CROSSBAR SYSTEMS
NO. 3
2-WAY OPERATOR OFFICE PLUG-ENDED TRUNK CIRCUIT
E AND M LEAD SUPERVISION - DP OR MF PULSING
COIN OR NON-COIN OR NON-COIN ONLY
IN-BAND COIN CONTROL

CHANGES

D. Description of Changes

D.01 For description of operation see CD Issue 2D.

D.02 Option A is added and option B is designated. Both are rated Standard.

BELL TELEPHONE LABORATORIES, INCORPORATED

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SECTION I - GENERAL DESCRIPTION

1. PURPOSE OF CIRCUIT

1.01 This circuit connects coin and noncoin customer dial zero outgoing calls to an attendant, alarm signals from an alarm sending circuit to an attendant; and also connects local customers to incoming terminating calls from a machine switched office and to incoming terminating regular and no-test calls from an attendant. The incoming calls can use either DP or MF signaling.

2. GENERAL DESCRIPTION OF OPERATION

2.01 Outgoing Features:

(a) This circuit directs all outgoing calls to an attendant. Option 2 provides noncoin customer services only, and option 3 provides both coin and noncoin customer services. Option 4 with option 3 permits an alarm sending circuits to use the facilities of this circuit to send alarm signals to the attendant.

(b) Low tone is transmitted to the answering attendant on coin calls to identify the class of service of the call as coin class of service.

(c) In noncoin circuits, the attendant initiates a wink signal to recall a customer. In coin circuits, an attendant initiated wink signal alerts a dual channel receiver which records MF tones transmitted by the distant office to distinguish between a coin collect, coin return, or customer recall function. Automatic coin disposal and coin service improvements (dial-tone-first) features are also provided.

(d) An alarm sending circuit may be directly connected to the two last choice trunk circuits equipped with options 3 and 4. This allows the alarm sending circuit to use this circuit to send alarm signals to the attendant. When this circuit is seized by the alarm sending circuit, the attendant interprets a silent termination as an alarm signal. The attendant then dials the alarm checking terminal over another trunk to receive the alarm information. The alarm sending circuit then causes an on-hook signal to be sent to the attendant over this circuit as a verification signal that the call was an alarm sending call. The attendant can then release this circuit.

2.02 Incoming Features:

(a) The switching circuits at the distant office allow mixed attendant and machine switched calls to reach this circuit for local completion. Tandem features are not provided in this circuit. Option T provides for dial pulse operation and options S and E provide for multifrequency operation. Option 4 with option 3 provides the attendant with no-test completion facilities.

(b) When options 3, 4, and B are provided, the incoming seizure alerts a dual channel receiver which records MF tones transmitted by the distant office to distinguish between regular and no-test calls.

(c) Machine switched calls and regular attendant calls are treated in the same manner. Ringing is automatic and a pickup relay is used to signal the beginning of a coded ringing cycle. An attendant no-test call to an idle line is treated in a similar manner except that ringing is started by a recall signal initiated by the attendant. A no-test call to a busy line does not require ringing.

(d) When option A is provided this circuit can be used for busy-line verification (no test) from TSPS only.

SECTION II - DETAILED DESCRIPTION

1. OUTGOING CALL - ESTABLISHING CONNECTION - SC1

1.01 After the marker has determined that a trunk of this type is required, it finds and selects an idle trunk in the following manner:

(a) Ground supplied by the trunk over the FT lead indicates to the marker that at least one trunk in the required group on the associated trunk switch and connector circuit is idle.

(b) Ground supplied by the marker is looped through the idle trunk on leads TG and TT and is directed by the marker connector, trunk block, and trunk group relays to operate one of 12 TT- relays.

(c) Battery supplied by the marker and directed by the marker connector, trunk block, and TT- relay through lead TF, operates the F relay in the trunk.

1.02 The operation of relay F:

(a) Breaks the operating lead of the AL relay.

(b) Opens the F lead to the IRL and operates the LF relay.

(c) Operates the S1 relay.

(d) Operates the AR relay.

(e) Replaces ground with battery on the M lead as an off-hook signal to the distant office.

(f) Removes ground from one of the operating paths of the E1 and ER relays.

(g) Locks itself to the TF lead.

1.03 The operation of relay LF:

(a) Connects the RC lead to the RC relay.

(b) Transfers a ground from an IN relay operating path to an RS relay operating path.

(c) Connects the R2 lead to the R2 relay.

(d) Connects the R3 lead to the R3 relay.

(e) Transfers the RC relay holding ground circuit from the RC relay to lead RA.

(f) Grounds the JC lead.

(g) Opens the PU relay operating lead.

(h) Grounds the SW lead.

(j) Operates the LF1 relay.

(k) Transfers the incoming T, R, and S leads from this circuit to the T1, R1, and SL leads, respectively.

1.04 The operation of relay S1:

(a) Partially closes the operating path of relay TM.

(b) Provides a holding ground for relay CN.

(c) Provides a holding ground for relay INS.

(d) Opens the MB lead to the test circuit.

(e) Operates the MB relay.

(f) Transfers an operating path from the E1 relay to the ER relay.

(g) Provides the 19-ohm holding ground for later use on the S lead to hold the switches and also to activate the TUR circuit.

(h) Provides a holding ground for the CL relay.

(j) Opens the operating path of the IN relay and closes a holding path for itself.

(k) Partially closes the operating path of the CC relay.

(ℓ) Provides an operating and locking ground for the CRL relay.

1.05 The operation of relay AR:

(a) Provides its own locking ground.

(b) Provides an operating and locking ground for the SD relay.

(c) Partially closes an operating path of the E1 relay.

(d) Opens the operating path of the CC relay.

(e) Connects ringing tone to the R lead.

(f) Maintains battery on the M lead as an off-hook signal.

(g) Partially closes the operating lead of the CL relay.

(h) Maintains ground on the S1 relay.

1.06 The operation of relay LF1.

(a) Connects the TPR lead to the TPR relay.

(b) Connects the BY lead to the BY relay.

(c) Partially connects ground to the TT1 lead.

(d) Connects the CN lead to the CN relay.

(e) Partially connects ground to the NT lead.

