Western Electric Co., Incorporated,
Engineering Dept.,
New York.

METHOD OF OPERATION
TRUNK TEST CIRCUIT
Trouble Desk - Full Mechanical Power Driven System.

GENERAL DESCRIPTION:

1. 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. A trunk is tested by inserting the plug of the cord in the testing jack of the trunk and operating the class and start keys. If the trunk terminates at an incoming selector, a final circuit is selected which, in turn, selects a line that is made permanently busy, causing the supervisory lamp to flash in synchronism with the busy-back interrupter. If the trunk under test terminates at a distant office selector, the terminals of the line selected are connected to an interrupter which causes the supervisory lamp to flash.

3. If the trunk terminates in a direct or tandem R.C.I. position, the numbers displayed before the operator will correspond with the busy back jack, and the plug of the trunk cord is inserted in that jack. If the trunk terminates in a mechanical tandem office, the associated selector seizes a trunk whose tip and ring terminals are connected to an interrupter.

4. Should the incoming or distant office selector associated with the trunk under test travel to overflow, the overflow lamp is lighted. Likewise, if the trunk is busy, the busy lamp lights when the start key is depressed.

5. The circuit is restored to normal by depressing the disconnect key.

6. AA talking key is provided which when operated, connects this circuit to the telephone circuit. This circuit is not designed for talking tests. The talking circuit is used only when the circuit is erroneously connected to a subscriber's line or a supervising operator's circuit.

DETAILED DESCRIPTION:

DIRECT MECHANICAL TRUNK TEST:

7. 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 start key (ST) is than operated, closing a circuit through the BY relay, which operates. 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, a cir-

cuit is closed through the ST and DM relays, which operate. The ST relay operated, closes a circuit through the sender lamp from battery on cam F causing the lamp to flash from battery on the 149-A interrupter. The ST relay operated, also closes a circuit from ground through its make contact, upper inner contact of cam B to battery through the R magnet, advancing the switch to position 2.

8. As the switch enters position 2 the circuit through the sender lamp is transferred from battery through the lower outer contact of cam F, to battery through the upper outer contact of cam F and the 149-A interrupter, causing the lamp to flash. A circuit is also completed from battery at the distant end of the trunk, over the tip side of the trunk, break contact of the VM relay, make contact of the ST relay, break contact of the FP relay, make contact of the DM key 14,500 ohms resistance, winding of the TG relay, both inner contacts of cam M, compensating resistance, make contact of the DM relay, break contact of the FP relay, make contact of the ST relay, break contact of the VM relay, out over the ring side of the trunk to ground in the incoming circuit, operating the TG relay. The TG relay. The TG relay operated, closes a circuit through the TG-1 relay, which operates. The TG-1 relay operated, closes a circuit through the R magnet, advancing the switch to position 3. As the switch leaves position 2, the TG relay releases, in turn releasing the TG-1 relay.

9. The TG-1 relay released in position 3, closes the fundamental circuit. The fundamental circuit is traced from battery through the line relay in the incoming circuit, over the tip side of the trunk, break contact of the VM relay, make contact of the ST relay, break contact of the FP relay, make contact of the DM key, break contact of the TG-1 relay, outer contacts of cam L, outer contacts of cam O, winding of the STP relay, break contact of the BO' relay, winding of the OFL relay, outer contacts of cam N, outer contacts of cam M, break contact of the TG-1 relay, compensating resistance, if any, make contact of the DM key, break contact of the FP relay, make contact of the ST relay, break contact of the VM relay, out over the ring to ground in the incoming circuit at the distant end of the trunk, operating the STP relay. The direction of the current is such that the polarized OFL relay will not operate.

BRUSH AND GROUP SELECTION:

NOTE:- The selection made depends upon the cross connection, between the terminals, IB, IG, FB, FJ, and FU and the counting relay terminals 1, 2, 3, 4 etc. The cross connections are made as desired by the Telephone Company.

10. 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.

