

COMMON SYSTEMS
SIGNAL CIRCUIT
NO-SUCH-NUMBER TONE SUPPLY
FOR CROSSBAR, STEP-BY-STEP OR PANEL OFFICE
OR PRIVATE SERVICE SYSTEMS

CHANGES

D. Description of Changes

- D.1 Circuit Note 104 is expanded to show connection to the Private Service Systems Switching System No. 305 Dial Selection Circuit.
- D.2 The working limits are revised to include the No. 305 switching system equipment.
- D.3 The circuit title is changed to include "or Private Service Systems."

F. Changes in CD Sections

- F.1 In SECTION I, 1.01, at end of last sentence, add: "and switching system No. 305 dial selection circuit."
- F.2 In SECTION II, 2.01 and 2.03, in first sentence, change: "tone jack, or tone demonstration circuits" to read "tone jack, tone demonstration, or dial selection circuits."
- F.3 In SECTION III, 1.01, add: (e) 10 No. 305 switching systems.
- F.4 In SECTION IV, 4, add: (z) Private Service Systems Switching System No. 305 Dial Selection Circuit SD-1G175-01.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 2364-JLB-JEM

COMMON SYSTEMS
SIGNAL CIRCUIT
NO-SUCH-NUMBER TONE SUPPLY
FOR CROSSBAR, STEP BY STEP OR PANEL OFFICE

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<u>SECTION I - GENERAL DESCRIPTION</u>	
<u>1. PURPOSE OF CIRCUIT</u>	
1.01 This circuit generates a distinctive tone for indicating to a subscriber or operator that dialing or keying has resulted in a no-such-number indication to the switching circuitry. This tone is supplied to vacant code trunks, sender circuits, step-by-step AMA outgoing trunk circuits, originating register-outpulsing	

controller circuits, and TOUCH-TONE calling signal to dial pulse converter circuits.

SECTION II - DETAILED DESCRIPTION

1. NORMAL CONDITION

1.01 With the transfer TR key of Fig. 2 in either the normal or operated position, ground will be connected over lead FIL₁ or FIL₂ for continuously energizing the filaments of the vacuum tubes OS and AM in the generator circuit per Fig. 1 that is to be the preferred source of tone. This places the tone generator in condition to give out a tone signal the moment ground is connected to start lead A of Fig. 2. Ground on lead FIL₁ or FIL₂ of Fig. 1 is traced through filament of amplifier tube AM, resistors H and H1, filament of oscillator tube OS, resistors G, F, and E in combination with potentiometer PO, and resistor D to battery. The potentiometer PO controls the pitch of the tone by varying the bias on grid G of the tube OS, a bias of 0.5 volt nominally being maintained at contacts 1 and 3 of relay B. This places the circuit in condition to start generating a tone the moment ground is connected to start lead A.

2. GENERATION OF DISTINCTIVE TONE

2.01 When vacant code trunk, timed release subscriber sender, tone jack, or tone demonstration circuits require tone, they will connect ground to start lead A which then conditions the circuit to supply tone over leads S, C, and D. Ground over the A₁ or A₂ lead is traced through the back contact of relay F and thence through the T winding relay A to the plate of tube AM. Relay A operates and causes relay C to operate which then connects ground through high resistor B. the 4-3 winding of inductor A, and contact 5-6 relay E to plate P₁ of tube OS which in combination with capacitor B causes tube OS to oscillate. This induces current in the 1-2 winding of inductor A which is connected to the grid G of the amplifying tube AM via terminals 1, 2, 3, or 4.

2.02 The amplified oscillating current or tone from plate P of tube AM passes through the T winding on relay A, contact 3-2 on relay F to ground on lead A₁ or A₂.

2.03 Relay A also serves as a transformer by inducing the tone in its secondary winding and thence over leads C₁D₁ or C₂D₂,

to vacant code trunk, tone jack, or tone demonstration circuits. Tone is also induced in its primary winding and is carried thence over lead S₁ or S₂ to a fuse alarm circuit on lead S where it is picked up by under circuits in crossbar and panel offices for indicating that dialing has resulted in a partial dial or stuck sender condition. The use of this tone for stuck senders is, however, required only in those central office areas where a centralized A patchboard is installed. In either of the above cases a subscriber receives the distinctive tone generated by this circuit and will be instructed to hang up, check the number, and dial again.

2.04 The tone is made to alternately ascend and descend in pitch at 1/2-second intervals due to the intermittent operation of relay B via contact 5-6 relay C over 10-1pm interrupter lead 3. The operation and release of relay B alternate the potential applied to the grid G₁ of tube OS, this potential varying in accordance with the charge and discharge rate of associated capacitor A. This change in potential causes a corresponding variation in the pitch of the tone generated by tube OS and amplified by tube AM.

