Western Electric Company, Inc.,
Equipment Engineering Branch,
Hawthorne.

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METHOD OF OPERATION
TEST CIRCUIT

For Automatic Routine Test of District Selectors - Line Switch Type - Three Digit - Full Mechanical Power Driven System.

This appendix cancels circuit requirements and test clip data shown on pages 22 to 30 inclusive.

ENG: J.J.B.
12-8-23.
F.G.H.

CHK'D BY: J.I.

APP'D: H.L. MOYNES
E.R.C.

Western Electric Company, Inc.,
Engineering Department,
Telephone Systems Development.

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METHOD OF OPERATION
TEST CIRCUIT

For Automatic Routine Test of District Selectors - Line Switch Type - Three Digit-- Full Mechanical Power Driven System.

This Method of Operation was prepared from issue 14 of drawing T-501123.

DEVELOPMENT

1. PURPOSE OF CIRCUIT - This circuit is designed to test automatically three digit subscribers district selector circuits that are used in connection with line switches.

2. WORKING LIMITS - This circuit is used when the voltage limit of the battery is from 24 to 25 volts and from 48.5 to 50 volts. The value of the several resistances incorporated in the circuit are such as to impose worse loop conditions upon the relays in the district selector circuit under test.

OPERATION

3. PRINCIPAL FUNCTIONS - The principal functions of this circuit are as follows:-

3.1 To make a particular brush and group selection, trunk hunting for a particular set of terminals, and returning the district elevator and sequence switch to normal upon the successful conclusion of a test.

3.2 This circuit is arranged to test either message register, coin collect or flat rate type of district selectors. The operation of a single key causes the circuit to start an automatic test of all district selector circuits even though they are not all of the same type.

3.3 The circuit is arranged to distinguish between selector circuits that are idle, or busy on regular service. The circuits are made busy by the insertion of the make busy plug in the make busy jack associated with the district selector circuit and also to pass by terminals on the line switch that are spare. When a test circuit tests busy, the test circuit waits until the terminal becomes idle, in the case of a district selector circuit in regular traffic or will pass by the busy terminal if either a busy pass by key or a make busy plug pass by key is operated. In case neither one of these keys is operated and if the terminal does not become idle within a reasonable length of time, the test cir-

cuit holds up the test and the time alarm signal is operated.

3.4 The circuit is provided with alarms which indicate trouble either in the test circuit or the district selector circuit. A time alarm also operates in case sufficient time is left over after the busy district selector has been discharged for the circuit to complete a test. The circuit is provided with registers which record the actual number of completed tests, the number of single tests, the number of terminals passed due to talking busy and the number of times the alarm is operated.

4. START KEY (ST) - The operation of this key alone starts an automatic test, which continues until all district circuits have been tested. If other keys are operated, the operation of this key starts a special test as determined by the keys operated. The release of the key at any time stops the test.

5. RETURN TO NORMAL KEY (RN) - The operation of this key and the release of the ST key causes the circuit to return to normal, releasing any relays that may be locked to ground on its contacts.

6. CONTROL ADVANCE KEY (CA) - This key is operated when the test circuit fails to complete its cycle due to either a fault in itself or in the circuit under test. The operation of the key restores the test sequence switch to normal and holds it at normal until the key is released.

7. REPEAT KEY (REP). - The operation of this key causes the circuit to repeat the test on the existing selector until the key is released. A single repeat test is made by momentarily operating the key.

8. TALKING BUSY PASS BY AND PLUG BUSY PASS BY KEY TBP & PBP -- The operation of the TBP key causes the test circuit to automatically pass any terminal which is busy due to the district selector circuit being used in regular traffic. The operation of the PBP key causes the test circuit to automatically pass any terminal on the group switch which tests busy due to the insertion of a make busy plug in the make busy jacks associated with the district selector circuits.

9. END OF CYCLE KEY (EC) - The operation of this key at the end of one completed cycle, causes the test circuit to start another cycle of test. Should the RN key be operated in conjunction with this key, the first master switch is restored to normal but no further test is made.

10. TIME ALARM KEY (TA) - The operation of this key restores the time alarm circuit to normal.

11. FALSE CHARGE KEY (FCH) - The operation of this key checks and releases the CS relay in the district circuit for non-charge on a busy back condition.

12. PARTICULAR CIRCUIT KEY (PC) - The operation of this key in combination with other keys numerated below allows the operator to make a test upon a particular district selector circuit.

13. For the purpose of testing a particular district selector, this circuit is provided with thousands keys (0 to 3, inclusive), hundreds key, tens keys and units keys (0 to 9) inclusive. The operation of these keys causes one master switch and one group switch to step until the desired selector switch is reached. It is assumed both in the design and write up of this circuit, that the district selector circuits are numbered from 0 up. In order to select the first district selector circuit in the line up, it is necessary to press the 0 key in each numerical row. After twenty district selector circuits connected to a group switch have been tested, the master switch is stepped one terminal to the next group switch. When 400 district circuits have been tested the master switch is connected to the last group switch and is restored to normal when the next master switch is stepped off-normal, ready to test the next 400 district circuits. When all the district circuits have been tested, the automatic circuit stops, and lights a lamp. When a particular circuit is desired, the test circuit is restored to normal, and the number of the district circuit is written up on the numerical keys which direct the test circuit to that particular district to be tested.

14. CONNECTING CIRCUITS - This circuit makes use of individual line switches which are part of the equipment in the exchange. These individual line switches are in turn selected by the master switches which form a part of the automatic test circuit.

DETAILED DESCRIPTION

PRELIMINARY OPERATION

15. To make a routine test upon all district selector circuits, the ST key is operated. The operation of the ST key (a) advancing the switch to position 2, from ground on the CA key, through RS and MON-1 relay contacts, (b) operates the TA or BYTA relay. (The function of the TA and BYTA relays is explained under "TIMING FEATURE") and (c) operates the ST-1 relay from ground on the REP key, through the I contacts of the (1) interrupter. The ST-1 relay operated, locks in series with the ST relay to ground on the PC key, under control of the SPT relay. The ST relay operates when the I contacts of the (1) interrupter breaks. Upon the second make of the interrupter, the STP relay operates. The STP relay operated, operates the MN-2 relay and the M-1 magnet. The operation of the MN-2 relay connects its winding in series with the MN-1 relay which operates and locks to ground on the RN key when the STP relay releases.

SETTING MASTER SWITCH

16. The release of the STP relay on the break of the I contacts on the

interrupter, opens the operating circuit through the M-1 magnet, releasing the magnet and stepping the brush assembly of the first master switch to terminal 1. With the brush assembly of the master switch resting on terminal 1, the OFN-1 relay operates. The OFN-1 relay operated, lights the OFN-1 lamp indicating that the master switch is off normal. The operation of the OFN-1 relay also closes a circuit through the 18-AG and 18-AP resistance and the MON relay, which however, does not operate (See paragraph 66.) Upon the third make of the I contact on the interrupter, the STP relay reoperates, operating the MN-4 relay, and also reoperating the M-1 magnet. The operation of the MN-4 relay locks in series with the MN-3 relay which operates when the STP relay releases. The break of the I contacts releases the STP relay, opening the operating circuit to the M-1 magnet, moving the brush assembly of the master switch to terminal 2. While the master switch is advancing from terminal to terminal, the OFN-1 relay does not release and with the brush assembly of the master switch on terminal 2, the CO-0 relay operates in series with the OFN-1 relay. The operation of the CO-0 relay performs no useful function at this time.

SETTING CLASS CIRCUIT

17. With the first master switch resting on terminal 2, the class circuit is set to make the particular type of test required for districts that are used, either message rate, coin collect or flat rate service. When the district selector under test in either a message rate or flat rate type of circuit, ground is connected to terminal 21 on the DS arc of the group switch associated with the master switch, operating the CL relay. When the district selector under test is a coin collect type, ground is omitted from terminal 21, preventing the operation of the CL relay. Upon the fourth make of the I contacts of the (1) interrupter, and with the CL relay operated, the STP relay reoperates in turn operating the MR and N relays. The N relay operated, opens the stepping lead to the CL magnet from the RN arc of the class switch, preventing the class switch from returning to normal until all district circuits associated with a group switch have been tested. The MR relay operated, connects its winding in series with the MR-1 relay which operates and locks to ground on the RN key when the STP relay releases. The operation of the STP relay also operates the G-0 stepping magnet associated with the first group switch. When the I contacts on the (1) interrupter break, the STP relay releases, moving the brush assembly of the group switch to terminal 22. When the brushes of the group switch rest upon any terminal numbered 22 to 20 inclusive, the SM-0 relay operates. The SM-0 relay operated, locks under control of the CO-0 relay. The operation of the CO-0 relay opens the "RESET" stepping circuit through the G-0 magnet preventing the group switch from returning to normal until after all district circuits associated with the particular group switch have been tested, or the CO-0 relay is released by the operation of the RN key as hereinafter described.

