CROSSBAR SYSTEMS
NO. 5
NO-SUCH-NUMBER TONE
SIGNAL CIRCUIT
OSCILLATING TONE

CHANGES

D. Description of Changes

D.01 This circuit is revised to rate the no-such-number tone from AT&TCo Standard to Mfr Disc. Since the only function of this circuit is to provide no-such-number tone, the entire circuit is rated Mfr Disc.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5243-AAA-ABVL-SVB

CROSSBAR SYSTEMS
NO. 5
NO-SUCH-NUMBER TONE
SIGNAL CIRCUIT
OSCILLATING TONE

CHANGES

D. Description of Changes

D.1 This circuit is revised to rate J27055A - (A&M Only) and add J29272C - (AT&TCo Standard) to the equipment information column of the SD.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5243-RAS-ABVL-PN

CROSSBAR SYSTEMS
NO. 5
NO-SUCH-NUMBER TONE
SIGNAL CIRCUIT
OSCILLATING TONE

CHANGES

C. Changes in Circuit Requirements Other Than Those Applying to Added or Removed Apparatus

C.1 The armature travel of relay A (code B621) is a standard value of 40. Therefore, the value of 30 required on this circuit is a special adjustment. "SPL" was added to the "ARM TRVL" column and "ARM TRVL 30" was placed in the remarks column.

D. Description of Circuit Changes

D.1 Information note 303 was added to clarify the method of connecting leads "LK" and "LK1" to the alarm sending circuit.

1. PURPOSE OF CIRCUIT

1.1 This circuit generates a distinctive tone for indicating to a subscriber or operator that dialing has resulted in a no-such-number indication to the switching mechanism and supplies this tone to trunk circuits and originating register circuits for transmission to the calling party.

2. WORKING LIMITS

2.1 This circuit has capacity for supplying tone to a maximum of 200 tone trunks and originating registers.

3. FUNCTIONS

3.1 To generate a distinctive siren link tone on a start-stop plate circuit and a continuously closed filament circuit basis.

3.2 To provide means for regulating the volume and pitch of the tone.

3.3 To provide a half second open period in the tone supply approximately once every six seconds to permit the release of voice frequency Toll Line Dialing connections.

3.4 Provides means for checking the voltage across the OS tube during the open tone period and to give an alarm if the tube exceeds certain limits.

3.5 To provide, through the use of a transfer key, for supplying tone from either of two sources.

3.6 To give an alarm upon failure of the preferred generator to supply tone.

3.7 To provide for automatically transferring the tone supply from a preferred generator to a standby generator under alarm conditions.

4. CONNECTING CIRCUITS

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

4.1 Tone Trunk Circuit - Noncoin - SD-25765-01.

4.2 Tone Trunk Circuit - Coin - SD-25719-01.

4.3 Originating Register - SD-25551-01 (typical).

4.4 No-Such-Number Signal Tone Trunk Circuit - SD-25824-01.

4.5 60 IPM or 120 IPM Interrupter Circuit - SD-25742-01.

4.6 Alarm Circuit - SD-25671-01.

4.7 Toll Systems - Toll Swbd. No. 3, 3C, or 3CF - Tone Jack Circuit - SD-62831-01.

4.8 Toll Systems - Toll Swbd. No. 1, Tone Jack Circuit - SD-64684-01.

4.9 Alarm Sending Circuit - SD-95417-01.

4.10 Power Ringing and Tone Distribution Circuit - SD-25599-01.

DESCRIPTION OF OPERATION

5. GENERAL

One transfer circuit (fig. 2) and two generator circuits (Fig. 1) are used to supply no-such-number tone for the entire office. The circuits are arranged so that either the first Figure 1 or the second Figure 1 can be the preferred circuit while the other circuit is used on a standby basis. In case of trouble in the preferred circuit, the transfer circuit will operate causing the standby circuit to function and supply tone to the "C" and "D" supply leads. At the same time indicating lamps will be lighted and an audible alarm will function thus informing the maintenance man of the trouble in the preferred circuit. Approximately every six seconds the tuned circuit is disconnected from the OS tube and the tone is stopped for approximately 0.5 second permitting the release of voice frequency Toll Line Dialing connections. During this 0.5 second period, resistance ground is connected to the plate of the OS tube and the plate-to-filament voltage of the OS tube is measured by means of the F relay. Should this voltage exceed a certain value, the F relay will operate and cause an alarm to be given and will also cause the transfer circuit to function to transfer to the standby circuit.

