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

Issue 5 BT-431740
Appendix #1
April 17, 1926.

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METHOD OF OPERATION

Trunk Test Circuit - Trouble Desk - Panel Machine Switching Circuit

On page 7, change paragraph 14 to read as follows:-

14. "N" WIRING

When "N" wiring is used the circuit functions as described in paragraph 13 excepting that the operation of the (TG-1) relay lights the (SUP) lamp to notify the test man that the trunk test has been made. The circuit being as follows:- Ground thru the operated (TG-1) relay, outer springs cam L, (SUP) lamp to battery. The (L) cam prevents the false lighting of the (SUP) lamp while the switch is in position 2. The lamp remains lighted until the operator depresses the assignment key in the trunk, releasing the (TG) and (TG-1) relays.

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April 17, 1926.
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(11 Pages, Page 1)
Issue 5 BT 431740
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Replacing all previous issues.

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METHOD OF OPERATION

Trunk Test Circuit - Trouble Desk - Panel Machine Switching System.

DEVELOPMENT

1. PURPOSE OF CIRCUIT

This circuit is used at the trouble desk in a full mechanical office to test trunks outgoing to direct mechanical offices, distant office selectors, direct R.C.I. offices, manual tandem offices and mechanical tandem offices.

2. WORKING LIMITS

2.1 When testing direct mechanical circuits, the maximum external circuit loop for trunk test, selections and supervision is 2520 ohms with a minimum leak of 30,000 ohms.

2.2 When testing R.C.I. trunks, the maximum external loop for trunk test and supervision is 5790 ohms with a minimum leak of 30,000 ohms.

OPERATION

3. PRINCIPAL FUNCTIONS

The principal functions of this circuit are as follows:

3.1 Sender lamp flashes when trunk to be tested is not busy.

3.2 Busy lamp lights if trunk to be tested is busy.

Direct Mechanical Trunk Test

3.3 Selection of proper incoming brush and group.

3.4 Selection of proper final brush and group.

3.5 Holds trunk busy to other selectors.

3.6 Gives a visible flashing supervisory signal.

3.7 Returns to normal.

Distant Office Trunk Test

3.8 Selection of proper office brush and group.

3.9 Holds trunk busy to other selectors.

3.10 Gives a visible flashing supervisory signal.

3.11 Returns to normal.

Direct R.C.I. Trunk Test

3.12 Lights assignment lamp at the distant office.

3.13 Originates pulses for distant R.C.I. position.

3.14 Establishes the "flashing or talking" connection.

3.15 Gives a visible flashing supervisory signal.

3.16 Returns to normal.

Mechanical or Manual Tandem Trunk Test

3.17 Originates impulses for distant tandem office.

3.18 Establishes the "flashing or talking" connection.

3.19 Gives a visible flashing supervisory signal.

3.20 Returns to normal.

Miscellaneous

3.21 Gives a visible signal when selectors travel to overflow.

4. CONNECTING CIRCUITS

This circuit functions with all standard outgoing trunks to direct mechanical, direct R.C.I. manual tandem or mechanical tandem offices and with the recording key circuit.

DESCRIPTION OF OPERATION

DIRECT MECHANICAL TRUNK TEST

5. PRELIMINARY FUNCTIONS

To test a direct mechanical trunk, the proper compensating resistance key is operated and the plug of the cord is inserted in the testing jack of the trunk. The plug in the jack of the trunk makes the trunk test busy to hunting selectors, under control of the (DISC) key and sender cam D. The start key (ST) is then operated, operating the (BY) relay. The (BY) relay operated, locks in series with the (BY-1) relay under control of the disconnect key. The (BY-1) relay operates. When the (DM) key is operated, the (ST) and (DM) relays operate. The (ST) relay operated, causes the sender lamp to flash and advances the sender switch to position 2.

