17

STEP-BY-STEP SYSTEMS
NO. 1, 350A, 355A OR 35E97
OUTGOING TRUNK CIRCUIT
LOOP OR E&M LEAD SIGNALING
SPECIAL TOLL OR OPERATOR ASSISTANCE
ANI TYPE B OR C FOR NO. 1, 350A, 355A OR
ANI TYPE C FOR 35E97 OR OPERATOR IDENTIFIED
TO CAMA OFFICE

CHANGES

D. Description of Changes

D.1 Option ZM is added in FS1 to insure lighting the TTO lamp in ANI-C test circuit on ground removal test.

D.2 Option ZO is added in FS2 and FS3 to eliminate the buzzing of the MR relay in the ANI-C test circuit on ground removal test. The former wiring is shown as ZN option which is rated Mfr Disc.

D.3 Information Note 306 is added for a change made in CAD 5.

D.4 Reference to options ZM, ZN, and ZO is added to Note 104.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5223-MKD-MR

STEP-BY-STEP SYSTEMS
NO. 1, 350A, 355A OR 35E97
OUTGOING TRUNK CIRCUIT
LOOP OR E&M LEAD SIGNALING
SPECIAL TOLL OR OPERATOR ASSISTANCE
ANI TYPE B OR C FOR NO. 1, 350A, 355A OR
ANI TYPE C FOR 35E97 OR OPERATOR IDENTIFIED
TO CAMA OFFICE

CHANGES

D. Description of Changes

D.1 Option ZL wiring and apparatus is added in FS 3 and rated Standard.

D.2 KS-13492, L1 (ZL option) is added in App Fig. 3.

D.3 Resistor BT is added in Apparatus Index, and ZL option is added in Note 104.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5223-WCB-MR

STEP-BY-STEP SYSTEMS
NO. 1, 350A, 355A OR 35E97
OUTGOING TRUNK CIRCUIT
LOOP OR E&M LEAD SIGNALING
SPECIAL TOLL OR OPERATOR ASSISTANCE
ANI TYPE B OR C FOR NO. 1, 350A, 355A OR
ANI TYPE C FOR 35E97 OR OPERATOR IDENTIFIED
TO CAMA OFFICE

CHANGES

B. Changes in Apparatus

B.1 Superseded	Superseded By
437A Capacitor A, ZJ Option	437QA Capacitor A, ZK Option

D. Description of Changes

D.1 Note 105 is added to show class lead designations for trunks equipped with RB relays, option ZB or ZC.

D.2 Reference to Note 105 is added at the CL- leads in FS 2 and FS 3.

D.3 In FS 1, the winding designations of the MB relay are changed from 1U and 2U to U and L, respectively.

D.4 The contact numbers for 5(PTK) and 3(TP) are shown above the break symbol instead of under it.

D.5 Reference to options ZJ and ZK is added to Note 104 and Option Index.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5823-MKD-MR

STEP BY STEP SYSTEMS
NO. 1, 350A, 355A OR 35E97
OUTGOING TRUNK CIRCUIT
LOOP OR E&M LEAD SIGNALING
SPECIAL TOLL OR OPERATOR ASSISTANCE
ANI TYPE B OR C FOR NO. 1, 350A, 355A OR
ANI TYPE C FOR 35E97 OR OPERATOR IDENTIFIED
TO CAMA OFFICE

CHANGES

C. Changes in Circuit Requirements Other Than Those Caused by Changes in Apparatus

C.1 Insulation of contact 2 for SPA or contact 4 for RV relay is added for testing the primary winding of the PTM relay.

D. Description of Changes

D.1 Options K, M, F, J, N, H, and G are changed from record to nonrecord options.

D.2 Information Note 305 is added.

D.3 Circuit Note 102 is revised to correct a drawing error in presenting the information for combined special toll and dial zero to TSPS No. 1.

D.4 Circuit Note 104 is revised to show the 221-type resistor superseding the 145-type resistor.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5823-CEH-MR

STEP-BY-STEP SYSTEMS
NO. 1, 350A, 355A, OR 35E97
OUTGOING TRUNK CIRCUIT
LOOP OR E & M LEAD SIGNALING
SPECIAL TOLL OR OPERATOR ASSISTANCE
ANI TYPE B OR C FOR NO. 1, 350A OR 355A OR
ANI TYPE C FOR 35E97 OR OPERATOR IDENTIFIED
TO CAMA OFFICE

CHANGES

B. Changes in Apparatus

B.1 Added

Diode A, 446F, ZH Option

C. Changes in Circuit Requirements Other Than Those Caused by Changes in Apparatus

C.1 Current flow requirements are shown for the 221FAH relay, App Fig. 3, for use when applying pulse repeating requirements G1, 30 to 65 percent break.

D. Description of Changes

D.1 Revise Circuit Note 104.

D.2 Diode A is added to App Fig. 3.

