Western Electric Co., Incorporated,
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Issue 2 - BT-431193.
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METHOD OF OPERATION
TRUNK CIRCUIT

Schemat.c -- For -- Through Wire Local Incoming From Full Mechanical Switching System.

The requirements for the following relays have been changed to:-

CIRCUIT REQUIREMENTS

THE READJUST REQUIREMENTS SHOWN BELOW ARE FOR MAINTENANCE USE ONLY.

MECHANICAL REQUIREMENTS

114-AK (R-1)

(a) The flutter spring shall be adjusted so it will lie approximately half way between the back contact and the armature, when the armature is in the operated position.

(b) There should be a clearance of .034" between the back contact and the flutter spring, when the flutter spring is pressed flat against the armature and the armature is in the operated position.

ELECTRICAL REQUIREMENTS

OPERATE	NON-OPERATE	RELEASE
Special requirements to insure A.C. operation.		
Test with "Testing Circuit" in offices in which a testing circuit is furnished or by connecting 550 ohms ± 1% non-inductive resistance in series with the relay during ringing period.	Test with "Testing Circuit" in offices in which a testing circuit is furnished or by connecting 1165 ohms ± 1% non-inductive resistance in series with the relay during ringing period.	
Readj. .036 amp.	Readj. .034 amp.	

NOTE: #1. The above "Test" resistances are based on a ringing machine speed of approximately 1200 R.P.M. (20 cycles) and an A.C. voltage of 95 to 110 volts.

NOTE: #2. 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 the test requirements.

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Western Electric Co., Incorporated,
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Issue 2 - BT-431193 .
Replacing all previous issues.
April 29th, 1921

METHOD OF OPERATION
TRUNK CIRCUIT
Schematic - For - Three Wire Local Incoming From Full Mechanical - Full Mechanical Switching System.

GENERAL DESCRIPTION.

1. This circuit is used as a three wire local incoming trunk from a full mechanical office. It is selected by a coin, non-coin or operator's district selector and connects to a local incoming selector.

DETAILED DESCRIPTION.

2. When a hunting district selector connects to the tip, ring and sleeve terminals of this circuit, the fundamental circuit is closed, operating the L relay. Ground is also connected to the S terminal, holding this selector busy to all other selectors. The fundamental circuit is traced from battery through the inner winding of the L relay, lower contacts of cam I, compensating resistance (T), lower contacts of cam Q, out over the tip of the trunk, through the associated district and sender circuits, back over the ring, through the inner contacts of cam R, compensating resistance (R), to ground through the lower contacts of cam J. The operation of the L relay closes a circuit from ground on its armature, cam C, to battery through the R magnet, advancing the switch to position 2. In position 2, the L relay locks through its inner winding, upper outer and the lower inner contacts of cam P, make contact of the L relay, upper outer and lower inner contacts of cam I, over the fundamental circuit, to ground on cam J, previously described. Ground through the inner contacts of cam K, is connected to lead S as a busy condition.

BRUSH AND GROUP SELECTION.

3. With the switch in position 2 a circuit is closed from ground on the armature of the L relay, both lower contacts of cam C, to battery through the UP magnet, which operates, moving the selector upward for brush selection. As the selector moves upward, carrying the brushes over the commutator, ground is intermittently connected to the tip side of the fundamental circuit by means of the A commutator brush and segments, holding the L relay operated but successively short circuiting and permitting the re-operation of the stepping relay in the associated sender circuit, until the proper brush has been selected. When sufficient impulses have been sent back to satisfy the sender, the fundamental circuit is opened by the operation of a relay in the sender circuit, releasing the L relay. The L relay released, opens the circuit through the UP magnet which stops the upward movement of the selector. The release of the L relay also closes a circuit from ground on its armature, through the lower outer contact of cam B, to battery through the R magnet, advancing the switch to position 3. As the switch passes through position 2-3/4 a circuit is closed from ground through one winding of the 25-A repeating coil, outer contacts of cam N, to battery through the selector group register which operates. Through positions 3 and 4 of the switch a circuit is closed from ground through the upper inner and lower outer contacts of cam E, to battery to the trip magnet which operates. In position 3, the L relay again operates and locks over the fundamental circuit, closing a circuit from ground on its armature, advancing the switch to position 4. In position 4, with the L relay operated the circuit through the UP magnet is again closed, moving the selector upward for group selection. The trip magnet being operated, causes the previously selected set

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of brushes to trip as the selector starts upward. As the selector moves upward for group selection, carrying the brushes over the commutator, ground is intermittently connected to the tip side of the fundamental circuit, this time by means of the B commutator brush and segment, through the lower contacts of cams H and Q, successively short circuiting the stepping relay in the associated sender circuit, thus releasing it and permitting its re-operation until the proper group has been selected. 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 UP magnet and advances the switch to position 5. In position 5, a circuit is closed from ground through the lower outer and upper inner contacts of cam D to battery through the outer winding of the L Relay, which operates, advancing the switch to position 6.

