

PANEL SYSTEMS
FINAL CIRCUIT
WITH MARGINAL RELAY TEST CIRCUIT

CHANGES

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 Test Note 6 of Circuit Requirement table sheet 2 is added to provide for a sequence adjustment of sequence switch cam springs SS2-G, SS3-H and SS3-J to eliminate a possible understep in final brush, tens or units selections.

D.2 The information in Test Note 5 of Circuit Requirement table sheet 2 was previously shown in Circuit Note 105 which is now removed.

All other headings under Changes, no change.

1. PURPOSE OF CIRCUIT

1.1 This circuit is for the purpose of completing connections from a manual, panel or crossbar office to a subscriber's or PBX line in a ground cut-off relay panel office. It is arranged to release on "No test" calls under control of the calling end and on permanent signals to release after a time interval.

2. WORKING LIMITS

2.1 The maximum subscriber's loop is 750 ohms, "J" option, and 1500 ohms, "K" option, with a minimum insulation resistance of 10,000 ohms.

2.2 External trunk loop for selections 1474 ohms maximum with a minimum insulation resistance of 30,000 ohms.

3. FUNCTIONS

This circuit is used to establish a connection from the incoming selector multiple to a subscriber's or PBX line. Its functions are as follows:

- 3.01 Selects proper subscriber's line by means of brush, tens and units selection.
- 3.02 Tests subscriber's line for an idle or busy condition.
- 3.03 Advances incoming selector when selections are completed.
- 3.04 For individual line or PBX group busy - Restores elevator rod to normal and transmits "busy back" tone to calling subscriber and "busy back" ground to incoming selector circuits.

- 3.05 Prepares talking circuit when line is idle.
- 3.06 Hunts for an idle line if the first line of the called PBX group is busy.
- 3.07 Advances from talking position under control of the incoming selector.
- 3.08 Returns to normal after calling subscriber disconnects under control of called subscriber or under control of selector time alarm circuit.
- 3.09 Disregards busy condition on "No test" calls.
- 3.10 Returns to normal without awaiting called subscriber's release after talking on "No test" call.
- 3.11 Maintains busy condition from the time that the called line has been selected (if it has been found idle) until the "tip" and "ring" leads are opened, after conversation has been completed.
- 3.12 Operates trip magnet in the "Down drive" positions.
- 3.13 Group peg count register.
- 3.14 Restores to normal on premature disconnect.
- 3.15 Restores to normal under control of incoming on tell tale.
- 3.16 Return of sequence switch to normal when moved out of position 1 manually.
- 3.17 Arranged for testing of subscribers' lines from the test desk.
- 3.18 Transmits "busy back" tone to calling subscriber and returns to normal under control of incoming on tell tale.
- 3.19 Is arranged to give a busy indication to the traffic usage recorder circuit.

4. CONNECTING CIRCUITS

When this circuit is listed on a key-sheet the connecting information thereon is to be followed.

- 4.1 Line Switch Circuit - ES-207698.
- 4.2 Ground Cut-off Relay Line Circuit - ES-240292 or SD-21715-01.

- 4.3 Incoming Selector Circuit - SD-21036-01, ES-21043-01, -02.
- 4.4 Miscellaneous Register Circuit - ES-20141-01.
- 4.5 Miscellaneous Tone and Interrupter Circuit - ES-207867.
- 4.6 Test Selector Circuits - SD-21354-01, SD-21355-01.
- 4.7 Subscribers Line Test Set - SD-21623-01.
- 4.8 Traffic Usage Recorder Circuit - SD-95738-01.

DESCRIPTION OF OPERATION

5. SEIZURE

When an incoming selector seizes the tip, ring and sleeve terminals of this circuit, ground in the incoming is connected to the sleeve terminal making this circuit test busy to other hunting incoming selectors and the incoming advances to the selection beyond position. With the incoming in selection beyond position, the final (L) relay operates over the fundamental circuit in series with the stepping relay in the sender. The (L) relay operated, operates the (TK) relay. The (TK) relay operated locks to ground on the sleeve of the associated incoming selector circuit and advances the switch to position 2.

