

CROSSBAR SYSTEMS
NO. 3
INCOMING PLUG-ENDED TRUNK
CIRCUIT
DP OR MF PULSING
E AND M LEAD SUPERVISION

CHANGES

B. Changes in Apparatus

<u>B.1</u>	<u>Superseded</u>	<u>Superseded By</u>
	M - 18BH Resistor - Fig. 1, Option S	M - 533A Diode - Fig. 1, Option R
	T1 - 535AS Capacitor - Fig. 1, Option P	T1 - 535BS Capacitor - Fig. 1, Option N
	R1 - 535AS Capacitor - Fig. 1, Option P	R1 - 535BS Capacitor - Fig. 1, Option N

D. Description of Changes

D.1 The FS1 has been revised to show the addition of R, N, and K options. Options S, P, and M were formerly not designated and are rated Mfr Disc. Circuit Note 104 revised accordingly.

D.2 The FS1 and CAD 2, reference to "Transmission and Signaling Facilities with Type I Interface" is added.

D.3 The SC2 has been revised.

F. Changes in CD SECTION II

F.1 In 5.01, change (a) and (b) to read:

- (a) Releases relay DS which opens the R lead to the trunk switch and connector circuit which opens the loop to the called line releasing the S relay.
- (b) Its 8 make-contact opens the sleeve lead controlling the connection to the called line.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5245-GFC

WE DEPT 25820-JRF-GWC-BT

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SECTION I - GENERAL DESCRIPTION

1. PURPOSE OF CIRCUIT

1.01 This incoming trunk circuit completes calls from local or tandem offices having senders or operator positions arranged for a start dial signal or for dial tone. The associated incoming registers are arranged to receive both dial pulsing and multifrequency pulsing.

2. GENERAL DESCRIPTION OF OPERATION

SEIZURE

2.01 An off-hook signal from the originating end causes the trunk to signal the incoming register link that a register is required. When an idle register is connected through the link to this circuit, a signal is sent to the originating office to start outputting. The digits transmitted either by dial pulsing or multifrequency pulsing are sent directly to the register. Upon completion of pulsing, the register summons a marker and passes to it the information necessary for completing the call.

COMPLETING THE CONNECTION

2.02 The marker seizes the trunk via the incoming register link but places the ringing code information in the trunk through the trunk switch and connector circuit. The marker sets up the connection to the called line, makes checks of the T, R, and S, turns supervision of the connection over to the trunk and releases both itself and the incoming register. Ringing of the called station is now started by the trunk.

ANSWER AND DISCONNECT

2.03 When the called customer answers, ringing is tripped, the talking path is cut through and answer supervision is returned to the calling end. If at the end of conversation, the calling party disconnects

first the trunk releases the connection to the called party and returns to normal. Should the called party disconnect first the trunk sends on-hook supervision to the calling end and awaits their disconnect. An optional time-out feature, if provided, will within 32 seconds release the local (called) customer line should the calling customer fail to hang up.

2.04 This trunk circuit has a link reseizure delay feature which prevents seizure of the incoming register link and an incoming register due to noise on the signal channel during disconnect.

SECTION II - DETAILED DESCRIPTION

1. SEIZURE - SCL

1.01 The originating office signals over the signaling circuit that it is off-hook by causing the E relay to operate. The E operated:

- (a) Its 12 make-contact connects resistance ground to the R lead. This will simulate a loop to the incoming register when the trunk is arranged for dial pulsing (option V).
- (b) Its 12 make-contact partially closes a resistive bridge across the T and R leads. This will simulate a loop to the incoming register when the trunk is arranged for multifrequency pulsing (option W).
- (c) Transfers the M lead from ground to resistance battery. This off-hook signal is the first "reversal" of the wink, start dial, signal.
- (d) Its 1 make-contact connector resistance battery to the ST start lead to the incoming register link as a bid for an incoming register.

In response to the bid for a register, the link functions to connect an idle incoming register to the trunk. Ground on lead CO is the signal that a register is attached and operation of the CO relay conditions the trunk that it has occurred. Relay CO operated:

- (a) Transfers the resistance battery from the ST lead to the sleeve of the T2 jack. The potentials which are switched on and off of the T2 jack are for use of the test circuit when a test call is directed to the trunk.

- (b) Through contact 10 make, partially closes a lock path for itself and also cuts the ground on the CO lead onto the BL lead as an indication to the incoming register that the CO relay has operated.
- (c) Opens the operate path to the RL thermal relay.
- (d) Thru contact 12 make, partially closes a path to ground for the S sleeve lead.
- (e) Its contact 9 make, partially closes an operate path of the PU pickup relay.