6. FUNDAMENTAL CIRCUIT CLOSURE

As the switch enters position 2, a circuit is completed from battery at the distant end of the trunk, over the tip side of the trunk, through the (VM), (ST) and (FP) relay contacts, the (DM) key, 14,500 ohms resistance, winding of the (TG) relay, cam M, contact of the (DM) key, contact of (FP) relay, compensating resistance, contacts of the (ST) and (VM) relays, out over the ring side of the trunk to ground on the incoming circuit, operating the (TG) relay. The (TG) relay operated, operates the (TG-1) relay. The (TG-1) relay operated, advances the sender switch to position 3. As the switch leaves position 2, the (TG) relay releases, in turn releasing the (TG-1) relay. The (TG-1) relay released in position 3, closes the fundamental circuit through the (STP) and (OFL) relays. The direction of the current is such that the polarized (OFL) relay will not operate. "N" wiring is the same as above excepting that the (SUP) lamp lights during the time the (TG-1) relay is operated.

7. SELECTION - NOTE -

The selection made depends upon the cross-connection between the terminals IB, IG, FB, FG and FU and the counting relay terminals 1, 2, 3, 4, etc. The cross-connections are made as desired by the Telephone Company. Assume the trunk test number to be 1111. This number, translated into impulses becomes: incoming brush 1, incoming group 3, final brush 2, tens 2 and units 2. These pulses will select the first or 0 incoming brush, third or 2 incoming group, second or 1 final brush, second group of 10 lines on the final bank, and the second terminal in that group.

7.1 Brush Selection

The (STP) relay operated, operates the counting relay 0. As the selector at the incoming end of the trunk moves upward, the commutator brush and segment short circuit the (STP) relay, releasing it. The (STP) relay released, opens the circuit through counting relay 0, but relay 0 locks in series with the (FO') and (BO') relays in parallel operating the (FO') and (BO') relays. The (BO') relay operated, opens the circuit through the (STP) relay, thus preventing its operation when the short circuit in the incoming circuit is removed, thereby releasing the line relay in the incoming circuit and stopping the up-drive. The (FO') relay operated advances the sender switch to position 4, the A cam advancing the switch to position 5. As the switch advances out of position 3, the (BO'), (FO') and 0 relays release.

7.2 Group Selection

As the switch enters position 5, the fundamental circuit is again closed for group selection, operating the (STP) relay. The (STP) relay operated, operates the counting relay 2. As the incoming selector moves upward, the commutator brush and segment short-circuits the (STP) relay when the tripped brush enters the zero group, releasing the (STP) relay. The (STP) relay released, opens the circuit through counting relay 2, but relay 2 locks to ground on cam D in series with counting relay 2' which operates. The counting relay 2' operated, transfers the counting circuit to counting relay 1. The (STP) relay reoperates when the short-circuit is removed, and counting relays 1 and 1' function similar to the relays 2 and 2'. When the brush enters group 1, the (STP) relay is again short-circuited and the counting relay circuit is transferred to relay 0. As the brush enters group 2, the (STP) relay is again short-circuited and counting relay 0 locks in series with (BO') and (FO') relays in parallel, which operate. The (BO') relay operated, opens the fundamental circuit, releasing the line relay in the incoming circuit. The (FO') relay operated, advances the sender switch to position 6, the A cam advancing the switch to position 7. As the switch leaves position 5, the operated counting relays release.

7.3 Final Selections

After an idle trunk in group 2 has been selected at the incoming circuit, the fundamental circuit is again closed for final brush

selection. As the final selector moves upward for brush selection, the A commutator brush and segment short-circuit the (STP) relay as the selector reaches the position to trip the zero brush. The counting circuit is completed through counting relay 1, which functions with counting relay 1', transferring the circuit to counting relay 0. As the selector reaches the position to trip the brush 1, the (STP) relay is again short-circuited, and releases. The (BO') and (FO') relays function as previously described, opening the fundamental circuit and advancing the switch to position 9, releasing the counting relays. As the switch enters position 9, the fundamental circuit is closed for tens selection. As the circuit is closed through counting relay 1 and sender cam H, the circuit functions as previously described for brush selection. As the brush enters the second group of 10 lines in the bank selected, the fundamental circuit is opened and the sender switch is advanced to position 11. As the switch enters position 11, the fundamental circuit is closed for units selection. The counting circuit is again closed through counting relay 1. The circuit functions as previously described for brush selection. As the brush seizes the terminals of the second line in that group, the fundamental circuit is opened, and the R magnet is operated, advancing the switch to position 12.