TRUNK HUNTING.

4. Should the first trunk in the selected group be busy, the L relay is held operated in a circuit from battery through its inner winding, upper outer and lower inner contacts of cam P, make contact of the L relay, upper contacts of cam L, to ground on the sleeve of the busy trunk, from some other incoming selector, connects to that particular terminal. With the L relay held operated, due to this busy condition, a circuit is closed from ground on the armature of the L relay, lower contacts of cam C to battery through the UP magnet which operates and causes 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 relay does not release immediately, as it is held operated through its outer winding to ground on the C commutator brush and segment. When the brushes are properly centered, the circuit thrcugh the C commutator segment is opened, releasing the L relay. The L relay released opens the circuit through the UP magnet, which steps the selector brush on the terminals of the selected trunk.

5. Note:- The adjustment of the C commutator brush, with relation to the tripped sleeve multiple brush, is such that it down 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 terminals and making contact with the sleeve terminals of the 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 trunk terminals, allowing the 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 C commutator feed bar (G) and releases the UP magnet, allowing the selector to drop into place, thus centering the brushes on the trunk terminals. During trunk hunting (in position 6 only) the commutator feed ground is supplied through cam Q from ground on the armature of and under control of the L relay. This is to prevent the re-operation of the L relay by the closing of a circuit between the C commutator brush and segment on the overthrow of the selector, or as it drops into place.

6. The release of the L relay connects ground through the upper inner and lower outer contacts of cam K, break contact of the L relay, upper contacts of cam L, to the sleeve terminal of the selected trunk, as a busy condition and advances the switch to position 7. In position 7 the L relay operates in a circuit from battery

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through its inner winding, inner contacts of cam G, to ground in the final circuit. The L relay operated, locks through the upper outer and lower inner contacts of cam P, its make contact, to ground on cam L, and advances the switch to position 8. As the switch enters position 7-3/4, the holding circuit through the L inner winding of the relay is transferred from ground on cam L, to ground on the ring of the final selector circuit. In position 8 the fundamental circuit is established for final selection. This circuit is traced from battery through the line relay in the associated final selector circuit, tip brush, inner contacts of cam H, compensating resistance, lower contacts of cam Q, out over the tip side of the trunk, through the associated district and sender circuits, back over the ring side of the trunk, inner contacts of cam R, compensating resistance (R), to ground on cam J. After selection beyond has been completed, the associated final selector advances, removing ground from the R terminal and releasing the L relay, which advances the switch to position 9. The L relay re-operates in position 9 over the ring side of the fundamental circuit. This circuit is traced from battery through the inner winding of the L relay, upper outer and lower inner contacts of cam J, compensating resistance, inner contacts of cam R, out over the ring of the fundamental circuit, through the associated district selector and sender circuit, back over the tip side of the fundamental circuit, lower contacts of cam Q, compensating resistance, to ground through both lower contacts of cam D. The L relay operated advances the switch to position 10. As the switch leaves position 9 the L relay releases. The L relay re-operates with the switch in position 10, upon trunk closure in the associated district selector. The circuit is traced from battery through the inner winding of the L relay, lower contacts of cam I, compensating resistance (T), lower contacts of cam Q, out over the tip of the circuit through the repeating coil and polarized relay in the associated district circuit, back over the ring side of the circuit, to ground through both lower contacts of cam R. The L relay operated in position 10, locks through its outer winding, lower contacts of cam P, make contact of the L relay, upper outer and lower inner contacts of cam K, to ground on the sleeve of the associated district selector. The L relay operated, closes a circuit through the R-2 relay which operates. This circuit is traced from ground on the armature of the L relay, lower inner and upper outer contacts of cam F, winding of the R-2 relay, break contact of the RI relay, compensating resistance (R), to battery through the inner contacts of cam J. The operation of the R-2 relay advances the switch to position 11, in a circuit from ground on its armature, upper outer contacts of cam B to battery through the R magnet, the A cam advancing the switch to position 13.