1.07 The operation of relay MB:

(a) Opens the FT lead.

(b) Opens the loop between leads TT and TG.

(c) Opens the TF lead.

(d) Opens the operating path of the AL relay.

1.08 On a coin call, the marker will operate the CN relay over lead CN (coin).

1.09 The operation of relay CN (coin):

(a) Partially closes an operating path for the CN1 relay (option ZE) or operates the CNA relay (option ZF).

(b) Partially closes low tone to the R lead.

(c) Locks itself to ground through an S1 relay contact.

(d) Partially removes ground from the control lead of the TMA time delay circuit.

(e) Transfers operating ground from the CRL relay to the CR relay (option Z).

(f) Partially closes an operating path of the R relay.

(g) Provides battery for the CR and CC relays.

1.10 The operation of relay CNA (option ZF):

(a) Replaces -48 volt and ground on the winding of the L relay with +48 volt and PBG for dial-tone-first, operation. Two make-contacts are in series with the +48 volt supply to minimize the possibility of a short between the +48 volt and -48 volt supplies.

(b) Locks to ground on an SD relay contact.

(c) Partially closes an operating path for the CN1 relay.

1.11 When the marker has connected the line through the network to the trunk it:

(a) Tests the sleeve lead for continuity.

(b) Tests the sleeve lead for a false ground.

(c) If above tests are successful, it releases the F relay.

(d) Releases itself.

1.12 The release of relay F releases the LF relay.

1.13 The release of relay LF:

(a) Connects 19-ohm ground to the S lead to hold the switches and activate the TUR circuit.

(b) Connects the incoming T and R leads to the trunk.

(c) Releases the LF1 relay.

1.14 The customers bridge across the T and R leads operates the L relay.

1.15 The operation of relay L:

(a) Provides a holding ground for relay AR.

(b) Operates the L1 relay.

1.16 The operation of relay L1:

(a) Operates the SD relay (option 2) or partially closes the operating path of the R relay (option 3).

(b) Partially closes an operating path of the E1 relay (option 2) or transfers an operating ground from the RS relay to the R relay (option 3).

(c) Removes the idle terminating network from across the T and R leads.

(d) Maintains battery on the M lead as an off-hook signal.

(e) Partially connects an 800-ohm resistor across the T and R leads.

1.17 The operation of relay SD (option 2):

(a) Partially connects a 4700-ohm resistor across the T and R leads to the IRL (option S).

(b) Replaces battery with ground on the M lead as an on-hook signal on incoming calls.

(c) Maintains ground on the M lead as an on-hook signal regardless of the state of the AR and F relays.

(d) Supplies an operating and locking ground for relay CNA.

(e) Transfers the SD relay from the T lead associated with the IRL to ground through a make-contact on the CD relay.

1.18 When the attendant answers, the E lead is grounded operating the E relay.

1.19 The operation of relay E:

(a) Partially closes an operating lead of the R relay (option 2).

(b) Partially closes an operating lead of the ER relay (option 3).

(c) Opens the operating path of HA relay (option 4) and partially closes the operate path of the INS relay.

(d) Adds a 120-ohm current limiting resistor in the E lead and locks itself to the E lead.

(e) Partially closes the ST lead to the IRL.

(f) Opens the TF lead.

(g) Transfers the E1 relay operating path from its outgoing call circuit to its incoming call circuit.

(h) Opens the TT and TG lead loop.

(i) Connects a 4700-ohm resistor across the T and R leads to the IRL (option S) or connects resistance ground to the R lead to the IRL (option T).

(j) Opens the FT lead and operates the SL relay.

1.20 The operation of relay INS:

(a) Provides its own locking ground.

(b) Partially closes the TT1 lead.

(c) Opens the MB lead to the test circuit.

(d) Supplies a holding ground for the AL and AL1 relays.

(e) Closes another operating ground for the MB relay.

(f) Partially grounds the S lead to hold for future connection.

1.21 The operation of relay SL;

(a) Partially closes the holding path of the E1 relay.

(b) Provides a locking circuit for the CT relay.

(c) Partially closes the operating and locking circuits of the IN relay.

(d) Removes ringing tone from the R lead and connects the R lead to the low tone circuit.

(e) Partially closes the operating path of the E1 relay.

(f) Opens the operating path of the CC relay.

(g) Partially closes the C2 ringing lead (added as isolation protection for the ringing leads).

(h) Provides a locking circuit for the AR relay.

(i) Operates the CR relay (option Z, coin).

(j) Partially closes the operating path of the TM relay.

(k) Operates the CL relay (option 3).

1.22 One of the following three courses of action will follow, dependant upon the options provided and the type of call in progress.

(a) With option 2, with options 3 and Y on a noncoin call, and with options 3 and Z on a noncoin call, the customer can now talk to the attendant.

(b) With options 3 and Y on a coin call, a low-tone signal is momentarily transmitted to the attendant to advise that it is a coin call, after which the customer can talk to the attendant.

(c) With options 3 and Z on a coin call coin return potential is automatically applied to the customers line along with low-tone to the attendant, after which the customer can talk to the attendant.

(d) The details of the above are covered in the following paragraphs.

1.23 The operation of relay CR (option Z, coin):

(a) Partially closes the operating path of the TM relay.

(b) Replaces coin collect with coin return potential on the CP lead.

(c) Operates the CR1 relay.

(d) Connects low-tone to the R lead.

1.24 The operation of relay CL (option 3):

(a) Closes its own holding ground.

(b) Operates the CRL relay (option Y or option Z, noncoin).

(c) Opens an operating path of the CC1 and CR1 relays.

(d) Transfers the M lead to direct ground.

(e) Partially closes an operating path of the CC relay.

1.25 The operation of relay CRL (option Y or option Z, noncoin):

(a) Partially closes the low-tone circuit.

(b) Closes its own holding ground.

(c) Opens the CR relay operating path.

(d) Partially closes the CC relay operating path.

(e) Partially removes ground from the control lead of the TMA time delay circuit.

(f) Closes an operating path of the CC1 and CR1 relays.

1.26 The operation of relay CR1 (option Z, coin):

(a) Connects coin return potential to the CP lead.

