

10

STEP-BY-STEP SYSTEMS  
NO. 1, 350A, 355A OR 35-E-97  
OUTGOING INTERCEPTING TRUNK CIRCUIT  
E AND M LEAD SUPERVISION

CHANGES

B. Changes in Apparatus

B.1 Added

C1, C2 Diode 446F, option K, App. Fig. 6

C. Changes in Circuit Requirement Table Not Covered By Changes in Apparatus

C.1 8B (B) added to "block or insulate" relay SL.

D. Description of Changes

D.1 Option "L" is designated and rated "Mfr. Disc.".

D.2 Option K is added and rated Standard to prevent a possible feedback between leads C2 and C3.

D.3 CAD 2 is changed to reflect "L" & "K" option.

BELL TELEPHONE LABORATORIES, INCORPORATED

Dept 5245-GFC  
WECO Dept-2311 -RWH-WEA

CIRCUIT DESCRIPTION

CD-32309-01  
ISSUE 2AC  
APPENDIX 5A  
DWG ISSUE 5A

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CHANGES

D. Description of Changes

D.1 Relay contact 4 (ST) on FS6 is transferred to the other side of 9(P) contact to eliminate the charging of multiple H capacitors thru the P-relay when ST-relay operates.

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DEPT 5225-LCB  
WECO DEPT 5152-FLS-WEA

STEP-BY-STEP SYSTEMS  
NO. 1, 350A, 355A OR 35E97  
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CIRCUIT  
E AND M LEAD SUPERVISION

CHANGES

B. Changes in Apparatus

B.1 Added

E, Network 185A, Option M

D. Description of Changes

D.1 Option M was added across the winding of the E relay to protect contacts in the signaling circuit.

F. Changes in Description of Operation

F.1 Under 3. Functions, change 3.15 to read:

To provide means for completion of calls through the Emergency Line Circuit.

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DEPT 5825-LCB  
WECO DEPT 5152-CGK-WEA

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CHANGES

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

C.1 On Relay T, Option N, under Circuit  
Preparation Block or Insulate,  
change, 6(T) to 1(T).

D. Description of Changes

D.1 Contact 4, Relay T, Option N was  
interchanged with contact 1, Relay  
T, Option N.

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DEPT 5825-ICB  
WECO DEPT 5152-CGK-WEA

STEP-BY-STEP SYSTEMS  
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CHANGES

B. Changes in Apparatus

B.1 Superseded

Superseded By

AF140(R) Relay, P Option  
AF64(T) Relay, P Option

AJ125(R) Relay, N Option  
AJ125(T) Relay, N Option

D. Description of Changes

D.1 Option N is added, replacing option P, to provide early break-make contacts in the M signaling lead.

F. Changes in Description of Operation

F.1 Under 4. Connecting Circuits, change 4.11 to read:  
Emergency Line Circuit - SD-32313-01.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5823-MKD-MR

~~C~~IRCUIT DESCRIPTION

CD-32309-01  
ISSUE 2AC  
APPENDIX 1AR  
DWG ISSUE 4AR

STEP BY STEP SYSTEMS  
NO. 1, 350A, 355A, OR 35E97  
OUTGOING INTERCEPTING  
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E AND M LEAD SUPERVISION

CHANGES

D. Description of Changes

- D.1 In FS4, lead T has been removed from the RT relay-  
2 make contacts.
- D.2 On this reissue, the circuit is rated A&M Only for 350A  
offices.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 2363-PHS-RJJ,Jr.

STEP BY STEP SYSTEMS  
No. 1, 350A, 355A, OR 35E97  
OUTGOING INTERCEPTING TRUNK  
CIRCUIT  
E AND M LEAD SUPERVISION

## CHANGES

## B. CHANGES IN APPARATUS

B.1 Superseded	Superseded By
1-400J Diode (R) (R) Option FS3&6	4-400J Diodes (R1), (R2), (R3), (R4). (Q) Option FS3&6
1-400J Diode (T) (R) Option FS2&6	4-400J Diodes (T1), (T2), (T3), (T4). (Q) Option FS2&6
1-400J Diode (RT) (R) Option FS4	4-400J Diodes (RT1), (RT2), (RT3), (RT4). (Q) Option FS4

## C. CHANGES IN CIRCUIT REQUIREMENTS OTHER THAN THOSE APPLYING TO ADDED, SUPERSEDED OR REMOVED APPARATUS

C.1 To facilitate the testing of relays (R), (T) and (RT) with Q option new circuit preparation information has been added to these relays.

## D. DESCRIPTION OF CIRCUIT CHANGES

D.1 All R, T and RT diodes are replaced by (R1, R2, R3, R4), (T1, T2, T3, T4) and (RT1, RT2, RT3, RT4) respectively (Q option).

