION DIALS A BUSY STATION

13.01 When the control station attempts to complete the trunk call to a busy station, the marker signals the trunk to return busy tone to the control station and not to camp-on the busy station.

13.02 Relay RAC operated prepares paths to operate the marker COSA and COSB relays to enable the marker to function as described above.

14. MISCELLANEOUS FEATURES

14.01 This circuit is not designed to complete an incoming central office call through a dial repeating tie trunk.

14.02 Option V provides for a continuous activation of the remote answer signal when incoming trunk calls are waiting to be answered and the auxiliary position circuit is busy.

14.03 Option T provides for the restoration of the remote trunk answer feature when power is restored after a power failure.

SECTION III - REFERENCE DATA

1. WORKING LIMITS

1.01 Maximum external loop resistance - A relay - 3300 ohms

1.02 Minimum insulation resistance - 10,000 ohms

1.03 Voltage Limits

Potential	Minimum	Maximum
-48 volts	-45 volts	-52 volts

2. FUNCTIONAL DESIGNATIONS

2.01 Relays

Designation	Meaning
A	Historical
B	Historical

3. FUNCTIONS

3.01 To receive indications of several simultaneous incoming trunk calls but serve them one at a time.

3.02 To enable an incoming trunk call to activate externally mounted signaling equipment to notify the PBX that a call is waiting.

3.03 To enable any station in the PBX (control station) to answer a trunk call by dialing the trunk code of the miscellaneous trunk termination assigned to this circuit.

3.04 To enable the control station to complete the trunk call to another PBX station.

3.05 To distinguish between control station dial pulses, switchhook flashes, and hang-up, and to use these indications to control the progress of the trunk call.

3.06 To restore the remote trunk answer feature after a power failure.

3.07 To provide continuous activation of the remote trunk answer signal when incoming trunk calls are waiting to be answered and the auxiliary position circuit is busy.

4. CONNECTING CIRCUITS

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

- (a) Line, Link, and Marker Circuit - SD-65741-01

- (b) 756A PBX Cabling Diagram - SD-65746-01
- (c) Two-Way Trunk Circuit to Central Office - SD-65752-01
- (d) Cordless Position Circuit - SD-65757-01
- (e) Alarm, Transfer, and Test Circuit - SD-66796-01
- (f) 756A PBX Feature Cabling Diagram - SD-66920-01
- (g) Power Supply Circuit - SD-81326-01
- (h) Power Supply Circuit - SD-81600-01

SECTION IV - REASONS FOR REISSUE

A. Changed and Added Functions

A.1 Provides for the continuous activation of the remote trunk answer signal when incoming trunk calls are waiting to be answered and the auxiliary position circuit is busy.

A.2 Provides for the restoration of the remote trunk answer feature when power is restored after a power failure.

B. Changes in Apparatus

B.1 Added

CW(0-9) diodes,
446P, App Fig. 1,
option V

5. MANUFACTURING TESTING REQUIREMENTS

5.01 This circuit shall be capable of performing all the service functions specified in this circuit description and of meeting all the requirements of the Circuit Requirements table.

6. TAKING EQUIPMENT OUT OF SERVICE

6.01 To take this equipment out of service, block the RA relay nonoperated and make the line circuit assigned to the auxiliary position circuit busy as specified in the circuit description covering the line, link, and marker circuit.

D. Description of Changes

D.1 The apparatus index is revised to show diodes CW(0-9).

D.2 Options V and T are added to the option index.

D.3 Options V and T are added as Standard.

D.4 Option V is added to Circuit Note 102.

D.5 Circuit Note 104 is revised to reflect Issue 5D.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 3221-WVS-RGP

PBX SYSTEMS
NO. 756A
BUSY VERIFICATION
AUXILIARY TRUNK CIRCUIT

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SECTION I - GENERAL DESCRIPTION1. PURPOSE OF CIRCUIT

1.01 The busy verification auxiliary trunk provides a method, auxiliary to attendant trunk 2, for establishing a talking connection between a PBX attendant and an idle, busy, or busy and camped-on station.

2. GENERAL DESCRIPTION OF OPERATIONA. General

2.01 The busy verification feature is associated with attendant trunk 2 only. It is activated by first operating the pick-up key for attendant trunk 2 and then operating the associated DIAL BACK key.

2.02 Operation of the DIAL BACK key causes insertion of the busy verification auxiliary trunk circuit between the attendant trunk and the marker and also transfers the tens-units registration of the attendant trunk to U0.

2.03 Transfer of tens-units registration to U0 gives the busy verification circuit a trunk class of service during marker action so that a connection may be established to a busy station.

2.04 Connections between the marker and the busy verification circuits are arranged to ignore the camp-on stop action of the marker so that a connection may be established to a station which is busy and

camped on.

3. Attendant Action

2.05 Activation of the busy verification feature by operation of the pickup and DIAL BACK keys results in the attachment of a register and return of dial tone to attendant.

2.06 With the register attached, the attendant dials the number of the station to be verified. Because of the trunk class indication and disregard of camp-on stop signals, the attendant is connected to the station regardless of an idle, busy, or busy and camped-on condition.

2.07 With a connection established to an idle station, the busy verification circuit furnishes ringing and, when the station answers, furnishes talking battery.

2.08 When the connection is established to a busy or busy and camped-on station, the attendant's taking path bridges the busy circuit through capacitors and neither ringing supply nor talking battery is furnished.

2.09 If option Z is provided, cut-through by the busy verification auxiliary trunk to a busy station activates a warning tone generator. This applies periodic spurts of tone (beeps) to the busy circuit as a warning that the attendant has established a monitoring connection.

2.10 With option R, the attendant will be able to talk on a busy connection.

SECTION II - DETAILED DESCRIPTION

1. SELECTION AND DIALING (SC1)

A. General

1.01 Attendant trunk 2 is picked up by operating the associated pickup key in the cordless position circuit. This results in the attachment of the marker, and in the case of marker action, attachment of a dial pulse register. At this time the attendant trunk functions as if the busy verification auxiliary trunk features were not provided.

1.02 If after operation of the pickup key, the attendant momentarily operates the DIAL BACK key. Talking and control circuits between the marker and attendant trunk 2 are rerouted via the busy verification auxiliary trunk circuit to provide busy verification features.

B. Activating Busy Verification Auxiliary Trunk

1.03 Momentary operation of the cordless position circuit DIAL BACK key operates relay NT in the cordless position circuit. This operates relay ST which performs the following functions:

- (a) Locks operated via released relay HM and operated relay ON in the attendant trunk circuit.
- (b) Operates relays BV and MKBV.

1.04 Relay BV operated:

- (a) Releases relay OUT in the attendant trunk circuit.
- (b) Transfers marker lead S from the attendant trunk circuit to a path for operating relay SL via released relays BY, RS, and RT.
- (c) Prepares locking paths for relays EY, RS, RT, and HM.
- (d) Locks via relay AC in the attendant trunk circuit.
- (e) Releases trunk hold magnet THM06 which releases the register.
- (f) Opens lead U6 to the marker and connects lead U6 of attendant trunk 2 to marker lead U0 via relay HM released.
- (g) Opens attendant trunk circuit lead IT07 to the marker and prepares a new operating path for trunk hold magnet THM06.
- (h) Opens lead NN to the marker, preventing the operation of relay IR-- in the inward restriction circuit, when the called station is inward restricted (option V).
- (i) Provides ground to the tone generator to make it operate as a free running generator.

1.05 Relay MKBV operated:

- (a) Opens marker lead ST90-1 preventing central office trunk 0 from being seized by the marker while the busy verification connection is being set up.
- (b) Prepares a path for operating relay HM and trunk hold magnet THM06 from marker lead ST90-1.

- (c) Locks to ground on marker lead LK.

C. Marker Action

- 1.06 Release of magnet THM06 operates marker relay TRO starting marker action. With marker relay U0 operated, relay COT in the dial pulse register will operate. This establishes a trunk class for the busy verification call.
- 1.07 In completing a connection to a register, the marker applies ground to lead ST90-1. This operates relay HM and reoperates magnet THM06.
- 1.08 Relay HM operated:
 - (a) Opens lead U0 to the marker.
 - (b) Opens the original operating path for relay MKBV.
 - (c) Releases relay ST.
 - (d) Locks operated via released relay MC and operated relay BV.
- 1.09 When a connection between the attendant trunk and the dial pulse register is established, the marker releases and relay SL is held operated by a 100-ohm ground from the dial pulse register circuit.
- 1.10 Relay SL operated prepares a path for operating relay P in the ring lead of the trunk circuit.
- 1.11 When attachment of the dial pulse register is completed, the attendant receives dial tone as an indication that dialing may start.
- 1.12 Relays BV, SL, and HM are operated and relays RT, RS, P, ST, MC, BY, and MKBV are released at this time.

2. COMPLETING BUSY VERIFICATION CALL

A. Call to Idle Station (SC2)

- 2.01 When dialing is completed the register recalls the marker. During the marker action which follows, register relay RV is operated, reversing battery and ground to tip and ring, thus operating relay P. Relay P in operating operates relay MC.
- 2.02 Relay MC operated:
 - (a) Prepares operating paths for relays RS and BY.
 - (b) Releases relay P.

- (c) Operates marker relay NT which inhibits the hunting feature of the marker.

- (d) Holds relay HM and magnet THM06 operated via marker lead ME.
- (e) Locks to ground on marker lead RLSE.
- (f) Opens ringing supply leads to prevent application of ringing when relay RS operates.
- (g) Applies battery to resistor SL1.

- 2.03 In the process of connecting the trunk to a station, the marker operates relay RS, which performs the following functions:

- (a) Locks operated via released relay RT and operated relay BV.
- (b) Releases relay SL and applies a 1000 ohm battery - 100 ohm ground voltage divider network to the S lead of the marker.
- (c) Opens the tip and ring talking path toward the attendant and prepares paths for applying ringing voltage and ground toward the station. The ring side of this path includes the primary winding of relay RT.
- (d) Completes audible ringing feedback path to the attendant for an indication that the called line is being rung.
- (e) With relay BY released connects talking battery and ground leads from the cordless position circuit to the tip and ring.

- 2.04 When the marker has completed a connection to the called station, it releases relay MC, completing the path for ringing the station.

- 2.05 When the station answers (goes off-hook) relay RT is operated on its primary winding and performs the following functions:

- (a) Locks operated on its secondary winding via operated relay BV.
- (b) Prepares a path for continuing the 1000-ohm battery - 100-ohm ground voltage divider network on lead S toward the link when relay RS releases.

(c) Releaser relay RS is cut through the tip and ring connections to the attendant.

(d) Provides a path for maintaining talking battery and ground connections to the tip and ring after the release of relay RS.

.06 Connection between the attendant and the called station has now been established and will continue until the station goes on-hook or the attendant releases attendant trunk 2.

.07 At this time relays RT, BV, and HM are operated and relays RS, P, ST, MC, L, BY, and MKBV are released.

. Call to Busy Station (SC3)

.08 Circuit action during a busy verification call to a busy station is the same as on a call to an idle station up to the point at which relay MC is operated by the marker.

.09 When the marker is recalled to complete the connection, a busy condition at the called station causes the marker to operate relay BY.

.10 Relay BY operated:

- (a) With relay MC operated, applies ground to the warning tone generator.
- (b) Closes paths from the output of the tone generator (if provided) to the tip and ring of the talking path.
- (c) Opens the path via relay RS for connecting talking battery and ground to the tip and ring conductors.
- (d) Locks operated via operated relay BV.
- (e) Opens the metallic connection and inserts capacitors T and R in the tip and ring talking paths.
- (f) Releases relay SL and connects a 1000-ohm battery - 100-ohm ground voltage divider network to the sleeve.
- (g) Operates relay MKBV via released relay RS.
- (h) Operates relay BVT.

11 Continuing action of the marker removes ground from lead ME which releases relay HM and trunk hold magnet THM06.

2.12 Continued marker action reapplies ground ME to reoperate relay HM and hold magnet THM06. Closure of the T and R crosspoints applies a warning tone (Z option) for approximately 0.1 second to the busy station as an indication that the talking path has been bridged.

2.13 Further action by the marker results in operation of relay RS and release of relay MKBV. This is followed by release of the marker.

2.14 The marker in releasing releases relay MC. Relay MC released:

- (a) Transfers the tone generator ground to a 7.5-IPM ground. This causes the tone generator to produce the warning tone (beep) at a 7.5-IPM rate (Z option).
- (b) Transfers relay HM and magnet THM06 from the operating and holding paths to a locking path via relay BV.
- (c) Releases marker relay NT.
- (d) Removes battery from resistor SL1.

2.15 A monitoring connection is now completed (via capacitors T and R) between the attendant and the busy station. If option Z is provided, the warning tone is audible to all parties on the busy connection as well as to the attendant.

2.16 With option R, the attendant will be able to talk on a busy connection.

2.17 At this time busy verification auxiliary trunk relays BV, BY, RS, and HM are operated and relays ST, P, MC, SL, RT, and MKBV are released.

C. Call to Busy and Camped-On Station

2.18 The camp-on stop condition set up in the marker during an attempt to make a connection to a station which is busy and camped-on has no effect on the busy verification circuit. The busy verification auxiliary trunk does not recognize the camp-on stop condition and directs the marker to make a double connection to the busy circuit.

2.19 If a busy station goes on-hook during busy verification, cut through of the camping trunk is prevented by the presence of 100-ohm sleeve ground in the busy verification auxiliary trunk. When the attendant releases the busy verification connection, a connection between the camping trunk and the camped on station is established.

D. Verification Denied - Message Registration Pulsing on Sleeve

2.20 During message registration pulsing, the link test function of the marker is disabled for calls to a busy station. With message register relay COD operated, the operation of marker relays HMKA,B:

(a) Operates relay H in place of relays CONA,B,AA,BA (marker provided with option XK) or relays CONAA,BA (marker provided with option WV).

(b) Operates marker relays COA,AA,B,BA.

2.21 Relay ST operated:

(a) Locks operated under control of relay BY.

(b) Operates relay FB in the cordless position circuit.

(c) Completes a path to provide a 120-IPM tone to the attendant as indication of an incomplete verification.

2.22 The release of the attendant pickup key will remove the 120-IPM tone and restore the busy verification trunk to normal.

3. RELEASE OF BUSY VERIFICATION CONNECTION (SC4)

3.01 The busy verification connection is released by operation of the RELEASE key in the cordless position circuit. This mechanically releases the pickup key which in turn releases relays AC and ON in the attendant trunk circuit.

3.02 Release of the attendant trunk circuit relay AC releases relay BV. Relay BV, in releasing, releases all operated relays in the busy verification auxiliary trunk circuit. This releases trunk hold magnet THM06 in the marker and restores the busy verification auxiliary trunk to the idle condition.

SECTION III - REFERENCE DATA1. WORKING LIMITS

1.01 Voltage limits 45-52 volts.

2. FUNCTIONAL DESIGNATIONS2.01 Relays

<u>Designation</u>	<u>Meaning</u>
BV	Busy Verification
BVT	Busy Verification Tone

DesignationMeaning

ST	Start
HM	Hold Magnet
MC	Magnet Control
BY	Busy
RS	Ring Start
RT	Ring-Trip
P	Polarized
SL	Sleeve
MKBV	Marker Busy Verification

3. FUNCTIONS

3.01 To permit seizure by the attendant when the pickup key of attendant trunk 2 and the DIAL BACK key are operated in sequence.

3.02 To seize PBX common equipment and provide a dialing path for the attendant.

3.03 To supply ringing current to an idle called station and an audible ringing tone to the attendant.

3.04 To recognize answer by an idle station and cut through the transmission path and supply talking battery to the station and attendant trunk.

3.05 To recognize a busy condition at the called station and out through the attendant talking path via capacitive coupling to the busy connection.

3.06 To supply an interrupted tone signal (7.5 IPM) to the busy or busy and camped-on station (option Z).

3.07 To release connection when the RELEASE key in the cordless position is operated.

3.08 Option V is added to disable the inward restriction circuit when busy verification is applied.

3.09 Resistor T is added to provide a load to the tone generator.

3.10 Option W is added to return a 120-IPM tone to the attendant if busy verification is not completed because of message registration pulsing over a sleeve.

3.11 Provision is made to permit the at-

tendant to talk on a busy connection.

4. CONNECTING CIRCUITS

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

- (a) Line, Link, and Marker Circuit - SD-65741-01
- (b) Attendant Trunk Circuit - SD-65753-01
- (c) Cordless Position Circuit - SD-65757-01
- (d) Ringing and Interrupter Circuit - SD-81577-01
- (e) Station Message Register Pulse and Surcharge Circuit - SD-5E021-01

5. MANUFACTURING REQUIREMENTS

5.01 The busy verification circuit shall be capable of performing all of the functions given in this circuit description; the relays with which it is equipped shall meet all requirements of the Circuit Requirements tables.

6. ALARM INFORMATION

6.01 An operated fuse supplying the busy verification trunk circuit results in visual and audible signals at the attendant position and in the alarm, transfer, and test circuit. Also, if alarm sending is provided, a major alarm is transmitted to the plant service center.

6.02 Replacing the operated fuse silences the audible alarm and extinguishes the alarm lamps.

7. TAKING EQUIPMENT OUT OF SERVICE

7.01 When maintenance tests and adjustments are to be made on the busy verification auxiliary trunk, both attendant trunk 2 and the busy verification auxiliary trunk must be taken out of service by grounding lead IT02 toward the line, link, and marker circuit. This is accomplished by:

- (a) Determining that no select magnet is operated.
- (b) Insulating 11M of relay B in attendant trunk No. 2.
- (c) Operating and blocking relay B in attendant trunk No. 2.

SECTION IV - REASONS FOR REISSUE

A. Changed and Added Functions

A.1 Provision is added to permit the attendant to talk on a busy connection.

D. Description of Changes

- D.1 Circuit Note 102 is revised.
- D.2 Circuit Note 104 is revised to reflect Issue 7D.
- D.3 Option R is added to the Option Index.
- D.4 The value of capacitance is added to capacitors T, R, and A.
- D.5 Relay RT is designated as slow-operate.
- D.6 Reference to the 402C tone generator is added to option Z.
- D.7 Option R is added as a standard option to permit the attendant to talk on a busy connection.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 3221-WVS-RGP

PBX SYSTEMS
NO. 756A
FEATURE CABLING DIAGRAM

CHANGES

D. Description of Changes

- D.1 Sheet A1 is updated.
- D.2 On sheet A2, GRD(0), GRD(20), GRD(40), SDT(BATT), and SDT(GRD) is added to the Lead Index.
- D.3 On sheet A3, options V, U, S, and R are added to the Option Index.
- D.4 On sheet A4, connector AW is added to slide 2 of the Connector Location Index.
- D.5 On sheet D1, options U, R, and S are added to the Record of Figures, Wiring and Apparatus Changes.
- D.6 On sheet D2, Table A, the option for dial conference, station controlled, 608A and 608B switchboard, is changed from option X to Z option.
- D.7 On sheet G2, plug AY, pins 0 and 12 are added to slide 6.
- D.8 On sheet G4, option R is added to the existing wiring from plug AY, pins 4 and 5 to connector M1. New wiring to the fuse panel, per option S, is added.
- D.9 On sheet G6:
- (a) Change the designation Conn U-- to Conn U4-- for pins 44 and 19 of plug P1.
 - (b) Add leads FB, BT, and FT to pins 44, 19, and 15, respectively, to plug P1 where used when the busy verification auxiliary trunk feature is not provided.
- D.10 On sheet G7, change option X to Z for five leads of connector C1 going to the dial conference trunk circuits.
- D.11 On sheet G8:
- (a) Add lead RA to pin 17 of connector AW5.
 - (b) Leads bracketed to show the termination to plug 2 of KS-16785, are extended to include a lead from pin 17 of connector AW5 to pin 41 of plug 2.
- D.12 On sheet G13:
- (a) Option R is assigned to C BATT and the C GRD leads of plug assemblies BB and DD.
 - (b) New option S lead is added to plug assemblies BB and DD.
- D.13 On sheet G14, CAD 6:
- (a) S1 lead is added to pin 46.
 - (b) Change the lead termination from pin 34 from 8(AC) to 8B(AC), and assign options ZG and XC.
 - (c) Add a new lead to pin 34 and assign options ZH and XB.
- D.14 On sheet G20, add plug AW2 to CAD12 and assign option U.
- D.15 On sheet G24, correct Sheet Note 3 to show the correct destination of connectors 2 and 3.
- D.16 On sheet G25:
- (a) Correct Sheet Note 1 to show the correct destination of connectors 2 and 3.

(b) Terminations for console cable leads
ACA9 and ACA12 are corrected to
show pins 9 and 12 of connector 1 in-
stead of connector 2.

D.17 On sheet G26, attendant console lead
ACA10 is changed from pin 6 to pin 5
of connector (R5/IN).

D.18 On sheet G27, attendant console lead
terminations for SG3, SG2, and TL2
are changed from pins 9 to 43, 11 to 18,
and 26 to 27, respectively.

D.19 On sheet G30, connector/plug T5 pin
16, leads are corrected to read TR
instead of TG.

D.20 On sheet G31, connector/plug W5:

(a) The lead termination at pin 6 is
corrected to read TL1, TL, L in-
stead of SL1.

(b) The lead termination at pin 17 is
corrected to read SL1, BL instead
of SL2.

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DEPT 3224-JRV-RVL

CIRCUIT DESCRIPTION -

CD-66920-01
ISSUE 2D
APPENDIX 3D
DWG ISSUE 18D

PBX SYSTEMS
NO. 756A
FEATURE CABLING DIAGRAM

CHANGES

D. Description of Changes

- D.1 Sheets A1, A2, A3, and D1 are updated to reflect changes made in this issue.
- D.2 Sheets G24 and G25 are reissued and new sheets G26 through G31 are added to show the revised console maintenance cable.
- D.3 The above changes are made on a D no-record basis per agreement with Western Electric Company.

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DEPT 3224-JRV-RVL

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PBX SYSTEMS
NO. 756A
FEATURE CABLING DIAGRAM

CHANGES

D. Description of Changes

- D.1 On sheets A1, A2, and A3, the Sheet, Lead, and Option Indexes are updated.
- D.2 On sheet D1, option V is added and rated AT&T Co Standard in Circuit Note 104. Circuit Note 102 is changed to reflect option V.
- D.3 On sheet G13, AW4 connector, the termination of leads TU(TT0) and TU(TT1) changes from pins 19 and 8 of connector R4 to pins 8 and 19, respectively.
- D.4 On sheet G21, CAD 13, the termination of leads TU(194,195) is changed from connector P to D on a no-record basis.
- D.5 Sheet G22 is renumbered to G23 and vice versa. On present sheet G22 terminal strip TMS B is changed to TMS A and on sheet G23 terminal strip TMS A is changed to TMS B. These changes are made on a no-record basis.
- D.6 Sheets G24 and 25 (CAD 15 per option V) are added.
- D.7 All changes which are made on a D no-record basis are in agreement with WECO standards.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5334-RHO-RVL

PBX SYSTEMS
NO. 756A
FEATURE CABLING DIAGRAM

CHANGES

D. Description of Changes

D.1. On sheets A1 and A3, the Sheet, Lead and Option Indices are brought up to date.

D.2 On sheet D1: Under Circuit Note 104, option W is added and rated standard; under Circuit Note 102, Traffic Measurement System feature and option W are added.

D.3 On sheet G13, leads TU() and option W are added.

D.4 Sheets G21, G22 and 23 are added.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5334DR-RHO-RVL

PBX SYSTEMS
NO. 756A
FEATURE CABLING DIAGRAMSECTION I - GENERAL DESCRIPTION1. PURPOSE OF CIRCUIT

1.01 The feature cabling diagram shows the interconnection of the equipment slides, the local slide cables, the interconnection of feature connector cables to the crown and the strapped plug assemblies required to arrange the 756A PBX for various optional plug-in features.

SECTION II - DETAILED DESCRIPTION

1.01 None.

SECTION III - REFERENCE DATA1. WORKING LIMITS

1.01 None.

2. CONNECTING CIRCUITS

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

- (a) Line, Link, and Marker Circuit - SD-65741-01.
- (b) PBX Cabling Diagram - SD-65746-01.
- (c) 2-Way Trunk Circuit to Central Office - SD-65752-01.
- (d) Attendant Trunk Circuit - SD-65753-01.
- (e) Cordless Position Circuit - SD-65757-01.
- (f) Alarm, Transfer and Test Circuit - SD-66796-01.
- (g) Dial Conference Trunk Circuit - Station Controlled - SD-66902-01.

