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

METHOD OF OPERATION
SCHEMATIC FOR
Sender Recording Key And Testing Cord Circuit - Local Test Desk - Full Mechanical Power Driven System.

This Appendix was prepared from Issue 21 of T-501002.

The requirements for E200 relay shall be changed to read as follows:-

CIRCUIT REQUIREMENTS

THE READJUST REQUIREMENTS SHOWN BELOW ARE FOR MAINTENANCE USE ONLY

	OPERATE	NON-OPERATE	RELEASE
E200 (ADV)	Armature travel .035" Contact pressure 20 grams. Readj. .016 amp. Test .023 amp.		

ENG.-TPI-VL.
12-6-22.

CHK'D.-CAL-CWP

APPROVED - J.L. DOW, G.M.L.

Western Electric Co., Incorporated,
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Appendix No. 1.
Issue 1 - BT-501002.
November 26, 1921.

METHOD OF OPERATION

Schematic For Sender Recording Key and Testing Cord Circuit - Local Test Desk - Full Mechanical Power Driven System.

Page 10, Paragraphs 42 and 43 should be changed to read as follows:

42. The howler can be applied only by means of the secondary test cord as the operation of the howler key (H) disconnects the primary test cord from the howler circuit.

43. The key marked "X" is used to interchange the primary and secondary test cords with respect to the primary and secondary testing circuits. When the key is in the normal position, the primary test cord is connected to the primary testing circuit and the secondary cord is connected to the secondary testing circuit. The operation of the key makes it possible to apply all primary tests over the secondary cord, and all secondary tests except the howler, over the primary cord.

ENG.--CHMcC-BH. CHK'D.--CAL-CWP. APPROVED - C. L. SLUYTER, G.M.L.
9-25-22.

Western Electric Co., Incorporated,
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Appendix 2.
Issue 1 - BT-501002.
Appendix Jan. 17, 1922.
February 1, 1922.

METHOD OF OPERATION
SCHEMATIC

Sender Recording Key and Testing Cord Circuit - Local Test Desk - Full Mechanical Power Driven System.

Page 5, paragraph 17, line 6 shall be changed to read as follows:

The ADV-1 relay operated, locks to battery on cam L and closes a circuit from battery through the 149 interrupter OFL pilot lamp to ground through the inner contact of cam D and also opens the fundamental circuit to keep the incoming from returning to normal.

Pages 11 and 12.

The 208 relays have been changed to read as follows:

MECHANICAL REQUIREMENTS

208-B (1'-9')
(a) Armature gap .015" ± .002"
(b) Contact gap - min. .004", max. .007"
(c) 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 the adjustment the stationary lug shall not be bent to an angle greater than 45 degrees from the vertical.

ELECTRICAL REQUIREMENTS

OPERATE	NON-OPERATE	RELEASE
Special requirements to insure fast operation.		
Readj. .015 amp.	Readj. .014 amp.	
Test .016 amp.	Test .013 amp.	
W.C.C. .058 amp.		

MECHANICAL REQUIREMENTS

208-G (0-9)
(a) Armature gap - .015" ± .002"
(b) Contact gap - min. .004" max. .007"
(c) 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.

ELECTRICAL REQUIREMENTS

OPERATE	NON-OPERATE	RELEASE
Special requirements to insure fast operation.		
Readj. .015 amp.	Readj. .014 amp.	
Test .016 amp.	Test .013 amp.	
W.C.C. .175 amp.		
Hold W.C.C. .058 amp.		

MECHANICAL REQUIREMENTS

208-M (0')

(a) Armature gap - .015" ± .002"
(b) Contact Gap - min. .004" max. .007"
(c) 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.

ELECTRICAL REQUIREMENTS

OPERATE	NON-OPERATE	RELEASE
Special requirements to insure fast operation		
Readj. .015 amp.	Readj. .014 amp.	
Test .016 amp.	Test .013 amp.	
W.C.C. .058 amp.		

Page 13.

The E194 has been replaced by the E1133 relay which has the following requirements.

	OPERATE	NON-OPERATE	HOLD	RELEASE
E1133 (PTC) (STC)	Special requirements to meet hold circuit conditions.			
	Readj. .093 amp.	Readj. .061 amp.	Readj. .072 amp.	
	Test .106 amp.	Test .058 amp.	Test .083 amp.	
	W.C.C. .119 amp.	W.C.C. .023 amp.	W.C.C. .094 amp.	

The E791 has been replaced by the E1076 relay which has the following requirements.

E1076 (ADV-1)	Readj. .018 amp.	Readj. .010 amp.
	Test .019 amp.	Test .0095 amp.
	W.C.C. .020 amp.	

ENG.-JLS-KX. CHK'D.-WAL-CWP. APPROVED - C. L. SLUYTER, G.M.L.
9-25-22.

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

Appendix 3,
Issue 1 - BT-501002.
June 6, 1922.

