

CIRCUIT DESCRIPTION
BELL TELEPHONE LABORATORIES, INC.,
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PANEL SYSTEM
INCOMING SELECTOR CIRCUIT
FROM KEY INDICATOR MANUAL OFFICE
4-PARTY SEMI-SELECTIVE RINGING

CHANGES

A. CHANGED AND ADDED FUNCTIONS

A.1 No change.

B. CHANGES IN APPARATUS

B.1 No change.

C. CHANGES IN CIRCUIT REQUIREMENTS OTHER THAN THOSE APPLYING TO
ADDED OR REMOVED APPARATUS

C.1 No change.

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 Rating changed from "Standard" to "A & M Only".

DEVELOPMENT

1. PURPOSE OF CIRCUIT

1.1 No change.

2. WORKING LIMITS

2.1 No change.

OPERATION

3. FUNCTIONS

3.1 No change.

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4. CONNECTING CIRCUITS

4.1 No change.

DETAILED DESCRIPTION

No change.

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4.1 - No change.

DETAILED DESCRIPTION

No change.

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CIRCUIT DESCRIPTION
BELL TELEPHONE LABORATORIES, INC.,
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Issue 1
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PANEL MACHINE SWITCHING SYSTEM
INCOMING SELECTOR CIRCUIT
FROM KEY INDICATOR MANUAL OFFICE
4 PARTY SEMI-SELECTIVE RINGING

DEVELOPMENT

1. PURPOSE OF CIRCUIT

- 1.1 This circuit is used for establishing a connection between an operator in a key indicator manual office and a subscriber or an operator in a panel machine switching office.

2. WORKING LIMITS

- 2.1 The external circuit loop for selections shall not exceed 1488 ohms resistance and shall not include more than 12 miles of cable. The insulation resistance of the trunk shall not be less than 30,000 ohms.
- 2.2 The external circuit loop resistance for trunk supervision shall not exceed 1390 ohms with 20 volts min. at the manual office, or 2875 ohms with 40 volts min. at the manual office. In either case the insulation resistance of the trunk shall not be less than 30,000 ohms.
- 2.3 The external circuit loop resistance for supervision toward the called subscriber shall not exceed 900 ohms and the insulation resistance of the subscriber's line shall not be less than 10,000 ohms.

2.4 Tripping Ranges:

<u>Ringling 20 Cycles</u>		<u>Silent Interval</u>	<u>Max. Ext. Ckt. Loop for Tripping</u>	
<u>A.C. Voltage</u>	<u>D.C. Voltage</u>		<u>For Ringling Interval</u>	<u>For Silent Interval</u>
95-103	16-19	46-52	800 ohms	730 ohms
95-110	-	46-52	450 "	730 "

OPERATION

3. FUNCTIONS

- 3.01 Recognizes selection.
- 3.02 Makes brush selection.
- 3.03 Trips the selected brush
- 3.04 Makes group selection.
- 3.05 Selects, and centers the multiple brush on the terminals of the first idle trunk in the selected group.
- 3.06 Grounds the sleeve terminal of the selected trunk as soon as it is seized and until the switch advances beyond the talking position.
- 3.07 Closes the "T" conductor of the incoming trunk to the "T" conductor of the final selector and connects ground to the "R" conductor of the incoming trunk during the time the final selector is making selections.
- 3.08 Recognizes the completion of final selections and signals the sender that all selections have been completed.
- 3.09 Recognizes trunk closure from the operator's cord circuit or from the key indicator link-circuit.
- 3.10 Closes the ringing circuit at the proper time for signalling the called station.
- 3.11 Transmits ringing induction to the calling subscriber while the ringing circuit is closed.
- 3.12 Opens the ringing circuit when the receiver is removed from the switchhook at the called station or when the operator releases the trunk.
- 3.13 Furnishes talking battery to the called station as soon as the ringing circuit is opened and until the connection is released.
- 3.14 Signals the operator when the called subscriber removes the receiver from the switchhook.
- 3.15 Signals the operator when the called subscriber replaces the receiver on the switchhook.

