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(1 Page, Page 1)
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METHOD OF OPERATION

Automatic Routine Test of Final Selectors - Automatic Routine Selector Test Frame - Panel System.

Page 40

Change Paragraph 6.35 to read as follows:-

"With the (COM) key at normal, grounded capacity, etc.

ENG: E.L.B.
April 16, 1929.
AR

CHK'D: E.L.B.

APP'D: A. PENROD
F.R.E.

This Method of Operation was prepared from Issue 1 of Drawing T-514023.

METHOD OF OPERATION

Automatic Routine Test of Final Selectors - Automatic Routine Selector Test Frame - Panel System.

DEVELOPMENT

1. PURPOSE OF CIRCUIT

1.1 This circuit is designed to test final selectors which operate with ground on the cut-off relay. By the operation of the (ST) and (TRA) keys in the test circuit an incoming selector which is associated with the test circuit is connected to the final selector that is to be tested. The incoming selector having been connected to the test circuit by means of a connector switch, is connected to the final selector which in turn is directed to either one of two test lines and "PBX" hunts to the third test line. The terminals 97 and 98 are busy PBX lines, while the sleeve condition of terminal #99 is changed to agree with the class of test made, this being determined by the setting of the class sequence switch in the test circuit. When this connection is established, a series circuit is closed indicating that the final selector is functioning properly. The test then advances and in turn advances the incoming selector used as a connecting circuit to the next final selector to be tested. The testing of the final selectors will progress automatically until all final selectors have been tested, after which a signal known as "End of Cycle" signal will be given indicating the completion of the test on all final selectors.

1.2 If trouble is encountered at any time an alarm signal is given.

1.3 In order to reach all final selectors, connector switches in the test circuit are used so that sufficient incoming selectors may be used to connect to every final selector working off the multiple of the incoming frames. The number of selectors will depend on the manner in which the final selectors are multipled on the incoming frames.

1.4 By means of a particular circuit feature any particular group of final selectors can be tested by means of directing the test circuit to any incoming selector used as a connector and in turn directing this selector to the incoming group in which the final selector is located. In order to test a particular final selector

the incoming selector must be raised manually to the terminal in that particular incoming group where the final is located.

1.5 A repeat test feature is provided so that tests may be repeated on any final selector.

1.6 In the case where the final selector happens to be busy an "Automatic or Manual" pass-busy feature is provided.

1.7 Continuity tests may be made of the brushes which do not have access to the test lines.

2. WORKING LIMITS

2.1 This circuit is designed to operate with the central office battery between 48.5 and 50 volts.

OPERATION

3. PRINCIPAL FUNCTIONS

3.01 This circuit automatically tests all final selectors in offices where line circuits have ground on the cut-off relays.

3.02 This circuit is arranged to test for busy, the required incoming selectors which have access to all the final selectors.

3.03 This circuit may be directed to any particular group of final selectors.

3.04 The incoming selectors used for connecting purposes are busy to service when used for test purposes. Two-wire incoming selectors (except repeating incoming selectors) that are used as local selectors, amy also be used as test selectors.

3.05 This circuit is arranged to distinguish between busy and idle selectors and to wait for a particular selector to become idle after which it will proceed with the test, or if desired, a "Pass-busy" key may be operated which will cause the test circuit to pass by the final selectors which are busy at the time the test circuit encounters them.

3.06 This circuit will give an alarm in the event trouble is encountered. An alarm will also be received after a definite interval in the event an incoming selector is busy too long and also if the final selector is busy too long an interval if the "Pass busy" key is not operated.

3.07 Registers are provided to indicate the number of single test (ST), the number of multiple tests made (MT) and the number of times the trouble alarm is brought in (ALM).

3.08 This circuit is arranged to apply a current flow hold test on the primary winding of the (L) relay.

3.09 This circuit is arranged to apply a current flow release test on the primary winding of the (L) relay.

3.10 This circuit is arranged to apply a speed operate and non-operate test on the PBX relay.

3.11 This circuit is arranged to apply a speed operate test of the (TB) relay.

3.12 This circuit is arranged to test the speed operate and release of the (L) relay during final selection.

3.13 This circuit is arranged to test the capability of the final selector to select an idle line. This is accomplished by directing the final for brush group and unit selections to a test line, in this case terminal 99.

3.14 This circuit is arranged to test the capability of the final to make a direct line busy test. This is accomplished by directing the final to terminal 99 where a busy condition is furnished on this particular line.

3.15 This circuit is arranged to make a "first PBX line idle test" last PBX line idle test" "last PBX line busy test" "intermediate PBX line idle test" and "no test". These tests are made by directing the final selector to terminal 97 or 99, as determined by the setting of the class sequence switch, in a similar manner as described in paragraphs 3.13 and 3.14.

3.16 This circuit is arranged so that in the event of trouble either in the test circuit or the circuit under test, by the

operation of the (CA) key the apparatus may be advanced to a point where a repeat test may be made or the test circuit may be advanced to the next selector. With the (CA) key operated the test sequence switch will not return to normal.

3.17 (TST) condenser is provided as a means for testing (AH) relay.

3.18 This circuit is arranged to give a visual signal in case the test line, (line 99), is seized on a test call or thru error.

3.19 The following tests are applied to the final selector:

3.191 Commutator resistance test.

3.192 Test of immediate line make busy path.

3.193 Non-operate test of (PBX) relay over ring.

3.194 Test of off-normal ground.

3.195 Test of return to normal.

3.196 Brush continuity test.

3.197 Time measure release test.

3.20 The circuit is arranged so that the "control advance" reature may be controlled from all final frames.

3.21 The (TRA) key is operated to close the test line thru to the test circuit, the test line is held busy except for a short interval after units selection.

4. CONNECTING CIRCUITS

4.1 This circuit will function with panel machine switching system incoming circuits and panel machine switching final circuits which operate with ground on cut-off relays.

DESCRIPTION OF OPERATION

5. APPARATUS AND FUNCTIONS

5.01 Connector Sequence Switches (R-1A), (R-1B) Etc.

These connector sequence switches are used to connect the

test circuit to the different incoming selectors. One connector serves to connect the test circuit to 3 different incomings. The wires to the different selectors are indicated by the numerals 1, 2, 3 etc. Where more than 3 incoming selectors are required for connecting purposes two or more connector sequence switches must be used. Only one incoming selector is connected to the test circuit at any one time.

5.02 Directing Switches

Associated with cross-connection terminals are one or more 200 type selector switches. These switches serve -

1st - to control the brush and group selections of the incoming used for connecting purposes.

2nd - They determine which incoming selector will be used for connecting purposes.

3rd - They set the overflow terminal counter to indicate how many overflow terminals are to be passed before returning the elevator.

5.03 Incoming Control Switch (IC)

Associated with the connector control sequence switch is a #200 type selector which determines how many overflow terminals are to be passed before the incoming elevator should be restored.

5.04 Connector Control Sequence Switch (R-2)

This switch controls incoming selectors directing them to the proper group of final selectors and restoring the incomings after tests have been made. It is a two cycle switch, that is the second half of a revolution serves the same purpose as the first half of the revolution.

5.05 Test Sequence Switch (R-4)

This switch controls the selections of the final selector and controls the test conditions imposed on the selector.

5.06 Trouble Timing Switch (TBL)

This switch in conjunction with an interrupter starts counting time when the circuit to be tested becomes idle. The switch

takes one step for each closure of the interrupter and the desired time is secured by passing the desired number of terminals on the bank before the switch stops on the trouble alarm terminal. On time measure release tests a longer time is counted off.

5.07 Busy Timing Switch (BY)

This switch in conjunction with an interrupter starts counting time when the test begins. The switch takes 1 step for each closure of the interrupter and the desired time is secured by passing the desired number of terminals on the bank before the switch stops on the terminal assigned for busy alarm.

5.08 Start Key (ST)

The operation of this key starts the automatic test which continues until all the final selectors have been tested. If other keys are operated, the operation of the start key starts a special test as determined by the keys operated. The release of the (ST) key stops the test circuit at the conclusion of the particular test in progress.

5.09 Return to Normal Key (RN)

The operation of this key causes all the test circuit apparatus to return to normal when (ST) key is released.

5.10 Control Advance Key (CA)

This key is operated when the test circuit fails to complete its cycle due to a fault in itself or in the circuit under test. The operation of this key advances the test switch to position 16 and when released advances it to position 1 to test the next circuit or the same one in case the (REP) key is operated.

5.11 Time Alarm Key (TA)

The operation of this key resets the timing switches and holds up progression of the test circuit to another final until the key is restored. The circuit will continue to test the same circuit however if the (REP) key is operated.

5.12 Repeat Key (REP)

The operation of this key causes the test circuit to repeat the particular cycle of tests being made on any selector as long as the key is operated. A single repeat cycle of tests is made by momentarily operating the key.

5.13 Automatic Pass Busy Key (APB)

The operation of this key causes the test circuit to automatically pass all finals that are busy.

5.14 Manual Pass Busy Key (MPB)

The operation of this key steps the incoming elevator from a busy terminal to the next terminal, which may or may not be busy. The test does not proceed until the key is restored to normal. By repeated operations of the key successive busy finals may be passed.

5.15 Particular Circuit Key (PC)

The operation of this key in combination with other keys enumerated below causes the apparatus to make a test on a particular group of final selectors. The particular test does not proceed until the key is released. If it is desired to test a particular final selector of a group, first the proper group is selected, then the elevator is raised to the desired terminal by hand. For the purpose of testing a particular group or groups, this circuit is provided with a tens and a row of units keys to select any desired terminal on the directing selectors, one or more twenties keys (TWA), (TWB) etc. each of which controls a particular directing selector switch: Group number keys (GN) 0 to 3 inclusive, to guide the incoming elevator to the particular groups to be tested: Overflow Count keys (OC) 0 to 3 inclusive which determine the number of overflow terminals to be passed before the incoming elevator is restored to normal.

