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STEP-BY-STEP SYSTEMS
NO. 1, 350A, 355A OR 35E97
OUTGOING
TRUNK CIRCUIT
LOOP OR E&M LEAD OPERATION
O+, O- ONI OPERATION
WITH CLASS OF SERVICE TONE
AND RING BACK OF CALLING STATION
TSPS/RTA COMPATIBLE

SECTION I - GENERAL DESCRIPTION

1. PURPOSE OF CIRCUIT

1.01 To complete an "O" operator office call from a SXS office to a TSPS office on an "ONI" basis. E&M or Loop signaling can be used.

1.02 To identify post pay station calls to the operator by a class of service tone.

1.03 To allow ringback of the originating station.

1.04 To wink off the calling station under control of TSPS.

1.05 To make the circuit busy under control of TSPS.

2. GENERAL DESCRIPTION OF OPERATION

SEIZURE AND SIGNALING

2.01 E&M Lead Operation - When this circuit is seized, relay A operates over the subscriber loop. Relay A applies battery to lead M to signal the distant office and input terminal 201 of CPS1. CPS1 responds by operating relay B which grounds lead S to hold the switchtrain. Relay A will repeat dial pulses, if required. CPS1 makes relay B slow to release to hold over dial pulses.

2.02 Loop Operation - When this circuit is seized, relay A operates over the subscriber loop. Relay A applies battery to lead M to operate relay A1, to signal the distant office, and input terminal 201 of CPS1. CPS1 responds by operating relay B which grounds lead S to hold the switchtrain. Relays A and A1 will repeat dial pulses, if required, as battery and ground pulses to TSPS.CP1 makes relay B slow to release to hold over dial pulses.

2.03 Operator Answer - When the distant operator answers, lead E is grounded by the signaling circuit of detector circuit to operate relay K which grounds input terminal 205 of CPS1. CPS1 responds to:

(a) Transfer the control of relay B from relay A to relay K.

(b) Make a resistance test on lead A to determine if service tone is required.

(c) Operate relay T for 750 milliseconds if tone is required.

(d) Operate relay C and place it under control of relay A.

2.04 Wink Ring Back - When the operator desires to ring back the calling station, a wink lasting approximately 100 milliseconds (.1 sec.) of the supervisory signal is furnished by TSPS. Relay K will repeat the "wink" to CPS1 which will detect the wink and operate relay RB for two seconds. Relay RB will apply a DC level shifted ringing signal to the originating station and hold relay A operated if the ring back is against answer supervision.

2.05 TSPS Hold - The TSPS office assumes control of the release of the trunk upon operator answer. If the subscriber flashes the switch hook or disconnects, supervision will be furnished to TSPS.

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2.06 Release - If TSPS releases while the subscriber is off-hook, the connection is "winked off" and the calling subscriber is returned to dial tone. If TSPS releases while the subscriber is on-hook, the trunk is released in a normal manner.

2.07 Reverse Make Busy - A supervisory signal from the TSPS will be recognized by the operation of relay K that will cause CPS1 to operate relay B to ground lead S. This will make the trunk busy under control of TSPS.

SECTION II - DETAILED DESCRIPTION

1. SEIZURE

1.01 When relay A operates, it applies battery to the M lead. Terminal 201 of CPS1 monitors the M lead. Battery on that input reverse biases diode D11, allowing C1 to discharge through R14.

1.02 When the voltage across C1 reaches the lower limit threshold of the Schmitt-Input-Trigger-Gate (ITG1), the output of the gate goes to a logic high level, enabling both the C relay Gate 1 (CG1) and the B relay Gate 2 (BG2) nand gates.

1.03 CG1 is disabled by C relay Gate 2 (CG2) at this time, but BG2 is enabled from the output pf CG1. BG2 applies a low to the input of B relay Gate 1 (BG1) causing its output to go high.

1.04 The high level output of BG1 allows base current to flow into Q2 through resistor R4. Q2 turns on, triggering the B Relay Timer (BRT) and discharges timing capacitor C9 through diode D8. Once triggered, the output of BRT goes high, turning on Q4 and operating relay B.

1.05 Relay B remains operated until Q2 turns off, which allows timing capacitor C9 to charge through the timing resistor R24. (The R24/C9 time constant determines the slow-to-release time of relay B.) When C9 charges to approximately 2/3 of Voo, BRT times out, turning off Q2 and releasing relay B.

1.06 The 300 ms time constant is adequate to hold relay B operated during dial pulsing for O+ calls.

Signaling - E&M

1.07 Battery on lead M will cause the signaling equipment to signal the distant office.

1.08 If the call was a O+ call, relay A will follow dial pulses and place alternate battery and ground on lead M.

Signaling - Loop

1.09 Battery on lead M will operate relay A1 which will close a loop through the reversal detector to TSPS and also operate relay B1.

1.10 Relay B1 will open the high resistance path of the reversal detector and prepare a path for the operation of relay C1.