- 3.16 Furnishes repeating coil and condenser transmission during the time the calling and called stations are connected.
- 3.17 Returns the elevator to normal, resets the multiple brush, and advances the sequence switch to normal when released by the operator.
- 3.18 Registers each revolution of the sequence switch.
- 3.19 If all of the trunks in the selected group are busy when the selector hunts for an idle trunk, the elevator stops on the top set of terminals in the group (known as the overflow terminals) and the selector functions as follows:
- (a) Signals the sender that an overflow condition exists.
 - (b) Recognizes trunk closure.
 - (c) Registers the overflow condition.
 - (d) Transmits an overflow signal to the operator.
 - (e) Returns to normal when released by the operator.
- 3.20 When the elevator travels to the top of the frame on a trouble condition (tell tale) the circuit functions as follows:
- (a) Releases the UP-drive magnet.
 - (b) Signals the sender as on an overflow condition.
 - (c) Recognizes trunk closure.
 - (d) Transmits an overflow signal to the operator.
 - (e) Returns to normal, when released by the operator.
- 3.21 Returns to normal if the switch is advanced off-normal manually.
- 3.22 Recognizes a wipe-out condition as soon as the switch enters the ringing position, opens the ringing circuit and returns to normal.

3.23 Uses the same sequence switch as the corresponding incoming circuit for panel machine switching service in order to permit conversion from manual to panel without changing cams.

4. CONNECTING CIRCUITS This circuit functions with:

- 4.1 Cord circuits in manual offices equipped with key indicator apparatus and the associated key indicator link and sender circuits.
- 4.2 Auxiliary and long O.G. trunk circuits.
- 4.3 Standard final selector circuits.
- 4.4 Standard trunk circuits for blank incoming multiple.
- 4.5 Standard "Miscellaneous Registers" circuits.
- 4.6 Standard "Miscellaneous Tones and Interrupters" circuits.
- 4.7 Standard test set circuits for testing incoming selectors.

DETAILED DESCRIPTION

5. SEIZURE When the trunk to an incoming selector circuit is seized by the key indicator link circuit and the associated sender closes the fundamental circuit for incoming brush selection the (L) relay operates in series with the (STP) "stepping" relay of the sender. The operation of the (L) relay closes a circuit which advances the switch to position 2.

6. BRUSH SELECTION With the switch in position 2, the UP-drive magnet 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 to the tip side of the fundamental circuit, alternately closing and opening a short circuit around the stepping relay in the sender circuit, thus causing the stepping relay to release and reoperate. 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 UP magnet; which stops the upward movement of the selector, and the switch advances to position 3 where a circuit is closed for operating the TRIP magnet.

7. GROUP SELECTION When the fundamental circuit is again closed through the sender, the (L) relay operates, advancing the switch to position 4. The UP magnet is again operated and the selector moves upward for group selection tripping the previously selected brush. 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, 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 (a) opens the circuit through the UP magnet thereby stopping the upward movement of the selector and (b) advances the switch to position 5. As the switch leaves position 4 the TRIP magnet releases,

8. TRUNK HUNTING In position 5, the (L) relay operates through its secondary winding, advancing the switch to position 6. If the first trunk in the group is idle when the switch advances from position 5 1/4 the (L) relay releases and connects ground at cam K to the S terminal of the trunk as a busy condition. The release of the (L) relay advances the switch to position 7. If the first trunk of the group is busy when the switch enters position 6, the (L) relay holds through its primary winding from ground on the busy S terminal and the UP magnet operates, causing the selector to move upward. When an idle trunk is found the holding circuit through the primary winding of the (L) relay is opened, but the (L) relay does not release immediately because of a circuit closed through the "C" commutator brush and segment. 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 primary winding of the (L) relay is opened by the sleeve brush leaving the busy terminal and making contact with the sleeve terminal of the idle trunk. The (L) relay and the (UP) 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 brush is slightly above the center of the selected set of terminals and the holding pawl enters the notch in the rack attached to the brush support rod. When the circuit to ground at the "C" commutator opens, the (L) relay releases, disconnecting ground from the commutator feed bar "G" and releasing the UP magnet. The selector

then drops back upon the holding pawl, thus centering the brush on the selected terminals. During trunk hunting, ground is connected to the "G" commutator through cam E and the front contact 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 advances the switch to position 7.