METHOD OF OPERATION
SCHEMATIC

Sender Recording Key and Testing Cord Circuit - Local Test Desk - Full Mechanical Driven System.

Pages 3 and 4, paragraph 13, Line 1, shall be changed to read as follows:

In position 11 a circuit is closed from battery through the line relay in the incoming selector over the ring of the cord, "X" key normal the PTC, SCO, NT, and ADV relays normal through the winding of the ADV relay, the PD relay operated, cam E, to ground on cam D operating the ADV relay.

ENG.--JLS-BH.
9-25-22.

CHK'D.--ASP-CVP.

APPROVED - C. L. SLUYTER, G.M.L.

Western Electric Co., Incorporated,
Engineering Dept.,
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METHOD OF OPERATION
SCHEMATIC FOR
Sender Recording Key And Testing Cord Circuit - Local Test Desk - Full Mechanical Power Driven System.

GENERAL DESCRIPTION

1. This circuit is used at the local test desk in a full mechanical office for setting up connections to and testing subscriber's lines. It is designed to operate in connection with a special incoming test selector. The connection to the selector is made by means of test lines which terminate in jacks at the local test desk. The special incoming selector has access to any final which may select the subscriber's line.

2. It may be arranged for testing both manual and mechanical lines, or manual or mechanical lines only. The circuit has three cords, a primary and secondary test cord and a sounder cord. The primary test cord is principally used in making the routine tests, such as tests for ground, foreign battery, resistance, ballistic, transmission, breakdown and tests requiring the use of the Wheatstone bridge. The secondary test cord is principally used for making those tests which do not involve the use of the volt-milammeter and Wheatstone bridge and is arranged for machine ringing, the howler, dial test and sounder. By means of a key, the primary and secondary test circuits are inter-changeable with respect to their cords.

3. The sender equipment is common to both the primary and secondary test cords of the test desk and is normally connected to both. When either of the two test cords is used, the sender is automatically disconnected from the other. Should both primary and secondary test cords be connected to the incoming test selector before the start key is operated, and the sender switch is off normal, the primary test cord automatically takes precedence over the secondary. The sender circuit is arranged to make selections on either a "test" or "no test" basis, depending on the selection of the start key.

4. The sleeves of the test lines to the special incoming test selector, with which the test cords are used, are normally grounded through a maximum resistance of 1102 ohms. This resistance is reduced to a maximum of 52 ohms for the purpose of discharging the sender and connecting the testing apparatus when selection is completed. The sleeve of test lines to the zero operator, toll switchboard and trouble desks, are grounded through a maximum resistance of 52 ohms. The sleeves of test lines to the main frames are grounded through a maximum resistance of 39 ohms.

DETAILED DESCRIPTION

"UNK "D INCOMING TEST SELECTOR

REGULAR LINE TEST-USING PRIMARY TEST CORD

5. The plug of the primary test cord is inserted in the jack of a test line to incoming test selector, the proper numerical keys are depressed, and the "ST" start key is operated. When the primary test cord is inserted in the jack of the test line, battery on the break contact of the PCO relay is closed

through the normally made contacts of the 3 WT key, winding of the PTC relay, to ground through the sleeve relay in the test line circuit. The PTC relay does not operate at this time, however, due to the high resistance in the sleeve of the test line. The operation of any of the numerical keys closes a circuit from ground through the common contacts of the operated numerical key, to battery through the winding of the TH, H, T, or U relay, operating any or all relays depending upon which numerical keys are operated. The TH, H, T, or U relays operated, closes a circuit from battery through the winding of the L relay in the incoming test selector, tip of the test line and cord, break contact of the PTC relay, winding of the PCI relay, cam J, break contact of the SCO relay, outer contacts of cam H, winding of the STP relay, A and B resistances, to ground on the armature of the O' relay. The PCI relay operates, but the L relay in the incoming circuit and the STP relay do not operate due to the high resistance of the winding of the PCI relay.

6. The PCI relay operated, (a) closes a circuit from battery through the lower inner and upper outer contacts of cam L, winding of the PCO relay, in multiple with the A lamp, make contact of the PCI relay, make contact of the operated TH, H, T, or U relay, make contact of the "ST" key, to ground on the lower contacts of cam C, lighting the A lamp and operating the PCO relay, (b) closes a circuit from battery, through one winding of the ST relay, which also operates to the same ground on cam C. The PCO relay operated, (a) locks to ground on its armature, (b) disconnects the tip and ring of the secondary test cord from the sender circuit, (this feature is provided so that if the plugs of both primary and secondary test cords are inserted in the jacks of test lines before the ST key is operated, and the sender switch has moved off normal, the primary test cord only is connected to the sender,) (c) disconnects ground from an armature of the SCO relay, (d) opens the circuit from battery through the winding of the PTC relay, and (e) closes a circuit from battery through the winding of the PD relay, which operates in the sleeve circuit. The PD relay operated, prevents the operation of the D relay, the function of which is described under "OVERFLOW".

