

CIRCUIT DESCRIPTION

CD-65756-01
ISSUE 5D
APPENDIX 2D
DWG ISSUE 10D

PBX SYSTEMS
NO. 756A
TIE TRUNK CIRCUIT
OUTGOING MANUAL AND DIAL SELECTED
WITH 2 SECOND RINGING SIGNAL
INCOMING RINGDOWN

CHANGES

D. Description of Changes

D.1 Option ZD is changed from Mfr Disc. to Standard to allow the operating company to choose either option ZD or option ZE.

D.2 Circuit Note 103 is revised and Note 106 is added.

D.3 On night connections with option ZD, relay R1 operated on an incoming call locks under control of relay S1 released. Since the call is not answered, relay S1 never operates to release relay R1. Relay R1 flashes the trunk lamp in the console and operates the console ringer continuously. With option ZE, the locking ground for relay R1 is under control of the battery cut-off relay in the alarm, transfer, and test circuit. On night connections, relay R1 releases to silence the console ringer and extinguish the console lamp.

D.4 Lead SI (option ZE) is changed to show a multiple to other tie trunks.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 3223-WVS-FKB

APR 26 1974

CIRCUIT DESCRIPTION

CD-65756-01
ISSUE 5D
APPENDIX 1D
DWG ISSUE 9D

PEX SYSTEMS
NO. 756A
TIE TRUNK CIRCUIT
OUTGOING MANUAL AND DIAL SELECTED
WITH 2 SECOND RINGING SIGNAL
INCOMING RINGDOWN

CHANGES

D. Description of Changes

D.1 The rating of this circuit is changed from AT&TCo
Standard to A&M Only.

BELL TELEPHONE LABORATORIES, INCORPORATED
DEPT 3224-WVS-RVL

PBX SYSTEMS
 NO. 756A
 TIE TRUNK CIRCUIT
 OUTGOING MANUAL AND DIAL SELECTED
 WITH 2 SECOND RINGING SIGNAL
 INCOMING RINGDOWN

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SECTION I - GENERAL DESCRIPTION

1. PURPOSE OF CIRCUIT

1.01 This trunk serves as a connecting link between the No. 756A PBX and a distant PBX. It is arranged for 2-way operation and employs ringdown signaling in both directions.

2. GENERAL METHOD OF OPERATION

2.01 The trunk may be dial selected by (a) a station, (b) a dial repeating tie trunk, or (c) manually selected by an attendant for outgoing calls. The attendant may also dial select the trunk via a central office trunk or another ringdown tie trunk for the completion of tandem calls through the PBX.

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 (SC2)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 6-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 1.27 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.

3. 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.

8. 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.

9. 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. Rering 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 PBX 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:

<u>Designation</u>	<u>Meaning</u>
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-3B200-01

* 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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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.