9. SELECTION BEYOND - In position 7, the (L) relay operates through its primary winding, advancing the switch to position 8, where the (L) relay holds over the ring side of the trunk to ground in the final selector circuit. The tip of the fundamental is closed through cam F from the final selector circuit to the sender and ground through the contact of the (L) relay is connected to the ring thus completing the fundamental circuit.

10. INCOMING ADVANCE - After selection beyond has been completed, the final selector circuit functions and removes ground from the ring, causing the (L) relay to release thereby advancing the switch to position 9. The (L) relay reoperates in position 9 over the fundamental circuit and advances the switch to position 10. This time the direction of the current over the tip and ring of the fundamental circuit is reversed. The A cam ground advances the switch to position 11. This causes the associated key indicator sender and link circuits to function. When the key indicator operator inserts the plug into the trunk jack, battery and ground is supplied by the operator's cord circuit over the trunk to operate the (A) relay thereby giving "trunk closure". The (A) relay operated, operates the (D) relay which in turn operates the (L) relay thus advancing the switch to position 12.

11. 4 PARTY SEMI-SELECTIVE RINGING - The P commutator bar of the 3-A commutator is so arranged that the subscriber's lines, which are served by final selectors that terminate as trunks in bank terminals of groups 0 and 2 on the incoming frame, are signalled with a 1 ring code and the lines which are served by final selectors that terminate in groups 1 and 3 are signalled with the 2 ring code.

11.1 "ONE RING" RINGING CODE - If the selected trunk is in a group which is signalled by the one ring code, the P commutator ground is absent, and the (L) relay releases when the switch advances from position 11 1/4. With the (L) relay released, the (PU) relay operates immediately in position 12 and advances the

switch to position 13. The (PU) relay locks under control of the (R) and (D) relays, (the (D) relay being under control of the (A) relay). In position 13, "one ring" ringing current is supplied for signalling the called subscriber and ringing induction is transmitted to the calling subscriber thru the (A) condenser. When the receiver is removed from the switchhook at the called station, the (R) relay operates, thereby releasing the (PU) relay which in turn operates the (L) relay, thus advancing the switch to position 14. As the switch leaves position 13 1/2, the (L) relay releases. In position 14, ground is supplied thru contacts 2T and 3T of the (L) relay to advance the switch to position 15. In position 15 a path is closed for advancing the switch to position 16.

11.2 "TWO RING" RINGING CODE - If the selected trunk is in a group which is signalled by the two ring code, the P commutator supplies ground for holding the (L) relay operated from position 11 1/2 to 13. Under this condition, the (L) relay remains operated in position 12 and the (PU) relay operates in position 12 from ground supplied by the "pick-up" interrupter. The operation of the (PU) relay in this manner insures that both rings of the initial "two ring" cycle are obtained as well as the succeeding ringing cycles. When the (PU) relay operates, it locks under control of the (R) and (D) relays, (the (D) relay being under control of the (A) relay) and advances the switch to position 13. In position 13 ground is supplied by contacts 1T and 2T of the (L) relay causing the switch to advance to position 14. In position 14, the (L) relay is locked operated thru contacts 1T and 2T of the (PU) relay and the called subscriber is signalled with two ring ringing current. Ringing induction is transmitted to the calling subscriber thru the (A) condenser in position 14. When the receiver is removed from the switchhook at the called station, the (R) relay operates thus releasing the (PU) relay which in turn releases the (L) relay and advances the switch to position 15. In position 15 a path is closed for advancing the switch to position 16.

12. TALKING - The (S) relay operates when the (PU) relay releases either in position 13 or 14 and remains operated until the receiver is replaced upon the switchhook at the called station or until the switch leaves position 16. When the (S) relay operates, it short-circuits the secondary winding of the (A) relay thus permitting the operation of the supervisory relay in the calling cord at the manual office. The (L) relay holds in position 16 under control of the (A) relay.

