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CROSSBAR SYSTEMS
NO. 3
REVERTING CALL PLUG-ENDED TRUNK CIRCUIT
SUPERIMPOSED RINGING

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SECTION I - GENERAL DESCRIPTION

1. PURPOSE OF CIRCUIT

1.01 This circuit is used to establish a connection between two stations on the same line using superimposed ringing.

2. GENERAL DESCRIPTION OF OPERATION

NO STATION DIGIT REQUIRED

2.01 When a customer on a 2-party selective line or a 4-party semiselective line makes a call to a station which is on the same line, the marker connects the line to an idle reverting call trunk. The marker operates the proper called party ringing combination relays in the trunk. The trunk applies busy tone to the line to signal the calling customer to hang up. Then the called customers ringing is applied to the line. At the same time, revertive ringing is applied to the opposite side of the line. When a station answers, the ringing is tripped and when the calling station goes off-hook again, both parties are connected for talking. When all stations on the line have hung up, the trunk releases the connection to the line and restores to normal.

STATION DIGIT REQUIRED

2.02 The marker determines from the class of service that a reverting call will require a station digit indication. The marker instructs the originating register to return second dial tone to the calling customer, as a signal to dial the station digit. The originating register stores the digit and recalls the marker with the reverting digit lead grounded. The marker decodes the station digit into calling party ringing information. When the marker selects an idle reverting trunk, it operates the proper called party ringing combination relays and also the calling party ringing combination relays in the trunk. The trunk applies busy tone to the line to signal the calling customer to hang up.

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Then the trunk alternately applies the called station and calling station ringing to the line. However, if both parties are of the same polarity and on the same side of the line, only the called party ringing will be applied as both parties will hear it. When a station answers, the ringing is tripped and when the calling station goes off-hook again, both parties are connected for talking. When all stations on the line have hung up, the trunk releases the connection to the line and restores to normal.

SECTION II - DETAILED DESCRIPTION

1. ESTABLISHING CONNECTION - SC1

TRUNK SELECTION

A. No Station Digit Required

1.01 When a call originated by a station on a line entitled to revertive ringing service is identified by the marker as being for the same line as the calling line, the marker determines from the class of service whether or not the calling party station digit is required to complete the call. No station digit is required on reverting calls from lines arranged for 2-party selective and 4-party semiselective ringing. On reverting calls to these lines the marker immediately selects an idle reverting call trunk. It looks first for a grounded FT lead from trunks of this type in trunk switch and connector circuits which are ready to handle a call.

B. Station Digit Required

1.02 When a reverting call is originated by a 4-party selective or an 8-party semiselective line, the marker determines from the class of service that a station digit is required to complete the call. The marker instructs the originating register to return second dial tone to the calling customer. The marker releases from the call but the originating register retains all the information already in it plus it again sends dial tone to the customer. The dial tone is a signal to the customer to dial the station digit. The register times for about 12 seconds after which, if the station digit is not received, the calling customer is returned to line lockout and reorder tone. Upon receipt of the station digit the originating register bids for another marker but this time it grounds the RD reverting digit lead to the marker. This tells the marker that the call is a reverting call and that the station digit is already registered. The marker then selects an idle reverting call trunk.

MARKER SEIZURE

1.03 There is one FT lead per trunk switch and connector circuit for reverting call trunks. If there is at least one idle reverting call trunk there will be ground on the FT lead to the trunk switch and connector circuit which serves the idle reverting trunk(s). The marker selects a trunk switch and connector circuit which is ready to handle a call and applies ground through the selected circuit to the TT leads of all of the associated reverting call trunks. The ground is returned to the marker by each idle reverting call trunk over their individual TG leads. The marker selects an idle trunk and operates its F relay by applying resistance battery to the trunk TF lead. The F relay operated:

(a) Locks to the TF lead through its 8 make-contact.

(b) 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.

(c) Cuts through to the marker to the operate paths of the R2G, R3G, and TPG the calling party ringing combination relays.

(d) Opens the operate path to the BT busy tone relay.

(e) Grounds the JC and SW leads to the trunk switch and connector circuit.

(f) Operates the F1 and S1 relays.

1.04 The S1 relay operated:

(a) Prepares a locking ground for itself and the RC ringing control relay through its 4 make-contact.

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(b) Through its 8 make-contact supplies a ground for the S sleeve lead by which the S1 will control the channel after the marker releases.

