

6

STEP-BY-STEP SYSTEMS  
NO. 1, 350A, 355A OR 360A  
LOCAL CONNECTOR CIRCUIT  
5 CODE FOR  
10 PARTY TERMINAL PER STATION  
DIVIDED RINGING  
ARRANGED FOR REVERTING CALLS

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SECTION I - GENERAL DESCRIPTION1. PURPOSE OF CIRCUIT

1.01 This circuit is for use in a dial office for making the final connections to a called line in 10-party terminal per station connector groups.

1.02 This circuit is arranged for reverting call service, for inductive balance of

the A and D relays, and for mounting on universal connector shelves.

SECTION II - DETAILED DESCRIPTION1. SEIZURE

1.01 When this circuit is seized by a selector, relay A operates over the subscriber loop which in turn operates relay G. Relay G returns ground to the S lead to hold the switches in the train in their operated positions and to guard the connector from seizure by another selector, opens the release circuit for the connector, and prepares the circuit for the operation of the vertical magnet as well as preparing certain circuits which will be described later. The operated G relay also starts the ringing machine.

2. VERTICAL STEPPING

2.01 The impulses sent out by the calling station, after the seizure of this circuit, release and operate relay A which operates the vertical magnet and steps the shaft in a vertical direction. Relay C operates in series with the vertical magnet. Relays G and C remain operated during this series of pulses, since they are slow to release. As soon as the shaft moves one vertical step on the first impulse, the original circuit through the off-normal springs for operating the vertical magnet is transferred from off-normal spring 5 to off-normal spring 6 and the front contact of relay C which is maintained due to the slow release action of relay C, for all the additional pulses of this digit sent out by the dial. When the pulses cease, relay C releases and prepares the circuit for rotary stepping.

3. ROTARY STEPPING

3.01 The next set of impulses sent out by the calling station operates the rotary magnet and steps the shaft in a rotary direction in accordance with the pulses sent out from relay A as before. Relay G remains operated during the rotary stepping on account of its slow release feature. Relay E operates in multiple with the rotary magnet and, due to its slow release feature, remains operated

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NOTICE

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beginning on January 1, 1964, AT&T will cease to use

ring the rotary stepping. Relay E closes a circuit for operating relay B which, upon its operation, prepares a part of the circuit for making the busy test of the called terminal.

#### 4. BUSY TEST OF CALLED TERMINAL

4.01 When the impulses of the last digit cease, relay E releases and opens the circuit to the winding of relay B and also closes a circuit for making the busy test of the called terminal. If the called terminal is busy, ground is found on the bank contacts for the S wiper and this operates relay L during the releasing time of the B relay, which releases slowly. Relay L locks to the S lead through its own contacts, closes a circuit for returning a busy signal as determined by option M or K, and connects ground to the tertiary winding of the B relay, which does not operate at this time.

4.02 With option M busy, tone through the L relay contacts is returned to the calling party. With option K, which requires an additional relay, busy tone and busy flash are connected by the K relay which is operated from contacts of the L relay. If the called line is idle, relay L does not operate and, on the release of relays E and B, the sleeve is closed through for operating relay M.

#### 5. CUTTING THROUGH TO CALLED LINES

5.01 When the called line is seized, relay M operates through its primary winding from battery in the called line circuit to ground at the front contact of relay G. This ground acts as a guarding potential on the S wiper until relay M operates and grounds the S wiper directly. The circuit to the primary winding of relay M serves only to operate springs 1B and 2B which close a local circuit to its secondary winding to fully operate the relay. This circuit is maintained until the switch releases. The operation of relay M also closes the tip and ring wipers through for ringing the called station and talking as described below.

5.02 The battery to the secondary winding of relay M is supplied through the rotary magnet to prevent the operation of the relay if a pulse is transmitted to the rotary magnet by an irregular operation at the calling station after springs 1B and 2B have made, and before springs 3B and 4B have broken. If relay M were permitted to operate under conditions described above, it might result in the calling party cutting in on a busy connection.