8. OPERATION OF SUPERVISORY SIGNAL - "M" WIRING

With the switch in position 12, the fundamental circuit is closed through the (SUP) relay and the repeating coil, to advance the incoming and final switches. The direction of current flow is such that the polarized (SUP) relay remains non-operated. The particular set of terminals at the final selector are made permanently busy and the busy back interrupter causes the supervisory relay in the incoming circuit to operate and release intermittently. The supervisory relay operated, reverses the direction of the current. The reversal of the current causes the (SUP) relay to operate over the circuit previously described. The (SUP) relay operated, closes a circuit through the supervisory lamp, which lights. The supervisory lamp flashes in synchronism with the busy back interrupter. With the switch in position 12, the sender lamp ceases to flash and burns steadily from direct battery on cam F until the switch is returned to normal.

9. OPERATION OF SUPERVISORY SIGNAL - "N" WIRING

When "N" wiring is used, the supervisory feature is the same as for "M" wiring with the exception of the following: The (SUP) lamp lights from ground on the back contact of the (SUP) relay as soon as the sender switch

moves into position 12. When the (SUP) relay operates, the (SUP) lamp is extinguished. When the (SUP) relay operates and releases intermittently, the 'SUP) lamp flashes.

10. DISCONNECTION

When the disconnect key is depressed, the circuit through the (BY) and (BY-1) relays is opened, releasing the relays. The (BY-1) relay released, releases the (ST) relay. The (ST) relay released, advances the sender switch to position 1, thereby restoring the circuit to normal.

11. DISTANT OFFICE TRUNK TEST

To test a distant office trunk, the proper compensating resistance key is depressed, and the plug of the cord is inserted in the testing jack of the trunk. The start and class keys are operated, causing the circuit to function as previously described, but the (DO) relay operates, when the (DO) key is operated. The (DO) relay operated, connects the counting relays for office brush and office group selection. The selections for office brush and office group are completed the same as the incoming brush and incoming group selections previously described under "DIRECT MECHANICAL CALLS". The office brush selection can be any number from zero to four and the group selection can be any number from zero to nine. The cross-connections between the terminals OB and OG and the counting relays are made as desired by the Telephone Company. When the office group selection is completed, the R magnet is energized through the make contact of the FO' relay, advancing the switch to position 6, the A cam advancing the switch to position 7. As the switch enters position 7, the fundamental circuit is again closed, operating the (STP) relay. The (STP) relay operated, operates the (ADV) relay. The (ADV) relay operated, locks to ground on cam D, and advances the switch to position 11. As the switch advances out of position 10, the (ADV) relay releases. The (ADV) relay released, advances the sender switch to position 12. From this point the circuit functions as described under "DIRECT MECHANICAL TRUNK TEST", paragraphs 8, 9 and 10.

DIRECT R.C.I. TRUNK TEST

12. PRELIMINARY FUNCTIONS

To test a direct R.C.I. trunk, the proper resistance key is depressed and the plug of the cord is inserted in the testing jack of the trunk. If the group of trunks is made busy by the operation of the make busy key on the call indicator position at the manual office

then the "no test" key (NT) must be operated in order to send the call over a busy trunk. The "no test" key may be left operated while testing the entire group of busy trunks. The R.C.I. class and start keys are operated, advancing the sender switch to position 2 as previously described.

13. SIGNAL TO DISTANT OFFICE - "M" WIRING

As the sender switch enters position 2, the fundamental circuit is closed, operating the (TG) relay, and causing the assignment lamp to light at the distant office. The (TG) relay operated, closes a circuit through the (TG-1) relay which operates. The (TG-1) relay operated, advances the sender switch to position 3 and short-circuits the inner contacts of cam M, thus preventing the (TG) relay from releasing when the switch advances from position 2.

14. "N" WIRING

"N" wiring is the same as above except that the operation of the (TG-1) relay lights the (SUP) lamp, thus notifying the testman that trunk test has been made. This lamp remains lighted until the operator depresses the assignment key, releasing the (TG) relays.