(c) Opens the MB lead with its 6 break-contact.

(d) Opens the FT, TF, and TT leads which will make the trunk appear busy and prevent its seizure by a marker during the remainder of the call.

The operated F1 relay closes the operate paths of the R2D, R3D, and TPR the called party ringing combination relays, the RC ringing control relay and the SDR station digit relay.

1.05 The marker operates the RC ringing control relay. It checks that the 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 5 make F, 6 break RT, and 4 make S1 to ground. The marker stores the called party ringing information in the trunk by operating the proper combination of R2D, R3D, and TPR relays. These relays lock operated to ground through 3 make RC.

1.06 If the marker has received a station digit from the originating register, it will operate the SDG relay in the trunk. The SDG relay operated primes the trunk to use the contents of the calling party ringing combination register (the R2G, R3G, and TPG relays). It insures, on calls to 4-party selective and 8-party semiselective lines, that if none of the register relays are operated the trunk will use that combination as a ringing code, too. The R2G, R3G, SDG, and TPG relays when operated lock up under control of 2 make RC.

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

(a) Releases the F1 relay.

(b) Partially closes the operate path of the BT busy tone relay.

(c) Transfers the tip and ring from the line into the trunk and onto the S relay. The S relay provides the talking battery and ground to the line and operates over the loop to the calling customer. Six make S also provides a lock path for the operated S1.

(c) Transfers the S sleeve lead and its control into the trunk.

The marker checks for ground appearing on the sleeve lead and then releases.

BUSY TONE

1.08 Earlier when the marker operated the RC relay, 4 make of that relay completed the operate path of the SO S operated relay which operated at that time but performed no useful function. However, when the F relay is released the operated SO relay prevents the BT relay from operating immediately thus putting the S1 under control of the S relay. This allows the trunk to release should the calling customer abandon the call before busy tone is applied. The S relay operating releases the slow-release SO relay. The SO released maintains the T and R path to the S relay and operates the BT busy-tone relay. Relay BT operated:

(a) Locks operated under control of the RC relay.

(b) Transfers the operate path of the SO relay from ground to the PU lead from the PRTD circuit.

(c) Partially closes paths to the RD ring called party and RG ring calling party relays.

(d) Contacts 3 and 9 make BT partially close paths for the application of ringing potentials to the tip and ring.

(e) Transfers the lock path of the S1 relay from control of the S relay. This will allow the trunk to hold the channel when the calling customer hangs-up after busy tone is sent.

(f) Closes ground to the ST start lead to the interrupter circuit.

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(g) Applies busy tone from the interrupter circuit LBT lead through the A capacitor, 7 break of the SO and 4 make BT to the tip circuit.

1.09 Busy tone applied to the tip circuit is the signal to the calling customer which tells that party to hang up so that ringing can begin. When the calling customer does go on-hook the S relay releases.

2. RINGING - SC1 AND SC2

START OF RINGING

2.01 When the calling customer releases upon hearing busy tone and releases the S relay, a path is completed from the SO relay to the PU lead from the PRTD circuit. Because the operated SO relay starts ringing, it is operated under control of the PU pick-up pulse to insure that ringing is started at the beginning of the 6-second ringing cycle and particularly not at some random time during a coded sequence. Relay SO operated:

(a) Locks to ground through its 8 make-contact.

(b) Removes busy tone from the tip circuit.

(c) Transfers the tip and ring leads from the S relay to the leads which supply the ringing potential.

(d) Enables the RD and RG relay. These relays control the application of the called, calling, and revertive ringing as controlled by the contents of the called and calling ringing combination registers.

With SO operated ringing commences. It is applied to the tip or ring by the RD and RG relays. The RD is controlled by coded grounds appearing on the CODE 2 GRD or CODE 3 GRD leads from the PRTD. The RG is controlled by coded grounds appearing on the RR, CODE B GRD or CODE C GRD leads. Sequence Chart 2 in the SD shows the pattern of grounds appearing on the leads during the 6-second ringing cycle. The following chart specifies the ringing combinations sent to the called and calling customer for the various combinations of operated R2D, R3D, TPR, and R2G, R3G, SDG, TPG relays.