1.02 When the incoming register is ready to receive digits from the originating end it grounds the tip lead operating the RV relay in the trunk. The RV locks to the grounded CO lead through 7 break S and 10 make CO. It removes the T idle circuit termination bridged across the T and R. On trunks arranged for MF pulsing (option W), RV applies a 4700-ohm bridge across the tip and ring to the register. Operation of the RV transfers the signaling circuit M lead from resistance battery to ground. This is an on-hook signal to the originating end and it is the second and last "reversal" of the wink signal. The originating end outputpulses the called number. When this trunk receives dial pulses, the E relay follows the pulses and its 12 make-contact transmits them to the incoming register.

1.03 When the register has received all of the digits, it makes a marker start and grounds the CT lead to the trunk which operates the CT cut through relay. The CT operated:

- (a) Cuts through the tip and ring leads from the signaling facilities to the trunk switch and connector circuit.
- (b) Locks relays CO and RV operated through contact 2 make.
- (c) Through 8 make, closes ground to the path which later will connect to the S sleeve and hold the connection to the called line.
- (d) Transfers the sleeve of the T2 jack from resistance battery to ground.
- (e) Removes the N or R resistor which is bridged on the ring lead.
- (f) Locks to ground under control of 1 make E.

Relay CT is a slow-release relay to hold over momentary releases of E relay due to noise on the channel. The register monitors the CT lead for the return of the CT relay locking ground as an indication that the call has not been abandoned. Absence of the ground causes the incoming register to time out and release.

2. MARKER OPERATIONS - SC1

2.01 The marker seizes the trunk through crosspoints on the incoming register link circuit. Resistance battery from the marker over lead F operates the F relay. Relay F operated:

- (a) Opens operate path of PU pickup relay.
- (b) Grounds the JC, SW, and T11 leads to the trunk switch and connector circuit.
- (c) Cuts through to the marker the operate paths of the R2, R3, and TP ringing combination relays.
- (d) Transfers the T, R, and S leads to the marker over the T1, R1, and SL leads. The marker performs a trouble ground test on the sleeve and controls the channel over the SL lead. After the channel has been set up, the marker checks tip and ring continuity using the T1 and R1 leads.
- (e) Operates relay DS through its 3 make-contact.

2.02 Relay DS operated locks through its 9 make-contact to 8 make CT. Its 10 break-contact further opens the ST to the link and later during disconnect will perform the delay link seizure function. Contact 8 make partially completes the path from ground to the sleeve lead.

2.03 The marker operates the RC ringing control relay. It checks that RC operates and that its locking path is intact by checking for ground on the RA lead. The path to ground starts at the RA lead and goes through 6 make F, 6 break RT, 12 make RC, and 8 make CT to ground. The marker stores the called party ringing information in the trunk by operating the proper combination of R2, R3, and TP relays. These relays lock to ground through 12 make RC and 8 make CT.

2.04 The marker sets up the channel from the called line to the trunk, performs its tests on the T, R, and S and prepares to release by releasing the trunk F relay. The released F relay transfers the T, R, and S

from the line into and under control of the trunk. The marker checks for ground, through 8 make CT, 12 make CO, 8 make DS, and 8 break F, to the sleeve lead and then releases. When it releases, the marker dismisses the incoming register which releases.

LINE-BUSY OR OVERFLOW

2.05 If the called line is busy or if there are no paths through the switches, the marker releases the RC relay. The released RC removes locking ground from the R2, R3, and TP ringing combination relays which release. The RC transfers the called end tip and ring leads from the ringing potential leads and cuts them through to the calling end. The marker connects the trunks vertical appearance on the trunk switch to level 9 of that switch. If it selects appearance A on level 9, 60-IPM line-busy tone will be sent to the calling end and selecting appearance B will send 120-IPM overflow tone. When the marker releases the F relay, line-busy or overflow will be returned to the calling end. Relay S does not operate to send answer supervision.

2.06 The trunk remains in this state until the calling customer hangs up. Relay E releases releasing relay CT. The CT removes ground from the sleeve releasing the trunk switch. Relays CO and DS release returning the trunk to its normal idle state.