RINGING - FOUR PARTY LINES - X WIRING.

7. With the switch in position 13, one ring ringing current is connected to the line through the inner contacts of cam M, winding of the R1 relay, make contact of the R2 relay, upper inner and lower outer contacts of cam G, R brush, through the associated final selector, to ground through the ringer at the sub-station, connected to that particular side of the line. Two ring ringing current is applied to the ring of the line with the switch in position 15. In this case the R2 relay is short circuited and released by ground on the P commutator as the switch passes through position 11 to 14. As the switch enters position 13, ground through the P commutator brush and segment is closed through cam O to the R magnet, advancing the switch to position 14. With the switch in position 14, a circuit is closed from ground through the pick-up interrupter, inner contacts of cam N, break contact of the R2 relay.

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upper contacts of cam F, winding of the R2 relay, break contact of the R1 relay, compensating resistance, to battery through the inner contacts of cam J, re-operating the R2 relay. The operation of the R2 relay advances the switch to position 15 in the circuit from ground on its armature, cam B to battery through the R magnet. Two ring ringing current is connected to the line through the lower contacts of cam M, winding of the R1 relay, make contact of the R2 relay, upper outer and lower inner contacts of cam G, R brush, through the associated final selector to ground through the ringer at the sub-station connected to that side of the line.

8. NOTE:- All party lines are arranges on a terminal per station basis, each station having a separate number in the final multiple banks. The station number of party lines are assigned in the final multiple so that all lines in one group will require the same polarity of ringing current, and the lines in the next group will require ringing current of the opposite polarity. The switch has two ringing positions, namely 13 and 15. In position 13, one ring ringing current is connected to the ring brush of the selector, and in position 15, two ring ringing current is connected to the ring brush. The switch stops in position 13 when the selector is on a final trunk, so located that the circuit through the P commutator is opened, but it advances to position 15, when the selector is on a trunk so located that the circuit to the P commutator is closed. Stations requiring one ring ringing current are assigned numbers in the final frame that can be reached through the final selectors terminating in either first or third groups on the incoming frame. Stations requiring two ring ringing current are assigned numbers which are selected through final trunks, terminating in either the second or fourth groups of the incoming frame. The ringing of the stations on the tip side of the line is cared for by a cross connection and reversing scheme at the distributing frames.

DIRECT AND TWO PARTY RINGING:

9. When this circuit is used with two party lines, Y wiring is specified. One ring ringing current is connected to the line with the switch in position 13. The station numbers on two party lines are assigned in the fuse multiple so that they are reached over final trunks so located that the circuit through the P commutator brush and segment does not close when the number is selected. Ringing takes place in a manner similar to that described for four party ringing, in position 13. Direct lines are assigned numbers in the final frame in the same banks with one ring parties. When the final selector associated with this circuit connects to a direct line and the switch reaches position 13, the called station is rung over the following circuit:- One ring ringing current is connected through both inner contacts of cam M, winding of the R1 relay, make contact of the R2 relay, upper outer and lower inner contacts of cam G, R brush, through the associated final selector, and line loop back over the tip side of the circuit, T brush, lower outer and upper inner contacts of cam F, to ground through the make contact of the R2 relay.

10. During the operation of ringing a small amount of ringing current is shunted through the .02 M.f. condenser and one winding of the repeating coil to ground, thus transmitting a tone to the calling party as an audible indication that the ringing current is connected to the called line.

SUBSCRIBER ANSWERS.

11. When the receiver is removed from the switchhook at the called station, in position 13, 14 or 15 the R1 tripping relay operates, releasing the R2 relay. The release of the R2 relay disconnects ringing current and the talking circuit is

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allowing the CS relay to operate. The operation of the CS relay connects ground to the tip side of the incoming trunk, while battery is connected to the ring side through cam I thus reversing the direction of the current over the tip and ring of the incoming trunk, which operates a polarized relay in the district selector circuit, causing the district selector to function.