6. NORMAL CONDITION

The position of the transfer (TR) key of Figure 2 determines which circuit is the preferred circuit. Ground from the TR key completes the filament circuit of the preferred generator circuit while the filament circuit of the standby circuit is not closed through. The filament circuit can be traced from ground on the TR key over lead "FIL 1" or FIL 2" through filament on amplifier tube AM in parallel with the register G, resistors F and E, filament of oscillator tube OS, resistors D, C and B in combination with potentiometer (PO), and resistor A to battery. The potentiometer (PO) controls the pitch of the tone by varying the bias on the grid of the OS tube, a bias of 0.5 volt nominally being maintained at contacts 1 and 3 of the B relay. This places the preferred circuit in condition to start generating a tone the moment the ST relay is operated by means of ground on the "A" start lead. Since the filament circuit of the standby circuit is not closed through, some precautions must be taken when manually changing the preference from one Figure 1 to the other. This procedure will be described later.

7. GENERATION OF DISTINCTIVE TONE

When a circuit requires no-such-number tone, it will connect a ground on the "A" start lead. This ground is applied through the J relay contacts, through the TR key to the "A1" or "A2" lead thus causing the ST relay in the preferred circuit to operate.

The operation of the ST relay,

(a) Partially closes through the "PU" lead to the D relay. ("T" Option)

(b) Connects a ground to the "ST" lead to the 60 IPM interrupter circuit causing that circuit to function.

(c) Partially closes the 60 IPM ground obtained from the interrupter circuit to the B relay.

(d) Connects ground to the screen grid of the AM tube and also to the plate of the AM tube through the back contacts of the F relay and the T winding of the A relay. This ground is also connected through the back contacts of the C and E relays to the "ALM 1 or ALM 2" lead, then through the TR and TST key to the G relay. However, the G relay is a slow operate relay and will not have time to operate as will be explained later.

The ground applied on the plate of the AM tube will cause plate current to flow through the T winding of the A relay causing it to operate. The A relay completes ground through the back contacts of the B relay to the C relay causing it to operate.

The operation of the C relay,

(a) Opens the operating path of the G relay - the A and C relays operate in less time than the time it takes the G relay to operate.

(b) Completes the 60 IMP ground connection to the B relay.

(c) Connects the grounded Y lead resistor in series with one winding of the A retard coil to the plate of the OS tube and also connects the tuned circuit consisting of the B capacitor and 1/2 of the A retard coil across the plate and filament of the OS tube. This will cause one OS tube to oscillate.

(d) Closes the "PU" lead to relay D when "T" option is provided.

(e) The functions of the other contacts of the C relay will be described later as they have no function at the present time.

The operation and release of the B relay due to the 60 IPM ground will cause the grid bias of the OS tube to change. The D condenser and P resistor are used so that a gradual change in grid bias is obtained, and consequently a gradual change in frequency is obtained. As a result, a tone alternately rising and falling in pitch is generated. The frequency and pitch of tone is controlled by means of the (PO) potentiometer, the adjustment of which is described in a later paragraph.

The tone generated by the OS tube is induced in the other half of the A retard coil and impressed across a network consisting of the M, K, and L resistors. The grid of the AM amplifier tube is connected to terminal 1 which in turn is connected to terminal 2, 3, or 4 of this network depending on the volume or tone desired. The AM tube amplifies this tone and it passes through the T winding of the A relay. This tone is induced in the S winding of the A relay and appears on the associated "C1 or C2" and "D1 or D2" leads from where it is connected to the "C" and "D" leads going to the trunk or register circuit through the contacts on the TR key and J relay. This distinctive tone is transmitted to a subscriber who upon receipt of the tone, should hang up, check the number and dial over again.

8. OPEN TONE PERIOD AND CHECK OF OS TUBE

Once every six seconds, ground appears on the "PU" lead for approximately 0.25 sec. This ground, with ST and C operated ("T" option) or ST operated ("V" option), will operate ("V" option), will operate D which in turn will operate E. D is slow release to insure the operation of E for approximately 0.5 second.

The operation of the E relay

(a) Further opens the "ALM 1 or ALM 2" lead thus preventing an alarm to be given during the open period after the C releases.

(b) Opens the operating circuit for the C relay thus allowing it to release.

(c) Partially connects the S resistor and F relay to the plate of the OS tube.

(d) Partially closes the S resistor to ground on the "B1 or B2" lead.