3. OPEN TONE INTERVAL

3.01 An open tone interval provides for extending voice frequency intertoll dialing connections over local train selectors in step-by-step offices. This is accomplished as a result of the operation of relay A which closes a circuit from battery through resistor N and normally closed contact 1-3 relay E through winding relay C to ground. Relay C operated closes a path for the operation of relay B on 60-ipm ground connected to lead 3, opens a path for giving an alarm over lead ALM₁ or ALM₂, and opens the circuits through contacts 1-2 to prevent the operation of relay F at this time. Relay C also closes a path traced from ground through relay D, through contact 4-5 relay E, through resistor P to 10-ipm battery supply over lead 4. When battery is closed to lead 4, relays D and E operate in sequence and the E relay at top contacts 2-4-5 transfers the circuit of relay D to direct battery through resistor R, thus making the release of relay D dependent on release of relay C. Relay E at bottom contacts 1-2-3 also transfers the circuit of relay C to the 10-ipm battery over lead 4. When this battery supply on lead 4 is opened by the interrupter, relay C at once releases and at contact 5-6 opens the plate circuit of tube OS because the parallel bottom contact 5-6 relay E was previously opened by operation of relay E. The release of relay C also opens the circuit through relay D to start timing of the period that the plate circuit of tube OS remains open. During this interval relay C closes the circuits through contact 1-2 to test relay F, which will be described later.

3.02 After approximately 0.5 second, relay D releases causing relay E to release, thereby again closing the plate circuit of tube OS at contact 5-6 relay E. The release of relay E at bottom contact 1-3 again closes the circuit for relay C which reoperates and restores the circuit conditions awaiting the next pulse of 10-ipm battery. The effect of this is to stop tone being generated in the T winding of relay A during the releasing time of the D and E relays. During this release time a circuit through resistor A₂ is connected in parallel with capacitor A to prevent distortion of the tone when it is again connected.

4. CONTROL OF PITCH AND VOLUME OF TONE

4.01 Tubes AM and OS are the source of the tone supply and therefore both the pitch and volume must be adjusted initially and readjusted if either tube is subsequently changed.

4.02 The pitch is changed by first blocking relay B nonoperated and then turning the knob of the potentiometer PO until the pitch corresponds approximately to that of central office dial tone.

4.03 The volume of tone may be increased or decreased within certain limits by connecting terminal 1 to terminal 2, 3, or 4. This acts as a potentiometer across the 1-2 winding of inductor A to change the potential of the grid of tube AM.

5. USE OF Y AND Z OPTIONS

5.01 With Z option a trouble condition in the preferred generator causes relay G to operate and close the filament circuit of the second generator. If the trouble condition remains long enough to permit relay J to operate and transfer the tone supply to the second generator and then disappear, tone supply to all circuits will be cut off. An alarm will sound as long as the trouble condition is present but terminates when the trouble disappears.

5.02 With Y option relay J supplements the filament ground whenever the tone supply is transferred to the second generator, thus preventing trouble in the preferred circuit from interfering with tone of the second generator.

6. MANUAL OPERATION OF TRANSFER KEY

6.01 The circuit of Fig. 2 is arranged so that tone is normally supplied from the first Fig. 1 tone generator circuit and automatically transfers to the second generator of Fig. 1 under alarm conditions. This preference of generator circuits may be reversed by transfer key TR. Certain procedures must, however, precede the operation or release of this key made necessary by the time element required for heating the vacuum tubes of the idle generator.

6.02 To change the preference from the first generator to the second generator, it is first necessary to operate the TST key. This opens the ground connections used in giving an alarm over leads 1 and 2. It opens the ground connection used to operate transfer relay J and closes a ground circuit for operating alarm relays G and H₁. Relay G operated at its bottom contacts, connects ground to leads A₁, A₂, and FIL₂ in order to condition the second generator for use. While the AM and OS tubes of the second generator are heating up, lamp 2 remains lighted due to the ground connected to lead A₂ traced through normal contacts on relays C and D over lead ALM₂. The latter relays cannot operate because relay A remains normal awaiting the heating of tube AM. Lamp 2 going out, therefore, indicates that the second generator is generating tone and that the transfer key may therefore be operated. After the TR key has been operated, the TST key must be restored in order to make the automatic transfer feature effective.

6.03 To change the preference from the second generator to the first generator, the TST key must first be operated as just described. Relay G operated at its bottom contacts, connects ground to leads A₂, A₁, and FIL₁ in order to condition the first generator for use. While the AM and OS tubes of the first generator are heating up, lamp 1 remains lighted. When lamp 1 goes out, the transfer key may then be released and following this the TST key must be released.