D.3 Options 2G and 2H are designated.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5641-CEH-RMW

STEP-BY-STEP SYSTEMS
NO. 1, 350A, 355A OR 35E97
OUTGOING TRUNK CIRCUIT
LOOP OR E AND M LEAD SIGNALING
SPECIAL TOLL OR OPERATOR ASSISTANCE
ANI TYPE B OR C FOR NO. 1, 350A OR 355A OR
ANI TYPE C FOR 35E97 OR OPERATOR
IDENTIFIED TO CAMA OFFICE

TABLE OF CONTENTS

TABLE OF CONTENTS (Cont)

SECTION I - GENERAL DESCRIPTION

1. PURPOSE OF CIRCUIT

1.01 This outgoing trunk circuit is required in a step-by-step office to complete special toll (0+) calls or dial zero (0-) calls to the CAMA office.

1.02 The trunk is reached by dialing a directing code. It repeats the called number to the CAMA office on 0+ calls or serves as a recording and completing trunk on 0- calls.

2. GENERAL DESCRIPTION OF OPERATION

2.01 If the 0+ trunk is in an office equipped with ANI, a test is made of the subscriber line between the first and second digits to determine if the customer is a tip or ring party; the tip party being identified when there is a ground through the station ringer. Between the second and third digits, a test is made to determine if the party test relay is in proper adjustment.

2.02 When the 0- trunk is in an office equipped with ANI, the party test and party test relay check occur in sequence immediately upon seizure.

2.03 When the reversal from CAMA is received, the 0+ and 0- trunks function identically.

2.04 When this trunk is arranged for combined 0- and 0+ operation, the party test is made either after the first digit is dialed or after receiving a reversal from CAMA.

2.05 When the trunk is in a non-ANI office, the reversal from the CAMA office places the connection under control of the CAMA office. If it is in an ANI office, the CAMA reversal also causes the trunk to bid for an outpulser by way of the outpulser connector circuit. The outpulser first receives the party indication, and then checks to see that the call has not been abandoned. It then causes the trunk to connect identification signal to the sleeve. The signal is generated by either an oscillator or pulse generator. This is used by the identifier to derive the calling number which is registered in the outpulser. After identification, the signal is removed and the outgoing tip and ring are transferred to the link tip and ring. The outpulser then sends the calling number to the CAMA office, using MF signaling.

2.06 The trunk is arranged to provide ring-back under control of the CAMA operator.

2.07 Since the connection is under control of the CAMA office (called party

control), no action takes place at the end of the call until that end releases. If the calling customer is still off-hook at this time, the switch train is winked off; and if the call has been from a tip party or from a 2-party message rate line, a ground removal test is begun. However, if the calling party is on-hook and is a tip party or has a 2-party message rate service, the ground removal test is begun immediately.

2.08 The ground removal test is made to insure against charging a customer falsely due to a trouble ground on the line. The ground removal test is continued for a time; if a ground is present, the outpulser will be recalled to make a trouble ticket after which the trunk and switches are released. The ground removal test can be made on the 2-party message rate trunk circuit since it is cut through after outpulsing of the calling number.

2.09 Provision is made for access to the trunk from a common automatic trunk test circuit. Other tests can be made with the standard test sets using test jacks provided.

SECTION II - DETAILED DESCRIPTION

1. SEIZURE

TRUNK ARRANGED FOR SPECIAL TOLL O+, ANI OPERATION

A. Loop Signaling

1.01 On seizure of the trunk, A operates over the loop.

1.02 A operated:

(a) Operates B.

(b) Closes the low-resistance bridge through inductor T, the coil of RB, and the primary of CS to seize the incoming trunk in the CAMA office.

1.03 B operated:

(a) Operates B1.

(b) Grounds the sleeve to hold the preceding circuits and to make the trunk test busy.

(c) Partially prepares the operate path of C.

(d) Removes the high-resistance secondary of CS from the trunk tip and ring.

B. E and M Lead Signaling

1.04 On seizure, relay A operates over the loop operating B. B operates B1 which grounds the sleeve to hold the preceding circuits and make the trunk test busy. Relay A changes the polarity on the M lead from ground to battery through resistance lamp M as a seizure signal to the CAMA office.

1.05 Relay B removes the 900-ohm termination and prepares the C relay circuit.

TRUNK ARRANGED FOR O+, NON-ANI OPERATION

1.06 Same as described in 1.01 to 1.05.

TRUNK ARRANGED FOR DIAL ZERO O-, ANI OPERATION

1.07 Same as described in 1.01 to 1.05.

TRUNK ARRANGED FOR O-, NON-ANI OPERATION

1.08 Same as described in 1.01 to 1.05.

TRUNK ARRANGED FOR COMBINED O- AND O+ OPERATION

1.09 Same as described in 1.01 to 1.05.

2. PULSING CALLED NUMBER

O+, ANI OPERATION

A. Loop Signaling

2.01 Relay A follows the dial pulses as the customer dials the called number. When A releases on the first open, it operates C which operates C1. C transfers the tip and ring to resistance battery and ground, respectively. Successive operations and releases of A interrupt this battery and ground, thereby transmitting pulses which aid the pulsing relay in the CAMA incoming trunk circuit. C and C1 hold during pulsing but release at the end of each digit restoring the loop condition. B holds over pulsing.