(b) Provides holding ground for the S1 relay.

(c) Opens the CC1 relay operating path.

(d) Partially closes its own holding circuit.

(e) Operates the CB relay.

(f) Connects an 800-ohm resistor across the T and R leads.

1.27 The operation of relay CB (option Z, coin call):

(a) Provides an operating path for the CNA relay.

(b) Removes ground from the control lead of the TMA time delay circuit.

(c) Opens the R lead.

(d) Opens the operating lead of the CC relay.

(e) Opens the T lead and connects coin return potential to the line.

(f) Connects an 800-ohm resistor across the T and R leads.

1.28 On a coin call, the operation of the CRL or CB relay activiates the TMA time delay circuit which operates the TM relay.

1.29 The operation of relay TM (coin):

(a) Opens the E1 relay locking circuit.

(b) Removes low tone from the R lead.

(c) Transfers locking battery for its operating circuit.

(d) Opens an R relay operating circuit.

(e) Operates the CRL relay (option Z).

(f) Opens a CL relay control path.

(g) Partially closes the ST lead to the IRL.

1.30 The operation of relay CRL (option Z, coin):

(a) See 1.25.

(b) Releases the CR relay.

1.31 The release of relay CR (option Z, coin):

(a) Removes coin return potential from the line.

(b) Releases the CR1 relay.

1.32 The release of relay CR1 (option Z, coin):

(a) Releases the CB relay.

1.33 The customer can now talk to the attendant.

2. COIN COLLECT (OPTION 3) - SC2

2.01 When the attendant momentarily operates the coin collect key, relay E releases.

2.02 The release of relay E operates the E1 relay.

2.03 The operation of relay E1:

(a) Partially closes an operating path of the R relay.

(b) Partially closes an operating path of the ER relay.

(c) Operates the TD relay.

(d) Partially closes its own locking path.

(e) Releases the TM relay and transfers it to a new operating path.

(f) Opens the circuit to the low-tone supply.

(g) Connects the ER relay shunting resistor to terminals 5 and 9 of the dual channel receiver to prevent the operation of relay ER if either terminal is grounded.

(h) Partially closes the IN relay operating path.

(i) Partially closes the control lead of the TMA time delay circuit.

2.04 The operation of relay TD:

(a) Opens an operating path of the R and RS relays.

(b) Partially closes the locking path of the E1 relays.

(c) Opens an operating path of the TM relay.

(d) Connects a 100-ohm resistor across its secondary winding to make it release slowly.

(e) Opens the operating path of the CN1 relay.

(f) Opens the operating path of the NT and INC relay.

2.05 Relay E operates, after the wink signal transmitted by the distant attendant, and operates the ER relay.

2.06 The operation of relay ER:

(a) Opens the ST lead to the IRL circuit.

(b) Transfers the T and R leads going to the distant office from this circuit to the dual channel receiver.

(c) Reconnects the TM relay to the TMA time delay circuit.

(d) Opens the TMA time delay circuit control lead.

(e) Transfers terminals 5 and 9 of the dual channel receiver from the ER relay shunting ground to the windings of the F1 and F2 relays, respectively.

(f) Connects an 800-ohm resistor across the T and R leads.

(g) Opens the BY relay control path.

(h) Opens the circuit to the low-tone supply.

2.07 The distant office transmits 700- and 1100-hertz (coin collect) signals which operate the P1 and P2 relays in the dual channel receiver, in turn operating the F1 and F2 relays.

2.08 The operation of relay F1:

(a) Releases the TD relay and operates the TM relay in tandem.

(b) Transfers an operating path from the CR1 to the CC1 relay.

(c) Transfers an operating path from the INC to the NT relay.

(d) Provides a holding ground for the ER relay.

(e) Partially closes an operating ground for the R and RS relays.

2.09 The operation of relay F2:

(a) Releases the TD relay and operates the TM relay in tandem.

(b) Partially closes the INC relay operating path.

(c) Opens the NT relay operating path.

(d) Transfers an operating path from the CR1 relay to the CN1 relay.

(e) Transfers a ground from the R and RS relays to the ER relay.

2.10 The release of relay TD releases the E1 relay and operates the CN1 relay.

2.11 The operation of relay CN1:

(a) Partially closes an operating ground for the CR1 and CC1 relays.

(b) Partially closes an operating ground for the CR1 relay.

(c) Provides a holding ground for the CR1 and CC1 relays.

(d) Operates the CC1 relay.

(e) Partially connects the coin collect and coin return potential to the CP lead.

2.12 The operation of relay CC1:

(a) Partially connects coin collect potential to the CP lead.

(b) Operates the CB relay.

(c) Closes its own holding circuit.

(d) Opens the CR1 relay operating path.

(e) Provides a holding circuit for the S1 relay.

(f) Opens an operating circuit for the R and RS relays.

(g) Connects an 800-ohm resistor across the T and R leads.

2.13 The operation of relay CB.

(a) See 1.27.

(b) Connects coin collect potential to the line.

2.14 The attendant removes the 700- and 1100-hertz signals from the line, releasing the P1 and P2 relays in the dual channel receiver, and in turn releasing the F1 and F2 relays.

2.15 The release of relays F1 and F2:

(a) Releases the ER relay.

(b) Releases the CN1 relay.

2.16 The release of relay CN1:

(a) Removes coin collect potential from the line.

(b) Releases the CC1 relay.

2.17 The release of the CC1 relay releases the CB relay.

2.18 The customer can now talk to the attendant.

2.19 If the distant office had failed to transmit the 700- and 1100-hertz signals, the TMA time delay circuit would operate the TM relay.

2.20 The operation of relay TM would release the E1 relay.

2.21 The release of relay E1:

(a) Releases the ER relay.

(b) Releases the TD relay.

2.22 The customer can now talk to the attendant.

3. COIN RETURN (OPTION 3) - SC3

3.01 When the attendant momentarily operates the coin return key, relay E releases.

3.02 The release of relay E operates the E1 relay.

3.03 The operation of relay E1:

(a) See 2.03.

(b) Operates the TD relay.

(c) Releases the TM relay.

3.04 The operation of relay TD:

(a) See 2.04.