#### 6. RINGING THE CALLED STATION

6.01 Ringing the called station is not started until relay J operates from ground on the pickup lead to insure the right number of rings being sent out over the line. Relay J

locks to its own contacts in series with contacts on relay F with F option or relay D with E option to ground at contacts on relay G, and closes the ringing machine leads and the ringing supply circuit. Relay L is operated and released from the ground pulses on the ringing machine leads connected to bank terminal A which may be code 1 ground, code 2 ground, code 3 ground, code 4 ground, or code 5 ground, thus transmitting ringing current over the called line in code as determined by the lead connected to terminal A. The A capacitor transmits ringing tone to the calling subscriber during the ringing period. This ringing continues until the called station answers, whereupon relay F operates to close contact with springs 1 and 2 due to the current through its primary winding. The secondary winding then being energized fully operates the relay. The operation of this relay connects the talking leads through to relay D which operates and supplies talking battery to the called station. The called and the calling stations are now connected for talking purposes through the T and R capacitors in the tip and ring leads. The operated D relay reverses the battery to the calling station for the purpose of supervision or metered service and other functions described below, and also releases relay J. If the called subscriber removes the receiver during the silent interval, relay F operates from battery on the back contact of relay L.

#### 7. REVERTING CALLS

7.01 When a station calls another station on the same line, the busy test of the called terminal and the busy tone to the calling station are the same as described under 4. When the calling station hangs up, relay A releases; this operates relay E and allows relay G to release. On the release of relay G, relay E is locked to a ground through the back contacts of relay G. Relay E grounds the sleeve wiper S which is now connected to the sleeve of the called line. When relay G releases, the busy ground is removed from the selector S lead and the shunt is removed from the primary winding of relay H.

7.02 On a revertive call, the sleeve of the calling line is the same as the called line. Thus, a ground from the break contact of the F relay through contacts of the E relay connected to the sleeve wiper and line circuits is also closed through the line finder and selector circuits to the primary winding of the H relay, operating the latter. The H relay then fully operates through its secondary winding.

7.03 The operation of relay H operates relay C in series with resistor A and the vertical magnet. The operation of relay C opens the holding circuit for relay E and removes the ground from the connector sleeve wiper, which allows all the switches in the train except the connector to release. When the ground is removed from the sleeve, relay

L releases, but the circuit for the release magnet of the connector is open by contacts on relay C. The release of relay L operates relay G during the release time of E. Relay G operated and relay E released ground the sleeve for the purpose of guarding the circuit from being seized by other selectors. The release of relay E also closes a circuit from ground through the primary winding of relay M in series with the CO relay in the line circuit to battery. This operates relay M sufficiently to close contacts 1 and 2B and the relay then fully operates over its secondary winding and remains energized until the connection is released. The release of relay E also allows relay C to release and opens the circuit to the winding of relay G, but it is slow in releasing and holds during the operating time of relay M. Battery through the rotary magnet and C resistor are connected in parallel with the winding of the E relay to increase the slow release characteristic of the E relay. Relay M closes a circuit for holding relay G. If no battery is found on the sleeve terminal for the operation of relay M, the switch will release when relay G releases. The operation of relay M also closes the tip and ring wipers through to relay F, prepares circuits to prevent the operation of the release and the rotary magnets, prevents the locking of the L relay, grounds the sleeve, and closes a circuit for operating relay J over the pickup lead. The operation of relay J starts the ringing in the same manner as already described under 6.

7.01 Ground over the RR lead operates relay B momentarily and transmits a short ring on the opposite side of the line to that of the code ringing of the called station. The purpose of this is to provide a signal to the calling station when the calling station ringer is on the opposite side of the line from that of the called station, so that the calling station will know when the called station answers. When the called station answers, relay F is operated the same as already described in 6. and talking battery is supplied to both stations through the windings of relay D. On the operation of relay F, ground is removed from the winding of relay G, but it is slow in releasing and therefore does not release during the operating time of relay D which reestablished the holding circuit for relay G. Relay G is held operated from the ground at contacts of relay D until the connection is released. If the called station does not answer, the calling station must remove the receiver from the hook and trip the ringing to release the connection.