B. E and M Lead Signaling

2.02 Relay A follows dial pulses as the customer dials the called number and in doing so repeats the pulses to the M lead changing the potential from battery to ground. A on the first release operates C which operates C1. C and C1 are slow to release and remain operated until the end of the digit. B holds over pulsing.

O+, NON-ANI OPERATION

2.03 Same as described in 2.01 and 2.02.

O-, ANI OPERATION

2.04 Does not apply.

O-, NON-ANI OPERATION

2.05 Does not apply.

3. PARTY TEST (ANI ONLY)

O+ OPERATION

3.01 A party test is made between the first and second digits as follows.

3.02 With C1 operated while the first digit is being dialed, PTM is operated on its secondary winding. PTM is a capacitor-timed polar relay, electrically biased on its primary winding. When C1 releases, capacitor C charges through the S winding. When the current in the S winding becomes less than the bias current in the P winding, PTM releases. The time to release depends upon the time constant of the charging path and is such that PTM will release in 50 to 60 msec.

3.03 Also when C1 releases, PTC operates to apply the party test relay PT to the line. A is removed but held operated by a preliminary make on PTC. -48 volt battery is applied to both tip and ring, but the paths through the PT contacts are held open until PTM releases to allow PT to settle into either operated or nonoperated position after being applied to the line.

O- OPERATION

3.04 In the O- operation, where no further pulsing is expected, the party test is performed as follows.

3.05 B1 operating upon seizure operates PTM, a capacitor-timed polar relay. PTM operating operates PTC. When PTC operates, capacitor C charges through the secondary winding of PTM holding it operated until the current in the S winding becomes less than the bias current in the P winding. When this occurs PTM releases. The time to release is determined by the time constant of the charging path and is such that PTM will release in approximately 50 to 60 msec.

3.06 PTC operated also applies PT, the party test relay, to the line and removes A but holds it operated through a preliminary make. -48 volt battery is applied to both tip and ring, but the paths through the contacts of PT are held open until PT settles into either operated or nonoperated position after being applied to the line.

TIP PARTY - FLAT RATE: O+ AND O- OPERATION

3.07 Tip party stations are equipped with 3640-ohm or 2650-ohm ringers connected to ground. PT operates in series with the ringer when PTM releases. Before PT is applied to the line it is preconditioned through 12,990 ohms to ground. This shortens the operate time of PT. PT operated operates TP, followed by TPA.

3.08 TP operated:

(a) Opens the circuit to RP.

(b) Removes PT from the line.

(c) Connects -48 volts to the line through resistance lamp PT.

3.09 The -48 volts discharges the line in such a way as to prevent bell tapping at customer stations and false release of A when it is reconnected to the line.

3.10 The holding path for PTC is also opened by PTM releasing. PTC is slow to release due to the shunting action of the secondary winding in series with resistor K1. Its release time is governed both by the shunt and the time to operate TPA which opens the shunt. This allows for the discharge of the line just described. The maximum time will not exceed an interdigital period. TP releases after PTC.

RING PARTY - FLAT RATE: O+ AND O- OPERATION

3.11 Ring party stations will have no ground on them. The test is made as in 3.07 to 3.10 but when PTM releases, PT should be nonoperated.

3.12 RP operated through the back contact of PT:

(a) Opens the circuit to TP.

(b) Operates RPA, which opens the secondary shunt of PTC.

(c) Disconnects PT from the line.

(d) Connects -48 volts to the line through resistance lamp PT until PTC releases as described in 3.09 to 3.10.

RP releases after PTC.

MESSAGE RATE LINES: O+ AND O- OPERATION

3.13 On calls from message rate lines, PT cannot test the line directly because of the intervening message rate trunk circuit. The party test will be made in that trunk, however. The test will always indicate a ring party regardless of whether the party is tip or ring; therefore, all message rate lines will be in the ring field for ANI.

MULTIPARTY LINES OTHER THAN 2-PARTY: O+ AND O- OPERATION

3.14 The party test on all such stations will be indicated as ring party but calls from these lines will be operator identified at the CAMA office as a result of the identifier and outpulser operation.

CHECK OF PARTY TEST FEATURE

A. O+ Operation

3.15 To insure against faulty functioning of PT, a combined current flow and time test is used.

3.16 C1 operating on second digit operates PTM as described previously. C1 releasing operates PTK through make contact of RPA or TPA. PTK locks to the sleeve under control of RV normal.

3.17 With TPA operated, a nonoperate test is applied to PT. RPA operated causes an operate test of PT. Both TPA and RPA connect the A resistor (5760 ohms) to the primary winding of the PT relay. With PTK and TPA operated and RPA normal, the release time for PTM is 32 msec maximum. PT must not operate before PTM is released.

3.18 If PT meets the above test requirements, RP operates operating RPA. The combination of RP, TPA, and RPA present a tip party indication to the outpulser as described later.

3.19 With PTK RPA operated and TPA normal, the release time of PTM is 50 msec minimum. PT must operate before PTM is released.

3.20 If PT meets this test requirement, TP operates operating TPA. The combination of TP, TPA, and RPA present a ring party indication to the outpulser as described later.