7. The ST relay operated, advances the switch to position 2. In position 2, a circuit is closed from battery through the contact of the 149 type interrupter, make contact of the ST relay and sender pilot lamp to ground on the lower inner contact of cam E, causing the lamp to flash. In position 2 the winding of the PCI relay is short circuited through the outer contacts of cam J releasing the PCI relay. The PCI relay released, reduces the resistance of the fundamental circuit sufficiently to operate the L relay in the incoming selector and the stepping relay in the sender circuit.

INCOMING BRUSH SELECTION

8. Assuming thousands key 6 to be operated, four impulses will be required to satisfy the sender, therefore the pulsing path is closed to the 3 counting relay. This circuit is traced from battery through the winding of the 3 counting relay, break contact of the 3' relay, lead 3, contact of the thousands key 6, upper outer and lower inner contacts of cam G, make contact of the STP relay, to ground on the lower outer contact of cam E, operating the 3 counting relay. During brush selection intermittent ground is connected to the tip side of the fundamental circuit by means of the A commutator in the incoming selector circuit,

alternately short-circuiting the STP relay thus releasing it and permitting its re-operation. When the STP relay releases, the short circuit around the winding of the 3' counting relay is removed allowing it to operate in series with the 3 counting relay. The 3 and 3' counting relays lock in series, to ground on cam D. The 2, 1, and 0 sets of counting relays are similarly operated by the second, third and fourth impulses from the incoming A commutator. The operation of the number 0' counting relay closes a circuit from ground on its armature, upper outer contact of cam B, to battery through the winding of the R magnet, advancing the switch to position 3, the A cam advancing the switch to position 4. In position 4 the fundamental is closed operating the STP relay for incoming group selection.

INCOMING GROUP SELECTION

9. Assuming hundreds key 7 to be operated, two impulses will be required to satisfy the sender for incoming group selection, the first impulse operating 1 set of counting relays. The operating circuit is from battery, through the winding of the 1 counting relay, break contact of the 1' counting relay, right outer contact of the 6 thousand key depressed, contacts of the 7 hundreds key, upper outer and lower inner contacts of cam F, make contacts of the STP relay, upper outer contact of cam E, to ground on the lower inner contact of cam D, operating the 1 counting relay. The tip side of the fundamental circuit is intermittently short-circuited by impulses from the incoming B commutator, thus the STP relay successively releases and re-operates. The release of the STP relay, removes the short circuit from the winding of the 1' counting relay, which operates. The zero counting relays are similarly operated by the second impulse applied to the fundamental circuit. The 0' counting relay operated, advances the switch to position 5, the cam A advancing the switch to position 6. As the switch advances from position 4 all operated counting relays release.

FINAL BRUSH SELECTION

10. In position 6 the fundamental circuit is again closed operating the STP relay for final brush selection. Final brush selection is made similar to incoming brush selection. When sufficient impulses have been sent back to satisfy the sender, the 0' counting relay operates, advancing the switch to position 7, the cam A, advancing the switch to position 8. As the switch leaves position 6 all operated counting relays release.

TENS SELECTION

11. In position 8 the fundamental circuit is again established operating the STP relay for final tens selection. Final tens selection is made similar to incoming brush selection. The required counting relays being operated, the fundamental circuit is opened and the switch is advanced to position 10 for units selection.

UNITS SELECTION

12. Units selection is made in a manner similar to incoming brush selection. Impulses from the final U commutator actuating the STP relay. When

sufficient impulses have been sent back to satisfy the sender the O' relay operates advancing the switch to position 11.

DISCHARGING THE SENDER

13. In position 11 a circuit is closed from battery through the line relay in the incoming selector, over the ring of the cord, break contacts of the PTC, SCO and NT relays, to ground through the winding of the ADV relay which operates. The ADV relay operated, locks to battery on cam L and closes a circuit from battery through the inner contacts of cam L, operating the ADV-1 relay. The operation of the ADV relay opens the ring of the circuit thus releasing the line relay in the incoming, which advances to its talking position. The ADV-1 relay operated, also locks to battery on cam L, and closes a circuit from ground on its armature, cam B, to battery through the winding of the R magnet, advancing the switch to position 12, the A cam advancing it to position 18. As the switch passes through positions 12 to 17 the ADV relays release and a circuit is closed from battery on cam L, to ground through the windings of the key release magnets which operate, releasing all operated keys. The release of the keys release the U, T, H and TH relays. As the sender switch advances from position 17, the circuit through the winding of the PCO relay is opened at cam L, releasing the relay. The PCO relay released, releases the ST relay. The ST relay released, lights the sender pilot lamp, to ground on cam E, and advances the switch from position 18 to normal. The lighted pilot lamp is an indication that selection is completed and the sender switch is returning to normal. The ST relay released also extinguishes the A lamp, connects the sender to the secondary test cord and maintains battery on the sleeve of the test cord through its continuity contacts and the winding of the PTC relay.