RINGING COMBINATIONS

Party	Relays Operated		Ringing	
	Called	Calling	Superimposed	Applied To
1	-	SDG	Code 1-	Ring
2	TPR	SDG,TPG	Code 1-	Tip
3	R2D	SDG,R2G	Code 1+	Ring
4	R2D,TPR	SDG,R2G,TPG	Code 1+	Tip
5	R3D	SDG,R3G	Code 2-	Ring
6	R3D,TPR	SDG,R3G,TPG	Code 2-	Tip
7	R2D,R3D	SDG,R2G,R3G	Code 2+	Ring
8	R2D,R3D,TPR	SDG,R2G,R3G,TPG	Code 2+	Tip

TWO-PARTY SELECTIVE AND FOUR-PARTY SEMI-SELECTIVE RINGING

2.02 For ringing on these lines no station digit is required, consequently the SDG is not operated nor are any of the calling party ringing combination relays. The RD ring called party relay follows either CODE 1 or CODE 2 ground pulses as controlled by the R3D 5 transfer contact. Eleven make RD applies SUP- ringing potential, through 10 break R2D (R2D will not be operated on reverting calls to these lines) through an RG break-contact to and through the RT ringing trip relay. The 2 and 3 transfer contacts of the TPR steer the ringing potential to the tip or ring and also apply ringing ground to the opposite side of the line.

2.03 The RG ring calling party relay follows the one-half second RR pulse which occur every three seconds. Relay RG operated applies SUP- ringing from 10 break R2G through the RT ringing trip relay to the opposite side of the line from the called party, through either 9 break or 1 make TPR. One make RG supplies the ringing ground through 1 break or 9 make TPR. This revertive ringing is different from all called party codes to avoid confusion. It is heard by calling parties when they are on the opposite side of the line from the called party. If the calling party is on the same side of the line as the called station or all ringers are bridged, both parties bells will hear the called party ringing. In both cases it will be recognized that the called party has answered when ringing stops.

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FOUR-PARTY SELECTIVE AND EIGHT-PARTY SEMI-SELECTIVE RINGING

2.04 For ringing on these lines the calling party station digit is required and has been obtained. The SDG relay is operated along with some combination of R2G, R3G, and TPG relays operated and not operated. The RD ring called party relay follows either CODE 1 or CODE 2 ground pulses as controlled by the R3D 5 transfer contact. The 11 make RD applies either SUP- or SUP+ ringing potential, as controlled by the R2D relay through its 10 transfer contact, through 2 break RG to and through the RT ringing trip relay. The 2 and 3 transfer contacts of the TPR relay steer the ringing potential to the tip or ring and steer ringing ground from 5 break RG to the opposite side of the line.

2.05 The RG ring calling party relay follows either CODE B or CODE C ground pulses as controlled by the R3G relay 3 transfer contact, except if the calling party ringer is on the same side of the line and is of the same polarity as the called party. In that case the TPG and TPR will both be operated or released and the R2G and R2D will both be operated or released. When this happens the path from 3 fixed R3G to 2 make SDG will be open and RG will not operate during the call. This is done because both parties, in this case, can hear the called party ringing and to have the called party hear two different codes of ringing would be confusing.

2.06 When the calling party code is required to be rung and the RG relay is following either the CODE B or CODE C ground pulses, SUP- or SUP+ ringing potential as controlled by the R2G relay 10 transfer contacts is applied through 2 make RG, the RT ringing trip relay, 3 make RG, 5 make SDG to the tip or ring through either 8 make or 9 break TPG. Ringing ground is supplied to the opposite side of the line from 1 make RG through 4 make SDG and to the tip or ring through 8 break or 9 make TPG relay. The 5 break of the RG relay removes the ringing ground supplied for the called party ringing.

3. ANSWER AND DISCONNECT - SC1

ANSWER

3.01 Ringing of both the 2-party selective, 4-party semiselective, and the 4-party selective, 8-party semiselective lines continues as described until someone on the line answers. A station off-hook on the line lowers the loop impedance sufficiently so that the resulting increase in current flow operates the RT ringing trip relay. If the answer occurs during ringing, the ringing supplies are the source of the increased current. If answer is during a silent interval the current source is either -48 volts or +TRIP BAT as controlled by the R2D relay 8 transfer contact. Ground is supplied through 5 break RG. In either case RT relay operates. Its 6 break contact opens the RC ringing control relay lock path. The RC released:

(a) Releases all of the operated ringing combination relays (R2D, R2G, R3D, R3G, SDG, TPG, or TPR).