3.21 If PT fails the nonoperate test, only the TPA is finally operated and neither the T nor R lead to the outpulser link has battery connected.

3.22 If PT fails the operate test, only the RPA is finally operated and neither the T nor R lead to the outpulser link has battery connected.

B. O- Operation

3.23 Same as 3.16 to 3.22 with the exceptions that:

(a) PTM is operated when either RP or TP is released at the end of the party test.

(b) PTM operated operates PTK.

(c) PTK opens the operate path of PTM and starts capacitor C to charging.

COMBINED O- AND O+ OPERATION

A. O+ Operation

3.24 Same as described in 3.01 to 3.03.

3.25 Immediately following the party test, a check of the party test feature is made. This is started by the release of either TP or RP which operates PTM. PTM operates PTK which locks to the sleeve under control of SPA normal.

3.26 Same as described in 3.17 to 3.22.

B. O- Operation

3.27 In the O- operation where no digits are dialed, the party test is made after the CAMA office times out (approx. 3.5 seconds) and sends a reversal to this trunk.

3.28 The party test is made as in 3.04 to 3.06 except that RV operates PTM.

3.29 The party test check is as in 3.25.

4. CAMA OFFICE READY TO PROCEED

SUPERVISION

A. O+, ANI and Non-ANI Operation

4.01 After the called number is pulsed to the CAMA office and the equipment in that office is ready to proceed, an off-hook signal is sent back to this trunk which operates CS or E. CS or E operates RV. RV operated operates P1 which locks under control of B1, and releases PTK (A option). P1 operated operates P2.

B. O-, ANI and Non-ANI Operation

4.02 Same as 4.01 and in addition RV operated opens the previously described operate path of PTM (A option).

CALLING-IN OUTPULSER (ANI ONLY)

4.03 P1 closes the ST lead from battery through resistance lamp PT to the outpulser connector to seize an outpulser, and starts the TA timer. If the trunk is arranged for combined operation, the start lead to the outpulser will be held open until the party test is completed.

4.04 The trunk and outpulser are connected by five leads, T, R, TPT, AB, and SP. When the outpulser is connected, it takes note of the party information on the T and R leads and then after testing the SP lead operates SP.

4.05 SP operated:

(a) Locks and removes itself from the SP lead.

(b) Opens the ST lead to the outpulser.

(c) Stops the timer.

(d) Releases RP and RPA if a tip station, removing battery from T lead or releases TP only if a ring station, removing battery from R lead.

(e) Connects SP1 to the SP lead.

(f) Connects MF to the AB lead (A option).

(g) Connects ID to the R lead.

(h) Operates SPA.

TESTING FOR ABANDONED CALL (ANI ONLY)

4.06 SPA operated:

(a) Connects MF to the AB lead.

(b) Releases PTK.

(c) Opens the operate path for PTM.

4.07 Before proceeding with the call, the outpulser tests to see that the customer is still connected to the trunk by operating SP1. SP1 operated transfers the subscriber T and R to the outpulser T and R, SP1 holding A operated. SP1 is released when the outpulser is satisfied that the loop is complete.

4.08 If the loop appears to be open, the outpulser releases SP1 and looks for an additional indication of an abandoned call by ground on the AB lead when B1 releases. If a ground does not appear on AB during a timed interval after SP1 releases, the outpulser prints a trouble ticket.

IDENTIFYING THE LINE (ANI ONLY)

4.09 When the outpulser is ready for line identification, it operates ID. ID connects either a tone or a pulse to the sleeve lead. The oscillator or pulse generator is low in dc resistance to hold the preceding circuits. ID also connects resistance lamp battery to the T lead as a check that it has operated. A is prevented from releasing during identification. When identification is complete, ID releases.

OUTPULSING THE CALLING NUMBER (ANI ONLY)

4.10 When the outpulser is ready to send out the calling number, it operates MF transferring the outgoing T and R of the trunk to the outpulser T and R. MF opens the trunk T and R releases CS and holds B and RV until the outpulser releases. Release of A during this time is ineffective.

RELEASE OF OUTPULSER (ANI ONLY)

4.11 When the outpulser has completed its work, it releases its connections to the trunk circuit. SP remains operated. The trunk is now in the talking condition.

5. RINGBACK (ANI AND NON-ANI)

LOOP SIGNALING

5.01 When the ringback signal (+130 volts on the tip, -48 volts on the ring) is applied by the CAMA office, CS releases and marginal relay RB operates. RB holds RV.

A. Calling Party Off-Hook

5.02 RB operated: (Option ZB)

(a) Places a holding bridge on A.

(b) Operates R which transfers the tip and ring to ringing current.

5.03 RB operated: (ZC option)

(a) Transfers the tip and ring to ringing current.

(b) Places a holding bridge on A.

B. Calling Party On-Hook, Option H

5.04 With A released C1 is operated.

5.05 C1 operated:

(a) Opens the +105 volt lead to the ringing circuit.

(b) Opens the bridge across A so that it will not reoperate when RB operates. Thus, ringing current is not applied to the line.

