TCP - 6 circuit
XBP & XBP1 - 14 circuits
XBP - 6

PANEL SYSTEMS
AUTOMATIC TEST OF
INCOMING SELECTORS

CHANGES

A. CHANGED AND ADDED FUNCTIONS

A.1 Provision has been made for connecting this circuit to the timing test set.

B. CHANGES IN APPARATUS

B.1 Added

Jack (TM1) 238 - Fig. D
Jack (TM2) 238 - Fig. D
Relay (BL) R656 Fig. D
Cam (Z_3) - Sequence Switch (R-3)-Fig. D

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 Figure D has been added to provide connections to the timing test set. Fig. C has been added to show the present wiring which does not provide for connection to the test set.

D.2 Circuit Note 65 has been added.

D.3 "BE" option has been added to Fig. 5 to provide additional Figs. 5 up to a maximum of three when more than one Fig. 5 is required.

D.4 "BH" option has been added to Fig. 6 to provide connection to second Fig. 6 when two Figs. 6 are required or to provide connection from first Fig. 6 to second Fig. 6 and from second Fig. 6 to third Fig. 6 when three Figs. 6 are required.

D.5 "BK" option of Fig. 7 has been designated and rated Mfr. Disc. and is superseded by "BL" option.

D.6 "BI" option has been added to Fig. 6 to provide connection to the preceding Fig. 6 when two or three Figs. 6 are required.

D.7 Circuit Notes 62, 63 and 64 have been added and the Figures and Options Used table changed to cover Options BE, BH, BI, BK and BL.

D.8 "BM" option has been added to provide a cam (Z_3), for use with Fig. D.

1. PURPOSE OF CIRCUIT

1.1 This circuit is designed to test 24 volt, 48 volt and 3-wire incoming selectors in a panel dial office. By the operation of a key in the test circuit a district or office selector which is associated with the test circuit is connected to the incoming selector that is to be tested. The incoming selector is directed to a test line in the final multiple. When these connections are established, the final test line sends a series of pulses to the test circuit indicating that the incoming selector is functioning properly. At the end of this series of pulses the test circuit advances, in turn advancing the district or office selector used as a connecting circuit to the next incoming selector to be tested. The testing of the incoming selectors will progress automatically until all of the incoming selectors have been tested after which a signal known as "end of cycle" signal will be given indicating the completion of the test of all incoming selectors.

If trouble is encountered an alarm signal is given after a measured time interval.

In order to reach all incoming selectors, connector switches in the test circuit are supplied so that sufficient district selectors or office selectors may be used to connect to every incoming selector reached through the multiple of the district or office frames. The number of district or office selectors will depend on the manner in which the incoming selectors are arranged on the district or office frames.

By means of a particular circuit key, any particular incoming selector group can be selected and tested by connecting to any district or office selector used as a connector. In order to test a particular incoming selector, it is necessary to move the district or office selector manually to the desired terminal to which the incoming is connected.

A repeat key is also provided so that tests may be repeated on any selector.

In case that the incoming selector is busy, automatic and manual pass busy keys are provided.

By the operation of a key, automatic polarity and continuity test can be made.

2. WORKING LIMITS

2.1 This circuit is to be used for testing 48 volt or repeating incomings up to 2000 ohms external cable loop or for testing 24 volt incoming selectors over cable loops up to 1300 ohms.

3. FUNCTIONS

3.01 This circuit will automatically test all incoming selectors working in conjunction with the office in which the test circuit is installed, under what is approximately worst circuit conditions.

3.02 The circuit is arranged to select and test for busy the required district or office selectors which will give access to all of the incoming selectors. The (BO) lamp lights in the event the particular district or office selector is busy.

3.03 The test circuit may be directed to connect to any particular group of incoming selectors.

3.04 Sender selector type subscribers district or 3 wire office selectors used for connecting purposes are made busy to other hunting selectors when used for this purpose. When not in use for testing, they serve to complete calls in regular traffic.

3.05 This circuit is arranged to distinguish between busy and idle selectors and to wait for a selector to become idle, after which it will proceed with the test, or if so desired, the (APB) may be operated which will cause the test circuit to pass all of the incoming selectors that are busy at the time the test circuit reaches them. The (BI) lamp lights when a busy incoming selector is encountered.