5.16 Remote Control Jack

The purpose of this jack in connection with a make busy plug or the 32-A test set is to make it possible for a man to watch the performance of the selector under test at the time the (CA) feature is brought into play.

5.17 Brush Continuity Test Key (BC)

With this key operated, a brush continuity test is made. The particular line selected is determined by the jacks in (B), (T) and (U) rows which are plugged up.

5.18 Jacks in (B) "Brush", (T) "Tens", and (U) "Units", Rows

Are used as keys by inserting a "make busy" plug in one jack in each row, to direct the final selector to any desired terminal when making brush continuity tests.

5.19 Multi-Test Key (MT)

When this key is operated, a series of tests is made of each final selector before progressing to the next final selector.

5.20 Time Measure Release Key (TMR)

When this key is operated a test of the time measure release feature of final selectors is made when (R3) switch is in position 5.

5.21 Commutator Test Key (COM)

When this key is operated the resistance of the fundamental circuit is reduced in order to detect excessive resistance between commutators and their brushes.

5.22 Transfer Key (TRA)

This key, when operated in one direction, connects the test line (line 99) to the automatic test circuit; when operated in the opposite direction, connects the test line to the jacks at the final frames for use with the portable test circuit.

5.23 Class Sequence Switch (R-3)

The purpose of this switch is to change the test conditions as required to simulate different line conditions and to cause the test circuit to advance to the next final when all the desired tests have been made.

5.24 Single Test Meter (ST)

This meter counts for every test call passed or attempted to be passed.

5.25 Multi-Test Meter (MT)

This meter operates each time a multi-test of a selector is completed.

5.26 Alarm Meter (ALM)

This meter counts each time the trouble alarm is brought in.

5.27 Busy Incoming Lamp (BI)

This lamp lights when a busy incoming is encountered.

5.28 Busy Final Lamp (BF)

This lamp lights when a busy final is encountered.

5.29 End of Cycle Lamp (EC)

This lamp lights when the test circuit completes a routine test of all finals.

5.30 Busy Alarm Lamp (BY)

This lamp lights in case a final remains busy for too long an interval when the test circuit is waiting to make a test.

5.31 Trouble Alarm Lamp (TBL)

This lamp lights when trouble is encountered in the final selector under test or in the test circuit during the test.

5.32 Busy Back Lamp (BB)

This lamp flashes on a brush continuity test if the line called is busy.

5.33 Intercepting Lamp (IN)

The lighting of this lamp on a brush continuity test may indicate that the line called is intercepted or that the sleeve is open.

5.34 Brush Continuity Switch (BC)

This switch controls the progress of a brush continuity test.

6. CIRCUIT OPERATION

6.01 Start of Test

The (ST) and (TBA) or (BC) keys are operated to start the test. The (ST) key operated, operates the (ST) relay under control of the (O) cam of each connector switch. Should any connector switch be off normal, the (ST) relay will not operate. The (ST) relay operated, locks under control of the (ST) key when the connector sequence switch advances and operates the stepping magnet associated with the (I-A) brush assembly. Circuit: battery, winding of the magnet, (TRA) relay normal, brush and normal terminal (I-A1), (TW) keys (ST) relay operated, (TRA) or (BC) key operated, to ground. The (T) relay does not operate at this time as its winding is short-circuited. The stepping magnet energized, opens its circuit, releases and advances the (I-A) brush assembly to terminal 1. When terminals on the (I) switches are not connected for a test, the terminals of arc A are connected to ground causing the stepping magnet to energize immediately upon the advance of the switch to that terminal. When the (I-A) brush assembly advances to a terminal which is connected for test the (T) relay operates in series with the stepping magnet. The stepping magnet does not operate due to the high resistance in the circuit. The (T) relay operated, operates the (CON) relay. The (CON) relay operated, locks under control of the (ST) key, and advances the (R-1A) switch to the succeeding or "test for busy" position. For the first test this will be position 2. Circuit: Battery, (R-1A) magnet, cam (B-1A), cross connection block 6-X lead 1, brush and terminal 1 of arc (I-A6, (CON) relay operated, to ground. Where more than one connector is required to test all the final circuits in an exchange, each succeeding connector cannot be moved out of normal until the preceding one used has returned to normal. For instance, it is assumed that the second connector shown in the Schematic is the last of a series of connector units. Connector 1 can only be moved out of position 1 or 10 after the last connector is restored to position 1 or 10. The circuit for restoring the last connector or any succeeding connector, is from ground on the (CON) relay operated, brush 6 and some terminal of the (I) switch cross connection on strip 6, cam P of last connector used, cam C to battery thru the (R) magnet. If one of the connector units is not

returned to normal, the circuit ceases to function and the alarm operates as hereinafter described.

6.02 Test Incoming for Busy

With (R-1A) switch in position 2, (TI) relay operates on its primary winding, the circuit being thru (R) cam of (R-1A) switch, cross connection block (5-X), arc (5) of (I-A) switch and front contacts of (T) relay. (TI) relay operated, lights (BI) lamp and advances (R-2) switch from 1 to 2. In position 1 3/4 battery thru the secondary winding and front contacts of (TI) relay is connected to (TK-1) lead. (TK-1) lead may connect to (TK) lead on the sleeve of a three-wire local incoming selector or to the associated sleeve terminal at the district or office multiple of a two-wire incoming selector used as a local incoming selector. If the incoming selector is normal, there will be no ground on the sleeve and (TI) relay should release when (R2) switch leaves position 1 1/2. If the incoming selector is busy (TI) relay will lock over (TK-1) lead and (BI) lamp will remain lighted.

When the incoming becomes free (TI) relay should release. (TI) relay released connects ground to (TK) lead to hold the incoming selector busy, extinguishes (BI) lamp and connects (TY-1) lead thru to (AV) interrupter. When (TY-1) lead becomes grounded and (AV) interrupter makes, (3) relay operates; when (AV) interrupter breaks (3') relay operates; when (AV) interrupter makes (2) relay operates; when (AV) interrupter breaks (2') relay operates; when (AV) interrupter makes (1) relay operates; when (AV) interrupter breaks (1') relay operates; when (AV) interrupter makes (0) relay operates; when (AV) interrupter breaks (0') relay operates. (0') relay operated advances (R2) switch from 2 to 3. The purpose of the delay occasioned by running down the counting relays is because (TY-1) lead is momentarily grounded by the sequence switch advancing paths, before the down-drive has taken place. On leaving position 2 the counting relays are released.

6.03 Setting Incoming Control Switch

When the (R-2) switch enters position 3, the (R-1A) switch advances to position 3, the (IC) stepping magnet is energized thru the (ST) key, and the (RS-2) relay operates. With the (R-1A) switch in position 3, the (TK-1) lead is connected to ground thru the break contact of the (PG) relay. The (RS-2) relay operated, operates the (TF) relay and advances the (R-2) switch to position 4. The (TF) relay operated, operates the (TF-1) relay when the (IC) switch is in odd positions and opens the operating circuit

for the (TR) relay, thus holding the (T) and (R) leads open. The (TF-1) relay performs no useful function at this time. The (IC) stepping magnet energized, opens its circuit and releases, advancing the (IC) brush assembly. The position of the (IC) switch determines the number of overflow terminals the incoming elevator must pass by before it is restored to normal, and thus determines the number of groups to be tested. With the scheme of cross-connection shown on the drawing and with the brushes of the (IA) switch resting on terminal 1, group 0 to 3 inclusive in the first frame are tested. As determined by the cross-connection of the (IA) switch and terminal strip 4, the (IC) magnet is short-circuited when its brush assembly rests on terminal 1. Circuit: ground on the (PC) key, brush 4 and terminal 1 of (IA) switch, cross-connection of terminal strip 4, lead 4, to terminal 1 of arc (IC-2). On the setting just made, the incoming elevator returns to normal when the elevator brushes have stepped to the fourth set of overflow terminals.

6.04 Incoming Brush Selection

With the (R-2) switch in position 4, the (UP) magnet in the incoming selector is energized by ground from the break contact of the (0') relay, cam (Q-2), (RS-2) relay operated, cam (D-2) over the (TU-1) lead, causing the elevator to ascend for incoming brush selection. The brush selected is controlled by the setting of the (IA) switch. With the (IA) switch on terminal 1 and with the cross-connection shown, the (0) brush will be selected. As the incoming brush elevator ascends, ground from the (A) commutater over the (TA-1) lead thru arc 2 of the (IA) switch and cross-connecting strip 2, operates counting relay (0). When the brush of the (A) commutator makes contact with an insulated segment of the commutator, the (0') relay operates. The (0') relay operated, opens the circuit to the (UP) magnet, stopping the elevator and advances the (R-2) switch to position 5. With the (R-2) switch in position 5, the (TM) magnet is energized over lead (TM-1) for tripping the brush. As the (R-2) switch leaves position 4-1/4 the (0) and (0') relays release. Ground on the contact of the (0') relay normal advances the (R-2) switch to position 6.

6.05 Incoming Group Selection

With the (R-2) switch in position 6, the (UP) magnet in the incoming is again energized causing the elevator to ascend for

incoming group selection. The (TM) magnet operated, trips the selected brush. Intermittent ground from the incoming (B) commutator over lead (TB-1) and thru arc 3 of the (IA) switch and cross-connecting block 3, operates the (O) relay for the given position of the (IA) switch and the cross-connection shown). The (O^1) relay operates when the ground is removed from the (O) lead by the functioning of the commutator. The (O^1) relay operated, stops the elevator again and advances the (R-2) switch to position 7. As the (R-2) switch leaves position 6 1/4 the (O) and (O^1) relays release. As the switch leaves position 6, the (RS-2) and (T) relays release. The (RS-2) relay released, opens the circuit through the 1000 ohm winding of the (TF) relay.