1.11 If the call was a O+ call, relay A, and in turn relay A1, will follow dial pulses.

1.12 Relay C1 will operate on the first release of relay A1 and convert the pulsing path from loop to battery and ground pulsing. Relay C1 will hold over until the end of pulsing of the digit and release to restore the loop signaling mode.

2. OPERATOR ANSWER

E&M

2.01 Ground on lead E from the signaling equipment will operate relay K.

Loop

2.02 Reverse battery supervision from TSPS will operate the reversal detector which will ground lead E to operate relay K.

2.03 Relay K operated applies a ground to input terminal 205 of CPS1 which turns on Schmitt Input Trigger Gate 2 (ITG2) which disables CG2 and BG1, and applies a low to the input of the Ringback Inverter Gate 2 (RBI2).

2.04 The output of CG2 goes high and enables CG1. Since the other input is also enabled at this time, CG1 switches and puts a low logic level at the input to C relay Inverter 1 (CI1).

2.05 CI1 turns on transistor Q1, which in turn, triggers the C Relay Timer (CRT) and holds the C10 timing capacitor discharged through diode D7.

2.06 Once triggered, the CRT output goes high, turning on Q3 which, in turn, operates relay C. Relay C remains operated until Q1 turns off, which allows timing capacitor C10 to charge through timing resistor R23. (The R23/C10 time constant determines the slow-to-release time of the C relay.)

2.07 When C10 charges to approximately 2/3 of VOD, CRT times out, turning off Q3 and releasing relay C. The 150 ms time constant is adequate to hold relay C operated over dial pulses.

2.08 The output of CG1 going low also causes the output of Tone Latch 1 (TL1) to go high and latch through regenerative feedback through Tone Latch 2 (TL2). When the output of TL1 switches high, it causes a short duration enable pulse to be applied to one input of Schmitt Input Trigger Gate 3 (ITG3), the other input of ITG3 monitors the resistance to ground of lead A as it comes into CPS1 on pin 204.

2.09 If lead A has 3000 ohms or less resistance to ground, the input to ITG3 is enabled and allows ITG3 to respond to the enable pulse form TL1. ITG3 will trigger the Service Tone Timer (STT) whenever both inputs are enabled simultaneously.

2.10 If there is over 3000 ohms resistance to ground, the input to ITG3 is disabled and will prevent ITG3 from triggering STT.

2.11 When STT is triggered, it turns on Q5 for 750 milliseconds. Q5 operates relay T. STT shuts off when the voltage on timing capacitor C8 reaches 2/3 VOD, shutting of Q5 and releasing relay T. Relay T applies the class of service tone to the tip side of the line when operated.

2.12 The low output from CG1 also causes the output of BG2 to go high and thus enabling one input of BG1. The other input to BG1 is controlled by relay K via IGT2. The output of BG1 controls relay B via Q2, BRT, and Q4.

2.13 The net result is that the operator answer operates relay K which, in turn, causes a service tone to be generated if required, prepares the ringback timing and wink timing circuits via RBI2, and transfers the control of relay B to relay K and the control of relay C to relay A via the CG1-CG2 latch circuit.

3. RING BACK

3.01 The TSPS position can ring back against on-hook or off-hook supervision by initiating a 100 millisecond (.1 sec.) supervisory wink.

3.02 The momentary release and reoperation (wink) of relay K causes a pulse from ITG2 to enable CG2, BG1, and RBI2. CG2 and BG1 are both disabled at this point in time from their other input terminals.

3.03 RBI2 disables one input of Ring Back Gate 1 (RBH1) for the duration of the pulse and then enables it again.

3.04 RBI2 also triggers Ring Back Timer 1 (RBT1) and turns off Ring Back Inverter 3 (RBI3) which, in turn, enables Schmitt Input Trigger Gate 4 (ITG4). Once triggered, the output of RBT1 goes high, is inverted by Ring Back Inverter 1 (RBI1) and disables ITG4 until RBT1 times out (60 msec.).

3.05 If the pulse is still present when RBT1 times out, both inputs to ITG4 are enabled causing its output to go low triggering Ring Back Timer 2 (RBT2). The output of RBT2 goes high enabling RBG1.

3.06 If the pulse ends while RBT2 output is high (90 msec.), both inputs to RBG1 will be enabled and RBG1 will trigger the Ring Back Timer 3 (RBT3).

3.07 The output of RBT3 goes high (for 2.00 seconds), turning on Q6 which operates relay RB. When RBT3 times out, Q3 turns off, releasing relay RB.