D.2 The (R) and (T) tubes are made non-directional by (Q) option.

## 1. PURPOSE OF CIRCUIT

This circuit is arranged to handle either a single class or three classes of intercept calls. If arranged for three classes of intercept, an associated pulse generator circuit provides pulses to signal the called end over the "M" lead of this circuit. In this case, the number of pulses sent for each particular call indicates the class of intercept involved.

## 2. WORKING LIMITS

Voltage Limits - 45-52V.

## 3. FUNCTIONS

- 3.01 To receive and trip ringing from the calling end.
- 3.02 To insure that the associated ringing machine is running.

3.03 To return audible ringing tone to the calling end until the called end answers.

3.04 To place battery on the "M" lead when ringing is received and tripped as a seizure signal to the called end.

3.05 To call in the associated Pulse Generator Circuit when required.

3.06 To repeat pulses furnished by the associated Pulse Generator Circuit over the "M" lead of this circuit as a class of intercept indication to the called end.

3.07 To hold this circuit busy under control of the calling end until the called end answers for machine or regular intercept and to lock this circuit busy until the called end answers for trouble intercept.

3.08 To remove audible ringing tone returned to the calling end when the called end answers.

3.09 To remove the idle line termination impedance from across the tip and ring lead of the associated signaling circuit when the called end answers.

3.10 To complete the transmission path when the called end answers.

3.11 To provide supervision to the called end.

3.12 To restore to normal when the intercept operator disconnects on calls from plugging up lines and when both the intercept operator or machine announcement circuit and the originating end disconnect on regular and machine intercepted calls.

3.13 To replace the idle line termination impedance across the tip and ring leads of the associated signaling circuit when this circuit restores to normal.

3.14 To make this circuit and the associated trunk finder busy on an optional basis in the event of a fuse failure in this circuit.

3.15 To provide means for completion of calls through the Emergency Transfer Circuit.

3.16 To provide means for making this circuit busy from a remote location without disturbing a call in progress.

3.17 To provide means for testing this circuit.

4. CONNECTING CIRCUITS

- 4.01 200 Ft. Trunk Finder Circuit - SD-33013-01\*.
- 4.02 22 Ft. Trunk Finder Circuit - SD-31793-01\*.
- 4.03 Pulse Generator and Counting Circuit - SD-32310-01.
- 4.04 Composite Signaling Type B Phantom Group or Single Circuit - SD-95048-01.
- 4.05 Line and Balancing Composite Sets and Repeating Coils - SD-95004-01.
- 4.06 Four Wire Terminating Set Circuit - SD-64303-01\*.
- 4.07 "V1" Telephone Repeater Application Schematic - SD-64903-01.
- 4.08 "V3" Telephone Repeater Application Schematic - SD-95144-01.
- 4.09 Make Busy Circuit - SD-31225-01.
- 4.10 Power Ringing Circuit - SD-80780-01.
- 4.11 Emergency Transfer Circuit - SD-32313-01.
- 4.12 Test Trunk Circuit - SD-32090-01.

\*Typical Circuit

DESCRIPTION OF OPERATION

5. SEIZURE

5.1 Arranged for One Class of Intercept

5.11 Regular Intercept, Ringing on Ring Conductor (App. Fig. 1 and 3)

When the associated trunk finder commences hunting for an incoming call, ground on the sleeve operates relay (SL). Relay (SL) operates relay (B), partially closes a path for locking relay (R) when the relay operates, partially closes through the path for connecting ground to the ringing machine start lead and provides a path for holding itself from ground on the sleeve. Relay (B), in operating, provides a path for locking itself under control of relays (E) and (S1), completes the path for connecting ground to the ringing machine start lead, closes through the tip and ring in preparation for receipt of ringing current, provides a ground for locking relay (OA) under control of relay (R) when relay (OA) operates on

answer and opens the lead to the make busy circuit.

Ringling current is received on the ring conductor causing tube (R) to fire across its starter gap. With Option (R) the main gap then breaks down and sufficient current flows during the negative half-cycles to operate relay (R). The (R) semiconductor diode is used to help the flux build-up in the (R) relay should it not operate and lock on the first half-cycle. With Option (Q) the tube is made non-directional by utilizing the starting gap only. The full wave rectifier (Q) permits the (R) relay to operate on either superimposed positive or negative ringling voltage. Relay (R) in operating provides a path for operating relay (S) bridged across the tip and ring, completes the path for locking relay (OA) when that relay operates, places battery on lead "M" to signal the called end, locks under control of relay (SL), connects the starter gap of tube (R) across the tip and ring leads, and removes the (R) semiconductor diode from the circuit.