18. When the district selector circuit under test is of a message rate type, terminal 22 on the DS arc of the district group switch is connected to ground, holding the CL relay operated. When the type of district selector circuit under test is either coin collect or flat rate, terminal 22 of the DS arc of the group switch is open, thus preventing the operation of the CL relay in case of a coin collect type and releasing the CL relay in the case of a flat rate type of district. When the I contacts of the (1) interrupter make for the fifth time and terminal 22 is grounded holding the CL relay operated message register type of district selectors are being tested, the STP relay operates in turn operating the S relay which locks and advances the R-2 sequence switch to position 4. With the MR and MR-1 relays only operated, the R-2 sequence switch advances to position 4.

19. The DTS relay which operates each time the R-2 switch moves, opens the circuit for moving the R-1 switch out of position 5 until the class switch is properly set. With the R-2 switch properly set the holding circuit of the DTS relay is opened. The STP relay operated also energizes the group magnet and when the STP relay releases the group switch advances to terminal 1.

20. If the CL relay is not operated, (coin district group) the operation of the STP relay on the fourth make of the interrupter connects ground through the break contacts of the CL and CC-1 relays, operating the CC and N relays. The CC-1 relay operates when the STP relay releases. When the interrupter contacts make for the fifth time the S relay operates advancing the R-2 switch to position 9.

21. When both sets of MR and CC relays are operated on the fourth and fifth make of the interrupter the class circuit is set for flat rate service, and the R-2 switch advances to position 14. The S relay in this class of call is operated through the CC-1 and MR relays, operated to ground on key RN.

22. The S relay operated and the STP relay normal, advances the (R-1) switch to position 3, from ground on cam T (R-1), the A cam carrying it to position 4. As the R-1 switch advances from position 2; the holding circuit for the ST, ST-1, MN-3, and MN-4 relays is opened at cam P, releasing the relays.

BUSY TEST OR DISTRICT SELECTOR CIRCUIT

23. If the district circuit associated with a terminal on a group switch is made busy by the insertion of a make busy plug in the MB jack of the district circuit, the test circuit tests for battery on the S lead and ground on the TEST lead. With the brush assembly of the group switch resting on terminal 1, as the R-1 switch is passing position 2 3/4 the PBP relay operates from battery in the district circuit associated with terminal 1 over the S lead. The operation of the PBP relay operates the PBP-1 relay. The PBP-1 relay operated, locks to bat-

tery on cam Q, (R-1) and lights the PBP lamp. The test circuit remains in position 4, until the operation of the PBP key. In position 4 the CK relay operates to ground on cam S, through the SLV-2 relay normal preventing a false revolution of the R-4 switch.

24. If the district selector circuit under test is busy on regular traffic, the test circuit tests for ground on the test and sleeve leads. Under this condition the SLV-3 relay operates, in position 3 1/2 from ground in the line circuit associated with the busy district over lead S. The SLV-3 relay operated, operates the SLV relay. The SLV relay operated, operates the SLV-1 relay which locks to ground on the test lead. The operation of the SLV-1 relay opens the test lead to TST relay and closes circuits (a) lighting the PBT lamp, indicating that the brush assembly of a group switch is resting on the terminals of a busy district selector circuit, and (b) operating the BSY relay. The operation of the BSY relay connects ground to one spring of the PBT key, which operates the PBT register when the key is operated, and releases the SLV-3 relay, which in turn releases the SLV relay. The circuit remains in position 4, until the selector becomes idle or the PBT key is operated which may not occur until after the time circuit operates.

25. If while the test circuit is advancing from position 2 to 4, battery is found on both the test and sleeve leads, it indicates that the district selector circuit under test is idle. During position 2 3/4 to 4, battery on the TEST lead operates the TST relay. The TST relay operated, operates the TST-1 relay and releases the PBP-1 relay should it have operated on an idle circuit. The TST-1 relay operated, locks and operates the HT relay in series with the SR relay. The SR relay does not operate due to the high resistance of the HT relay. The function of the HT relay is explained under paragraph 35. The operation of the TST-1 relay also operates the SLV-2 relay from battery over the S lead and thus causing the district to function connecting ground to the test lead. The SLV-2 relay operated, locks and releases the TST and CK relays. The TST relay is slow in releasing thus operating the TG relay after the SLV-2 relay operates from ground on the TEST lead. The TG relay operated, locks and advances the R-1 switch to position 5,

26. When the brush assembly of a group switch rests upon a spare set of terminals, none of the PBP, TST or SLV relays operate due to a ground being on the test lead and the sleeve lead being open. When the R-1 switch reaches position 3 1/2, ground on cam W through the SLV and TST relays normal advances the R-1 switch to normal, and stepping the group switch to the next set of terminals as hereinafter described, paragraph 40.

27. Assume for expediency, that the district selector circuit under test is idle. With the R-1 switch in position 5, the TG relay releases and the PC relay operates from battery and ground in the sender circuit associated with the district selector circuit under test over the ring and tip of the district selector circuit. The PC relay operated, advances the R-1 switch to position 6 from ground over the TEST lead.

When the switch leaves position 5 1/4, the PC relay releases.

28. In position 6, the EC-1 relay operates to ground on cam U, and locks to ground on the RN key through the EC key. The EC-1 relay operated, opens the stepping lead for stepping the first master switch off of the first terminal at the end of a complete cycle. When the last district selector circuit in the line up is tested, the test circuit is again connected to the first master switch and tries to step the master switch to the first group switch, but instead operates the EC relay. The EC relay operated locks, opens the battery lead for the ST-1 relay, and lights the EC lamp. (See paragraph 43.) The release of the ST and ST-1 relays together with the opening of the battery lead, holds the test circuit in position 2, and at the end of a time measure interval an alarm is given.

TEST OF DISTRICT - REPEATING COIL OUT

29. In position 6, ground on cam V (R-1) over lead D, advances the R-4 switch from position 1, and cam B carries it through one complete revolution. As the R-4 switch is making its first revolution, the fundamental circuit, from the sender is closed over the lead T, DT arcs on the group and master switches, cam L (R-1) lead 4, cam E and I (R-4), over lead 2, cam M (R-2), cams N and M (R-1), through the DR brushes of the master and group switches over the ringside of the fundamental circuit to the sender. When the switch reaches position 2 1/2 the fundamental circuit is open and the pulses to the sender circuit are sent through the upper outer contacts of cam E (R-4), over lead A. Pulses are sent until the R-4 switch reaches position 8, when the E cam is shorted by cam I and lead 2 preventing further pulses being sent to the sender circuit. As the R-4 switch is passing thru position 14 to 15, ground on cam C operates the CK relay. The CK relay operated, locks over lead D to ground on cam V (R-1). In positions 19 1/2 to 20 of R-4, ground through cam C (R-4) over lead E, advances the R-1 switch to position 7. In position 7, the CK relay releases, and the pulses required for second digit registration are sent to the sender.

30. In position 7 of R-1, the circuit through cam V to the R-4 magnet is reestablished, moving the R-4 switch out of position 1 and causing it to make a second revolution. The pulses necessary for second digit registration are sent to the sender by means of cam E until shorted in position 9 1/4, by cam H (R-4) and lead 7. The CK relay operates as the R-4 switch enters position 14. In position 18 to 18 1/2, ground on cam C (R-4), over lead B, advances the (R-1) switch to position 8. In position 8, the CK relay releases and a circuit is closed from ground through cam V to the R-4 magnet, moving the R-4 switch out of position 1, causing it to make a third revolution. On the third revolution of the R-4 switch, the last digit of a three number office code is sent to the sender circuit, through cam E (R-4) until shorted by cam H and lead 6 in

position 10 1/2. As the switch enters position 14 on the third revolution, the CK relay reoperates and locks to ground on cam V. In position 16 1/2 to 17 ground on cam D (R-4) over lead C advances the (R-1) switch to position 9. With the CK relay locked through cam V (R-1) in position 6, 7, and 8 of the R-1 switch, the R-4 switch is prevented from making another revolution and from sending a false code should the R-1 test switch fail to move out of either position 6, 7, or 8 after the corresponding digit code has been sent.

31. In position 9, the GS relay operates to ground on cam W. The GS relay operated connects ground to the S-1 and S-2 leads, causing the first two lines in the selected group to test busy to the trunk hunting district elevator. Also the elevator of the district selector under test is driven to the uppermost bank of the frame, and the brushes rest on the terminals of a test line which connects to the automatic test circuit as shown in the upper left hand corner of the test circuit. The TC relay operates over the tip side of the district selector circuit, fundamental tip and associated sender circuit, back over the fundamental ringside of the sender and of the district selector circuit to ground on cam H (R-1). The TC relay operated, operates the TC-2 relay. The TC-2 relay operated, connects its winding in series with the TC-1 relay, which operates and locks to ground on cam W, when the TC relay releases. The sender circuit functions and opens the operating circuit for the TC relay which releases. The operation of the TC-1 relay, connects ground to the S terminal in the district multiple, holding the test line circuit busy to other hunting district selectors. As the sender advances, the energizing circuit for the TC relay is again closed, operating the relay. The TC relay operated, advances the (R-1) switch to position 10.

