

10

CROSSBAR SYSTEMS
NO. 5
INCOMING TRUNK CIRCUIT
WITH OR WITHOUT TANDEM COMPLETING
REPEATED DIALING
USING BY-LINK
REVERSE BATTERY SUPERVISION

CHANGES

B. Changes in Apparatus

B.1 Added

L Resistor, KS-19150, L1, 2K ohms,
Option ZL, Fig. 1

D. Description of Changes

D.1 A KS-19150, L1, 2K ohm resistor is connected across diode D, to eliminate the possibility of "bell tapping."

D.2 Circuit Note 104 is changed and Circuit Note 111 is added to reflect the change mentioned in D.1.

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DEPT 5141-KMR-RBC-JF

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CHANGES

B. Changes in ApparatusB.1 Added

D - 446F Diode - Option ZK

D. Description of Changes

- D.1 A diode D and a contact 5M(D) is added in series with one winding of relay A to prevent a possible split pulse condition. This may occur where this circuit is associated with an E6 repeater with a nonloaded build-out network.
- D.2 Circuit Note 104 is revised to show the addition of option ZK and Note 109 is added.
- D.3 To provide this change, option ZK is added and rated Standard. Former wiring is designated option ZJ and rated Mfr Disc.
- D.4 Circuit Note 109 is added to explain the use of option ZK for field modifications.
- D.5 Circuit Note 110 is added to clarify special adjustment applied to relay A, code AJ29, option V, on Issues 10D.

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DEPT 5611-AAA-RBC-GW

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LOCAL CALL	4	<u>1. PURPOSE OF CIRCUIT</u>	
TANDEM CALL.	4	1.01 This circuit is designed for use in the No. 5 crossbar office as an incoming trunk circuit from a step-by-step office. It is arranged for bylink operation and provision is made for tandem operation on an optional basis.	
A. <u>Marker Operation</u>	4	<u>2. GENERAL</u>	
B. <u>Abandoned Call</u>	4	SEIZURE	
C. <u>Supervision.</u>	4	2.01 Seizure of this trunk is made during interdigital time, thereby making it	
D. <u>Overflow</u>	4		
E. <u>Disconnect</u>	5		
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necessary for a register to be attached and ready for pulsing during this interval. The register link is provided with a bylink path so that pulses, repeated by relay A, may actuate the register before the bylink switch is operated. In the event that pulsing takes place prior to closure of the bylink path (this might occur on delay in obtaining a register), means are provided to return overflow signals to the customer.

RINGING

2.02 Ringing current is supplied by means of a 6-wire ringing selection switch. By the proper selection of two select magnets, the trunk can be supplied with any type of ringing required.

LINE-BUSY AND OVERFLOW

2.03 Line-busy and overflow conditions are established by the same means (overflow is received from the 60- or 120-IPM interrupter circuit when this condition is caused by pulsing starting before bylink closure).

SECTION II - DETAILED DESCRIPTION

1. SEIZURE AND PULSING

1.01 On a call incoming from a step-by-step office, this trunk is seized by the operation of relay A over a loop. Relay A operated prepares a pulsing path to the register by grounding leads R and BL, connects battery to lead ST to the register, and operates relay B which holds the trunk busy over lead S until the originating end disconnects and also grounds lead S to the traffic usage recorder circuit. As soon as the bylink path is closed (lead BL is grounded), relay R is operated from the register over its primary winding and locks through its own contact to relay B operated. Relay R operated extends ground to the SXS selector bank to avoid the possibility of a wrong number when this circuit is seized immediately after partial dialing from the SXS office. Should pulsing begin before the bylink path is closed or in the event that there is a delay in obtaining a register, relay R will not be operated and with relay A releasing, a shunt path is opened allowing relay BY to operate in series with the primary winding of relay B. Relay BY operated grounds the

start lead to the 60- or 120-IPM interrupter circuit, connects overflow tone to the trunk, and, if ZC option is provided, connects interrupter ground to relay T with relay RC released so that relay T will return overflow flashes to the originating end. Relay B is slow-release and will remain operated should relay A momentarily release and reoperate during reversal of the loop. Relay B operated holds the trunk busy until disconnect by the calling customer.