14. The sleeve of the test line is grounded through a maximum resistance of 1102 ohms until after incoming test selector switch advances to position 1-3/4, (which occurs after the winding of the PCI relay is short circuited). As the incoming advances a relay in the test line circuit operates, reducing the sleeve resistance to a maximum of 52 ohms, causing the PTC relay to operate. The PTC relay operated, disconnects the tip and ring of the primary test cord from the sender and connects them to the testing equipment. The PTC relay operated, also closes a circuit from ground on its armature, lighting the primary supervisory lamp as an indication that the test man may proceed with the tests.

LINE TEST - NO TEST BASIS. - PRIMARY CORD

15. To select a line on a no test basis, the operation is the same as that described under "Regular line test - Using Primary test cord," except that the no test key (NT) of the sender circuit and the M key of the primary test circuit are operated, instead of the "ST" key. The operation of the M key, (a) closes in part the operating circuit of the PCO relay, (b) disconnects the repeating coil and battery from the test set and (c) connects the monitoring

circuit to the test cord. Therefore, the PCO relay operates to ground on cam C through the contacts of the "NT" and "M" keys. This is to prevent the interference with the transmission of a subscriber's line, should the R.C.C.I. key of the test circuit be operated when a busy line is selected.

16. After final tens selection in position 8, the O' relay operates and closes a circuit from ground on its armature, upper contacts of cam C, contacts of the NT key, to battery through the windings of the NT relay which operates. The NT relay operated, locks through the break contacts of the SCO and PTC relays, ring of the test cord, test line, and incoming selector, to ground on the ring of the final selector. As the final selector, upon the completion of final units selection, advances through its "no test" position, battery through the windings of the NT relay, in parallel with the battery through the 1200 ohm winding of the L relay in the incoming, operates the P.B.X. relay in the final selector, allowing the final selector to rest on a busy terminal. As the final selector advances the NT relay releases.

OVERFLOW

17. Should the special incoming test selector go to overflow during selection, a circuit is closed from battery on the ring of the incoming, ring of the test line, and test cord, break contact of the PTC, SCO and NT relays, to ground through the winding of the ADV relay which operates. The ADV relay operated, closes a circuit from battery through the inner contacts of cam L, make contacts of the ADV relay to ground through the winding of the ADV-1 relay which operates. The ADV-1 relay operated, locks to battery on cam L, and closes a circuit from battery through the 149 interrupter, OFL pilot lamp, to ground through the inner contacts of cam D. The OFL pilot lamp flashes until the plug of the test cord is momentarily withdrawn from the jack of the test line, or the disconnect key in the associated test line circuit is operated, releasing the PD relay. The PD relay released closes a circuit from ground on cam D, upper inner contact of cam E, break contacts of the PD and SD relays, to battery through the winding of the D relay which operates. The D relay operated, locks to ground on cam D and also closes a circuit from the same ground to battery through the winding of the R magnet, advancing the switch to position 17. The A cam advances the switch to position 18. The switch advances to normal from ground on the armature and break contact of the ST relay. The key release magnets and the TH , H, T, and U relays release, as described in paragraph 13.

18. The testing key equipment of the test cord circuit consists of, (a) a key marked REV. which is used to reverse the tip and ring sides of the primary test circuit with respect to all apparatus connected back of the ringing keys, (b) a key marked "G" used to connect ground to either side of the line under test, (c) a repeating coil cut-in key marked RCCI to connect talking battery to the test cords. (d) a key marked "M" to connect the telephone circuit to the primary test circuit for monitoring purposes, (e) a key marked T which is used to connect the wire chief's telephone set to the primary test circuit for talking purposes, (f) a set of ringing keys (not shown on this drawing) used to operate the ringers at sub-station sets, (g) a transmission test key marked "TMT" used to connect the telephone circuit and an artificial

the line, (h) a key marked "3 WT", used to test the sleeves of the circuits to which the plug of the test cord is connected, (i) a key marked "FEMF" used to disconnect the volt-milliammeter from the testing battery and to connect it to ground to test for foreign potential, (j) a key marked "VM-REV" used in conjunction with the FEMF key, to reverse the leads from the voltmeter windings of the volt-milliammeter with respect to the tip and ring of the line under test, (k) a key marked "20,000 ohms", used to disconnect the 100,000 ohm volt-milliammeter winding and the hundred volt testing battery from the testing circuit and to connect the 20,000 ohm volt-milliammeter winding in series with the 20 volt testing battery to the testing circuit, (l) a key marked "1000 ohms" used in a manner similar to that described above for the use of the 20,000 ohm scale changing key, but connecting the 1000 ohm winding of the voltmeter in series with the 20 volt battery to the testing circuit, (m) two coin keys one marked "CC" and "CR" for making coin collect and coin refund tests, (n) a key marked "RHE" used to disconnect a short circuit from the windings of the rheostats, (o) three rheostats used to vary the current in the milliammeter winding of the volt-milliammeter.

