

Western Electric Co., Incorporated,
Equipment Engineering Branch, Hawthorne.

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Issue 2 BT 431573
Appendix #2
February 3, 1925.

This Appendix was prepared from Issue #21 of T-431573.

METHOD OF OPERATION

Selector Circuit - Cordless Incoming From Manual - Four Party Semi-Selective
Ringing - Panel Machine Switching System.

Under heading of Working Limits, add Paragraph 2.1 as follows:-

The ringing trip range of the 114-AK relay when used with AC-DC
is 750W.

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February 3, 1925.
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METHOD OF OPERATION
SELECTOR CIRCUIT

Cordless - Incoming From Manual - Four-Party Semi-Selective Ringing - Full Mechanical Power Driven System.

This Method of Operation was prepared from issue 9 of drawing T-431573.

DEVELOPMENT

1. PURPOSE OF CIRCUIT

1.1 This circuit is used to establish connections from manual offices to full mechanical power driven offices when the manual offices have no other means for accomplishing the above than with regular manual circuits. This circuit is arranged to work with trunk finders which hunt for open circuit on the hunting lead.

2. WORKING LIMITS

2.1 This selector circuit works over regular inter-office manual trunk loops of 858 ohms maximum resistance and with subscriber's loops of 900 ohms maximum resistance with a minimum leak resistance of 10,000 ohms.

OPERATION

3. PRINCIPAL FUNCTIONS

3.1 This circuit is used in establishing connections between manual A position and a standard final selector. Its principal functions are as follows:

3.11 After the operation of the assignment key, the starting of a previously allotted sender selector hunting for this trunk and selecting an idle sender.

3.12 Selection of proper idle final selector and dismissing of sender and sender selector at the end of selection.

3.13 Ringing the called station.

3.14 Establishing talking connection.

3.15 Providing visual signals to the B operator, to show the progress of the call.

3.16 Returning to normal when the disconnect key is depressed.

4. CONNECTING CIRCUITS

This cordless incoming functions with:

4.1 Standard A cord circuits.

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4.2 Standard final selector circuits.

4.3 Wordless allotter key control, sender selector and sender circuits.

DETAILED DESCRIPTION

5. ASSIGNMENT KEY DEPRESSED

Normally this circuit connects ground to the (HTG) lead so that all trunk finders pass by this trunk. When the "B" operator, having assigned a trunk over the call wire, depresses the assignment key, the switch advances to position 2, and the peg count register (not shown) operates. In position 2 the white lamp burns steadily; ground is connected to the Hold, (ST) and (FUND) leads; and ground is disconnected from the (HTG) lead in order that the trunk finder may stop when it reaches the terminals of this trunk. After a key for each digit has been depressed, ground from the key control circuit (not shown) is connected to the (ADV) lead, and the switch advances to position 3. As the switch enters position 2-3/4, the ground for the holding lead is supplied at cam (N), and as the switch enters position 3, ground is connected to the hunting (HTG) lead through cam (N). In position 3, the white lamp is extinguished and the green lamp flashes rapidly from ground on the flicker (149-E) interrupter. After the sender has registered the key setting, ground through the sender (STP) relay is connected over the fundamental lead to the inner winding of the (L) relay which operates. The (L) relay operated, closes a circuit from ground to battery through the (R) magnet, advancing the switch to position 4, the (A) cam advancing it to position 5. As the switch passes through position 4, the (L) relay locks to ground on the fundamental lead.

6. CONNECTION ESTABLISHED IN MANUAL OFFICE BEFORE ASSIGNMENT KEY IS DEPRESSED

Should the "A" operator plug into the assigned trunk before the assignment key is depressed, the (A) relay operates. The (A) relay operated, closes a circuit from ground to battery through the 12000 ohm winding of the (L) relay, operating the (L) relay. The (L) relay operated, lights the white lamp. When the assignment key is depressed, the switch advances to position 2, and as the switch leaves position 1, the (L) relay releases so that ground will not be connected to the (HTG) lead in position 2. From here the circuit functions as described in paragraph 5.

7. BRUSH AND GROUP SELECTIONS

With the switch in position 5, a circuit is closed through the (UP) magnet, causing the selector to move upward for brush selection. As the selector travels upward, the (A) commutator brush and segment apply ground impulses over the fundamental lead to the associated sender circuit, successively short-circuiting and causing the reoperation of the stepping relay in the sender circuit. When sufficient impulses have been sent back to satisfy the sender, the fundamental circuit is opened, releasing the (L) relay.