32. In positions 9 1/4 to 11 of the R-1 switch, a circuit is closed from battery through the repeating coil and DC relay in the district, over the ring lead cam M (R-1), cams L and K (R-2), cam J (R-1), OP relay normal inner winding of the A relay, cam L (R-1) to ground in the district circuit supplying a soaking current to the DC relay, in the district and operating the A relay, which perform no function at this time. In position 10 the PSK relay operates, connecting 48 volt battery to the ringside of the test line to soak the polarized supervisory relay in the district and also closes a circuit to operate the SK relay when the I contact of the (3) interrupter closes. The SK relay operated, locks to ground on the RO relay normal. When the II contact of the (3) interrupter makes, the SK-1 relay operates and locks. On the next make of the I contacts on the (3) interrupter, the (R-1) switch advances to position 11, the A cam carrying it to position 12. As the switch advances, the PSK, SK, and SK-1 relays release. As the R-1 switch is advancing from position 9 to position 12, the S terminal of the district brush is held busy by ground on cam G.

33. As the PSK relay releases, the CS relay operates in series with the polarized supervisory relay in the district, which also operates. The

CS relay operated, performs no useful function at this time. The operation of the polarized supervisory relay in the district advances the district to its "Talking to Operator" position. The CS relay releases as the R-1 switch advances out of position 11.

34. On position 12, the CS relay reoperates over the ringside (repeat coil out) of the test and district circuits through the RO and OP relays normal to ground on cam F (R-2). The CS relay operated, operates the RO relay. The RO relay operated, opens the shunt around the B, C, and D resistances and RLS relay thereby increasing the resistance in the operating circuit of the CS relay which holds. The DC relay in the district releases but performs no useful function at this time, the district being held by ground over lead S-3 from cam G (R-1). The RLS relay does not operate at this time. The RO relay operated, also operates the SK relays under control of the (3) interrupter. The SK relays locks through the RO relay normal over the tip side of the district and test circuits to ground on cam F (R-2). The SK and SK-1 relays operated advance the R-1 switch to position 13 under control of the (3) interrupter. As the R-1 switch advances from position 12, the RO, SK, SK-1, and CS relays release and ground is removed from lead S-3 releasing the district.

35. As the R-1 switch advances to position 13, ground is again connected to the S-3 lead holding the terminals busy, and the A relay is connected across the incoming end of the district reoperating and soaking the DC (district) relay thus stopping the district in the overflow position. The A relay operates, in turn operating the OP relay under control of the (2) interrupter. The OP relay operated, locks in series with the OP-1 relay which operates when the I contact of the (2) interrupter opens. The OP relay also opens the shunt around the B, C, and D resistances and RLS relay, thus releasing the DC (District) relay and operating the RLS rleya. The release of the DC relay advances the district switch one position. The RLS relay operated, operates the WD-1 relay. The WD-1 relay operated, operates the WD relay. When the district has advanced out of "OF" position the RLS relay releases in turn releasing the WD-1 relay. The SL relay releases (non-charge) and the district circuit is restored to normal. The WD-1 relay released advances the switch to position 14. The switch is carried to position 1 of the second revolution by ground on cam F (R-2). In position 18 1/2 the FR relay operates and locks to ground on the RN key. The FR relay advances the R-2 switch to position 5. The operation of the FR relay also closes a circuit through the RS relay, to ground on the test lead operating the RS relay. The HT relay operated, connects ground to the TA relay in the alarm circuit holding the TA relay in the alarm circuit holding the TA relay operated after the R-1 switch leaves position 18. The purpose of holding the TA relay operated from position 18 on the first revolution of the R-1 switch is to make one time measure interval serve two revolutions of the R-1 switch. As the switch leaves position 18 1/2, the TST-1 and HT relays release.

TEST OF DISTRICT - REPEATING COIL IN

36. When the district selector circuit under test is restored to normal, ground is removed from the test lead, releasing the RS relay, advancing the R-1 switch to position 2. Ground on cam E (R-2) advances the switch to position 3, the A cam to position 4. In positions 2 3/4 to 4, the district is retested for busy conditions as described for the first revolution of the test switch. If it tests idle, the TG relay operates and advances the R-1 switch to position 5. From positions 5 to 13, the circuit functions as described under paragraphs 27 to 32 inclusive, except that leads 1, 3 and 5 to the pulse circuit are used instead of leads 2, 6, and 7, the "SK" relays do not operate previous to position 13 and the PSK relay does not operate. In this test the repeating coil is in and the DC relay is being soaked as in the previous test except through the lower contacts of cam J. With the CS relay operated, the CS-1 relay operates under control of the III contacts of the (1) interrupter. The CS-1 relay operated, locks and connects battery through its make contact, to the SK relay, which operates when the IV contacts make. The SK relay locks to ground on the break contact of the RO relay. On the make of the III contacts the SK-1 relay operates and locks. Upon the next make of the IV contacts ground on cam Q is connected to cam D advancing the R-1 switch to position 14. The time interval between successive makes of the IV contacts allows the OP and OP-1 relays to perform their function. A circuit is also closed from ground on cam V through the I contact of the (2) interrupter to the OP relay, which operates. The OP relay operated, connects its winding in series with the winding of the OP-1 relay which operates and locks to ground on cam V when the I contact of the (2) interrupter breaks. The operation of the OP relay opens the circuit for the soaking current through the DC relay and removes the shunt from the B, C, and D resistances which reduces the current through the DC relay to its releasing value. The operation of the OP-1 shunts the D or D and C resistance reoperating the DC relay. The time interval during which the DC relay is released, after the operation of the OP relay until the operation of the OP-1 relay, cannot be more than .100 seconds because the slow release relay (D) in the district circuit, may release and allow the district circuit to return to normal. Ground on cam F (R-2) advances the R-1 switch from position 14 to 18.

MESSAGE REGISTERING AND COIN COLLECTION

37. When message register type district selectors are under test, the R and R-5 relays are connected to the sleeve of the district circuit in positions 6 to 18 of the R-1 switch. If the selector circuit tests satisfactory, message register current is sent out by the district circuit in position 18 of the R-1 switch on its second revolution, operating the R and R-5 relays. The operation of the R relay operates the WD-1 relay. The operation of the WD-1 relay operates the WD relay which locks to battery. When the district selector circuit under test opens the message register current, the R relay releases, in turn releasing the WD-1 relay which advances the switch to position 1. As the switch leaves position 18, the

holding circuit for the WD relay is opened at cam V, releasing the relay. The switch advances to position 2 for the next test through the contacts of the ST key. The R-5 relay performs no function at this time.

38. On coin service district selectors, the C and CR relays are connected to the tip side of the selector circuit in positions 17 and 18. When coin collect current is connected to the tip side of the district by the associated sender, the C relay operates from ground on cam F (R-2). The CR relay does not operate unless the FCH key is operated (See paragraph 62.) The operation of the C relay closes a circuit to the WD-1 relay, which operates. From this point, the R-1 switch is advanced to position 2 as explained in paragraph 37.

39. As the R-1 switch entered position 10 on its second revolution, a circuit was closed from ground on cam U, (R-1) to the SR relay which operated and locked to ground on cam D (R-2). The SR relay operated, closes a circuit from ground through the windings of the HC and SR-1 relays, to battery on cam Q (R-1) when the switch enters position 18 1/2 on its second revolution, operating the SR-1 and HC relays. The SR-1 relay operated, locks to cam O (R-2). The HC relay locks to battery on the make contact of the FR relay, which operates in position 18 1/2. The operation of the SR-1 relay also closes a circuit from ground through the make contact of either the MR or CC relay, advancing the R-2 switch to position 1. With the R-2 switch in position 1, a circuit is closed through the make contacts of the MR and CC relays, depending upon the type of district selector under test, to ground on the make contact of the S relay, advancing the switch to position 4, 9, or 14. As the R-2 switch returns to normal, the SR and SR-1 relays release. The operation of the HC relay prevents the R-2 switch from advancing out of position 4, 9, or 14 prematurely by ground on the make contact of the FR relay. The HC relay is slow to release to insure the above condition. As the R-1 switch advances through positions 17 and 18 on its second revolution, the CT register operates. This register records the completed test and does not operate on a repeated test. In the same position, a circuit is also closed through the ST register to ground on cam E (R-2), operating this register. This register records the number of single tests, including repeated tests. When the R-1 switch leaves position 18 on its second revolution, the holding circuit for the TA relay is opened at the lower outer contact of cam T, releasing the relay. The release of the TA relay closes a circuit from ground through terminals on arc RN and brush RN of the time measure switch to battery through the break contact and winding of the TM stepping magnet, restoring the time measure switch to normal.