1.02 Should pulsing begin after a register is properly attached, relay R will operate and lock as described above, transferring control of the register start lead to the LK lead battery. Subsequent operation in the register link causes the crossbar switch crosspoints to connect leads T, R, F, and D directly to the register. Relay B operated also grounds lead S to the preceding selector, when connected. At the conclusion of pulsing the register grounds lead D operating relay D which locks to relay B operated. Relay D operated closes through the transmission circuit and prepares to hold the sleeve to the called line.

2. LOCAL SERVICE ONLY

MARKER OPERATION

2.01 The marker associates itself with this trunk via the register and register link and operates relay LF over lead F. Relay LF operated

- (a) grounds lead FA to operate an auxiliary trunk link relay,
- (b) connects lead TC from the trunk link frame to lead TC from the ringing selection switch,
- (c) connects lead RC to relay RC,
- (d) connects the ringing selection switch hold magnet on lead H to lead TP from the trunk link frame, and
- (e) operates a peg count register for local calls.

2.02 After the marker has operated the select magnets of the ringing selection switch to set the proper ringing, it grounds lead RC operating relay RC and grounds lead TP operating the ringing

selection switch hold magnet. The hold magnet operated closes the crosspoints allowing ground, via an operated D contact, to extend through the crosspoints to lead RC as a check to the marker that the crosspoints are closed, relay RT is released and relay RC is operated. Relay RC operated connects the ringing supply leads to the called end of the trunk. Ground supplied by the ringing selection switch to lead TC from the marker is a check to the marker of ringing selection switch crosspoint continuity.

2.03 When these functions have been completed, the marker releases the LF relay which transfers control of the ringing selection switch hold magnet, via the crosspoints, to an operated contact of relay D. Relay LF released also removes ground from lead FA releasing the auxiliary trunk link relay which connects the called customer line to the trunk.

RINGING AND TRIPPING

2.04 If relay PU (App Fig. 4) is not furnished, ringing starts as soon as the auxiliary trunk link relay releases. For offices requiring coded ringing, relay PU is provided and except for code one stations, ringing will not start until relay PU operates on the next closure of the pickup interrupter. Thus, the start of machine ringing is delayed until the beginning of the cycle. For other than code one ringing, the ringing selection switch closes a circuit over lead PKU operating relay PU to start ringing immediately. In either case, relay PU operates, transfers its winding from lead PU to ground from an operated D contact, and locks to relay RC.

2.05 After the called customer answers, relay RT operates on the increased current flow. Relay RT operated releases relay RC which removes ringing from the line and also releases relays PU and RT.

SUPERVISION

2.06 When the called end answers, relay RT operates which releases relay RC causing relay S to operate. Relay S operated supplies talking battery to the called customer, operates relay T, and removes the shunt from across capacitor C allowing it to charge. Relay T operated reverses the tip and ring polarity to send an off-hook signal back to the originating end.

2.07 The time constant of the capacitor-resistor circuit is such that it takes 2 to 5 seconds for the tube to break down and conduct operating relay CH. Relay CH operated

- (a) locks through its own front contact,
- (b) extinguishes the tube, and
- (c) prepares a circuit for timed release as described in a later paragraph.

ABANDONED CALL

2.08 Should the calling end abandon the call before the called end answers, relays A, B, R, and D release, releasing relays PU and RC and all hold magnets restoring the circuit to normal.

LINE-BUSY

2.09 If the called line is busy, the marker will set levels 1 and 9 of the ringing selection switch connecting busy tone to capacitor A. The trunk will remain in this condition until disconnect by the originating end.

OVERFLOW

2.10 Should the marker be unable to complete the call because linkages are not available, it will set levels 0 and 9 of the ringing selection switch and operate relay RC. When the hold magnet operates and the crosspoints close, overflow tone is connected to capacitor A. The trunk will remain in this condition until disconnect by the calling end.

CALLING PARTY DISCONNECTS FIRST

2.11 In this case, relays A, B, and D release. Relay B in releasing transfers the hold path of relay CH, via a continuity, to relay S and the called end sleeve is maintained by ground through relay CH operated and RC released. Relay B released releases relay R. Should the called end fail to hang up within 13 to 32 seconds, thermal relay RL will operate operating relay RC. Relay RC locks to relay CH and removes sleeve ground to release the link hold magnets freeing the called line. When the link crosspoints open, relay S releases releasing relay CH. Relay CH released releases relay RC thus restoring the circuit to normal.