11. The STP relay operated, closes a circuit from battery through the winding of the counting relay O, over the cross connection to terminal 1B, make contact of the DM relay, upper inner contact of cam H, lower inner contact of cam G, break contact of the DO relay, to ground through the make contact of the STP relay operating counting relay O. As the selector at the incoming end of the trunk moves upward, the commutator brush and segment short circuits the STP relay, releasing it. The STP relay released, opens the circuit through counting relay O, but relay O locks in a circuit traced from battery through its winding, windings of the FO' and BO' relays in parallel, make contact of counting relay O, upper outer contact of cam E, to ground through the lower inner contact of cam D, 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, operates the R magnet, advancing the 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 O relays release.

12. As the switch enters position 5, the fundamental circuit, previously traced, (paragraph 9) is again closed for group selection, operating the STP relay. The STP relay operated, closes a circuit from battery through the winding of counting relay 2, break contact of counting relay 2', over the cross connection to terminal 1G, make contact of the DM relay, upper outer contact of cam H, lower inner contact of cam G, break contact of the DO relay, to ground through the make contact of the STP relay, operating 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 O. As the brush enters group 2, the STP relay is again short circuited and counting relay O 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, operates the sender R magnet, advancing the switch to position 6, the A cam advancing the switch to position 7. As the switch leaves position 5, the counting relays release.

FINAL SELECTIONS:

13. 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 circuits 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.

14. As the switch enters position 9, the fundamental circuit is closed for tens selection. As the circuit is closed through counting relay 1 and the lower inner contact of 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 R magnet is operated advancing the switch to position 11.

15. As the switch enters position 11, the fundamental circuit is closed for units selection. The counting circuit is again closed through counting relay 1, and the upper outer contact of cam G. The circuit functions as is 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. As the switch advances out of position 11, the sender lamp is extinguished.

16. 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 hand 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 from ground through its make contact, cam J, to battery 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.

DISCONNECTION:

17. When the disconnect key is depressed, the circuit through the BY and BY-1 relay is opened, releasing the relays. The BY-1 relay released, opens the circuit through the ST relay which releases. The ST relay released, operates the R magnet advancing the switch to position 1, thereby restoring the circuit to normal.

DISTANT OFFICE TRUNK TEST:

18. 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 eight. The cross connections between the terminals OB and OG and the counting relays are made as desired by the Telephone Company.

19. 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.

20. As the switch enters position 7, the fundamental circuit is again closed, operating the STP relay. The STP relay operated, closes a circuit from ground through its armature and make contact, make contact of the DO relay, both inner contacts of cam I, to battery through the winding of the ADV. relay, which operates. 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, operates the R magnet through the lower inner contact of cam C, and the break contact of the DM key, advancing the switch to position 12.

21. From this point the circuit functions as described under "DIRECT MECHANICAL TRUNK TEST".

DIRECT R.C.I. TRUNK TEST:

22. 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. The R.C.I. class, and start keys are operated, advancing the sender switch to position 2 as previously described.

23. 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, break contact of the VM relay, make contact of the ST relay, break contact of the FP relay, make contact of the R. C. I. key, winding of the TG relay, both inner contacts of cam M, compensating resistance, make contact of the R. C. I. key, break contact of the FP relay, make contact of the ST relay, break contact of the VM relay, out over the ring side of the trunk, to ground at the distant office, 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, operates the R magnet through the lower outer contact of cam B, advancing the 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.

24. 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, closes a circuit from ground thru both lower contacts of cam D, break contact of the TG-1 relay, make contact of the R. C. I. key, both lower contacts of impulser cam C, to battery through the winding of the FP relay which operates. The FP relay operated, connects the tip and ring of the trunk to the impulser circuit, locks to ground on impulser cam D, and completes a circuit through the FP-1 relay, which operates. The FP-1 relay operated operates the impulser R magnet through the lower outer contact of impulser cam B, 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 R magnet is again operated through the lower outer contact of cam B, and the make contact of the FP-1 relay, advancing 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 lock, displaying the test call at the R. C. I. position. As the switch enters position 10, a circuit is completed from ground on impulser cam D, through the lower outer contact of impulser cam E, to battery through the winding of the ADV. relay, which operates. The ADV. relay operated, operates the sender R magnet through the lower inner contacts of cam B, advancing 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 relay. The ADV. relay released, operates the sender R magnet, through the lower inner contacts of cam C, advancing 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.