6.06 Final Busy Test

If the final selector seized is busy there is ground , on the (S) lead. When the incoming seizes a final which is busy, the (TF) relay holds through its 800 ohm winding over lead (TB-1) and the (BF) lamp is lighted. If the final when seized is free, or when it becomes free, the (TF) relay releases. The (TF) relay released and the (TF-1) relay remaining operated, operates the (TR) relay, thru odd terminals of (5) arc of (IC) switch and back contacts of (ZC) relay. The (TF) relay released, connects ground thru its back contacts to the sleeve of the final holding it busy.

If the final selector which is seized is busy and is of the type that has the time measure release feature, there is a possibility of the final selector (TK) relay reoperating while the final is restoring to normal and locking to ground thru back contacts of (TF) relay. Under this condition the final will advance to its busy back position.

6.061 With (TR) relay operated and (R4) switch in position 1, (YT) relay is connected to the ring, and should be operated and released by the busy back pulses. The first operation of (YT) relay operates (YT1) relay in turn operating (YT2) relay which locks under control of (TR) relay in position 1 of (R4) switch. When (YT) relay releases, (YT1) relay releases and a circuit is closed from ground, (G) cam of (R4) switch, back contacts of (YT1) relay and front contacts of (YT2) relay operating (TF) relay. (TF) relay operated disconnects ground from the final sleeve allowing the final (TK) relay to release and releasing (TR) relay. (TR) relay released releases (YT2) relay. (TF) relay locks to ground on the final sleeve until the final has restored to normal.

6.07 Advance of Test Switch

6.071 (TR) relay operated, connects the tip and ring leads from the final to the test circuit. (R4) switch being in position 1, battery thru the winding of (YT) relay is connected to the ring and (YT) relay should operate from the 40 ohm ground on the final ring when the final selector is in the normal position. (YT) relay operated locks over the final ring and operates (YT-1) relay, which closes ground thru the winding of (TG) relay to the tip of the final and operates (YT-2) relay. (TG) relay should operate from the battery thru the winding of the final (L) relay, but the (L) relay should not operate on account of the high resistance of (TG) relay. (TG) relay operated, operates (TG1) relay which advances (R4) switch from 1 to 2. On leaving position 1, (YT2), (TG) and (TG1) relays release and the operating circuit of (YT) relay is broken.

6.08 Final Brush Selection

In position 2, the fundamental circuit for final brush selection is closed and (STP) relay operates in series with the final (L) relay. (STP) relay operated, operates (SO), (1), (2), (3) or (4) counting relay, the particular counting relay operated depending upon the bank in which the test lines are located if (BC) key is normal and upon the jack in (B) row in which a "make busy" plug is inserted if (BC) key is operated. Impulses from the final (A) commutator, short circuit and release (STP) relay, allowing the prime relay corresponding to the operated counting relay to operate. The operation of the prime relay transfers the pulsing lead to the next counting relay. The impulses from the final selector circuit continue until (SO) counting relay operates. When (STP) relay releases, (BO^s) and (FO^s) relays operate. The operation of (BO^s) relay opens the fundamental circuit, causing the final circuit to advance. The operation of (FO^s) relay advances (R4) sequence switch from 2 to 3. On leaving position 2, the battery supply to the counting relays is broken releasing them. (FO^s) relay released, advances (R4) switch from 3 to 4.

6.09 Final Tens Selection

In position 4, the fundamental circuit for final tens selection is closed and (STP) relay operates, operating (9) counting relay if (BC) key is normal or the counting relay corresponding to the jack in (T) row in which a "make busy" plug is inserted

if (BC) key is operated. As pulses are received the successive counting relays operate; when (BO') and (FO') relays operate, the fundamental circuit is broken advancing the final selector and advancing (R4) switch from 4 to 5. On leaving position 4, the battery supply to the counting relays is broken releasing them. (FO') relay released, advances (R4) switch from 5 to 6.

6.10 Final Units Selection

In position 6, the fundamental circuit for final units selection is closed and (STP) relay operates, operating (7) or (9) counting relay depending upon the position of (R3) switch if (BC) key is normal or the counting relay corresponding to the jack in (U) row in which a "make busy" plug is inserted if (BC) key is operated. As pulses are received the successive counting relays operate; when (BO') and (FO') relays operate, the fundamental circuit is broken advancing the final selector and advancing (R4) switch from 6 to 7. On leaving position 6, the battery supply to the counting relays is broken releasing them. (FO') relay released advances (R4) switch from 7 to 8.

In position 6, battery from (J) cam of (R4) switch is closed thru to (MB) relay. The winding of (MB) relay is short circuited by ground thru back contacts of (SO) relay, so that it does not operate until (SO) relay operates. (MB) relay operated, remains operated until (R4) switch advances out of 9 and until (TKR) relay releases. (MB) relay operated, switches the sleeve of the test line from a busy condition to the test circuit.

6.11 Idle Line Tests

6.111 Idle Line Conditions

With (R3) switch in position 1, the test line (line 99) resembles an idle direct line, and the final selector is directed to it.

With (R3) switch in position 5, the test line, (line 99) resembles an idle lower line of a P.B.X. group, and the final selector is directed to it.

With (R3) switch in position 7, the test line, (line 99) resembles an idle last line of a P.B.X. group, and the final selector is directed to line 97 and P.B.X. hunts to line 99.

With (R3) switch in position 11, the test line, (line 99) resembles an idle lower line of a P.B.X. group, and the final selector is directed to line 97 and P.B.X. hunts to line 99.

6.112 Final Advance

6.1121 The final advances after units selection, disconnecting ground from the ring, releasing (YT) relay in turn releasing (YT1) relay. (YT) relay released connects ground to the ring of the test line. When the final stops on line 99 after testing it for busy, it connects battery thru a resistance to the sleeve, operating (TL) relay, lighting (TL) lamp and also operating (SLV) or (SLV1) relay closing a circuit thru back contacts of (YT3) relay to operate (SL) relay. (SL) relay operated, locks independently of (YT3) relay. When the final advances further, the ring is closed thru and a circuit is closed from ground, from cam (E) of (R4) switch, back contacts of (YT1) relay, the ring of the test line, the ring of the final, cam (I) of (R4) switch, back contacts of (YT) relay, cam (Q) of (R3) switch, winding of (YT3) relay to battery, operating (YT3) relay. (YT3) relay operated, opens the operating circuit of (SL) relay; this is for the purpose of preventing the operation of (SL) relay and blocking the test circuit in case the immediate make busy path of the called line is open. With (YT3) and (SL) relays operated, a circuit is closed thru their front contacts to advance (R4) switch from 8 to 9. On leaving position 8, (YT3) relay releases.

6.113 Test Operations

With (R4) switch in position 9, (SUB) relay is bridged across the tip and ring of the test line; battery thru the winding of (TKR) relay is connected to the ring of the final, and ground is connected to the tip of the final. With the final in the talking position (TKR) relay should operate in series with (SUB) relay and should lock thru front contacts of (SLV) or (SLV1) relay; (SUB) relay may operate but will be immediately shunted by the ground to which (TKR) relay locks. (TKR) relay operated, operates (TK1) relay, and holds (TK) relay operated. (SR) relay was operated in position 6 of (R4) switch, thru back contacts of (TK1) relay, it operated (FR) relay. On leaving position 8 the operating circuit of (SR) relay

was broken but it remained locked thru back contacts of (TK1) relay. (TK1) relay operated, operates (TK2) relay, which locks thru (F) cam of (R4) switch. The operation of (TK1) relay also disconnects ground from the final sleeve and switches the locking circuit of (SR) relay from ground to the final sleeve. When ground is disconnected from the final sleeve, the final (TK) relay should release and connect ground to the sleeve thru its back contacts; this ground should hold (SR) relay operated. Should the ground not be connected to the sleeve by the release of the final (TK) relay, (SR) relay would release, releasing (FR) relay opening the operating circuit of (CH) relay, blocking the test circuit in position 15. The final should advance to its "awaiting called subscriber's release" position. The final (L) relay should hold in series with (SUB) relay, operating (SUB) relay. (SUB) relay operated, operates (MT) relay in turn operating (MT1) relay which advances (R4) switch from 9 to 10. The operating circuit of (MT) relay in positions 9 and 11 is thru front contacts of (TKR) relay. (TKR) relay is held thru front contacts of (SLV) or (SLV1) relay. This is for the purpose of detecting a cross between the tip and sleeve of the final brush, as a cross of this type would cause (SLV) or (SLV1) relay to be shunted and released from the ground on the final tip in the talking position and the "awaiting" called subscriber's release position, and the advance of the test circuit would be blocked. On leaving position 9 (MT) relay releases, releasing (MT1) relay and advancing (R4) switch from 10 to 11. In position 11, if the final (L) relay is still holding as it should, (SUB) relay should still be operated and (MT) relay should operate, operating (MT1) relay. If the final (L) relay fails on its hold test (SUB) relay should be released and the test circuit should block in position 9 or 11. (MT1) relay operated, looks to ground on (J) cam of (R4) switch and advances (R4) switch from 11 to 12. On leaving position 11 (MT) relay releases advancing (R4) switch from 12 to 13. On leaving position 12, the circuit thru (SUB) relay is opened; however, ground from (E) cam of (R4) switch thru resistances is left connected to the ring of the test line, applying a release test to the final (L) relay. In position 13, (MT) relay should operate in local circuit, closing a circuit from ground thru its front contacts and front contacts of (MT1) relay to advance (R4) switch from 13 to 14. On leaving position 13 (MT) relay releases. In position 14, (SUB) relay is again bridged across the tip and ring of the test