19. The testing key equipment of the secondary test cord circuit consists of (a) howler key marked (H) and apparatus for applying a graduated howler tone to the line, (b) a dial test key marked "DT" used for connecting apparatus A to test the speed and accuracy of station and position dials, (c) an associated ringing circuit (not shown on this drawing), for making semi-selective machine ringing tests of subscribers' stations, (d) a key marked "REV" for reversing the tip and ring of the test cord with respect to the tip and ring of the secondary testing circuit, (e) a grounding key, (G) used to connect ground to the tip of the line when the repeating coil ground is disconnected, (f) a monitoring key (M) for connecting telephone sets to the secondary test circuit for monitoring purposes, (g) a key marked "T" for connecting the telephone set to the secondary test circuit, (h) a key marked "S" for connecting battery and ground to the ring of the secondary test circuit.

20. The "X" key is used to interchange the testing equipment of the Primary and secondary test cords, with the exception of the Howler equipment, which can be used only with the secondary test cord.

21. The various tests and operations and the methods employed in performing them are as follows:- (a) TALKING OVER PRIMARY AND SECONDARY TEST CORDS.

22. The telephone set is normally disconnected from the testing line. To talk over a line which is connected to the primary testing circuit, operate the primary "TALKING" and "R.C.C.I." keys the operation of which connects the telephone set to the line and supplies talking battery. To talk over a line connected to the secondary test cord circuit, the secondary talking key (T) is operated. In both cases, regular "A" cord supervision is obtained.

TESTS FOR GROUNDS - Primary Test Circuit

23. To test for grounds on the ring of the line, no keys need be operated. Normally the 100 volt testing battery is connected to the ring, in series with the 100,000 ohm winding of the volt-milliammeter. If the line is clear the voltmeter should show no deflection or at most a very small one, except, in the case of a party line with the receiver off the switchhook at a "ring" station. If a ground is indicated the resistance may be determined as explained later under "Tests for Short Circuits". If the deflection is in excess of that which the testing battery can produce, there is an indication that the line is crossed with a foreign source of current. To test a ground on the tip of the line, reversing key is operated.

24. To measure a high resistance ground the 100 volt testing battery is used. On account of the high resistance in series with the 100 volts of the volt milliammeter and the needle shows a greater deflection than would be the case if the 20 volt testing battery were used, thereby giving a chance for greater accuracy. In measuring small resistances the 20 volt battery is used.

25. To test with the milliammeter the repeating coil cut in key is operated. This connects one winding of the volt-milliammeter to the ring of the circuit in series with the central office battery. If the line is clear no deflection will occur. This test is made on the tip by operating the reversing key also.

TESTS FOR GROUNDS - SECONDARY TEST CIRCUIT

26. When the voltmeter indicates a swinging around, of apparantly high resistance it is desirable to supplement the foregoing tests by a test with the SR relay. This test is made with all keys in their normal positions, except the relay key "S". The operation of this key connects ground to the tip and 24 volt battery through to the winding of the SR relay to the ring of the testing circuit. The SR relay operates, if there is ground on the ring or a cross on the line, in turn operating the sounder (S). A test is made on the tip by operating the reversing key in addition to the operation of the S key.

27. If the optional wiring "To Buzzer Test Circuit", is furnished the operation is the same except that a relay with a make and break spring combination replaces the SR relay and a buzzer replaces the sounder S.

TESTS FOR SHORT CIRCUITS

28. Tests for crossed lines are made by operating the ground key (G). If the line is crossed the voltmeter needle shows a deflection which is unchanged when the REV. key is operated. The smaller the resistance of the short circuit in the line, the greater is the deflection. In all cases, the voltmeter reading bears the same ratio to the voltmeter resistance, as the difference between this reading and the testing battery voltage bears to the external resistance. The line resistance is calculated by dividing the difference between the testing battery voltage and the voltmeter reading by

the voltmeter reading and multiplying this quotient by the resistance of the voltmeter coil. For example, if the voltmeter coil has a resistance of 100,000 ohms, the testing battery has a potential of 100 volts and a reading of 40 volts is obtained in the line, the resistance of the line is 100 minus 40, multiplied by 100,000 or 150,000 ohms. For measuring lower resistances the lower scale and lower voltages are used.

29. To test with the milliammeter, operate the R.C.O.I. and G keys. The deflection of the milliammeter results if the line is crossed. The milliammeter needle returns to zero when the R.C.O.I. key is restored to normal.