6.04 If lamp 1 or 2 in the above procedure does not go out, it indicates the generator is not functioning properly and the position of the transfer key should not be changed until the trouble in the second or first generator respectively is cleared.

7. OPERATION OF ALARMS

VACUUM TUBE (AM)

7.01 Any trouble condition affecting the filament or plate of the tube AM or the operation of relays A, C, and D will connect ground to lead ALM₁ or ALM₂ to give an alarm, prepare the second generator for use, and automatically transfer the tone supply to it. When ground is first connected to lead A₁ or A₂, a normally closed path to lead ALM₁ or ALM₂ exists, which if not opened at contact 3-4 on relay C will permit this ground to give an alarm.

7.02 Relay C may not operate due to a poor contact on relay E or A, an open resistor N, or failure of A relay to operate. The latter relay may fail due to adjustment, insufficient plate current from a poor tube AM, an open filament circuit through tube AM, a poor contact 2-3 on relay F, or a shorted capacitor E.

INTERRUPTER LEADS 3 AND 4

7.03 Failure to receive a ground pulse on interrupter lead 3 will cause a steady low pitch tone to be generated without giving an alarm. The failure to receive a battery pulse on interrupter lead 4 will prevent the introduction of an open interval in the tone without giving an alarm and will prevent testing of tube OS. Both leads 3 and 4, however, are partially protected by their own alarms.

VACUUM TUBE (OS)

7.04 A test is made of tube OS during every open interval in the tone, while relays D and E are operated and relay C is released. Upon release of relay C at contacts 1-2, the winding of test relay F in series with resistors C and T is connected across the gap in tube OS between the plate and filament terminals, and ground through resistor S is connected to the plate of the tube. The circuit of the winding of relay F thus in effect makes a voltmeter test of the tube OS. One characteristic of this tube is that the constant voltage between plate and filament increases as the age of the tube increases. For good tubes the voltage should lie between 18 and 26 volts. As the tube ages, this voltage gradually increases and test relay F with its close adjustment therefore detects poor tubes giving voltages somewhere between 26 and 31 volts. Either a poor tube or open tube filament therefore operates relay F which, at its back contact, opens the circuit of the T winding of relay A and at its front contact locks operated by connecting the ground on lead A₁ direct to resistor S. Opening the circuit of relay A causes it to release and give an alarm as previously described.

7.05 The preceding paragraph refers only to the Fig. 1 that is the preferred circuit because a similar test of tube OS in the second Fig. 1 is prevented by a contact on the TR key in the lead B₁ or B₂ being open. This prevents false operation of the F relay in the second circuit due to the tubes not yet being heated up.

8. AUTOMATIC TRANSFER TO IDLE GENERATOR

8.01 Any alarm condition resulting in ground being connected to the ALM₁ or ALM₂ lead of the preferred generator in service causes lamp 1 or 2 to light and relay G to operate. The G relay: at bottom contact 1-2 supplements ground on start lead A in order to prevent wiping out the alarm in case ground is removed from start lead A; at top contacts 5-6 and 7-8 connect ground to office alarms; at bottom contacts 3-4 and 5-6 connect ground to spare generator lead FIL₂ or FIL₁ and A₂ or A₁ to condition the spare generator for supplying tone; at top contact 3-4 connects winding

relay H to lead ALM₂ or ALM₁ in order to operate this relay on ground over the alarm lead from the spare generator while the tubes of the generator are heating up. Relay H in turn operates relay H₁. When the spare generator is operating properly, relay A will operate and cause relays H and H₁ to release and close the circuit through the relay J. Relay J when operated locks release key REL, lights lamp TR, and transfers the A, S, C, and D leads to the second generator.

8.02 Lamps 1 or 2 lighted and lamp TR lighted indicates trouble in one of the generators, with tone supply transferred to the other generator.

8.03 In this case throw test key TST to cut off office alarms and insure operating ground to both generators while testing the generator in trouble or while continuing to hold this generator out of service.

8.04 When trouble is cleared, as indicated by lamp 1 or 2 going out, restore TST key and momentarily operate REL key to put out TR lamp and restore tone supply to the preference circuit due to release of relay J.

8.05 Both lamps 1 and 2 lighted and lamp TR out indicates trouble in both generators and no transfer of tone supply.

8.06 In this case throw test key TST to cut off office alarms, insure operating ground to both generators, and prevent operation of transfer relay J.

8.07 Proceed with test on opposite one of the generators to which the TR key gives preference.

8.08 When trouble is cleared, as indicated by lamp 1 or 2 going out, restore TST key to permit the supply circuit to be transferred to the spare generator as indicated by lighting of lamp TR.

