# PANEL SYSTEMS
# SUBSCRIBER RECORDING
# COMPLETING TRUNK
# TWO WIRE
# OUTGOING TO TOLL OFFICE
# NOT ARRANGED TO RECALL THE SUBSCRIBER

CHANGES

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 Note 114 has been revised and extended to cover the case where the circuit is used with both a panel and a cross-bar office. Note 114 Previously Read:

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Provide "E", "N", "V", "W" and "E" Options As Follows: See Note 117

| Areas | Wiring Arrangement | | Used In Ckt. |
|---|---|---|---|
| | Where The Pan. Cent. Off. Is Equipped With The Sdr. Sel. Type Dist. Sel. | Where The Pan. Cent. Off. Is Equipped With The Link Type Dist. Sel. | |
| Where Sub. P.B.X.'s Are Arranged For Toll Diversion | V & E | Z & E | A & M Only |
| Where The Sub. P.B.X.'s Are Not Arranged For Toll Diversion | W & E<br>N & Z | W & E<br>N & Z | Disc. |

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All other headings, No change.

BELL TELEPHONE LABORATORIES, INC.

DEPT. 3350-DFJ-RSW

# PANEL SYSTEMS
# SUBSCRIBER RECORDING
# COMPLETING TRUNK
# TWO WIRE
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## CHANGES

### D. DESCRIPTION OF CIRCUIT CHANGES

D.1 Circuit Note 118 was rated "Mfr. Disc." and superseded by Circuit Note 126. Circuit Note 126 refers to the use of "J" option in panel areas arranged for toll diversion on an "A & M Only" basis. This permits the use of the trunk test circuit without change where additions to an office employing the "J" option is required.

All other headings, No change.

BELL TELEPHONE LABORATORIES, INC.

DEPT. 3350 TVC-RSW

# PANEL SYSTEMS
# SUBSCRIBER RECORDING
# COMPLETING TRUNK
# TWO WIRE
# OUTGOING TO TOLL OFFICE
# NOT ARRANGED TO RECALL THE SUBSCRIBER

## CHANGES

### A. CHANGED AND ADDED FUNCTIONS

A.1 Provision was made for restoring the talking battery to the tip conductor of the subscriber's line, immediately following the removal of the holding ground from the sleeve circuit of the connected switches, when this circuit is available to both a panel and a crossbar office.

A.2 Provision was made for connecting this trunk to the trunk make busy circuit in the panel office.

### B. CHANGES IN APPARATUS

B.1 Added

(MB) Y99 Relay - Figure 5

### D. DESCRIPTION OF CIRCUIT CHANGES

D.1 "H" option was added for use where this circuit is available to both a panel and a crossbar office. "K" option was designated to provide for its use where this circuit is available to a panel office only. "H" option permits the immediate release of relay (RV) following the disconnection of the holding ground from the connected switches to reduce the probable holding time of the crossbar marker circuit.

D.2 Figure 5 and "Q" option was added and "Q" option designated to provide for the connection of this circuit to a trunk make busy circuit in a panel office, when specified. Relay (MB), Figure 5, prevents interference with a call which is already in progress when the trunk make busy circuit connects ground to this circuit.

D.3 Circuit Note 123 was changed to clarify the use of "R" option. Circuit Note 123 formerly read as follows: "Provide 'T' option where 'F' option is furnished and Figure 4 is specified. Prior to Issue 12-D 'R' option was an intricate part of Figures 1 and 2."

D.4 Circuit Notes 124 and 125 were added.

D.5 Circuit Note 115 was changed to cover the use of "B" option when figure 2 is not furnished.

All other headings under Changes, no change.

## 1. PURPOSE OF CIRCUIT

1.1 This circuit is for use in completing toll calls from non-coin panel systems subscribers. It is a two-wire circuit and functions between the panel district selector or office selector circuits and two-wire recording completing trunk equipment at a combined line and recording toll switchboard. This circuit is also arranged for operation in areas equipped with subscriber PBX's arranged for toll diversion.