line. This is for the purpose of holding the final (L) relay in case it has failed to meet its release test. In position 14, a circuit is closed from ground thru back contact of (MT) relay, (W) cam of (R4) switch, (DL) interrupter, (R) cam of (R3) switch, (1) relay to battery, operating (1) relay when (DL) interrupter closes. When (DL) interrupter opens (1*) relay should operate, when (DL) interrupter again closes (SO) relay should operate, and when (DL) interrupter again opens, (SO*) and (FO*) relays operate. (FO*) relay operated, advances (R4) switch from 14 to 15. On leaving position 14 the counting relays are released. In position 15, if the final (L) relay has failed to release (SUB) relay will be operated and (MT) relay will operate in turn operating (MT1) relay which locks and blocks the test circuit in position 15. If the final (L) relay meets its release test the final will advance and disconnect battery from the sleeve of the test line, releasing (TL) relay which extinguishes (TL) lamp and releasing (SLV) or (SLV1) relay in turn releasing (SL) and (TKR) relays. (TKR) relay released, releases (TK1) and (MB) relays. (TK1) relay released, switches the final sleeve from the locking circuit of (SR) relay to the locking circuit of (FR) relay. (SR) relay releases but (FR) relay should lock to ground on the final sleeve. A circuit is closed from ground thru back contacts of (SR) relay and front contacts of (FR) relay to operate (CH) relay. This is for the purpose of checking the locking circuit of (FR) relay. (CH) relay operated, locks to ground on (E) cam of (R4) switch. When the final selector has restored to normal, it will disconnect ground from the sleeve, releasing (FR) relay. (FR) relay released, connects ground to the final sleeve to hold the final selector busy and a circuit is closed from ground thru back contacts of (MT1) relay in parallel thru contacts of (TMR) key normal and contacts of (N) cam of (R3) switch in position 6 to 4, back contacts of (SUB) relay, front contacts of (CH) relay, back contacts of (FR) relay and (W) cam of (R4) switch, advancing (R4) switch from 15 to 16.

6.12 Busy Line Tests

With (R3) switch in position 3, the test line (line 99) resembles a busy direct line when the final selector is testing it, and the final selector is directed to it.

With (R3) switch in position 9, the test line (line 99) resembles a busy last line of a P.B.X. group, when the final selector is testing it, and the final is directed to line 97 and P.B.X. hunt to line 99.

On both of these tests when (R4) switch reaches position 6, battery thru resistances is connected to the sleeve of the test line holding it busy and operating (SLV) or (SLV1) relay in turn operating (SL) relay. When the final advances after units selection, it disconnects ground from the ring, releasing (YT) relay, in turn releasing (YT1) relay. (YT1) relay released, advances (R4) switch from 8 to 9. The final selector tests the line and finding it busy, the elevator should restore to normal and the final should advance to the busy back position. Busy back pulses, interrupted ground, over the ring should operate and release (BB) relay. The first operation of (BB) relay should operate (2) relay, the release of (BB) relay permitting (2') relay to operate, the next operation of (BB) relay should operate (1) relay, the release of (BB) relay permitting (1') relay to operate, the next operation of (BB) relay should operate (SO) relay, the release of (BB) relay permitting (BO') and (FO') relays to operate. (FO') relay operated, advances (R4) switch from 9 to 10. On leaving position 9 battery is disconnected from the sleeve of the test line releasing (SLV) or (SLV1) relay in turn releasing (SL) relay and (BB) relay is disconnected from the ring and the counting relays are released. In position 10 (CA1) relay operates, advancing (R4) switch from 10 to 16. With (CA1) relay operated, the ground is disconnected from the sleeve as (R4) switch advances from position 15 to position 16. This should permit the final (TK) relay to release and the final to restore to normal.

6.13 <u>No Test Calls</u>

With (R3) switch in position 13, the test line (line 99) resembles a busy direct line when seized by the final selector, and the final selector is directed to the test line on a "no test" basis. The "no test" indication is transmitted to the final over the ring by the low resistance shunt around the winding of (YT) relay; this should cause the operation of the final (FBX) relay when the final advances after units selection. When (R4) switch reaches position 6, battery thru resistances is connected to the sleeve of the test line holding it busy and operating (SLV) or (SLV1) relay in turn operating (SL) relay. When the final advances after units selection, it disconnects ground from the ring, releasing (YT) relay, in turn releasing (YT1) relay. The final selector

should stop on the test line in spite of its busy condition and should advance closing through the ring and a circuit is closed from ground from (E) cam of (R3) switch, back contacts of (YT1) relay, the ring of the test line, the ring of the final, cam (I) of (R4) switch, back contacts of (YT) relay, cam (Q) of (R3) switch, winding of (YT3) relay to battery, operating (YT3) relay. With (YT3) and (SL) relays operated, a circuit is closed through their front contacts to advance (R4) switch from 8 to 9. On leaving position 8, (YT3) relay releases. (NT) relay is connected to the tip of the test line, and when the final reaches the talking position it should operate from ground from (E) cam of (R4) switch, in position 9, over the tip of the final selector. (NT) relay operated, connects (TKR) relay to the final ring.

Where "I" wiring is used, in positions 9 to 15 of (R4) switch, ground from (D) cam of (R3) switch through the winding of (SUB) relay, (V) cam of (R4) switch and (P) cam of (R3) switch is connected to the ring of the test line. Where "J" wiring is used, in position 9 of (R4), ground from (D) cam of (R3) switch through (V) cam of (R4) switch and (P) cam of (R3) switch is connected to the ring of the test line. (TKR) relay should operate and should lock through front contacts of (SLV) or (SLV1) relay. (TKR) relay operated, operates (TK1) relay and holds (MB) relay operated. (SR) relay was operated in position 6 of (R4) switch, through back contacts of (TK1) relay, it operated (FR) relay. On leaving position 3 the operating circuit of (SR) relay was broken but it remained locked through back contacts of (TK1) relay. (TK1) relay operated, operates (TK2) relay, which locks through (F) cam of (R4) switch. The operation of (TK1) relay also disconnects ground from the final sleeve, and switches the locking circuit of (SR) relay from ground to the final sleeve. When ground is disconnected from the final sleeve, the final (TK) relay should release and connect ground to the sleeve thru its back contacts; this ground should hold (SR) relay operated. Should the ground not be connected to the sleeve by the release of the final (TK) relay, (SR) relay would release, releasing (FR) relay opening the operating circuit of (CH) relay, blocking the test circuit in position 15. (TK2) relay operated, advances (R4) switch from 9 to 15. On leaving position 9, the battery supplied to the sleeve of the test line from (Y) cam of (R4) switch is disconnected. The final should advance from the talking position. Where "I" wiring is used, ground thru the winding of (SUB) relay is connected to the ring, but the finals which are arranged not to await the called subscriber's release on no test calls should not be held by this ground. However, if this feature of a final selector is inoperative, the final (L) relay may lock in series with (SUB)

relay, operating (SUB) relay, in turn operating (MT) relay in position 15, in turn operating (MT1) relay which locks thru (J) cam of (R4) switch and prevents (R4) switch from advancing from 15 to 16. Where "J" wiring is used the ground is disconnected from the ring when (R4) switch leaves position 9, this wiring is used where there are final selectors which await the called subscriber's release on no test calls as well as on other calls. The advance of the final disconnects battery from the sleeve of the test line, releasing (SLV) or (SLV1) relay in turn releasing (SL) and (TKR) relays. (TKR) relay released, releases (TK1) and (MB) relays. (TK1) relay released, switches the final sleeve from the locking circuit of (SR) relay to the locking circuit of (FR) relay. (SR) relay releases but (FR) relay should lock to ground on the final sleeve. A circuit is closed from ground thru back contacts of (SR) relay and front contact of (FR) relay to operate (CH) relay, this is for the purpose of checking the locking circuit of (FR) relay. (CH) relay operated, locks to ground on (E) cam of (R4) switch. When the final selector has restored to normal it will disconnect ground from the sleeve, releasing (FR) relay. (FR) relay released, connects ground to the final sleeve to hold the final selector busy and a circuit is closed from ground thru back contacts of (MT1) relay, contacts of (N) cam of (R3) switch, back contacts of (SUB) relay, front contacts of (CH) relay, back contacts of (FR) relay and (W) cam of (R4) switch, advancing (R4) switch from 15 to 16.

6.14 Time Measure Release Test

With (R3) in position 5 if (TMR) "time measure release" key is operated, a test of the time measure release feature is made on disconnection. The test proceeds as described in par. 6.113 until (R4) switch leaves position 12, except that (SUB) relay is bridged directly across the tip and ring of the test line and is not in series with resistances, and when (R4) switch leaves position 12 this circuit is not broken, this prevents the final from advancing out of the "awaiting called subscriber's release" position. The test circuit advances to position 15 as described in par. 6.113. (SUB) relay should remain operated, this should operate (MT) relay in position 15, in turn operating (MT1) relay, which locks thru (J) cam of (R4) switch. After a period of time the final selector should be advanced by means of interrupters out of the "awaiting called subscriber's release" positions, releasing (SUB) relay in turn releasing (MT) relay, and also disconnecting battery from the sleeve releasing (SLV) or (SLV1) relay in turn releasing (SL) and (TKR) relays. (TKR) relay released, releases (TK1) and (MB)

relays. (TK1) relay released, switches the final sleeve from the locking circuit of (SR) relay to the locking circuit of (FR) relay. (SR) relay releases but (FR) relay should lock to ground on the final sleeve. A circuit is closed from ground thru back contacts of (SR) relay and front contacts of (FR) relay to operate (CH) relay, this is for the purpose of checking the locking circuit of (FR) relay. (CH) relay operated, locks to ground on (E) cam of (R4) switch. When the final selector has restored to normal, it will disconnect ground from the sleeve, releasing (FR) relay. (FR) relay released, connects ground to the final sleeve to hold the final selector busy and a circuit is closed from ground from (J) cam of (R4) switch, front contacts of (MT1) relay, (N) cam of (R3) switch contacts of (TMR) key operated, back contacts of (SUB) relay, front contacts of (CH) relay, back contacts of (FR) relay and (W) cam of (R4) switch, advancing (R4) switch from 15 to 16.