ADVANCE GROUP SWITCH

40. With the time measure switch normal, the TA relay reoperates from ground through the ST key, and locks to ground on cam T. A circuit is closed from ground through the contacts of the CA and ST keys, break contacts of the RS and MON-1 relays, to cam B advancing the sequence switch to position 2.

In position 2, the ST-1 relay operates on the first make of the I contact on the (1) interrupter and locks in series with the ST relay through the make contact of the ST-1 relay as explained under paragraph 15. Upon the second make of the I contact on the (1) interrupter, the STP relay operates, operating the G-0 magnet and the MN-4 relay. When the contacts of the interrupter break, the STP relay releases, in turn advancing the R-1 switch to position 3, and releasing the G-0 magnet, which moves the brushes of the first group switch to terminal 2. The test of the district selector associated with this terminal, proceeds in the same manner as the test on the district selector associated with the first terminal of the switch. When this selector circuit is satisfactorily tested, the G-0 magnet reoperates and advances the group switch to terminal 3. This procedure is repeated until all twenty district circuits associated with the first group switch are tested. When the first group switch leaves terminal 20 and advances to terminal 21, a circuit is closed from ground through the contacts of the REP, PC, ST, and CA keys, the SR relay normal, II contact of the (1) interrupter, make contact of the ST relay, operated terminal 21 and STP brush of the first group switch, make contact of the SM-0 relay, to the M-1 magnet associated with the first master switch, energizing the magnet. When the II contact on the interrupter breaks, the M-1 magnet releases, moving the brush assembly of the first master switch to terminal 3. As the brush assembly of the master switch leaves terminal 2, the CO-0 relay of the group switch releases, in turn releasing the SM-0 relay.

41. Each time the R-1 switch revolves making a "Repeating Coil Out" test, a circuit is closed through the CL magnet associated with the class switch, to ground on cam S (R-1), energizing the CL magnet, which moves the brush assembly of the class switch to the next terminal when the R-1 switch leaves position 6. When all the district selector circuits associated with the first district switch have been tested, the brush assembly of the class switch rests on terminal 21 until the SR-1 relay operates, which when operated, releases the N, MR, and CC relays. The N relay released, returns the class selector switch to normal. The MR and CC relays normal advance the R-2 switch to normal. When the first master switch steps to the next terminal, another group switch is used. From this point on, the test of the district selector circuits associated with the other group switches proceed in the same manner as described for the first district selector circuits tested. The class circuit is reset according to the type of district selector circuits associated with each of the other group switches.

SELECTION OF SECOND MASTER SWITCH

42. When all the selector circuits associated with the twentieth group switch associated with the first master switch have been selected, the G-19 stepping magnet associated with the twentieth group switch is energized moving the brush assembly of the switch to terminal 21. Upon the next make of the II contact on the 149-C interrupter, a circuit is closed from ground through the

make contact of the ST relay, terminal 21 and STP brush of group switch 19, make contact of the STM-19 relay, to the M-1 magnet associated with the first master switch. When the interrupter contacts break, the switch advances to normal. A circuit is also closed through another make contact of the STM-19 relay, to the M-2 magnet which operates and moves the second master switch to terminal 1. With the M-2 switch on terminal 1 the OFN-2 and SPT relays operate, moving the M-2 switch to terminal 2 through the DR arc. The selector circuits associated with this switch are tested in a similar manner to those of the first master switch.

43. When the twentieth group switch associated with the fifth master switch leaves terminal 20, a circuit is closed from ground through the II contact on the (1) interrupter, contacts of the STM-99 relay, terminal 21 and STP brush of group switch 99, to the windings of the M magnets associated with the first and fifth master switches, operating the magnets. The operation of the M-1 stepping magnet, moves the brush assembly of the first master switch to terminal 1. The operation of the M-5 magnet, restores the fifth master switch to normal. A circuit is closed from ground through the make contact of the STP relay, STP brush and terminal 1 of the first master switch, to the EC relay and lamp, operating the relay and lighting the lamp. The EC relay operated, locks to ground on the RN key. The EC lamp, indicates the end of one cycle of routine tests. The circuit does not make another routine test unless the EC key is operated on account of the circuit through the M-1 magnet being opened at the contact of the EC-1 relay.

CONCLUSION OF A ROUTINE TEST

RETURN TO NORMAL KEY (RN)

44. If another cycle of tests is not desired, the RN key is depressed, and the ST key released. The operation of the RN key releases all relays locked through its contacts and extinguishes the EC lamp; it operates the TR relay in positions 4 to 18. The function of the TR relay is described in paragraph 58. The operation of the RN key, closes a circuit from ground through its make contact, winding of the MRN relay to battery, operating the relay. The RN key also connects ground through cam D to battery through the R-1 magnet advancing the test switch to normal. The operation of the MRN relay connects ground through the make contact of the OFN-1 and any other "OFN" relay, break contact and winding of the associated stepping magnet, restoring the first master switch or other off normal switch to normal. Each time the brush assembly of a master switch steps to another terminal, the CO relay associated with that terminal operates but performs no useful function. Ground through the break contacts of the MR or CC relay to cam C, restores the R-2 sequence switch to normal. With the release of the RN key, the MRN relay releases restoring the entire circuit to normal.

TEST OF A PARTICULAR DISTRICT SELECTOR CIRCUIT

45. The operation of a set of numerical keys, the PC and ST keys in the order named, closes a circuit from ground through the make contact of the PC key, lead 5 and contacts of an operated hundreds numerical key to battery thru the winding of either the R-1, R-2 or R-3 relay which operates. The operation of the ST key advances the R-1 switch to position 2, and also operates the TA relay which performs its usual function. The operation of the PC key, advances the R-3 switch to position 2, operates the GP relay which locks and opens the locking circuit for the ST relays. Assuming that thousands key 0, hundreds key 3, tens key 5, and units key 7 are operated, ground is connected from the PC key, break contact of the R-4 relay, lead 5, contacts of hundreds key 3, lead 9, to the R-3 relay which operates. The operation of the R-3 relay, operates P and OV relays through terminals 0 to 14 inclusive on the M arc. The P relay operated closes circuits, (a) from ground through one winding of the MG relay, operating the REG magnet, and (b) from ground through the other winding of the MG relay, lead 1, make contacts of hundreds key 3, thousands key 0, operating the M-1 magnet. The operation of the VO relay holds the stepping lead of the REG magnet open, during the time the stepping switch steps over grounded terminals. A circuit is closed from ground through the key release magnets, operated cam F, ML arc to battery through the M lamp, which lights indicating that master selection is being made.

46. The closure of circuits through both windings of the MG relay causes it to operate and open the circuit for the P relay, which releases. The release of the P relay in turn opens the circuits through the MG relay which releases the magnets and moves the brush assemblies of the register switch and the master switch to the next terminal. The circuits through the P and MG relays are re-established, as long as the brush assembly of the register switch rests on grounded terminals, repeating the operation just described. When the brush assembly of the register switch steps to terminal 15 on the M arc it finds this and the next terminal grounded, through the make contacts of tens key 5, and the PC and REP keys. The stepping magnets reoperate and move the brush assemblies to the next terminal. This is done in order to make allowance in the setting of the master switch for the first two terminals of the master which are not connected to group switches. Terminals 17 and 18 are likewise grounded by the operation of tens key 5 causing the register and master switches to step to terminal 19, which terminal is connected to the proper group switch. When an idle terminal is found on the M arc of the register switch, the VO relay releases, stepping the REG switch to terminal 21 from ground through the key release magnets operated. With the brush assembly of the switch resting on terminal 21 the SS relay operates in series with the REG magnet. The magnet does not operate in series with the high resistance of the relay. The operation of the SS relay advances the R-3 switch to position 3.

47. In position 3, a circuit is closed from ground through the common contacts of the key release magnets, to the REG magnet, advancing the register switch to normal. The same ground shorts the winding of the SS relay, preventing

its operation. With the brush assembly of the register switch normal, circuits are closed from ground through the common contacts of the key release magnets, ML brush and terminal 0 of the switch, to the R-3 magnet, advancing the sequence switch to position 4. As the switch is advancing from position 3 to 4, the CL relay operates through cam M (R-3), to the first terminal of the D3 arc on the group switch associated with the terminal selected by the master switch, setting the class circuit. The CC, CC-1, MR, MR-1 and L relays operate under control of the MG and CL relays.

48. In position 4 ground on the RN key through terminals 0 and 1 and G brush of the register switch cause the P and OV relays to operate. The P and OV relays operated, perform the same function as previously described except the group switch is stepped instead of the master switch. This is done in order to have access to the first working terminal of the group switch, and to set the class circuit as determined by the selected group. The S relay operated and the R-2 switch off normal advances the R-3 switch to position 5.

49. When the register switch enters position 3, a circuit is closed from ground through the PC key, lead 6, tens key 5, cam K, terminals 2 to 11 inclusive and G brush of the register switch, operating the P and OV relays. The P relay performs its usual function, stepping the register and group switches to terminals 12 and 11, respectively.