7.05 This circuit should not be used for calls incoming over repeaters or trunks that place a holding ground forward on the sleeve at the time when the connector is in process of releasing. This may cause a false reverting call test if, after finding the called terminal busy, the terminal becomes idle before the connection is released, and if on the release the G relay releases just enough

before the forward ground is removed from the sleeve to operate relay H and the ground is removed a sufficient length of time before the release of relay E to allow the reoperation of relay G.

### 8. RELEASE - NONREVERTING CALLS

8.01 When the called subscriber disconnects, the D relay releases and reverses battery toward the originating subscriber or operator. With option F the release of the D relay also connects ground to the SUPV 1 lead for alarm purposes. When the calling party disconnects, the A relay releases, operating the E relay and releasing the G relay. The released G relay releases the E relay, opens the lead to the ringing machine, removes the busy ground from the selector S lead, and removes the locking ground from the M relay which releases and closes a circuit to operate the release magnet. The energized release magnet returns the switch to normal and releases the F relay.

8.02 With option E provided, if the calling party fails to replace his receiver on-hook after the called party has disconnected, releasing the D relay, the connector is automatically disconnected after a predetermined interval. With D released and F operated, ground over lead AUT DISC through P resistor, VON spring, and RLS magnet to battery operates RLS on first step to release G. Relay G released permits the preceding switches to restore and open the loop to release A. Relay G also releases relay M. The release of A fully operates the RLS magnet, returning the connector to normal. With option E, when D releases, the J relay operates when ground is on the PKU lead and locks to ground on G. Relay L follows the ground pulses on lead A. Neither J nor L, at this time, perform any useful function.

8.03 If the calling subscriber disconnects first, the circuit functions as described in 8.01 except that the D relay is released when the M relay releases.

8.04 If the calling party disconnects before ringing, or before ringing is tripped, the release of the A and G relays releases the M relay, removing ringing from the tip and ring wipers, operates the release magnet and restores circuit to normal as described in 8.01.

8.05 On a busy connection, the release of the A relay releases the G relay. During the releasing time of the G relay the E relay operates as on reverting calls, but on the release of the G relay, relay H does not operate because the connector S wiper is not associated with the calling line; therefore, the ground is removed from the sleeve when the G relay releases. On the release of the G relay, relay I releases and closes a circuit which energizes the release magnet and restores the switch and circuit to normal.

8.06 The circuit through the release magnet is opened when the switch VON springs return to their nonoperated position.

sing, see keysheets.

## 9. RELEASE - REVERTING CALLS

9.01 On a reverting call, relay D remains operated until both the calling and the called station disconnect. Relay D will then release and allow relay G to release. The released G relay releases the M relay. A circuit is then closed for energizing the release magnet which returns the switch to normal. When the switch returns to normal, the F and H relays release, restoring the circuit to normal.

## 10. SUPERVISORY NO. 1, OPTION F

10.01 On a nonrevertive call, if the called station disconnects before the calling station, a circuit is closed through a back contact of relay D and a front contact of relay F for operating a signal designated "PV No. 1."

## 11. TEST JACKS

11.01 Test jack springs 3 and 4 may be used to make the connector busy to incoming calls. Springs 1 and 2 may be used for making local tests of the connector. The make-busy feature of the test jack is also duplicated by the removal of the switch from its jack, since the jacks are arranged to place a ground on the incoming S lead when the switch is removed from its mounting position.

## 12. CONTACT PROTECTION

12.01 The C network is provided for protecting the contacts which make and break the circuit to the stepping magnet. The B network is provided for protecting the contacts of relay F which break the ringing current when the ringing is tripped.