RESELECTION OF TRUNK DURING TIMED RELEASE FUNCTION

2.12 If the trunk circuit is reselected during the time-out period before relay RL operates, relays A and B operating cause a register to be attached in the usual manner. However, when relay B operates, the holding ground for relay CH is removed since relay D has not yet operated. Relay CH released releases the crosspoints causing relay S to release. Relay D operates at the end of dialing and opens the operating path of relay RL. The marker operates relay LF. Relay LF operated connects ground to lead FA operating the auxiliary trunk link relay allowing the call to proceed in the usual manner.

CALLED PARTY DISCONNECTS FIRST

2.13 In this case, relay S releases releasing relay T to return an on-hook signal to the calling end. Since the connecting step-by-step office does not provide facilities with which to release the called customer line in the event the calling end stays on, this circuit is arranged to time out and also give a permanent signal alarm under such a condition.

2.14 Relay S released allows thermal relay RL to heat. After 13 to 32 seconds relay RL operates operating relay RC which releases relay D, removes ground from the called sleeve and operates relay PS (App Fig. 3). Relay PS operated returns a permanent signal alarm to the connected step-by-step office and the circuit will await disconnect by the calling party before restoring to normal. When the calling end releases, relays A, B, and R release. Relays PS, CH, and RC release restoring the trunk circuit to normal. Option G permits the permanent signal alarm feature to be omitted by removing the operating path for relay PS.

3. LOCAL SERVICE WITH TANDEM OPTION

LOCAL CALL - (Same as for Local Service Only)

TANDEM CALL - APP FIG. 2

A. Marker Operation

3.01 For tandem operation the marker will operate relay TF. If the called party of a preceding call is still connected to the trunk, the TF relay removes the holding ground to the line link sleeve disconnecting the linkages for that connection.

3.02 When the marker operates the "line" hold magnet associated with this circuit, relay TS operates in parallel with that hold magnet. Relay TS operated transfers the transmission circuit from the trunk link frame to the line link frame, opens the sleeve to the trunk link frame, and operates a peg count register for tandem calls. When the marker has established the connection to this trunk from the trunk link appearance of the selected outgoing trunk, it releases relay TF. Relay TF released allows relay TS to lock to ground through an operated D contact. This locking ground acts as both a check to the marker and to hold the connection.

B. Abandoned Call

3.03 Should the originating end abandon the call before the called customer answers, relays A, B, R, and D release. Relay D released, releases both the line link hold magnet and relay TS restoring the trunk to normal.

C. Supervision

3.04 When the called end answers, relay CS operates operating relay T immediately with option Z or after 2 to 5 seconds if the step-by-step trunk is arranged for immediate charge. The 2- to 5-second delay, before returning an off-hook signal, is provided for the purpose of preventing line-busy or paths-busy flash being repeated to a step-by-step immediate charge coin box trunk or message register trunk circuit.

D. Overflow

3.05 If there are no available outgoing trunks to the called office or there is no path available through the links and junctors from this incoming trunk to an idle outgoing trunk or for any reason that the marker cannot establish the connection the marker sets up a "local" paths-busy condition as previously described. The proper ringing selection switch vertical will be set and relay RC will be operated. Relay RC operated removes ground for holding both the line link sleeve and relay TS. Relay TS released, releases relay CS which releases relay T (Z option provided). This will release any partially established connection. The trunk will remain in this condition until disconnect by the calling end at which time the trunk will be restored to normal.

E. DISCONNECT

3.06 When the calling end disconnects first, relays A, B, D, CH, and R release. Relay B released, releases relay D which removes ground from both the sleeve and relay TS. Relay TS released, releases relay CS which releases relay T (Z option provided) restoring the circuit to normal.

3.07 If the called end releases first releasing relay CS and the calling end fails to hang up within 13 to 32 seconds, relay RL operates operating relay RC. Relay RC operated releases relay TS

which removes ground for holding the "line" hold magnet. The hold magnet released opens the crosspoints releasing the called line. Relay CS released releases relay T. Relay RC operated also operates relay PS to return a permanent signal alarm to the associated step-by-step office and the circuit will remain in this condition until the calling end hangs up restoring the circuit to normal.