(e) With "T" option, supplies a supplementary path connecting D to the "PU" lead. D will, therefore, remain operated as long as ground is maintained on the "PU" lead even though the C relay releases.

(f) The purpose of the other make contact will be described later.

The release of the C relay

(a) Opens the 60 IPM ground to the B relay.

(b) Disconnects the tuned circuit and the load resistor from across the OS tube and consequently the tube stops oscillating.

(c) Completes the connecting of the S resistor to ground through the front contacts of the E relay, the "B1 or B2" lead, the TR key, the J relay to the "A" start lead.

(d) Completes the connecting of the S resistor and the F relay to the plate of the OS tube. The F relay in series with the H and J resistors is now connected between the filament and plate of the OS tube.

(e) A back contact in series with a closed front contact on the E relay connects the T resistor in parallel with the D capacitor and the P resistor. The reason for this is to prevent frequency distortion when the OS tube begins oscillating again after termination of the open period.

(f) Partially recloses the "ALM 1 or ALM 2" lead which is held open by the operated E relay.

(g) Opens the original operating path of the D relay. ("T" Option)

If the voltage across the gap of the OS tube does not exceed a certain value the F relay will not operate and the test is satisfied. However, if the voltage exceeds a certain value, the F relay will operate and lock up. The locking path is from ground on the ST relay, through the front contacts of the F relay, through the S resistor, through the F relay winding, through the H and J resistors to battery connected through the A, B, C and D resistors. Should the F relay operate, the A relay will release since the circuit to the T winding is open.

After approximately 0.25 second, ground is removed from the "PU" lead causing the D relay to release which will cause the E relay to release.

The release of the E relay

(a) Connects the C relay winding to the front contact of the A relay.

(b) Disconnects the F relay and the S resistor from the plate of the OS tube and connects the tuned circuit across the gap of the OS tube.

(c) Recloses the "ALM 1 or ALM 2" lead through to ground on the ST relay.

(d) Removes ground coming over the "B1 or B2" lead from the S resistor.

(e) Removes the T resistor from across the D capacitor.

(f) Opens up the holding path for the D relay. ("T" Option)

If the A relay is released, which means that the F relay has operated, the C relay will not reoperate and ground on the "ALM 1 or ALM 2" lead will cause the G relay to operate. This will cause an alarm to operate and cause the transfer circuit to function (described in a later paragraph). If the A relay is operated, which means that the F relay has not operated, the C relay will reoperate and it

(a) Reconnects the load resistor to the plate of the OS tube to start it oscillating again.

(b) Reconnects the 60 IPM ground to the B relay.

(c) Reopens the "ALM 1 or ALM 2" alarm lead thus preventing the G relay from operating.

The circuit is now in the same operating condition as before and the tone will be sent to the connected trunk or register circuit until six seconds later when ground is again received on the "PU" lead causing the D and E relays to operate thus repeating the open period and the test of the OS tube.

9. DISCONNECT

When the circuit being served is disconnected, the ground is removed from the "A" lead causing the ST relay to release which

(a) Removes ground from the plate of the AM tube causing the A relay to release.

(b) Opens the "PU" lead which will cause the D and E relays to release if operated.

(c) Removes the ground to the interrupter thus causing it to cease functioning.

(d) Opens the 60 IPM interrupter lead.

10. TRANSFER CIRCUIT

10.1 Manual Transfer

When it is desired to change the preference of the two tone generating circuits, a definite procedure must be followed due to the fact that the filaments of the tubes of the standby circuit are not heated. The preference is governed by the position of the TR key.

10.11 To change the preference from the first Figure 1 to the second Figure 1 of the following procedure must be followed:

Operate the TST key.

(a) This prevents an alarm when the G relay operates by removing the 800 ohm battery.

(b) Disconnects the ground used for operating the J relay.

(c) Supplies a ground for operating the H1 relay.

(d) Disconnects the G relay from the "ALM 1" lead and connects it to ground causing it to operate.

The G relay operated

(a) Grounds the "A2" lead through the TR key.

(b) Partially closes the operating path to the J relay but this path is opened at the operated H1 relay and TST key.

(c) Grounds the "FIL 2" lead thus closing the filament circuit for the AM and [illegible] tubes of the second Figure 1.

(d) Closes a path from the AR key through the TR key to the "A1" and "B1" leads. Ground on the "LK" lead, "W" option, or direct ground "X" option, on the AR key causes the first Figure 1 to function but it serves no useful purpose at this time.