15. PULSING

When the assignment key at the distant office is depressed, the circuit through the (TG) relay is opened, allowing it to release. The (TG) relay released, releases the (TG-1) relay. The (TG-1) relay released, operates the (FP) relay. The (FP) relay operated, connects the tip and ring of the trunk to the impulser circuit, locks to ground on impulser cam D, and operates the (FP-1) relay. The (FP-1) relay operated, operates the impulser R magnet, advancing the switch to position 2, the A cam advancing the switch to position 8. The (FP-1) relay is slow operating in order to delay the operation of the impulser switch so as to give a complete first pulse. When the switch reaches position 8, the (FP-1) relay operated, advances the impulser switch to position 9, the A cam advancing it to position 1. While the impulser switch is advancing through one revolution, positive and negative impulses are sent over either the tip or ring side of the trunk to the distant office, causing certain relays to operate and locks, displaying the test call at the R.C.I. position. As the switch enters position 10, the (ADV) relay operates. The (ADV) relay operated, advances the sender switch to position 11. When the impulser switch advances out of position 20-1/4, the circuits through

the (ADV) and (FP) relays are opened, releasing the relays. The (ADV) relay released, advances the sender switch to position 12. The (FP) relay released, connects the tip and ring of the trunk to the "flashing or talking" circuit, and releases the (FP-1) relay. When the plug of the trunk cord is inserted in the busy back at the R.C.I. office, the supervisory lamp flashes as described under "DIRECT MECHANICAL TRUNK TEST". The circuit is restored to normal by depressing the disconnect key, causing the circuit to function as described under "DIRECT MECHANICAL TRUNK TEST".

16. FINAL HEAVY + PULSE FEATURE

16.1 Direct R.C.I. "Z" Wiring

When the R.C.I. key is operated and the (HP-2) relay operates, after the TG test has been made, the (FP), (HP-1) and (FP-1) relays are operated. The impulser switch advances as described in paragraph 15. As the switch enters position 11, the counting relay (9) operates, and when the switch passes out of position 12, the (9') relay operates and both relays lock. As the switch enters position 18, the (HP) relay operates and locks to impulser cam U. With the (HP) relay operated, the remaining R.C.I. pulses are sent through the V and W cams, the end of the last pulse being sent at position 20-1/4. As the switch passes out of position 20-1/4, the (FP), (FP-1) and (HP-1) relays release. The impulser switch goes through a second revolution due to the (HP) relay remaining operated. In position 20-3/4 of the V cam, a short circuit is placed across the tip and ring for the purpose of discharging the loop preparatory to sending the final heavy+ pulse. When the switch leaves position 1, the short circuit is removed and the tip and ring are opened until position 4/5, when the final heavy + pulse is sent. As the impulser switch passes out of position 10 on the second revolution, the (HP) relay releases and the switch returns to normal.

16.2 Tandem R.C.I.

The operation for sending a tandem R.C.I. call is similar to the one described in paragraph 16.1 except that one of the tandem keys is operated instead of the R.C.I. key, and the switch goes through two revolutions to send the R.C.I. pulses. The (9) and (9') relays operate in positions 18 and 19 of the first revolution. The operation of the (HP) relays occurs in positions 18/19 of the second revolution, the (HP-2) relay being normal. The

heavy pulses are sent at positions 4/5 of the third revolution as described in paragraph 16.1.

MANUAL TANDEM TRUNK TEST

17. PRELIMINARY FUNCTIONS

To test a manual tandem trunk, the proper resistance key is operated, and the plug of the cord is inserted in the testing jack of the trunk. The manual tandem class key is operated, and the start key is momentarily depressed. The manual tandem class key operated, energizes the impulser R magnet, advancing the impulser switch to position 2, the A cam advancing it to position 8. The (TG) and (TG-1) relays operate and the sender switch is advanced to position 3 as described under "DIRECT R.C.I. TRUNK TEST".

18. OFFICE CODE PULSING

When the assignment key at the incoming office is depressed, the (TG) relay releases. The (TG) relay released, releases the (TG-1) relay. The (TG-1) relay released, operates the (TAN) relay. The (TAN) relay operated, locks to ground on impulser cam D, and operates the (FP) relay. The (FP) relay operated, locks to ground on impulser cam D, connecting the tip and ring of the trunk to the impulser circuit and operates the (FP-1) relay. The (FP-1) relay operated, operates the impulser R magnet, advancing the switch to position 9, the A cam advancing the switch to position 1. As the impulser switch advances from position 8 to 1, impulses for the tandem office code sent over the trunk go to the R.C.I. position.