3.06 The circuit is arranged so it will, by the operation of a key, test continuity and polarity of all trunks to incoming selectors. When the polarity has been proven and the continuity of trunk established, the operation of (CP) relay will cause the circuit to function to advance the district or office selector to the next incoming trunk or group.

3.07 The circuit is arranged to regulate the number of multiple groups of incoming selectors tested, this being done by means of cross-connections to an arc on the (DC) switch, these cross-connections being made so that when the overflow terminal at the end of a test group is reached, the test circuit will automatically return the district or office selector to normal and start a test on the next group of incoming selectors.

3.08 It is arranged to apply an operate test to the (L) relay of the incoming selector.

3.09 It is arranged to apply a service test to the (A) relay of the incoming selector.

3.10 It is arranged so that different loop relays may be cross-connected through arcs of the directing selectors to give the approximate current for the current flow test over the variable cable loops.

3.11 It is arranged so that a condenser may be connected across the tip and ring lead for a release test of local, incoming selector (L) relays.

3.12 By the operation of the (BC) key in conjunction with the (GN-IB) and the (OC-IG) keys a brush continuity test of all brushes of the incoming selector is made in any group of the incoming frame multiple.

3.13 A trunk guard test is made before and after making a test.

3.14 This circuit will automatically function with final multiple test line circuits arranged with or without synchronizing pulses.

3.15 A test is made for momentary opens in the fundamental leads after selections which would cause a premature release of a two wire office selector in service.

3.16 The (REP-1) key when operated causes a single repeat test to be made and cancels the two TG tests between the two tests on each incoming. It is for the purpose of detecting sticking (A) relays.

3.17 The operation of the (ST) key starts the automatic test which continues until all incoming selectors 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 (ST) key at any time stops the test at the end of the test under way. However, routine testing cannot be continued without restoring the circuit to normal by use of the (RN) key and reaching the desired incoming by use of the (PC) key.

3.18 The operation of the (RN) key causes the directing selectors to return to normal after it has caused the connector control switch to return to normal.

3.19 The (CA) key is operated when either 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 and the district elevator unless the (REP) key is operated. The circuit does not resume testing until the key is restored to normal.

3.20 The operation of the (REP) key causes the test circuit to repeat the tests upon a selector until the key is restored.

3.21 The operation of the (APB) key causes the test circuit to pass all terminals that are busy,

3.22 The operation of the (MPB) key steps the district or office 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.

3.23 The (NO CAP) key when normal connects the artificial cable to the TT and TR leads when Fig. 3 and "G" wiring are used. When "F" wiring is used it connects a .3 MF condenser across the fundamental. When operated it removes the artificial cable and substitutes resistance only.

3.24 The (CP) key when operated causes the test circuit to make a polarity and continuity test, operate the (CT) meter and advance the test district selector or office selector to the next incoming selector.

3.25 The operation of the (PC) key, in conjunction with the other keys as enumerated below, causes the apparatus to make a test upon a particular group of incoming circuits. The particular test does proceed until the key is released. For the purpose of testing a particular group or groups, this circuit is provided with units (U) key, 0 to 9 inclusive; a tens (T) key, which adds the first digit to the (U) key in case of two digit numbers; one or more twenty, (TWA), (TWB), (TWC), (TWD), etc., keys, each of which controls a particular directing selector; a set group number (GN) keys, 0 to 9 inclusive, to guide the district elevator to the particular group to be tested and a set of overflow count keys, 0 to 9 inclusive to control the numbers of multiple groups of incoming selectors to be tested.

3.26 The remote control jack, in connection with the 32A test set is to make it possible to watch the functioning of the selector under test at the time the (CA) key is operated.

3.27 The listening jack (L1) is used for the purpose of receiving tone indications from the final multiple test line circuit, in the event of failure.

3.28 The (EC) lamp lights when all incoming selectors have been tested.

3.29 The (BY) lamp lights when a busy district, office or incoming selector is encountered, holding the automatic test circuit for a period whose duration will permit the busy alarm signal to be operated.