C. Calling Party On-Hook, Option G

5.06 R (ZB option) or RB (ZC option) operated transfers the tip and ring to ringing current. Contact 7B of C1 is shunted by option G maintaining continuity to the +105 volt lead and ringing current is applied to the line.

E AND M LEAD SIGNALING

5.07 Ringing can be applied to the calling subscriber line by a 70- to 130-msec wink of relay E. Relay P will operate when E releases. RV holds over the momentary release of E, as it is slow to release. P operated with reoperated E operates RB, and also starts the timer. RB connects continuous ringing to the line as per 5.02 to 5.06.

5.08 Relay TM operates from the timer in approximately 2 seconds and operates TN. TN operated releases P and TM. TM releasing releases RB which returns the trunk to its former state.

6. DISCONNECT

CALLING PARTY DISCONNECTS FIRST (ANI AND NON-ANI)

A. Loop Signaling

6.01 When the calling party disconnects, A releases.

6.02 A releases:

(a) Completes a shunt path through resistor S to prevent C from operating.

(b) Operates C1.

(c) Releases B which releases BI.

(d) Opens the loop toward the CAMA office.

Opening the loop toward CAMA releases CS but C1 operating connects the high-resistance secondary of CS across T to R reoperating it. RV is slow-release and holds over this open. There is no further action until CS is released by an on-hook signal from CAMA.

B. E and M Lead Signaling

6.03 Proceeds the same as 6.01 and 6.02 until item (d) under "A released:".

(d) Transfers the M lead from battery to ground to signal an on-hook to CAMA.

There is no further action until E is released by an on-hook signal from CAMA.

ON-HOOK SIGNAL FROM CAMA AFTER CALLING PARTY DISCONNECTS (NON-ANI ONLY)

6.04 The on-hook signal releases the appropriate CAMA supervisory relay (CS, loop signaling; E, E and M lead signaling). The release of the supervisory relay releases RV. RV releasing releases P1 which releases P2. P1 releasing removes ground from the sleeve lead to release the preceding circuits. RV and P1 are slow-release so that the CAMA office circuits have restored to normal before this trunk can be reseized. P1 released releases C1 and the trunk is normal.

ON-HOOK SIGNAL FROM CAMA AFTER CALLING PARTY DISCONNECTS (ANI ONLY)

C. Calling Party Previously Identified as Ring Party

6.05 If RPA and TRA are operated, the circuit releases as in 6.04 except that in addition:

(a) RV releasing also releases SP.

(b) P1 releasing also releases RPA and TPA.

D. Calling Party Previously Identified as Tip Party - (Ground Removal Test)

6.06 When the calling station is a tip party TPA will be operated and the line is held while a test is made for removal of the tip ground to insure that a tip party had not been falsely charged due to a trouble ground on a call from a ring party.

6.07 CS or E releasing releases RV. RV releasing releases SP and opens the circuit to slow-release P1. B1 already down, and SP released operate GRT through contacts of P2, which releases after P1 releases.

6.08 GRT operated:

(a) Operates PTC which provides a locking path for GRT.

(b) Connects ground to the sleeve before P1 releases to hold the preceding circuits and hold TPA operated.

(c) Operates PTM to delay closure of ground to the contacts of PT. With PTC operated a test of the line is made by PT in a manner similar to that previously described. PTM begins its timed release when C1 releases. Also PTK operates when C1 releases, but serves no purpose at this time.

6.09 If there is no ground on the line, PT will remain nonoperated and when PTM releases, RP will operate. RP removes ground from the sleeve which releases the preceding circuits, TPA and PTK. TPA releasing releases GRT which, in turn, releases RP and PTC. Until PTC releases A cannot be reoperated.

E. Line Previously Identified as 2-Party Message Rate Line - (Ground Removal Test)

6.10 During the outpulsing of the calling number the operation of MF grounds the A lead. On calls from 2-party MR lines this lead extends back to the 2-party MR trunk circuit and the ground causes that circuit to cut through as on operator calls. When MF releases, ground is returned from the MR trunk on the lead to operate MR. Even though a ring party will have been indicated on the party test, GRT operates during the disconnect since MR contacts shunt the contacts of RPA; therefore, a ground removal test is made as described in 6.06 to 6.09.

F. Ground Removal Failure

6.11 When the ground removal test is started by GRT operating as described in 6.06 to 6.10 the timing circuit is also started. If a ground is still on the line when PTM releases, PT will be operated and the circuit does not release immediately. The ground may be due to a trouble or to the customer attempting to reoriginate. The circuit times for 9.5 to 10.5 seconds during which time the circuit will release if PT releases. If PT has not released at the end of this time, a trouble condition is assumed and the outpulser is called in to make a trouble record.

6.12 At the end of timing TM operates, operating TMI which is slow acting. TMI releases TM at which time a circuit is completed for operating TP which locks.

6.13 TMI releases and with TP operated closes the ST lead to the outpulser connector circuit to call for an outpulser.

6.14 The indication to the outpulser of ground removal failure is ground on the TPT lead for 2-party flat rate lines and ground on the AB lead for 2-party MR lines. MR operated transfers the ground to the AB lead.