CONTINUITY TEST - PRIMARY TEST CIRCUIT

30. Continuity tests are made in the same manner as tests for crosses. On lines equipped with standard common battery sub-station sets which have a condenser in series with the ringer, no deflection occurs unless the receiver is removed from the switchhook at the sub-station, or the line is crossed. If it is not convenient to have the receiver removed, a very satisfactory test of continuity can be made by operating the REV key several times. This results in momentary deflections of the voltmeter needle, due to the discharge of the station condenser, if the line is continuous. A test for continuity should always be preceded by a test for ground.

TESTS FOR CROSSES WITH LINES CARRYING CURRENT - PRIMARY TEST CIRCUIT

31. To test a line for foreign battery, the battery cut-off key "FEMF" is operated. This connects the voltmeter to the ring of the test circuit, with ground. The external potential causes a negative reading of the voltmeter, the "REV" key is then also operated, thereby reversing the voltmeter connection with respect to the line. To test the tip side of the line the regular "REV" key is operated.

TESTS FOR CROSSES WITH OTHER LINES - PRIMARY AND SECONDARY TEST CIRCUITS

IN CONJUNCTION WITH EACH OTHER

32. To test for a cross between two lines, one of them is connected to the primary testing circuit and the other to the secondary testing circuit. The tip and ring of the secondary testing circuit is connected to ground by the operation of the secondary ground and reversing keys and testing the line connected to the primary testing position for ground as described under "Test for grounds".

BALLISTIC CAPACITY TESTS - PRIMARY TESTING CIRCUIT

33. These tests are made to determine approximately the value of the capacity of the line in locating an open or the capacity of the attached condensers. The circuit is arranged for a grounded capacity test only, unless the Wheatstone bridge circuit is equipped, in which case tests for mutual capacity are made by operating the Wheatstone bridge key which disconnects ground from the testing battery. To test a line for grounded capacity, the ground key is operated, then the reversing key is quickly operated and released

several times. This causes a deflection proportional to the capacity on the ring, when the reversing key returns to normal and proportional to the capacity on the tip when the reversing key is operated. If an extension bell is connected in series with the ringer of the subscriber's main set a slight reduction in the deflection of the needle results.

BREAKDOWN TEST - PRIMARY TEST CORD

34. When the breakdown test key is operated, the following sequence of operation occurs:- (a) the springs of the impulse wheel "A" close, operating the BT, CR and CC relays. The BT relay operated, connects the ring of the test circuit direct to ground, and prepares for a closure of the high voltage battery when the CR and CC relays operate, connect the tip of the test circuit to ground through 96,000 ohms, under control of the "B" cam of the impulse wheel, (b) the springs of the impulse wheel "B" operate, removing ground through the 96,000 ohm resistance from the tip of the test circuit and connecting the 200 volt break down potential through the 96,000 ohm resistance, make contacts of the BT and CR relays, the armeter winding of the volt-milliammeter and the tip of the test circuit, the ring of the cord remaining connected to ground, (c) the springs of the impulse wheel "C" operate short circuiting the 96,000 ohm resistance and connecting the breakdown potential through the resistance lamps and make contact of the BT and CR relays, through the milliammeter winding of the volt-milliammeter to the tip of the test circuit. By gradually charging the line condensers in this manner, bell taps are avoided, (d) the springs of the impulse wheel "C" release again impressing the 200 volt potential on the tip of the test circuit through 96,000 ohms, (e) the springs of the impulse wheel "B" release disconnecting the 200 volt battery and connecting ground to the tip of the test circuit, (f) the springs of the impulse wheel "A" release, causing the BT, CR and CC relays to release, restoring the circuit to normal. To make the breakdown test on the ring of the line, the REV. key is operated, together with the insulation breakdown key.

TRANSMISSION TEST - PRIMARY TEST CORD

35. These tests are made for testing the degree of transmission on the line. Each operation of the transmission test key (TMT) completing coil cut-in keys connect the line to the telephone circuit. The rheostat key is then operated, and the current through the transmitter varied by adjusting the rheostat.

COIN COLLECT AND RETURN - PRIMARY AND TERTIARY

36. To test the operation of the coin boxes on the subscriber's line, the CC or CR key is operated. The operation of the CC coin collect key operates the D and CC relays. The operation of these relays connect 110 volt positive direct current to the tip side of the test circuit through the milliammeter winding of the volt-milliammeter. When the key is restored, the relays release. The operation of the coin return key "CR" operates the CR and CC relays connecting the 110 volts negative direct current to the tip side of the test circuit

through the milliammeter winding of the volt-milliammeter. The current through the coin collector may be regulated by operating the special rheostat key and then adjusting the rheostat. In any case when a coin is deposited in a coin box of a pre-payment line to which the primary test circuit is connected, the deflection of the volt-milliammeter needle indicates what disposition has been made of the coin.