3.08 If the pulse is shorter than 60 msec. or longer than 150 msec., the RBG1 will not trigger the Ring Back Timer.

3.09 The ring back signal is applied to the ring side of the line (tip grounded) through a DC level shifting circuit made up of R-1, R-2, and R which effectively passes the full peak to peak ringing potential while making sure the positive peaks do not go more positive than ground

3.10 Relay RB also provides a holding path for relay A if ring back is applied to an off-hook condition.

4. DISCONNECT

4.01 If the TSPS disconnects first, the on-hook supervision will release relay K.

4.02 Relay K released turns off ITG2 which enables BG1, turning off Q2.

4.03 When Q2 turns off, C9 charges to 2/3 VOD through R24 (300 msec.) and allows BRT to reset, turning off Q4 and releasing relay B.

4.04 When relay B drops, it removes the holding ground on the sleeve to the incoming switch train, dropping the train.

4.05 When relay A drops due to the open loop, it puts a ground on terminal 201 of CPS1, turning on ITG1.

4.06 A low on the output of ITG1 disables CG1, turning on CT1 and turning off Q1.

4.07 This allows CRT to time out (150 msec.), turning off Q3 and releasing relay C.

4.08 The wink-off is provided by a path from ground through a break contact of relay A, diode S, and a make contact of relay C, such that a protective ground is applied to the sleeve from the time relay A drops till relay C drops (150 msec.).

4.09 If the calling station flashes the switchhook, relay A or relays A and A1 will follow to recall the TSPS attendant.

4.10 If the calling party goes on-hook first, relays A and C (E&M) or A, C, A1 and B1 (Loop) release and disconnect supervision is furnished to TSPS.

4.11 The TSPS will hold the trunk circuit until it returns a on-hook supervisory signal. The release of the trunk will then be similar to 4.02-4.04.

5. REVERSE MAKE BUSY

5.01 Relay K will be operated by the off-hook supervisory signal from TSPS.

5.02 A ground from relay K contacts turns ITG2 on, disabling BG and causing its output to go high, turning on Q2 which, in turn, triggers the BRT. BRT turns on Q4 which operates relay B. Relay B puts a ground on the sleeve to the incoming switch-train.

6. MAKE BUSY

6.01 The release of relay MB, caused by the removal of CPS1 or CPS2 or a blown fuse, will mark the trunk circuit busy.

6.02 The trunk circuit can be made busy by inserting a plug in the test jack. Confirm the trunk circuit is not busy before inserting the plug.

SECTION III - REFERENCE DATA

1. WORKING LIMITS

1.01 Relay A

Max Ext Ckt Loop Res	1500
Min Insulation Res	15K

1.02 Reversal Detector

Max Ext Ckt Loop Res	10K
Min Insulation Res	30K
Max Earth Potential	±3V
Max Supervisory "E" Lead Res	50

2. FUNCTIONAL DESIGNATIONS

2.01 Circuit Packages

Designation	Function
CPS1	Electronic Wink Detector, Service Tone Timer, Ring Back Timer and Slow to Release Simulator for B and C Relays
CPS2	A Relay Board
CPS3-(DET)	Reversal Detector

2.02 Relays

Designation	Function
A	Battery Feed and Pulsing
A-1	Loop Control
B	Hold Over Dial Pulsing
B-1	Loop Control

Designation	Function
C	Guard
C-1	Battery and Ground Pulsing Control
T	Tone Application

2.03 Jacks

Designation	Function
T	Selector Level Test Jack
TT	Test Termination (Loop)

3. FUNCTIONS

3.01 To hold the preceding switch train.

3.02 To function as a Loop (battery and ground pulsing) or E&M lead trunk circuit to TSPS.

3.03 Detect a class of service (3000 ohm resistance ground) signal.

3.04 Apply a 750 msec. class of service tone, if required.

3.05 To repeat dial pulses on an E&M or battery and ground pulsing basis.

3.06 To release under control of the TSPS.

3.07 To respond to a reverse make busy signal.

3.08 To ring back the calling station for 2.0 seconds under "wink" control from the TSPS.

3.09 To control the MS lead.

3.10 To control the BR lead.

3.11 To furnish an idle circuit termination on loop operation when jack TT is plugged.

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) Signaling and Transmission Systems Compatibility Information - SD-99421-01

(c) Traffic Register Circuit - SD-30896-01

(d) Miscellaneous Alarm Circuit Register - SD-31976-01

(e) Power Ringing Circuit - SD-81131-01*

(f) Miscellaneous Alarm Circuit - SD-31974-01*

*Typical

5. MANUFACTURING TESTING REQUIREMENTS

5.01 This circuit shall be capable of performing all of the functions specified in SECTION III - REFERENCE DATA, and meeting all of the requirements of the Circuit Requirements Table and J sheets.

6. TAKING EQUIPMENT OUT OF SERVICE

6.01 The circuit may be made busy by inserting a dummy plug into the test jack T which grounds the selector multiple sleeve. The removal of CPS1 or CPS2 will cause the release of relay MB and the grounding of the selector multiple sleeve. Before making the circuit busy in this manner, a check should be made that the trunk is not in service.

6.02 The trunk will also make itself busy in response to a supervisory signal from TSPS (Reverse Make Busy).

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