1.2 A multiple of this circuit on the office link and connector circuit in a crossbar office located in the same building is provided on a "Provisional" basis to permit the common use of this circuit by subscribers in both the panel and the crossbar offices. Separate subscriber loops are provided the crossbar subscribers for each wiring arrangement of the supervisory relay which may be required in the associated panel office.

## 2. WORKING LIMITS

2.1 See attached table for the working limits for relays (A) and (A1).

2.2 The maximum external trunk circuit loop resistance with which relay (TK) will operate satisfactorily is 3050 ohms.

2.3 The minimum external loop resistance with which relay (TK) will not operate satisfactorily is 14,450 ohms.

2.4 The minimum external trunk loop insulation resistance shall be 30,000 ohms.

2.5 The maximum rated external resistance for the satisfactory operation of the (TG) relay shall be 1200 ohms to 45-50 volts battery.

## 3. FUNCTIONS

Panel Connection

3.01 Provides means for preventing the false flash of the line signal during the trunk guard test by the sender circuit.

# WORKING LIMITS

## (A) G80 Relay

| Wiring | Adj. No. | Windings in Ckt. | Min. Ext. Rated Res. During Trk. Guard Test By Sender | Max. Subs. Ckt. Loop Res. Panel | Max. Subs. Ckt. Loop Res. Cross-bar | Max. Earth Potential Subs. Line | Min. Insulation Res. Subs. Lines | Max. Ext. PBX Trk. Ckt. Loop Res. Panel | Max. Ext. PBX Trk. Ckt. Loop Res. Cross-bar | PBX Trk. Rel. Ckt. Min. Rated Res. to Max. 56 V Bat. at PBX | Max. Earth Potential PBX Trunk | Min. Insulation Res. PBX Trunk |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| "J", "W" & "E" | 1 | P1/P2 | 1937Ω | 1200Ω | 1200Ω | ± 20V | 10000Ω | 1200Ω | 1200Ω | 6000Ω | ± 10V | 15000Ω |
| | | P1 or P2 | or 2954Ω | 750Ω | | | | | | | | |
| "J", "W" & "E" | 4 | P1/P2 | | 1500Ω | 1500Ω | ± 20V | 10000Ω | 1500Ω | 1500Ω | 6000Ω | ± 10V | 15000Ω |
| | | P1 or P2 | 2954Ω | 750Ω | | | | | | | | |
| "J", "Z" & "E" | 2 | P1/P2 | 2954Ω | 800Ω | 800Ω | ± 20V | 10000Ω | 800Ω | 800Ω | 6000Ω | ± 10V | 15000Ω |
| "J" "V" & "E" | 3 | P1/P2 | 1937Ω | 750Ω | 1300Ω | ± 20V | 10000Ω | 750Ω | 1300Ω | 6000Ω | ± 10V | 15000Ω |
| | | | or 2954Ω | | | | | | | | | |
| "J" "N" & "Z" | 1 | P1/P2 | 1937Ω | 1200Ω | 1200Ω | ± 20V | 10000Ω | 1200Ω | 1200Ω | 6000Ω | ± 10V | 15000Ω |
| | | P1 or P2 | or 2954Ω | | | | | | | | | |
| "J" "N" & "Z" | 4 | P1/P2 | | 1500Ω | 1500Ω | ± 20V | 10000Ω | 1500Ω | 1500Ω | 6000Ω | ± 10V | 15000Ω |
| | | P1 or P2 | 2954Ω | 750Ω | | | | | | | | |
| "F" "Z" & "E" | 5 | P1/P2 | 1937Ω | 1500Ω | 1500Ω | ± 20V | 10000Ω | 1500Ω | 1500Ω | 6000Ω | ± 10V | 15000Ω |
| | | | or 2954Ω | | | | | | | | | |
| "F", "V" & "E" | 5 | P1/P2 | 1937Ω | 940Ω | 1500Ω | ± 20V | 10000Ω | 940Ω | 1500Ω | 6000Ω | ± 10V | 15000Ω |
| | | | or 2954Ω | | | | | | | | | |

## (A1) G81 RELAY

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| All Options | | P1/P2 | | | 1500Ω | ± 20V | 10000Ω | | 1500Ω | 6000Ω | ± 10V | 15000Ω |

3.02 Provides means for signaling the toll operator when the district selector circuit has reached the "Awaiting Operator" position.