- (h) Dial Conference Trunk Circuit - Attendant Controlled - SD-66908-01.
- (i) Station Dial Transfer Controller Circuit - SD-66909-01.
- (j) Auxiliary Position Circuit for Remote Trunk Answering - SD-66910-01.
- (k) Busy Verification Auxiliary Trunk Circuit - SD-66911-01.
- (l) Station Dial Transfer Trunk Circuit - SD-66921-01.
- (m) Inward Restriction Unit - SD-5E003-01.
- (n) Station Message Registers - SD-5E021-01.
- (o) Make Busy and Busy Display - SD-5E029-01.
- (p) Power Supply Circuit - SD-81600-01.

SECTION IV - REASONS FOR REISSUED. Description of Changes

D.1 In CAD 1, option Y is designated and rated Manufacture Discontinued. Option X is added and rated Standard to arrange the cabling so the remote trunk answering feature will function with the transistorized link test circuit designed for the marker.

D.2 In CAD 11, option WU per SD-65741-01 is added to shorting plug AU6 used when station message register is not required

BELL TELEPHONE LABORATORIES, INCORPORATED

(WECO 2120HW-RCL-WHK)
DEPT 5337-LAH

CIRCUIT DESCRIPTION

CD-66921-01
ISSUE 2D
APPENDIX 1B
DWG ISSUE 10B

PBX SYSTEMS
NO. 756A
STATION DIAL TRANSFER
TRUNK CIRCUIT
WITH ADD-ON CONFERENCE

CHANGES

D. Description of Changes

- D.1 Options K and M are added to the Option Index.
- D.2 Option K is designated and rated as Standard to provide a release path for relay TR- in the station dial transfer controller circuit.
- D.3 Option M is designated and rated Mfr Disc.
- D.4 Circuit Note 104 is revised to reflect Issue 10B.

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DEPT 3224-WVS-RVL

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PBX SYSTEMS
NO. 756A
STATION DIAL TRANSFER
TRUNK CIRCUIT
WITH ADD-ON CONFERENCE

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SECTION I - GENERAL DESCRIPTION

1. PURPOSE OF CIRCUIT

1.01 The station dial transfer trunk circuit working with the station dial transfer controller circuit allows any PBX station to transfer an incoming call to any other PBX station (including a station reached by a tie trunk) without the assistance of the attendant. Add-on conference is provided by allowing a maximum of two stations to converse simultaneously with the incoming party.

2. GENERAL DESCRIPTION OF OPERATION

A. Definitions and Operation Charts

2.01 Table A defines terms used in this description. A block diagram showing the station and switching actions involved in transferring the outside party to another station is shown in the circuit notes.

B. Assignment of Switch Verticals

2.02 The two transfer trunk circuits are permanently assigned to the first two verticals of crossbar switch 9. Transfer trunk 0 is used as a first choice. If a second station requests transfer, transfer trunk 1 is used. In case a third station requests service when both trunks are busy, the transfer must be handled by the attendant.

C. Transferring Party A to Another Station

2.03 When station B flashes, the central office trunk involved in the connection activates the controller circuit.

2.04 When the controller is thus activated, it performs the following functions:

- (a) Obtains a transfer trunk circuit according to the preference circuit, unless both transfer trunks are busy.
- (b) Puts party A on hold at the central office trunk.

2.05 The transfer trunk circuit, when called, performs the following functions:

- (a) Activates the marker to connect station B to a dial pulse register.
- (b) Returns dial tone to station B.
- (c) Makes itself busy for subsequent requests for transfer.
- (d) Prepares to repeat the dialing of station B into the dial pulse register. Station B may now dial the number of station C.

2.06 When dialing is completed, the marker functions to connect station C to station B through the transfer trunk circuit and part of the controller circuit associated with the particular central office trunk. At this point, stations B and C can talk to each other but not to party A.

TABLE A
DEFINITION OF TERMS

TERM	DEFINITION
PARTY A	An outside party connected to a PBX station through a central office trunk.
STATION B	A PBX station connected to an outside party A through a central office trunk.
STATION C	A PBX station to which party A requests transfer.
STATION D	A PBX station to which an incoming call is transferred by station C.
CONTROLLER CIRCUIT	Station dial transfer controller circuit. Working with the station dial transfer trunk circuits with add-on conference and associated with the 10 central office trunks.
TRANSFER TRUNK CIRCUIT	Two identical trunk circuits (0 and 1) associated with a station C by PBX switching circuits.
SWITCHHOOK FLASH	Operation of switchhook and release in not less than 75 ms nor more than 850 ms.

2.07 Either station B or C can call in party A by operating the switchhook momentarily. Stations B and C and party A are now mutually connected and can talk to each other. Subsequent flashing by either station cannot change the connection unless station A or B hangs up.

2.08 If station C hangs up, it performs the following functions:

- (a) Releases itself from the connection.
- (b) Releases the transfer trunk circuit involved in the connection.
- (c) Releases part of the controller circuit associated with the particular central office trunk circuit.
- (d) Restores the central office trunk circuit to the state which existed before transfer took place.

Station B and party A are now connected together as they were originally, through the central office trunk circuit.

2.09 If station B hangs up, it performs the following functions:

- (a) Releases itself from the connection. It may then make or receive other calls in a normal manner.
- (b) Releases part of the transfer trunk circuit involved in the connection.

- (c) Prepares the transfer trunk circuit for further transferring.
- (d) Releases part of the central office trunk.
- (e) Transfers control of the circuit to station C for further transferring.

D...Second Transfer of Party A

2.10 Assuming party C has hung up, station B and party A are connected through the central office trunk as they were originally. Operation of the switchhook by station B causes the same effects as were described for the first transfer to a station C.

2.11 Assuming party B has hung up, operation of the switchhook by station C causes the following operations:

- (a) Activates part of the transfer trunk.
- (b) Prepares the central office trunk for calling the marker.

2.12 The central office trunk circuit, called, performs the following functions:

- (a) Activates the marker to connect station A to dial pulse register.
- (b) Returns dial circuit to station C.

- (c) Prepares to repeat the dialing of station C into the dial pulse register. Station C may now dial the number of station D.

2.13 When dialing is completed, the marker functions to connect station D to station C through the central office trunk, part of the controller circuit, and through the transfer trunk circuit. At this point, stations C and D can talk to each other but not to party A.

2.14 Either station C or D can call in party A by operating the switchhook momentarily. Stations C and D and party A are now connected together and can talk to each other. Subsequent flashing by either station does not change the connection unless one of the stations hangs up.

2.15 If station D hangs up, it performs the following functions:

- (a) Releases itself from the connection. It may then make or receive other calls in a normal manner.
- (b) Releases part of the transfer trunk involved.
- (c) Prepares the transfer trunk circuit for further transferring.
- (d) Puts party A on hold.

After station D hangs up, operation of the switchhook by station C activates part of the transfer trunk and prepares the central office trunk for calling in the marker.

2.16 When station C hangs up the following release actions are performed:

- (a) Releases itself from the connection.
- (b) Releases the transfer trunk circuit involved in the operation.
- (c) Releases part of the controller circuit associated with the particular central office trunk circuit.
- (d) Restores the central office trunk circuit to the state which existed before transferring took place.

Station D and party A are now connected via the central office trunk.

2.17 If any time during the transferring of calls, the called station is busy or does not answer when rung, the calling station cancels the call to this station by a second switchhook operation. This dismisses the PBX switching circuits and returns the transferring station to party A for further consultation.

2.18 The action of cancelling by operation of the switchhook, including cancelling after partial dialing, may be taken at any time prior to answer by the called party.

2.19 The number of transfers between stations is unlimited and the two stations connected to the transfer trunk circuits may make transfers independently.

2.20 Calling the attendant from any PBX station during transferring is done by dialing zero. The transfer trunk circuit activates the marker which in turn abandons the call to an attendant trunk, setting up a station recall condition to the attendant. The red lamp associated with the particular central office trunk circuit flashes at 120 ipm and continuous ringing is applied.

SECTION II - DETAILED DESCRIPTION1. GENERAL

1.01 When the dial transfer feature is provided, an incoming trunk call is first terminated on the called PBX station or tie line by the PBX attendant using normal procedure.

1.02 If the terminating station is reached by tie line, a switchhook flash at the distant PBX station results in a flashing recall signal at the attendant position.

1.03 When the trunk call is terminated on a local PBX station a switchhook flash results in dial tone to the station and transfer to another station or tie line is effected without recalling the attendant.

1.04 When necessary, the PBX attendant may be recalled to a trunk terminated on a local PBX station by dialing 0. This results in a flashing recall signal to the attendant.

2. FIRST TRANSFER OF PARTY A (SC1)A. Central Office Trunk Response

2.01 Assume an established talking connection between party A and station B through central office trunk 0. Also assume that transfer trunk circuit 0 is idle. Party B depresses the switchhook momentarily.

2.02 Relay S in the central office trunk follows the operation of the switchhook. The central office trunk functions as in station recall, grounding the TP lead and operating relay TPO in the controller circuit.

B. Controller Circuit Attached

2.03 Relay TPO operated:

- (a) Locks through its own contact under control of relays FF and DR in the central office trunk.
- (b) Prepares operating paths for relays TOA and TOB in the controller circuit.
- (c) Operates relay GP in the controller circuit.

2.04 Relay GP operated:

- (a) Prevents starting other transfers while the controller is in the process of obtaining a transfer trunk circuit.
- (b) Operates relay TOA in the controller circuit.

C. Transfer Trunk Circuit 0 Attached

2.05 Relay TOA operated:

- (a) Operates relay STB in the transfer trunk through the contacts of relay CTZ in the transfer trunk and relay TPO in the controller circuit.
- (b) Operates relay TRO in the controller circuit through the same path.
- (c) Prepares an operating path for relay STO in the controller circuit.
- (d) Prepares an operating path for relay RLDT.
- (e) Prepares a path for transferring control of the central office trunk.
- (f) Prepares an operating path for relay MCB.
- (g) Prepares an operating path for relay MCA.
- (h) Prepares paths for connecting station B to the transfer trunk circuit.
- (i) Prepares a path for calling in party A.
- (j) Prepares an operating path for relay RLBY.
- (k) Prepares an operating path for relay ARO in the controller circuit.

2.06 Relay STB operated:

- (a) Locks under control of relays RLS and CTZ.
- (b) Prepares operating paths for relays DLBA, STC, RM, CTZ, and W. Also prepares operating paths for relays DLB and DLG.
- (c) Prepares locking paths for relays TT and BY.
- (d) Operates relay MCB.

2.07 Relay TRO operated in the controller circuit:

- (a) Provides a holding path for party A.
- (b) Connects station B to the transfer trunk circuit and splits the central office trunk.
- (c) Releases relay FF in the central office trunk.
- (d) Transfers control of the central office trunk to the transfer trunk circuit.
- (e) Operates relay B under control of relay MCB.

2.08 Relay FF released in the central office trunk:

- (a) Releases relay DR in the central office trunk.
- (b) Removes ground from the starting lead TP, releasing relay TPO.

2.09 Relay TPO in the controller circuit released:

- (a) Permits other central office trunks to request transfer through station B when relay GP is released.
- (b) Releases relay GP in the controller circuit.

2.10 Relay GP in the controller circuit released permits other central office trunks to request transfer through station B.

2.11 Relay MCB operated:

- (a) Prepares an operating path for relay B.
- (b) Prevents relay STO from operating when station C answers.
- (c) Provides a parallel path for controlling the timer circuit which operates relay DLB.
- (d) Prepares a locking path under control of relays CB and DLB.

2.12 Relay B operated:

- (a) Operates relay BA.
- (b) Prevents operation of relay RLBY once station C has answered.
- (c) Prepares an operating path for relay P when a dial pulse register has been attached.

D. Marker Starting

2.13 Relay BA operated:

- (a) Prepares an operating path for controller circuit relay TRT1.
- (b) Prevents relay DLB from operating (via the timer circuit) when relay BB operates.
- (c) Prevents relays W and CTZ from operating when relay BB operates.
- (d) Operates relay BB.
- (e) Prevents relay RLS from operating when called station C is rung or is busy.
- (f) Prepares an operating path for relay U9 in the marker circuit under control of relay TRT1 in the controller circuit.
- (g) Prepares a locking path for relay HM.

- (h) Operates relay TR1 in the marker.

2.14 Relay BN operated:

- (a) Prepares a holding path for relay DLC.
- (b) Prepares a locking path for relay RLS.
- (c) Supplies a holding path for relay MCB.
- (d) Prevents controller relay STO from operating when station C answers.
- (e) Prepares an operating path for relays W and CTZ.
- (f) Prepares an operating path via the timer circuit for relay DLB.
- (g) Provides a locking path under control of relay DLB.

2.15 Operation of marker relay TR1 starts the marker for the purpose of obtaining a dial pulse register. In the process of obtaining the register, relay TRP1 in the marker operates. This operates relay TRT1 in the controller circuit.

2.16 Controller relay TRT1 operated:

- (a) Prepares operating paths for marker relays U9 and U8.
- (b) Operates relay SMC9 in the controller circuit.
- (c) Prepares operating paths for relays HM in the transfer trunk circuits and trunk hold magnets THM90 and THM91 in the controller circuit.
- (d) Prevents register relay AC from operating.

2.17 In the sequence of operation, marker relay SMRAB operates. Relay SMRAB operated extends ground over lead TU(TR-) to the TMS remote scanner and operates relay HM in the transfer trunk and trunk hold magnet THM90 in the controller.

2.18 Relay HM operated:

- (a) Prevents controller relay TRT1 from reoperating when the marker is completing another operation.
- (b) Prevents marker relay TR1 from reoperating when the marker has attached a dial pulse register to the transfer trunk circuit.
- (c) Prevents marker relay U8 or U9 from operating.
- (d) Directs subsequent requests for transfer to transfer trunk 1.
- (e) Locks under control of relay BA.

E. Register Attached

2.19 Operation of trunk hold magnet THM90 connects the tip, ring, and sleeve to the dial pulse register. A 100-ohm ground over the S lead operates relay SL. At this time station B hears dial tone.

2.20 Relay SL operated:

- (a) Prepares a path for operating relay RLS under control of relays BA and P.
- (b) Provides a holding path for relay HM under control of relay STB.

3. STATION B TRANSFERS TO STATION C (SC2)A. Calling Station C

3.01 After receiving dial tone from the register, station B dials the number of station C.

3.02 After the register has received the proper number of digits, it reverses the tip and ring. This operates relay P which is polarized by diodes A and B. At the same time, the register calls the marker.

3.03 Relay P operated operates relay MC which performs the following functions:

- (a) Operates marker relay CCC which cancels the camp-on function if the called line is busy.
- (b) Prepares operating paths for relays TT, DBO, BY, DB9, and RS.
- (c) Locks under control of the marker.
- (d) Releases relay P.
- (e) Starts ringing when relay RS operates.

3.04 When the marker completes the call to station C, relay RS operated:

- (a) Prepares a holding path for relay STC.
- (b) Prepares a path for applying ringing to station C.
- (c) Prepares an operating path for relay RLS.
- (d) Operates relay CTD.

3.05 Relay CTD operated:

- (a) Operates relay STC under control of relays RS and STB.
- (b) Prepares a locking path under control of relays STC and CB.

3.06 Relay STC operated:

- (a) Provides a holding path for relays RS and CTD.

- (b) Opens a holding path for relay MCB.

- (c) Provides a holding path for relay HM.

- (d) Opens the operating circuit for relay P and closes the ring side of the talking path.

- (e) Prepares an operating path for relay C.

- (f) Provides an alternate operating path for relay CCC in the marker.

- (g) Prepares a locking path for relay C.

- (h) Releases relay SL and connects 100-ohm resistance to the sleeve.

3.07 After the marker has completed its functions, it releases itself and the dial pulse register from the connection. Release of the marker causes relay MC to release. Relay MC released with relay RS operated connects a ringing supply through the primary winding of relay RT to station C. Audible ringing feedback is transmitted through capacitor FB to station B.

B. Called Station C Answers (SC3)

3.08 When called station C answers, relay RT operates on its primary winding and performs the following functions:

- (a) Locks under control of relay STC.
- (b) Provides a holding path for relay STC.
- (c) Releases relay RS.

3.09 When station C answers, relay C operates and performs the following functions:

- (a) Operates relay CA.
- (b) Prepares an operating path for relay MCA.
- (c) Provides an operating path for relay P in the central office trunk when a dial pulse register has been attached.

3.10 Relay CA operated:

- (a) Prevents relay DLC from operating via the timer circuit when relay CB operates.
- (b) Prevents relays W and CTZ from operating when CB operates.
- (c) Operates relay CB.
- (d) Prevents relays DLBA and RLDT from operating.
- (e) Prevents relay BB from operating when station C transfers.

- (f) Provides an operating path for relay STO in the controller circuit and for relay RLB.

3.11 Relay CB operated:

- (a) Provides an operating path for controller relay STO.
- (b) Provides alternate holding paths for relays MCB and STB.
- (c) Releases relay CTD.
- (d) Prepares an operating path for relays W and CTZ and for relay DLC via the timer circuit.
- (e) Locks to ground under control of relay CA.

3.12 Relay CTD released transfers control of relay STC to relay CB only.

C. Station B Calls in Party A (SC4)

3.13 Station B or station C can call in party A by flashing the switchhook. When station B operates the switchhook, the tip and ring loop is opened, releasing relay B.

3.14 Relay B released releases slow release relay BA which in turn operates relay W. Relay BA releases if the switchhook is held operated more than about 150 ms.

3.15 When the switchhook is released, relays B and BA reoperate thus operating relay CTZ. At this point, stations B and C and party A are mutually connected and can talk to each other.

D. Station C Calls in Party A (SC5)

3.16 If station C operates the switchhook, relay C releases which in turn releases slow release relay CA. Relay CA releases if the switchhook is held operated more than about 150 ms.

3.17 Relay CA in releasing operates relay W. When the switchhook is released, relays C and CA reoperate thus operating relay CTZ. At this point, stations B and C and party A are mutually connected and can talk to each other.

4. STATION B DISPOSES OF DIAL TONE OR PARTIAL DIAL (SC6)

4.01 If station B has received dial tone or has partially dialed, the call can be canceled and the station may return to party A by flashing the switchhook.

4.02 When station B depresses the switchhook, relay B releases which in turn releases relay BA. Relay BA released operates relay RLS through the contacts of relay SL.

4.03 Relay RLS operated:

- (a) Prevents relay TR1 in the marker from operating when relay HM releases.
- (b) Releases relays STB and DB9A and relays TOA and TRO in the controller circuit.
- (c) Locks to ground under control of relay BB.

4.04 Controller relay TRO released releases relay B which in turn releases relay BA. Relay BA released removes ground from lead TU(TT-) to the TMS remote scanner and operates relay DLB. Relay DLB operates in about 800 ms and releases relays BB and MCB.

4.05 Relays BA and STB released release relays HM, DLB, and THM90 in the controller circuit. When the connection is released, the register is released and relay SL also releases.

4.06 At this time, station B is connected to party A through the central office trunk, the register is released, and the transfer trunk used to call in the register is cleared and made available for subsequent requests for transfer.

5. STATION B DISPOSES OF DON'T ANSWER (SC7)

5.01 If the called station C does not answer, station B may cancel the call and return to party A by flashing the switchhook.

5.02 When station B depresses the switchhook, relay B releases which in turn releases relay BA. Relay BA released operates relay RLS through the contacts of relay RS.

5.03 Relay RLS operated:

- (a) Prevents relay TR1 in the marker from operating when relay HM releases.
- (b) Releases relays STB and DB9A and relays TOA and TRO in the controller circuit.
- (c) Locks to ground under control of relay BB.

5.04 Relay TRO released releases relay B which in turn releases relay BA. Relay BA released removes ground from lead TU(TT-) to the TMS remote scanner and operates relay DLB. DLB operated releases relays BB and MCB.

5.05 Relays BA and STB released release relays HM, DLB, and STC. Relay STC released releases relays RS and CTD. When the connection is released, the register is released.

5.06 At this time, station B is connected to party A through the central office trunk, the register is released, and the transfer trunk used to call in the register is cleared

and made available for subsequent requests for transfer.

6. STATION B DISPOSES OF BUSY LINE (SC8)

6.01 If the called station C is busy, station B may cancel the call and return to party A by flashing the switchhook.

6.02 When station B depresses the switchhook, relay B relay B releases which in turn releases relay BA. Relay BA released operates relay RLS through the contacts of relay BY which was operated by the marker because of the busy condition.

6.03 Relay RLS operated:

- (a) Prevents relay TR1 in the marker from operating when relay HM releases.
- (b) Releases relays STB and DB9A and relays TOA and TRO in the controller circuit.
- (c) Locks to ground under control of relay BB.

6.04 Controller relay TRO released releases relay B which in turn releases relay BA. Relay BA released removes ground from lead TU (TT-) to the TMS remote scanner and operates relay DLB. Relay DLB operated releases relays BB and MCB.

6.05 Relays BA and STB released release relays HM, DLB, and THM90 in the controller circuit. When the connection is released, the register is released.

6.06 At this time, station B is connected to party A through the central office trunk, the register is released, and the transfer trunk used to call in the register is cleared and made available for subsequent requests for transfer.

7. STATION B DIALS 0 TO CALL ATTENDANT (SC9)

7.01 Station B may recall the attendant by dialing zero. The transfer trunk circuit activates the marker which in turn abandons the call to an attendant trunk, setting up a station recall condition to the attendant. The red lamp associated with the particular central office trunk circuit flashes at 120 ipm and continuous ringing is applied.

A. Marker Responds to 0 Dialed by Station B

7.02 When station B dials zero, the register and marker function to connect the calling station to an attendant trunk. Relay P operates operating relay MC. When relay TKBO in the marker operates, relay DBO operates via contacts of relay MC.

7.03 Relay DBO operated:

- (a) Operates relay RLS.
- (b) Operates relays ACA and ACB in the marker.
- (c) Operates relay ARO in the controller.
- (d) With option N, operates relay LCO to open leads FFA and FFB to prevent the false flashing of the SL lamp in the attendant console associated with an attendant trunk.

7.04 Relay RLS operated:

- (a) Prevents relay TR1 in the marker from operating when relay HM releases.
- (b) Releases relays STB and DB9A and relays TOA and TRO in the controller circuit.
- (c) Locks to ground under control of relay BB.

7.05 Controller relay TRO released releases relay B which in turn releases relay BA. Relay BA released removes ground from lead TU (TT-) to the TMS remote scanner, and operates relay DLB. Relay DLB operated releases relays BB and MCB.

7.06 Relays DA and STB released release relays HM, DLB, and THM90 in the controller circuit. When the connection is released, the register is released.

B. Call Abandoned After Dialing Zero

7.07 Relays ACA and ACB operated in the marker release relays DCKA and DCKB which in turn operate relays RLA, RLB, RLAA, RLAB, RLBA, and RLBB.

7.08 Operation of the marker relays stops marker timing and releases the marker.

C. Attendant Recall

7.09 Relay ARO operated:

- (a) Locks under control of relays AC and HD in the central office trunk.
- (b) Flashes the red lamp associated with the central office trunk at 120 ipm.
- (c) Prevents relays MCA and STO from operating.
- (d) Applied continuous ringing to signal the attendant.

D. Attendant Answers (SC10)

7.10 When the attendant answers the recall by operating the pickup key, relay AC operates and releases relay ARO which in turn silences the audible signal and transfers the red lamp from 120 ipm to steady battery. At this time station B, party A, and the attendant are mutually connected through the

central office trunk and may talk to each other.

8. DIAL 9 TRUNK ACCESS DENIED

8.01 The transfer trunk circuit is arranged to deny access to central office trunks and to return 120-ipm tone if trunk access code 9 is dialed by any station.

A. Station B Dials 9 (SC11)

8.02 When station B dials 9, the register and marker function in a normal manner for connecting a dial 9 call. When marker relay TKB9 operates, it operates relay DB9 via contacts of relay MC.

8.03 Relay DB9 operated:

- (a) Locks to ground under control of relay MC.
- (b) Operates relay DB9A.
- (c) Operates relays ACA and ACB in the marker.