6.15 When the outpulser is connected and after it has received the ground removal failure indication, it operates SP. SP locks, removes itself from the SP lead, and connects the secondary winding of GRT to the SP lead.

6.16 Identification of the calling line is made as before, ID operating over the R lead to connect a signal to the sleeve.

6.17 With ID and GRT operated, RPA, if operated, and TPA are released opening the primary winding of GRT and placing GRT and final release of the circuit under control of the outpulser. PTK also releases.

6.18 GRT released releases SP, TP, PTC, and, if operated, MR. GRT also removes the ground from the sleeve to release the preceding circuits. PTC being slightly slow to release holds the T and R open so that if a new call were to seize the trunk, the previously operated relays would be normal before A and B are operated.

CALLED PARTY DISCONNECTS FIRST - TIMED DISCONNECT (ANI AND NON-ANI)

6.19 When the calling party does not disconnect and the called party does, the trunk circuit at the CAMA office will, after a delay interval, release and return an on-hook signal to this trunk releasing CS or E which in turn releases RV.

6.20 RV released operates C through P1 operated. C operated opens the sleeve to release the preceding circuits. When one of these opens the tip and ring, A releases.

6.21 A shunts down C and opens B. When C releases it reconnects ground to the sleeve to make the trunk appear busy until the trunk releases.

7. TIMING CIRCUIT

AWAITING OUTPULSER FOR IDENTIFICATION

7.01 Referring to 4.03 to 4.05, P1, operated to call in the outpulser, also starts the timing circuit so that if the outpulser is not connected within a period of 3.8 to 4.2 seconds, the start circuit will be opened to prevent holding out other trunks.

7.02 Assuming an outpulser is not connected, P1 operating operates P2. P2 transfers battery from terminal 1 of TA timer to terminal 2. Capacitor D in parallel with the C1 capacitor (mounted on CPS D3) and the F resistance comprise the timing network. When the voltage at terminal 1 of the TA timer equals the voltage at terminal 3, TA will function, operating TM. TM operates TM1. TM1 locked through B1 operated transfers battery from terminal 2 of TA to terminal 1, resetting the timer and releases TM.

7.03 After disconnect by the subscriber, TM1 is released by B1. If a tip party had originated the call, no ground removal test is made since TPA and RPA are still operated and MR has not operated.

7.04 After disconnect by the subscriber, TM1 releases when B1 does. If a tip party had called, no ground removal test is made since TPA and RPA are still operated when B1 releases since SP has not operated.

GROUND REMOVAL FAILURE

7.05 Referring to 6.11 to 6.18 GRT operating starts the timer circuit. With GRT operated resistor E is in the charging path instead of resistor F as described in 7.01 to 7.04.

7.06 The time constant of the circuit with resistor E in the charging path is 8.7 to 11.3 seconds.

AWAITING OUTPULSER ON GROUND REMOVAL FAILURE

7.07 The timer is again recycled to time for 9.5 to 10.5 seconds. As described in 6.11 to 6.18. TP operates when TM released and TM1 operated at the end of timing. TM1 releases and its slow release allows capacitor D to fully discharge before the next timing cycle begins. TM1 released with TP operated closes the start lead to the outpulser connector.

7.08 Timing will be stopped when the trunk restores to normal as a result of the outpulser releasing GRT.

7.09 If the outpulser is not connected, TM operates releasing GRT. GRT removes ground from the sleeve, releases relays PTC, PTK, TPA, TP, also RPA and MR if they were previously operated. The timer is reset and TM released by release of GRT. If TM1 operated, it is now released. Its operation and release at this time has no circuit function.

7.10 If the outpulser is connected but fails to release the trunk TM operates TM1 which releases GRT by removing ground from its secondary winding. GRT restores the trunk to normal as in 7.09.

8. TESTING

FROM TEST JACKS

8.01 Test jacks T and TT provide access to the incoming and the outgoing ends of the trunk circuit for testing.

FROM TEST CIRCUIT

8.02 Relay TT and TT1 and their associated contacts provide access from the automatic trunk test circuit. Relay TT is first operated over the test circuit. Operated TT grounds lead FR to the miscellaneous circuit on the trunk frame, which operates and cuts through trunk leads required for testing. A class indication is given on the CL- lead. The selector multiple sleeve is closed to the test circuit so that it may test the trunk for busy before making it busy and proceeding with the test which it does by operating the TT1 relay. This relay gives access to other leads required for the test and opens the trunk conductor tip and ring.

8.03 When the outpulser is called in on a test call, the TST lead to the outpulser connector is grounded to indicate that it is a test call.

9. MISCELLANEOUS

PEG COUNT

9.01 Whenever the timing circuit functions on failure to obtain an outpulser for line identification, lead OSF to the miscellaneous circuit (for trunk frames) is grounded from the time TM is operated until TM1 operates. No registration is made on ground removal operation of the timer as GRT opens the OSF lead.