(e) Connects the H relay to the "ALM 2" lead.

(f) Closes the "MN" alarm lead to the TST key. However no alarm is operated since the TST key is in the operated position.

Ground on the "A2" lead causes the ST relay of the second Figure 1 to operate which in turn supplies a ground on the "ALM 2" lead through the back contacts of the E and C relays of the second Figure 1. Ground on the "ALM 2" lead will light the 2 lamp and operate the H relay. However, the H relay performs no useful function at this time. The lighted 2 lamp is an indication that the second Figure 2 is not genrating tone. When the filaments of the tubes of Figure 2 are heated, plate current of the AM tube flows through the T winding of the [illegible] relay causing it to operate. Operation of the A relay causes the C relay to operate and remove ground from the "ALM 2" lead. The 2 lamp will become extinguished indicating that the second Figure 1 is generating tone and relay H releases. The TR transfer key can now be operated to position 1.

Operation of the TR key

(a) Transfers the ground coming from the TR key from the "FIL 1" lead to the "FIL 2" lead.

(b) Transfers the ground coming from the G relay from the "FIL 2" lead to the "FIL 1" lead.

(c) Transfers the G relay from the "ALM 1" lead to the "ALM 2" lead (after the TST key is released).

(d) Transfers the "A" lead from the "A1" lead to the "A2" lead.

(e) Transfers the "C" lead from the "C1" lead to the "C2" lead.

(f) Transfers the "D" lead from the "D1" lead to the "D2" lead.

(g) Connects the "B2" lead to the "A2" lead.

(h) Opens up the circuit between the "A1" and "B1" leads.

(i) Transfers the H relay from the "ALM 2" lead to the "ALM 1" lead.

The TST key must now be released in order to be able to automatically transfer from the second Figure 1 to the first Figure 1 in case trouble occurs in the second Figure 1. The release of the TST key releases the G and H1 relays. The G relay removes ground from the "FIL 1" lead. Since the G relay is slow in releasing, a ground from the TST key would tend to operate the J relay. However, the H1 relay which is slower in releasing than the G relay keeps the operating path of the J open until the G relay has released. The transfer of the preference from the first Figure 1 to the second Figure 1 has now been completed.

10.12 To change the preference from the second Figure 1 to the first Figure 1, the keys must be operated in the same sequence;

(a) Operate TST key - The 1 lamp will light.

(b) Wait for the 1 lamp to become extinguished.

(c) Operate the TR key to the 1 position.

(d) Release the TST key.

10.2 Automatic Transfer

10.21 Assuming that the first Figure 1 is the preference circuit, the TR key being in the 1 position, and a ground is obtained on the "ALM 1" lead due to some trouble condition, the transfer circuit functions to energize the second Figure 1 and transfers the "A", "C" and "D" leads to the second Figure 1. This is accomplished as follows: Ground on the "ALM 1" lead lights the 1 lamp and operates the G relay which

(a) Connects an 800 ohm battery to the "MN" lead which causes an audible alarm to function.

(b) Connects a supplementary ground to the "A1" lead which ensures keeping the G relay operated even through the circuit being served has removed ground from the "A" lead.

(c) Connects a ground to the "FIL 2" lead closing the filament circuit of the second Figure 1.

(d) Connects a ground to the "A2" lead. This ground operates the ST relay of the second Figure 1 which feeds ground through the back contacts of the C and E relays to the "ALM 2" lead. This ground will light the 2 lamp and operate the H relay through the contact of the operated G relay. Operation of the H relay will cause the H1 relay to operate. The ST and H are fast operating so that it operates before the J relay has a chance to operate, thus preventing the J relay from operating.

The circuit remains in this condition until the plate current of the AM tube has reached a value of sufficient magnitude to operate the A relay. The operated A relay will cause the C relay to operate which removes the ground from the "ALM 2" lead. Ground removed from the "ALM 2" lead extinguishes the 2 lamp and allows the H and H1 relays to release. The release of the H and H1 relays allows the J relay to operate which

(a) Locks up under control of relay G to the AR key with option "R" or to the AR key and lead "LK1" with option "S".

(b) Transfers the "A", "C", and "D" leads from the "A1", "C1", and "D1" leads to the "A2", "C2" and "D2" leads respectively.

(c) Supplies a supplementary ground on the "FIL 2" lead.

(d) Lights the TR lamp.