8.04 Relay DB9A operated:

- (a) Locks to ground under control of relay RLS.
- (b) Provides 120-ipm tone to station B.
- (c) Prepares an operating path for relay RLS.

B. Station B Disposes of 120-ipm Tone (SC12)

8.05 If station B has dialed 9 and received 120-ipm tone, it may release the call and return to party A by a switchhook flash.

8.06 When the switchhook is operated momentarily at station B, relay B releases momentarily which in turn releases relay BA. Relay BA released operates relay RLS through the contacts of relay DB9A.

8.07 Relay RLS operated releases the transfer trunk circuit and connects station B to party A through the central office trunk. The register is cleared and made available for subsequent calls.

9. DIAL REPEATING TIE TRUNK ADDED TO TRANSFER TRUNK CIRCUIT

9.01 Dial repeating tie trunks with reverse battery supervision may be added to the transfer trunk circuit.

A. Station B Dials a Tie Trunk Number (SC13)

9.02 When station B dials a tie trunk number (eg, 86), the register and marker function to connect the calling station to a tie trunk via the transfer trunk. When the

tie trunk is connected, relay P operates, operating relay MC.

9.03 Relay MC operated prepares a path for operating relay TT via the marker and grounds marker lead CCC to cancel the camp-on function.

9.04 The marker, when connected, operates relay TT which performs the following functions:

- (a) Prevents relay MC from operating when relay P reoperates as a result of answer by the distant PBX station.
- (b) Provides an alternate holding path for relay STB.
- (c) Locks to ground under control of relay STB.
- (d) Prepares a holding path for relay W.

9.05 When the marker completes the call to the tie trunk it releases, releasing relay P. Station B may now dial the number of the station at the distant PBX.

9.06 If a supervisory signal is received from the distant PBX indicating that the called station is busy or does not answer, station B may cancel the call and return to party A by a switchhook flash.

B. Station at the Distant PBX Answers (SC13)

9.07 If the distant station answers, reverse battery supervision provided by the trunk operates relay P.

9.08 Station B may call in party A by flashing the switchhook. A switchhook flash at the distant PBX station has no effect unless station B has hung up.

9.09 The station at the distant PBX may recall the attendant by flashing which causes relay P to release momentarily. This operates relay ARO, signaling the attendant.

10. SECOND TRANSFER OF PARTY A (SC14)

A. Central Office Trunk Response

10.01 Assume an established talking connection between party A and station C through transfer trunk 0. Also assume that station C operates the switchhook momentarily.

10.02 When station C depresses the switchhook, relay C releases which in sequence releases relay CA and relay W. When relay C reoperates, relay CA operates, releasing relay CTZ.

B. Marker Starting

10.03 Relay CTZ releasing operates relay STO in the controller circuit, performing the following functions:

- (a) Operates relay HD in the central office trunk.
- (b) Starts the marker by operating relay TR-.
- (c) Prepares an operating path for relays MCB and MCA and for relay CCC in the marker.
- (d) Operates relay RCO in the controller circuit, which in turn prevents relay AC in the register from operating.

10.04 Central office trunk relay HD operated prepares the central office trunk for obtaining a dial pulse register by performing the following functions:

- (a) Connects relay SL to the sleeve lead.
- (b) Prepares an operating path for relay TT.
- (c) Locks to off-normal ground.

10.05 Operation of relay TR- in the marker starts the marker for the purpose of obtaining a dial pulse register. In the sequence of operations, the marker obtains a dial pulse register and attaches it to the central office trunk.

C. Register Attached

10.06 When the select magnet timing relay in the marker operates, ground is transmitted through the operated trunk magnet relay in the marker to operate central office trunk relay HM over lead ST. Relay HM and hold magnet THM-- in the marker operate in parallel.

10.07 Relay HM operated in the central office trunk:

- (a) Holds operated to off-normal ground through operated central office relays HD, SL, and relay MC normal.
- (b) Operates relays MCB and MCA in the transfer trunk through the controller circuit.
- (c) Operates relay CCC in the marker.
- (d) Releases relay RCO in the controller circuit.

11. STATION C TRANSFERS TO STATION D

A. Calling Station D (SC15)

11.01 Operation of magnet THM-- connects the tip and ring to the dial pulse register. At this time, station C hears dial tone. After receiving dial tone from the register, station C dials the number of station D.

11.02 After the register has received the proper number of digits, it reverses the tip

and ring. This operates relay P in the central office trunk.

11.03 Relay P operated:

- (a) Operates relay MC in the central office trunk.
- (b) Operates relays MCB and MCA at the transfer trunk.
- (c) Operates relay CCC in the marker.

11.04 The central office trunk connects station D to station C through the central office trunk, controller circuit, and transfer trunk circuit as it does on any other central office to station call.

11.05 Relay MCB operated:

- (a) Prepares an operating path for relay B.
- (b) Releases relay STO in the controller.
- (c) Locks to ground under control of relays CB and DLB.

11.06 Relay MCA operated:

- (a) Prepares an operating path for relays DC0 and DC9.
- (b) Locks to ground under control of the marker.

11.07 After the marker has completed its functions, it releases itself and the dial pulse register from the connection. Release of the marker causes relay MCA to release. Ringing is applied to station D from the central office trunk. Audible ringing feedback is transmitted to station C through capacitor FB of the central office trunk.

B. Called Station D Answers (SC16)

11.08 When the called station D answers, relay RT operates in the central office trunk. Closing the tip and ring at station D operates relay B which in turn operates relays BA and BB.

11.09 At this time stations C and D can talk to each other but not to party A. Station C or D can call in party A by flashing the switchhook.

12. STATION C DISPOSES OF DIAL TONE OR PARTIAL DIAL (SC17)

12.01 If station C has received dial tone or has partially dialed, the call may be canceled and the station may return to party A by flashing the switchhook.

12.02 When station C depresses the switchhook, relay C releases which in turn releases relay CA. Relay CA released operates relays RLDT and W.

12.03 Relay RLDT operated operates relay DLBA which does the following:

- (a) Releases relays DC9A and RLBY.
- (b) Releases relays HM, RT, and TLA in the central office trunk and THM-- in the marker circuit, restoring the central office trunk to normal as it was before station C flashed for dial tone.

12.04 At this time, station C is connected to party A through the central office trunk and transfer trunk circuit. Also, the dial pulse register is cleared and made available for subsequent calls.

13. STATION C DISPOSES OF DON'T ANSWER (SC18)

13.01 If the called station D does not answer, station C may cancel the call and return to party A by flashing the switchhook.

13.02 When station C operates the switchhook momentarily, relay C releases momentarily which in turn releases relay CA. Relay CA released operates relay BB via the central office trunk and also operates relay W.

13.03 Relay BB operated operates relay DLB via the timer which releases relays BB and MCB and operates relay DLBA.

13.04 Relay DLBA operated releases relays HM, RT, TLA, and RS in the central office trunk and THM-- in the marker circuit, restoring the central office trunk to normal as it was before station C flashed for dial tone.

13.05 At this time, station C is connected to party A through the transfer trunk and the central office trunk.

14. STATION C DISPOSES OF BUSY LINE (SC20)

14.01 If called station D is busy, station C may cancel the call and return to party A by flashing the switchhook.

14.02 The central office trunk, finding the called station D busy, transmits a ground through the RLS lead and operates relay RLBY. Also, relay B operates from the busy tone trunk, operating relays BA and BB in sequence.

14.03 Relay RLBY operated prepares an operating path for relay DLBA and locks to ground under control of relay DLBA.

14.04 When station C operates the switchhook momentarily, relay C releases momentarily which in turn releases relay CA. Relay CA released operates relay DLBA and also operates relay W.

14.05 Relay DLBA operated:

- (a) Releases relay RLBY.
- (b) Releases relays HM, RT, and TLA in the central office trunk, and THM-- in the marker circuit, restoring the central office trunk to normal as it was before station C flashed for dial tone.

14.06 THM-- releasing releases the busy tone trunk and releases relay B in the transfer trunk circuit.

14.07 Relay BA releasing operates relay DLB via the timer which in turn releases relays BB and MCB.

14.08 Relay DLB operated operates relay DLBA. This removes ground from lead GRD insuring that the central office trunk is restored to normal.

14.09 At this time, station C is connected to party A through the transfer trunk and the central office trunk.

15. STATION C DIALS 0 TO CALL ATTENDANT (SC21)

15.01 Station C may recall the attendant by dialing zero. The transfer trunk circuit activates the marker which in turn abandons the call to an attendant trunk, setting up a station recall condition to the attendant. The red lamp associated with the particular central office trunk circuit flashes at 120 ipm and continuous ringing is applied.

A. Marker Responds to 0 Dialed by Station C

15.02 When station C dials zero, the register and marker function to connect the calling station to an attendant trunk. When relay P in the central office trunk is operated, relay MCA operates via lead MCC. Relay MCA operates in parallel with relay MC in the central office trunk. When marker relay TKBO operates, relay DCO operates via contacts of relay MCA.

15.03 Relay DCO operated:

- (a) Operates relays ACA and ACB in the marker.
- (b) Locks to ground under control of relay MCA.
- (c) Operates relay ARO in the controller circuit.
- (d) Operates relay BB.
- (e) With option N, operates relay LCO to open leads FFA and FFB to prevent the false flashing of the SL lamp in the attendant console associated with an attendant trunk.

B. Abandoned Call

15.04 Relays ACA and ACB operated in the marker release relays DCKA and DCKB which in turn operate relays RLA, RLB, RLAA, RLAB, RLBA, and RLBB in the marker.

15.05 Operation of the marker relays stops marker timing and releases the marker.

15.06 Controller relay ARO operated:

- (a) Locks to ground under control of relays CA and AC in the central office trunk.
- (b) Flashes the red lamp associated with the central office trunk at 120 ipm and also applies continuous ringing to the attendant.
- (c) Prevents relay MCA and controller relay STO from reoperating.

15.07 Relay BB operated operates relay DLB via the timer which releases relays BB and MCB and operates relay DLBA.

15.08 Relay DLBA operated releases relays HM, HD, and TLA in the central office trunk and THM-- in the marker circuit, restoring the central office trunk to normal as it was before station C flashed for dial tone.

C. Attendant Answers (SC22)

15.09 When the attendant answers the recall by operating the pickup key, central office trunk relay AC operates and releases controller relay ARO which in turn silences the audible signal and transfers the red lamp from 120 ipm to steady. At this time, station C, party A, and the attendant are mutually connected through the transfer trunk and the central office trunk and may talk to each other.

16. STATION C DIALS 9 (SC23)

16.01 When station C dials 9, it receives 120-ipm tone as an indication that the call will not be completed.

A. Marker Functioning

16.02 When station C dials 9, the register and marker function in a normal manner for connecting a dial 9 call. When marker relay TRB9 operates, it operates relay DC9 via contacts of relay MCA.

16.03 Relay DC9 operated:

- (a) Locks to ground under control of relay MCA.
- (b) Operates relay DC9A.
- (c) Operates relays ACA and ACB in the marker which in turn release the marker.

16.04 Relay DC9A operated:

- (a) Prevents controller relay STO from reoperating.
- (b) Prepares an operating path for relay BB under control of relay CA.
- (c) Provides 120-ipm tone to station C.
- (d) Locks to ground under control of relay DLBA.

B. Station C Disposes of 120-ipm Tone (SC24)

16.05 If the station C party has dialed 9 and has received 120-ipm tone, the call may be released and the party may return to party A by flashing the switchhook.

16.06 When station C operates the switchhook momentarily, relay C releases momentarily which in turn releases relay CA. Relay CA released operates relay BB via the contacts of relay DC9A.

16.07 Relay BB operated operates relay DLB via the timer which releases relays BB and MCB and operates relay DLBA.

16.08 Relay DLBA operated releases relays HM and HD in the central office trunk and THM-- in the marker circuit, restoring the central office trunk to normal as it was before station C flashed for dial tone.

17. DIAL REPEATING TIE TRUNK ADDED (SC25)

17.01 Station C may add a tie trunk with reverse battery supervision to the central office trunk through the transfer trunk.

A. Station C Dials a Tie Trunk Number

17.02 When station C dials a tie trunk number (eg, 86) the register and marker function to connect the central office trunk to a tie trunk. Central office trunk relay P operates, operating relay MC in the central office trunk and relay MCA.

17.03 The marker, when connected, operates relay TT in the central office trunk and relay TTA in the transfer trunk, performing the following functions:

- (a) Prevents relay MCA and controller relay STO from reoperating when relay MCB releases.
- (b) Releases relay MCB.
- (c) Prepares an operating path for relay RLDT under control of relay PA.
- (d) Locks to ground under control of relays DLBA and STC.
- (e) Prepares an operating path for relay PA.

17.04 When the marker completes the call to the tie trunk it releases, releasing relay P in the central office trunk. At this time station C hears dial tone from the distant PBX. Station C may now dial the number of the station at the distant PBX.

17.05 If a supervisory signal is received from the distant PBX indicating that the called station is busy or does not answer, station C may cancel the call and return to party A.

17.06 To cancel the call and return to party A, station C flashes the switchhook.

17.07 When station C depresses the switchhook, relay C releases which in turn releases relay CA. Relay CA released operates relay RLDT through the normal contacts of relays PA and TTA.

17.08 Relay RLDT operated operates relay DLBA which does the following:

- (a) Releases relays DC9A, RLBY, and TTA.
- (b) Releases relays HM, RT, TLA, and TT in the central office trunk and THM-- in the marker circuit, restoring the central office trunk to normal as it was before station C flashed for dial tone.

17.09 At this time, station C is connected to party A through the central office trunk and transfer trunk circuit. Also, the dial pulse register is cleared and made available for subsequent calls.

B. Station at the Distant PBX Answers

17.10 When the distant station answers, reverse battery supervision provided by the trunk operates relay P in the central office trunk which in turn operates relay RT in the central office trunk.

17.11 Relay RT operated in the central office trunk operates relay PA through thermistor FA performing the following:

- (a) Prevents relay RLDT from operating when relay TTA operates.
- (b) Provides a parallel holding path for relay P in the central office trunk.

17.12 Station C can call in party A by flashing the switchhook. Switchhook flashes at the distant PBX station will have no effect unless station C has hung up.

17.13 The distant PBX party may recall the attendant by flashing the switchhook. This type of recall must be handled by the attendant.

18. TRANSFER TRUNKS BUSY

18.01 If both transfer trunk circuits are busy and another station requests transfer the call is routed to the attendant.

18.02 Relay GP operated in the controller circuit operates controller relay ATB which in turn operates relay AR, performing the following functions:

- (a) Locks to ground under control of the central office trunk.
- (b) Flashes the red central office trunk lamp in the attendant console at 120 ipm.
- (c) Applies continuous ringing to the attendant.
- (d) Releases controller relay TPO which in turn releases relays GP and ATB also in the controller.

19. DISCONNECTS

A. After Dialing Zero Station B Disconnects Before Attendant Answers

19.01 If station B hangs up before the attendant answers, the central office trunk releases and the signals at the attendant console disappear.

B. Station C Hangs Up After Answering (SC26)

19.02 Station C releases from the connection when hung up. This also releases the transfer trunk and makes it available for subsequent requests for transfer. When station C hangs up, relay C releases which in turn releases relay CA. Relay CA releasing operates relay DLC via the timer.

19.03 Relay DLC operated:

- (a) Locks to ground under control of relay ~~AB~~.
- (b) Supplies an alternate holding path for the relays in the central office trunk.
- (c) Prevents marker relay TR1 from operating when relay HM releases.
- (d) Releases relay CB.

19.04 Relay CB releasing releases relays STC and STB. When relay STB releases, it releases relay MDB. This releases the transfer trunk circuit and releases controller relays TOA and TRO.

C. Station B Hangs Up After Station C has Answered (SC27)

19.05 When station C has answered station B may release from the connection by hanging up either before or after party A has been

called in. When station B releases, it frees the central office line end making it available for subsequent transfers.

19.06 When station B hangs up, relay B is released which in turn releases relay BA. Relay BA released operates relay DLBA and the timer.

19.07 Relay DLB operated releases relays BB and MCB and operates slow release relay DLBA.

19.08 Relay DLBA operated:

- (a) Releases relays DC9A and RLBY.
- (b) Releases relays HM, RT, and TLA in the central office trunk circuit and THM-- in the marker circuit, restoring the central office trunk to normal as it was after the attendant answered the incoming call from party A.

D. After Dialing Zero Station C Disconnects Before Attendant Answers (SC28)

19.09 If station C hangs up before the attendant answers, relay CA is released which in turn operates relay DLC via the timer. This causes the transfer trunk to release and makes it available for subsequent requests for transfer.

19.10 Relay DLC operated locks to ground under control of relay BB and releases relay CB.

19.11 Relay CB releasing releases relays STC and STB. When relay STB releases, it releases relay MCB. This releases the transfer trunk circuit and releases relays TOA and TRO in the controller circuit.

20. FUNCTION OF MAKE BUSY AND BUSY DISPLAY CIRCUIT

A. Dial Transfer Trunk Key Normal

20.01 With the dial transfer key (DLTR key) normal in the make busy and busy display circuit, the station dial transfer trunk and controller circuits will function as described previously. However, the ground placed on lead HM by the marker to operate both relay HM in the transfer trunk and trunk hold magnet THM9- in the controller will also light the dial transfer trunk busy lamp (DLTR

lamp) in the make busy and busy display circuit. The lighting of lamp DLTR indicates that the transfer trunk has been made busy through normal operations.

B. Dial Transfer Trunk Made Busy

20.02 If it is desired to make a dial transfer trunk busy, the associated DLTR key in the make busy and busy display circuit is operated. Key DLTR operated will operate the associated MBT relay in the station dial transfer trunk circuit. Relay MBT operated:

- (a) Opens lead HMPA in the transfer trunk circuit if transfer trunk 0 is being made busy or HMPB if transfer trunk 1 is being made busy.
- (b) Connects lead GP or ATB through contacts of relays MBT and HM to lead TC in the transfer trunk circuit.
- (c) Opens lead HM from the make busy and busy display circuit to the dial transfer trunk circuit.
- (d) Grounds lead HM toward the make busy and busy display circuit to light lamp DLTR.

20.03 The lighting of lamp DLTR indicates that the dial transfer trunk has been made busy. The opening of lead HMPA or HMPB prevents the use of the associated transfer trunk circuit. The connecting of lead GP or ATB to lead TC directs subsequent requests for transfer to the other transfer trunk circuit.

20.04 If both transfer trunk circuits are made busy, any subsequent request for transfer by a PBX station will be routed to the attendant.

21. OPTIONS

21.01 Option N opens leads FFA and FFB toward the attendant trunks to prevent the false flashing of the SL lamp in the attendant console associated with an attendant trunk when a station dials 0 to call the attendant.

21.02 Option R relocates relay P from the ring side of the circuit to prevent an unbalanced condition that might result in hum or other unwanted noise.

SECTION III - REFERENCE DATA1. WORKING LIMITSLINES AND TRUNKS

1.01 The maximum external loop resistance is 1500 ohms. The minimum insulation resistance is 10,000 ohms.

VOLTAGE LIMITS

1.02	<u>Minimum</u>	<u>Maximum</u>
	-45 volts	-52 volts

2. FUNCTIONAL DESIGNATIONS

<u>Designation</u>	<u>Meaning</u>
B, BA, BB	Supervisory Relays (Station B)
BY	Busy
C, CA, CB	Supervisory Relays (Station C)
CTD	Cut-Through Destination
CTZ	Sequence Circuit
DB0	Station B Dials Zero
DB9	Station B Dials Nine
DB9A	Station B Dials Nine Auxiliary
DC0	Station C Dials Zero
DC9	Station C Dials Nine
DC9A	Station C Dials Nine Auxiliary
DLF	Delay Station B
DLBA	Delay Station B Auxiliary
DLC	Delay Station C
HM	Hold Magnet
LCO	Lamp Cutoff
MBT	Make Busy Trunk
MC	Marker Connect
MCA	Marker Connect Auxiliary
MCB	Marker Connect to B
P	Polarized
PA	Polarized Auxiliary
RLBY	Release Busy Condition
RLDT	Release Dial Tone

RLS	Release Transfer Trunk
RS	Ring Start
RT	Ring Trip
SL	Sleeve
STB	Station Transfer B
STC	Station Transfer C
TT	Tie Trunk
TTA	Tie Trunk Auxiliary
TTF	Tie Trunk Flashing
TTR	Tie Trunk Release
W	Sequence Circuit

3. FUNCTIONS

3.01 To provide means which permit a PBX station, originally connected to an outside party through a central office trunk, to transfer the outside party to another PBX station without the assistance of the attendant.

3.02 To disconnect any station from the transfer trunk after the transfer has taken place.

3.03 To return a transfer station to the attendant through the central office trunk without going through an attendant trunk.

3.04 To return 120-ipm tone if any station involved in a transfer attempts to add a central office trunk by dial 9 procedure.

3.05 To release the transfer trunk or part of the transfer trunk and part of the central office trunk from a partially completed call if the switchhook is flashed at any time prior to answer by the called station.

3.06 To provide for operation of the trunk with the traffic measurement system No. 1A remote scanner.

3.07 To provide for a dial transfer trunk busy indication to the make busy and busy display circuit.

3.08 To provide for being made busy by the make busy and busy display circuit.

4. CONNECTING CIRCUITS

4.01 When this circuit is listed on a keysheet, the information thereon is to be followed.

4.02 This circuit is connected to the following circuits which are part of the 756A PBX system:

- (a) Line, Link, and Marker Circuit - SD-65781-01.
- (b) Ringing Circuit SD-81288-01 and Power Supply Circuit SD-81326-01, or Power Supply Circuit SD-81577-01 alone, or Power Supply Circuit SD-81600-01 alone.
- (c) Tie Trunk Circuit - SD-65535-01 (by switching action).
- (d) Controller Circuit, Dial Transfer Station Controlled - SD-66909-01.
- (e) Make Busy and Busy Display Circuit - SD-5E029-01.
- (f) Relay Time Delay Circuit - SD-99361-01 (Option W).
- (g) Relay Time Delay Circuit - SD-66793-01 (Option X).
- (h) Traffic Measurement System No. 1A Remote Scanner and Encoder Circuit, Portable Type - SD-3B200-01.

4.03 This circuit also includes two plug-in timing circuits, SD-66793-01.

5. ALARM INFORMATION

5.01 An operated fuse supplying the station dial transfer trunk circuit with add-on conference results in visual and audible signals at the attendant position and in the alarm, transfer, and test circuit. Also, if alarm sending is provided, a major alarm is transmitted to the plant service center.

5.02 Replacing the operated fuse silences the audible alarm and extinguishes the alarm lamps.

6. MANUFACTURING TESTING REQUIREMENTS

6.01 The dial transfer trunk circuit, station controlled, shall be capable of performing all of the functions given in this circuit description. The relays with which it is equipped shall meet all requirements of the Circuit Requirements table.

7. TAKING EQUIPMENT OUT OF SERVICE

7.01 When the make busy and busy display circuit is not provided, the station dial transfer trunk circuit, with add-on conference, may be taken out of service by the following procedures in sequence:

- (a) Determine that the circuit is not in use by observing that all relays are released.
- (b) Block relay STB released.
- (c) Remove all battery supply fuses.
- (d) Block relay HM operated.

7.02 When the make busy and busy display circuit is provided, the station dial transfer trunk circuit may be taken out of service by the following procedure in sequence:

- (a) Determine that the circuit is not in use by observing that the dial transfer trunk busy lamp (DLTR lamp) in the make busy and busy display circuit is not lighted.
- (b) Operate key DLTR in the make busy and busy display circuit.

SECTION IV - REASONS FOR REISSUE

B. Changes in Apparatus

B.1 Added

LCO Relay, 1/2AK4,
Spare with Option W,
App Fig. 1, Option N

C Diode, 446F, App Fig. 1,
Option R

D. Description of Changes

D.1 Relay LCO is added to the Apparatus Index.

D.2 Leads FFA and FFB are added to the Lead Index for the attendant trunk.

D.3 Options N, R, and S are added to the Option Index.

D.4 Option N is added as Standard to open leads FFA and FFB to prevent flashing the attendant trunk SL lamp falsely when a station dials 0 to call the attendant.

D.5 Option S is designated and rated Mfr Disc.