The (L) relay released, opens the circuit through the (UP) magnet, thus releasing the magnet and stopping the upward movement of the selector, and advances the switch to position 6. In position 6, the Trip magnet operates to ground at cam (N), and the (L) relay again operates over the fundamental circuit, advancing the switch to position 7. In position 7, the circuit through the (UP) magnet is again closed, causing the selector to move upward for group selection. The Trip magnet being operated in position 6 to 8, the previously selected set of brushes are tripped as the selector moves upward in position 7. As the selector moves upward, carrying the brushes over the commutator, the (B) commutator brush and segment apply ground impulses to the fundamental (Fund) lead, successively short-circuiting and permitting the reoperation of the stepping relay in the associated sender circuit. When sufficient impulses have been sent back to satisfy the sender for brush selection, the circuit through the (I) relay is opened, releasing it. The (L) relay released, opens the circuit through the (UP) magnet, stopping the brushes at the selected group, and the switch advances to position 8. In position 8 the (L) relay operates from battery through its secondary winding to ground at cam (H).

8. TRUNK HUNTING

The (L) relay operated, advances the switch to position 9 for trunk hunting. If the first trunk of the group is idle as the switch enters position 9, the (L) relay releases and the sleeve terminal is held busy from ground through the break contact of the (L) relay to lead (S). If the first trunk of the group selected is busy, the (L) relay is held operated through its 1200 ohm winding, from ground on the sleeve of the busy trunk. The (UP) magnet, therefore operates to ground on cam (S), causing the selector to move upward until an idle trunk is found. When an idle trunk is found, the circuit through the inner winding of the (L) relay is opened, but the (L) relay does not release immediately due to a circuit being closed from ground on the C commutator brush and segment to battery through the 800 ohm winding of the (L) relay.

9. (a) 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 inner winding of the (L) relay is opened, by the sleeve brush leaving the busy terminal and making contact with the sleeve terminal of an idle trunk. The (UP) magnet, therefore, remains operated and the selector continues to travel upward until the brushes are carried slightly above the center of the idle trunk terminals, allowing the locking pawl to enter the notch on the rack attached to the brush support rod. At this time, the holding circuit through the outer winding of the (L) relay is opened at the (C) commutator, releasing the relay. The (L) relay released, disconnects ground from the commutator feed bar (G) and releases the (UP) magnet. The selector then drops into place, thus centering the brushes on the trunk terminals. During trunk hunting, in position 9 only, the commutator feed ground is supplied from cam (S) under control of the (L) relay. This is to prevent the reoperation of the (L) relay by the closing of a circuit between the (C) commutator brush and segment on the over-throw of the selector, or as it drops into place.

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10. SELECTION BEYOND

The release of the (L) relay advances the switch to position 10, the (S) cam advancing it to position 11. From position 10 to 16-1/4, the selected trunk is held busy to all other hunting selectors by ground connected to the sleeve terminal through the upper contacts of cam (I). In position 11, the fundamental circuit is closed for selection beyond, the fundamental lead being closed through the inner contacts of cam (F), to the tip of the trunk and the fundamental (FR) lead closed through cam (G), to the ring terminal of the trunk. When selection beyond has been completed, the associated sender selector circuit functions and connects ground over the (LDV) lead, to battery through the (R) magnet, advancing the switch to position 12. As the switch leaves position 11, ground is disconnected from the (HLD) lead causing the sender selector to function and return the sender and sender-selector to normal. In position 12, the white lamp lights and burns steadily, and the green lamp changes from a flashing to a steady light.

11. TRUNK CLOSURE

When the plug of the cord is inserted in the jack of the assigned trunk at the "A" board, battery and ground are connected to the (T) and (R) leads, operating the (A) relay through both windings in series. As the switch enters position 12, a circuit is closed through the inner winding of the (L) relay, which operates, and locks through its 800 ohm winding to ground on cam (I). This locking circuit is provided to prevent the premature release of the (L) relay, should the "A" operator withdraw the plug from the jack and release the (A) relay at this time. The (L) relay operated, advances the switch to position 13, when the white lamp is extinguished.

FOUR PARTY SEMI-SELECTIVE RINGING

12. ONE RING RINGING

Ring selection is made as the switch enters position 13 by means of the (P) commutator. Parties which are called by one ring of the station bell are called through trunks in either the first or third group on the incoming frame. In this case the circuit through the (P) commutator is open, allowing the (L) relay to release as the switch advances from position 12 to position 13. The (L) relay released, operates the (PU) relay to ground at the (A) relay operated, or on the (N) cam. Should the "A" operator withdraw the plug from the jack at this time, the (PU) relay remains locked through position 13 to ground on cam (E). The (PU) relay operated, (a) locks (b) advances the switch to position 14, and (c) closes a circuit for ringing battery through the one ring interrupter, winding of the (R) relay, over the ring of the line to ground through the sub-station set. As the switch enters position 14 ringing current is connected to the line from ringing battery through the one ring interrupter, over the ring side of the line to ground through the sub-station ringer, and the (L) relay operates through its 1200 ohm winding. The operation of the (L) relay does not perform any useful function at this time.