6.15 Multi-Test Operation

With (MT), "multi-test", key operated, a series of tests is made on each final selector, the first with (R3) switch in position 1. On the completion of this test (R4) switch will be in position 16. A circuit will be closed from ground from (E) cam of (R4) back contacts of (CA) and (BC) relays contacts of (MT) key operated, (B) cam of (R3) switch advancing (R3) switch from 1 to 2. Ground from (C) cam of (R3) switch advances (R4) switch from 16 to 17. Ground thru contacts of (ST) key operated, advances (R4) switch from 17 to 1. Each time (R4) switch advances from position 17 to position 1, (ST) message register operates, counting the number of single tests made. Ground from (F) cam of (R4) switch advances (R3) switch from 2 to 3. With (R3) switch in position 3 the next test of the final is made and when (R4) switch reaches position 16 (R3) switch will advance from 3 to 4, causing (R4) switch to restore to normal advancing (R3) switch from 4 to 5. In like manner the tests are made with (R3) switch in positions 5, 7, 9, 11 and 13. With (R3) switch in 13, when (R4) switch reaches position 16, (R3) switch is advanced from 13 to 15 and is advanced by the (A) cam from 15 to 18. In position 18 of (R3) switch a circuit is closed from ground, (D) cam of (R3) switch, contacts of (MT) key operated, back contacts of (REP) relay, contacts of (TA) key normal, winding of (RS3) relay to battery, operating (RS3) relay. (RS3) relay operated, locks through back contacts of (RS4) relay and advances (R4) switch from 16 to 17. Ground through contacts of (ST) key operated, advances (R4) switch from 17 to 1. As (R3) switch advances

from position 17 to position 1, (MT) message register operates, counting the number of multi-tests made. Ground from (F) cam of (R4) switch advances (R3) switch from 18 to 1.

6.16 Single Test Operation

With (MT) key normal, a single test is made on a final selector and then the final selector is released and another final selector is tested. The particular test made will depend upon the position of (R3) switch, which may be set by hand in any desired test position. At the completion of every successful test (R4) switch will be in position 16 and a circuit will be closed from ground, (E) cam of (R4) back contacts of (CA) and (BC) relays, contacts of (MT) key normal, back contacts of (REP) relay, contacts of (TA) key normal winding of (RS3) relay to battery, operating (RS3) relay. (RS3) relay operated, locks through back contacts of (RS4) relay and advances (R4) switch from 16 to 17. Ground through contacts of (ST) key operated, advances (R4) switch from 17 to 1. As (R4) switch advances from position 17 to position 1, (ST) message register operates, counting the number of single tests made.

6.17 Brush Continuity Test

6.171 Operation of Test

The brush continuity test is provided to test the continuity of brushes not having access to the test lines. The brush continuity test cannot be made as part of a multi test so that (MT) key should be normal during the progress of a brush continuity test. When making brush continuity tests (TRA) key need not be operated to close the test line, (line 99) to the test circuit, as the test line is not utilized. (BC) key is operated and "make busy" plugs are inserted in one jack in (B) row in one jack in (T) row and in one jack in (U) row. The jacks in which the "Make busy" plugs are inserted control the final brush, tens and units selections. Numbers should be set up to test the desired brush by directing the final selector to some working line in the bank. The operation of (BC) key causes (R3) switch to advance to position 11, in which position it should remain. The test will proceed as described in paragraphs 6.07 to 6.10 until position 8 of (R4) switch except that (MB) relay does not operate. Ground thru contacts of (BC) key operated, advances (R4) switch from 8 to 9. In position 9 (BC) relay operates through back

contacts of (AC) and (AC1) relays. (BC) relay operated, locks through back contacts of (CA-1) relay. (BC) relay operated, causes (BC) selector switch to advance from position 1, its normal position, under control of (BC) interrupter. In position 2, (CT) relay operates, connecting ringing current through windings of the repeat coil, closing the final tip through the repeat coil and (AC) relay and operating (AC1) relay. (AC1) relay operated, connects battery to the winding of (AH) relay. The purpose of the delay in closing the circuit to (AH) relay is to prevent operating (AH) relay, should (AC) relay momentarily operate due to a surge. (BC) switch advances from position to position under control of (BC) interrupter.

6.172 O.K. Operation.

If the line to which the final selector is directed is idle and is a working line, the final selector will stop on it, operate the cut-off relay or any other relay that is controlled over the sleeve and advance to its talking position, closing the tip and ring conductors through to the multiple brushes. (AC) relay should operate provided the tip and ring are closed through the multiple brushes and there is a bridge across the tip and ring which will pass ringing current. A bridge of this type will be present on various types of lines as follows:

1. Direct subscriber's line, ringer and condenser in series bridged across the line.

2. 2 party line or 4 party semi-selective line (except where only partially equipped), tip and ring both connected to ground through ringer and condenser in series.

3. 4 party selective line, relays in sub-sets in series with condensers bridged across tip and ring.

4. P.B.X. line, ring-down relay in series with a condenser bridged across the tip and ring.

5. Central office desk or switchboard line arranged for ring-down operation, ring-down relay in series with a condenser bridged across the tip and ring.

The induced ringing current applied across the line is of such a small value that it should not tap a ringer nor operate a ring-down relay, but should operate (AC) relay, in turn operating (AH) relay in turn operating (OK) relay which locks thru (4) arc of (BC) switch. The purpose of operating (AH) relay is that (AC) relay will have very low contact pressure and will follow the A.C. pulses but (AH) relay operating in local circuit should have sufficient contact pressure and its time of operation should be sufficient to operate (OK) relay. The resistance which is in parallel with (AH) relay is provided to slow the release of (AH) relay. (OK) relay operated, switches the advancing circuit of (BC) selector switch from control of (BC) interrupter and causes it to advance by self interruptions to position 10. On leaving position 5, (CT) relay releases. In position 7 (CT1) relay operates. With (CT1) relay operated, the tip is connected thru the winding of (IN) relay to battery and the ring is connected thru the winding of (BL) relay to battery. On O.K. tests neither of these relays should operate. (BC) switch advances from position 10 to position 12 under control of (BC) interrupter. On leaving position 11 (CT1) relay releases.

In position 12, (BC1) relay operates, advancing (R4) switch from 9 to 15, connecting battery thru the winding of (BC2) relay to the tip and operating (TK1) relay. (SR) relay was operated in position 6 of (R4) switch, thru back contacts of (TK1) relay, it operated (FR) relay. When (R4) switch left position 8 the operating circuit of (SR) relay was broken but it remained locked thru back contacts of (TK1) relay. (TK1) relay operated, operates (TK2) relay, which locks thru (F) cam of (R4) switch. The operation of (TK1) relay also disconnects ground from the final sleeve and switches the locking circuit of (SR) relay from ground to the final sleeve. When ground is disconnected from the final sleeve, the final (TK) relay should release and connect ground to the sleeve thru its back contacts; this ground should hold (SR) relay operated. The final should advance and on leaving the talking position should connect ground to the tip, this should operate (BC2) relay. When the final has advanced further ground will be disconnected from the tip, permitting (BC3) relay to operate in series with (BC2) relay. (BC3) relay operated, releases (TK1) relay. (TK1) relay released, switches the final sleeve from the locking circuit of (SR) relay to the locking circuit of (FR) relay. (SR) relay releases but (FR) relay should lock to ground on the final

sleeve. When the final has restored to normal, it will disconnect ground from the sleeve, releasing (FR) relay. (FR) relay released, connects ground to the final sleeve to hold the final selector busy and a circuit is closed from ground, front contacts of (BC1) and (BC3) relays and back contacts of (FR) relay to advance (R4) switch from 15 to 16. A circuit is closed from ground on (E) cam of (R4) switch, back contacts of (CA) relay, front contacts of (OK) relay, back contacts of (IN1) and (BL1) relays, contacts of (MT) key normal, back contacts of (REP) relay, contacts of (TA) key normal, winding of (RS3) relay to battery, operating (RS3) relay. (RS3) relay operated, locks thru back contacts of (RS4) relay and advances (R4) switch from 16 to 17. On leaving position 16, (BC) relay releases, releasing (BC1) relay in turn releasing (BC2) and (BC3) relays and advancing (BC) switch from position 12 to position 1, its normal position. On leaving position 12 (OK) relay releases. Ground thru contacts of (ST) key operated, advances (R4) switch from 17 to 1.

6.173 Trouble Conditions

6.1731 Open Tip or Ring

In case no brush is tripped or in case either tip or ring is open or in case the line on which the final selector stops has no bridge capable of passing ringing current, (AC) relay cannot operate. In any of these cases, the test circuit will function as follows. (BC) switch will advance from position to position under control of (BC) interrupter. On leaving position 5 (CT) relay releases. In position 6 a circuit is closed from ground thru (5) arc of (BC) switch and back contacts of (OK) relay to the trouble alarm lamp and register, giving a trouble indication. In position 7, (CT1) relay operates. With (CT1) relay operated, the tip is connected thru the winding of (IN) relay to battery and the ring is connected thru the winding of (BL) relay to battery. However, under any of the above conditions there should be no circuit for operating either of these relays. (BC) switch should advance to position 12. On leaving position 11, (CT1) relay releases. In position 12, (BC1)

relay operates, advancing (R4) switch from 9 to 15, connecting battery thru the winding of (BC2) relay to the tip and operating (TK1) relay. The final selector should restore to normal and the test circuit should function as described in paragraph 6.172 until (R4) switch reaches position 16, when the test circuit will block.