The ringling voltage supplied by the preceding intercept circuit is high enough during the half-cycle peaks to break down the starter gap of tube (R) and keep it conducting to operate the tripping relay. When ringling is tripped in the preceding circuit, it transfers to the talking condition and supplies battery and ground to this circuit. This voltage is below the sustaining voltage of tube (R). The tube is then extinguished but remains across the tip and ring leads in event of subsequent ringling. The application of talking battery by the preceding circuit operates relay (S) which in turn operates relay (S1). Relay (S1) places audible ringling tone back toward the calling end and holds relay (B) operated until the called end answers.

5.12 Machine Intercept, Ringing on Tip Conductor (App. Figs. 1 and 2)

Operation of this circuit under this condition is similar to that described for a regular intercept call in the preceding section with the exception that the (R) tube, (R) relay, (R) semiconductor diodes ((Q) or (R) option) and associated circuitry are replaced by the (T) tube, (T) relay, (T) semiconductor diodes ((Q) or (R) option) and associated circuitry. Ringling current is received on the tip conductor rather than the ring conductor.

5.13 Trouble Intercept, Ringing on Tip or Ring Conductor (App. Figs. 1, 4 and 5)

If the intercepted call is for a line plugged up for trouble, the trunk finder will place ground through normal post springs to the "A" lead in addition to initially supplying ground on the sleeve lead to operate relay (SL). Relay (SL) in

operating locks to itself through a break contact on relay (B), closes the path for operation of relay (TBL) from ground on lead "A", operates relay (B), and partially completes the path for connecting ground to the ringing machine start lead. Relay (TBL) in operating provides a locking path for relay (SL) under control of relay (S1) when relay (B) operates, partially closes a locking path for relay (RT) when that relay operates, partially closes the path for connection of ground to the ringing machine start lead, and provides a locking path for itself under control of relays (B), (OA), and (SL). (TBL) operated also holds ground on the sleeve lead until (SL) releases when ground from a back contact on (SL) and a make on (B) is held on the sleeve to lock in this circuit until the called end answers and disconnects. Relay (B) in operating provides a path for locking itself under control of relays (E) and (S1), completes the path for connecting ground to the ringing machine start lead, completes the path for locking relay (RT) when that relay operates, closes through the tip and ring in preparation for receipt of ringing current, provides a ground for locking relay (OA) when that relay operates, and completes the holding path for relay (SL) and on the release of (SL) for (TBL).

Ringing current is received on either the tip or ring conductor, causing either tube (T) or tube (R) to fire across its starter gap. With (R) option the main gap of the fired tube then breaks down and sufficient current flows during the negative half-cycles to operate relay (RT). The (RT) semiconductor diode is used to help the flux build-up in the associated relay should it not operate and lock on the first half-cycle. With Option (Q) the tube is made non-directional by utilizing the starting gap only. The full wave rectifier (Q) permits the (RT) relay to operate on either superimposed positive or negative ringing voltage. Relay (RT) in operating provides a path for operating relay (S) bridged across the tip and ring, completes the path for locking relay (OA) when that relay operates, places battery on lead "M" to signal the called end, locks under control of relay (TBL), and connects the starter gap of the activated tube across the tip and ring.

The ringing voltage supplied by the preceding intercept circuit is high enough during the half-cycle peaks to break down the starter gap of the tube connected across the tip and ring and keep it conducting to operate the tripping relay. When ringing is tripped in the preceding circuit, it transfers to the talking condition and supplies battery and ground on the tip and ring to this circuit. This voltage is below the sustaining voltage for the tube. The tube is then extinguished but remains across the tip and ring in event of subsequent ringing.

The application of talking battery operates relay (S) bridged across the tip and ring. This relay in turn operates relay (S1) which places audible ringing tone back toward the calling end on the ring lead, holds relay (B) operated until the called end answers, and releases relay (SL). Relay (SL) in releasing closes the locking path for relay (TBL).

## 5.2 Arranged for More Than One Class of Intercept (App. Figs. 1, 5 and 6)

Initial operation of the circuit is similar to that described for single class intercept in Section 5.1. Indication as to the class of intercept involved is determined by the location of ringing (either on the tip or on the ring) and the condition of the "A" lead. For machine intercept calls, ringing will be received on the tip conductor; for regular intercept calls, ringing will be received on the ring conductor; for trouble intercept calls, ringing will be received on either the tip or ring conductor but ground will be placed on the "A" lead.

As the trunk finder passes levels on which plugging up line circuits are terminated, ground may be momentarily placed on lead "A" which may operate relay (TBL) momentarily. (TBL) will not lock up under this condition, however. When the trunk finder stops on levels on which plugging up line circuits are terminated, (TBL) will operate and remain operated locking up when relay (SL) releases.