13. TWO RING RINGING

If the call is for a two ring station, the connection is over trunks in the second or fourth groups. In this case a circuit is closed through the (P) commutator to ground, thus holding the (L) relay operated through position 13. As the switch enters position 13, a circuit is closed operating the (PU) relay through the (PU) interrupter. The (PU) relay operated, functions as previously described advancing the switch to position 14. As the switch leaves position 13, the (L) relay releases, but reoperates in position 14 through its 12000 ohm winding. (It is necessary to release the (L) relay in this manner because a holding circuit through the 800 ohm winding in position 14 will put this winding in parallel with the (R) magnet and when the switch is required to stop in position 14 this circuit arrangement may make the (R) magnet so slow in releasing that the switch will overstep and advance to position 15.) As the switch enters position 14, a circuit is closed from ground on the (P) commutator advancing to position 15. The (L) relay remains locked in position 15. With the switch in position 15, ringing current is connected to the called line from the two ring interrupter, to the ring side of the line.

14. AUDIBLE RINGING SIGNAL

During the operation of ringing, a small amount of ringing current is shunted through the .02 mf condenser and cam E, to ground through the quiet battery. This induces a ringing tone to the calling side of the repeating coil as an audible ringing signal.

15. (a) P COMMUTATOR

The switch has two ringing positions, namely 14 and 15. In position 14, the one ring ringing code is connected to the ring brush, and in position 15, the two ring ringing code is connected to the ring brush. Stations which are rung with the one ring ringing code are assigned numbers which are reached through final trunks terminating in either 0 or 2 group on the incoming frame. Stations which are rung with the two ring ringing code are assigned numbers which are reached through final trunks terminating in either the 1 or 3 group on the incoming frame. The ringing of stations on the tip side of the line is cared for by a cross connecting and reversing scheme at the distributing frames. The switch stops in position 14 when the selector is on a final trunk so located that the circuit through the (P) commutator brush and segment is opened, and advances to position 15 when the selector is on a trunk so located that the circuit through the P commutator is closed.

16. CALLED SUBSCRIBER ANSWERS

When the receiver is removed from the switchhook at the called station, the (R) relay operates over the sub-station loop to ground at cam (G), opening the locking circuit for the (PU) relay, which releases. The (PU) relay released, disconnects ringing current from the line releasing the (R) relay; closes a circuit from ground to battery through the (R) magnet, advancing the switch to position 16 and closes a circuit through the (S) relay which

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operates in series with the sub-station set and short-circuits the 12000 ohm winding of the (A) relay, extinguishing the supervisory lamp at the originating (A) board. The (S) relay operates in position 14 if ringing takes place in this position and the receiver is removed from the switchhook, thereby hastening the closure of the talking circuit. As the switch enters position 16, battery and ground are connected to the tip and ring of the called line for talking.

17. DISCONNECTION

When the receiver at the called station is replaced on the switchhook, the (S) relay releases removing the short circuit from the 12000 ohm winding of the (A) relay, thus increasing the resistance in the outgoing trunk which lights the supervisory lamp at the manual office. When the plug of the cord is removed from the trunk jack at the manual office, the (A) relay releases. The (A) relay released, opens the circuit through the inner winding of the (L) relay, releasing the (L) relay. The (L) relay released, the white and green lamps flash as a disconnect signal. (If the (NB) relay is used, it follows the (149-G) interrupter, closing and opening the night alarm circuit.) When the locking disconnect key is depressed, a circuit is closed advancing the switch to position 18. In position 18, a circuit is closed from ground to battery through the down magnet, which operates, restoring the selector to normal. When the selector reaches normal, the switch is advanced to position 1 in a circuit from ground on the (Y) commutator, to battery through the (R) magnet. As the switch leaves position 18, both the green and white lamps are extinguished, restoring the circuit to normal.

18. OVERFLOW

Should all the trunks of a group be busy, the selector while hunting in position 9, advances to the top of the group and rests on the overflow terminals. As the (C) commutator is open at overflow, the holding circuit through the (L) relay is opened, releasing the (L) relay. The release of the (L) relay advances the switch to position 10, the (A) cam advancing it to position 11 and the switch advances to position 12 by means of the (Z) commutator. In position 12 the (L) relay operates. The (L) relay operated, advances the switch to position 13, when ground on the (Z) commutator, advances the switch to position 17. In position 17, the white lamp flashes rapidly from ground on the (149-E) interrupter. The disconnect key is then operated advancing the switch to position 18. In position 18 the down magnet operates to ground on cam (N), returning the selector to normal. When the selector reaches normal, the (Y) commutator advances the switch position 1. The white lamp then burns steadily. Should the cordless operator remember the number called, it is again set up on the keys, otherwise the trunk is connected with the supervisor.