6. BRUSH SELECTION

With the switch in position 2, the high speed up drive magnet (HS) operates, causing the selector to move upward for brush selection. As the selector moves upward carrying the commutator brushes over the commutator segments, the A segments and brush intermittently connect ground through to the tip side of the fundamental circuit alternately closing and opening a short circuit around the stepping relay in the associated sender circuit, thereby releasing it and permitting its reoperation. When sufficient impulses have been sent back to satisfy the sender, the fundamental circuit is opened by the sender, releasing the (L) relay and consequently opening the circuit through the (HS) magnet, which stops the upward movement of the selector and the switch advances to position 3.

7. TENS SELECTION

In position 3 when the fundamental circuit is closed by the sender, the (L) relay operates and advances the switch to position 4. The (HS) magnet is again operated and the selector moves upward for tens selection. The trip magnet being operated in position 3 to 5, the previously selected set of brushes is tripped as the selector moves upward in position 4. Also,

as the selector moves upward, the B commutator segments and brush intermittently connect ground to the tip side of the fundamental circuit, alternately closing and opening a short circuit around the stepping relay in the associated sender circuit and thereby releasing and permitting the reoperation of the stepping relay until sufficient impulses have been sent back to satisfy the sender. The fundamental circuit is then opened by the sender, releasing the (L) relay which opens the circuit through the (HS) magnet, stopping the upward movement of the selector and advancing the switch to position 5.

8. UNITS SELECTION

When the fundamental circuit is again closed through in the sender, the (L) relay operates advancing the switch to position 6. The low speed (LS) magnet operates causing the selector to move upward and the U commutator brush and segments function the same as the A commutator brush and segments as previously described. When sufficient impulses have been sent back to satisfy the sender, the fundamental circuit is opened releasing the (L) relay. The release of the (L) relay opens the circuit through the (LS) magnet stopping the selector brushes on the tip, ring and sleeve terminals of the called line and advances the switch to position 7, the A cam advancing it to position 9. When in position 6 $\frac{3}{4}$ the PBX relay is connected in parallel with the 40 ohm resistance (T) to the ring, but does not operate due to the high resistance to battery in the incoming circuit. As the switch advances beyond position 7 $\frac{1}{4}$, ground is disconnected from the ring, permitting the associated incoming circuit to advance.

9. INDIVIDUAL LINE OR FIRST LINE OF TERMINAL HUNTING GROUP, NOT BUSY

9.1 With Figure A furnished and switch in position 9, the (L) relay operates through its primary windings, advancing the switch to position 10, the (A) cam advancing it to position 12. As the switch leaves position 11, the (L) relay releases, connecting battery through the two 110 ohm resistances to the (S) terminal to operate the cut-off relay in the line circuit. The release of the (L) relay also advances the switch to position 13, ground from the armature of the (TK) relay advancing the switch to position 14 and ground through the break contact of the (L) relay advancing the switch to position 15. As the switch passes through position 13- $\frac{1}{2}$, ground is connected through cam (I) to the selector group register circuit, operating that register.

9.2 With Figure B furnished to minimize double connections and the switch in position 9, the (DCT) relay operates from battery on cam K to ground on the (TK) relay.

When the switch advances to position 12 for testing PBX hunting the (DCT) relay locks to battery through cam Q. As the switch advances out of position 12 the locking circuit through cam Q is opened. If an idle line has been selected the (DCT) relay will release and connect battery through the two 110 ohm resistances to the sleeve of the selected line. The switch advances to position 15 as described above.

10. DISCONNECTION

When the associated incoming selector advances from the talking position, ground is disconnected from the sleeve terminal, releasing the (TK) relay. The (TK) relay released, operates the (L) relay through its secondary winding, advancing the switch to position 16. In position 16, the primary winding of the (L) relay shunted by the (SH) resistance is connected to the subscribers loop to the called station, holding the (L) relay operated if the called party has not disconnected, and ground is connected through the (D) cam to the selector time alarm circuit which operates if the switch remains in position 16 for an abnormal length of time and "L" & "R" wiring is used. When the receiver is replaced on the switchhook at the called station, the (L) relay releases and advances the switch to position 18, ground on the armature of the (TK) relay advancing the switch to position 18, where the DOWN magnet operates, moving the selector downward. When "T" wiring and the associated apparatus is provided the trip magnet is operated in positions 17-1/2 to 18 to prevent snagging of the brushes during the return of the selector. When the selector reaches normal, ground through the (Y) commutator advances the switch to position 1, releasing the DOWN magnet. When "M" & "R" wiring is used, the holding circuit for the (L) relay in position 16 is opened by the operation of a relay in the selector time alarm circuit after a definite time interval; so that the selector advances from position 16 and restores to normal as described above even though the called subscriber has not replaced the receiver on the switchhook. When "L" and "W" wiring is used, a relay in the selector time alarm circuit opens the holding circuit to the (L) relay from the ring side of the line. This arrangement is to insure the release of this relay on calls to the tip party on party lines where the tip side of the line is grounded at the substation.