6.1732 Open Sleeve

If the sleeve is open or if for any other reason the sleeve relay of the line called fails to operate, (AC) relay may operate thru the back contacts of the sleeve relay. This would cause (AH) and (OK) relays to operate and (BC) switch to advance under self interruptions to position 10. On leaving position 5, (CT) relay releases. In position 7, (CT1) relay operates. (CT1) relay operated, connects the tip thru the winding of (IN) relay to battery and the ring thru the winding of (BL) relay to battery. Ground thru back contacts of the sleeve relay will operate either (BL) or (IN) relay, depending upon how the tip and ring of the line are connected. (ground is usually connected to the tip, but on party lines some of the terminals will be reversed). Depending on the connection, either (BL) or (IN) relay should operate. In case (IN) relay operates, (IN-1) relay operates and locks thru (4) arc of (BC) switch and (IN) lamp is lighted. In case (BL) relay operates, (BL-1) relay is operated. In either case a circuit to the trouble alarm lamp and register will be closed, giving a trouble indication. (BC) switch should advance to position 12. On leaving position 11, (CT1) relay releases, this will release (IN) or (BL) relay.

(BL) relay released, will light (BB) lamp and will permit (BL-2) relay to operate if (BL-1) relay is operated. In position 12 (BC-1) relay operates, advancing (R4) switch from 9 to 15, connecting the winding of (BC-2) relay to the tip and operating (TK1) relay. The final selector should restore to normal and the test circuit should function as described in paragraph 6.172, until (R4) switch reaches position 16 when the test circuit will block.

6.1733 Intercepted Line

6.17331 Operator Does Not Answer

In case the line on which the final is resting is an intercepted line and is not of the "ring-down" variety, there will be no circuit to operate (AC) relay until the operator answers. If the operator does not answer until after (BC) switch has reached position 12, no lamp signal other than the trouble alarm will be given and the circuit will function as described in paragraph 6.1731.

6.17332 Operator Answers Before Passing Position 5

In case the operator answers the call before (BC) switch has passed position 5, (AC) relay may operate operating (AH) relay in turn operating (OK) relay. (OK) relay operated, switches the advancing circuit of (BC) selector switch from control of (BC) interrupter and causes it to advance by self interrupters to position 10. On leaving position 5, (CT) relay releases. In position 7 (CT-1) relay operates. With (CT-1) relay operated, the tip is connected thru the winding of (IN) relay to battery and the ring is connected thru the winding of (BL) relay to battery. (IN) relay should operate from 24 volt battery on tip of the intercepted operator's cord circuit. (IN) relay operated, operates (IN-1) relay which locks thru (4) arc of (BC) selector switch, lights (IN) lamp and closes a circuit to the trouble lamp and register, giving a trouble indication. (BL) relay may operate from the tripping path in turn operating (BL-1) relay, and when the tripping circuit is broken (BL-2) relay will operate, however, with (IN) relay operated, the circuit for advancing (BC) switch is

independent of the path thru back contacts of (BL2) relay. (BC) switch advances from position 10 to position 12 under control of (BC) interrupter. On leaving position 11, (CT1) relay releases, releasing (IN) relay and (BL) relay if operated. The release of (BL) relay will cause (BL2) relay to operate in series with (BL1) relay. In position 12 (BC1) relay operates, advancing (R-4) switch from 9 to 15, connecting the winding of (BC-2) relay to the tip and operating (TK1) relay. The final should restore to normal and the test circuit should function as described in paragraph 6.172 until (R4) switch reaches position 16, when the test circuit will block.

6.17333 Operator Answers After Passing Position 5 But Before Passing Position 11

In case the operator answers the call after (BC) switch has passed position 5 but before it has passed position 11, (AC) relay will not operate and (OK) relay will not operate. In position 6 a circuit is closed from ground thru (5) arc of (BC) switch and back contacts of (OK) relay to the trouble alarm lamp and register, giving a trouble indication. In position 7, (CT1) relay operates. With (CT1) relay operated, the tip is connected thru the winding of (IN) relay to battery and the ring is connected thru the winding of (BL) relay to battery. (IN) relay operates and the test circuit and final should function as described in paragraph 6.17332.

6.174 Busy Line

In case the line called is busy, there will be no circuit for operating (AC) relay and the test circuit will function as described in paragraph 6.1731 until (BC) switch has reached position 7 and (CT1) relay has operated. The final should advance to its busy back position and busy back pulses, interrupted ground on the ring, should operate

and release (BL) relay. The first operation of (BL) relay operates (BL1) relay. The first release of (BL) relay permits (BL2) relay to operate in series with (BL1) relay. (BL2) relay operated opens the advancing circuit of (BC) selector switch, causing it to stop in some position between 7 and 11. The test circuit will block and with (BL1) relay operated, the operation and release of (BL) relay from the busy back pulses will flash (BB) lamp.

6.175 Restoring on Trouble Conditions

In order to advance the test circuit in case of trouble on brush continuity tests, (CA) key should be operated. (CA) key operated, operates (CA) relay in turn operating (CA1) relay. (CA1) relay locks thru (G) cam of (R4) switch, advances (R4) switch to position 16 if it is not already there and releases (BC) relay. (BC) relay released advances (BC) selector switch from any position it may be in to position 1, its normal position, and all relays, operated or locked thru arcs of (BC) switch, are released. If the trouble encountered was due to a busy, trouble, intercepted or partially equipped condition of the line called or if the line called has no bridged ringer or relay the plugs in (T) and (U) rows of jacks should be reset to direct the final selector to a different line and the test should be repeated, by operating (REP) key and then releasing (CA) key.

6.18 Advancing Incoming Selector

When (RS3) relay operates at the conclusion of the test of a final selector it locks thru back contacts of (RS4) relay and advances (R4) switch from 16 to 17 as described in paragraphs 6.15 and 6.16, it also operates (RS2) relay and (RS) relay when (R4) switch reaches position 1. A circuit is closed thru the outer winding of (RS1) relay but there is not sufficient current to operate (RS1) relay. (RS2) relay operated, operates (TF) relay on its primary windings. (RS2) and (RS) relays operated, connect ground to the (UP) magnet in the incoming, over lead (TU-1) causing the incoming elevator to ascend. As the elevator moves upward, ground from the (C) commutator holds (RS) relay operated and operates (RS1) relay. When the incoming brush centers on the terminals of the next final the (C) commutator brush breaks contact with the metal segment of the (C) commutator.

This causes (RS) relay to release but (RS1) relay will hold through its secondary winding. (RS) relay released, stops the incoming elevator on the terminals of the next final and connects ground thru its back contacts, thru front contacts of (RS1) and (RS3) relays, operating (RS4) relay. (RS4) relay operated, releases (RS3) relay. (RS3) relay released, releases (RS1), (RS2) and (RS4) relays. When (RS2) relay releases, the secondary winding of the (TF) relay is put under sole control of the sleeve and a busy test of the selected final is made in the same manner as described in paragraph 6.06.

6.19 Pass By Overflow Terminals

In order to test all of the finals, the incoming elevator must pass by the overflow terminals of one group to the first trunk terminals of the next. As the incoming brush makes contact with the overflow terminal of a group, ground on the (Z) commutator over lead (TA1) operates the (ZC) relay. (ZC) relay locks thru front contacts of (RS4) relay; this is to hold (ZC) relay as the circuit to the (Z) commutator may be momentarily broken as the selector rides past the terminal until it settles back. The (ZC) relay operated, energizes the stepping magnet associated with the (IC) switch. The (IC) switch is advanced to terminal 2. On terminal 2 the (ZC) relay releases. The (ZC) relay released, operated the (RS3) relay thru terminal 2 and brush 1 arc (IC). The (RS3) relay operated, operates the (RS2) and (RS) relays. The (RS), (RS1), (RS2), (RS3) and (RS4) relays function as described in paragraph 6.18 for advancing the incoming brush to the terminals of the next trunk. The (RS4) relay operated, advances the (IC) switch to position 3. With the (IC) switch in position 3, the finals associated with the second incoming group are tested. In a similar manner the finals in the third and fourth incoming groups are tested in positions 5 and 7 respectively of the (IC) switch. At the end of the test on the fourth group the incoming brush is resting on the overflow terminal at the top of the group.

6.20 Incoming Elevator Down Drive

The (ZC) relay operates over lead (TA-1) to ground on the (Z) commutator. The (ZC) relay operated, advances the (IC) switch to position 8. With the (IC) switch in position 8, the (ZC) relay releases. The (ZC) relay released, advances the (R-2) switch to position 8. The (TRIP) magnet of the incoming selector is energized when (R2) switch reaches position 7-3/4. In position 8 of the (R-2) switch the (DOWN) magnet in the incoming is energized

over lead (TD-1) causing the incoming elevator to descend. When the elevator is returned to the normal position, ground thru the (Y) commutator in the incoming over lead (TY-1) advances the (R-2) switch to position 9. On leaving position 8 the (TRIP) magnet of the incoming selector is released. As the (R-2) switch passes through position 8-3/4 to 9, ground on the (ET) key operated thru cam (S-2) energizes the IA magnet and as the R2 switch leaves position 9, the IA switch advances to position 2. In position 9 of (R2) switch, a circuit is closed to step (IC) switch from 8 to 9, and while (IC) switch is in position 8, a circuit is closed to advance (R2) switch from 9 to 10. At this time (R2) switch may advance from 9 to 10 and (IC) switch may advance from 8 to 9. If (IC) switch does not have time to advance while (R2) switch is in position 9, it will remain in position 8 until (R2) switch reaches 3 or 12, and (TF1) and (RS1) relays will be held operated, and when (R2) switch reaches position 3 or 12 (IC) switch will advance thru its normal position and proceed to take its regular setting. If (IC) switch advances out of position 8 before (R2) switch leaves position 9, (IC) switch will advance to position 12 and with (IC) switch in position 12 (R2) switch is advanced from 9 to 10.