8.09 Again throw TST key and proceed as under 8.02.

J. RELEASE

9.01 When the circuits connected to the tone supply no longer require tone, ground will be removed from lead A, thus opening the ground circuit through winding T of relay A to plate of tube AM and the ground circuit through resistor B, through winding of inductor A to plate P₁ of tube OS. The release of relay A releases relay C and therefore prevents further operation of relays D and E. Ground through the filaments of tubes AM and OS, however, remains connected on the preferred circuit in order to avoid a delay in sending out tone the next time lead A is grounded.

SECTION III - REFERENCE DATA

1. WORKING LIMITS

1.01 This circuit has capacity for supplying tone to a maximum of 200 vacant code trunks and a maximum of:

- (a) 500 senders for panel and No. 1 crossbar
 - (b) 1000 AMA outgoing trunks
 - (c) 300 originating registers
 - (d) 100 TOUCH-TONE calling signal converters
- } Step-by-Step

2. FUNCTIONAL DESIGNATIONS

None.

3. FUNCTIONS

- 3.01 To generate a distinctive siren like tone on a start-stop plate circuit and a continuously closed filament circuit basis.
- 3.02 To provide means for regulating the volume and pitch of the tone.
- 3.03 To provide a 1/2-second open period in the tone supply approximately once every 6 seconds to permit the release of voice frequency toll line dialing connections.
- 3.04 To provide, through the use of a transfer key, for supplying tone from either of two separate sources.
- 3.05 To give an alarm upon failure of a generator to supply tone.
- 3.06 To provide for automatically transferring the tone supply from one generator to a second generator under alarm conditions.

4. CONNECTING CIRCUITS

- (a) Vacant Code Trunk Circuits - SD-21038-01, SD-25134-01, SD-25272-01, and SD-31937-01.
- (b) Signal Circuit Vacant Level Tone in Old No. 1 and 350A Step-by-Step Offices - SD-31228-01.
- (c) Tone Jack Circuit in Toll DSA Boards - SD-62831-01.
- (d) Tone Jack Circuit in Local DSA Board - ES-241904.
- (e) Tone Demonstration Circuit in Crossbar or Panel Office - SD-96299-01.

- (f) Subscriber Sender Circuits - SD-21193-01 and SD-25012-01 (arranged for timed release).
- (g) Fuse Alarm Circuit for Senders - SD-21272-01 and SD-25048-01 (arranged for timed release).
- (h) Interrupter Frame Circuit in Crossbar Offices - SD-25062-01.
- (i) Miscellaneous Circuit for Miscellaneous Interrupter Frame in Panel Offices - SD-21666-01.
- (j) 60- and 120-IPM Interrupter Circuit in Step-by-Step Offices - SD-31606-01.
- (k) 10-IPM Interrupter and Impulse Clock Circuit in Step-by-Step Offices - SD-96343-01.
- (l) Audible and Visual Alarm Circuit - SD-96188-01.
- (m) Pilot Lamp and Power Alarm Lamp Circuit in 350A Step Office - SD-31573-01.
- (n) Miscellaneous Alarm Circuit for Aisle Pilots in 355A Step Office - SD-31980-01.
- (o) Miscellaneous Alarm Circuit for Alarm Control in 355A Step Office - SD-31970-01.
- (p) Miscellaneous Alarm and Register Circuit in Old 355A Step Office - SD-31798-01.
- (q) Pilot Lamp Circuit in Old No. 1 Step-by-Step Office - SD-31548-01.
- (r) Floor Alarm Frame Miscellaneous and Auxiliary Alarm Circuit in Old Crossbar Offices - SD-25047-01.
- (s) Floor Alarm Board Miscellaneous and Auxiliary Alarm Circuit in Panel Offices - SD-21203-01.
- (t) Miscellaneous Alarm Circuit for Relay Rack in 355A Step-by-Step Offices - SD-31974-01.
- (u) Vacant Code Trunk Circuit - SD-25508-01.
- (v) Switch Trouble Alarm Circuit for Selector Shelves in No. 1 is 350A Offices or Miscellaneous Alarm Circuit for Selector Shelves in 355A Office - SD-32043-01.
- (w) Step-by-Step No. 1 AMA Outgoing Trunk Circuit - SD-32204-01.
- (x) Originating Register Circuit, Outputting Controller Circuit - SD-32351-01.
- (y) TOUCH-TONE Calling Signal to Dial Pulse Converter Circuit - SD-32328-01.

SECTION IV - REASONS FOR REISSUE

D. Description of Changes

- D.1 Circuit Note 104 is expanded to show connection to the following equipment:
 - (a) AMA outgoing trunk circuit.
 - (b) Originating register circuit outputting control circuit.
 - (c) Miscellaneous fuse board.
 - (d) TOUCH-TONE calling signal converter circuit.
- D.2 The working limits have been revised to include the step-by-step equipment.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 2364-WMS-JEM