25. When the plug of the trunk cord is inserted in the busy back jack at the R. C. I. office, the supervisory lamp flashes as described under "DIRECT MECHANICAL TRUNK TEST".

26. The circuit is restored to normal by depressing the disconnect key, causing the circuit to function as described under "DIRECT MECHANICAL TRUNK TEST".

MANUAL TANDEM TRUNK TEST:

27. 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 through the upper inner contact of impulser cam B, 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".

28. 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, closes a circuit from ground through both lower contacts of sender cam D, break contact of the TG-1 relay, make contact of the class key, upper contacts of the impulser cam C, to battery through the winding of the TAN relay,which operates. The TAN relay operated, locks to ground on impulser cam D, and closes a circuit through the FP relay which operates. The FP relay operated, locks to ground on impulser cam D, connects 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 to the R.C.I. position.

29. The ADV. relay operates as the impulser switch enters position 10. The ADV. relay operated, operates the sender R magnet through the lower inner contact of cam B, advancing 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 through the lower inner contact of sender cam C, advancing the sender switch to position 12. The flashing or talking circuit is not completed however, until the FP relay releases.

30. As the impulser switch advances out of position 20-1/4, the locking circuit of the FP relay is opened, but the circuit through the relay is maintained through the make contacts of the TAN. relay, and the upper outer contact of cam E. As the impulser switch advances to position 1, the impulser R magnet is again energized through the lower outer contact of impulser cam B, and the make contact of the FP-1 relay, advancing the switch 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 impulser R magnet is again operated thru th

lower outer contact of impulser cam B, the A cam advancing 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 exactly the same as described under "R.C.I. TRUNK TEST", and is restored to normal as described under "DIRECT MECHANICAL TRUNK TEST".

MECHANICAL TANDEM TRUNK TESTS:

31. If the tandem code number is the same for manual and mechanical tandem trunks, the circuit functions exactly the same, Y wiring being used, and the T-1 and T-2 relays 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 connections between the A and B terminals, and the contacts of the cams G and H, thus changing the cord 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".

32. 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".

TRUNK BUSY:

33. 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 from ground through the break contact of the ST key, make contact of the BY relay, break contact of the BY-1 relay, busy lamp, make contact of the BY relay, to battery, lighting the busy lamp. The circuit is restored to normal by removing the plug of the cord from the jack.

OVERFLOW:

34. 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, completes a circuit from ground on the sender cam D, through the upper inner contact of cam E, make contact of the OFL relay, the lower inner and upper outer contacts of cam J,

to battery through the OFL-1 relay, which operates. The OFL-1 relay operated, operates the sender R magnet through the lower outer contact of cam C, advancing the switch to position 16, lights the OFL lamp in a local circuit, and locks to ground through cams E and D.

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

CIRCUIT REQUIREMENTS

MECHANICAL REQUIREMENTS

206-C
(SUP)

(a) Total contact travel .004".
(b) The biasing spring shall be tensioned against the armature with sufficient force to meet release requirements.
(c) Contact pressure between the armature and either contact screw shall be approximately equal.

ELECTRICAL REQUIREMENTS

OPERATE	NON-OPERATE	RELEASE
After a soak of .020 ampere in the direction opposite to operating current. Test .0028 amp. Readj. .0026 amp.		On open circuit after a soak of .020 ampere in the same direction as operating current.

MECHANICAL REQUIREMENTS

206-E
(Wdgs. in Parallel)
(OFL)

(a) Total contact travel .003".
(b) The pole piece screws on each side shall be screw toward the armature until the armature sticks against either side with a pressure of 1 gram minimum.

ELECTRICAL REQUIREMENTS

After a soak of approximately .055 ampere in the opposite direction to operating current. Test .009 amp. Readj. .0085 amp.	On current reversal after a soak of .005 ampere in the direction of operating current. Test .009 amp. Readj. .0085 amp.