(b) Releases slow-release relay (SO).

(c) Releases BT relay.

Relay BT released:

(d) Transfers the S1 relay lock path to control of 6 make S relay.

(e) Cuts through the tip and ring to the S supervisory relay which supplies talking battery and ground the line. The S operates over the loop holding S1 operated.

(f) Removes ringing from the tip and ring releasing RT.

When BT removes ringing from the line, it is the signal to the calling party that someone is on the line. The calling party again goes off-hook and in doing so is connected to the answering station. Conversation may now take place.

DISCONNECT

3.02 When the last party hangs up, the S relay releases releasing the S1 relay. Relay S1 released:

(a) Removes ground from the S sleeve lead releasing the channel hold magnets and dropping the connection.

(b) Indicates that the trunk is idle by reconnecting ground to the FT lead and the TG and TT leads together.

(c) Makes the trunk available for marker seizure by reconnecting the R relay to the TF lead.

SECTION III - REFERENCE DATA

1. WORKING LIMITS

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

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2. FUNCTIONAL DESIGNATIONS

2.01 Relays

Designation	Meaning
BT	Busy Tone
F	Traditional
F1	F Auxiliary
R2D	Called Party Positive Ringing
R2G	Calling Party Positive Ringing
R3D	Called Party Code 2
R3G	Calling Party Code 2
RC	Ringing Control
RD	Ringing Called Party
RG	Ringing Calling Party
RT	Ringing Trip
S	Supervisory
S1	Supervisory Auxiliary
SDG	Station Digit (Calling)
SO	S (Has) Operated
TPG	Tip Party (Calling)
TPR	Rip Party (Called)

3. FUNCTIONS

3.01 Indicate to the marker that there are idle trunks of this type on a selected trunk switch and connector circuit.

3.02 Indicate to the marker which of these trunks associated with a particular trunk switch and connector circuit are idle.

3.03 Connect the selected idle trunk to the marker.

3.04 Operate the S1 relay to make the trunk busy.

3.05 Transfer the T, R, and S to the trunk switch and connector circuit for connection to the marker for tests and channel control.

3.06 Ground the JC and SW leads to the trunk switch and connector circuit which cuts through various leads from the trunk to the marker.

3.07 Register the called party ringing combination.

3.08 When a station digit has been received, to register the calling party ringing combination.

3.09 After marker release, to return busy tone to the calling customer as a signal to hang-up.

3.10 To await calling party disconnect and then delay the start of ringing to the beginning of the 6-second ringing cycle.

3.11 To ring the called party code on that stations side of the line with the proper polarity.

3.12 On calls to 2-party selective and 4-party semiselective lines, to apply revertive ringing on the opposite side of the line from the called party.

3.13 On calls to 4-party selective and 8-party semiselective lines, to apply the calling party ringing except if that station is of the same polarity and on the same side of the line as the called party.

3.14 Provide trip battery during silent ringing intervals.

3.15 Trip ringing and restore called and calling party ringing combination registers to normal when the called station or any other station on the line removes their receiver from switchhook.

3.16 Furnish talking battery and ground and supervision for the called and calling stations.

3.17 Restore trunk to normal when all stations have receiver on switchhook.

3.18 To be made busy for test without interfering with an established call.

4. CONNECTING CIRCUITS

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

(a) Trunk Switch and Connector Circuit - SD-26383-01.

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(b) Power, Ringing and Tone Distribution Circuit - SD-26414-01.

(c) Test Circuit - SD-26411-01.

(d) 60- or 120-IPM Interrupter Circuit - SD-26407-01.

(e) Traffic Usage Recorder - SD-96494-01 - (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 A jack per trunk is provided at the test circuit for making these trunks busy. When a sleeve ring shorting plug is inserted, ground through a normal contact of relay TST in the test circuit is passed over lead MB to the trunk TPR relay secondary coil. If the trunk is idle TPR will operate and:

(a) Remove ground from the FT lead.

(b) Break continuity between leads TG and TT.

(c) Remove the F relay from the TF lead.

6.02 If the trunk is in use, 6 break of the S1 relay will remove the TPR secondary coil from the MB lead. Therefore, insertion of the plug will not interfere with a call. However, when all parties have gone on-hook the trunk returns to normal releasing the S1 relay. The S1 released completes the path from the MB lead to the secondary of the TPR relay which operates. The trunk then appears busy to a marker.

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