3.03 Provides the toll operator with switchhook supervision after the district circuit has reached the "Cut-Through" position.

3.04 Provides the subscriber with ringing induction tone until the toll operator answers, and permits the return of the ringing induction tone whenever the toll operator disconnects before the subscriber.

3.05 Reverses the battery supply to the district selector circuit when the toll operator answers.

3.06 Provides means for holding the connection under control of both subscriber and toll operator.

3.07 Provides a test busy condition to other hunting district selector circuits and crossbar markers after the district has reached the "Awaiting Operator" position.

3.08 Permits the subscriber to abandon the call and release the connection before the primary line signal has been answered.

3.09 Provides means for connecting a test set for making routine operating tests.

3.10 Provides for the satisfactory operation of this circuit when using in areas where the PBX's are arranged for toll diversion.

3.11 Provides 48 volt transmission.

3.12 Provides a connection to a "Test and Make Busy" jack in the "Outgoing Trunk Test Board" for testing the interoffice cable.

3.13 Provides a connection to a "Test and Make Busy" jack in the "Outgoing Trunk Test Board" for making operating tests.

3.14 Provides a test jack with the circuit for making operating tests.

3.15 Provides for holding the subscriber's talking battery connected to the ring conductor of the subscriber's line for a short interval to insure the release of the switches before the reversing relay restores to normal. This feature is omitted when this circuit is available to both a panel and a crossbar office.

3.16 Provides for connection to a trunk make busy circuit.

Crossbar Connection

3.17 Provides means for signaling the toll operator when this circuit is connected to the crossbar district junctor circuit.

3.18 Provides the toll operator with switchhook supervision when the circuit is connected to the district junctor circuit. The district junctor is automatically cut through on this type of connection without awaiting a reversal from the recording completing trunk.

3.19 Provides a subscriber with ringing induction tone until toll operator answers and permits the return of the ringing induction tone whenever the toll operator disconnects before the subscriber.

3.20 Provides an auxiliary supervisory relay in series with the regular supervisory relay on connections to crossbar subscribers to permit the maximum possible subscriber loop connections, regardless of the wiring conditions of the supervisory relay serving the panel subscriber connections. The winding of this relay is short-circuited when the toll operator answers and the regular supervisory relay is then operating at its maximum efficiency. The maximum subscriber's loop is determined by the adjustment on the regular supervisory relay.

3.21 Reverses the battery supply to the subscribers line when the toll operator answers. Prior to this reversal the direction of the polarity of the battery is such as to cause the operation of toll diversion apparatus in a connected PBX trunk when required.

3.22 Provides means for holding the connection under control for both the subscriber and the toll operator.

3.23 Provides a test busy condition to hunting marker circuits and panel district selector circuits when this circuit is connected to the crossbar district junctor circuit.

3.24 Permits the subscriber to abandon a call and release the connection before the primary line signal has been answered.

3.25 Provides a connection to "Test and Make Busy" jack in the "Outgoing Trunk Test Board" in the crossbar office for testing the interoffice cable and for making operating tests.

3.26 Provides for the immediate release of the reversing relay following the disconnection of the holding ground from the connected switches at the end of a call.