NOTE:- A ground is only connected to cam K (R-3) when the district selector appears in the second half of the group switch, and it holds the VO relay operated. When the district appears in the first half of a group switch, the holding circuit for the VO relay is open at terminals 2 to 11, inclusive on the G arc. The release of the VO relay allows the REG magnet to operate and step the brush assembly of the register switch to terminal 12 without moving the brush assembly of the group switch.

With the brush assembly of the register switch resting on terminal 12, a circuit is closed from ground through the make contact of the units key 7, break contacts of units 6 to 1, inclusive, terminal 12 to 13 on the G arc to the P and OV relays, which operate and steps the register and group switches to terminals 19 and 18, respectively. The release of the VO relay on open terminal 19, closes the stepping lead through the REG magnet, to ground on the PC key, causing the brush assembly of the register switch to terminal 21. In position 5, the G lamp is lighted indicating the group selection is being made. The SS relay reoperates and advances the R-3 switch to position 18. The R-3 switch remains in position 18, and the register switch remains on terminal 21, until the release of the PC key.

50. As the R-3 switch enters position 6, the R-1 switch advances from position 2. From this point the "Repeating Coil Out" test of the particular incoming circuit proceeds in the usual manner.

As the sequence switch R-3 is passing position 10 to 15, a circuit is closed from battery on cam H, to ground through the key release magnets which operate, releasing the operated numerical keys. At the conclusion of the test on a particular district circuit, the PC key is released, restoring the R-3 switch to normal. With the (R-3) switch normal, the register switch is restored to normal. When the register switch leaves terminal 21, the G lamp is extinguished.

ROUTINE TESTING AFTER A PARTICULAR TEST

51. In order to make the test, with "Repeating Coil In", upon the particular district circuit, which consists of testing the supervisory relay, it is necessary to allow the test circuit to continue on a routine test basis. This is done by allowing the ST key to remain operated, after the release of the PC key. The GP relay which operated with the depression of the PC key, closes a circuit with the R-3 switch in position 5 to the CL magnet, energizing the magnet. Each time the MG relay operates and releases due to the register switch and group switches stepping, the CL magnet associated with the class switch releases and re-operates, moving the class switch one terminal. The class switch thus follows the group switch on a particular setting and is able to change its setting when a group brush assembly steps off the last terminal of the switch.

52. On a routine test continuation after the second revolution of the R-1 switch, which makes the "Repeating Coil In" test on a particular district selector circuit, the G magnet associated with the group switch in which the particular district appears is operated in a circuit from battery through the winding of the magnet, STP arc of the master switch, contacts of the DR, STP relays to ground on cam T on R-1, moving the brush assembly of the group switch to the next terminal. The R-1 switch has in the meantime passed position 18 on the second revolution and opens the circuit of the GP relay at cam Q (R-1), releasing the relay. From this point a routine test of the remaining district selectors progresses in the usual manner unless the RN key is operated. When all the district selectors have been tested, the EC lamp lights and the circuit is restored to normal as previously described under "Conclusion of a Routine Test".

TIMING FEATURE

COMBINED TROUBLE AND BUSY ALARM (FIG. 1)

53. As stated under "Preliminary Operations", the operation of the ST key closes a circuit to the TA relay which operates and locks to cam T on R-1. Should trouble develop in the test circuit or the district selector circuit under test, or should the selector circuit be kept busy in traffic too long to allow sufficient time after the discharge of the district to permit the completion of a test, the time alarm circuit operates, lighting the lamp and operating a register.

54. The operation of the TA relay closes a circuit from ground through the contacts of a 152 interrupter and of the TA relay, terminals and brush on arc C of the time measure switch, to the TM magnet, which operates. When the interrupter contact breaks, the energizing circuit of the magnet is opened, releasing the magnet, which moves the brush assembly of the time measure switch to the next terminal. This cycle is continued until the brush assembly of the time measure switch rests on terminal 16. If this occurs before the R-1 switch is in position 18 on its second revolution, a circuit is closed from ground through the make contact of the TA relay, AL brush and terminal 16 of the TA switch to the ALM register and the DIST. lamp, lighting the lamp and operating the register. The brushes remain on terminal 16 until the operation of the TA key, which opens the locking circuit for the TA relay, which releases. The TA relay released, closes a circuit from ground through the break contact of the relay, terminal and brush of arc A, break contact and winding of the TM magnet which restores the time measure switch to normal.

SEPARATE TROUBLE AND BUSY TIME ALARMS (FIG. 2)

55. When separate alarms are used, the operation of the ST key operates the BYTA relay which locks through its make contact. The BYTA relay connects the 152 type interrupter through the break contact of the TBLTA relay to the BYTA selector magnet. Should a district circuit be kept busy too long to allow sufficient time to complete a test the BYTA magnet moves the brush assembly of its selector switch to terminal 17, lighting the BYTA lamp. Upon the operation of the TA key the BYTA relay releases, restoring the busy time alarm switch to normal as described in the paragraph above.

56. The TBLTA relay does not operate until after the district circuit has been seized and the TST-1 relay operates. Should trouble then develop the TBLTA magnet steps its brush assembly over 2 or 3 terminals (dependent upon with a 1 min. or a 1 1/2 min. delay is desired). A circuit then is closed through the TBLTA lamp and TBL register, lighting the lamp and operating the register which records the number of troublesome district selectors. The circuit waits until the operation of the TA key, which operates the HA relay. The HA relay locks to the TST-1 relay preventing the BYTA relay from operating until the test circuit has moved to the next selector. When the test circuit is restored to normal the HA and TBLTA relays release, the latter relay restoring the trouble time alarm switch to normal.

END OF CYCLE (EC) KEY

57. When a second cycle of routine test is desired, the EC key is operated, releasing the EC and EC-1 relays. The EC relay released,

extinguishes the EC lamp and connects battery to the winding of the ST-1 relay, allowing it to operate upon the make of the I contact on the (1) interrupter. The release of the EC-1 relay closes the circuit to the M-1 stepping magnet allowing the brush assembly to move to the second terminal. From this point, a second routine test is made upon all district selectors in the same manner as described for the first routine test.

CONTROL ADVANCE (CA) KEY

58. If trouble develops in either the test circuit itself or in the district selector circuit under test, the time alarm lamp lights as described under "TIMING FEATURE". If after the TA key is operated, the circuit has not continued its function, the CA key is operated. The operation of the CA key advances the R-1 sequence switch to position 1, and connects battery to terminal 21 on the class switch to hold the class setting when the brush assembly of the switch rests on this particular terminal. A circuit also is closed by the operation of the key, operating the TR relay, which locks. The TR relay operated opens the T and R leads to the district circuit thereby preventing false operations in the district circuit. The switch does not move out of position 1 as long as the CA key is operated. Upon the release of the CA key, the circuit advances to the next district circuit or a repeat test is made upon the defective selector circuit if the REP key is operated. When the REP key is not operated, the release of the CA key closes a circuit through the ST key, to the R-1 magnet, advancing the switch to position 2, from which point the routine test is continued on the next district selector connected to the group switch.

REPEAT (REP) KEY

59. When it is desired to repeat a test upon a certain district selector circuit, the REP key is operated. The operation of the REP key operates the DR relay. The DR relay operated, locks and opens the stepping lead to the CL magnet and also opens the stepping lead to the G magnet associated with the group switch, preventing the magnets from operating and moving the brush assemblies of the switches to the next terminal. The operation of the REP key, also opens the circuit through the CT register, preventing it from registering on a repeat test. With the CA key, normal, the R-1 switch advances to position 2 where a second test is made upon the same district selector circuit. The test continues indefinitely on the same district selector until the release of the REP key, allowing the G magnet to operate. If only a single repeat test is desired, the key is momentarily operated. The REP key connects battery to terminal 21 of the class switch performing the same function as the CA key (See paragraph 58).

PASS BUSY PLUG (PBP) KEY

60. When a busy plug has been inserted in the jack associated with a circuit under test, the test circuit waits in position 4 until the

operation of the PBP key. The operation of the PBP key advances the R-1 switch to position 5. As the sequence switch leaves position 4, the holding circuit for the PBP-1 relay is opened at cam Q to release the relay. The release of the PBP-1 relay opens the circuit through the PBP-1 lamp, extinguishing the lamp. The PBP, TST and SLV relays normal advance the R-1 switch to normal. The R-1 switch is moved out of position 1 by ground on the ST key and in position 2, the ST-1 relay re-operates and moves the brush assembly of the group switch to test the next terminal. The circuit passes any terminal which tests "plug busy" as long as the PBP key is operated.