D.6 Option R is added as Standard.

D.7 Circuit Note 104 is revised to reflect Issue 9D.

D.8 Circuit Note 105 and Information Note 305 are added.

D.9 Sequence Charts SC9 and SC21 are revised to show options to relay LCO.

D.10 CAD Fig. 1 is revised to add leads FF, FFA, and FFB.

D.11 The Diode Index is corrected to add diode C.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 3221-WVS-RGP

POWER SYSTEMS
POWER SUPPLY CIRCUIT
FOR 756A PBX
WITH BATTERY RESERVE
J86464

CHANGES

A. Changed and Added Functions

- A.1 Added battery reserve arrangement (App Fig. 7) to supply +10V for DSS and busy lamps.
- A.2 Added battery reserve arrangement (App Fig. 8) to supply +48V for direct station selection.

B. Changes in Apparatus

Added

App Fig. 7

App Fig. 8

D. Description of Changes

- D.1 In FSI added App Fig. 7 and 8
- D.2 In FSI designated wiring option "T".
- D.3 Changed circuit notes 102 and 103 to include information on D.1 and D.2.
- D.4 Added App Fig. 7 and 8 to sheet 4.

F. Changes in Description of Operation

In SECTION II:

- F.1 Change 1.02 to read "Positive 48V dc is provided from the output of the J87230B, dc to dc converter."

F.2 Change 1.04 to read "Positive 10V dc is provided from the output of the J87225A, dc to dc converter."

F.3 Change 1.08 to read "---- is covered by fuses F1 through F10."

In SECTION III:

F.4 Change 1.01 to read " AC Input
105 to 129 volts, 60 Hz $\pm 2\%$ "

F.5 Change 1.02 (b) to read
"(b) +48 40 52.6 0 to 1.5
Noise max, 56 dBrn C-Message
Bridge Conn."

F.6 Add the following to 1.02
"(c) +10 9 11 0 to 3
Noise max, 150 millivolts, peak to peak."

F.7 Delete 1.03.

F.8 Change 3.01 (c) to read "Provide 10 volts dc for lamps in sets."

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 4257-RRG
WECO DEPT 8143-JRP-ET

POWER SYSTEMS
POWER SUPPLY CIRCUIT
FOR 756A PBX
WITH BATTERY RESERVE
J86464

SECTION I - GENERAL DESCRIPTION1. PURPOSE OF CIRCUIT

- 1.01 To provide power supplies for 756A PBX systems with battery reserve.

SECTION II - DETAILED DESCRIPTION1. INPUT AND OUTPUT VOLTAGES

- 1.01 105 to 129 volts commercial ac power is supplied from a nearby outlet through the plug, cord and line switch to the input distribution point, TS1, to provide power for the J87211A rectifier which furnishes negative 48V dc power to float the batteries.
- 1.02 Positive 48-volt dc is provided from the output of the T1 transformer rectified with a 426A diode, CR1, and filtered with C1 and C2 capacitors, 2000 microfarads, to reduce output noise.
- 1.03 An applique, "X" option, is provided to add 0 to 96 volts output having a low ripple content.
- 1.04 10 volts 60 Hz is obtained from a tap on the secondary winding of the T1 transformer. To maintain the outputs of the T1 transformer within working limits, the input winding is equipped with taps for normal 111-, 117-, or 123-volt service.
- 1.05 Ringing is supplied by the J86464H transistorized ringing generator which has the audible ringing tone superimposed on the 20 hertz output.
- 1.06 Low tone is supplied by the J86464G transistorized tone generator which provides an output of 600 Hz modulated at 120 Hz. The LT1 output is approximately 2 volts and is interrupted at 60 IPM & 120 IPM to provide busy tones.
- 1.07 TOUCH-TONE® dial tone is provided by the 404C tone generator. The TT1 output is approximately 1.75 volts for dial tone.
- 1.08 Distribution fusing for this circuit and connecting circuits is covered by fuses F1 through F7.

2. INTERRUPTER AND 60 HERTZ INVERTER

- 2.01 A small 10-volt ac motor in the interrupter (INT) drives a series of cams through a gear arrangement. The rotating cams open and close contacts to provide various timing pulses as shown in Table A.

- 2.02 The 10 volts ac for the interrupter motor is provided by the 60 hertz ac inverter, the output of which is coupled by the T2 transformer to the interrupter motor. A typical half-cycle of operation occurs as follows:

(a) Assume Q1 transistor has just switched on. At this instant the difference between the supply voltage and the voltage drop across R2 (100Ω) appears across winding (5-8) of T2 transformer. The shape of the voltage across winding (5-8) of T2 transformer is rectangular because C3 capacitor provides a low impedance source of voltage for the inverter circuit. The collector current of Q1 transistor will increase exponentially with time as a consequence of the applied rectangular voltage and the primary inductance of T2 transformer.

(b) Because of transformer action, a voltage is induced in winding (9-12) of T2 transformer. This induced voltage is of such a polarity and magnitude as to provide a forward-bias voltage across feedback network R1, R4, R5B, that maintains Q1 transistor saturated. Because Q1 transistor is saturated, feedback network R2, R3, R5A has very little voltage across it. This voltage is insufficient to turn Q2 transistor on. As a result, the collector current of Q2 transistor is minimum during this part of the cycle.

(c) Switching action begins when the increasing collector current of Q1 reaches a value equal to its base current times the transistor current gain, beta. At this time Q1 transistor comes out of saturation and its collector to emitter voltage increases rapidly. The voltage across feedback network R2, R3, R5A increases. This increase in voltage causes Q2 transistor to turn on. Because Q2 transistor is now saturated, feedback network R1, R4, R5B has very little voltage across it. As a result, Q1 transistor is held off.

(d) The ganged potentiometers, R5A and R5B, provide a means to adjust the frequency and compensate for manufacturing variation of inductance in both the transformer and the motor. Diodes CR1 and CR2 insure that the maximum voltage across any transistor cannot exceed twice the voltage across C3 by providing a return path for the lagging current caused by the inductance of the motor load. That is, the voltage across either half of the transformer primary winding is restricted to be not greater than the voltage across C3.

SECTION III - REFERENCE DATA

1. WORKING LIMITS

1.01 AC Input

105 to 129 volts, 60 Hz

1.02 DC Output

	<u>Volts</u>	<u>Min.</u>	<u>Max.</u>	<u>Amp</u>
(a) -48	45	52.6	0 to 11	
Noise max. 39 dBrn C-Message Bridge Connection				
(b) +48	40	60	0.1	
Noise max. 52 dBrn C-Message Bridge Connection				

1.03 AC Output

	<u>Volts</u>	<u>Min.</u>	<u>Max.</u>	<u>Amp</u>
±10, 60 Hz	8	11	2.1	

1.04 Ringing Output

20 hertz, 65 to 90 volts

1.05 Busy Tone Output

LT1 2.0 volts

1.06 TOUCH-TONE Dial Tone Output

TT1 1.75 Volts

2. FUNCTIONAL DESIGNATIONS

None

3. FUNCTIONS

3.01 This power supply circuit is designed to perform the following functions:

- (a) To provide negative 48 volts dc for relay and talking power.

(b) Provide positive 48 volts dc for direct station selection.

(c) Provide 10 volts ac for lamps in sets.

(d) Provide low tone for busy tone.

(e) Provide TOUCH-TONE dial tone.

(f) Provide audible ringing tone of 460 Hz modulated at 40 Hz superimposed on the 20 hertz output.

(g) Provide machine ringing.

(h) Provide signalling interruptions, battery operated 60 hertz inverter to power the interrupter.

(i) Provide negative 96 volts dc for operation of the "Make Busy and Busy Display" test feature.

4. CONNECTING CIRCUITS

4.01 When this circuit is listed on a key sheet the information thereon is to be followed.

4.02 This circuit will function with the following PBX system circuits.

(a) Alarm, Transfer and Test Circuit - SD-66796-01

(b) 756 PBX CAD - SD-65746-01

(c) Two-way Trunk Circuits to Central Office - SD-65752-01

(d) Dial Pulse Register Circuit - SD-65742-01.

(e) -96 Volt DC Applique Circuit - SD-81920-01

SECTION IV - REASON FOR REISSUE

B. Changes in Apparatus

B.1 Removed

KS-15886, L141D Battery. APP Fig. 6

D. Description of Changes

D.1 The KS-15886, L141D lead-calcium batteries were expected to have a life time of double that of the KS-5361 lead-antimony batteries. However, recent studies indicate that their normal life is identical.

Since the KS-15886 batteries cost more than KS-5361 cells with no important advantages, the use of them has been rated "Mfr Disc."

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5147-RRQ
WECO 8143-EAD-TRC-EAF

Page 2
2 Pages

POWER SYSTEMS
SIGNALING CIRCUIT
TRANSISTOR LOW TONE SUPPLY
756A PEX
J864646

CHANGES

B. CHANGES IN APPARATUS

B.1 In CAD1 under Transformers the 530A output transformers (T1 & T2) "Z" option, have been replaced by the 530C output transformers "Y" option.

All other headings under Changes, no change.

1. PURPOSE OF CIRCUIT

1.1 To provide low tone signals for dial tone and busy tone as required by the 756A PEX.

2. WORKING LIMITS

2.1 0.5 Volts ac for Dial Tone
2.0 Volts ac for Busy Tone
45-52 Volts dc

3. FUNCTIONS

3.1 To provide low tone, for dial tone, at the voltage required by the 756A PEX.

3.2 To provide low tone, for busy tone, at the voltage required by the 756A PEX.

4. CONNECTING CIRCUITS

This circuit was originally designed to connect to the following circuit.

4.1 Transistor Transfer & Alarm Circuit - SD-81331-01.

DESCRIPTION OF OPERATION

5. GENERAL

5.1 Oscillators

The oscillators for the 600 cps and 120 cps are L-C tuned Colpitts type using a single pnp junction transistor per oscillator. The transistors are connected in the common collector configuration. Feedback is taken from the emitter through the ADJ 600~ (or ADJ 120~) potentiometer to the junction of capacitors C1 & C2 (or C3 & C4). The oscillator outputs are taken through transformers T1 and T2.

5.2 The modulator is a shunt diode bridge type with the diodes switching at the 120 cps rate. The output of the modulator is a double sideband amplitude modulated signal, with the 600 cps as carrier and the 120 cps as the modulating frequency. This is the actual low tone signal.

5.3 The output amplifiers are common emitter type using a single pnp junction transistor each. Resistor R1 in series with the base of the transistor of LT1 provides the correct signal input to the amplifier to provide 2 volts output for busy tone. Similarly, resistor R5 provides the correct signal input for LT2 to provide 0.5 volt output for dial tone.

5.4 Adjustments

Only two adjustments are provided in this circuit. These are the ADJ 600~ and the ADJ 120~ potentiometers. The potentiometers are first turned completely counter-clockwise. A high impedance ac voltmeter is connected in turn across the primaries of T1 & T2. A KS-14510, 11 Volt-Ohm-Milliammeter, or equivalent, is satisfactory for the voltage measurements. The voltmeter leads are connected to A6R & C4L for T1 and to B6R & C4L for T2. Then, starting with the 600~ oscillator each potentiometer is slowly turned clockwise until the voltmeter reaches a peak. Initially the 600~ output will peak at 5 volts. and the 120~ output will peak at 4.5 volts. After the 120~ potentiometer has been adjusted it will be found that the 600~ output now peaks at about 4.5 volts also. the correct adjustment is at this peak in output and provides a maximum undistorted oscillator output with the correct modulation percentage and with no drift between the two frequencies in the modulated signal. These adjustments may require resetting if the oscillator printed wire boards are changed.

Connect the voltmeter to terminals 2 & 3 on the LT T.S. This voltage read on the 3V ac scale, should be in the range 0.4 to 0.65 volts. Then connect the voltmeter to terminals 2 & 4 on the LT T.S. This voltage should be in the range 1.6 to 2.0 volts.

For all of the above adjustments the applied voltage should be 52V dc.

5.5 The networks shown in FS2, FS3 and FS4 consist of the transistors and other small components such as resistors, diodes and capacitors. These networks are mounted on 1-1/2 by 4 inch printed wire boards and may easily be replaced in case of failure of transistors or other components. Both the printed wire boards and their respective connectors are keyed so

that only the correct board can be inserted in each socket.

Caution: Disconnect the battery supply before removing or inserting any of the networks (printed wire boards). All continuity tests on the networks or the circuit when the networks are in place should be made with an ohm-meter.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT. 5152-JWO-HHS-BT

POWER SYSTEMS
RINGING CIRCUIT
TRANSISTOR 20~ SUPPLY
756A PBX & 800A PBX
J86464HSECTION I - GENERAL DESCRIPTION1. PURPOSE OF CIRCUIT

1.01 To provide 20 Hz ringing current with audible tone, as required by the 756A PBX and 800A PBX.

2. GENERAL DESCRIPTION

2.01 A 20 Hz Colpitts oscillator provides a signal to drive the preamplifier. The output of the preamplifier provides sufficient power to drive the output stage. The square wave output signal is filtered to provide a sine wave. Harmonics from the square wave are fed around the filter to add audible ringing tone.

SECTION II - DETAILED DESCRIPTION1. OSCILLATOR

1.01 The 20 Hz oscillator consists of the network shown in FS2 and C1 and C2 capacitors, L1 inductor, and R1 potentiometer in FS1. It is an L-C tuned Colpitts type oscillator employing a single pnp junction transistor connected in the common collector configuration. Feedback is taken from the emitter through the ADJ 20~(FS1) potentiometer to the junction of C1 and C2 capacitors (FS1) of the tuned network. The oscillator output is taken from the emitter through C2 capacitor (FS2).

2. DRIVER AMPLIFIER

2.01 The driver amplifier consists of the network shown in FS3, T1 transformer in FS1 and, AMP 1 shown in FS4. This amplifier is a conventional common emitter type using a pnp junction power transistor. The R1 resistor (FS3) is a voltage dropping resistor to drop 52 volts dc down to about 12 volts for the oscillator and driver amplifier. The C1 capacitor (FS3) is a power supply bypass capacitor.

3. OUTPUT STAGE

3.01 The output stage consists of C3 and C4 capacitors, R3 and R4 resistors and T2 transformer shown in FS1, and AMP 2 and AMP 3 shown in FS4. This stage is a pushpull amplifier with the transistors operating as switches. That is, they are driven alternately into saturation and to cutoff by the 20 Hz signal from the driver amplifier.

Thus the output from this stage is a 20 Hz square wave. C3 and C4 capacitors (FS1) and their respective bleeder resistors R3 and R4, (FS1) form a voltage divider to make efficient use of the available 52-volt dc supply without exceeding the transistor voltage rating. One capacitor is connected in series with the emitter-collector circuit of each transistor. Thus, since the applied voltage divides equally, one half of this voltage is applied to each transistor. The high value of the capacitance (1000 μ F) sustains the dc voltage during the interval that the transistor is cut off. The R2 resistor (FS1) is a series resistor used to drip 52 volts down to 40 volts so that no more than 20 volts is applied to each transistor when "Z" option is provided. When "Y" option is provided R2 resistor serves as a voltage adjustment. The "TR2" lead connected to T2 transformer secondary (FS1) supplies a 12.5-volt signal for the transfer and alarm circuit.

4. LOW-PASS FILTER

4.01 A conventional low-pass filter made up of L2 inductor and C5 capacitor (FS1) is used to attenuate the higher harmonics of the square wave and thus convert it to a sine wave. The filter cutoff frequency is set at about 40 Hz.

5. AUDIBLE TONE NETWORK

5.01 The audible tone network consists of two tuned L-C circuits. A series L-C circuit, tuned to about 420 Hz, made up of L3 inductor and C6 capacitor picks off higher harmonics ahead of the low-pass filter. This signal is fed to a parallel L-C circuit, also tuned to 420 Hz, made up of L4 inductor and C7 capacitor. The parallel circuit is shock excited, by the applied signal, at a 40 Hz rate with an excitation frequency of about 420 Hz. The resulting waveform is approximately 420 Hz double-sideband amplitude modulated with 40 Hz. The 40 Hz is not sinusoidal. This modulated signal is the actual audible tone, and since it is in series with the generator output it is superimposed on the 20 Hz as required.

6. ADJUSTMENTS

6.01 Two adjustments are provided in this circuit. These are the ADJ 20~ and the R2 potentiometers (FS1). With no battery applied to the generator, set R2 so that there

is 70 ohms in the circuit when "Z" option is provided and zero ohms when "Y" option is provided. Apply 52 volts dc to the circuit. Turn the ADJ 20~ potentiometer completely counterclockwise and then slowly turn it clockwise until an ac voltmeter connected across the generator output reaches a peak. This will be at about 90 volts. A KS-14510, 11 Volt-Ohm-Milliammeter, or equivalent is satisfactory for the voltage and resistance measurements. With these adjustments there will be approximately 38 volts dc across C3 to C4 capacitors (FS1) when "Z" option is provided and 52 volts when "Y" option is provided. If the output voltage is higher than 90 volts increase the resistance of R2 (FS1) until the output voltage drops to the correct value. If the output voltage is too low the resistance of R2 may be reduced to increase the generator output voltage. If the circuit cannot be adjusted to provide 90 volts for "Y" option with zero ohms in R2 resistor the lead connected to terminal 3 on T2 transformer can be moved to terminal 2 and the resistance in R2 resistor increased so that 90 volts is obtained. The adjustment of R2 must be made when the generator is first installed. It should not be necessary to change this adjustment. It may be necessary to readjust the ADJ20~ potentiometer when networks (printed wire boards) are changed.

6.02 The networks shown in FS2 and FS3 are mounted on 1-1/2 by 4-inch printed wire boards and so may easily be replaced in case of failure of the transistors or other small components. Both the printed wire boards and their respective connectors are keyed so that only the correct board can be inserted in each socket.

6.03 The amplifiers shown in FS4 are pnp power transistors mounted on a heat sink. The entire assembly can be replaced with only a screw driver.

Caution: Disconnect the battery supply before removing or inserting any of the networks (printed wire boards) or amplifiers (transistor heat sink assemblies). All continuity tests on the networks or on the circuit when the networks and amplifiers are in place should be made with an ohmmeter.

SECTION III - REFERENCE DATA

1. WORKING LIMITS

- 1.01 65-90 volts ac
45-52 volts dc

2. FUNCTIONAL DESIGNATIONS

- 2.01 None

3. FUNCTIONS

- 3.01 To provide 20 Hz ringing current at the voltage required by the 756A PBX and 800A PBX.
- 3.02 To provide audible tone superimposed on the 20 Hz at the level required by the 756A PBX, and 800A PBX.

4. CONNECTING CIRCUITS

- 4.01 This circuit was originally designed to connect to the following circuit:

SD-81331-01 Transistor Transfer and Alarm Circuit

SD-81971-01 Power Supply Circuit for the Battery Reserve 800A PBX

SECTION IV - REASONS FOR REISSUE

A. CHANGED AND ADDED FUNCTIONS

- A.1 The 20 Hz output is shown superimposed on the ground for the battery reserve version of the 800A PBX.

D. DESCRIPTION OF CHANGES

- D.1 In FS1, reference to note 106 has been added.
- D.2 In FS1 terminal 7 of transformer T2 is shown connected to ground per "W" option.
- D.3 CAD 3 is added for 800A PBX application.
- D.4 NOTE 203 has been added.
- D.5 NOTE 106 has been added.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5144-JWO-JJS-EAF

CIRCUIT DESCRIPTION

CD-81540-01
ISSUE 6B
APPENDIX 5B
DWG ISSUE 18B

POWER SYSTEMS REGULATED RECTIFIER SEMI-CONDUCTOR TYPE 48 VOLTS, 11 AMPERES DC 115/230 VOLTS, 60 CYCLE AC J87211A

CHANGES

B. Changes in Apparatus

<u>B.1</u>	<u>Superseded</u>	<u>Superseded By</u>
	D1 Diode 425L	D1 Diode 485L
	D2 Diode 425H	D2 Diode 485H

D. Description of Changes

- D.1 The CR1 "U" option was changed to include only the KS-15989,L9 Diode.
- D.2 The G.E. Co. 2N3656 SCR was designated as an "F" option.
- D.3 Circuit note 108 was removed.
- D.4 Circuit note 109 was added.
- D.5 Circuit note 104 was changed.
- D.6 The 14 gage wire designation was moved from above to below the "H" option.

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DEPT 5147-RRG
WECO 8143-WLL-TRC-EAF

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CIRCUIT DESCRIPTION

CD-81540-01
ISSUE 6B
APPENDIX 4D
DWG ISSUE 17D

POWER SYSTEMS
REGULATED RECTIFIER
SEMICONDUCTOR TYPE
48 VOLTS 11 AMPERES DC
115/230 VOLTS 60 CYCLE AC
J87211A

CHANGES

B. Changes in Apparatus

B.1 Superseded

R9 Resistor,
21.5Ω, KS14603, L3D

Superseded By

R9 Resistor
1.0Ω, KS14603, L3D

B.2 M1 Meter, KS14784, L4

M1 Meter, KS14507, L24

D. Description of Changes

D.1 The "F" option was added to decrease the series gate resistor thereby increasing the available gate current to CR1.

D.2 Circuit Note 108 was added.

D.3 Circuit Note 104 was changed

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5454-RR-CSK-EAF

CIRCUIT DESCRIPTION

CD-81540-01
ISSUE 6B
APPENDIX 3D
DWG ISSUE 16D

POWER SYSTEMS
REGULATED RECTIFIER
SEMICONDUCTOR TYPE
48 VOLTS 11 AMPERES DC
115/230 VOLTS 60 CYCLES AC
J87211A

CHANGES

D. Description of Changes

- D.1 The commercial code for the KS-15989, List 9
CR1 silicon controlled rectifier was furnished.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5454-RR-CSK-EJO'

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POWER SYSTEMS
REGULATED RECTIFIER
SEMICONDUCTOR TYPE
48 VOLTS, 11 AMPERES DC
115/230 VOLTS, 60 CYCLES AC
J87211A

CHANGES

D. Description of Changes

D.1 Circuit Note 107 is added.

D.2 The "G" option is required when the rectifier is used in the battery reserve power plant of the 2A Automatic Call Distributor. This option provides control circuit voltage directly from the battery instead of the rectifier terminals to overcome the blocking effect of the power diode in the charge leads of the 2A Automatic Call Distributor power plant.

D.3 The following drawing changes are made "For Record Only"

- (a) "J" option symbol added to R14 resistor of Fig. 1.
- (b) Transistor leads designations of Q1 in Fig. 3 corrected.

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DEPT 5154-RR-CSK-EAF

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POWER SYSTEMS
REGULATED RECTIFIER
SEMICONDUCTOR TYPE
48 VOLTS, 11 AMPERES DC
115/230 VOLTS, 60 CYCLES AC
J87211A

CHANGES

B. Changes in Apparatus

B.1 Removed

Q1 transistor 30A - Fig. 3, "H" option

B.2 Removed

Replaced By

Q1 transistor
2N3766 - Fig. 3,
"G" option

Q1 transistor 2N3766 -
Fig. 3

D3 diode 446A -
Fig. 3, "G" option

D3 diode 446A - Fig. 3

D. Description of Circuit Changes

D.1 The designation of the 511 ohm resistor in series with the "PG" lead was changed from R13 to R14 since the R13 designation is already used.

D.2 The battery alarm "J" option and ground alarm "R" option features were added to the Feature Or Option table in note 102.

D.3 An undesignated capacitor symbol was removed from the schematic in Fig. 3.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5154-RS-CSK-EAF

48 VOLTS, 11 AMPERES DC
115/230 VOLTS, 15 AMPERE AC
187211A

1. PURPOSE OF CIRCUIT

SECTION II - DETAILED DESCRIPTION

1.01 This rectifier was developed to be used in conjunction with a regulator control circuit such as that shown on SD-81541-01. An over-all description of the operation of this type circuit is given in CD-81541-01.

1.03 If either the load current or the output voltage is too high, CBL circuit breaker will trip to disconnect the rectifier from the discharge circuit and battery, and auxiliary contacts on CBL will apply ground to the RFA lead when "R" option is used or battery through 500-ohm to the PG lead when "J" option is used. Pole A of CBL circuit breaker regardless of option "X" or "Y" will always remain in the battery lead. Tripping on high voltage is controlled by Q1 transistor and associated high voltage detecting circuitry. The Q2 transistor provides a selective shut down feature, such that if rectifiers are operated in parallel, the rectifier that is delivering current at high voltage, will be shut down permitting the other rectifiers to regulate within proper voltage limits. The R2 resistor provides a holding current path to keep the controlled rectifier in the "on" state at no-load or light loads where L1 inductor is below critical inductance.