3.05 Relay E reoperates, after the wink signal transmitted by the distant attendant, and operates the ER relay.

3.06 The operation of relay ER:

(a) See 2.06.

3.07 The distant office transmits 1100- and 1700-hertz (coin return) signals which operates the P2 relay in the dual channel receiver, in turn operating the F2 relay. The 1700-hertz signal is sent only to balance the load on the MF supply; it does not affect the receiver.

3.08 The operation of relay F2:

(a) See 2.09.

(b) Releases the TD relay and operates the TM relay in tandem.

3.09 The release of relay TD releases the E1 relay and operates the CN1 relay.

3.10 The operation of relay CN1:

(a) See 2.11.

(b) Operates the CR1 rather than the CC1 relay.

3.11 The operation of relay CR1:

(a) Partially connects coin return potential to the CP lead.

(b) Provides a holding circuit for the S1 relay.

(c) Opens the CC1 relay operating path.

(d) Closes its own holding circuit.

(e) Operates the CB relay.

(f) Connects an 800-ohm resistor across the T and R leads.

3.12 The operation of relay CB:

(a) See 1.27.

(b) Connects coin return potential to the line.

(c) Operates the CNA relay (option ZF, incoming).

(d) Cuts of ringing if the called customer has not answered (option ZF, incoming).

3.13 The operation of relay CNA (option ZF, incoming):

(a) See 1.10.

(b) Releases relays L and L1 in tandem and sends an on-hook signal to the attendant if the called customer has answered.

3.14 The attendant removes the 1100- and 1700-hertz signals from the line, releasing the P2 relay in the dual channel receiver, and in turn releasing the F2 relay.

3.15 The release of the F2 relay:

(a) Releases the ER relay.

(b) Releases the CN1 relay.

3.16 The release of relay CN1:

(a) Removes the coin return potential from the line.

(b) Releases the CR1 relay.

3.17 The release of the CR1 relay releases the CB relay.

3.18 The release of relay CB:

(a) Reapplies ringing if the called customer has not answered (option ZF, incoming).

(b) Operates relays L and L1 in tandem, sends an off-hook signal to the attendant, and permits the customer to talk to the attendant if the called customer has answered (option ZF, incoming).

(c) Permits the customer to talk to the attendant (outgoing).

3.19 If the distnat office had failed to transmit the 1100-hertz signal, the TMA time delay circuit would operate the TM relay.

3.20 The operation of relay TM would release the E1 relay.

3.21 The release of relay E1:

(a) Releases the ER relay.

(b) Releases the TD relay.

3.22 The customer can now talk to the attendant unless:

(a) The called customer has not answered, in which case ringing continues (option ZF, incoming).

4. RECALLING CUSTOMER (OPTION 3) - SC4

4.01 When the attendant momentarily operates the recall key, relay E releases.

4.02 The release of relay E operates the E1 relay.

4.03 The operation of relay E1:

(a) See 2.03.

(b) Operates the TD relay.

(c) Releases the TM relay.

4.04 The operation of relay TD:

(a) See 2.04.

4.05 Relay E operated after the wink signal transmitted by the distant attendant, and operates the ER relay.

4.06 The operation of relay ER:

(a) See 2.06.

(b) Releases the BY relay and sends an on-hook signal to the attendant (no test busy returned to idle).

4.07 The distant office transmits 700- and 1700-hertz (recall) signals which operate the P1 relay in the dual channel receiver, in turn operating the F1 relay. The 1700-hertz signal is sent only to balance the load on the MF supply; it does not affect the receiver.

4.08 The operation of relay F1:

(a) See 2.08.

(b) Releases the TD relay and operates the TM relay in tandem.

4.09 The release of relay TD releases the E1 relay and initiates one of the following three courses of action dependant upon the options provided and the type of call in progress:

(a) On incoming on-hook (unanswered) calls, relays RS and PU will operate to apply coded ringing to the line and the RT relay will operate to trip ringing when the customer answers.

(b) On incoming off-hook calls, outgoing coin calls, outgoing noncoin off-hook calls, and outgoing noncoin on-hook with option R calls, the R relay will operate to apply 20-hertz ringing to the line.

(c) On outgoing noncoin, on-hook without option R calls, ringing is not applied to the line.

(d) The details of the above are covered in the following paragraphs.

4.10 The operation of relay RS:

(a) Partially closes the operating path of the PU relay.

(b) Transfers the incoming T and R leads from this circuit to the coded ringing supply and ground.

(c) Provides its own locking circuit.

4.11 Relay PU will operate immediately if relay R3 is normal and if relay R2 is normal or option P is provided; otherwise it will operate when the PU pulse grounds the PU lead.

4.12 The operation of relay PU:

(a) Connects coded ringing to the line.

(b) Transfers its locking circuit for its operating circuit.

4.13 The operation of relay R:

(a) Partially closes the operating path of relay TM.

(b) Opens the T lead and connects ringing ground to the T lead.

(c) Opens the E1 relay holding circuit (option 2).

(d) Partially opens the TMA time delay circuit control lead (option 2).

(e) Opens the R lead and partially connects an 800-ohm resistor across the T and R leads.

(f) Connects 20-hertz ringing to the R lead.

(g) Provides its own locking circuit (option 2).

4.14 The attendant removes the 700- and 1700-hertz signals from the line, releasing the P1 relay in the dual channel receiver, and in turn releasing the F1 relay.

4.15 The release of relay F1:

(a) Releases the ER relay.

(b) Releases the R relay if operated, removing 20-hertz ringing from the line.

4.16 If coded ringing is applied, the RT relay will operate when the customer answers.

4.17 The operation of relay RT releases the RS relay.

4.18 The release of relay RS:

(a) Releases the PU relay.

(b) Releases the RT relay.

(c) Removes coded ringing from the line.

(d) Connects the L relay to the line, operating the L and L1 relays in tandem which sends an off-hook signal to the attendant and permits the customer to talk to the attendant.

4.19 If coded ringing was not applied, and:

(a) The line is off-hook, the customer can now talk to the attendant.

(b) The line is on-hook, when the customer answers, the L and L1 relays will operate in tandem which sends an off-hook signal to the attendant and permits the customer to talk to the attendant.