PASS BUSY TALKING (PBT) KEY

61. When a terminal tests busy on regular traffic, the SLV-1 relay operates, lighting the PBT lamp and the test circuit remains in position 4 until the operation of the PBT key. The operation of this key closes circuits from ground on the operated BSY relay, to the TR relay which operates and performs the same function as described in paragraph 58, and also operates PBT register which records the number of "talking busy" terminals. The operation of the PBT key also closes a circuit from ground through its make contact, to cam D, advancing the switch to position 5. As the test switch leaves position 4, the holding circuit for the BSY and SLV-1 relays is opened, releasing the relays, which in turn advances the R-1 switch to normal, releases the PBT register and extinguishes the PBT signal lamp. When the switch leaves position 18, the holding circuit for the SLB-3 relay is opened at cam O, releasing the relay. From this point, the circuit functions as described in the paragraph above.

FALSE CHARGE KEY (FCH)

62. When the FCH key is normal the circuit functions as described under paragraphs 36 to 39, inclusive. When operated, the FCH key closes a circuit operating the BB and BB-1 relays from battery on cam R (R-2), and also connects the CR relay in parallel with the C relay. The BB relay operated, operates the CS relay in positions 13 and 18, and connects battery through 1000 ohms and a 149 type interrupter to the ringside of the district under test to similate a busy back condition on the CS relay. The BB-1 relay, operated, transfers the operating circuit for the SK relays so that they operate under control of the W and Z relays, and prepares an operating circuit for the Z and W relays under control of the IV contact of the (2) interrupter and the CS-1 relay.

63. With the R-1 switch in position 13 and the CS relay operated, the CS-1 relay operates under control of contact III of the (1) interrupter. The CS-1 relay locks and operates the Z relay under control of contact IV of the (2) interrupter. The Z relay operated, locks in series with both windings of the W relay which operates when contact IV breaks. The next make of contact IV releases the Z relay and holds the W relay, in turn operating the SK relay. The contact III of the (2) interrupter operates the

SK-1 relay. The third closure of contact IV re-operates the Z relay followed by the operation of the W relay. The fourth closure of contact IV releases the Z relay advancing the R-1 switch to position 14, and ground on cam F (R-2) advances it to position 18.

64. The CS relay should operate and release following the interrupter. If it should fail to release the charge relays in the district operate falsely and the R and R-5 relay in the test circuits operate in position 18, falsely. The operation of the R relay closes a circuit operating the FCH relay through the make contact of the BB relay. The FCH relay connects its winding in series with that of the FCH-1 relay which operates when the message registering current is opened by the district. The FCH-1 relay operated lights the FCH lamp and prevents the R-1 switch from advancing out of position 18. If the CS relay (District) releases, the call is not charged and hence the R-5 relay not operating advances the R-1 switch to position 1 and the circuit is restored to normal.

65. In coin type districts the CS relay in the district should follow the interrupter. However the sleeve relay is held operated connecting negative coin battery to the test circuit, operating the CR relay. The CR relay operated, operates the WD-1 relay and in turn the WD relay. The CR relay releases when coin battery is removed from the T lead, releasing the WD-1 relay. The WD-1 relay normal advances the switch to normal. Should the CS relay fail to release, positive coin battery operates the C relay, causing the FCH and FCH-1 relays to operate and block the test circuit. In either case of false charge the district sequence switch continued to revolve preventing the selector being seized by a line switch. The R-1 switch is moved out of position 18 by the operation of the CA key, which releases the FCH and FCH-1 relays, and extinguishes the FCH lamp.

STOP AUTOMATIC TEST

66. The ST key may be released at any time to stop the routine test of the district circuits but the test circuit does not cease to function until the test at the time of the release of the key is completed. The release of the key prevents the R-1 switch from advancing at the completion of the test then being made; it also opens the circuit preventing the re-operation of the TA, ST and ST-1 relays. If it is desired to restore the test circuit to normal at the release of the ST key, the RN key is operated, causing the circuit to function as described under "Completion of a Routine Test".

MISCELLANEOUS

67. Should two master switches step off normal or get off normal at the same time, a circuit is closed from battery through the 726 ohms resistance associated with each master switch, make contact of the OFN relay over the common lead to ground through the winding of the MON relay, operating the relay. The MON relay does not operate in series with one 726 ohm resistance

alone. The MON relay operated, closes a circuit lighting the MON lamp and also operates the MON-1 relay. The MON-1 relay operated, locks to ground on cam U and closes a circuit to cam D, advancing the switch to position 1. It also opens the ground lead from the make contact of the ST key to cam D, preventing the R-1 switch from advancing from normal.

68. The off normal switches are returned to normal by the operation of the RN key, which causes the circuit to function as described under paragraph 44. With the master switches normal, the MON relay releases. Upon the release of the MON relay, the lamp is extinguished and the MON-1 relay released. The MON-1 relay released reestablishes the circuit from ground through the contacts of the ST key, to the R-1 magnet, allowing the test circuit to continue its test.

69. When a spare terminal with no associated group switch is encountered on a master switch, a circuit is closed through the SPT relay, spare terminal and CO brush, to ground through the OFN relay, operating the two relays. The SPT relay operated (a) opens the circuit to the MON relay preventing its operation if a second master switch is off normal, (b) opens the holding circuit for the ST and ST-1 relays, releasing them, and (c) it closes a circuit from ground on the PC key, through cams N and M (R-1), break contact of the TR relay, DR brush and spare terminal, make contact of the OFN relay, break contact and winding of the associated M magnet, which moves the brush assembly to the next terminal. If this terminal is used, the SPT relay releases and the test proceeds.

REVOLVING DISTRICT SWITCH

70. Should the CS relay in the district fail to release, the district switch revolves. In this case, ground is connected to the TST lead and battery to the sleeve. Should this condition occur as the test circuit starts its second test on the district the PBP and PBP-1 relays operate and as the R-1 switch advances to position 4 the PBP-2 relay operates opening the sleeve and TST leads. The test circuit is held in this position as a trouble condition. The operation of the CA key releases the relays and restores the circuit to normal.

See Test Note 51.

CIRCUIT REQUIREMENTS

READJUST VALUES ARE FOR MAINTENANCE PURPOSES ONLY

SEE SPECIFICATION X-70087 FOR EXPLANATION OF FORM.

APPARATUS	SPEC.NO.	APPARATUS	SPEC.NO.	APPARATUS	SPEC.NO.
Interrupter 149 C and J	X-70018	Sel. Sw. 200-I	X-71112	Seq. Sw. A88, A89, A90 and B108	X-70026
Sel. Sw. 200-F	X-71119	Sel. Sw. 200-R	X-71115		

RELAYS		MECHANICAL REQ.					DIRECT CURRENT FLOW REQ.					CIRCUIT PREPARATION				
		SPEC.	SKETCH	CONT.	ARM.	TEST	TEST	AFTER TEST	READJ	S.S.		TEST CLIP DATA		TEST SET	SEE TEST	
CODE	DESIG.	NUMBER	NUMBER	PRESS.	TRVL	WDG.	FOR	SOAK	AMPS.	AMPS.	POS.	BLOCK	CONN.BAT.	CONN.GRD.	PREP	NOTE	REMARKS
206-AF	(C)	X-70055	3				0		.076	.057			SS4-F-2	SS1-L-1	B/G	52	
							NO		.043	.046			SS4-F-2	SS1-L-1	B/G		
206-AF	(CR)	X-70055	3				0		.065	.057						52	A
							NO		.043	.046							A
							0		.136	.119			SS1-L-1	SS4-F-2	B/G	53	B
							NO		.090	.097			SS1-L-1	SS4-F-2	B/G	53	B
B91	(CS)	X-70056	6				0		.0016	.001				3T (PSK)	G		
							R		.0002	.0003				3T (PSK)	G		
B205	(PBP)	X-70056	1				0		.0058	.0025			SS3-0-1		Bat.		
							R		.0007	.0008			SS3-0-1		Bat.		
B263	(RLS)	X-70056	6				0		.0034	.0032			SS4-K-2	3T(OP-1)	B/G		C
							R		.0007	.0008			SS4-K-2	2T(OP-1)	B/G		C
E23	(SPT)	X-70037	3/2	20	.020		0		.022	.016				RU(SPT)	G		
E65	(R-4)	X-70037	3	20	.020		0		.019	.013				RU(R-4)	G		
E155	(R	X-70037	3	10	.020		0		.114	.090							A
							0		.272	.214			RL(R)		Bat.		D