DISCONNECTION:

12. When the receiver at the called station is replaced on the switchhook, the CS relay releases, removing ground from the tip of the incoming trunk circuit, allowing the district selector circuit to function. When the district selector returns to normal it opens the holding circuit through the sleeve terminal releasing the L relay. With the L relay released, the circuit is held busy from ground through both lower contacts of cam L, until the switch leaves position 18. The L relay released, closes a circuit from ground on its armature, cam B, to battery through the R magnet, advancing the switch to position 18. In position 18 the DOWN magnet operates to ground through the upper contacts of cam E, returning the selector to normal. When the selector reaches normal a circuit is closed from ground through the Y commutator brush and segment, upper inner contact of cam B, to battery through the R magnet, advancing the switch to normal.

OVERFLOW:

13. Should all the trunks of a group be busy, the selector while hunting, in position 6, advances to the top of the group and rests on the overflow terminals. As the S terminal is open at overflow, the holding circuit through the L relay is opened, releasing the relay. The release of the L relay advances the switch to position 7. In position 7 a circuit is closed from ground on the Z commutator brush and segment, lower inner contact of cam B, to battery through the R magnet, advancing the switch to position 9. With the switch in position 9, battery through the inner winding of the L relay is connected to the ring of the trunk, thus the direction of the current connected through the fundamental circuit is reversed, causing the associated sender circuit to function. The operation of the L relay advances the switch to position 10. When the switch leaves position 9, the L relay releases, and re-operates in position 10, over the fundamental circuit. The L relay operated locks through its outer winding, lower contacts of cam P, make contact of the L relay, upper outer and lower inner contacts of cam K to ground on the sleeve of the associated district selector. The L relay operated in position 10, closes a circuit through the R2 relay which operates, and advances the switch to position 11, the A cam advancing the switch to position 13. As the switch passes through position 11, the holding circuit through the L relay is transferred from its outer to its inner winding. This circuit is traced from battery through the inner winding of the relay, upper outer and lower inner contacts of cam P, make contact of the L relay, upper outer and lower inner contacts of cam K, to ground on the sleeve of the associated district selector circuit. After the associated district selector has functioned, the holding circuit through the L relay is opened, releasing the relay. The release of the L relay advances the switch to position 18. In position 18, the DOWN magnet operates restoring the selector to normal. When the selector reaches normal, ground on the Y commutator brush and segment advances the switch to normal.

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TELL TALE

14. Should the selector go to tell tale during selection in position 2, ground on the X commutator brush and segment advances the switch to position 3. In position 3, the L relay operates in a circuit from battery through its inner winding, through the associated district selector and sender circuits, to ground through both lower contacts of cam J. The L relay operated advances the switch to position 4. In position 4, ground on the X commutator brush and segment advances the switch to position 5. The L relay operates in position 5 through its outer winding, to ground on cam D, advancing the switch to position 6. When the switch leaves position 5-1/4, the holding circuit through the L relay is opened, releasing the relay, In position 6 ground on the X commutator brush and segment advances the switch to position 7, where it remains until it is restored to normal manually.

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CIRCUIT REQUIREMENTS

114-AK
(R-1)

MECHANICAL REQUIREMENTS

(a) The flutter spring should not lie flat against the armature, when the armature is in the operated position.

(b) There should be a clearance of .034" between the back contact and the flutter spring when the flutter spring is pressed flat against the armature and the armature is in the operated position.

ELECTRICAL REQUIREMENTS

	OPERATE	NON-OPERATE	RELEASE
	Test with "Testing Circuit" or by connecting 630 ohms ± 1% non-inductive resistance in series with the relay during the ringing period.	Test with "Testing Circuit" or by connecting 1165 ohms ± 1% non-inductive resistance in series with the relay during the ringing period.	
	Readj. .032 amp.	Readj. .030 amp.	

NOTE:- The above "Test" resistances are based on a ringing machine speed of approximately 1200 R.P.M. (20 cycles) and an A.C. voltage of 95-110.

B1 (CS)	Test .021 amp. Readj. .015 amp.		Test .0037 amp. Readj. .005 amp.
Spl. E80 D22155 (R2)	Test .026 amp. Readj. .024 amp.	Test .012 amp. Readj. .013 amp.	
E526 (L) Inner Wdg. (1000 ohms)	Test .0168 amp. Readj. .016 amp.	Test .0114 amp. Readj. .012 amp.	
Outer Wdg. (1000 ohms)	Test .043 amp.		

NOTE:- The E526 relay to be equipped with special armature stop (piece part 163914.)

ENG.--TML-JO 5/21/21. CHK'D.--RAP-CWP. APPROVED C.L.SLUYTER, G.M.L.

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