11. NO TEST

11.1 Fig A

When this circuit is selected by an incoming selector from the D.S. "A" switchboard arranged for "No Test" operation, the circuit functions as described in paragraphs 5 to 8 until the switch reaches position 6-3/4 when battery through a low

resistance in the incoming selector circuit is connected to the ringside of the fundamental circuit, operating the (PBX) relay. The (PBX) relay operated, releases the (TK) relay, which advances the switch from positions 8 to 13 without testing the called line for busy or waiting for PBX hunting. The release of the (TK) relay connects ground to the sleeve of the incoming circuit to keep it busy. As the switch leaves position 8-1/4 the (PBX) relay releases. Since the (TK) relay is released, the (L) relay does not operate in position 9 as described in paragraph 9. In position 13, the (TK) relay operates and locks through its primary winding, advancing the switch to position 14. Since the (L) relay is normal, the switch advances to position 15 immediately. Disconnection takes place in the same manner as described in paragraph 10.

11.2 Fig. B

The (TK) relay will be normal in positions 9 to 12 and the (DCT) relay will not operate thus cancelling the second busy test. Otherwise the circuit functions as described above.

12. BUSY INDIVIDUAL LINE

12.1 Fig. A

In case the called line is an individual line which is busy, the circuit functions as described in paragraphs 5 to 8 until the switch enters position 11. In position 11 high potential battery on the (S) terminal operates the (PBX) and (TB) relays in series. The (TB) relay operated, holds the (L) relay operated through its primary winding and the (PBX) relay operated, releases the (TK) relay. The (TK) relay released, advances the switch to position 13. When the switch leaves position 12-1/2, the (PBX) and (TB) relays release, but the (L) relay holds through its secondary winding. In position 13, the (TK) relay operates and locks to ground in the associated incoming selector, advancing the switch to position 14, where the DOWN magnet operates, restoring the selector to normal. When the selector reaches normal, ground on the (Y) commutator segment advances the switch to position 17. In positions 13 to 14, the TRIP magnet operates but does not perform any useful function at this time. In position 17, a circuit is closed from interrupted ground over lead "D" from the busy flash interrupter through cam (P) to operate and release the (L) relay as controlled by the interrupter. The operation of the (L) relay closes a circuit from tone supply ground or lead "B" of the miscellaneous tone and interrupter circuit thru resistances (BE) and (S) to the ringside of the trunk, thereby giving a busy back tone to the calling subscriber and a flash to an originating "A" operator. When the calling subscriber or operator disconnects,

the associated incoming selector advances to remove ground from the sleeve terminals, thus releasing the (TK) relay. The release of the (TK) relay advances the switch to position 18 where ground on the (Y) commutator advances it to normal.

12.2 Fig. B

In position 12 the (DCT) relay remains locked up to the battery on the sleeve. With the (DCT) relay locked up, the (L) relay will operate as the switch goes to position 13. Another locking circuit is provided for the (DCT) relay at the Q cam. The operated (TK) relay advances the switch to position 14 as usual and with the (L) relay operated the down drive will function and a busy signal will be returned.

13. PBX OR TERMINAL HUNTING

If the line on whose terminals the selector brushes rest at the end of units selection is the first of a group of PBX lines, and one or more of this group is busy, when the switch reaches position 11, low potential battery on the (S) terminal operates the (TB) relay. The (TB) relay operated, holds the (L) relay and as the switch enters position 12, the (LS) magnet operates, causing the selector to move upward. When an idle terminal is reached, ground potential on the "S" lead releases the (TB) relay, opening the holding circuit through the primary winding of the (L) relay, which however holds through its secondary winding to ground on the (C) commutator. The adjustment of the (C) commutator brush with relation to the tripped sleeve multiple brush is such that it does not break contact with the (C) commutator segment until slightly after the holding circuit through the winding of the (TB) relay is opened at the time that the sleeve brush breaks contact with the busy terminal and makes contact with the sleeve terminal of an idle line. The (L) relay and the (LS) magnet therefore remain operated and the selector continues to travel upward until the (C) commutator brush breaks contact with the metal segment. At this time, the brushes are slightly above the center of the selected terminals and a locking pawl enters the notch on the rack attached to the brush support rod. With the circuit to ground on the (C) commutator opened, the (L) relay releases, disconnecting ground from the commutator feed bar (G) and releasing the (LS) magnet. The selector then drops back against the locking pawl, thus centering the brushes on the line terminals. During PBS (terminal) hunting, ground is connected to the (G) commutator through cam (D) from and under control of the (L) relay. This is to prevent the reoperation of the (L) relay by the closing of a circuit from ground through the (C) commutator brush and segment as the selector drops into place. The release of the (L) relay also advances