Placing the Rectifier in Service

2.01 To place the rectifier in service, select primary tap on T1 transformer as shown in Circuit Note 105. Check to see that all fuses are in place, then operate the S1 switch and the CB1 circuit breaker to the ON position.

2.02 To adjust rectifier output voltage rotate the R7 potentiometer, VOLTS ADJ, to the maximum counterclockwise (ccw) position. This R7 potentiometer is located in the regulator circuit and is shown on SD-81541-01. Rotate the R7 potentiometer in a clockwise (cw) direction until the rectifier is charging the batteries at 2.17 volts per cell.

2.03 The CC slide wire resistor located in the regulator circuit SD-81541-01, which limits the output current of the rectifier, and the R8 resistor which determines the voltage level at which the high voltage shut down operates, are factory adjustments and should only be readjusted in the field in case of trouble conditions.

2.04 To adjust the current droop, move the slider of the CC resistor to extreme left. Load rectifier to approximately 13 amperes. Move the slider of the CC resistor to the right until M1 ammeter reads 11 amperes.

Caution: Checking and adjustment of the high voltage shut down circuit requires raising the battery voltage above float limits; and as such, may cause damage to connected equipment.

2.05 To adjust the high voltage shutdown circuit, proceed as follows:

Figure 2 (Mfr Disc.) R8 Slide Wire Resistor

- (1) Turn off the rectifier (S1 switch and CBI circuit breaker in OFF position) and remove the F1 fuse.
- (2) Position the slider of the R8 resistor at the approximate midpoint of its travel.
- (3) Replace F1 fuse and turn on rectifier.
- (4) Load rectifier to approximately 2 amperes and increase the output voltage to the specified value, if no value is specified adjust the 2.45 volts per cell by rotating the VOLTS ADJ potentiometer in a cw position.
- (5) If the rectifier shuts down at less than the specified value or 2.45 volts per cell, turn the rectifier off and remove the F1 fuse. Move the slider to the right about 1/8 inch. This will cause the high voltage shutdown circuit to operate at a higher output voltage. (Moving the slider to the left will cause shutdown at a lower voltage.) Repeat steps (3), (4), and (5) as required.
- (6) Readjust the VOLTS ADJ potentiometer for proper float voltage.

Figure 3 R8 Potentiometer "G" Option

- (1) Rotate the R8 potentiometer to its extreme cw position.
- (2) Load the rectifier to approximately 8 amperes and rotate the VOLTS ADJ potentiometer in a cw direction increasing the output voltage to the specified value. If no voltage is specified adjust to 2.45 volts per cell.
- (3) Slowly rotate the R8 potentiometer in a ccw direction until the rectifier shuts down.

- (4) Readjust the VOLTS ADJ potentiometer for proper float voltage.

Figure 3 R8 Potentiometer "H" Option

- (1) Turn off the rectifier (S1 switch and CBI circuit breaker in the OFF position) and remove the F1 fuse.
- (2) Rotate the R8 potentiometer to its extreme ccw position and disconnect pole B of the CBI circuit breaker by removing the LINE lead on pole B.
- (3) Replace F1 fuse and turn ON the rectifier. With the rectifier load to approximately 8 amperes, rotate the VOLTS ADJ potentiometer in a cw direction increasing the output voltage to the specified value. If no voltage is specified, adjust to 2.45 volts per cell.
- (4) Using a KS-14510, L5 multimeter on the 3 Volt DC range, monitor the voltage between terminals 2 and 1 of the Q1 transistor, positive to negative respectively. The meter reading should be a small positive value. Slowly rotate the R8 potentiometer cw until the meter reads 0 volts, then remove the multimeter.
- (5) Rotate the VOLTS ADJ potentiometer in a cw direction increasing the output 0.5 volt above the value specified in step (3). Then, touching the LINE lead to pole B of the CBI circuit breaker should cause the breaker to operate. If the breaker does not operate within several seconds, repeat step (4) adjusting the R8 potentiometer until the multimeter reads 0.05 volt positive. This will cause shutdown at a lower voltage.
- (6) Turn the rectifier OFF and reconnect the LINE lead to pole B of the CBI circuit breaker. Rotate the VOLTS ADJ potentiometer ccw, turn ON the rectifier and readjust the VOLTS ADJ potentiometer for the proper float voltage.

Caution: The preceding steps (1) to (6) will set the shutdown value to within 1/4 volt of the desired value. To avoid operating the High Voltage Shutdown circuit outside its design limits, do not increase the output voltage slowly to verify this value.

SECTION III - REFERENCE DATA

1. WORKING LIMITS

1.01 AC Input

105-, 115-, or 125-; or 210-, 230- or 250-, ± 10 percent ac volts rms applied to the proper taps. 60 cycle ± 2 percent, single phase.

1.02 DC Output

Amperes

Volts

0 to 11

49 to 55

1.03 DC Output Voltage Regulation: ± 1 percent for output current 0 to 10 amperes, including the ± 10 percent line voltage variation.

2. FUNCTIONS

2.01 This rectifier is designed to perform the following functions.

- (a) To furnish filtered dc power to a battery at a constant voltage within the designed load range.
- (b) To limit the output current to a safe value under overload.
- (c) To disconnect the rectifier from the load in event of a high voltage trouble condition.

(d) To provide negative output "X" option, or positive output "W" option, dc voltage.

3. CONNECTING CIRCUITS

3.01 This rectifier uses the J87214A regulator control circuit per SD-81551-01.

SECTION IV - REASONS FOR REISSUE

CHANGES

B. Changes in Apparatus

B.1 Superseded

Superseded By

Q1, 30A Transistor
H Option

Q1, 2N3766 Transistor G Option and
D3, 446A Diode
G Option

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5154-FPH-CSK-SPF

POWER SYSTEMS
POWER SUPPLY CIRCUIT
AC, DC & RINGING SUPPLY
J86812A&B

CHANGES

A. Changed and Added Functions

A.1 This circuit has been revised to provide optional arrangements for use in the 400 Switching System, 756A PBX and the new 558A PBX. The wiring has been changed so that the options can be selected by strapping terminals at the terminal strip. Under the present arrangement it is necessary to alter the shop wiring to adapt this circuit for the 756A PBX. The possibility of damaging the unit under this procedure is eliminated by this change.

D. Description of Changes

D.1 Wiring option "N" was added to remove the hard wired $\pm 10V$ ac from the interrupter and to free a terminal for access to the inverter.

D.2 Wiring option "M" was added to maintain continuity of the ground and to connect the interrupter to the terminal strip. The 756A PBX uses this unit with these options.

D.3 Added options "J" and "K" to circuit note 102. Option "J" provides interrupted ground for the 558A PBX, and option "K" provides interrupted $\pm 10V$ ac for the 400 Switching System.

POWER SYSTEMS
POWER SUPPLY CIRCUIT
AC, DC & RINGING SUPPLY
J86812A & B

CHANGES

B. Changes in Apparatus

B.1 Superseded

Sprague Capacitors
C5 & C6 in Fig. 5
D39159 ("R" option)

Superseded By

KS-20133, L9 Capacitor
("Q" option)

D. Description of Changes

D.1 Options "Q" and "R" were added to the drawing.

D.2 In Fig. 2, L1 inductor was changed to 293Y.

This is a "NO RECORD" change as it was erroneously listed as 239Y on issue 9D and was never manufactured incorrectly.

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DEPT 5143-HMK-DET-EAF

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POWER SYSTEMS
POWER SUPPLY CIRCUIT
AC, DC & RINGING SUPPLY
J86812A & B

CHANGES

A. Changed and Added Functions

A.1 An additional dc output (-96 volts) is provided for operation of the "Make Busy and Busy Display" test feature.

B. Changes in Apparatus

B.1 Added

Fig. 6, "S" Option, -96 Volt Applique

D. Description of Changes

D.1 An applique is provided, "S" option, to add a -96 Volt dc output having a low ac ripple content.

D.2 Circuit notes 102, 103 and the option index are revised. Information note 302 is added. The Maintenance Specification BSP number is added to the drawing.

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DEPT 5153-SR-DET-EAF

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POWER SYSTEMS
POWER SUPPLY CIRCUIT
AC, DC & RINGING SUPPLY
FOR SWITCHING SYSTEM 400
J86812 A & B

CHANGES

B. Changes in Apparatus

<u>B.1</u>	<u>Superceded</u>	<u>Superceded By</u>
	410A Transformer	410B Transformer
	"V" option	"T" option

D. Description of Circuit Changes

- D.1 This drawing is reissued to rate the use of the 410A transformer, T1, "MFR DISC", replaced by the 410B transformer.
- D.2 Circuit note, 103 and the option index are revised.

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DEPT 5153-SR-DET-EAF

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POWER SYSTEMS
POWER SUPPLY CIRCUIT
AC, DC & RINGING SUPPLY
FOR SWITCHING SYSTEM 400
J86812A & B

SECTION I - GENERAL DESCRIPTION1. PURPOSE OF CIRCUIT

- 1.01 To provide power, ringing and tones for Switching System 400.

2. GENERAL DESCRIPTION OF OPERATION

- 2.01 The 105 to 129 volts commercial ac power is supplied from a nearby outlet through the plug, cord and line switch to the input distribution point, TS1. Output distribution is on TS2, J1 and J2.

SECTION II - DETAILED DESCRIPTION1. -48V RECTIFIER

- 1.01 Negative 48 volts dc power is supplied by the KS-19642 rectifier. Capacitors C5 and C6 in the switching system are provided on the -48V output as protection against power failures of less than 0.25 second duration.

2. POSITIVE 48V DC SUPPLY

- 2.01 Positive 48 volts dc supply is provided from the output of the T1 transformer, rectified by CR1 diode, and filtered, by capacitors C3 and C4 to reduce output noise.

3. ±10V AC SUPPLY

- 3.01 10 volts 60 cps is obtained from a tap on the secondary winding of the T1 transformer. To maintain the outputs of T1 transformer within working limits the input winding is equipped with taps for nominal 111-, 117-, or 123-volt service.

4. FREQUENCY GENERATOR RING G

- 4.01 Ringing is supplied by the RING G frequency generator that converts 60 to 20 cps and connects to a circuit consisting of C1 capacitor and winding (1-2) of L1 inductor. This circuit resonates at about 460 cps and is shock excited by the current pulses due to an abrupt drop in voltage across the V1 gas tube each time the tube fires. The current through the tube is controlled by the circuit consisting of C2 capacitor, R1 resistor and winding (3-4) of L1 inductor. With the circuit constants used, the tube fires twice on each positive and negative half cycle supplying 40 pulses per second.

The resulting output is 460 cps modulated at 40 cps which produces a pleasing tone.

5. FREQUENCY GENERATOR LT

- 5.01 Low Tone is supplied by the LT frequency generator that converts 60 to 600 cps modulated at 120 cps. On lead "[LT1]" the output is approximately 2 volts and is interrupted at 60 IPM to provide busy tone.

6. TONE GENERATOR TT

- 6.01 TOUCH-TONE dial tone is provided by the 404C tone generator. On lead "[TT1]" the output is approximately 1.75 volts for dial tone.

7. INTERRUPTER INT

- 7.01 A small 10 volt ac motor in the INT interrupter drives a series of cams through a gear arrangement. The rotating cams open and close contacts to provide various timing pulses as shown in Table A.

8. ALARMS

- 8.01 Provisions for fuse failure alarms are supplied on -48 volts to the ringing circuit and 10 volts ac to the output and interrupted circuits.

SECTION III - REFERENCE DATA1. WORKING LIMITS1.01 AC Input:

105 to 129 volts 60 cps.

1.02 Outputs(a) DC Outputs

Nominal Volts	Voltage Range Volts	Load Range Amperes
-48	-45 to -52.6	0.5 to 8.0 normal 12 intermittent
+48	40 to 60	0.1

(b) AC Output

<u>Nominal Volts</u>	<u>Voltage Range Volts</u>	<u>Load Range Amperes</u>
±10,60 cps	8 to 11	2.1

(f) To provide 20 cps ringing current with an audible ringing tone of 460 cps modulated at 40 cps.

(g) To provide machine ringing.

(h) To provide signaling interruptions.

1.03 Output

Nominal
Volts DC

-48

Noise max. 34 dbrnc
BRDG

Ripple max. 0.050 peak
to peak at
8 Amp load

+48

Noise max. 52 dbrnc
BRDG

Ripple max. 1.0V rms

4. CONNECTING CIRCUITS

4.01 This power supply connects to SD-69471-01 No. 1 Slide Equipment and other switching circuits.

SECTION IV - REASONS FOR REISSUECHANGESB. Changes in Apparatus1.04 AC Outputs (Ringing and Tone Supply)

(a) Ringing - 75 to 100 volts, 20 cps

(b) Busy Tone - 2.0 volts, [LT1]

(c) TOUCH-TONE
Dial Tone - 1.75 volts, [TT1]

B.1 SupersededSuperseded By

C5, C6, C7
Capacitors,
KS-19076,
7000 uf each-
Fig. 3

C5, C6 Capacitors,
Sprague D39159
16,000 uf each-
Fig. 5

C5, C6, C7
Capacitors,
KS-19319,
7000 uf each-
Fig. 4

C5, C6 Capacitors,
Sprague D39159
16,000 uf each-
Fig. 5

2. FUNCTIONAL DESIGNATIONS

None

3. FUNCTIONS

3.01 This circuit is designed to perform the following functions:

(a) To provide -48 volts dc for relay and talking power for switching systems with no reserve battery.

(b) To provide +48 volts dc for direct station selection.

(c) To provide 10 volts ac for lamps in sets and interrupted power.

(d) To provide low tone for busy tone.

(e) To provide TOUCH-TONE dial tone.

D. Description of Changes

D.1 Figs. 3 and 4 were rated "Mfr Disc." replaced by Fig. 5 which was added to the drawing.

D.2 Circuit note 103 was brought up to date to add reference to changes on issues 3D and 4D.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5153-HMK-DET-EAA

POWER SYSTEMS
SLIDE NO. 1 POWER SUPPLY
FOR 757A PBX
J86808B

CHANGES

D. Description of Changes

D.1 In Fig. A the size of the 3-conductor portable cable has been changed from 12 gauge to 10 gauge to conform to the National Electrical Code.

D.2 Equipment Note No. 213 has been added.

D.3 In Fig. 1 the DSL lamp has been rated "Mfr Disc." (Option A) since it does not serve an important role in the functions of a maintenance craftsman.

D.4 Since the 40-line traffic capacity "A" system is rated "Mfr Disc." and Figs. B & D apply to this system, Figs. B & D are rated "Mfr Disc."

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 2433-RRG
WE DEPT 8143-EAD-TRC

CIRCUIT DESCRIPTION

CD-81581-01
ISSUE 5B
APPENDIX 2D
DWG ISSUE 19D

POWER SYSTEMS
SLIDE NO. 1 POWER SUPPLY
FOR 757A PBX
J86808B

CHANGES

B. Changes in Apparatus

B.1 Superseded

Superseded By

Connector- Plug,
Hubbell, No. 9965G -
Fig. B, "E" Option

Cap, Hubbell,
No. 2321 - Fig. B,
"B" Option

Connector Receptacle,
Hubbell No. 7310BG -
Fig. B, "E" Option

Outlet, Hubbell..
No. 2320 - Fig. B,
"B" Option

D. Description of Changes

D.1 Added options "B" and "E" to replace the
ac supply cap and outlet to conform to
UL standards.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 4257-RRG
WFO DEPT 8143-EAD-ET

CIRCUIT DESCRIPTION

CD-81581-0.
ISSUE 5B
APPENDIX 1D
DWG ISSUE 18D

POWER SUPPLY SLIDE NO. 1 POWER SUPPLY FOR 757A PBX J86808B

CHANGES

B. Changes in Apparatus

<u>B.1</u>	<u>Superseded</u>	<u>Superseded By</u>
	DS1 lamp, type 2Y	DS1 lamp, type M1
	DS2 lamp, type 2Y	DS2 lamp, type M1
	DS3 lamp, type 2Y	DS3 lamp, type M1
	DS4 lamp, type 2Y	DS4 lamp, type M1
	DS5 lamp, type 2Y	DS5 lamp, type M1

D. Description of Changes

- D.1 For the lamps DS1, DS2, DS3, DS4, and DS5, the code 2Y has been rated "MFR DISC", and replaced by the M1 type lamps.
- D.2 Circuit note 111 has been deleted because it should not have been put in this circuit and it is incompatible with the schematic issue classification 17B.
- D.3 Reference to circuit note 111 in the circuit note 104 has been deleted.

F. Changes in Description of Operation

F.1 Add the following under section II paragraph 2.06:

D1 diode is connected across LV relay.
R1 resistor is connected in series with the LV1 relay coil. The C2 capacitor is connected across the LV1 relay coil. The function of components D1, R1, and C2 is to provide a time delay for the release of LV and LV1 relays.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 8143-EAD-TRC-EAF
DEPT 5147-RRG

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POWER SYSTEMS
SLIDE NO. 1 POWER SUPPLY
FOR 757A PBX
J86808B

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SECTION I - GENERAL DESCRIPTION1. PURPOSE OF CIRCUIT

1.01 This power supply furnishes various dc and ac voltages from a commercial 117-volt, 60 Hz ac supply for operation of the 757A PBX system without battery reserve.

2. GENERAL DESCRIPTION OF OPERATION

2.01 The J86808B List 1 power supply is used with modular PBX's having capacities up to 200 lines. It is identified as Slide No. 1 for installation in a power cabinet consisting of three slide units. The other two slide units are used to accommodate additional -48 volt rectifiers and their associated load capacitors. Nominal 117-volt, 60 Hz ac power is brought to a junction box located in the crown of the power cabinet. Nominal 117-volt power for operation of the Slide No. 1 power supply is taken either from the junction box or directly from a commercial ac power service.

2.02 Small 40-Line (Plan A) 757A PBX System

The J86808B, List 2 power supply is similar to the List 1 except that here the slide unit receives 117-volt, 60 Hz ac power direct from a wall receptacle. It is the basic power plant for the 40-line (Plan A) PBX and is identified as Slide No. 1 for installation in a 757A PBX cabinet.

SECTION II - DETAILED DESCRIPTION1. CIRCUIT FUNCTIONS

1.01 Nominal 117-volt, 60 Hz ac commercial power is connected by 3-conductor cable wiring directly to the dc distribution panel. A circuit breaker is provided on the panel to furnish protection and also to permit the ac power turndown of the slide unit. An operated neon indicating lamp (DS1) shows when the panel is energized. Five twist-lock connector receptacles are provided to serve the five ac operated units installed on Slide No. 1.

1.02 -48V Rectifier No. 1 (-48V1)

This rectifier is used to supply the marker, and other loads of a pulsating type. The dc output is connected to a load capacitor (Fig. 10) in order to reduce noise at stations served by this rectifier, during register attached time and on delayed calls. The dc output connections are wired via the block in the crown of the cabinet for external load connection.

1.03 -48V Rectifier No. 2 (-48V2)

This rectifier is used to supply steady-state type loads. The dc output is connected to load capacitors (Fig. 9) which provide the power reserve in the batteryless plant for the steady-state supply during short term commercial ac interruptions (less than 0.25 second). The load at the time of the power failure will determine the actual reserve available. A 0.25 second reserve is available if the drain on the rectifier does not exceed 5 amperes. The dc output connections are wired via the dc distribution and alarm panel to a terminal block in the crown of the cabinet for external load connection.

1.04 +48V/10V AC Rectifier (+48V/10V AC)

This rectifier has two outputs: (a) +48 volts used to supply the optional direct station selection (DSS) load and marker and

register circuits of the PBX and (b) 10 volts ac used as a lamp supply for the PBX circuits. Both outputs are wired via the dc distribution and alarm panel to terminal blocks in the crown of the cabinet for external load connection.

1.05 Ringing Machine and Interrupter (RING)

A ringing machine per KS-15985, List 1 supplies the ringing current and interruption for the PBX circuits. The output connections are brought to the crown of the cabinet for external load connection. Low voltage alarm leads "R" and "R1" are wired to the dc distribution and alarm panel, providing for the operation of relays and a single lamp.

1.06 Frequency Generator (TONE)

A type 102B frequency generator is mounted on the ringer panel and used to supply tone of approximately 540 Hz for the PBX circuits. The output of the frequency generator is brought to the crown of the cabinet for external load connections.

1.07 When there are provisions for TOUCH-TONE[®] dialing, a 404C tone generator is required. The "LT2" lead from the ringing and tone circuit is not used and the dial tone is obtained from the 404C tone generator.

2. DC DISTRIBUTION, ALARMS AND INDICATING LAMPS

2.01 The 10V AC, +48V, -48V1, and -48V2 supplies connect to circuit breakers CB1, CB2, CB3, and CB4, respectively, on the dc distribution and alarm panel and then in turn to terminal blocks in the crown of the cabinet. This provides the external load disconnect means for the power supply. The alarm circuit constitutes a closed loop through the series of closed contacts of the various alarm relays held operated by their individual supplies. A failure of any one supply causes its alarm relay to release thereby opening the alarm circuit loop transmitting an alarm to the central office. The alarm circuit terminates on terminals designated MJ and MJ1. Associated with each alarm relay is a lamp to indicate the failure of its power supply. In addition to the alarm terminals -48 volts is brought to the other slide units of the power cabinet for the operation of indicating lamps. Normally the -48 volts required for this is obtained from the -48V1 rectifier through contacts of the NV1 relay. In the event of failure of the -48V1 rectifier the NV1 relay releases, causing an alarm and switching the -48 volt indicating lamp supply to the -48V2 rectifier for standby operation. Individually the alarms and indicating lamps operate as follows:

2.02 10V AC Lamp Supply (10V AC)

The ac relay NAC is bridged across the load side of CB1 circuit breaker. The NAC1 wire spring relay is energized by the contact

of NAC relay. A failure of the 10-volt ac supply causes NAC relay to release, thereby releasing NAC1 relay which operates DS1 lamp and opens the alarm circuit loop.

2.03 +48V Rectifier (+48V)

The NV wire spring relay is connected to the load side of CB2 circuit breaker. A failure of the +48 volt supply causes NV relay to release, operating DS2 lamp and opening the alarm circuit loop.

2.04 -48V (Rectifier No. 1 (-48V1))

The NV1 wire spring relay is connected to the load side of CB3 circuit breaker. A failure of the -48V supply causes NV1 relay to release, switching the indicating lamp supply from -48V1 to -48V2 rectifier, operating DS3 lamp and opening the alarm circuit loop.

2.05 -48V Rectifier No. 2 (-48V2)

The NV2 wire spring relay is connected to the load side of CB4 circuit breaker. A failure of the -48V2 supply causes NV2 relay to release, operating DS4 lamp and opening the alarm circuit loop.

2.06 Ringing Machine (RING)

The "R" and "R1" alarm leads from the ringing machine are connected to LV ac relay. A failure of the ringing supply causes LV relay to release thereby releasing LV1 relay which operates DS5 lamp and opens the alarm circuit loop. The RMFA relay together with the F1 fuse transfer contact provides a fuse failure alarm for the ringing machine. The C1 capacitor provides current on an emergency basis in the event of fuse failure.

SECTION III - REFERENCE DATA

1. WORKING LIMITS

1.01 AC Input to Slide No. 1 power supply
117 Volts $\pm 10\%$, 60 ± 0.1 Hz, 12 amperes at full load.

1.02 AC/DC Output

Supply	Output Volts	Output Amperes	
		Con- tinuous	Inter- mittent
-48V Rect.	45 to 52.6	8*	12
+48V Rect.	44 to 52	1.5	2.0
10V AC	9 to 11	13.6	-
Ring (20 Hz)	65 to 90	-	-
Tone	0.7 to 4.5	-	-

*The load on any one -48V rectifier shall be limited to a maximum continuous load of 8 amperes.

1.03 Ambient Temperature

10 to 40°C

1.04 Noise

-48V rectifier with load capacitor connected to output terminals will not exceed 34 dBa with F1A line weighting.