4.20 If the distant office had failed to transmit the 700-hertz signal, the TMA time delay circuit would operate the TM relay.

4.21 The operation of relay TM would release the E1 relay.

4.22 The release of relay E1:

(a) Releases the ER relay.

(b) Releases the TD relay.

4.23 The customer can now talk to the attendant if the phone is off-hook.

5. RECALLING CUSTOMER (OPTION 2) - SC12

5.01 When the attendant momentarily operates the recall key, relay E releases.

5.02 The release of relay E:

(a) Causes no action if the customers phone is on-hook and option R is not furnished. Relay E reoperates after the wink signal transmitted by the distant attendant.

(b) Operates the E1 relay if the customers phone is off-hook or if the customers phone is on-hook and option R is furnished.

5.03 The operation of relay E1:

(a) See 2.03.

5.04 Relay E reoperates after the wink signal transmitted by the distant attendant, and operates the R relay.

5.05 The operation of relay R:

(a) See 4.13.

(b) Releases the E1 relay.

(c) Connects 20-hertz ringing to the line.

5.06 The release of relay E1:

(a) Opens the TMA time delay control lead causing the operation of the TM relay.

5.07 The operation of relay TM:

(a) See 1.30.

(b) Releases the R relay.

5.08 The release of relay R:

(a) Removes 20-hertz ringing from the line.

(b) Releases the TM relay (incoming call).

(c) If the line is on-hook, answer by the customer will operate the L and L1 relays in tandem, sending an off-hook signal to the attendant, and permit the customer to talk to the attendant.

(d) If the line is off-hook, the customer can talk to the attendant.

6. OUTGOING CALL - DISCONNECT - SC5

6.01 When the customer hangs up, relays L and L1 release in tandem.

6.02 The release of the L1 relay sends an on-hook signal to the attendant.

6.03 When the attendant disconnects, the E relay is released.

6.04 The release of relay E:

(a) Releases the SL relay.

(b) Operates the E1 relay (options 3 or R).

6.05 The operation of relay E1 (options 3 or R):

(a) See 2.03.

(b) Releases the TM relay.

(c) Operates the TD relay (option 3).

6.06 The release of relay (option 3).

(a) Releases the AR relay.

(b) Releases the TM relay (option 2).

6.07 The release of relay AR:

(a) Releases the SD relay (option 2).

(b) Operates the CC relay (coin).

(c) Releases the S1 relay (noncoin).

(d) Releases the E1 relay (option 3 or R).

6.08 The release of the E1 relay releases the TD relay (option 3).

6.09 The operation of relay CC (coin):

(a) Operates the CC1 relay.

(b) Closes its own locking path.

(c) Partially connects coin collect potential to the line.

(d) Connects the TM relay to the TMA time delay circuit.

6.10 The operation of relay CC1 (coin):

(a) See 2.12.

(b) Operates the CB relay.

6.11 The operation of relay CB (coin):

(a) See 1.27.

(b) Connects coin collect potential to the line.

(c) Opens the TMA time delay circuit control lead causing the operation of the TM relay.

6.12 The operation of relay TM (coin):

(a) See 1.29.

(b) Release the CL relay.

6.13 The release of relay CL (coin):

(a) Releases the CC relay.

6.14 The release of relay CC (coin):

(a) Removes coin collect potential from the line.

(b) Releases the TM relay.

(c) Releases the CC1 relay.

6.15 The release of relay CC1 (coin):

(a) Releases the CB relay.

(b) Releases the S1 relay.

6.16 The release of relay S1:

(a) Releases the CN relay (coin).

(b) Releases the CRL relay (coin).

(c) Releases the CL relay (option 3, non-coin).

(d) Releases the INS relay.

(e) Releases the channel hold magnets.

6.17 The release of relay CN (coin):

(a) Releases the CNA relay (option ZF).

6.18 The release of relay CL (option 3, noncoin):

(a) Releases the CRL relay.

6.19 The release of the INS relay releases the MB relay.

6.20 The trunk circuit is now idle.

7. OUTGOING CALL - ABANDONED - SC6

7.01 If the customer hangs up before the attendant answers, relays L and L1 will release in tandem.

7.02 The release of relay L releases the AR relay.

7.03 The release of relay AR:

(a) Releases the SD relay (option 2, non-coin).

(b) Releases the S1 relay (noncoin).

7.04 The release of relay S1:

(a) Releases the INS relay.

(b) Releases the CN relay (coin).

(c) Releases the channel hold magnets.

7.05 The release of relay CN (coin):

(a) Releases the CNA relay (option ZF).

7.06 The release of relay INS release the MB relay.

7.07 The release of the MB relay restores the trunk to its idle condition.

8. ALARM SENDING (OPTION 4) - SC7

8.01 When the alarm sending circuit seizes this circuit, it operates the AL relay.

8.02 The operation of relay AL:

(a) Connects the AL1 relay to lead CK.

(b) Operates the HA relay.

(c) Opens the TF lead.

(d) Opens the FT lead.

(e) Opens the loop between the TT and TG leads.

(f) Partially closes its own holding circuit.

8.03 The operation of relay HA:

(a) Provides its own holding ground.

(b) Replaces ground with battery on the M lead as an off-hook signal to the attendant.

(c) Opens the E1 relay operating path.

(d) Closes a holding circuit for the AL relay.

8.04 The attendant answers and operates the E relay.

8.05 The operation of relay E:

(a) See 1.19.

(b) Operates the INS relay.

8.06 The operation of relay INS:

(a) See 1.20.

(b) Operates the MB relay.

8.07 The operation of the MB relay:

(a) See 1.07.

8.08 The attendant interprets a silent termination as an alarm signal. The attendant then dials the alarm checking terminal over another trunk to receive the alarm information.

8.09 The alarm checking terminals causes the alarm sending circuit to ground the CK lead of this trunk, operating the AL1 relay.

8.10 The operation of relay AL1:

(a) Provides its own holding circuit.

(b) Provides a holding circuit for the AL relay.

(c) Releases the HA relay.

(d) Provides another operating circuit for the MB relay.

(e) Opens the operating lead of the E relay.