13. RETURN TO NORMAL - When the plug of the calling cord is removed from the outgoing trunk jack at the manual office, the (A), (D) and (L) relays release. The release of the (L) relay advances the switch to position 18, in which position the DOWN magnet is energized returning the elevator to normal. The TRIP magnet is energized in position 17 1/2 /18 to prevent snagging the multiple brush on the trip fingers when the elevator is returning to normal. When the elevator reaches normal the tripped multiple brush is reset and ground on the Y commutator advances the switch to normal.

14. RETURN TO NORMAL ON AN ABANDONED CALL - If the plug of the calling cord is removed from the outgoing trunk jack at the manual office while the switch is in either of the ringing positions, the (A) and (D) relays release. The release of the (D) relay releases the (L) relay, advancing the switch to position 15. Operation of the (L) relay in position 15 advances the switch to position 16. The (L) relay releases when the switch advances from position 15. The switch advances to position 18 from which point return to normal is completed as described in paragraph 13.

15. OVERFLOW - If all of the trunks in the group selected test busy when trunk hunting in position 6, the selector will continue upward until the multiple brush makes contact with the top set of terminals in the group, known as the overflow terminals. The sleeve commutator bar is open at overflow to prevent grounding the sleeve terminal of the multiple bank while the switch is moving out of trunk hunting position. The (L) relay releases when this terminal is reached and advances the switch out of the trunk hunting position. The advance of the switch from position 7 to 12 is described in paragraphs 9 and 10. Ground on the Z commutator advances the switch to position 17. The overflow register, connected to the tip multiple bank terminal, operates from generator and repeating coil ground as the switch passes thru position 13/16. Interrupted ground from the "Miscellaneous Tones and Interrupters" circuit over lead PB alternately operates

and releases the (S) relay, thereby alternately short-circuiting, and opening the short circuit around, the secondary winding of the (A) relay. The supervisory relay in the calling cord at the manual office is alternately operated and released, flashing the calling cord supervisory lamp as an overflow signal. When the plug of the calling cord is removed from the outgoing trunk jack at the manual office, the (A), (D) and (L) relays release thereby restoring the selector to normal as described in paragraph 13.

16. TELL-TALE - If the elevator is driven to the top of the frame (tell-tale) in any of the UP-drive positions, ground on the "X" commutator and contacts 1T and 2T of the (L) relay will advance the switch to position 9. The (L) relay operates when the sender closes the fundamental circuit and the selector returns to normal as described in paragraph 15 except that the overflow register is not operated.

17. SELECTOR GROUP REGISTER - Each time the switch passes through position 10 ground is connected to the lead "GR" to the selector group register so as to record all of the calls which are completed through a group of incoming selectors.

18. GROUP BUSY REGISTER - As long as the switch is in the normal position, ground is connected to the PBR lead to the group busy register indicating an idle connection. When all the selectors in a group are off normal, the group busy register is operated.

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and releases the (S) relay, thereby alternately short-circuiting, and opening the short circuit ground, the secondary winding of the (A) relay. The supervisory relay in the calling cord at the manual office is alternately operated and released, flashing the calling cord supervisory lamp as an overflow signal. When the plug of the calling cord is removed from the outgoing trunk jack at the manual office, the (A), (D) and (I) relays release thereby restoring the selector to normal as described in paragraph 13.

16. TELL-TALK - If the elevator is driven to the top of the frame (tell-tale) in any of the UP-drive positions, ground on the "I" commutator and contacts IT and ST of the (I) relay will advance the switch to position 2. The (I) relay operates when the sender closes the fundamental circuit and the selector returns to normal as described in paragraph 15 except that the overflow register is not operated.

17. SELECTOR GROUP REGISTER - Each time the switch passes through position 10 ground is connected to the lead "GR" to the selector group register so as to record all of the calls which are completed through a group of incoming selectors.

18. GROUP BUSY REGISTER - As long as the switch is in the normal position, ground is connected to the FBR lead to the group busy register indicating an idle connection. When all the selectors in a group are off normal, the group busy register is operated.

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