207-A
(STP)

Armature gap .013" to .014"
Contact gap .003" to .004".

Test .010 amp. Readj. .0098 amp.	Test .009 amp. Readj. .0092 amp.

CIRCUIT REQUIREMENTS

MECHANICAL REQUIREMENTS

208-B
(1' to 9')

The retractile spring tension shall be adjusted by bending the stationary lug on the relay frame and not by bending the lug on the armature. In making this adjustment, the stationary lug shall not be bent to an angle greater than 45 degrees from the vertical.
Armature gap .018" to .021".
Contact gap .004" to .005".

ELECTRICAL REQUIREMENTS

OPERATE	NON-OPERATE	RELEASE
Test .0152 amp.	Test .0138 amp.	
Readj. .0148 amp.	Readj. .0142 amp.	

MECHANICAL REQUIREMENTS

208-C
(BO'
and FO')

The retractile spring tension shall be adjusted by bending the stationary lug on the relay frame and not by bending the lug on the armature. In making this adjustment, the stationary lug shall not be bent to an angle greater than 45 degrees from the vertical.
Armature gap .018" to .021".
Contact gap .004" to .005".

ELECTRICAL REQUIREMENTS

Through relay winding: Readj. .0118 amp.	Through relay winding: Readj. .0112 amp.
Through parallel combination: Test .0244 amp. Readj. .0236 amp.	Through parallel combination: Test .0126 amp. Readj. .0224 amp.

CIRCUIT REQUIREMENTS

MECHANICAL REQUIREMENTS

208-G
(0 to 9)

The retractile spring tension shall be adjusted by bending the stationary lug on the relay frame and not by bending the lug on the armature. In making this adjustment, the stationary lug shall not be bent to an angle greater than 45 degrees from the vertical.
Armature gap .018" to .021".
Contact gap .004" to .005".

	OPERATE	NON-OPERATE	RELEASE
	Test .0152 amp. Readj. .0148 amp.	Test .0138 amp. Readj. .0142 amp.	
B64 (BY-1)	Test .013 amp. Readj. .0055 amp.		Test .0017 amp. Readj. .0018 amp.
B167 (TG)	Test .0022 amp. Readj. .0021 amp.	Test .0016 amp. Readj. .0017 amp.	
E65 (T-1)	Test .017 amp. Readj. .013 amp.	Test .0085 amp. Readj. .009 amp.	
E429 (VM)	Test .017 amp. Readj. .013 amp.	Test .0085 amp. Readj. .009 amp.	
E476 (FP)	Test .018 amp. Readj. .015 amp.	Test .0066 amp. Readj. .007 amp.	
E530 (BY)	Test .017 amp. Readj. .013 amp.		Test .001 amp. Readj. .002 amp.

CIRCUIT REQUIREMENTS

	OPERATE	NON-OPERATE	RELEASE
E557 (TAN)	Test .018 amp. Readj. .015 amp.	Test .0066 amp. Readj. .007 amp.	
E600 (T-2)	Test .019 amp. Readj. .017 amp.	Test .0095 amp. Readj. .010 amp.	
E634 (DO) & (ST)	Test .018 amp. Readj. .015 amp.	Test .0066 amp. Readj. .007 amp.	
E672 (ADV)	Test .017 amp. Readj. .012 amp.	Test .0066 amp. Readj. .007 amp.	
E730 (TG-1)	Test .020 amp. Readj. .019 amp.	Test .011 amp. Readj. .012 amp.	
E886 (DM)	Test .019 amp. Readj. .016 amp.		Test .0015 amp. Readj. .003 amp.
E889 (OFL-1)	Test .017 amp. Readj. .013 amp.		Test .001 amp. Readj. .002 amp.
E1554 (FP-1)	Test .021 amp. Readj. .020 amp.	Test .012 amp. Readj. .013 amp.	

ENG.--CAW-JO.
10/7/21.

CHK'D.--WJT-WHL.

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