the switch to position 13. From this point on the circuit functions as previously described in paragraphs 9 and 10. If the last line of a PBX group is reached, since the sleeve condition is the same as for an individual line, the (TB) relay releases in position 12 if the line is idle or the (PBX) relay operates in position 12 if the line is busy and the circuit functions from here the same as described for an individual line.

14. PAX DIALING - FIG. A

When the office in which this final circuit is located has lines terminating in private automatic exchanges, this final circuit is arranged with "X" wiring. In this case, ground is connected to the ringside of the trunk until the switch advances from position 14-1/2 to hold the incoming selector in the "Selection Beyond" position. This circuit then functions as under an "Individual Line" to connect to the line where ground on the ring of the PBX trunk holds the incoming in the selection beyond position until all selections have been completed. This circuit is in talking position when PAX selection takes place. Disconnection is the same as for an individual line.

15. PREMATURE RELEASE

Should the calling subscriber replace the receiver on the switchhook or the originating "A" operator or cordless operator disconnect before the final switch advances from position 14, the incoming selector functions and removes the ground from the sleeve, releasing the (TK) relay. The (TK) relay released, advances the switch from any position between 1 and 13 to position 13, where the (TK) relay operates and advances the switch to position 14. The (TK) relay now releases in turn operating the (L) relay through its secondary winding which operates the DOWN magnet, restoring the selector to normal. In positions 13 to 14, the TRIP magnet is energized so that in case the premature release starts before the final has advanced beyond brush tripping zone, the trip finger shall not be in the way of the returning selector brushes. When the selector reaches normal, ground on the (Y) commutator advances the switch to position 17, ground on the armature of the (TK) relay advancing the switch to position 18 and ground on the (Y) commutator advancing it to normal.

16. TELLTALE

Should the selector travel to the top of the frame, "Telltale" position during selection in positions 2, 4, 6 or 12, ground on the (X) commutator brush and segment advances the switch to position 13. The switch now advances to position 15 under control of operated (TK) and released (L)

relays and awaits the advance of the incoming circuit to release the (TK) relay. From this point the circuit is returned to normal as described in paragraph 10.

When the circuit is arranged to give line busy tone to the calling subscriber on telltale, the (X) commutator advances the switch from position 15 to position 16 through cam B. Relay (L) being released in position 16, advances the switch to position 17. In position 17, the circuit functions to give busy back tone and flash to the calling subscriber as covered in paragraph 12. From this point, the circuit is returned to normal as described in paragraph 12, except that the DOWN magnet operates in position 18 to restore the elevator to normal.

17. TESTING SUBSCRIBERS' LINE FROM THE TEST DESK

When provision is made to test the subscribers' line circuits from the test desk, relay (SC) is provided and "v" wiring is used. When the final selector has advanced to position 15, the operation of a key at the test desk causes ground to be

connected to the "SC" lead operating the (SC) relay. The operation of the (SC) relay opens the locking circuit of the (L) relay through the subscribers' loop, to allow the final to advance on disconnect regardless of whether or not the called subscriber is on the line and releases the (CO) relay of the subscriber's line circuit, which in turn causes the (L) relay of the line circuit to operate and start a line finder hunting for this line. When the line is found by the line finder, a check for dial tone is obtained at the test desk. The purpose of this test is to determine whether the subscriber's line is seized by a line finder and whether dial tone is applied to the line.

18. TEST JACK

Jack (MB) is for the purpose of making this circuit busy during testing. Jack (T) is used to test the operation of this circuit.

19. TRAFFIC USAGE RECORDER

When "Q" option is furnished, the "S" lead to the traffic usage recorder circuit is grounded while the final is busy. Ground is removed from the "S" lead when the final is idle.

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