APPLICATION OF THE HOWLER - SECONDARY TEST CIRCUIT ONLY

37. If there is a cross of sufficiently low resistance on a line to which the secondary test circuit is connected the SS relay operates, connecting the winding of the A relay across the secondary test circuit supervisory lamp, operating the relay to ground on the armature of the STC relay preventing the lamp from lighting. When the howler key H is operated, a circuit is closed from ground on the H key, C brush of the 200-R selector, make contact of the A relay, a second contact of the H key, to battery through the winding of the H-1 relay, which operates. The H-1 relay operated, (a) locks to ground on its armature under control of the H key, and connects the winding of the H-2 relay, to the break contact of the A relay, (b) closes a circuit from the howler source, break contact of the H-2 relay, make contact of the H-1 relay, break contact of the SR-2 relay, primary winding of the 49-A repeating coil, back to the howler source, and (c) closes a circuit from ground through the 149 interrupter, break contact of the SR-2 relay, S brush and normal contact of the 200-R selector, to battery through the winding of the selector magnet which operates, moving the selector to the off-normal. With the selector switch in its off-normal position, a circuit is closed from ground through the 149 interrupter, break contact of the SR-2 relay, S brush of the selector, off-normal contact of the selector, to battery through the winding of the stepping magnet, which operates and steps the brush assembly to the next terminal. The operation of the interrupter continues to step the selector through one revolution.

38. The C brush of the selector in the off-normal position connects section A-B of the secondary circuit of the 49-A repeating coil in series with the 5-6 and 1-2 windings of the 25-A repeating coil of the secondary test circuit, causing a minimum howler tone to be induced through to the line under test. As the selector switch advances, additional sections of the secondary of the 49-A repeating coil are added to the circuit until the maximum howler tone is reached, at a half revolution of the selector. At the next step of the selector, the tone is again reduced to a minimum and is built up to a maximum at the step previous to the return to normal. At this point, a circuit is closed from ground on the SR brush of the selector, break contact of the SR-1 relay, to battery through the winding of the SR relay, which operates. The SR and SR-1 relays lock to ground on the make contact of the H-1 relay, when the SR arm of the selector switch leaves the last contact. The SR-1 relay operated, closes in part a circuit from battery through the winding of the SR-2 relay, make contacts of the SR-1 relay, to the last contact of the SR arc.

39. The selector moves through the second revolution in the same manner as it does through the first, but when the SR arm reaches the last terminal, a circuit is closed from ground on the SR arm, last contact of the SR arc, make contact of the SR-1 relay, to battery through the winding of the SR-2 relay which operates. The SR-2 relay operated, opens the circuit through the stepping

magnet, stopping the interrupter. The SR-2 relay operated, also locks to ground on the armature of the H-1 relay and opens the circuit through the primary windings of the 49-A repeating coil, disconnecting the howler tone. To repeat the operation, the H key must be again operated, opening the circuit in which the H-1 relay is locked, releasing the relay. The H-1 relay released, releases the SR, SR-1 and SR-2 relays restoring the circuit to normal.

40. Should the plug be removed from the line at any time while the howler is being applied, the SS relay releases, releasing the A relay. The A relay released, closes a circuit from ground on the armature of the H-1 relay, to battery through the winding of the H-2 relay which operates. The H-2 relay operated locks to ground on the armature of the H-1 relay under control of the H key and opens a circuit to the primary of the 49-A repeating coil, disconnecting the howler tone from the line. The howler tone will not be reconnected even though the line again becomes crossed and the SS and A relays re-operate.

41. The selector completes its two-revolutions and returns to normal as described above. When the H key is restored to normal, the H-1, H-2 and SR, SR-1 and SR-2 relays release. Should the H key be released at any time before the selector has completed its second revolution, the H-1 relay releases, closing a circuit from ground on its armature, RN brush of the selector, to battery through the winding of the stepping magnet restoring the switch to normal. The H-1 relay released, also opens a circuit through the primary winding of the 49-A repeating coil disconnecting the howler tone. With the H key re-operated immediately, the howler will not be applied until the RN brush has caused the selector to return to normal as the circuit in which the H-1 relay operates is opened at the C brush of the selector. This assures a graduated application to the howler tone.

42. The howler can be applied only by means of the secondary test cord as the operation of the howler key (H) disconnects the primary and secondary test cords from the howler circuit.

43. The key marked X is used to interchange the primary and secondary test cords with respect to the primary and secondary testing circuits. When the key is in the normal position, the primary test cord is connected to the primary testing circuit and the secondary cord is connected to the secondary test circuit. The operation of the key makes it possible to apply all primary and secondary tests except the third wire test over the secondary cord, and all secondary tests except the howler test, over the primary cord.

CIRCUIT REQUIREMENTS

MECHANICAL REQUIREMENTS

207-A
(STP)

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

ELECTRICAL REQUIREMENTS

OPERATE	NON-OPERATE	RELEASE
Test .010 amp.	Test .009 amp.	
Readj. .0098 amp.	Readj. .0092 amp.	