8.11 The release of relay HA replaces battery with ground on the M lead as an on-hook verification signal to the attendant.

8.12 The attendant then disconnects releasing the E relay.

8.13 The release of relay E releases the INS relay.

8.14 The release of the INS relay:

(a) Releases the AL relay.

(b) Releases the AL1 relay.

8.15 The release of relay AL1 releases the MB relay and restores the trunk to its idle condition.

9. INCOMING SEIZURE (OPTION 2 OR X) - SC8

9.01 When this trunk is seized for an incoming call, the E lead is grounded operating the E relay.

9.02 The operation of relay E:

(a) See 1.19.

(b) Operates the SL relay.

9.03 The operation of relay SL:

(a) See 1.21.

(b) Operates the IN relay.

9.04 The operation of relay IN:

(a) Connects battery to the M lead as an off-hook (stop dial) signal to the distant office.

(b) Provides a ground to operate the INC or NT relay.

(c) Opens the TF lead.

(d) Opens the R lead and transfers it to the IRL circuit (option E).

(e) Transfers a ground circuit from the E1 relay to the ER relay.

(f) Provides its own holding ground.

(g) Opens the T lead and transfers it to the IRL circuit.

(h) Provides a holding ground for the INS relay.

(i) Connects resistance battery to the ST lead to the IRL as a start signal.

(j) Partially closes the C3 ringing lead. (Added as isolation protection for the ringing leads.)

(k) Opens the AL relay operating lead.

(l) Transfers an operating ground from the R relay to the RS relay.

9.07 The circuit now awaits action by the IRL.

10. INCOMING SEIZURE (OPTION 4B) - SC9

10.01 When this trunk is seized for an incoming call, the E lead is grounded operating the E relay.

10.02 The operation of relay E:

(a) See 1.19.

(b) Operates the SL relay.

(c) Operates the E1 relay.

10.03 The operation of relay E1:

(a) See 2.03.

(b) Operates the TD relay.

10.04 The operation of relay TD:

(a) See 2.04.

10.05 The operation of relay SL:

(a) See 1.21.

(b) Operates the IN relay.

10.06 The operation of relay IN:

(a) See 9.04.

(b) Operates the ER relay.

10.07 The distant office transmits:

(a) The 1100- and 1700-hertz signals which operate the P2 relay in the dual channel receiver, in turn operating the F2 relay (incoming).

(b) The 700- and 1700-hertz signals which operates the P1 relay in the dual channel receiver, in turn operating the F1 relay (no-test).

10.08 The operation of the F1 or F2 relay:

(a) See 2.08 or 2.09.

(b) Releases the TD relay.

10.09 The release of relay TD:

(a) Releases the E1 relay.

(b) Operates the TM relay.

(c) Operates the Incoming (INC) relay.

(d) Operates the No-Test (NT) relay.

10.10 The operation of relay TM:

(a) See 1.29.

10.11 The operation of relay (INC):

(a) Provides its own holding circuit.

(b) Connects battery to the M lead as an off-hook (remove tones) signal to the distant attendant.

10.12 The operation of relay (NT):

(a) Partially closes the operating path of the BY relay.

(b) Connects battery to the M lead as an off-hook (remove tones) signal to the distant attendant.

(c) Opens the operating path of the RS relay.

(d) Closes the loop between the TPC and SPL leads.

(e) Provides its own holding circuit.

(f) Partially closes the NT lead.

10.13 The off-hook signal causes the removal of the 700- or 1100- and 1700-hertz signals from the trunk, releasing the P1 or P2 relay in the dual channel receiver, and in turn releasing the F1 or F2 relay.

10.14 The release of relay F1 or F2 releases the ER relay.

10.15 If for some reason, the 700- or 1100- and 1700-hertz tones had not been transmitted or received, the TMA time delay circuit would operate the TM relay and the off-hook (remove tones) signal would not be sent to the distant office. This would prevent the outpulsing of the digits by the distant office (no tones).

10.16 The operation of relay TM releases the E1 relay (no tones).

10.17 The release of relay E1 (no tones):

(a) Releases the ER relay.

(b) Releases the TD relay.

10.18 The release of relay ER connects resistance battery to the ST lead to the IRL as a start signal.

10.19 The circuit now awaits action by the IRL.

11. INCOMING CONNECTION - SC10

11.01 When the IRL connects an incoming register to this circuit, it grounds the CO lead operating the CO relay.

11.02 The operation of relay CO:

(a) Grounds the BL lead.

(b) Provides a holding ground for the SD relay.

(c) Provides a holding ground for the RS relay.

(d) Partially provides a holding circuit for the CT relay.

(e) Opens the ST lead.

(f) Provides a holding circuit for the IN relay.

(g) Provides a holding circuit for the SL relay.

(h) Partially closes the operating circuit for the RS relay.

(i) Provides operating ground for the CC1 and CR1 relays.

(j) Partially closes the R lead.

11.03 When the incoming register is ready to receive digits, it ground the T lead operating the SD relay.

11.04 The operation of relay SD:

(a) See 1.17.

(b) Replace battery with ground on the M lead as an on-hook (start dial) signal.

11.05 The distant office then starts pulsing and the pulses are transmitted to the incoming register as follows:

(a) Dial pulses appear as ground pulses on the E lead. Relay E follows these pulses and repeats them by pulsing the 750-ohm ground on the R lead (option T).

(b) The MF pulses are transmitted directly over the T and R leads into the incoming register (option S).

(c) If the 700- or 1100- and 1700-hertz tones had not been transmitted or received, the distant office would not outpulse the digits and accordingly the incoming register would time out (no tones).

11.06 Upon completion of pulsing or time out, the incoming register grounds the CT lead operating the CT relay.

11.07 The operation of relay CT:

(a) Partially grounds the S lead to hold the future connection.

(b) Transfers the T and R leads from the IRL back to this circuit.

(c) Opens a holding circuit for the SL relay.

(d) Opens the AR relay operating circuit and closes the CO relay holding a circuit.

(e) Removes the 4700-ohm bridge across the T and R leads (option S), or removes the 750-resistance ground from the R lead (option T).

(f) Provides its own holding ground.