HOLDING CIRCUIT FOR TRACING TROUBLE (ANI-B)

9.02 The TR relay may be operated by the outpulser over the TPT lead with MF operated when it is desired to hold the circuit for tracing trouble. TR locks to battery on LU lead from the miscellaneous circuit for trouble ticketer. TR grounds the sleeve to hold the connection. This operation will only take place on a regular identification and not on a ground removal failure, and a ground removal test will not be made on disconnect when TR is operated.

FUSE OPERATION

9.03 Relay MB is normally held operated through the M resistor. If the circuit fuse is operated or is removed, MB releases and closes ground to the sleeve to make the circuit busy.

DOWN CHECK OF PARTY TEST RELAYS DURING TRUNK DISCONNECT (ANI ONLY)

A. Originating Subscriber Tested as Ring Party

9.04 TPA and RPA are locked to sleeve ground under control of relay P1. P1 releasing releases TPA, RPA, and preceding equipment. During the release time of TPA and RPA, the trunk sleeve is unguarded. If seized by a selector during this interval, a 1300-ohm ground is placed on the sleeve, possibly locking up the TPA and RPA relays. To prevent the possibility of false party information being locked on the trunk, thereby causing false charging; the operate path of the B1 relay is guarded by break contacts of TPA and RPA.

B. Originating Subscriber Tested as Tip Party or MR (No Ground Removal Failure)

9.05 The sleeve is now under control of the GRT and RP relays. P1 releases C1 which operates PTK and releases PTM. If the PT does not operate during the release time of PTM (50 to 60 msec); RP operates, indicating no ground on the line. RP operating removes ground from the sleeve releasing PTK, TPA, MR and RPA if the calling subscriber was message rate. The down check is accomplished as in 9.04 with break contacts of TPA, RPA, PTK, and MR in the operate path of B1.

C. Originating Subscriber Tested as Tip Party or MR (Ground Removal Failure)

9.06 Same as 9.05 to release interval of PTM. PT operates, and when the timer functions, TM operates operating TM1 which releases TM. TM releasing operates TP and releases TM1 to start outpulser seizure timing. TM1 normal and TP operated closes start lead to outpulser. TP grounds TPT lead to indicate to the outpulser a ground removal failure 2-party flat rate. If MR is operated the ground is switched from TPT lead to AB lead, indicating 2-party MR. The outpulser functions, operates ID to provide a signal path for line identification, and releases PTK, TPA, and RPA if calling subscriber was message rate. After the outpulser causes a trouble record to be made, it releases the trunk by releasing GRT. GRT releases PTC, SP, TP, and MR. The down check is effective as described in 9.04 and 9.05.

9.07 If the trunk fails to seize an outpulser, the timer functions operating TM. TM releases GRT on its primary winding. GRT removes ground from the sleeve and releases PTC, PTK, TPA, TP, and MR and RPA if calling subscriber was message rate. GRT also resets the timer, releasing TM. If TM1 has operated, TM normal releases TM1 which has no circuit function at this time.

9.08 If the outpulser is sezied and it fails to release the trunk, the timer functions operating TM which operates TM1. TM1 resets the timer and releases TM and GRT on its secondary winding. GRT releasing functions as described in 9.07 to restore trunk to normal.

SECTION III - REFERENCE DATA

1. WORKING LIMITS

1.01 Battery Voltages: -45 to -52 volts.

1.02 Relay Limits: A relay pulsing: maximum external circuit loop resistance: 1500 ohms.

1.03 A relay supervision: maximum external circuit loop resistance: 2575 ohms (loop), 2300 ohms (E and M).

1.04 A pulsing and supervision: minimum insulation resistance: 15,000 ohms.

1.05 RB relay: supervision, maximum external circuit loop resistance: ZB option 3600 ohms, ZC option 3900 ohms.

1.06 CS relay: supervision, maximum external circuit loop resistance: 4100 ohms.

1.07 CS and RB relay: supervision, minimum insulation resistance: 30,000 ohms.

1.08 PT relay: maximum external circuit loop resistance: 1500 ohms.

1.09 PT relay: minimum insulation resistance: 15,000 ohms.

1.10 PT relay: maximum resistance to ground at tip party of 2-party FR line: 4004 ohms.

	Earth Potential	
Supply 48 Volts Talk	DC	60 Hz AC
45 to 52 Volts	+5, -5 Volts	20 Volts

2. FUNCTIONAL DESIGNATIONS

None.

3. FUNCTIONS

3.01 When a loop is closed, ground the sleeve lead to hold the preceding circuits and to send an off-hook signal to the distant office.

3.02 To repeat dial pulses on a battery and ground basis on special toll calls (loop signaling).

3.03 To repeat dial pulses on the M lead when handling special toll calls (E and M signaling).

3.04 To serve as a recording completing trunk on dial zero calls.

3.05 To provide for operation on ANI or non-ANI basis.

3.06 To permit CAMA office control of trunk while attached.

3.07 To provide ringback under control of the CAMA office.

3.08 To make a party test.

3.09 To test the party test relay for nonoperate if it had operated and for operate if it had nonoperated on the party test.