6.21 Testing In 1, 2, 3 and 4 Incoming Banks

When all of the finals associated with the (0) incoming brush (as determined by the cross connections) have been tested and the incoming elevator returned to normal the test circuit proceeds to test the finals associated with the 1, 2, 3 and 4 brushes in a manner similar to that described for the (0) brush. According to the given cross-connection scheme, all four groups in the 1, 2, 3 and 4 banks of the first incoming frame will be tested. At the end of the testing of each incoming bank the (IA) switch advances to the next terminal wired for test.

6.22 Second Incoming Elevator Selected

Assuming that when the (IA) switch reaches terminal 6 all finals accessible through the incoming selector used above, have been tested. With the (IA) switch on terminal 6 and the (CON) relay still operated, the (R-1A) switch advances to position 4, connecting the test circuit to the second incoming selector. As the switch enters position 3-1/4, the (PG) relay operates in a circuit from ground on cam (A-1A) thru cam (S-1A) to battery. The operation of the (PG) relay removes ground from the (TK-1) lead, thereby permitting the immediate use of

the associated incoming elevator when necessary in regular traffic. When the switch passes position 3-1/2, the (PG) relay releases. The test circuit functions from this point on in a similar manner to that before described. The second incoming selector may not test all the banks or all the groups in the banks. Those tested will depend on the arrangement of the incoming and final frames and are governed by the cross-connections at the arcs of the (IA) switch. With the cross-connection scheme shown, the second incoming selector tests finals in groups 0 and 1 of bank 0, (terminal 6 of (IA) switch), group 0, 1 (terminal 7) and 3 of bank 1 (terminal 8) and 0 to 3 of bank 2 (terminal 9). The incoming is advanced by the test circuit thru consecutive groups without being restored to normal, but when testing groups 1 and 3, the test circuit must select brush 1 and group 0 first, then return the incoming to normal, advance the (IA) switch one terminal and select brush 1 and group 3.

6.23 Advancing Second Connector

Assuming that the brushes of the (IA) switch rest on terminal 15 at the completion of the test of finals through the third incoming, the (R-1A) switch is advanced to position 8 or 17 by ground from the (CON) relay operated, terminal 15 and brush F (I-A), lead 4, cam (P-1A) cam (C-1A) to battery thru the (R-1A) magnet, the A cam advancing the switch to normal position 1 or 10. With the (IA) switch in position 15 and the (R1A) switch in position 1 or 10, the (R1B) switch is advanced to position 2 thru cams (B-1B) and (P-1A) over the same circuit. From this point on the test set functions as described for connector 1.

6.24 (IB) Switch

Should the terminals of the (IA) switch be insufficient to test all of the finals in an office, a second switch (IB) is provided. When the (IA) switch reaches terminal 21, the (ACA) relay operates thru the primary winding. The (ACA) relay operated, operates the (TRA) relay. The (TRA) relay operated, operates the (RN) relay and transfers the control leads from the (IA) switch to the (IB) switch. The (TRA) relay operated, advances the (IB) switch to terminal 1. From this point on the test circuit functions in a similar manner to that before described.

6.25 Conclusion of Routine Test

Upon the conclusion of a routine test when the last (I) switch reaches 21, (EC) lamp lights as an indication that the cycle of

tests has come to an end. When it is desired to restore the test circuit to normal (ST) key is restored to normal releasing (ST) and (CON) relays and advancing the last connector switch to normal. (CON) relay released, extinguishes (EC) lamp. (RN) key is then operated, operating (RN1) relay which locks under control of (RN) relay, if operated and independently of (RN) relay if (IA) switch is in 21. Where "A" wiring is used the locking circuits of (ACA) and (RN) relays, if operated, are shifted from the back to the front contacts of (RN1) relay thru its continuity contacts. The locking circuits of (ACA) and (RN) relays are maintained directly under control of (RN) key operated, when (RN1) relay operates. (RN) key should then be released. When (RN) key is released, the release magnet of (T) row of keys is operated, if any of the keys in the row are operated, as long as (RN1) relay is operated, releasing any operated keys in that row. When (RN) and (TWB) keys are released (ACA), (TRA) and (RN) relays, if operated, release and the (RN2) relay operates. The directing switches step from 21 to normal directly under control of (RN) key normal where "A" wiring is used and under control of (RN2) relay operated. When (IA) switch leaves 21, (RN1) relay releases, releasing (RN2) relay.

6.26 Particular Group Test

To facilitate the testing of a particular group of finals or a particular final, a chart is provided on the final test frame showing the groups of final trunks available to a brush on an incoming frame, and what keys to operate in conjunction with the (ST), (TRA) or (BC) and (PC) keys to cause an (I) switch to step to a terminal which permits the test of a particular group of trunks. The (GN) key operated, determines the incoming group selected, the (TWA) or (TWB) etc. key operated, determines the (I) switch which is used to reach that incoming. The (T) and (U) keys operated, determine which terminal the (I) switch is stepped to, the (OC) key operated, determines the number of groups to be tested. The (ST) key operated starts the test. No keys in (GN) and (OC) rows need be operated if it is desired to test all the finals that are accessible from the terminal to which the directing selector is directed. The (ST) key operated, operates the (ST) relay. The (ST) relay and the (TWA) key if operated, energize the (IA) magnet and cause the associated brush assembly to advance off normal. The selector continues to advance by means of ground from the (PC) key operated through the contacts of the normal (U) keys. When the (IA) switch has advanced to the position to which the contact of the operated (U) key is

wired it stops due to the circuit being open through the operated key. Should the final group desired be accessible through (IB) switch, the (TWB) key operated, operates its associated (ACA) relay thru the secondary winding. The (ACA) relay operated, operates the corresponding (TRA) relay and (RN) relay. The (TRA) relay operated, advances the associated (IB) switch off normal. (IB) switch advances in the same manner as described for (IA) switch to the position determined by the operated (U) key. The (T) relay operates when the (IA) or (IB) switch makes contact with the open contact, through the operated (W) key. From this point on the test circuit functions in a manner before described with the following exceptions:

(1) When the (I) switch reaches the preselected terminal, the connector switch takes its setting advancing from normal to the position required for the desired test. For instance suppose the (IA) switch to be used stopped on terminal 6. When the switch makes contact with terminal 6, the (R-IA) switch advances from normal to position 4. As the (R-IA) switch enters position 1-1/2 the associated (PG) relay operates and remains operated as long as the rotary magnet is energized (until the switch enters position 4 in the assumed case). Circuit: from the ground which advances the (R-IA) switch, cam (B-IA) winding of the (PG) relay, cam (S-IA). (PG) key operated, cam (P-2) to battery. The (PG) relay operated, prevents the incomings which are passed by, from being made busy.

(2) When the (R-2) switch enters position 3, the (IC) switch is set under control of the (OC) key operated.

(3) When (R-2) switch is in position 6 and incoming group selection has been completed, (PC) key should be released, permitting the advance of (R-2) switch.

(4) When the (R-2) switch reaches position 7 and (KR) interrupter makes, the key release magnets of (U), (GN) and (OC) rows of keys operate and release the operated keys. The key release magnets releas when (KR) interrupter breaks.

6.27 Particular Circuit Test

e test for particular circuit is the same as for particular gro exce that the incoming elevator used for test is raised by hand to connect with the terminals of a desired final in the selected group after group selection is completed and before (PC) key is released.

6.28 Time Alarm

With (ST) key operated and (BY) switch normal a circuit is closed thru (J) cam of (R-4) switch in position 1 to operate (BY) relay. (BY) relay operated, locks thru contacts of (ST) key operated as long as (R-4) switch is in position 1 and closes the circuit to permit (BY) switch to advance under control of (TM) interrupter. (TM) interrupter advances (BY) switch one step every 30 seconds where "X" wiring is used or one step a minute where "Y" wiring is used. Should (R-4) switch still be in position 1 when (BY) switch reaches terminal 10, the (BY) lamp lights and the alarm functions. The operation of (TA) key releases the (BY) relay which extinguishes (BY) lamp, stops the alarm and advances (BY) switch to its next normal position. If (R-4) switch advances from position 1 before the alarm is brought in, (BY) relay is released advancing (BY) switch to its next normal position.

With (R-4) switch in any position except 1, and (TBL) switch normal a circuit is closed to operate (TBL) relay. (TBL) relay operated, locks as long as (R-4) switch is off normal and closes a circuit to permit (TBL) switch to advance under control of (TM) interrupter. (TM) interrupter advances (TBL) switch one step every 30 seconds.

With (R-3) switch in any position except 5, or with (R-3) switch in position 5 and (TMR) key normal, if (R-4) switch is still normal when (TBL) switch reaches position 3, (TBL) lamp lights, the register operates and the alarm functions. With (R-3) switch in position 5 with (TMR) key operated the alarm will not be brought in until (TBL) switch reaches position 11, this increased time is in order to prevent false indications of trouble on "time measure release" tests. The operation of (TA) key operates (TBL-1) relay which locks as long as (R-4) switch is off normal and releases (TBL) relay. (TBL) relay released, extinguishes (TBL) lamp, stops the alarm and steps (TBL) switch to its next normal position. If (R-4) switch restores to normal before the alarm is brought in, (TBL) relay is released, advancing (TBL) switch to its next normal position.