3.27 Provides for connection to a trunk make busy circuit in a panel office.

## 4. CONNECTING CIRCUITS

4.01 Panel district selector circuits - "Sender Selector" offices - ES-240071.

4.02 Panel district selector circuits - "Link" offices - SD-21627-01.

4.03 Panel office selector circuits - ES-240252.

4.04 Two-wire panel subscriber recording completing trunk at No. 1 and No.3 toll offices - SD-62187-01 and SD-62426-01.

4.05 Test set circuit for two-wire panel system subscriber recording completing trunks - SD-90470-01.

4.06 Crossbar office link and connector circuit - SD-25033-01.

4.07 Power ringing circuit - SD-80594-02.

4.08 Test and make busy jack circuit - Panel office - SD-21613-01.

4.09 Test and make busy jack circuit - Crossbar office - SD-25166-01.

4.10 Test cord circuit for outgoing trunks at the "Outgoing Trunk Test Board" Panel office - SD-21612-01.

4.11 Test cord circuit for outgoing trunks at the "Outgoing Trunk Test Board" - Crossbar office - SD-25177-01.

4.12 Trunk make busy circuit in panel office - SD-21075-01.

## DESCRIPTION OF OPERATION

## 5. INCOMING CALL - Panel Connection

When this trunk is seized by a district or office selector, battery - through lamp (B) or (T) ("W" option); - through lamp (B) or (T) and the (P1) winding of relay (A) ("Z" option); - through lamp (B) or (T), the (P1) winding of relay (A) and resistance (C) ("V" option; - on the tip side of the trunk and ground - through lamps (G) or (T) ("N" option); - through lamp (G) or (T) and the (P2) winding of relay (A) ("E" option) on the ring side of the trunk, causes a momentary closure through the (TG) and overflow relays in the sender circuit which is connected to the district circuit during the period of selection in the district selector. Relay (A)* may or may not operate at this time. When the district selector circuit reaches the "Awaiting Operator" position, relay (A) operates in series with a polarized relay in the district selector circuit in turn operating relay (F). The operation of relay (F) operates relay (B)** which

connects ground to the district sleeve circuit and to the "S1" lead in the associated crossbar office, if "R" option is provided, or operates relay (K) - "T" option, and if "J" and "G" options are used operates relay (B1). The operation of relay (B) also - with "Q" option - operates relay (MB) which disconnects the trunk make busy lead from lead "S" to the panel switches and lead "S1" to the crossbar switches and operates relay (B1) if "J" option is used. The operation of relay (K) connects ground thru the winding of relay (TG) to the panel district selector circuit and ground to the "S1" lead in the crossbar office. If "F" option is used the district selector circuit will be caused to step on to the "Cut-Through" position and as the district selector circuit leaves the "Awaiting Operator" position, ground is removed from the sleeve lead in the district selector and replaced by the holding ground from relay (B) or (K). When the ground is removed from the district selector relay (TG) in this circuit operates in series with the (L) relay in the district selector circuit. The operation of relay (TG) connects ground to the closed contact of relay (B) or (MB) which operates relay (B1). The operation of relay (B1) operates relay (C). The operation of relay (C) connects ringing induction tone to the subscribers end of the trunk and connects battery and ground through the windings of relay (TK) to the ring and tip conductors outgoing to the toll office, causing a high resistance relay at the toll office to operate and light a line lamp. Relay (TK) will not operate at this time due to the high resistance loop.

* Relay (A) is given a non-operate adjustment to prevent its operation during the trunk guard test with "J" option. Relay (A) may or may not operate during the trunk guard test when "F" option is used. However, if it does operate it cannot cause a signal to be sent to the toll operator because relay (TG) of this circuit is not operated.

** Relay (B) is a slow to release relay to prevent the release of the selector switch should the subscriber flash the switchhook before the toll operator answers. ("V" and "E" option) or ("Z" and "E" option).