## SECTION III - REFERENCE DATA

### WORKING LIMITS

1.01 Limits are for single office areas. For multioffice areas and for operator pul-

TABLE A

45-VOLT MINIMUM (OHMS)

Type of Dial or Adjustment	Pulsing From Subscriber			Called Station Supervision	
	2,4, or 5	6	7	Adjust- ment A	Adjust- ment B
Maximum external circuit loop*	750	1200	1100	1000	1400
Maximum external circuit loop†	850	1400	1300	1000	1400
Maximum external circuit loop**	1000	1400	1400	1000	1400
Minimum insulation resistance	15,000			15,000	

TABLE B

48-VOLT MINIMUM (OHMS)

Type of Dial or Adjustment	Pulsing From Subscriber			Called Station Supervision	
	2,4, or 5	6	7	Adjust- ment A	Adjust- ment B
Maximum external circuit loop*	850	1500	1400	1115	1500
Maximum external circuit loop†	850	1500	1400	1115	1500
Maximum external circuit loop*	1000	1500	1500	1115	1500
Maximum external circuit loop**	1115	1500	1500	1115	1500
Minimum insulation resistance	15,000			15,000	

\* When using 1000-ohm loop; leak B in pulsing test set

† When using 1200-ohm loop; leak A in pulsing test set

\*\* When using 1400-ohm loop; leak A in pulsing test set

TABLE C  
TRIPPING RANGES

Type Ringing and Dis- trict	Ringing 20 Hz		Silent Inter- val Voltage	Maximum External Circuit Loop for Tripping	
	AC Volt- age	DC Volt- age		Adjust- ment A (ohms)	Adjust- ment D or E (ohms)
AC-DC	75-110	45-52	45-52 48-52	1030 1115	1400 1500
Super- vision	65-90	37-40	45-52 48-52	1030 1115	1400 1500

1.02 This circuit can be used for reverting call service only where there is a direct local circuit from the sleeve of the line circuit to the connector multiple bank sleeve terminal.

1.03 This circuit shall not be used for calls over incoming repeaters or trunks which place a holding ground forward on the sleeve at the time when the connector is releasing.

## 2. FUNCTIONAL DESIGNATIONS

None.

## 3. FUNCTIONS

3.01 To return ground on the S lead for holding the switches back of it in their operated position and to prevent intrusion from selectors hunting for an idle connector.

3.02 To step the shaft in a vertical and in a rotary direction in response to impulses sent out by the dial at the calling station.

3.03 To connect the talking wires through to the called line and remove the line relay from the called line.

3.04 To place a busy test on the called line.

3.05 To furnish talking battery to both the calling and the called stations.

3.06 To signal the called party with code ringing and trip the ringing when the called party answers.

3.07 To give the calling party an audible ringing signal during the time that the called party's bell is being rung.

3.08 To test for a busy line and return a busy tone to the calling end when the line is busy.

3.09 To return a busy flash signal for operator-originated calls when the called line is busy.

3.10 To make a test, on the release from a busy line, to determine whether the call is for a party on the calling line.

3.11 To release on a reverting call test if no battery is found on the sleeve of the called terminal.

3.12 To ring both the called and the calling station bells on a reverting call.

3.13 To release the line finder and selectors on reverting calls.

3.14 To release when the calling party hangs up.

3.15 Arranged to provide supervision.

3.16 To allow the calling party to release the train of switches back of the connector without releasing the connector, or a reverting call.

3.17 To start the ringing machine.

3.18 To automatically release the connector and switch train on nonreverting calls within a predetermined time when the called party disconnects but calling party fails to disconnect.

## 4. CONNECTING CIRCUITS

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

- (a) Selector Bank Multiple Circuit SD-32123-01.
- (b) Selector Circuit - SD-31734 (typical)
- (c) Incoming Selector Circuit - SD-30972 01 (typical).
- (d) Miscellaneous Alarm Circuit or Switch Trouble Alarm Circuit - SD-32045-01.
- (e) Power Ringing Circuit - SD-80780-0 (355A).
- (f) Subscribers Line Circuit - SD-32133-0 (typical).
- (g) Intercepting Trunk Circuit SD-31337-01.
- (h) Interrupter Relay Circuit SD-31868-01.
- (i) Connector Bank Multiple Circuit SD-32128-01.
- (j) Ringing Interrupter and Alarm Circuit - SD-31298-01 (No. 1, 350A or 360A)