3. RINGING - SC1

3.01 The marker released the trunk F relay when it prepared to release. The 11 break of the F completes a path from the PU pickup relay coil to either ground or to the PU lead from the PRTD circuit. The combination of transfer contacts, 9 on R2 relay and 4 on R3 relay, and options Y and Z provide that, if code 1 ringing is to be applied to the tip or ring, the operate path of the PU relay will be grounded through 9 make CO and it will operate immediately. If on the other hand any other code of ringing is to be applied, the operate path will be brought out to the PU lead. The 250-millisecond pulse of ground, which appears on the PU lead near the end of the 6-second ringing cycle, operates the PU at a time which assures that ringing codes 2, 3, or 4 are applied at the beginning of their sequences. In any event the PU relay operates and locks through its 5 make-contact to ground appearing at 12 make of the RC. One of the ringing potentials coming from the PRTD over leads C1, C2, C3, and C4 is applied through the RT ringing trip relay and 3 make PU to either the tip or ring of the

called customers line. The following chart specifies the ringing codes sent to the called customer for the various combinations of operated R2, R3, and TP relays.

RINGING COMBINATIONS				
Called Party	Relays Oper	Ringing		Applied To
		Superimp	Coded	
1		Code 1-	Code 1	Ring
2	TP	Code 1-	Code 1	Tip
3	R2	Code 1+	Code 2	Ring
4	R2,TP	Code 1+	Code 2	Tip
5	R3	Code 2-	Code 3	Ring
6	R3,TP	Code 2-	Code 3	Tip
7	R2,R3	Code 2+	Code 4	Ring
8	R2,R3,TP	Code 2+	Code 4	Tip

4. ANSWER - SC2

4.01 Ringing potential is applied to the ring lead of the customers line through 9 make RC or to the tip lead through 8 make RC. Ringing ground through either 3 break or 5 make TP is applied to the side of the line opposite from ringing potential. Some of the ringing potential is feedback as audible tone to the calling customer through the T1 and R1 capacitors. When the called customer answers, the impedance of the line is reduced so that the resultant increased current flow operates the RT ringing trip relay. Contact 6 break of the operated RT opens the lock path of the RC ringing control relay causing it to release. The RC released:

- (a) Releases the ringing combination relays R2, R3, and TP.
- (b) Opens both the operating and locking paths of the PU relay releasing it.
- (c) Completes another path, through its 12 break-contact, from ground to the S sleeve lead.
- (d) The 8 and 9 transfer contacts remove ringing from the called line and cut on the S supervisory relay, which supplies talking battery and ground to the called party; operating the S relay and releasing RT.

4.02 When the S relay operates, its 7 break-contact opens the lock path of the CO relay releasing it. The 8 transfer contact on S changes the potential on the M signaling lead from ground to resistance battery as the answer signal to the originating end. The trunk is now in the state in which conversation can take place between the calling and called customers. It will remain in this state, with its CT, DS, E, RV, and S relays operated, until disconnect.

5. DISCONNECT - SC2

CALLING STATION FIRST

5.01 The calling station hanging up causes the E relay to release from the on-hook signal from the originating end. Transfer contact 8 prepares a path to ground for the M signaling lead. The 1 make opens the lock path of relay CT releasing it. The CT released:

- (a) Releases relay DS.
- (b) Its 8 make-contact opens the sleeve lead controlling the connection to the called line. The release of the channel releases the S relay.
- (c) Opens the tip and ring paths through the trunk.
- (d) Opens the lock path of the RV relay which releases.

The released RV relay connects ground, through 8 break E and 3 break RV, to the M signaling lead as an on-hook signal. The trunk is now normal.

CALLED STATION FIRST

A. Without Timing

5.02 When the called party hangs up first the S relay releases. Contact 8 of the S transfers ground onto the M signaling lead. This changes the supervisory signal to the originating end from off-hook to on-hook. The trunk then waits for the calling customer to release or to be timed off the connection by the originating equipment. When the connection at the far end drops the resulting on-hook signal releases E relay. The opened 1 make-contact of E releases slow-release CT relay. The CT relay released does two things. It removes ground from the S sleeve lead which drops the channel hold magnets removing the connection from the trunk to the called customers line and, it releases the RV and DS delay seizure relays. The trunk is now normal.

B. With Timing (Option T)

5.03 The trunk action is the same as in 5.02 except, that while the trunk is waiting for the disconnect signal from the originating end, it starts a timed disconnect function of its own. The S relay released completes a path from ground on 2 make of the CT relay through 7 break S, 10 break CO, and 10 break RC to the heater of the RL thermal time delay relay. Sometime within an interval of 13 to 32 seconds the RL relay closes its contacts and operates the RC relay. Relay RC operated:

- (a) Removes ground from the RL heating element allowing it to cool.
- (b) Removes ground from the S sleeve lead dropping the connection to the called customer thus freeing that line.
- (c) Locks to ground on 8 make CT.