+48V rectifier will not exceed 50 dBa with F1A line weighting.

1.05 The rectifier working limits are covered in the respective specifications of the rectifiers.

2. FUNCTIONAL DESIGNATIONS

DC Distribution and Alarm Circuit

Designations

2.01 Relays

Meaning

LV	Low ringing voltage
LV1	Low ringing voltage
NAC	No 10V AC voltage
NAC1	No 10V AC voltage
NV	No +48V voltage
NV1	No -48V1 voltage
NV2	No -48V2 voltage
RMFA	Ringing Machine Fuse Alarm

2.02 Circuit Breakers

10V AC (CB1) 10V AC Supply

+48V (CB2) +48V Supply

-48V1 (CB3) -48V1 Supply

-48V2 (CB4) -48V2 Supply

2.03 Output Fault Indicating Lamps

10V AC (DS1) Failure 10V AC Supply

+48V (DS2) Failure +48V Supply

-48V1 (DS3) Failure -48V1 Supply

-48V2 (DS4) Failure -48V2 Supply

RING (DS5) Failure Ringing Supply

2.04 Input Power Indicating Lamp

(DS1) ac input power

3. FUNCTIONS

3.01 To furnish -48 volts dc for relay and talking power, +48 volts dc for relay operation and 10 volt ac for lamp supply; ringing, ringing interruptions and tone for 757A PBX systems without battery reserve.

3.02 To provide for an associated remote alarm to indicate loss of output voltage from any one of the power supplies and to light an associated fail lamp on the dc distribution and alarm panel.

3.03 To provide a means of connecting the various outputs to the PBX load.

3.04 To provide ringing and tone power for 608-type PBX switchboards.

4. CONNECTING CIRCUITS

4.01 This power supply connects to the following circuits:

- (a) SD-66721-01 - Position Circuits
- (b) SD-66722-01 - Auxiliary Signal, Fuse Alarm, Battery Cutoff, and Miscellaneous Circuits
- (c) SD-66735-01 - 757A PBX Cabling Diagram
- (d) SD-66744-01 - Originating Register Circuit
- (e) SD-81569-01 - Power Supply Circuit for 757A PBX
- (f) SD-81582-01 - Slide No. 2 Power Supply for 757A PBX
- (g) SD-81583-01 - Slide No. 3 Power Supply for 757A PBX

5. MANUFACTURING TESTING REQUIREMENTS

5.01 Manufacturing testing requirements are covered by specification B133387.

6. ALARM INFORMATION

6.01 A detailed description of the alarm and indicating lamp circuits is covered in Section II, Paragraphs 2.01 to 2.06. Under normal operating conditions the neon lamp on the ac distribution panel is lit indicating that the panel is energized: all fail lamps on the dc distribution and alarm panel are extinguished and the alarm circuit is in its closed loop condition. Failure of an output from the 10V AC, +48V, -48V1, -48V2 or ringing machine will light its associated fail lamp and open the alarm loop thereby bringing in an alarm at the central office.

7. TAKING EQUIPMENT OUT OF SERVICE**7.01 Removal of Rectifier**

Remove the associated twist lock plug from the receptacle on the ac distribution panel and operate associated circuit breaker or breakers on the dc distribution and alarm panel to OFF position.

7.02 Safety Precautions

Hazardous voltages are present within the rectifiers and every precaution should be observed to avoid any contact with exposed terminals when the rectifiers are in operation.

SECTION IV - REASONS FOR REISSUE**B. Changes in Apparatus****B.1 Superseded**

KS-19962, L1
Rectifier ("N"
Option)

Superseded By

KS-19962, L2 or L4
Rectifier ("H"
Option)

Superseded

CB2 Circuit
Breaker KS-5648,
L14 ("Q" Option)

Superseded By

KS-15815, L132
("P" Option)

D. Description of Changes

D.1 "P", "Q" and "H" options were added to the drawing.

D.2 The KS-19962, L1 rectifier has been replaced by the KS-19962, L2 or L4 rectifiers.

D.3 CB2 circuit breaker, KS-5648, L14 (1 ampere) has been replaced by KS-15815, L132 (2 amperes).

BELL TELEPHONE LABORATORIES, INCORPORATED

WPT 5143-HMK-DET-EAF

CIRCUIT DESCRIPTION

CD-81600-01
ISSUE 3B
APPENDIX 2D
DWG ISSUE 3D

POWER SYSTEMS
POWER SUPPLY CIRCUIT
AC, DC & RINGING SUPPLY
FOR 756A BATTERYLESS PBX
J86464L

CHANGES

D. Description of Changes

D.1 In Fig.1, present wiring of "FC1" lead has been designated option "S" and rated MFR DISC. New wiring of "FC1" lead is designated option "R". This change is made to agree with associated drawing.

D.2 Circuit note 104 is rated MFR DISC. as concerned wire will no longer be provided.

D.3 Added BSP 802-618-150 to supporting information.

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DEPT 8143-JRP-TRC-EAF
DEPT 5147-RRG

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POWER SYSTEMS
POWER SUPPLY CIRCUIT
AC, DC & RINGING SUPPLY
FOR 756A BATTERYLESS PBX
J86464L

CHANGES

A. Changed and Added Functions

A.1 An additional dc output (-96 volts) is provided for operation of the "Make Busy and Busy Display" test feature.

D. Description of Changes

D.1 An additional output (-96 volts), "T" option, is provided on the Fig. 1 supply.

D.2 Circuit note 103 is revised.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5153-SR-DET-EAF

POWER SYSTEMS
POWER SUPPLY CIRCUIT
AC, DC & RINGING SUPPLY
FOR 756A BATTERYLESS PBX
J86464L

SECTION I - GENERAL DESCRIPTION1. PURPOSE OF CIRCUIT

- 1.01 To provide power supplies for the 756A Batteryless PBX system.

2. GENERAL DESCRIPTION OF OPERATION

2.01 The circuit consists of ferroresonant regulated rectifier K3-19642, load capacitor panel J868083, AC, DC and ringing supply panel J86812B, and interconnections between these units. TOUCH-TONE dial tone is provided by the 404C tone generator which is part of J86812B.

2.02 Commercial ac power, 105 to 129 volts, is connected to the supply panel and distributed to the rest of the circuit. A line switch on this panel removes power from the entire circuit. Connections are shown for furnishing output power, ringing, tones and interruptions to the PBX circuits. The lead connecting 10V ac from terminal 6 on TS2 to terminal 8 on J1 of the J86812B unit must be disconnected for operation in the 756A PBX.

2.03 A 48,000 uf capacitor bank provides protection against power failures of less than 1/4 second duration.

3. ALARMS

3.01 Provision for fuse failure alarms are provided on -48 volts dc to the ringing circuit and 10 volts ac to the interrupter motor and output circuit.

SECTION II - REFERENCE DATA1. WORKING LIMITS1.01 AC Input:

105 to 129 volts, 60 cps.

1.02 Outputs(a) DC Outputs

Nominal Volts	Voltage Range Volts	Load Range Amperes
-48	-45 to -52.6	0.5 to 8.0 normal 12 intermittent
+48	40 to 60	0.1

(b) AC Output

Nominal Volts	Voltage Range Volts	Load Range Amperes
±10, 60 cps	8 to 11	2.1

1.03 Output Noise and Ripple

Nominal Volts DC	
-48	Noise max. 34 dbrnc Ripple max. 0.050 peak to peak at 8 amp load
+48	Ripple max. 1.0V rms

1.04 AC Outputs (Ringing and Tone Supply)

- (a) Ringing - 75 to 100 volts, 20 cps
(b) Busy Tone - 2.0 volts, (LT1)
(c) TOUCH-TONE
Dial Tone - 1.75 volts, (TT1)

2. FUNCTIONAL DESIGNATIONS

None

3. FUNCTIONS

3.01 This circuit is designed to perform the following functions:

- (a) To provide -48 volts dc for relay and talking power.
(b) To provide +48 volts dc and 10 volts ac for direct station selection.
(c) To provide low tone for busy tone.
(d) To provide TOUCH-TONE dial tone.
(e) To provide 460 cps modulated at 40 cps superimposed on 20 cps for audible ringing, machine ringing and signaling interruptions.

4. CONNECTING CIRCUITS

4.01 This circuit connects to the 756A Batteryless PBX switching circuits.

SECTION III - REASONS FOR REISSUE

CHANGES

D. Description of Changes

D.1 In Fig. 4, the use of the load capacitor panel J86808G, L2, SD-81581-01, Fig. 9 was rated "Mfr Disc." replaced by J86808G, L(), SD-81581-01. The new list number of the load capacitor panel and Fig. number of the circuit drawing were omitted to avoid reissuing the drawing everytime the list number and Fig. number of the load capacitor panel are changed.

D.2 Reference to note 104 from TS2, terminal 5 to J1, pin 8 erroneously read note 101.

D.3 Designations of 14 and 16 gauge to leads "E" and "F" in Fig. 4 and to leads "A", "B", "C", "D", "E" and "F" in Fig. 1 were added.

D.4 Equipment note 201 was changed to add "Leads over 20GA shall be KS-13385 stranded".

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5153-HMK-DET-EAA

POWER SYSTEMS
POWER SUPPLY CIRCUIT
-96 VOLT DC APPLIQUE
FOR 756A PBX
J86464P

CHANGES

B. Changes in Apparatus

B.1 Superseded

TB1 Terminal Board,
Marathon, 6A-106HS -
FS 1

Superseded By

TB1 Terminal Board,
Cinch-Jones, 6-164-3/4W -
FS 1

D. Description of Changes

D.1 Options "Y" and "Z" were added to the drawing.

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DEPT 5453-HMK-DET-EAA

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Page 1
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POWER SYSTEMS
POWER SUPPLY CIRCUIT
-96 VOLT DC APPLIQUE
FOR 756A PBX
J86464PSECTION I - GENERAL DESCRIPTION1. PURPOSE OF CIRCUIT

1.01 This power supply circuit produces a -96 volt dc output when it is used in conjunction with a 410B transformer, separately provided.

1.02 This circuit is intended for use with the 756A PBX to provide operating power for the make busy and busy display test feature.

SECTION II - DETAILED DESCRIPTION1. AC SUPPLY

1.01 The ac supply is obtained from series connected secondary windings of a 410B transformer. The primary winding of the 410B transformer is tapped to permit operation with a 111-, 117-, or 123-volt, single phase, 60-hertz source.

2. -96 VOLT APPLIQUE

2.01 This circuit consists of a voltage doubler which converts the output from the 410B transformer to a -96 volt dc voltage having a low ripple content.

2.02 The voltage doubler functions to half-wave rectify the ac input by means of CR1 diode and charge C1 capacitor. When the input voltage reverses polarity C1 discharges through the transformer secondary windings and charges C2 capacitor. The combination of the voltage on C1 together with the transformer voltage results in twice the peak transformer secondary voltage being impressed across C2. The output is taken from across C2 capacitor. The R1 resistor is provided to discharge both C1 and C2 when the power supply is turned down for servicing.

SECTION III - REFERENCE DATA1. WORKING LIMITS

1.01 AC Input - This circuit functions with an input of 36 volts ± 10 percent. This voltage is provided from series connected secondary windings of a 410B transformer. This transformer is tapped to permit operation from a 111-, 117-, or 123-volt ± 5 percent, single phase, 60-hertz source.

1.02 DC Output - The voltage limits are 93 to 108 volts for all conditions of line voltage and load current variations of 0 to 100 milliamperes. The voltage limits include variations which are a result of other, independent, loads on the 410B transformer.

1.03 Output Ripple - 1 volt rms maximum

1.04 Ambient Temperature - 0° to 50°C

2. FUNCTIONAL DESIGNATIONS

2.01 None.

3. FUNCTIONS

3.01 To provide a circuit which utilizes the output of a 410B transformer and provides a dc output having a low ripple content.

3.02 To provide a -96 volt dc output for a load range of 0 to 100 milliamperes for operation of connecting 756A PBX circuits.

4. CONNECTING CIRCUIT

4.01 This power supply circuit will function with the following circuits:

- (a) SD-81326-02 - Power Supply Circuit for 756A PBX with Battery Reserve
- (b) SD-81577-01 - Power Supply Circuit AC, DC and Ringing Supply
- (c) SD-81599-01 - Power Supply Circuit +48 Volt DC and 10 Volt AC Applique for 756A Batteryless PBX

5. TAKING EQUIPMENT OUT OF SERVICE

5.01 When servicing this power supply, the ac input should always be disconnected. A voltage reading of the output should then be taken to insure that the capacitors are fully discharged.

5.02 If this power supply is to be removed from service for an appreciable period of time (one month or longer), the electrolytic capacitors must be connected to a source of direct current of suitable voltage and polarity as covered in Section 032-110-701 of the Bell System Practices Plant Series.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5153-SR-DET-EDC

CIRCUIT DESCRIPTION

CD-5E003-01
ISSUE 1
APPENDIX 1D
DWG ISSUE 2D

PBX SYSTEMS
NO. 756A
INWARD RESTRICTION CIRCUIT

CHANGES

D. Description of Changes

- D.1 On sheet 01-5 color designations
on leads of the local cable are
removed on a Class D, No-Record basis.
- D.2 A minor drafting error is corrected
on sheet 01-6.

BELL TELEPHONE LABORATORIES, INCORPORATED

(WECO 7120HW-EWS-JGW)
DEPT 5337-RAV

PBX SYSTEMS
NO. 756A
INWARD RESTRICTION CIRCUIT

TABLE OF CONTENTS	PAGE	Attendant Action
<u>SECTION I - GENERAL DESCRIPTION</u>	1	2.03 The attendant completes a call to a restricted station by the usual call-completion procedure. The marker, finding the called line inward restricted, treats it as an unassigned line and completes the call to an attendant trunk. When the marker completes the call to an attendant trunk, the inward restriction circuit releases when marker relays RIA,B operate.
1. <u>PURPOSE OF CIRCUIT</u>	1	
2. <u>GENERAL DESCRIPTION OF OPERATION</u>	1	
<u>SECTION II - DETAILED DESCRIPTION</u>	1	
1. <u>SELECTION AND DIALING</u>	1	2.04 When the connection is established to an attendant trunk, the attendant answers the call by operating the pick-up key obtaining a single spurt of tone indicating that this call is intercepted.
2. <u>COMPLETING INWARD RESTRICTION CALL</u>	1	2.05 In releasing the connection, the attendant first reoperates the pick-up key of the central office trunk and then operates the HOLD key.
3. <u>ATTENDANT ANSWERS CALL</u>	2	
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7. <u>ALARM INFORMATION</u>	3	
<u>SECTION I - GENERAL DESCRIPTION</u>		
1. <u>PURPOSE OF CIRCUIT</u>		
1.01 The inward restriction circuit provides means which prevent the attendant from completing a central office class call to an inward restricted station.		
2. <u>GENERAL DESCRIPTION OF OPERATION</u>		
<u>General</u>		
2.01 The inward restriction feature is associated with the marker circuit. In completing a central office class call to an inward restricted station, the marker operates the corresponding IR- line relay which prevents the call from being completed to the called station.		
2.02 Connections between the marker and the inward restriction circuit are arranged to consider the restricted line as an unassigned one. The feature of hunting is also eliminated to prevent the call from being completed to a station in the same hunting group.		
		<u>SECTION II - DETAILED DESCRIPTION</u>
		1. <u>SELECTION AND DIALING</u>
		<u>General</u>
		1.01 The attendant in answering an incoming central office trunk call, operates the associated pick-up key in the cordless position circuit. This results in a talking connection between the attendant and the outside party.
		1.02 In extending the call to the requested line, the attendant operates the HOLD key. This results in attachment of the marker and in marker action to attach a dial pulse register. At this time the central office trunk and marker circuit function as if the inward restriction feature were not provided.
		1.03 In completing the call to an inward restricted station, the marker recognizes the restricted station and reroutes the call to the attendant as an intercepted call.
		2. <u>COMPLETING INWARD RESTRICTION CALL (SCI)</u>
		<u>Activating Inward Restriction Circuit</u>
		2.01 When dialing is completed, the register recalls the marker. The marker functions to complete the call to the called station as usual. The sequential operation of the marker does not change regardless of the state of the called station i.e. idle, busy or busy and camped o

2.02 In the process of connecting the trunk to the called station, the marker operates the corresponding AU-relay performing the following functions:

- (a) Locks operated via released marker relays RLA,B.
- (b) Prepares a path for operating the corresponding line relay IR-.
- (c) Prevents marker relays HCA,B from operating.
- (d) Prepares a path for operating marker relays BSYAA,BA.

2.03 When marker relays COTA,B and corresponding TCS- operate, they operate the corresponding line IR- relay performing the following functions:

- (a) Prevents the corresponding marker relay S- from operating and so provides the marker with the necessary signals to consider the called station as unassigned.
- (b) Locks operated via released marker relays RLA,B.

2.04 The marker proceeds to complete the call to an attendant trunk. When the call is completed, the marker releases by the operation of marker relays RL(A,AA, AB,B,BA,BB). Relays RLA,B operated also release relays AU- and IR-.

3. ATTENDANT ANSWERS CALL

3.01 The attendant in response to an audible signal and flashing SL and TL lamps operates the pick-up key associated with the attendant trunk. A momentary spurt of tone is heard as a signal to the attendant that this is an intercepted call.

4. RELEASE OF INWARD RESTRICTION CONNECTION

4.01 In releasing the connection, the attendant first reoperates the pick-up key associated with the central office trunk and then momentarily operates the HOLD key in the cordless position circuit.

SECTION III - REFERENCE DATA

1. WORKING LIMITS

1.01 Voltage limits 45-52 volts.

Page 2

2. FUNCTIONAL DESIGNATIONS

<u>2.01 Designation</u>	<u>Meaning</u>
AU-	Auxiliary Unit
IR-	Inward Restriction

3. FUNCTIONS

- 3.01 To recognize an inward restricted station.
- 3.02 To signal the marker to connect a central office trunk to an attendant trunk if the call is intended for an inward restricted station.
- 3.03 To inhibit the hunting feature of the marker.
- 3.04 To substitute for the nonoperation of marker relays HCA,B in the completion of an inward restricted call.

4. CONNECTING CIRCUITS

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

4.02 Typical connecting circuits:

- (a) Line, Link and Marker Circuit - SD-65741-01.
- (b) Busy Verification Auxiliary Trunk Circuit - SD-66911-01.

5. MANUFACTURING REQUIREMENTS

5.01 The inward restriction circuit shall be capable of performing all of the functions given in this circuit description; the relays with which it is equipped shall meet all requirements of the circuit requirement tables.

6. TAKING EQUIPMENT OUT OF SERVICE

6.01 When maintenance tests and adjustments are to be made, the inward restriction circuit can be taken out of service as follows:

- (a) Block the AUO-9 relays nonoperated.
- (b) Remove necessary lead providing inward restricted service to individual stations.

7. ALARM INFORMATION

7.01 An operated fuse supplying the inward restriction circuit results in visual and audible signals at the attendant position and in the alarm, transfer and test circuit. Also, if alarm sending

is provided, a major alarm is transmitted to the plant service center.

7.02 Replacing the operated fuse silences the audible alarm and extinguishes the alarm lamps.

BELL TELEPHONE LABORATORIES, INCORPORATED

(WEC- 7760HW-GAM-JGW)
DEPT 5337-RAV

PBX SYSTEMS
NO. 756A
STATION MESSAGE REGISTER
PULSE AND SURCHARGE CIRCUITCHANGESB. Changes in Apparatus

B.1	<u>Removed</u>	<u>Replaced By</u>
	ALM Diode 446F - Fig. 4	ALM Diode 458A - Fig. 4

D. Description of Changes

D.1 This circuit is reissued to correct the release monitor alarm portion of this circuit as follows:

- (a) Pin designations 3 and 4 of the J1 connector are reversed to correct the connecting information to the relay timer delay circuit (ALM).
 - (b) Series diode ALM is removed and placed in parallel with relay ALM to provide more reliable transistor protection for the relay timer delay circuit (ALM). Also, the code of diode ALM is changed from 446F to 458A.
- D.2 On sheet A1, the sheet index is brought up to date.
- D.3 On sheet A2, the coordinate location for diode ALM is revised.
- D.4 On sheet C1, the code of diode ALM is changed from 446F to 458A. Also, coordinate locations for pins 3 and 4 of the J1 connector and diode ALM are revised.
- D.5 On sheet G2, TS(C), pin 18: The pin designation of the J1 connector is changed from pin 3 to pin 4.

BELL TELEPHONE LABORATORIES, INCORPORATED

(WECO 5120HW-JJM-LKJ)
DEPT. 5337-RVL

PBX SYSTEMS
NO. 756A
STATION MESSAGE REGISTER
PULSE AND SURCHARGE CIRCUITCHANGESD. Description of Changes

D.1 This circuit is reissued to provide for message registration and surcharge registration on a per trunk basis.

D.2 Option K is added and rated Standard to provide message registration on a per trunk basis.

D.3 Options V and W are rated Manufacture Discontinued and option J is added and rated Standard to provide surcharge registration on a per trunk basis.

D.4 On sheet A1, the sheet index is brought up to date.

D.5 On sheet A2, options J' and K are added to the option index.

D.6 On sheet D1: Circuit Note 102 is revised for clarification, Circuit Note 104 is revised to reflect the changes in this issue, and Equipment Notes 204 and 205 are added.

D.7 On sheets G1, G2 and G4, the CADs are revised to reflect the changes made on this issue.

F. Changes in CD Sections

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

5. OPTIONS.....

A. Options Applying to or Affecting the Station Message Register Pulse and Surcharge Circuit.....

F.2 In TABLE A - MESSAGE UNIT PULSE PATTERNS: Delete options V and W from the Circuit Options column and replace option V with option J.

F.3 In SECTION II - DETAILED DESCRIPTION, change the minor heading on Page 2 to read as follows:

Without Surcharge Circuit (Options X and J)

F.4 In SECTION II, under major heading C, change the minor heading to read as follows:

Without Surcharge Circuit (Options Z and J)

F.5 In SECTION II, under major heading D, change the minor heading to read as follows:

Without Surcharge Circuit (Options Y, X, and J)

F.6 In SECTION II, add Part 4 omitted erroneously on rewrite for Issue 2D of this CD as follows:

4. MISCELLANEOUS FEATURES

4.01 The surcharge circuit may be tested by the following procedure.

(a) Observe that the circuit is idle by verifying the unoperated condition of relay MS and absence of ground on lead S1.

(b) Manually operate relay MS. This starts the surcharge circuit.

(c) Observe that associated pulse circuit relay SX operates and releases.

(d) Count the number of operations of pulse relay SX. This should correspond to the surcharge units specified for the particular installation.

(e) Alternative check: Connect the (+) terminal of a test voltmeter to ground at unit terminal strip and the (-) terminal to lead AA. Count the number of downscale swings during a simulated surcharge sequence. This should correspond to the number of surcharge units specified for the particular installation.

4.02 This test procedure does not change the registration on any station line register or trunk register.

F.7 In SECTION II, add Part 5 as follows:

5. OPTIONS

A. Options Applying to or Affecting the Station Message Register Pulse and Surcharge Circuit

5.01 Optional wiring and apparatus arrangements to provide certain operating features of the circuit are shown in Table B.

TABLE B
OPTIONS APPLYING TO OPERATING CONDITIONS

OPTION	DESCRIPTION
V(MD)	Provides wiring when surcharge registration is not required on all C.O. Trunks
K	Provides wiring for those C.O. Trunks on which message registration is not required
J	Provides wiring for those C.O. Trunks on which surcharge registration is not required.
W(MD)	Provides wiring when pulse pattern B (Table A) is required for message registration and surcharge registration is not required.

BELL TELEPHONE LABORATORIES, INCORPORATED

(WECO 5120HW-JJM-LKJ)
DEPT 5337-RVL

PBX SYSTEMS
NO. 756A
STATION MESSAGE REGISTER
PULSE AND SURCHARGE
CIRCUIT

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TABLE A
MESSAGE UNIT PULSE
PATTERNS

TYPE	START OF PULSE (S)	END OF PULSE (S)	CIRCUIT OPTIONS
A. Single or multiple pulse	Shortly (2-5 sec.) after calling and called party are connected	Last pulse ends before either calling or called party are disconnected	X or X and V
B. Single post call pulse	Within 450 milli-seconds after disconnect of calling or called party	About 200 milli-seconds after start of pulse	Y and X or Y, X, V and W
C. Single long pulse	Shortly (2-5 sec.) after calling and called party are connected	When trunk circuit is released	Z or Z and V

SECTION I - GENERAL DESCRIPTION1. PURPOSE OF CIRCUIT

1.01 The station message register pulse and surcharge circuit provides for transferring message unit registrations originating in a central office to message registers associated with the trunk and PBX station.