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19. TELL TALK

Should the selector travel to the top of the frame during selection, the switch advances to position 10 in a circuit from ground on the (X) commutator, to battery through the (R) magnet, the (A) cam advancing the switch to position 11. In position 11, the green lamp flashes rapidly in a circuit from ground on the armature of the flicker interrupter. The switch remains in position 11 until the disconnect key is depressed. The operation of the disconnect key advances the switch to position 18. From this point on the circuit functions as described under Disconnect.

20. THE B OPERATOR DEPRESSES THE WRONG ASSIGNMENT KEY

Should a wrong assignment key be depressed, a circuit is closed through the (R) magnet, advancing the switch to position 2, when the white lamp lights and burns steadily. When the first key is released and the assignment key of the proper trunk is depressed, a circuit is closed from ground through the contacts of the second key to the common strapping, through the contacts of the first key, inner contacts of cam (K) to battery through the inner winding of the (L) relay, which operates and locks through its 800 ohm winding, to ground on cam I. The (L) relay operated, connects ground to the (NEG) lead so that this trunk will test busy to any trunk finders which may be functioning and closes a circuit through the (R) magnet, advancing the switch to position 4, the (A) cam advancing the switch to position 5. As the switch leaves position 3, the circuit through the (L) relay is opened, releasing the relay. With the (L) relay released, a circuit is closed through the (R) magnet, advancing the switch to position 6. In position 6, a circuit is closed through the (Y) commutator brush and segment, and the (R) magnet, advancing the switch to position 1.

CIRCUIT REQUIREMENTS

READJUST VALUES ARE FOR
MAINTENANCE PURPOSES ONLY

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RELAYS	MECHANICAL REQ.	DIRECT CURRENT FLOW REQ.	CIRCUIT PREPARATION	TEST SEE
SPEC. SKETCH CONT. ARM.	TEST TEST AFTER TEST READJ S.S.		TEST CLIP DATA	SET TEST REMARKS
CODE DESIG. NUMBER	PRESS. TRVL. WDG. FOR SOAK AMPS. AMPS.	SS. BLOCK	CONN. BAT. CONN. GRD.	PREP NOTE

TEST NOTES (Continued)

2. (a) Thru requirements on special to insure A.C. operation.
- (b) The flutter spring shall be adjusted so that it will lie approximately half-way between the back contact and the armature when the armature is in the operated position.
- (c) There should be a clearance of .034 ± .003" between the flutter spring when the flutter spring is pressed flat against the armature and the armature is in the operated position.
3. Test with "Testing Circuit" in offices when a testing circuit is furnished or by connecting 550 ohm ± 1% non-inductive resistance in series with the relay during the ringing period.
4. Test with "Testing Circuit" in offices when a testing circuit is furnished or by connecting 1165 ohms ± 1% non-inductive resistance in series with the relay during the ringing period.
5. (a) The above test resistances are based on a ringing speed of approximately 1200 rpm (20 cycles) and on A.C. voltage of 95 to 110 volts.

CIRCUIT REQUIREMENTS

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READJUST VALUES ARE FOR
MAINTENANCE PURPOSES ONLY

RELAYS	MECHANICAL REQ.	DIRECT CURRENT FLOW REJ.	CIRCUIT PREPARATION	TEST SEE
SPEC.	SKETCH CONT.	ARM. TEST TEST AFTER TEST READJ S.S.	TEST CLIP DATA	SET TEST REMARKS
CODE DESIG.	NUMBER PRESS.	TRVL. WDG. FOR SOAK AMPS. POS.	BLOCK CONN. B.A.T. CONN. GRD.	PREP NOTE

TEST NOTES: (Continued)

5. (Cont'd.)
 - (b) If the relay fails to meet its test requirements it shall be readjusted to its readjust requirements. If, after having been readjusted the relay still fails to meet its test requirements its adjustment shall be modified until it does meet its test requirements.
6. The (NB) relay shall be tested or readjusted only during periods of light traffic loads as it is necessary to insulate the contacts of the 149-G interrupter.
 - A. Max. ext. ckt. loop 750 ohms.
 - B. Max. ext. ckt. loop 900 ohms.
 - C. Min. leak resistance 10,000 ohms.
 - D. Max. ext. ckt. loop 858 ohms.
 - E. Spl. requirements to meet circuit conditions.

REMARKS:

ENG:--ARR-RS
8/27/23.

CHK'D:--CVR-EMM

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