3.08 Option G permits the permanent signal alarm feature to be omitted by removing the operating path for relay PS.

SECTION III - REFERENCE DATA

1. WORKING LIMITS

1.01	TRUNK PULSING						Called Sub.	Call- ing Sub.	Trunk Supv. CS Relay			
	Loop	Bat	Trunk Grd		Supv A Relay	V			See No. 5 Crossbar Keysheet	See Note 101	40-50V	40-56V
ZG or W Opt	V Opt	ZG or W Opt	V Opt	ZG or W Opt	V Opt		Opt	Opt				
Max. Ext Ckt Loop Res					2410	4465			8000	7110	3415	3575
Max. Cond Loop Res	1200**	2500*	2000	4200								
Max. Miles of Cable							See Note 103					
Min. Ins Res			30,000	30,000						30,000		

* See Note 102
 ** Min. 1200

1.02 Where No. 5 crossbar is in same building with SXS office with this trunk connected directly to SXS selector bank, the calling customer working limits (ie, SXS Sub.) are the same as for the preceding selector and the resistance of the sleeve lead from this trunk to the SXS line finder multiplied bank shall be 13 ohms maximum.

1.03 This circuit with W or ZG option may be used with trunk conductor loops of 2000 ohms to 2400 ohms provided the associated SXS outgoing repeater is of the Bat-Grd supervision and Bat-Grd pulsing type such as SD-31147-01.

1.04 Where the entire length of cable is 19 gauge the "Max. Miles of cable" is 32. The "Max. Miles of cable" is 24 for any other case.

2. CIRCUIT FUNCTIONS

SEIZURE

2.01 To connect battery to the start lead to the incoming register link circuit.

2.02 To operate a slow-release relay to ground lead S to hold a preceding selector, when connected.

2.03 To close the pulsing circuit.

PULSING

- 2.04 To return 120-IPM overflow to the calling end in the event that pulsing starts before the bylink path is closed through to the register link circuit.
- 2.05 To repeat pulses into the register if pulsing starts after a register is properly attached.
- 2.06 To close through the transmission circuit and ground the sleeve lead.
- 2.07 To provide for connection to the traffic usage recorder circuit.

LOCAL SERVICE ONLY

A. Marker Operation

- 2.08 To operate the LF relay which grounds lead FA to operate an auxiliary trunk link relay, opens lead PU, connects the RC relay to the marker through the trunk link frame, closes through the TC lead from the ringing selection switch to the marker through the trunk link frame and operates a peg count register for local calls.
- 2.09 To operate relay RC and extend control of the ringing selection switch hold magnet to the marker over lead TP.
- 2.10 To operate the ringing selection switch hold magnet, close the cross-points and provide a locking path for the RC relay.
- 2.11 To ground lead TC from the ringing selection switch and extend this ground to the marker as a check that the ringing selection switch is operated, the RC relay is operated, and that the trunk is set to charge for the call.

B. Ringing, Tripping

- 2.12 To connect ringing, as set up on the ringing selection switch, to the called station after the marker has released the LF relay.
- 2.13 To return part of the audible ringing tone to the calling station.
- 2.14 To trip ringing after the called end has answered.

C. Line-Busy

- 2.15 To connect line-busy tone to the trunk under control of the ringing selection switch when the called line is busy.

D. Paths Busy

- 2.16 To connect overflow tone to the trunk under control of the ringing selection switch when the called line cannot be reached because linkages are not available.
- 2.17 To prepare the circuit for timed release after conversation time of 2 to 5 seconds.

DISCONNECT BY CALLING END FIRST

- 2.18 To release the trunk holding relay restoring the trunk polarity to normal and releasing a preceding selector, if connected.
- 2.19 To remove ground from the called end sleeve after a minimum of 13 seconds so as to release the switches connecting the called customer to the trunk.
- 2.20 To close the register link start circuit and call in a register allowing the new call to proceed normally on reselection of the trunk during the time-out interval.
- 2.21 To stop timed release of the called customer after relay CH releases upon losing its holding ground on reselection of the trunk during time-out.
- 2.22 To restore the trunk to normal after a 13- to 32-second delay.