3.10 To close the ST lead to the outpulser connector circuit when battery and ground are reversed at the distant office.

3.11 When the outpulser connector has connected an outpulser circuit to this circuit, indicate tip or ring party by battery on the T or R lead; remove the party indication when the outpulser operates the SP relay; connect the outpulser tip and ring to the subscriber tip and ring for an abandoned call test when the outpulser operates the SPI relay; connect identification signal to the sleeve from either an oscillator or pulse generator when the outpulser operates the ID relay; connect the outgoing tip and ring to the outpulser operates the MF relay; connect ground to the A lead to cut through the 2MR trunk if it is connected.

3.12 When a 2MR trunk is connected, operate a lock the MR relay after that trunk cuts through.

3.13 On hang up by the calling party, send an on-hook signal toward the distant office and hold the connection under control of distant office.

3.14 On release by distant office after calling party has hung up, make a ground removal test if the calling party was a tip party or either party of a 2MR line; restore to normal immediately if the calling party was a ring party; restore to normal after the ground removal test shows the line is clear of ground; on ground removal test when the line is not clear of ground after 9.5 to 10.5 seconds call in the outpulser, ground the TPT lead on flat rate lines or the AB lead on message rate lines to the outpulser on ground removal failures; remove the failure indication when the outpulser operates the SP relay; connect identification tone to the sleeve when the ID is operated; hold the GRT relay from the outpulser over the SP lead and restore the trunk and preceding circuits to normal when the outpulser opens this lead.

3.15 When the calling party fails to disconnect before the distant end incoming trunk times out, open the sleeve to the ROTS multiple long enough to release the preceding switches; restore to normal when the tip and ring leads open; and reclose ground to the sleeve during release of the trunk.

3.16 To allow the CAMA office to wink off on an abandoned call.

3.17 To test busy when battery and ground are reversed from the distant office when the trunk is normal.

3.18 To test busy when a fuse operates.

3.19 To operate a peg count register when the timing circuit functions on failure to seize outpulser.

3.20 To operate test relays and give access to various leads when selected by the automatic trunk test circuit.

3.21 To hold the connection from releasing when the outpulser operates the TR relay.

3.22 To provide a down check of the party test relays during disconnect on ANI calls.

4. CONNECTING CIRCUITS

(a) Incoming Trunk in Crossbar Tandem Office - SD-27079-01 and SD-27080-01.

(b) Outpulser Connector Circuit - SD-95890-01.

(c) Automatic Trunk Circuit - SD-32315-01.

(d) Oscillator Circuit - SD-95827-01.

(e) Miscellaneous Circuit for Trouble Ticketer - SD-95823-01.

(f) Rotary Out Trunk Switch Circuit - SD-30868-01.

(g) Timer Amplifier Circuit - SD-32371-01.

(h) Miscellaneous Circuit Trunk Frame - SD-32248-01.

(i) Power Ringing Circuit - SD-80885-01 (typical).

(j) Identifier Circuit - SD-95810-01.

(k) Composite Signaling Circuit - SD-95028-02 (typical).

(ℓ) Composite Set and Repeating Coil Circuit - SD-95015-01 (typical).

(m) 4-Wire Terminating Circuit - SD-96463-01 (typical).

(n) Pulse Generator Circuit - SD-32378-01.

(o) Test and Line Verification Circuit - SD-32379-01.

(p) Incoming Trunk in TSPS No. 1 Office - SD-1B002-01, SD-1B003-01, SD-1B004-01 and SD-1B005-01.

5. TAKING EQUIPMENT OUT OF SERVICE

5.01 The circuit may be made busy by plugging into test jack T which grounds the selector multiple sleeve. Before making the circuit busy in this manner, a test should be made on the sleeve of the jack to insure that the trunk is not busy.

5.02 This circuit may also be made busy from the incoming trunk circuit at the distant office by operating either CS or E which will operate RV. RV operated applies ground to the sleeve.

SECTION IV - REASONS FOR REISSUE

B. Changes in Apparatus

B.1 Added

SPA Relay AF114

B.2

Superseded	Superseded By
R - Relay AF146 - ZB option	
RB - Relay AF86 - ZB option	RB Relay AJ144 ZC option
PTK - Relay AF100 - A option	PTK Relay AJ15 ZA option
D4 - Diode 446F - ZB option	
HL Resistor 145A, 590 ohms ZB option	
JL Resistor 145A, 1720 ohms ZB option	

D. Description of Changes

D.1 Circuit Notes 102 and 104 are revised.

D.2 Working Limits for the RB relay are revised.

D.3 Option Used Table is revised.

D.4 ZF option is designated which provides a last trunk busy lead (LTB).

D.5 Options ZB and ZC are designated. These options apply to the RB relay.

D.6 Options A and ZA are designated. They apply when the circuit is used for combined O and O+ operation to a TSPS No. 1 office.

D.7 The A, C, or CE lead is changed to A, C, or EC lead to correct an earlier error.

D.8 Option ZD and ZE are designated.

D.9 Option and apparatus index is revised.

D.10 Information Note 303 is revised.

D.11 CAD 1, 3, 4, 5, 6, 7, 8, 9, and 10 are revised.

BELL TELEPHONE LABORATORIES, INCORPORATED

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