19. FLASHING OR TALKING CIRCUIT

The (ADV) relay operates as the impulser switch enters position 10. The (ADV) relay operated, advances the sender switch to position 11. When the impulser switch advances out of position 20-1/4 and the sender switch has advanced out of position 10, the (ADV) relay releases. The (ADV) relay released, energizes the sender R magnet, advancing the sender switch to position 12. The "flashing or talking circuit" is not completed, however, until the (FP) relay releases.

20. STATION AND NUMERICAL DIGIT PULSING

As the impulser switch advances out of position 20-1/4, the locking circuit of the (FP) relays is opened, but the circuit through the relay

is maintained through the make contacts of the (TAN) relay. As the impulser switch advances to position 1, the (FP) relay locked in turn, holds the (FP-1) relay advancing to position 2, the A cam advancing the switch to position 8. As the switch enters position 2, the (FP) relay again locks to ground on cam D. As the switch leaves position 2, (second revolution), the (TAN) relay releases. As the switch enters position 8, the (FP-1) relay again energizes the impulse magnet and the A cam advances the impulser switch to position 1 or normal. During the second revolution of the impulser switch, the impulses for the stations and numerical digits are created. The circuit functions the same as described under "R.C.I. TRUNK TEST", and is restored to normal as described under "DIRECT MECHANICAL TRUNK TEST".

21. MECHANICAL TANDEM TRUNK TEST

If the tandem code number is the same for manual and mechanical tandem trunks, the circuit functions the same for both the (T-1) and (T-2) relays being omitted. If the tandem code number is different, X wiring and the (T-1) and (T-2) relays are used. The (T-1) and (T-2) relays operate in series under control of the mechanical tandem class key. The (T-1) and (T-2) relays operated, change the cross-connection between the 1, 2, 3 and 4 terminals, and the contacts of the cams G and H, thus changing the code number transmitted. The tandem, station and numerical code numbers are transmitted to the R.C.I. station as previously described under "MANUAL TANDEM TRUNK TEST". The relays and other apparatus in the mechanical tandem points respond to the impulses and cause the number to appear on the cordless board. When the numerical and start keys at the cordless board are depressed, the associated district or office selector selects the terminals of a flashing circuit, causing the supervisory lamp to flash. The circuit is restored to normal as previously described under "DIRECT MECHANICAL TRUNK TEST".

22. WHEN USED IN 2-DIGIT OFFICE

When used for a two-digit office where tandem pulses are required, the (TAN-1) relay and the X cam are added. The (TAN) and (TAN-1) operate together. The (TAN-1) relay operated, grounds the tip and ring while the pulsing switch passes through the tandem hundred cam cuttings. After the tandem ten and tandem unit R.C.I. pulses are sent, the switch moves out of position 4, thereby releasing the (TAN) and (TAN-1) relays. The (TAN-1) relay released, removes the ground from the tip and ring when the numerical hundred pulses are going through in the second revolution.

23. TRUNK BUSY

If the plug of the cord is inserted in the testing jack of a busy trunk, the (BY) relay operates when the start key is depressed. The (BY) relay operated, locks to ground on the sleeve of the trunk. The (BY-1) relay does not operate because it is short-circuited due to the ground on the sleeve of the trunk. With the (BY-1) relay and start key released, a circuit is closed, lighting the busy lamp. The circuit is restored to normal by removing the plug of the cord from the jack.

24. OVERFLOW Top Left Contact on OFL-1. Relay adj Open To prevent Release of Inc. on OFL.

If the incoming or office selector should travel to overflow with the sender switch in position 7, the direction of the current is reversed in the fundamental circuit and the (OFL) relay operates. The (OFL) relay operated, operates the (OFL-1) relay. The (OFL-1) relay operated, advances the sender switch to position 16, lighting the (OFL) lamp in a local circuit, and locks to ground through cams E and D.

25. VOLTMETER TEST

When the test cord is inserted in the jack of an O.G.T. and the (TEST) key in voltmeter test cord circuit is operated, the (VM) relay operates. The (VM) relay operated, transfers the tip and ring of the O.G.T. to the voltmeter test cord circuit. When the key is restored to normal, the (VM) relay releases.

26. RETURN TO NORMAL

The circuit is restored to normal as described under "DIRECT MECHANICAL TRUNK TEST".

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