As described in paragraph 6.17 (TBL) lamp may be lighted and the alarm brought in by failure on "brush continuity tests", even before (TBL) switch has advanced to its trouble position. The operation of (TA) key extinguishes (TBL) lamp and stops the alarm when brought in by a "brush continuity" test.

(TA) key is locking so that in cases of trouble which require considerable time to run down, repeated alarms will not be brought in. With (TA) key operated, it is impossible to progress to another final selector.

6.29 Control Advance Feature

If trouble develops in the circuit under test or in the test circuit the time or trouble alarm functions as explained in paragraph 6.28.

If it is desired to restore the final selector and advance the test circuit (CA) key is operated. If (REP) key is operated, a make busy plug inserted in the associated jack at the final selector frame or the operation of one of the buttons of a (32A) test set plugged into this jack will cause the circuit to function in the same manner as the operation of (CA) key. (CA) key operated, operates (CA) relay in turn operating (CA1) relay. (CA1) relay operated locks thru position 2 to 16 of (R-4) switch independently of (CA) relay, and advances (R-4) switch from any off normal position below 16 to position 16. When advancing from position 15 to 16 ground is disconnected from the final sleeve, this should release the final (TK) relay if operated, restoring the final selector to normal if it is off normal. The test circuit cannot progress to the next final selector, advance (R-3) switch or repeat on the same final until (CA) key is released, releasing (CA) relay.

6.30 Repeating Test (REP) Key

To repeat a test on a certain final the (REP) key is operated. The (REP) key operated, operates the (REP) relay which locks to ground on cam (J-4) if a single test is being made, or thru the (MT) key operated to ground on cam (D-3) if a multi-test is being made.

If (MT) key is normal, the (REP) relay operated, advances the (R-4) switch from position 16 to 17, and ground on the contact of the (ST) key advances it to position 1. With the (R-4) switch in position 1, the test on the final is repeated. Should the (REP) key remain operated, the test will be repeated until the key is released and when released the test in progress is not affected and one repeat test is made after this on the same final selector before progressing to the next final selector. Should the (REP) key be operated only momentarily the (REP) relay is locked from position 2 to 1 to ground on cam (J-4). Under this condition the (REP) relay releases when the (R-4) switch enters position 1 or 2 at the end of a test, however, one repeat test is made before progressing to the next final selector.

If (MT) key is operated, the (REP) relay operated, will not affect the progress of a multi-test, but when (R-3) switch reaches position 18, (R-4) switch will be advanced from position 16 to 17, and ground on the contact of the (ST) key advances it to position 1.

The complete multi-test is repeated. Should the (REP) key remain operated, multi-tests will be repeated on the same final selector until the key is released, and when released the multi-test in progress is completed and one complete multi-test after this is made on the same final selector before progressing to the next final selector. Should the (REP) key be operated only momentarily the (REP) relay is locked from position 2 to 18 1/4 of (R-3) switch. Under this condition (REP) relay releases when (R-3) switch enters position 1 at the end of a multi-test, however, one repeat test is made before progressing to the next final selector.

If (BC) and (REP) keys are both operated, the test circuit will block in position 16, until (CA) key is operated and released. The operation of (CA) key operates (CA) relay in turn operating (CA1) relay which locks thru (G) cam of (R-4) switch. When (CA) key is released (CA) relay releases. With (REP) and (CA1) relays operated and (CA) relay released, a circuit is closed to advance (R-4) switch from 16 to 17 and the repeat test proceeds as before described. For successive repeat tests (CA) key must be operated and released for each test. This feature is to prevent undue interference with a subscriber's line which might result if unrestricted repeat tests were permitted on brush continuity tests.

6.31 Automatic Pass Busy (APB) Key

Should it be desired to pass by busy finals automatically during the test, the (APB) key is operated. The (APB) key operated, removes the short circuit from the winding of the (PB) relay allowing the (PB) relay to operate in series with the 800 ohm winding of the (TF) relay should the final test busy. The (PB) relay operated, operates the (RS-3) relay. The (RS-3) relay operated, operates the (RS) and (RS-2) relays. The (RS) relay operated, causes the incoming elevator to ascend to the next free final terminals.

The (RS-2) relay is made slow releasing to prevent the premature release of the (TF) relay when the momentum of the incoming elevator carries the brushes beyond the last of a series of busy terminals to an idle terminal. The premature release of the (TF) relay would release the (PB) relay thus causing the incoming selector to remain on the terminals of the busy final. Should the incoming elevator step to an overflow position with the (APB) key operated the (TF) and (PB) relays release and the (ZC) relay operates. The (ZC) relay operated, advances the (IC) switch to an even numbered terminal, from which it advances to

the next odd terminal. Where the (ZC) relay releases. The (RS-3) and its associated relays operate, as heretofore described, and advance the incoming to the first trunk in the next group. If the first trunk in the next group is busy the test circuit functions as before described. When the (MT) key is operated, (APB) key will not be effective unless (R3) switch is in position 1. Therefore, before starting the test circuit with these two keys operated, (R3) switch should be placed in position 1 by hand, in order to pass by the first final, if busy.

6.32 Manual Pass Busy (MPB) Key

When a busy condition on a final is encountered the (BF) lamp lights in parallel with the 800 ohm winding of the (TF) relay. If it be desired to pass by this particular final, the (MPB) key is operated. The (MPB) key operated, extinguishes the (BF) lamp and operates the (PB) relay. The (PB) relay functions as desired in paragraph 6.31. The (RS-2) relay operated, operates the (MPB) relay and holds the (TF) relay operated. The (RS-3) relay operated, functions as described in paragraph 6.31. The (MPB) relay operated, locks under control of the (MPB) key and prevents the reoperation of the (RS-3) relay should the next terminals test busy and cause the (PB) relay to operate. When the (MPB) key is released the (MPB) relay releases and the test of the free final proceeds.

6.33 To Stop Test

To stop an automatic test at any point, (ST) key is released. If the test circuit is waiting for a busy incoming connector to become idle, the off normal (R1) switch will be restored to normal, releasing (ST) and (CON) relays. (CON) relay released advances (R2) switch to 9. If a test is in progress it will proceed until (R-4) switch reaches position 17 and with (ST) key released (R-4) switch is advanced to 18, advancing (R-2) switch from 7 to 8. With (R-2) switch in position 8, down-drive takes place in the associated incoming selector. When the down-drive is completed, ground from the (Y) commutator advances (R-2) switch from 8 to 9. (IC) switch advances to normal, advancing (R-2) switch from 9 to normal, in turn advancing (R-4) switch from 18 to 1. With (R-2) switch in positions 9 to 11 or 18 to 2, the (R-1 switches are restored to normal. When all of the (R-1) switches are normal, (ST) and (CON) relays release. If (ACA), (TRA) and (RN) relays are operated they will remain operated and the directing switches will remain in the positions that they are left. (TRA) key, if operated, should be

released if the test is to be stopped for any considerable length of time.

If the (ST) key is again operated before (RN) key is operated and (TRA) or (BC) key is operated, (ST), (T) and (CON) relays reoperate and the test proceeds, connecting to the bottom final in the group directed to by the directing switches in the positions that they were left.

If with (ST) key released (RN) key is operated, (RN-1) relay operates and locks under control of (RN) relay, if operated. The locking circuits of (ACA) and (RN) relays are maintained directly under control of (RN) key operated, when (RN1) relay operates. With (R-2) switch normal and (CON) relay released, (IA) switch spins to 21 if in any other off normal position, if (IA) switch is normal or in position 21, (IB) switch spins to 21 if in any other off normal position. With (IA) switch in 21, (RN-1) relay locks independently of (RN) relay. (RN) key should remain operated until the directing switches which are off normal are advanced to 21. (RN) key should then be released. When (RN) key is released, the release magnet of (T) row of keys is operated if any of the keys in the row are operated, as long as (RN-1) relay is operated and the operated keys in (T) row should release. When (RN) and (TWB) keys are released, (ACA), (TRA) and (RN) relays, if operated, release and the directing switches step from 21 to normal. When (IA) switch leaves 21, (RN-1) relay releases.

6.34 Intercepting Operator

Lines 97, 98 and 99 are used for test purposes only. Should one of these lines be selected falsely, lines 97 and 98 test busy, and line 99 will route the call to the intercepting operator if the line is not under test and (TRA) key is normal. Under this condition (TL) relay should operate lighting (TL) lamp.

6.35 Fundamental Circuit Capacity

The (CON) key is operated, grounded capacity is connected to the tip of the fundamental circuit when (R-3) switch is in positions 1, 3 and 5. This has the effect of a trunk loop in making the final (L) relay slow in releasing. The making of proper selections and seizing the test line checks the proper release of the final (L) relay and the adjustment of the (A), (B) and (U) commutator brushes.

6.36 Commutator Resistance Test

The operation of (COM) key reduces the resistance of the fundamental circuit and disconnects the capacity from the tip. With the resistance of the fundamental circuit reduced, any resistance between the final selector commutator segments (A), (B) and (U) and the associated brushes will be more pronounced as it will give a greater drop in potential across the stepping relay during the closed interval of the brush than is obtained over the regular fundamental circuit. The making of proper selections and seizing the test line checks the proper functioning of the circuit. If any other line is seized due to false selections, the trouble may have been caused by excessive commutator resistance.

This test can be made in conjunction with any other test except Time Measure Release Tests. It should not however be made in conjunction with "brush continuity" tests as wrong selections would be passed as O.K. This test had best be made with (R-3) switch in positions 1, 5 or 13 as in these positions false selections on brush, tens or units selections will be detected.

ENG: F.S.G.
January 17, 1928
BMR

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