6. INCOMING CALL - Crossbar Connection

When this trunk is connected to a crossbar district junctor circuit battery - through lamp (B) or (T) ("W" option); through lamp (B) or (T) and the (P1) winding of relay (A)* "Z" option); - through lamp (B) or (T) the (P1) winding of relay (A)* and resistance (C) ("V" option); and the winding of relay (A1), figure 4 on the tip side of the trunk and ground - through lamps (G) or (T) ("N" option); - through lamps (G) or (T) and the (P2) winding of relay (A)* ("E" option) on the ring side of the trunk operates relay (A1) in series with the connected subscribers line. The operation of

relay (A1)* operates relay (F1). The operation of relay (F1)** (a) connects ground to the bottom contact of relay (B) or (MB) ("F" option), (b) operates relay (F) and (c) connects ground to the "S" lead of the office link and connector circuit. The operation of relay (F) operates relay (B) which connects ground to the panel district sleeve circuit and the "S1" lead of the office link connector circuit ("R" option) or operates relay (K) ("T" option). The operation of relay (K) connects ground through the winding of relay (TG) to the panel district selector sleeve circuit and ground to the "S1" lead in the crossbar office. The operation of relay (B) also with "G" option operates relay (B1) or with "Q" option operates relay (MB). The operation of relay (MB) disconnects the trunk make busy circuit from this circuit and operates relay (B1). The operation of relay (B1) operates relay (C), the operation of relay (C) connects ringing induction tone to the subscribers end of the trunk and connects battery and ground through the winding of relay (TK) to the ring and tip conductors outgoing to the toll office causing a high resistance relay at the toll office to operate and light a line lamp, relay (TK) will not operate at this time due to the high resistance loop*.

* Relay (A) performs no function at this time and whether it operates or not when relay (A1) operates is irrelevant to the description of operation of this circuit at this time.

** Relay (F1) is a slow to release relay to prevent the release of the crossbar switches should the subscriber flash the switchhook before the toll operator answers.

7. TOLL OPERATOR ANSWERS

When the toll operator answers the high resistance is short-circuited at the toll switchboard thereby operating relay (TK) which operates relay (H). The operation of relay (H) (a) disconnects the ringing induction tone from the subscriber's end of the trunk, (b) operates relay (RV) and (c)* closes the talking circuit through condenser (B). The operation of relay (RV) - "W" option - (a) reverses the battery supply to the panel district circuit, causing it to step into the "cut-through" position or reverses the battery supply to the crossbar subscriber's line and (b) arranges the connections to relay (A) to include both windings in the circuit. The operation of relay (RV) - "V" or "Z" options - (a) reverses the battery supply to the panel or to the crossbar subscriber's line and (b) disconnects resistance (C)+ - "V" option only. The operation of relay (RV) - "W","V" or "Z" option - also (a) locks itself up under control of relay (B1)++ - "K" option - or relay (B) or relay (K) - "H" option+++, and (b) connects a ground to the winding of relay (B) with "Y" option or operates relay (J) Fig. 4 with "X" option. The operation

of relay (J) (a) connects ground from relay (H) to the winding of relay (B) for holding the connection under control of the toll operator, (b) short-circuits the windings of relay (A1) causing relay (A1) to release, (c) connects ground to the lower contact of relay (B) - "F" option - and (d) connects ground to lead "S" of the office link and connector circuit. The release of relay (A1) releases relay (F1) which restores the control of relay (F) to relay (A). The circuit is now arranged for talking.

* The talking circuit through condenser (B) was left open until this time to prevent the false operation of relay (TK) due to the charging and discharging of condenser (B).

** Only one winding of relay (A) was wired in the circuit before the toll operator answered in order to obtain easier nonoperate margins during the trunk guard test.

\+ Resistance (C) is used to reduce the click that occurs when the sender selector type district selector cuts through.

++ Relay (B1) is a slow to release relay and is used to prevent a reversal of the talking battery before the district selector switch is disconnected at the end of a call.

+++ The feature of holding relay (RV) operated until the switches are released is waived where Fig. 4 is provided.

## 8. SIGNALING THE TOLL OPERATOR

Relay (A) in following the operation of the switchhook at either the panel or the crossbar subscriber station causes relay (F) to operate and release in unison. The operation and release of relay (F) reverses the battery and ground to the toll board end of the trunk, causing the supervisory lamp in the connected toll cord circuit to flash as a recall signal or to light steadily as a disconnect signal.