The circuit remains in this condition, the G and J relays operated and the 1 and TR lamps lighted, until the maintenance man has removed the trouble in the first Figure 1. To shoot trouble in the first Figure 1 the following procdure must be followed. The TST key must be operated which

(a) Operates the H1 relay.

(b) Opens the "MN" alarm lead thus silencing the audible alarm.

(c) Disconnects the G relay from the ground on the "ALM 1" lead and connects it to ground on the TST key.

Ground is supplied to the "A1" and "A2" leads through the operated G relay. Under this condition the standby circuit is functioning continuously while trouble shooting can be done on the preferred circuit. When trouble is cleared, indicated by lamp 1 going out, the TST key must be restored which

(a) Releases the G relay and reconnects it to the "ALM 1" lead.

(b) Releases the H1 relay.

Then the AR key must be momentarily operated which will release the J relay. The release of the J relay transfers the "A", "C" and "D" leads from the standby circuit back to the preferred circuit. The TR lamp will become extinguished and ground is removed from the "FIL 2" lead thus opening up the filament circuit of the standby circuit.

10.22 While the above describes the circuit operation when the first Figure 1 is the preferred circuit, the circuit function in a similar manner when the second Figure is the preferred circuit. When the 2 and T lamps are lighted it indicates trouble in the second Figure 2. Then the TST key should be operated before starting trouble shooting on the circuit. Clearance of trouble will be indicated by the extinguishing of the 2 lamp. Then the TST should be released and finally the AR key should be momentarily operated until the TR lamp is extinguished.

10.23 Trouble in both generators is indicated when both the 1 and 2 lamps are lighted and the TR lamp is not lighted. It indicates that trouble occurred in the preferred circuit and transfer to the standby circuit was attempted but not completed because of trouble in the standby circuit. The procedure to be followed is to operate the TST key which will cut off the office alarms, ensures operating grounds to both generators, and prevents the operation of the J transfer relay. Then the trouble should be cleared on the standby circuit (position of TR key indicates the preferred circuit). When the trouble is cleared, as indicated by lamp 1 or 2 becoming extinguish the TST key should be restored to permit the transfer circuit to function so that the tone will be supplied by the standby circuit. When the TR lamp lights, it indicates that the transfer is completed and the trouble in the preferred circuit should now be cleared by operating the TST key and proceeding as explained in 10.21 or 10.22.

10.24 When a trouble developes and the office is unattended, the alarm is extended to a distant master office. The grounds on "LK" and "LK1" leads are under control of the master office and it can be removed to see if the trouble persists.

11. CONTROL OF PITCH AND VOLUME OF TONE

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

11.1 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.

11.2 The volume of tone may be adjusted by strapping terminals on the unit terminal strip. This acts as a potentiometer across the 1-2 winding of the retard coil A to change the potential of the grid of the AM tube.

12. OPERATION OF ALARMS

12.1 Vacuum Tube AM

When the ST relay is operated, any trouble conditions affecting the filament of plate of the tube AM or the operation of relays A and C will connect ground to the "ALM 1 or ALM 2" lead to give an alarm, prepare the second generator for use and automatically transfer the tone supply leads to it. Relay C may not operate due to contact trouble on relays E or A, or failure of the A to operate. The latter relay may fail due to adjustment, insuffiecient plate current from a poor AM tube, an open filament circuit through the AM tube, a back contact failure on the F relay, or a shorted A condenser.

12.2 Vacuum Tube OS

As previously described, a test is made of the OS tube during every open interval in the tone, while relay E is operated and relay C released. Upon the release of the C relay, the winding of the F relay in series with H and J resistors is connected across the gap of the OS tube (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 OS tube. 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 be 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, opens the circuit of the T winding of the A relay and also locks operated by connecting the ground from the ST relay direct to the S resistor. Opening the circuit of the A relay causes it to release so that the C relay fails to reoperate when the E relay releases. The "ALM 1 or ALM 2" lead is connected through back contacts on the E and C to ground on the ST relay causing the G relay to operate. The operation of the G relay will cause the audible alarm circuit to function and start the transfer circuit to function as previously described.

12.3 Interrupter Lead 60 IPM

Failure to receive a ground pulse on the 60 IPM ground lead will cause a steady low pitch tone to be generated without giving an alarm. However the 60 IPM lead is partially protected by an alarm on the interrupter circuit. Failure to receive the 0.25 second ground on the "PU" lead will prevent the introduction of an open interval in the tone without giving an alarm and will prevent testing the OS tube. However, the "PU" lead is connected to an alarm circuit.

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