CIRCUIT REQUIREMENTS

READJUST VALUES ARE FOR MAINTENANCE PURPOSES ONLY

RELAYS		MECHANICAL REQ.				DIRECT CURRENT FLOW REQ.						CIRCUIT PREPARATION		TEST	SEE	
		SPEC.	SKETCH	CONT.	ARM.	TEST	TEST	AFTER	TEST	READJ	S.S.	TEST CLIP DATA		SET	TEST	
CODE	DESIG.	NUMBER	NUMBER	PRESS.	TRVL	WDG.	FOR	SOAK	AMPS.	AMPS.	POS.	BLOCK	CONN.BAT.	CONN.GRD.	PREP	NOTE	REMARKS
E176	(SLV-2)	X-70037	7/3	20	.020	S	O		.040	.033			LU (SLV-2)		Bat.		
						P	H		.044	.030				RU(SLV-2)	G		
E207	(MON)	X-70037	3/1	10	.020		O		.049	.046			RL (MON)		Bat.		C
							NO		.034	.036			RL (MON)		Bat.		C
E214	(PSK)	X-70037	3/1	10	.020		O		.038	.015				RU(PSK)	G		
E272	(DR)	X-70037	15/14	20	.035		O		.038	.021			RL(DR)		Bat.	54	
E346	(SLV-3)	X-70037	1	Spl.	.015		O		.006	.0055				RU(SLV-3)	G	63	
E380	(MN-2)	X-70037	1	20	.015		O		.038	.009				RU(MN-2)	G	55	
							H		.026	.007				RU(MN-2)	G		
E380	(ST-1)	X-70037	1	20	.015		O		.038	.009			RL(ST-1)	RU(ST-1)	B/G		
							H		.026	.007			RL(ST-1)	RU(ST-1)	B/G		
E380	(TC-2)	X-70037	1	20	.015		O		.038	.009				RU(TC-2)	G	57	
							H		.026	.007							A
							H		.032	.0087				RU(TC-2)	G		E
E385	(R-3)	X-70037	11/1	20	.015		O		.025	.015				RU(R-3)	G		
E414	(OP-1)	X-70037	3	20	.020		O		.026	.017				RU(OP-1)	G		
E416	(MN-3)	X-70037	11/2	20	.015		O		.026	.018			RL(MN-3)	RU(MN-3)	B/G		
E458	(HT)	X-70037	1	20	.015		O		.015	.011		(FR)NO		RU(HT)	G	56	
E458	(R-2)	X-70037	1	20	.015		O		.019	.011				RU(R-2)	G		
E525	(MN-4)	X-70037	1	20	.015		O		.086	.020			RL(MN-4)	RU(MN-4)	B/G		
							H		.026	.015			RL(MN-4)	RU(MN-4)	B/G		
E572	(TBLTA)	X-70037	8/3	20	.030		O		.020	.016				RU(TBLTA)	G		

CIRCUIT REQUIREMENTS

READJUST VALUES ARE FOR MAINTENANCE PURPOSES ONLY

RELAYS		MECHANICAL REQ.				DIRECT CURRENT FLOW REQ.					CIRCUIT PREPARATION			TEST SET	SEE TEST NOTE	REMARKS
CODE	DESIG.	SPEC. NUMBER	SKETCH NUMBER	CONT. PRESS.	ARM. TRVL	TEST WEG.	TEST FOR	TEST AFTER SOAK	TEST AMPS.	READJ AMPS.	S.S. POS.	BLOCK	TEST CLIP DATA CONN.BAT.	CONN.GRD.			
E376	(RO)	X-70037	10/3	20	.020		0		.019	.015				RU(RO)	G		
E382	(CO-0)	X-70037	2/1	20	.015		0		.018	.011				RU(CO-0)	G	59	
E582	(CO-1 to CO-99 inc.)																
E582	(WD-1)	X-70037	2/1	20	.015		0		.019	.011				RU(WD-1)	G		
E592	(TST-1)	X-70037	8	20	.020		0		.027	.025				RU(TST-1)	G		
							NO		.017	.018				RU(TST-1)	G		
E592	(BB)	X-70037	8	20	.020		0		.026	.024							A
							NO		.012	.0128							A
							0		.054	.050			RL(BB)	RU(BB)	B/G		F
							NO		.025	.027			RL(BB)	RU(BB)	B/G		F
E596	(BYTA)	X-70037	11/3	20	.020		0		.039	.016				RU(BYTA)	G		
E598	(TST-1)	X-70037	8/3	20	.020		0		.020	.019				RU(TST-1)	G		
							NO		.014	.0147				RU(TST-1)	G		
E603	(TR)	X-70037	10/2	20	.015		0		.033	.031				RU(TR)	G		
E611	(PBP-1)	X-70037	8/11	20	.020		0		.038	.028			RL(PBP-1)		Bat.		
E630	(SK)	X-70037	11/14	20	.035		0		.019	.016			RL(SK)		Bat.	57	
							H		.017	.014			RL(SK)		Bat.	57	
E640	(CL)	X-70037	3	20	.020		0		.018	.0083				RU(CL)	G		
E640	(RS)	X-70037	3	20	.020		0		.038	.0083		(FR)0		RU(RS)	G		
E643	(GP)	X-70037	3/1	20	.020		0		.019	.012				RU(GP)	G	57	
E643	(SK-1)	X-70037	3/1	20	.020		0		.019	.012			RL(SK-1)		Bat.	57	

CIRCUIT REQUIREMENTS

READJUST VALUES ARE FOR
MAINTENANCE PURPOSES ONLY

RELAYS		MECHANICAL REQ.				DIRECT CURRENT FLOW REQ.					CIRCUIT PREPARATION			TEST SEE	
		SPEC.	SKETCH	CONT.	ARM.	TEST WDG.	TEST FOR	TEST AFTER SOAK	TEST AMPS.	READJ AMPS.	S.S. POS.	TEST CLIP BLOCK	DATA CONN.BAT.	CONN.GRD.	SET PREP	TEST NOTE	REMARKS
CODE	DESIG.	NUMBER	NUMBER	PRESS.	TRVL												
E665	(BSY)	X-70037	10/3	20	.020		0		.038	.019							A
							0		.128	.060				RU(BSY)	G		G
E676	(HC)	X-70037	14	20	.035		0		.039	.037							A
							0		.082	.078			RL(HC)		Bat.		H
E686	(SLV-1)	X-70037	10/3	20	.020		0		.019	.015				RU(SLV-1)	G		
							H		.018	.013				RU(SLV-1)	G		
E690	(S)	X-70037	11	20	.015		0		.020	.019				RU (S)	G		
E690	(FR)	X-70037	11	20	.015		0		.020	.019				RU (FR)	G	55	
E727	(R-1)	X-70037	1	20	.015		0		.019	.007				RU (R-1)	G		
E727	(PC)	X-70037	1	20	.015		0		.018	.007			RL(PC)	RU (PC)	B/G		
E727	(SS)	X-70037	1	20	.015		0		.037	.007			RL(SS)	RU(SS)	B/G		
E731	(TG)	X-70037	1	20	.015	P	0		.032	.011				RU(TG)	G		
						S	H		.051	.024				LL(TG)	G		
E751	(CK)	X-70037	14/2	20	.035		0		.020	.012				RU(CK)	G		
E763	(VO)	X-70037	2	20	.015		0		.011	.010				RU(VO)	G		
E798	(BB-1)	X-70037	8/3	20	.020		0		.025	.019							A
							NO		.010	.011							A
							0		.053	.040			RL(BB-1)	RU(BB-1)	B/G		I
							NO		.021	.023			RL(BB-1)	RU(BB-1)	B/G		I
E801	(OP)	X-70037	2/1	20	.015		0		.078	.020				RU(OP)	G		
							H		.026	.018				RU(OP)	G		

CIRCUIT REQUIREMENTS

READJUST VALUES ARE FOR MAINTENANCE PURPOSES ONLY

RELAYS		MECHANICAL REQ.				DIRECT CURRENT FLOW REQ.						CIRCUIT PREPARATION TEST CLIP DATA			TEST SET PREP	SEE TEST NOTE	REMARKS
CODE	DESIG.	SPEC. NUMBER	SKETCH NUMBER	CONT. PRESS.	ARM. TRVL	TEST WDG.	TEST FOR	AFTER SOAK	TEST AMPS.	READJ AMPS.	S.S. POS.	BLOCK	CONN.BAT.	CONN.GRD.			
E814	(WD)	X-70037	1	20	.015		0		.038	.014		(WD-1)	O	RU(WD)	G		
E826	(HA)	X-70037	3/2	20	.020		0		.020	.012				RU(HA)	G		
E831	(CS-1)	X-70037	11/3	20	.020		0		.038	.021			RL(CS-1)	RU(CS-1)	B/G	56	
E833	(DTS)	X-70037	15/2	20	.015		0		.020	.014							A
							0		.224	.156				RU(DTS)	G		J
E867	(FCH-1)	X-70037	15/3	20	.020		0		.033	.023		(FCH)	NO	RU(FCH-1)	G		
E916	(MG)	X-70037	2	20	.015	P	0		1.35	1.28			RL(MG)		Bat.		
						P	NO		.90	.95			RL(MG)		Bat.		
						S	0		.99	.94			LU(MG)		Bat.		
E933	(P)	X-70037	1	20	.015		0		.032	.030				RU(P)	G		
E956	(TC-1)	X-70037	3/1	20	.020		0		.026	.022		(TC-2)	NO	RU(TC-1)	G		
E976	(MN-1)	X-70037	10/2	20	.015		0		.027	.025		(MN-2)	NO	RU(MN-1)	G		
E1036	(TC)	X-70037	1	20	.015		0		.010	.009				RU(TC)	G		
E1041	(SR-1)	X-70037	10/3	20	.020		0		.038	.020		(HC)	O	RL(SR-1)	Bat.		
E1041	(SLV)	X-70037	10/3	20	.020		0		.038	.020				RU(SLV)	G		
E1057	(EC)	X-70037	2/1	20	.015		0		.018	.011							A
							0		.103	.060				RU(EC)	G		K
E1082	(STM-1)	X-70037	11/14	20	.035	P	0		.031	.022				RU(STM-1)	G	56/60	
						S	H		.040	.032				RU(STM-1)	G	60	
																60	

E1082 (STM-1 to STM-99 inc.)