The trunk remains in this state waiting for the disconnect signal from the originating end. When the E relay releases, the results are the same as in 5.02 except that the CT relay releases the RC relay instead of the already released channel.

SECTION III - REFERENCE DATA

1. WORKING LIMITS

1.01 The customer working limits for this trunk will be found in the No. 3 crossbar keysheet.

2. FUNCTIONAL DESIGNATIONS

2.01 Relays

<u>Designation</u>	<u>Meaning</u>
CO	Cut Off
CT	Cut-Through
DS	Delay Seizure
E	Traditional
F	Traditional
PU	Pick Up
R2	Ringling (Combination)
R3	Ringling (Combination)
RC	Ringling Control
RL	Release
RT	Ringling Trip
RV	Reverse
S	Supervisory
TP	Tip Party

3. FUNCTIONS

- 3.01 To provide an idle circuit termination on the T and R to the transmission and signaling facilities.
- 3.02 To connect resistance battery to the ST lead to the incoming register link as a bid for an incoming register.
- 3.03 Option V - To provide resistance to ground on the ring lead to the incoming register. This resistive ground simulates the dial pulsing loop and under control of the E relay transmits the dial pulses to the register.
- 3.04 Option W - To provide a T and R path from the transmission facilities to the incoming register and to simulate a loop to the register by connecting a 4700-ohm bridge across the T and R.
- 3.05 To remove the idle circuit termination.
- 3.06 To remove resistance battery from the ST lead.
- 3.07 To apply resistance battery to the sleeve of the T2 jack for test circuit use when the incoming register is attached.
- 3.08 To ground the BL lead to the incoming register as an indication that CO relay has operated.
- 3.09 To send the wink start-dialing signal and the on-hook/off-hook supervisory signals to the originating office over the M lead of the transmission and signaling facilities.
- 3.10 Upon completion of pulsing to cut through the tip and ring leads from the transmission and signaling facilities to the trunk switch and connector circuit.
- 3.11 To provide a locking ground for relay CT under control of relay E and extend this ground to the register as a check that the call has not been abandoned.
- 3.12 To ground the sleeve of the T2 jack for test circuit use, when pulsing is completed.
- 3.13 To operate the trunk F relay when the marker applies resistance battery to F lead of the incoming register link.

- 3.14 To ground leads JC, SW, and TTL to the trunk switch and connector circuit.
- 3.15 To cut through to the marker the operate paths of the R2, R3, RC, and TP relays.
- 3.16 To return the RC relay locking ground to the marker over lead RA.
- 3.17 To transfer the T, R, and S leads to the T1, R1, and SL leads to the marker for tests and control of the channel.
- 3.18 Prepares a circuit to ground for the S sleeve lead.
- 3.19 When the marker releases the F relay, to connect ringing current of the proper code and polarity on the side of the line to which the called customers ringer is attached.
- 3.20 To operate the PU pickup relay immediately on calls requiring code 1 ringing.
- 3.21 To delay the start of ringing to the beginning of the ringing cycle for other than code 1 ringing.
- 3.22 To transmit audible ringing to the calling customer.
- 3.23 When the called customer answers, to trip ringing, release the ringing combination relays, establish the connection between the called and calling customer, supply transmitter battery and ground to the called customer and send to the originating end as an answer supervisory signal.
- 3.24 When the calling customer disconnects first, to release the called customers line.
- 3.25 When the called customer disconnects first, to send an on-hook supervisory signal to the originating end and await disconnect from that end.

3.26 Option T - When the called customer disconnects first, to send an on-hook supervisory signal to the originating end and to time for an interval of 13 to 32 seconds; at the end of which, to release the called customer line.

3.27 To provide access for testing the trunk circuit and cutoff of the trunk pair.

4. CONNECTING CIRCUITS

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

- (a) Trunk Switch and Connector Circuit - SD-26383-01.
- (b) Incoming Register Link Circuit - SD-26394-01.
- (c) Power, Ringing, and Tone Distribution Circuit - SD-26414-01.
- (d) CX Set and Repeat Coil Circuit - SD-95004-01 (Typical).
- (e) N1 Carrier Applique Schematic - SD-95121-01 (Typical).

5. MANUFACTURING TESTING REQUIREMENTS

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

6. TAKING EQUIPMENT OUT OF SERVICE

6.01 To take this trunk out of service, have the associated outgoing trunk circuit in the distant office made busy.

6.02 The T1 and T2 test jacks provide access to this circuit for test purposes. Insertion of plugs in the jacks disconnects the trunk circuit from the transmission and signaling facilities.

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