(g) Partially closes the RC relay holding circuit.

11.08 The incoming register communicates with a marker and the marker connects battery to the F lead operating the LF relay.

11.09 The operation of relay LF:

(a) See 1.03.

(b) Operates the LF1 relay.

11.10 The operation of relay LF1:

(a) See 1.06.

(b) Operates the INS relay.

11.11 The operation of relay INS:

(a) See 1.20.

(b) Operates the MB relay.

11.12 The operation of relay MB:

(a) See 1.07.

11.13 One of the following four courses of action will follow dependant upon the options provided and the type of call in progress:

(a) On overflow calls, the marker connects the trunk to overflow tone and releases the LF and LF1 relays in tandem. The trunk now awaits disconnect by the customer.

(b) On regular busy calls, the marker connects the trunk to busy tone and releases the LF and LF1 relays in tandem. The trunk now awaits disconnect by the customer.

(c) On no-test busy calls, the marker operates the BY and RC relays and the R2, R3, and TPR relays if required.

(d) On idle calls, the marker operates the RC relay and R2, R3, and TPR relays if required.

(e) The details of C and D are covered in the following paragraphs.

11.14 The operation of relay BY:

(a) Replaces ground with battery on the M lead as an off-hook signal to the distant attendant.

(b) Opens the T and R leads to the L relay.

(c) Provides its own holding ground.

11.15 The operation of relay RC:

(a) Provides an operating ground for the E1 relay (option 3).

(b) Provides a holding ground for the PU relay.

(c) Operates the RS relay (incoming).

(d) Grounds the RA lead and provides its own holding ground.

(e) Provides a holding ground for the R2, R3, and TPR relays.

11.16 The operation of relay R2 (if required):

(a) Transfers the PU relay operating lead to the option M path.

(b) Transfers the C4 ringing lead for the C3 lead.

(c) Transfers the the C2 ringing lead for the C1 lead.

(d) Closes its own locking path.

11.17 The operation of relay R3 (if required):

(a) Closes its own locking path.

(b) Transfers the C3 and C4 ringing leads for the C1 and C2 leads.

(c) Transfers the PU lead for direct ground.

11.18 The operation of relay TPR (if required):

(a) Closes its own locking path.

(b) Interchanges ground and ringing on the T and R leads.

11.19 The marker connects the trunk to the called line, releases the LF and LF1 relays in tandem; and releases itself.

11.20 One of the following three courses of action will follow, dependant upon the type of call in progress and the state of the called line:

(a) On a no-test off-hook call, the attendant can now talk to the customer.

(b) On a no-test on-hook call, a recall operation by the attendant initiates ringing. (See SC4 for the sequence of operations following in this case.)

(c) On a regular incoming call, the release of the LF relay automatically initiates ringing as follows:

11.21 Relay PU will operate immediately if relay R3 is normal and if relay R2 is normal or option P is provided; otherwise it will operate when the PU pulse grounds the PU lead.

11.22 The operation of relay PU:

(a) See 4.12.

(b) Connects coded ringing to the line.

11.23 One of the following two courses of action will follow dependant upon the options furnished and the type of call in progress:

(a) On an incoming call to a coin line and with option ZF furnished, the attendant should operate the coin return key. This causes the operation of relay CNA and replaces -48 volts with +48 volts as talking battery. The +48 volt supervision is used to operate the nickel-trap relay in the coin telephone. This allows the attendant to collect a single nickel if necessary on a collect call. With option ZE, the -48 volt talking battery operates the nickel-trap relay. (See SC3 for the sequence of operations following in this case.)

(b) In all other cases, answer by the customer operates the RT relay resulting in the following operations:

11.24 The operation of relay RT releases the RS relay.

11.25 The release of relay RS:

(a) Removes the ringing from the line.

(b) Releases the PU relay.

(c) Releases the RT relay.

(d) Connects the L relay to the line operating the L and L1 relays in tandem which sends an off-hook signal to the attendant and permits the attendant to talk to the customer.

12. INCOMING DISCONNECT - SC11

12.01 When the called customer disconnects, relays L and L1 release in tandem sending an on-hook signal to the attendant (idle or no-test busy).

12.02 The on-hook signal (idle or no-test busy) or overflow or busy-tone (overflow or regular busy) signals the attendant to disconnect.

12.03 Disconnect by the attendant releases the E relay.

12.04 The release of relay E:

(a) Releases the SL relay.

(b) Operates the E1 relay (options 3 or R).

12.05 The operation of relay E1 (options 3 or R):

(a) See 2.03.

(b) Releases the TM relay (option 4).

(c) Operates the TD relay (option 3).

12.06 The operation of relay TF (option 3):

(a) See 2.04.

12.07 The release of relay SL:

(a) Releases the CT relay.

(b) Releases the E1 relay (option 3 or R).

12.08 The release of relay E1 (option 3 or R):

(a) Releases the TD relay (option 3).

12.09 The release of relay CT:

(a) Releases the RC relay.

(b) Releases the CO relay.

12.10 The release of relay RC:

(a) Releases the R2 relay (if operated).

(b) Releases the R3 relay (if operated).

(c) Releases the TPR relay (if operated).

12.11 The release of relay CO:

(a) Releases the SD relay.

(b) Releases the IN relay.

(c) Opens the R lead and breaks the current in this circuit and not in the switch cross-points.

12.12 The release of relay SD releases the CNA relay (option ZF, coin call).

12.13 The release of relay IN:

(a) Releases the INS relay.

(b) Releases the INC relay (option 4, incoming).

(c) Releases the NT relay (option 4, no-test).

12.14 The release of relay NT (option 4, no-test):

(a) Releases the BY relay (if operated).

12.15 The release of relay INS releases the MB relay.

12.16 The release of relay MB restores the trunk to its idle state.

13. TESTING

13.01 Testing of the outgoing features of this trunk is performed by setting up a test connection to this trunk from a test line. Routine operations are performed from the test line to the distant attendant in the same manner as for a regular service call.

13.02 Testing of the incoming features of this trunk is performed by accessing the T and R leads through jack T1 and the E and M leads through jack T2. This enables the test employee to control the supervisory circuits of this trunk and to dial pulse and talk into it. Attendant assistance is required if it is desired to test the MF features of this trunk.