READJUST VALUES ARE FOR MAINTENANCE PURPOSES ONLY

RELAYS CODE	DESIG.	MECHANICAL REQ. SPEC. NUMBER	SKETCH NUMBER	CONT. PRESS.	ARM. TRVL	DIRECT CURRENT FLOW REQ. TEST WDG.	TEST FOR	TEST AFTER SOAK	TEST AMPS.	READJ AMPS.	S.S. POS.	CIRCUIT PREPARATION TEST CLIP DATA BLOCK	CONN.BAT.	CONN.GRD.	TEST SET PREP	SEE TEST NOTE	REMARKS
E1083	(SM-O)	X-70037	14/1	20	.035	P	O		.031	.016				RU(SM-O)	G	56	
						S	H		.040	.025				LL(SM-O)	G		
E1118	(N)	X-70037	2	20	.015	P	O		.037	.015							A
						P	H		.021	.013							A
						P	O		.130	.052				RU(N)	G		L
						P	H		.073	.045				RU(N)	G		L
						S	O		.037	.020							A
						S	H		.021	.017							A
						S	O		.130	.070				LL(N)	G		L
						S	H		.073	.057				LL(N)	G		L
E1138	(STP)	X-70037	3/1	20	.020		O		.019	.017			RL(STP)	RU(STP)	B/G		
E1140	(EC-1)	X-70037	11/2	20	.015		O		.019	.014				RU(EC-1)	G	55	
E1140	(MON-1)	X-70037	11/2	20	.015		O		.019	.014				RU(MON-1)	G		
E1397	(R-5)	X-70037	2	20	.015		O		.281	.020			RL(R-5)		Bat.		
E1449	(TST)	X-70037	3/1	20	.020		O		.034	.032			RL(TST)		Bat.		
E1514	(CC-1)	X-70037	3/1	20	.020		O		.035	.033				RU(CC-1)	G	55	M
E1514	(MR-1)	X-70037	3/1	20	.020		O		.035	.033				RU(MR-1)	G	55	M
E1529	(FCH)	X-70037	2/1	20	.015		O		.020	.019				RU(FCH)	G	58	M
							H		.018	.017							A
							H		.021	.020				RU(FCH)	G		N
E1558	(PBP-2)	X-70037	2	20	.015		O		.038	.036			RL(PBP-2)	RU(PBP-2)	B/G		
							NO		.022	.024			RL(PBP-2)	RU(PBP-2)	B/G		

CIRCUIT REQUIREMENTS

READJUST VALUES ARE FOR MAINTENANCE PURPOSES ONLY

RELAYS		MECHANICAL REQ.				DIRECT CURRENT FLOW REQ.						CIRCUIT PREPARATION			TEST SET	SEE TEST	
CODE	DESIG.	SPEC. NUMBER	SKETCH NUMBER	CONT. PRESS.	ARM. TRVL	TEST WDG.	TEST FOR	AFTER SOAK	TEST AMPS.	READJ AMPS.	S.S. POS.	BLOCK	TEST CLIP DATA CONN.BAT.	CONN.GRD.	PREP	NOTE	REMARKS
E1566	(SR)	X-70037	11/3	20	.020		O		.086	.043				RU (SR)	G		
							NO		.025	.027				RU (SR)	G		
E1626	(GS)	X-70037	1	20	.015		O		.0105	.010				RU (GS)	G		
E1633	(OFN-1)	X-70037	11/1	20	.015		O		.018	.017			RL(OFN-1)		Bat.	61	
E1635	(OFN-2 to OFN-5 inc.)															61	
E1821	(ST)	X-70037	8/3	10	.020		O		.026	.022			RL(ST)	RU(ST)	B/G		
E1824	(A)	X-70037	1	20	.015	P	O		.209	.060			RL (A)	RU (A)	B/G		
						P	NO		.027	.029			RL (A)	RU (A)	B/G		
						S	H		.079	.058				LL (A)	G		
E1862	(MRN)	X-70037	23/11	20	.030		O		.038	.034				RU (MRN)	G		
E1885	(MR)	X-70037	8/11	20	.020		O		.042	.040							A
							H		.026	.024							A
							O		.063	.060				RU (MR)	G		O
							H		.039	.036				RU (MR)	G		O
E1885	(CC)	X-70037	8/11	20	.020		O		.042	.040							A
							H		.026	.024							A
							O		.063	.060				RU (CC)	G		O
							H		.039	.036				RU (CC)	G		O
E1893	(Z)	X-70037	11/2	20	.015		O		.063	.030			RL (Z)	RU (Z)	B/G		
							H		.041	.024			RL (Z)	RU (Z)	B/G		

CIRCUIT REQUIREMENTS

READJUST VALUES ARE FOR MAINTENANCE PURPOSES ONLY

RELAYS		MECHANICAL REQ.				DIRECT CURRENT FLOW REQ.					CIRCUIT PREPARATION TEST CLIP DATA			TEST SET PREP	SEE TEST NOTE	REMARKS
CODE	DESIG.	SPEC. NUMBER	SKETCH NUMBER	CONT. PRESS.	ARM. TRVL	TEST WDG.	TEST AFTER SOAK	TEST AMPS.	READJ AMPS.	S.S. POS.	BLOCK	CONN.BAT.	CONN.GRD.			
E1894	(W)	X-70037	8/11	20	.020	P	O	.046	.043							A
						P	O	.052	.049			RL (W)	RU (W)	B/G		P
						S	NO	.114	.120			LU (W)	LL (W)	B/G		
						S	H	.190	.175			LU (W)	LL (W)	B/G		
5-C	(PBT)	Message Register				O	O	20 Volts					U wdg	G	62	
							NO	18.5 Volts					U wdg	G	62	
5-C	(ST, CT, EBL and AIM)														62	

TEST NOTES:

51. All sequence switches should be blocked in position 1 and all keys should remain in normal position unless otherwise specified.
52. (a) Total contact travel .003".
    (b) The biasing spring shall be tensioned against the armature with sufficient force to meet the non-operate requirements.
53. Operate the (FCH) key while testing this relay.
54. Insulate (SS4-P-1) and operate the (REP) key.
55. Operate the (RN) key while testing this relay.
56. Connect direct battery to the (RL) terminal of relay.
57. Connect direct ground to the (RU) terminal of relay.
58. Block this relay non-operated while current flow values are being adjusted.
59. The requirements for the E582 relays (CO-1 to CO-99 inc.) are the same as for the (CO-0) relay and are tested and adjusted in a manner similar to the (CO-0) relay.
60. The requirements for the E1082 relays (STM-2 to STM-99 inc.) are the same as for the (STM-1) relay and are tested and adjusted in a manner similar to the (STM-1) relay.
61. The requirements for the E1633 relays (OFN-2 to OFN-5 inc.) are the same as for the (OFN-1) relay and are tested and adjusted in a manner similar to the (OFN-1) relay.

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

TEST NOTES: (Cont'd).

62. The requirements for the 5-C message registers (ST, TC, TBL and ALM) are the same as for the 5-C (FBT) register and are tested by connecting ground test clip to the upper winding terminal and the battery clip to the lower winding terminal of the register.
63. No definite contact pressure specified.

REMARKS:

A. Requirements for relay winding alone.
B. Requirements are for circuit combination of (C) and (CR) relays.
C. Special requirements to meet circuit condition.
D. Requirements are for circuit combination of (R) relay and 18AL resistance.
E. Requirements are for circuit combination of (GS), (TC-1) and (TC-2) relays.
F. Requirements are for circuit combination of (BB) and (BB-1) relays.
G. Requirements are for circuit combination with (PBT) lamp.
H. Requirements are for circuit combination with (SR-1) relay.
I. Requirements are for circuit combination with (BB) relay.
J. Requirements are for circuit combination with the (R-2) magnet.
K. Requirements are for circuit combination with the (EC) lamp.
L. Requirements are for circuit combination with (MR or CC) relay.
M. Requirement for fast operation.
N. Requirements for circuit combination with (FCH-1) and (TST-1) relays.
O. Requirements for circuit combination with (N) relay.
P. Requirements for circuit combination with (Z) relay.