1.02 By using a surcharge applique (FS2) with the station message register pulse circuit (FS1) a preset number of surcharge units are added to the station line registration for each completed call.

2. GENERAL DESCRIPTION OF OPERATION

2.01 Message unit pulses originating in the central office equipment are transmitted to the message register pulse circuit over a third wire associated with each PBX trunk

The surcharge circuit at the central office applies +48V pulses to the third wire. These pulses must be applied in one of the patterns shown in Table A. The type of pulse pattern applied depends on the type of central office equipment involved.

2.03 The surcharge circuit may be arranged for adding from 0 to 6 message units at the end of each call just before the line circuit of the calling station is released from the trunk. Pulses required for surcharge registration are originated by the surcharge circuit (PS2).

SECTION II - DETAILED DESCRIPTION

1. TRANSFER OF CENTRAL OFFICE REGISTRATIONS

A. General

1.01 When a call has been established via a PBX trunk and central office circuits, the central office applies one or more battery pulses to a third wire associated with the PBX trunk and its station message register pulse and surcharge circuit.

1.02 Pulses from the central office for message unit registration must be in one of the patterns shown in Table A.

1.03 The station message register pulse circuit must be equipped with the indicated option or options for proper registration of the message unit pulses.

B. Registration of Message Unit Change (SCI)

Without Surcharge Circuit (Options X and V)

1.04 The pulse train for pulse pattern A (Table A) contains a number of pulses corresponding to the basic message unit charge for the call.

1.05 A battery on the third wire from the central office is applied via lead M to operate relay SX over its primary winding.

1.06 Relay SX operated:

(a) Applies +48V via lamp MR and lead SS1 through the crosspoints of the operated switches to score the line message register (LINE) associated with the calling PBX station.

(b) Applies battery via resistor TR to score the trunk message register (TRK) associated with the trunk circuit.

(c) Operates relay COD.

1.07 Diode SX between leads SS1 and SS2 provides a path to the line hold magnet (LHM) in the line, link, and marker circuit and prevents +48V from reaching leads M and SS2. During the operation of relay SX, LHM is held operated by relay SX in the central office trunk circuit via lead SS1, diode SX, and lead SS2. Once relay SX has fully operated, the +48 volts applied to lead SS1 to score the message register (LINE) holds LHM operated.

1.08 Removal of the battery pulse from lead M releases relay SX which in turn releases relay COD and message register LINE and TRK thus returning the message register pulse circuit to normal.

1.09 If the call requires registration of several message units the action of operating and releasing relay SX is repeated for each message unit. This scores the corresponding number of counts on the station line message register and the trunk register. Relay COD follows each operation of relay SX.

With Surcharge Circuit (Option X)

1.10 When the surcharge circuit is provided, the operation of the pulse circuit is identical to that described previously with the exception that the operation of relay SX also operates relay MS in the surcharge circuit.

1.11 Relay MS operated:

(a) Locks operated.

(b) Prepares a path for its own shunt down release.

(c) Provides a holding path for relay SR in the trunk circuit via lead SR and diode PP.

(d) Connects terminals of SC selector arc 1 to the secondary winding of pulse circuit relay SX to prepare for registration of surcharge at the end of the call.

(e) Prepares a path for operating magnet ROT of selector SC when relay IMP operates.

(f) Prepares a path for operating relay DS when relay S1 in the trunk circuit releases at the end of the call.

1.12 When the calling station disconnects, relay S1 in the trunk circuit releases. Release of relay S1 removes the shunt down path provided by lead S1, and relay DS in the surcharge circuit operates via lead SS2. The circuitry is now set for surcharge registration and proceeds to function as described in Section 2.

C. Long Pulse Cut-Off (SC2)

Without Surcharge Circuit (Options Z and V)

1.13 The pulse train for pulse pattern C (Table A) contains a single long pulse and only one registration will be made.

1.14 A battery pulse on lead M operates relay SX which in turn performs the functions described in Registration of Message Unit Charge and in addition applies battery via resistor TR and diode LP to relay P. The operation of relay P is delayed due to the action of thermister LP in its ground path. If relay SX remains operated longer than 200 to 1000 (nominal 500) milli-seconds, relay P operates.

1.15 Relay P operated:

- (a) Locks to the pulse on lead M.
- (b) Short circuits thermister LP.
- (c) Releases relay SX.

1.16 Relay SX released:

(a) Releases the station line message register (LINE) and the trunk message register (TRK) in the message register circuit.

(b) Releases relay COD.

1.17 An important function of relay P is to shorten the interval during which +48V is connected to the sleeve lead of the FBX switch train. This reduces the interval which a maximum load may be imposed on the +48V supply by simultaneous charging in a number of trunk circuits, and reduce the interval during which the line, link, and marker circuit is prevented from making a camp-on type connection.

1.18 When the call is terminated by the calling party, the battery pulse is removed from lead M. Removal of the battery pulse begins the slow release of relay P. Once relay P is released, the pulse circuit is returned to normal.

With Surcharge Circuit (Option Z)

1.19 When the surcharge circuit is provided, the operation of the pulse circuit is identical to that described previously with the exception that the operation of relay SX also operates relay MS in the surcharge circuit. Relay MS operated performs the same functions as described in Registration of Message Unit Charge.

1.20 When the calling station disconnects, relay S1 in the trunk circuit releases operating relay DS in the surcharge circuit. The circuitry is now set for surcharge re-

gistration and proceeds to function as described in Section 2.

D. Post Call Pulse Hold (SC3).

Without Surcharge Circuit (Options Y, X, V and W).

1.21 The pulse train for pulse pattern B (Table A) contains a single pulse and only one registration will be made after the calling station has disconnected.

1.22 When the calling station is connected to the central office trunk circuit, trunk relay S1 operates. Relay S1 operated connects ground via lead S1 and thermister PP to relay P. The operation of relay P is delayed 1 to 5 (nominal 2.5) seconds by thermister PP to prevent premature operation of relay SR via lead SR.

1.23 Relay P operated:

- (a) Provides a holding ground for trunk circuit relay SR.
- (b) Short circuits thermister PP.

1.24 When the call is terminated by the calling party, trunk circuit relay S1 releases and starts the slow release of relay P. The combined release times of relays S1 and P provide a minimum of 450 milli-seconds before starting the slow release of trunk circuit relay SR. During this interval, a battery pulse is applied from the central office to lead M. The battery pulse operates relay SX which in turn performs the functions described in Registration of Message Unit Charge.

1.25 When relay P has released, the pulse on the M lead from the central office is removed and relay SX releases. Relay SX released returns the pulse circuit to normal.

With Surcharge Circuit (Options Y and X)

1.26 When the surcharge circuit is provided, the operation of the pulse circuit is identical to that described previously with the exception that the operation of relay SX also operates relay MS in the surcharge circuit. Relay MS operated performs the same functions as described in Registration of Message Unit Charge.

1.27 The release of relay P removes the shunt down path provided and relay DS in the surcharge circuit operates via lead SS2. The circuitry is now set for surcharge registration and proceeds to function as described in Section 2.

2. SURCHARGE REGISTRATION (SC4)A. End of Call

2.01 When the call is terminated by the calling party, relay S1 in the trunk circuit releases, thus removing shunt-down ground from relay DS. Relay DS operates by the previously operated relay MS and trunk circuit relay SR. With option Y, operation of relay DS is delayed by the slow release of pulse circuit relay P.

2.02 Relay DS operated:

- (a) Locks operated under control of trunk circuit relay SR.
- (b) Opens the shunt-down path to ground at relay S1 in the trunk circuit.
- (c) Connects ground via lead ST to relay IMP. Relay IMP operates from the interrupter circuit of the 756A PBX at a rate of 120 ipm.
- (d) Connects ground to the release monitor alarm circuit (FS7).
- (e) Connects ground supplied from relay IMP to arc 1 of selector SC and by previously operated relay MS, to magnet ROT of selector SC.
- (f) Opens the path via selector off-normal contacts for operating magnet RLS of selector SC.
- (g) Removes ground from lead H to the central office trunk circuit to prevent the completion of an incoming call to the PBX station that is being held for surcharge registration.
- (h) Opens the path between leads R1 and R2 to the central office trunk to prevent ringing on an incoming call during surcharge registration.

B. Registration of Zero to Six Surcharges

- 2.03 The first operation of relay IMP at the end of a call (if of sufficient duration) energizes magnet ROT of selector SC. The selector is rotated to step 1.
- 2.04 To insure that full pulses are gotten from the interrupter started by relay IMP, step 1 is unused.
- 2.05 With the selector stepped off-normal the selector off-normal contacts are closed. This prepares a path for operating selector RLS when relay DS releases.
- 2.06 To allow time for any post-call lead M charge to disappear, selector step 2 is unused and 3 is used for zero surcharge.

2.07 When the selector is stepped to position 4, 120-ipm ground is applied by arc 1 and operated relay MS to operate pulse circuit relay SX on its secondary winding.

2.08 This partially registers a count on the station line message register and operates relay COD. During the 120-ipm off period, the count registration is completed.

2.09 Subsequently ground impulses on lead IMP step the selector to subsequent positions scoring the station message register each time.

2.10 After registering the last surcharge for which the unit is wired, the release of pulse circuit relay SX applies ground by wiper and arc 2 of the selector SC to the winding of relay MS causing its release by shunt-down action.

2.11 Relay MS, in releasing, opens the impulse path to magnet ROT and releases the trunk circuit relay SR which in turn releases relay DS.

2.12 Relay DS released completes a path by closed selector off-normal contacts for operating magnet RLS of the selector. Ground is restored on lead H to the two-way trunk circuit. Leads R1 and R2 are reclosed to the trunk circuit completing the operating path of trunk relay R1.

2.13 With its release magnet energized, the selector restores to normal. Other off-normal make contacts open to de-energize the release magnet.

2.14 The trunk and message register pulse and surcharge circuit are restored to normal and are ready for the next usage.

3. Function of Marker Controller Circuit (FS8)A. General

3.01 Operation of relay SX in the pulsing circuit operates relay COD in the marker controller circuit. If relay COD is operated prior to the operation of marker relays HMKA,B during a camp-on call termination, the link testing function of the marker circuit will be disabled and the camp-on call termination will not be made. The manner in which the marker controller circuit performs this function depends on marker options XK and WV.

B. Registration Pulse Applied - Marker in Camp-On Call Termination (SC5)Marker Circuit Equipped with Option XK (Option T provided).

3.02 Relay COD operated:

- (a) Locks under control of marker relays COTA, B.
- (b) Transfers the operating path of marker relays CONA, AA, B, BA to relay H.
- 3.03 Operation of marker relays HMKA, B operates relay H. Relay H operated:
- (a) Operates C.O. trunk relay RS.
- (b) Provides a holding ground for marker relay DCKA, B.
- (c) Provides a holding ground for the trunk hold magnet THM-- and trunk relay HM.
- (d) Prepares a path to operate relay BY in the register.
- (e) Operates relay ST in the busy verification circuit if the marker is performing the camp-on operation in connection with busy verification.
- 3.04 During the marker release: relay H releases, and relay COD will release provided relay SX in the pulse circuit has released.

Marker Circuit Equipped With Option WV (Option S provided).

- 3.05 Relay COD operated:
- (a) Locks under control of marker relays COTA, B.
- (b) Transfers the operating path of marker relays CONAA, BA to relay H.
- (c) Prevents the operation of marker alarm relays COAL and XCAL.
- 3.06 Operation of marker relays HMKA, B operates relay H. Relay H operated:
- (a) Operates relay ST in the busy verification circuit if the marker is performing the camp-on operation in connection with busy verification.
- (b) Prevents the operation of marker alarm relay IALI when marker relays CONA, B operate and CONAA, BA do not.
- (c) Removes ground from leads MR5 and MR6 to prevent marker relays LTCA, B from operating.
- 3.07 During the marker release: relay H releases, and relay COD will release provided relay SX in the pulse circuit has released.

SECTION III - REFERENCE DATA

1. WORKING LIMITS

- 1.01 Maximum resistance of third wire plus ground return resistance.

Max. Adverse Ground Pot	Max. Res. of Third Wire Plus Ground Return Resistance	
	Co Batt. 40V Min.	Co Batt. 45V Min.
0	1040	1345
1	980	1285
2	920	1225
3	865	1165
4	865	1105
5	750	1040
10	465	750

Note: Linear extrapolation may be used to obtain maximum permissible resistance for other values of CO battery and adverse ground potential.

- 1.02 Minimum insulation resistance (third wire to ground) 50,000 ohms.

2. FUNCTIONAL DESIGNATIONS

2.01 Relays

Designation	Meaning
ALM	Alarm
COD	Camp-On Denied
DS	Disconnect Started
H	Hold
IMP	Impulse (120 or 60-1pm)
MR	+48V Fuse Alarm
MS	Message (Charge) Started
NV	No Voltage
P	Pulse (For Option Y or Z)
SX	Sleeve Switching.

2.02 Selectors

Designation	Meaning
SC	Surcharge Control

3. FUNCTIONS

- 3.01 To operate a line message register individual to a PBX station in accordance with message unit registration pulses originated at the connected central office.
- 3.02 To operate a trunk message register individual to a central office trunk in accordance with message unit registration originated at the connected central office.
- 3.03 To activate a message registration alarm lamp and the PBX common alarm circuit when surcharge registration is not completed during a specific interval after termination of a trunk call.
- 3.04 To disable the link testing function of the line, link and marker circuit during a camp-on call termination when in the process of scoring a message register.

4. CONNECTING CIRCUITS

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

4.02 The station message register pulse and surcharge circuit as used in the 756A PBX system has the following typical connecting and associated circuits:

- (a) Two-Way Trunk Circuit to Central Office - SD-65752-01.
- (b) Message Register Circuit - SD-65852-01.
- (c) Line, Link, and Marker Circuit - SD-65741-01.
- (d) Alarm, Transfer and Test Circuit - SD-66796-01.
- (e) Relay Time Delay Circuit - SD-99361-01.
- (f) Interrupter Circuit - SD-81288-01.
- (g) Busy Verification Auxiliary Trunk Circuit - SD-66911-01.

4.03 The central office circuit to which the PBX trunk has access must be arranged to apply message registration pulses to a third wire (lead M) associated with each PBX trunk pair.

5. ALARM INFORMATION

5.01 The rectifier +48V power supply holds relay NV operated over unfused lead NV. Failure of the +48V supply releases the PBX power failure alarm and lights lamp NV.

5.02 The failure of a +48V fuse operates relay MR grounding lead EXT to actuate the PBX alarm circuit and lights lamp MR.

5.03 When relay DS operates during surcharge, ground is connected to the relay time delay circuit. If surcharges are not registered within approximately 2 minutes after the station disconnects,

relay ALM will operate. Relay ALM operated lights lamp RA and applies ground via lead EXT to the alarm, transfer, and test circuit resulting in a failure alarm.

6. MANUFACTURING TESTING REQUIREMENTS

6.01 The station message register pulse and surcharge circuit shall be capable of performing all of the functions given in this circuit description; the relays with which it is equipped shall meet all requirements of the circuit requirements table.

7. TAKING EQUIPMENT OUT OF SERVICE

7.01 During maintenance of the station message register pulse and surcharge circuit, the associated two-way CO trunk should be made busy at the central office to prevent incoming calls.

7.02 The station message register pulse and surcharge circuit may be disabled by blocking relay SX unoperated. In this condition the associated CO trunk circuit may be used for incoming and outgoing calls, but message unit charges will not be recorded on any station message register nor on the trunk register.

SECTION IV - REASONS FOR REISSUED. Description of Changes

D.1 Option T is designated and rated Additions and Maintenance Only. Option S is added and rated Standard to provide wiring to make the station message register pulse and surcharge circuit functional with the line, link, and marker circuit when the marker is equipped with option WV.

D.2 Option R is designated and rated Manufacture Discontinued to prevent interaction between two central office trunks over the sleeve lead when the marker circuit is setting up a camp-on connection. The break contact of relay SX is removed from between leads SS1 and SS2, since diode SX maintains the necessary continuity on these leads and also prevents any interaction between two central office trunk circuits. Option Q is added and rated Standard to revise wiring on sheet G1 (CAD 1) to accommodate the changes made necessary by the deletion of R wiring.

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D.3 Option M is designated and rated Manufacture Discontinued. Option N is added and rated Standard to revise wiring on sheets G2 and G3 (CAD 3). Option N provides terminals for strapping either option S or option T.

D.4 On sheet D1, Circuit Note 104 is revised to reflect the changes in this issue and Circuit Note 106 is added.

D.5 On sheet E1, the sequence charts are revised and sheet note 1 is added.

D.6 On sheet E2, sequence chart SC4 is revised and Circuit Notes 1 and 2 on sequence chart SC5 are added.

D.7 On sheets G1, G2, and G3, CADS 1 and 3 are revised to reflect the changes in this issue.

BELL TELEPHONE LABORATORIES, INCORPORATED

(WECO 2120HW-JJM-WHK)
DEPT 5337-LAH

PBX SYSTEMS
NO. 756A
MAKE BUSY AND BUSY DISPLAY CIRCUIT

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SECTION I - GENERAL DESCRIPTION1. PURPOSE OF CIRCUIT

1.01 The make busy and busy display circuit functions as a test circuit for the PBX. The circuit provides a means for making certain individual circuits of the PBX busy for testing purposes.

2. GENERAL DESCRIPTION OF OPERATIONA. Make Busy Keys Normal

2.01 With the make busy keys unoperated, the circuits in the PBX function as normal. However, when a circuit is made busy under normal operations, an associated make busy lamp will light, provided the make busy circuit power key is operated.

B. Make Busy Key Operated

2.02 When it is desired to make a circuit of the PBX busy, the associated make busy key is operated (pulled out). Warning: Do not operate the make busy key if the circuit is busy through previous PBX operations. In general, a make busy key operated:

(a) Makes the circuit busy or simulates a busy condition for subsequent requests for service.

(b) Lights the associated make busy lamp indicating that the circuit has been made busy.

C. Restoration of PBX Circuit

2.03 To restore the PBX circuit to use, the make busy key must be released (pushed in).

SECTION II - DETAILED DESCRIPTION1. POWER KEY AND LAMPS (FS1)A. General

1.01 The make busy and busy display circuit power key (PWR key) must be operated as an initial step in the use of the make busy and busy display circuit.

B. Power Key Operated

1.02 Operation of key PWR to the ON position applies both the -48 volt and -96 volt batteries to the circuit. The -48 volt battery supplies power to:

- (a) The 909 ohm and 8 volt zener diode voltage divider network used for busying the links (FS4).
- (b) The circuit power lamp (PWR-48 lamp).

1.03 The -96 volt battery supplies power to:

- (a) All the busy lamps in the circuit.
- (b) The circuit power lamp (PWR-96 lamp).

C. Power Key Returned to Normal Position

1.04 Releasing the power key disables the make busy and busy display circuit only to the extent that the busy lamps will not light when a busy condition is detected. If it is desired to return the entire PBX circuitry to normal, it is necessary to release all the busy keys in the make busy circuit in addition to releasing key PWR.

2. STATION DIAL TRANSFER TRUNKS (FS2)A. Dial Transfer Trunk Key NormalTransfer Trunk Requested

2.01 A transfer trunk is requested when a PBX station, in transferring an incoming call to another PBX station, depresses the switchhook momentarily. When the PBX station flashes, the central office trunk involved in the connection calls on the controller circuit to select one of the two transfer trunks provided. To obtain a transfer trunk, the controller circuit proceeds to ground lead GP.

Transfer Trunk Selected

2.02 The states of the HM relays in the two transfer trunk circuits dictate

to the controller which transfer trunk circuit will be selected for the transfer. If both HM relays are unoperated, ground on lead GP grounds lead HMPA and the controller will select transfer trunk 0. If relay HM in trunk 0 is operated, the ground on lead GP grounds lead HMPB and the controller will select transfer trunk 1.

Transfer Trunk Seized

2.03 After the controller circuit selects one of the available transfer trunks, the marker is requested to seize the selected trunk. The marker proceeds through a sequence of operations and, as a result, operates relay SMR-- in the line, link, and marker circuit. With relay SMR-- operated:

- (a) Relay HM of the selected transfer trunk operates in the dial transfer trunk circuit.
- (b) Trunk hold magnet THM9- of the selected transfer trunk operates in the controller circuit.
- (c) Dial transfer trunk busy lamp (DLTR lamp) lights in the make busy and busy display circuit.

Transfer Trunk Busy Indication

2.04 The lighting of lamp DLTR indicates that the associated transfer trunk has been made busy by the controller circuit through normal operations.

B. Dial Transfer Trunk Made Busy (SC1)Dial Transfer Trunk Key Operated

2.05 If it is desired to make a dial transfer trunk busy, the associated DLTR key in the make busy and busy display circuit is operated. Key DLTR operated will operate the associated MBT relay in the station dial transfer trunk circuit. Relay MBT operated:

- (a) Opens lead HMPA in the transfer trunk circuit if transfer trunk 0 is being made busy or HMPB if transfer trunk 1 is being made busy.
- (b) Connects lead GP or ATB through contacts of relays MBT and HM to lead TC in the transfer trunk circuit.
- (c) Opens lead HM from the make busy and busy display circuit to the dial transfer trunk circuit.
- (d) Grounds lead HM toward the make busy and busy display circuit to light lamp DLTR.

2.06 The lighting of lamp DLTR indicates that the associated dial transfer trunk has been made busy. The opening of lead HMPA or HMPB prevents the use of the associated transfer trunk circuit. The connecting of lead GP or ATB to lead TC directs subsequent requests for transfer to the other transfer trunk circuit.

2.07 If one of the transfer trunk circuits is made busy, the controller circuit, in trying to obtain a transfer trunk, will be forced to select the remaining transfer trunk.

2.08 If both transfer trunk circuits are made busy, the PBX station requesting the transfer will be routed to the attendant.

3. BUSY TONE TRUNK (FS3)

A. Busy Tone Trunk Key Normal

Busy Tone Trunk Requested

3.01 When a PBX line or trunk other than a two-way C.O. trunk originates a call to a PBX line or trunk which is found busy by the marker, the marker will attempt to establish a connection between the calling line or trunk and the busy tone trunk.

Busy Tone Trunk Seizure

3.02 Before seizing the busy tone trunk, the marker will proceed to place a busy test on the trunk by connecting battery through the trunk hold magnet THMO7 to relay SO in the line, link, and marker circuit. If the trunk is busy, relay SO will not operate and the marker will direct the register to return busy tone to the calling station. If the trunk is idle, the battery through THMO7 will operate relay SO and light the trunk busy lamp (BT lamp). The marker will then proceed to seize the idle trunk by operating relay SMR--.

Busy Tone Trunk Busy Indication

3.03 The lighting of lamp BT indicates that the busy tone trunk has been called on by the marker through normal operations.

B. Busy Tone Trunk Made Busy (SC3)

Busy Tone Trunk Key Operated

3.04 If it is desired to place the busy tone trunk in a busy condition, the busy tone trunk key (BT key) in the make busy and busy display circuit is operated. Key BT operated grounds lead HM in the line, link, and marker circuit. Grounding lead HM in the marker circuit:

- (a) Operates the busy tone trunk hold magnet.
- (b) Makes the busy tone trunk busy to the marker on subsequent requests for service.
- (c) Lights lamp BT in the make busy and busy display circuit.

3.05 The lighting of lamp BT indicates that the busy tone trunk has been made busy.

3.06 If the busy tone trunk has been made busy by the operation of key BT, the marker, in trying to connect to the busy tone trunk, will find it busy and direct the register to return busy tone.

4. LINKS (FS4)

A. Link Key Normal

General

4.01 When a link is requested, the marker operates relays LTA,B and LTCA,B in the line, link, and marker circuit. Operation of these relays connects the link testing circuitry to relays LT2-9. If a link is idle, the respective sleeve will be open and the associated LT relay will operate. If a link is busy, the respective sleeve will have a potential of approximately -8 volts to ground and the associated LT relay will not operate.