DISCONNECT BY CALLED PARTY FIRST

- 2.23 To remove ground from the sleeve to release the switches toward the called customer and to send a permanent signal alarm after a minimum of 13 seconds.
- 2.34 To restore the trunk to normal after both parties have disconnected.

LOCAL SERVICE WITH TANDEM OPTION

A. Marker Operation

- 2.35 Local Call - same as for local service only except that relay TF operates in series with LF from the marker.
- 2.36 Tandem Call - App Fig. 2.
- 2.37 To operate relay TF, thus establishing a circuit for the subsequent operation of relay TS.
- 2.38 To operate relay TS which operates a peg count register for tandem calls, establishes reverse battery supervision and tandem call condition, and opens up the tip, ring, and sleeve to the trunk link and connector circuit.
- 2.39 To supply ground to the sleeve lead when relay TF is released to maintain the hold magnets and relay TS operated.

B. Supervision

- 2.40 To return reverse battery supervision immediately after the called customer answers (option Z).
- 2.41 To return reverse battery supervision only after an answer condition of 2 to 5 seconds.
- 2.42 To provide for timed release and a permanent signal alarm in the event that the calling end fails to hang up within 13 to 32 seconds after the called end hangs up.
- 2.43 To restore the trunk to normal and release the connection when the originating end hangs up.

C. Paths Busy

- 2.44 To set up the paths-busy indication as on a local call when no outgoing trunk to the distant office is available or there is no path from this incoming trunk to available outgoing trunks (this condition is established by the marker).
- 2.45 To provide means for testing this circuit by opening up the trunk pair.

3. TESTING

- 3.01 Test jack T provides access to the trunk relays. When a plug is inserted, the trunk pair is opened and the sleeve of the jack is connected to relay D.
- 3.02 On incoming bylink calls, jack TM of the office test frame is patched to jack SP. At the relay rack location of the trunk under test, connect the sleeve lead of jack SP to punching 42 of the trunk CO lead. In the dial pulse incoming register lead CO is connected to the tip conductor through a capacitor. This lead provides facilities for tone application when this circuit is being tested from a package installation having office test frames.

4. MAKE BUSY (APP FIG. 5)

- 4.01 When this trunk is to be made busy, the MB key is operated. The MB key operated grounds the sleeve lead to the step-by-step selector, thus preventing seizure of this trunk.

5. CONNECTING CIRCUITS

- 5.01 When this circuit is listed on a **keysheet** the connecting information thereon is to be followed.
- (a) Trunk Link and Connector Circuit SD-25549-01.
 - (b) Incoming Register Link Circuit SD-26048-01.
 - (c) Ringing Selection Switch Circuit, Six Wire, SD-26080-01.
 - (d) 60 or 120 IPM Interrupter Circuit SD-25742-01.
 - (e) Line, Line Link and Connector Circuit, SD-25548-01.
 - (f) Traffic Register Circuit, SD-25762-01.
 - (g) Miscellaneous Circuit, All Frames SD-25574-01.

- (h) Alarm Circuit, SD-25671-01.
- (i) Auxiliary Trunk Circuit, SD-25503-01, (Typical).
- (j) Power, Ringing and Tone Distributing Circuit, SD-25599-01.
- (k) Standard Outgoing Register Circuits in Step-by-Step Office, SD-31779-01, (Typical).
- (l) Step-by-Step System No. 1 Selector Bank Multiple Circuit, SD-32123-01.
- (m) Traffic Usage Recorder Circuit, SD-95738-01.
- (n) Trunk Link Circuit, SD-26032-01.

- (o) Line, Line Link and Marker Conn. Control Circuit, SD-26030-01.
- (p) Standard Outgoing Repeater Circuits in Step-by-Step Office, SD-32087-01, (Typical).

SECTION IV - REASONS FOR REISSUE

D. Description of Changes

D.1 This change is made to modify Circuit Note 107 to alert the installer that when a circuit manufactured prior to Issue 100 is modified to option ZA the B relay must be readjusted to the values specified in the CRT.

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