MECHANICAL REQUIREMENTS

208-B
(1' to 9')

Armature gap .018" to .021".
Contact gap .004" to .005".

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 the adjustment the stationary lug shall not be bent to an angle greater than 45 degrees from the vertical.

ELECTRICAL REQUIREMENTS

Test .0152 amp.	Test .0138 amp.
Readj. .0148 amp.	Readj. .0142 amp.

MECHANICAL REQUIREMENTS

208-C
(0')

Armature gap .018" to .021"
Contact gap .004" to .005".

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 the adjustment the stationary lug shall not be bent to an angle greater than 45 degrees from the vertical.

ELECTRICAL REQUIREMENTS

Test .0122 amp.	Test .0108 amp.
Readj. .0118 amp.	Readj. .0112 amp.

CIRCUIT REQUIREMENTS

MECHANICAL REQUIREMENTS

208-G
(0-9)

Armature gap .018" to .021".
Contact gap .004" to .005".

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 the adjustment the stationary lug shall not be bent to an angle greater than 45 degrees from the vertical.

ELECTRICAL REQUIREMENTS

	OPERATE	NON-OPERATE	RELEASE
	Test .0152 amp. Readj. .0148 amp.	Test .0138 amp. Readj. .0142 amp.	
B1 (PS SS)	After a soak of approximately .3 amp. Test .021 amp. Readj. .015 amp.		After a soak of approximately .3 amp. Test .0037 amp. Readj. .005 amp.
B99 (SR)	Test .0048 amp. Readj. .0045 amp. Ringing Bak. on Relay		Test .0023 amp. Readj. .0025 amp.
B147 (PCI SCI)	Test .0020 amp. Readj. .0010 amp.		Test .0002 amp. Readj. .0003 amp.
E23 (H-2)	Test .028 amp. Readj. .016 amp.	Test .011 amp. Readj. .012 amp.	
E62 (CR-CC) (BT)	Test .049 amp. Readj. .042 amp.	Test .030 amp. Readj. .032 amp.	
E62 (D)	Test .063 amp. Readj. .042 amp.	Test .030 amp. Readj. .032 amp.	
E64 (A)	Test .064 amp. Readj. .035 amp.	Test .022 amp. Readj. .024 amp.	
E193 (PTC) (STC)	Test .096 amp. Readj. .069 amp.	Test .038 amp. Readj. .040 amp.	

CIRCUIT REQUIREMENTS

	OPERATE	NON-OPERATE	RELEASE
E361 (PD) & (SD)	Test .017 amp. Readj. .016 amp.	Test .010 amp. Readj. .011 amp.	
E367 (H)	Test .017 amp. Readj. .012 amp.	Test .0075 amp. Readj. .008 amp.	
E380 (SR)	Test .025 amp. Readj. .009 amp.		Test .0005 amp. Readj. .001 amp.
E396 (PCO-SCO)	Test .018 amp. Readj. .015 amp.		Test .0028 amp. Readj. .003 amp.
E447 (H-1)	Test .034 amp. Readj. .027 amp.	Test .013 amp. Readj. .014 amp.	
E539 (T-U)	Test .016 amp. Readj. .010 amp.	Test .0055 amp. Readj. .006 amp.	
E791 (ADV-1)	Test .017 amp. Readj. .014 amp.		Test .0019 amp. Readj. .002 amp.
E1037 (SR-1)	Test .021 amp. Readj. .016 amp.	Test .0095 amp. Readj. .010 amp.	
E1041 (SR-2)	Test .030 amp. Readj. .020 amp.	Test .0095 amp. Readj. .010 amp.	
E1054 (TH)	Test .019 amp. Readj. .016 amp.	Test .0095 amp. Readj. .010 amp.	
E1134 (NT)	Test .052 amp. Readj. .018 amp.	Test .011 amp. Readj. .012 amp.	
E1309 (D)	Test .017 amp. Readj. .012 amp.	Test .0070 amp. Readj. .0074 amp.	
E200 (ADV)	Test .021 amp. Readj. .016 amp.	Test .0028 amp. Readj. .003 amp.	

NOTE:- Adjust the straight outside spring of the make break spring combination to give the greatest possible contact pressure against the bent outside spring.

CIRCUIT REQUIREMENTS

	OPERATE	NON-OPERATE	RELEASE
E1520 (ST)	Test .030 amp. Readj. .023 amp.	Test .014 amp. Readj. .015 amp.	
Outer Wdg. 500 ohms	Test .040 amp.		

MECHANICAL REQUIREMENTS

12521
Sounder

The air gap between the armature and cores, with the lever down, shall be .005" minimum.

ELECTRICAL REQUIREMENTS

The sounder shall be adjusted to operate on .050 amp. and to release on open circuit, after operating on approximately .250 amp.

ENG.--ASP-JO. 9-27-22.

CHK'D.--RAP.-CWP.

APPROVED - C. L. SLUYTER, G.M.L.