Link Busy Lamp Indication

4.02 When a link key (LINK key) is normal in the make busy and busy display circuit, the associated link busy lamp (LINK lamp) will light when a direct or resistance ground is applied to the respective S sleeve lead.

4.03 Therefore, when the marker operates the LT relays associated with the idle links during the link testing sequence, those busy lamps associated with idle links will light momentarily. As the marker proceeds to select and busy one of the idle links during the link selection sequence, the busy lamp associated with the selected link will re-light through the resistance ground applied to the sleeve lead of the selected link.

4.04 The lighting of lamp LINK indicates that the associated link has been made busy by the marker through normal operations.

B. Link Made Busy (SC4)Link Key Operated

4.05 If it is desired to make a link busy to the marker, the associated LINK key is operated. Key LINK operated applies a 909 ohm resistor (1A) and 8 volt zener diode (DLT) voltage divider circuit to the associated sleeve lead.

4.06 Zener diode DLT connected to the sleeve:

(a) Holds the sleeve to ground potential at approximately -8 volts thereby making the link busy to the marker.

(b) Lights the associated LINK lamp in the make busy and busy display circuit indicating that the link has been made busy.

4.07 If all the links except the one being tested are made busy, the marker, in testing for an idle link, will be forced to select the one idle link.

5. UNIVERSAL LINES ASSIGNED TO TWO-WAY TIE TRUNKS (FS5)A. General

5.01 The make busy and busy display circuit is used in conjunction with a universal line circuit only when the universal line is assigned to a two-way tie trunk.

B. Universal Line Key NormalOutgoing Call

5.02 For an outgoing call, the line busy lamp (LINE lamp) will light in the make busy and busy display circuit when direct or resistance ground is applied to the operate path of relay OT. This occurs when the marker places a busy test on the line by applying battery through relay OT to operate the associated S relay. The resistance ground of the S relay lights the busy lamp. In the following sequence, the marker operates relay SMR-- to operate relay OT. The direct ground through the operated SMR-- contact operates relay OT and maintains the busy lamp. After the marker completes and releases from the connection, relay OT and lamp LINE are maintained by the ground applied on lead S2 from the tie trunk.

Incoming Call

5.03 For an incoming call, lamp LINE will light when the universal line circuit is seized and made busy to the marker by the operation of relay L in the line circuit. In the following sequence, the marker operates relay IN. Relay IN operated

releases relay L and maintains the busy lamp. After the marker completes and releases from the connection, relay IN is maintained by the ground applied on lead S2 from the tie trunk.

Line Busy Indication

5.04 The lighting of the associated LINE lamp indicates that the line circuit has been made busy through normal operations.

C. Universal Line Made Busy (SC5)Universal Line Key Operated

5.05 If it is desired to make a universal line circuit busy to the marker for outgoing tie trunk calls, key LINE is operated. Key LINE operated:

(a) Opens the operate path for relay OT in the line, link, and marker circuit.

(b) Applies ground to lamp LINE in the make busy and busy display circuit.

5.06 The lighting of lamp LINE indicates that the associated tie trunk has been made busy. Opening the operate path of relay OT prevents the operation of the associated S relay in the marker circuit. Grounding the operate path toward the S relay makes the line busy to the marker for outgoing tie trunk calls.

5.07 To prevent the use of the tie trunk for an incoming call, the tie trunk must be made busy at the distant PBX.

6. ATTENDANT TRUNKS (FS6)A. Attendant Trunk Key NormalIncoming Attendant Trunk Call

6.01 On an incoming attendant trunk call, the trunk busy lamps (ATND TRK lamps) associated with the idle trunks will light when the marker, in testing for an idle trunk, operates the associated S relays in the line, link, and marker circuit. After the marker selects and seizes one of the idle trunks, the operation of relay B in the trunk circuit places a ground on lead HM of the selected trunk. The marker then proceeds on to release all operated S relays. The release of the S relays extinguishes all the ATND TRK lamps except that lamp associated with the selected trunk.

Attendant Originated Trunk Call

6.02 After the attendant selects an idle attendant trunk by operating the pick-up key in the attendant's equipment, the marker proceeds to connect the associated S relay in the line, link, and marker circuit to the trunk lead ITO-. Battery through the trunk hold magnet THM operates the S relay and lights the associated trunk busy lamp (ATND TRK lamp).

Intercepted Call

6.03 On an intercepted call, the marker will select an idle attendant trunk by testing leads IT(00-02). During the selection sequence, the marker operates the TN relay associated with the selected trunk. Relay TN operated grounds lead HM in the trunk circuit. The ground applied to lead HM:

- (a) Operates the associated trunk hold magnet THM in the marker circuit.
- (b) Lights the associated trunk busy lamp (ATND TRK lamp) in the make busy circuit.

Trunk Busy Indication

6.04 The lighting of lamp ATND TRK in the make busy and busy display circuit indicates that the associated trunk has been made busy through normal operation.

B. Attendant Trunk Made Busy (SC6)Attendant Trunk Key Operated

6.05 If it is desired to place an attendant trunk in a busy condition, the attendant trunk key (ATND TRK key) in the make busy and busy display circuit is operated. Key ATND TRK operated operates relay B in the attendant trunk circuit. Relay B operated grounds the associated IT(00-02) and HM(0-2) leads to the line, link, and marker circuit.

6.06 The ground applied to lead HM by the operation of relay B:

- (a) Operates the trunk hold magnet (THM) in the marker circuit.
- (b) Makes the attendant trunk busy to the marker for incoming calls.
- (c) Makes the trunk inaccessible to the attendant for an attendant originated call.
- (d) Lights lamp ATND TRK in the make busy and busy display circuit indicating that the trunk has been made busy.

6.07 The ground applied to the associated IT(00-02) lead makes the attendant trunk busy to the marker for intercepted calls.

6.08 If all the attendant trunks except the one being tested are made busy, the marker, in trying to complete an attendant trunk call, will be forced to use the one idle attendant trunk.

6.09 If all the attendant trunks are made busy, the marker, in trying to complete an attendant trunk call, will route the call to the busy tone trunk.

7. JUNCTORS (FS7)A. Junctor Key NormalJunctor Requested

7.01 When a junctor is requested on a "junctor class" call, the marker proceeds to test the THM leads of the terminating hold magnet of the junctors for a ground. If a ground is present on the lead, the marker realizes that the junctor is already busy. If a ground is not present on the lead, the marker realizes that the junctor is idle and proceeds to seize the idle junctor.

Junctor Seizure

7.02 To seize an idle junctor, the marker places a ground on lead THM- by operating relays SMT- in the line, link, and marker circuit. Relays SMT- operated:

- (a) Operates the terminating hold magnet (THM) of the junctor.
- (b) Operates the line hold magnet of the called line.
- (c) Lights the associated junctor terminating lamp (JCTR TERM lamp) in the make busy and busy display circuit.

7.03 Having established a connection to the called line, the marker recycles to operate the originating hold magnet of the junctor with relays SMT-. The ground placed on lead OHM- of the originating hold magnet:

- (a) Operates the originating hold magnet (THM) of the junctor.
- (b) Lights the associated junctor originating lamp (JCTR ORIG lamp).
- (c) Connects the originating end of the junctor to the calling line through a link.

Junctor Busy Indication

7.04 The lighting of lamp JCTR TERM in the make busy and busy display circuit indicates that a connection has been made to the terminating side of the associated junctor through normal operations.

7.05 The lighting of lamp JCTR ORIG in the make busy and busy display circuit indicates that a connection has been made to the originating side of the associated junctor through normal operations.

B. Junctor Made Busy (SC7)

Junctor Key Operated

7.06 If it is desired to place a junctor in a busy condition, the junctor key (JCTR key) in the make busy and busy display circuit is operated. Key JCTR operated grounds lead THM in the line, link, and marker circuit. Grounding lead THM:

- (a) Operates the junctor's terminating hold magnet in the marker circuit.
- (b) Makes the junctor busy to the marker on subsequent requests for service.
- (c) Lights the associated JCTR TERM lamp in the make busy and busy display circuit.

7.07 The lighting of lamp JCTR TERM indicates that the associated junctor has been made busy.

7.08 If all the junctors except the one being tested are made busy, the marker, in trying to complete a call requiring a junctor, will be forced to use the one idle junctor.

7.09 If all the junctors are made busy, the marker, in trying to complete a call requiring a junctor, will route the call to the busy tone trunk.

8. DIAL PULSE REGISTERS (FS8)

A. Register Key Normal

Register Requested

8.01 When a receiver is lifted off-hook at a station, or a trunk circuit requests inward PBX service, the respective line or trunk tens relay in the line, link, and marker circuit will operate. This operation sets off a chain of operations that results in the marker connecting the line through an idle link to an idle register.

Register Seizure

8.02 When a register is idle, battery and ground through break contacts of register relays ON and RT operate the associated register allotter RA-- relay in the line, link, and marker circuit. Relay RA-- operated prepares an operate path for the register hold magnets THM-8 and THM-9 in the marker. In the process of link selection, the marker operates THM-8 and THM-9.

8.03 The marker, in selecting an idle link, operates the select magnet timing relays SMT- in the marker. Operation of SMT- will operate the register hold magnets THM-8 and THM-9 in the line, link, and marker circuit. The register

then prepares a holding ground for the hold magnets by operating relay SR. Relay SR operated opens the shunt path to light lamp REG- in the make busy circuit.

Register Busy Indication

8.04 The lighting of lamp REG- in the make busy and busy display circuit indicates that the associated register has been made busy by the marker through normal operation.

B. Register Made Busy (SC8)

Register Key Operated

8.05 If it is desired to make the register appear busy to the marker, the associated register busy key (REG-key) in the make busy and busy display circuit is operated. Key REG- operated operates register relay RT. Relay RT operated:

- (a) Makes the register busy to the marker by removing ground from leads ONG- and RHM- in the register circuit.
- (b) Lights lamp RT in the register circuit.
- (c) Lights lamps TR in the cordless position and alarm circuits to indicate that there is an off normal condition in the PBX.
- (d) Prepares to light the ARB lamp at the attendant position when the other register is in use.

8.06 Removing the ground from lead RHM- opens the shunt path to light lamp REG- in the make busy circuit. This indicates that the register has been made busy.

8.07 If both registers are idle, operation of key REG- disables Register- forcing the marker to use the remaining register.

8.08 If both registers are made busy by the operation of register keys REG 0, 1, the marker is forced to hold the call until a register becomes idle. Both register keys operated also light lamp ARB in the cordless position circuit to indicate that all registers are busy.

9. CENTRAL OFFICE TRUNKS (FS9)

A. C.O. Trunk Key Normal

Outgoing Call to Central Office

9.01 For an outgoing dial selected trunk call, the trunk busy lamps (TRK-BY lamps) associated with the idle trunks

If light when the marker, testing for idle trunks, operates the S- relays in the line, link, and marker circuit. After the marker selects and seizes one of the idle trunks, the operation of relay S1 in the trunk circuit places a ground on lead IT9- of the selected trunk. The marker then proceeds to release all operated S- relays. The release of the S- relays extinguishes all the TRK BY lamps except the lamp associated with the selected trunk.

9.02 For an unrestricted attendant originated trunk call, the attendant is equipped to select an idle trunk by operation of an associated pickup key. Operation of the pick-up key results in the operation of relay S1 in the trunk circuit. Relay S1 operated grounds lead IT9- of the selected trunk thereby lighting the associated TRK BY lamp.

Incoming Call From Central Office

9.03 For an incoming central office trunk call, lamp TRK BY will light when the C.O. trunk is seized and made busy to the marker by operation of relay SR in the trunk circuit. After answering and processing the incoming call, the attendant calls the requested PBX station. When the called station answers, relay RT in the trunk circuit operates on the primary winding. Relay RT operated applies ground to its own secondary winding thereby lighting the trunk busy incoming lamp (TRK BY INC lamp).

Night Connection

9.04 When a C.O. trunk is seized for a night connection, relay N in the trunk circuit is operated. Relay N operated grounds lead IT9- of the selected trunk thereby lighting the associated TRK BY lamp.

C.O. Trunk Busy Indication

9.05 The lighting of lamp TRK BY indicates that the associated C.O. trunk has been made busy to the marker by a central office trunk call.

9.06 The additional lighting of lamp TRK BY INC indicates that the associated C.O. trunk has been made busy to the marker by an incoming central office trunk call.

B. C.O. Trunk Made Busy (SC2)

C.O. Trunk Key Operated

9.07 If it is desired to make a C.O. trunk busy to the marker for outgoing C.O. trunk calls, key CO TRK in the make busy and busy display circuit is operated. Key CO TRK operated:

- (a) Opens the associated IT9- lead to the line, link, and marker circuit.
- (b) Applies ground to lamp TRK BY in the make busy and busy display circuit.

9.08 The lighting of lamp TRK BY indicates that the associated C.O. trunk has been made busy. Opening lead IT9- prevents the operation of the associated S relay in the marker circuit. The ground applied to lead IT9- makes the trunk appear busy to the marker for outgoing C.O. trunk calls.

9.09 To prevent the use of the central office trunk by an incoming call, the central office trunk must be made busy at the central office.

9.10 If all the C.O. trunks except the one being tested are made busy, the marker, in trying to complete a central office trunk call, will be forced to connect the calling station to the one idle trunk.

9.11 If all the C.O. trunks are made busy, the marker will be forced to connect the calling station to the busy tone trunk.

SECTION III - REFERENCE DATA

1. WORKING LIMITS

1.01 None.

2. FUNCTIONAL DESIGNATIONS

2.01 The functional meanings of the designations of the keys of the make busy and busy display circuit are listed below:

<u>Designation</u>	<u>Meaning</u>
ATND TRK-	Attendant Trunk
BT	Busy Tone Trunk
CO TRK-	Central Office Trunk
DLTR	Dial Transfer Trunk
JCTR-	Junctor
LINE 8-	Universal Line
LINK--	Link
PWR	Power
REG-	Register

2.02 The functional meanings of the designations of the lamps of the make busy and busy display circuit are listed below:

<u>Designation</u>	<u>Meaning</u>
ATND TRK-	Attendant Trunk
BT	Busy Tone Trunk
DLTR	Dial Transfer Trunk
JCTR- ORIG	Junctor Originating End
JCTR- TERM	Junctor Terminating End
LINE 8-	Universal Line
LINK--	Link

<u>Designation</u>	<u>Meaning</u>
PWR-48	Power, -48 volt
PWR-96	Power, -96 volt
REG-	Register
TRK- BY	Trunk Busy
TRK- BY INC	Trunk Busy Incoming

3. FUNCTIONS

- 3.01 To provide a visual indication of a register busy condition.
- 3.02 To provide a means for making a register busy.
- 3.03 To provide a visual indication of a busy tone trunk busy condition.
- 3.04 To provide a means for making the busy tone trunk busy.
- 3.05 To provide a visual indication of a C.O. trunk busy condition for all calls.
- 3.06 To provide an additional visual indication of a C.O. trunk busy condition for an incoming call.
- 3.07 To provide a means for making a C.O. trunk busy to the marker for outgoing C.O. trunk calls.
- 3.08 To provide a visual indication when a connection is made to the terminating side of a junctor.
- 3.09 To provide a visual indication when a connection is made to the originating side of a junctor.
- 3.10 To provide a means for making a junctor busy.
- 3.11 To provide a visual indication of an attendant trunk busy condition.
- 3.12 To provide a means for making an attendant trunk busy.
- 3.13 To provide a visual indication of a link busy condition.
- 3.14 To provide a means for making a link busy.
- 3.15 To provide a visual indication of a dial transfer trunk busy condition.
- 3.16 To provide a means for making a dial transfer trunk busy to the controller circuit.
- 3.17 To provide a visual indication of a universal line (assigned to a two way tie trunk) busy condition.
- 3.18 To provide a means for making a universal line (assigned to a two way tie trunk) busy.

4. CONNECTING CIRCUITS

- 4.01 When this circuit is listed on a key sheet, the information thereon is to be followed.
- 4.02 This circuit is connected to the following circuits which are part of the 756A PBX system:
 - (a) Line, Link, and Marker Circuit - SD-65741-01.
 - (b) Dial Pulse Register Circuit - SD-65742-01.
 - (c) PBX Cabling Diagram - SD-65746-01.
 - (d) Junctor Circuit - SD-65750-01.
 - (e) Two-Way Central Office Trunk Circuit - SD-65752-01.
 - (f) Attendant Trunk Circuit - SD-65753-01.
 - (g) Busy Tone Trunk Circuit - SD-65754-01.
 - (h) Station Dial Transfer Trunk Circuit With Add-On Conference - SD-66921-01.
 - (i) Alarm, Transfer and Test Circuit - SD-66796-01.

5. TAKING EQUIPMENT OUT OF SERVICE

- 5.01 The make busy and busy display circuit may be taken out of service by the following procedure in sequence.
 - (a) Determine that all make busy keys are returned to normal.
 - (b) Return the PWR key to normal.

6. MANUFACTURING TESTING REQUIREMENTS

- 6.01 The make busy and busy display circuit shall be capable of performing all the functions specified in this circuit description.

SECTION IV - REASONS FOR REISSUEB. Changes in Apparatus

<u>B.1 Superseded</u>	<u>Superseded By</u>
DLT Diode 425AC - Fig. 1, Z Option	DLT Diode 485AC - Fig. 1, Y Option

D. Description of Changes

- D.1 This circuit is reissued to:
 - (a) Change the 425AC code of diode DLT to the preferred 485AC code. Option Z is designated on the 425AC code and rated Additions and Maintenance only. Option Y is added and rated Standard to provide the new 485AC code.

- (b) Change the code of lamp PWR-48 from M1 to 2Y. Option X is designated on the M1 code and rated Manufacture Discontinued. Option W is added and rated Standard to provide the new 2Y code. This change is made necessary due to the low shock resistance of the M1 lamp resulting in failures of lamp PWR-48 to light.
 - (c) Revise the terminal numbering on diode DLT to correct records only.
 - (d) Clarify the connecting information on CAD 1 (Sheet Note 1) for the A&M version of the Make Busy and Busy Display Circuit.
- D.2 On sheet A1, the sheet index is brought up to date.
 - D.3 On sheet A2, options Z, Y, X and W are added to option index.
 - D.4 On sheet B3, the terminal numbering on diode DLT is corrected to indicate the cathode (Stud) as being terminal 1 and the anode as being terminal 2 to correct records only. Also, on sheet B3, diode DLT is designated as option Z and option Y apparatus.
 - D.5 On sheet C1, the 425AC code of diode DLT is optioned as Z apparatus and the new 485AC code is added and optioned as Y apparatus. Also, the M1 code of lamp PWR-48 is optioned as X apparatus and the new 2Y code is added and optioned as W apparatus.
 - D.6 On sheet D1, Circuit Note 104 is revised to reflect the changes on this issue.
 - D.7 On sheet G1, Note 1 is modified to clarify connecting information for field modification of the 756A PBX when the addition of the make busy and busy display unit is requested.

BELL TELEPHONE LABORATORIES, INCORPORATED

(WECO 5120HW-JJM-RHP)
DEPT 5337-RVL

3

PBX SYSTEMS
VOLTAGE REDUCTION DETECTOR
AT MIDPOINT OF VOLTAGE DIVIDER NETWORKCHANGESD. Description of Changes

D.1 This circuit is reissued on a No-Record basis per agreement with the Western Electric Standards Organization to change the resistance values of the biasing resistor R(1-5)1 and R(1-5)2 from 15K and 1K ohms to 8.2K and 680 ohms respectively to improve the performance of the circuit.

D.2 On sheet 1, the OFF and ON conditions in information note 302 are revised to reflect the change in the biasing resistors.

D.3 On sheet 3, the values of resistors R(1-5)1 and R(1-5)2 are changed in CPS1 to 8.2K and 680 ohms respectively.

F. Changes in CD Sections

F.1 In SECTION II - DETAILED DESCRIPTION, change the second sentence of paragraph 1.01 to read as follows:

.....When voltage is applied to the circuit, the voltage divider, consisting of

biasing resistors R-1 and R-2, establishes a negative potential to ground at the base of Q-.

F.2 In SECTION II - DETAILED DESCRIPTION, change paragraph 1.03 to read as follows:

1.03 If a voltage divider, consisting of resistors R2 and R3, is applied through external switching to the emitter of Q- such that R2 is equal to or less than twelve times R3, the base of Q- will still remain more positive with respect to the emitter and the transistor will remain off.

F.3 In SECTION II - DETAILED DESCRIPTION, change paragraph 1.04 to read as follows:

1.04 If a third resistor R4 is applied in parallel with R3 to the emitter of Q- such that the combined total resistance of R3 and R4 lowers the emitter potential to 0.8 volts or less, the base of Q- will be more negative with respect to the emitter and the transistor will be driven into saturation.

BELL TELEPHONE LABORATORIES, INCORPORATED

(WECO 2120HW-JJM-WHK)
DEPT 5337-LAH

PEA SYSTEMS
VOLTAGE REDUCTION DETECTOR
AT MIDPOINT OF VOLTAGE DIVIDER NETWORK

SECTION I - GENERAL DESCRIPTION

1. PURPOSE OF CIRCUIT

1.01 To provide semi-conductor circuit packs which when connected to external voltage divider networks constitute a bridge network to detect and give an indication of a decrease in the midpoint voltage of the voltage divider.

2. TYPES OF CIRCUIT PACKS

A. CPS 1

1.01 This circuit pack consists of five transistor detectors mounted on an omplas assembly. Any or all of the five detector circuits may be used to drive an external output relay after detecting a decrease in the midpoint voltage of a voltage divider network.

1.02 Each detector circuit consists of one transistor, two resistors, and one diode. The resistors provide the biasing for the transistor and constitute one leg of the bridge network. The emitter of the transistor is connected through a diode and by external switching to a voltage divider network which constitutes the other leg of the bridge. The emitter-base junction detects an unbalanced condition in the bridge when the midpoint voltage of the voltage divider decreases. This unbalance drives the transistor into conduction. The conduction of the collector-emitter junction drives the external relay.

SECTION II - DETAILED DESCRIPTION

1. CIRCUIT DESCRIPTION

A. CPS 1

1.01 The following description assumes that the circuit is energized with -48 volts. When voltage is applied to the circuit, the voltage divider, consisting of resistors R1 and R2, establishes a potential to ground of -3 volts at the base of Q-.

1.02 If the emitter of Q- is open, the base of Q- is more positive with respect to the emitter and the transistor is off (not conducting).

1.03 If a voltage divider is applied through external switching to the emitter of Q- such that R2 is equal to or less than fifteen times R3, the base of Q- will still remain more positive with respect to the emitter and the transistor will remain off.

1.04 If a third resistor R4 is applied in parallel with R3 to the emitter of Q- such that the combined total resistance of R3 and R4 lowers the emitter potential to 2.8 volts or less, the base of Q- will be more negative with respect to the emitter and the transistor will be driven into saturation.

1.05 With a circuit connection as shown in CKT 1, FS1, relay R will operate when the direct ground (R4=0) is applied through Q-.

2. CALCULATIONS OF EXTERNAL RESISTANCE NECESSARY FOR DESIRED OPERATION

A. CPS 1

2.01 The values of external resistance may be determined from information note 302 for use with a -48 volt battery supply.

SECTION III - REFERENCE DATA

1. WORKING LIMITS

1.01 The working limits for CP1 are as detailed in information note 302.

2. FUNCTIONAL DESIGNATIONS

2.01 None

3. FUNCTIONS

3.01 To detect a decrease in the midpoint voltage of a voltage divider network.

3.02 To operate an external output relay as an indication of a decrease in the midpoint voltage.

4. CONNECTING CIRCUITS

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

(a) 756A PBX Line, Link, and Marker Circuit - SD-65741-01.

5. MANUFACTURING TESTING REQUIREMENTS

5.01 The voltage reduction detector circuits shall be capable of performing all the service functions specified in this circuit description and information notes 302 and 303.

6. TAKING EQUIPMENT OUT OF SERVICE

6.01 The information for the removal of the detector circuits from service shall be provided in the various connecting circuits in which the detector circuits are an integral part.

BELL TELEPHONE LABORATORIES, INCORPORATED

(WECO 2120HW-JJM-WHK)
DEPT 5337-LAH