Operation of either relay (R) or relay (T) places battery on lead "M" as a signal to the called end and connects relay (ST) to lead "PU" to the associated pulse generator circuit. Relay (ST) will operate when the pulse generator circuit is idle. When relay (ST) operates, ground is applied to lead "ST" as a start signal to the pulse generator and connects relay (P) to lead "PLS-"

Ground pulses from the pulse generator on lead "PLS-" pulses relay (P) which, in turn, pulses lead "M". At the end of the required number of pulses, relay (C) operates from ground on lead "C1", "C2", or "C3". Relay (C) operated prevents any further pulsing by disconnecting relay (P) from lead "PLS-", removes ground from lead "ST", locks to relay (B) operated, and releases relay (ST). The "M" lead will have been pulsed three times for machine intercept calls, two times for trouble intercept calls, and one time for regular intercept calls.

## 6. CALLED END ANSWERS

When the intercept operator answers or the machine announcement circuit is connected, ground is applied to lead "E" to operate relay (E). Relay (E) operates relay (OA) and provides ground for locking relay (B). Relay (OA) operated removes the

audible ringing tone from the ring conductor, removes ground from the ringing machine start lead, removes the idle line termination impedance from the repeating coil in the associated connecting circuit, cuts the tip and ring through to the succeeding circuit, releases relay (S), provides ground for locking (TBL) and locks under control of relay (B) and relay (R), (RT), or (T). The release of relay (S) releases relay (Sl).

## 7. DISCONNECT

### 7.1 Abandoned Call

#### 7.1.1 Regular or Machine Intercept

If the calling end disconnects before the called end answers, relay (SL) will release from the removal of ground from the sleeve and relay (S) will release from removal of battery and ground from the tip and ring. The release of relay (SL) releases either relay (R) or relay (T) depending upon which one of those relays were operated. The release of relay (S) releases relay (Sl). The release of relay (R) or (T) releases relays (C) and (ST) if the circuit is arranged to handle more than one class of intercept and either of those relays are operated. Relay (Sl) releases relay (B) to restore the circuit to normal.

#### 7.1.2 Trouble Intercept

When the calling end hangs up in this case, nothing can happen since the circuit is locked in until the intercept operator answers. When the intercept operator does answer and finds the call abandoned, she will disconnect to release relay (E) which in turn releases relay (B). Relay (B) releases relay (R), (RT) or (T) and relay (OA) which releases relay (TBL) to restore the circuit to normal.

### 7.2 Calling Party Disconnect First

If the calling end disconnects before the called end, relays (SL), (R) or (T), (OA) and (C) will release (if not for trouble intercept call). The circuit then remains busy until the called end disconnects at which time relay (E) releases to release relay (B). If the call is for trouble intercept the circuit action is as described in paragraph 7.1.2.

### 7.3 Called Party Disconnects First

When the called end disconnects, relay (E) releases. If for regular or machine intercept, the calling end then disconnects to released relays (SL), (R) or (T), (OA), (C) and finally, relay (B) to restore the circuit to normal. If for trouble intercept, the release of (E) will release (B), (OA), (R), (RT) or (T), (C) and (TBL) to restore the circuit to normal.

## 8. MISCELLANEOUS

Jacks (TST) and (Tl) along with plug (Tl) are provided to facilitate testing this circuit.

Relay (MB) is a fuse failure make busy relay provided to ground the sleeve and make this circuit busy in the event that a fuse failure occurs.

Thermistor (B) and resistor (B) (App. Fig. 5) are provided to permit the operator to be signaled so that she may answer and release this circuit in the event that the call is for trouble intercept and this circuit is seized but no ringing is received. When relay (TBL) operates, ground is connected through a voltage dividing network to one side of thermistor (B). After an interval required for heating the thermistor, enough current will flow to operate relay (Sl). Relay (Sl) locks to relay (OA) released, removes the path through the thermistor to allow it to commence cooling, release relay (SL) and close battery through resistance (B) to operate relay (T) is App. Fig. 6 is provided or (RT) if App. Fig. 4 is provided. The circuit is then in the same condition that it would have been had ringing been received on the tip conductor. When the operator subsequently answers, relay (E) operates to operate relay (OA) which, in turn, releases relay (Sl). When the operator disconnects, relay (E) is released to release relay (B). Relay (B) releases relays (T) and (OA), (T) releases (C), and (OA) releases (TBL) to restore the circuit to normal. In the usual condition, the circuit would be seized, ringing would be received and relay (S) would operate to operate (Sl) before sufficient time had elapsed for (Sl) to operate through the thermistor.

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DEPT. 2335-MPC-FBB-RI