## 9. HOLDING AND DISCONNECT

A connection is held as long as the toll operator's cord is connected to the trunk or the subscriber has the receiver off the switchhook. When the subscriber disconnects relays (A) and (F) release and function as described in Paragraph 8. When the toll operator disconnects, relay (TK) releases in turn releasing relays (H), (B) and (K). The release of relays (B) and (K), (a)* disconnects ground from the panel district sleeve circuit and the crossbar "S1" lead, releasing relay (TG), "F" option, (b) releases relay (B1)** and relay

(J) - "G" option - and (c) releases relay (MB) which in turn releases relays (B1) and (J) - "Q" option - and (d) releases relay (RV) - "H" option. The release of relay (J) removes the short circuit from the winding of relay (A1), removes ground from the lower contact of relay (B) or (MB) and removes ground from the "S" lead of the office link and connector circuit.+ The release of relay (B1) releases relay (C) and relay (RV) - "K" option. The release of relay (C) opens the signaling circuit to the toll switchboard. The release of relay (RV) restores the talking battery to the tip conductor and ground to the ring conductor.

* Removal of ground from the panel district sleeve circuit disconnects the panel district selector circuit.

** Relay (B1) is a slow to release relay and is used to prevent a reversal of the talking battery before the panel district selector switch or the crossbar switches have been disconnected - "K" option. This feature is not used with "H" option.

\+ The removal of ground from the "S" lead of the office link and connector circuit causes the release of the connected crossbar switches.

10. TESTING

To make this trunk busy to hunting panel district selectors or crossbar markers connect ground to the "S" lead at the panel district or office multiple or at the local IDF or to the "S1" lead on the office link and connector frame (secondary multiple) in the crossbar office.

To make routing operating tests in a panel office a plug of the test set will be inserted into the jack shown in Fig. 2. The insertion of the plug will (a) connect the tip and ring of the trunk to the tip and ring of the test circuit respectively, (b) open the sleeve circuit to the panel district selector circuit between the trunk and the district or office multiple, (c) connect ground to the associated sleeve terminal in the district or office multiple or the "S1" lead on the secondary multiple of the office link and connector frame and (d) connect the trunk sleeve circuit to the test set. When the test is completed the plug of the test set is removed and the circuit is restored to normal.

To test this circuit from the outgoing trunk test board in the panel office the outgoing trunk test cord shall be connected to the "test and make busy" jack, wiring for which is shown in Fig. 3. When the test cord is connected to this jack, ground will be connected to the sleeve of this circuit on the panel office multiple and on the "S1" lead of the crossbar secondary multiple thereby providing a busy condition to

hunting panel district selectors or crossbar markers. To test the conductors used for connecting this trunk to the toll office, a connection shall be made at the "outgoing trunk test board" in the panel office to the associated "test and make busy" jack, the wiring for which is shown on the trunk side of this circuit. When the test circuit is connected, ground will be connected to the sleeve of this circuit on the panel office multiple and to the "S1" lead on the crossbar secondary multiple of the office link and connector frame thereby providing a busy condition to hunting panel district selectors or crossbar markers.

To test the conductors that are used for connecting this trunk to the toll office a connection may be made to the associated "test and make busy" jack at "outgoing trunk test board" in the crossbar office, the wiring for which is shown in Fig. 1. When the test circuit is connected, ground will be connected to the sleeve of this circuit on the panel office multiple and the "S1" lead of the secondary multiple of the crossbar office link and connector circuit thereby providing a busy condition to hunting selectors or markers.

To make routing operating tests on this circuit from the outgoing trunk test board in a crossbar office, a connection is made to this circuit at the test board via the test jack which is shown on the office link and connector circuit.

11. TOLL DIVERSION

When a subscriber in a PBX equipped for toll diversion dials a long distance code, battery on the tip conductor and ground on the ring conductor of this trunk will cause the operation of the toll diversion feature at the private branch exchange.

BELL TELEPHONE LABORATORIES, INC.

DEPT. 3350

TVC)
RSW) JB