14. MISCELLANEOUS

14.01 Network A is provided as an idle termination for the T and R leads when jack T1 is operated.

14.02 Network B is provided as an idle termination for the T and R leads when jack T1 is normal.

14.03 Network S is provided to protect the diodes in the line circuits.

14.04 Networks F1 and F2 are provided to protect the circuits in the dual channel receiver.

14.05 The M, CC, and CR lamps are used to provide M lead, coin collect, and coin return potentials, respectively.

14.06 The A resistor is used to provide operating battery for the TM and TD relays.

14.07 The C resistor is used to hold the L relay operated as required when it is disconnected from the line.

14.08 The E resistor and E capacitor are used as a pulse correcting network for incoming dial pulses on the E lead.

14.09 The F resistor is used as an input impedance for MF pulsing into the incoming register.

14.10 The L resistor is used to control the release time of the TD relay.

14.11 The M resistor is used with the M lead signaling circuit and also as a means of repeating dial pulses on the R lead to the incoming register.

14.12 The N resistor is used to detect falsely operated P1 or P2 relays in the dual channel receiver.

14.13 The P, Q, and R resistors and the H capacitor are used to dissipate the charge on a line after the application of coin collect or coin return potential.

14.14 The SL resistor is used for on-hook and off-hook signaling on the S lead.

14.15 The ST registor is used to provide a start signal for the IRL.

14.16 The S1 and T1 resistors and the D and F capacitors are used as timing elements for the TMA delay circuit.

14.17 The T and R capacitors are used to transmit some ringing energy back to the attendant.

14.18 The C and G capacitors are used to isolate ringing tone and low tone, respectively.

15. INCOMING SEIZURE (OPTION 4, A) SC13

15.01 This circuit can only be used for busy line verification from a TSPS position when wired for option A. Ringing of a not busied verified station, under control of the TSPS attendant, it not permitted.

15.02 No 700- 1100-, or 1700-hertz tones are expected or required with this operation.

15.03 Option A shall only be used to modify existing trunk circuits. One-way incoming trunk, SD-26419-01, or equal should be furnished for new installations or additions.

15.04 The sequence of operations is similiar to that described in 10.01 through 10.06.

15.05 Relay IN also operates relay NT which will:

(a) Partially close the operating path of the BY relay.

(b) Connect battery to the M lead as an off-hook signal.

(c) Open the operating path of the RS relay.

(d) Close the loop between the TPC and SPL leads.

(e) Provide its own holding circuit.

(f) Partially close the NT lead.

(g) Operates relay TM.

15.06 The operation of relay TM releases relay E1 and TD.

15.07 The operation of relay E1 releases relay ER.

15.08 Go to incoming connection 11 - SC10.

SECTION III - REFERENCE DATA

1. WORKING LIMITS

1.01 See the No. 3 crossbar keysheet for customer line supervision limits.

2. FUNCTIONAL DESIGNATIONS

2.01 Relays

Designation	Meaning
AL	Alarm Sending
ALL	Alarm Sending Auxiliary
AR	Auxiliary Release
BY	Busy
CB	Coin Battery
CC	Coin Collect
CL	Coin Lock
CN	Coin Class
CO	Cutoff
CR	Coin Return
CT	Cut Through
CC1	Coin Collect Auxiliary
CN1	Coin Auxiliary
CNA	Coin Auxiliary
CR1	Coin Return Auxiliary
CRL	Coin Release Lock
E	Ear
E1	Ear Auxiliary
ER	Enter Receiver
F	Frame
F1	Frequency 1
F2	Frequency 2
HA	Hold Auxiliary
IN	Incoming
INC	Regular Incoming Class
INS	Incoming Seizure

Designation (Cont)	Meaning
L	Line
L1	Line Auxiliary
LF	Line Frame
LF1	Line Frame Auxiliary
MB	Make Busy
NT	No-Test Incoming Class
PU	Pickup
R	Ring
R2	Ring Auxiliary
R3	Ring Auxiliary
RC	Ring Control
RS	Ring Start
RT	Ring Trip
S1	Sleeve (Outgoing)
SD	Start Dial
SL	Sleeve (Incoming)
TD	Time Delay
TM	Timer
TPR	Two-Party Relay

3. FUNCTIONS

3.01 See SECTIONS I and II for functions of this circuit.

4. CONNECTING CIRCUITS

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

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

(b) Incoming Register Link Circuit - SD-26394-01.

(c) Traffic Usage Recorder Circuit - SD-96494-01.

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

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

(f) Dual Channel Receiver Circuit - SD-26348-05.

(g) Alarm Sending Circuit - SD-26442-01.

(h) Time Delay Control Circuit - SD-94820-01.

(i) Transmission Facilities Circuit - SD-64724-01, (Typical).

(j) Auxiliary Outgoing Trunk Circuit (Distant Office) - SD-27611-01.

(k) Switchboard Trunk Circuit (Distant Office) - SD-56525-01.

(ℓ) Busy Line Verification Limiter Circuit - SD-97761-01.

5. MANUFACTURING TESTING REQUIREMENTS

5.01 This circuit shall be capable of performing all the functions listed in this Circuit Description and meeting the requirements listed in the Circuit Requirements Tables.

6. TAKING EQUIPMENT OUT OF SERVICE

6.01 If it is desired to remove this trunk from service for trouble or other reasons, the test circuit is arranged to ground the MB lead which operates the MB relay. This sets the trunk in the busy state.

6.02 The test circuit can ground the MB lead by either of the following methods:

(a) Insertion of a make-busy plug in the associated TRK MB- jack.

(b) Operation of the remote make-busy facilities if they are provided.

6.03 Removal of ground from the MB lead will restore this circuit to service.

SECTION IV - REASONS FOR REISSUE

D. Description of Changes

D.01 Option B is designated and option A is added both are rated Standard. (Part of Issue 5B.)

D.02 Contact 8 of relay E1 is added on a no-record basis. (Issue 4D.)

D.03 The uncut loop cap is added to spring 4B relay AL.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5242-DAJ

WE DEPT 45820-RWH-WEA-SVB