3.30 The (CP) lamp lights when the polarity of trunk is wrong or the continuity of the trunk has failed.

3.31 The (BY) key when operated causes the incoming under test and the final it seizes to connect with a busy line in the final multiple. It is used for making rapid tests of the functions of the incoming selectors other than the supervisory and tripping functions.

3.32 The (TBL) switch starts counting time when a test is started and allows sufficient time for an O.K. test to be completed.

3.33 The TBL register records the number of troubles encountered.

3.34 The (TBL) lamp gives a visual indication of a trouble and is associated with anaudible alarm circuit.

3.35 The (TA) key when operated will cause the (TBL) switch to restore, will prevent it from being moved off normal and will prevent the test circuit from advancing progressively to other final selectors.

3.36 The (BY) switch starts counting time when the test circuit is started and when each test call is started and allows sufficient time for an incoming selector to become idle and an (O.K.) call to be completed.

3.37 The (CT) register records the number of circuits tested.

3.38 The (RST) register records the number of repeat tests made.

3.39 Associated with cross connection terminals are one or more 206 type selectors known as directing selectors. These selectors serve, first, to control the brush and group selections of the district or office selector used for connecting purposes; second, they also determine which district or office selector will be used for connecting purposes; third, to determine the point at which the test selector is restored to normal; and fourth; to supply connections for changing the trunk loop in order to make an operate test of the (L) relay. The number of directing selectors required depends upon the number of district or office selectors used for connecting purposes and the number of times they must be directed to a group of incoming selectors.

3.40 The connector control switch controls the districtor office selectors, directing them to the proper group of incoming selector terminals and restoring them to normal after tests have been made. It is a two cycle switch, that is, the second half of the revolution serves the same purpose that the first half of the revolution does.

3.41 The test sequence switch controls the selectors of the incoming and final selectors and controls the test conditions imposed on the selector.

3.42 The connector sequence switch is used to connect the different district or office test selectors to the test circuit, one switch serving to connect three district or office selectors to the test circuit. The leads to the different selectors are indicated by the numerals 1, 2, 3. Where more than three district selectors are required for testing purposes, two or more sequence switches are used. Only one district or office selector is connected to the test circuit at any time.

3.43 In a panel office, subscriber nonlink district or office selectors used for regular service are made busy to regular service when required for testing purposes. The necessary control wires are connected to the test circuit so that the selector may be directed to any group of terminals in order to gain access to the incoming selectors. Link type district selectors must be permanently removed from service. Two wire office of district selectors not used in service are assigned for this purpose. They are connected to the test circuit, however, in the same manner.

3.44 When the APB key is normal the circuit will detect and by-pass unequipped terminals.

4. CONNECTING CIRCUITS

4.1 This circuit is to be used with all types of districts and office selectors for the purpose of connecting to the incoming selectors which are to be tested.

4.2 This circuit is also used with the office alarm circuit.

4.3 Timing Test Set Circuit - SD-21984-01.

5. DESCRIPTION OF OPERATION

5.1 Routine Test

An automatic test is started upon all incoming selectors with the operation of the (ST) key. The (ST) key operated, closes a circuit from ground through the (V) cam of all the connectors (if all connectors are normal) to the (ST) relay which operates. The (ST) relay operated, energizes the (D-A) magnet from ground through the (TW) key normal, "N" terminal and brush 1 of the (D-A) switch contacts of the (TRA) relay (when used) to the (D-A) selector magnet. Ground is also connected through the operated (ST) relay and cam (J) to the winding of the (T) relay, but the (T) relay does not operate on account of ground being connected to the other side of the winding through brush 1 of the D-A switch. The energized selector magnet opens its operating circuit and releases, stepping the brush assembly of the D-A switch to terminal 1. If this terminal is wired for an incoming test, ground is removed from one side of the (T) relay, causing it to operate. The selector magnet does not operate in series with the (T) relay on account of the high resistance of the relay. When a terminal of a (D) switch is not wired for a test, ground is connected to that terminal on arc 1, causing the associated selector magnet to energize and move the brush assembly to the next terminal. The operation of the (T) relay closes a circuit operating the (CON) relay, which locks. The operation of the (CON) relay, operates the (RN) relay, which advances the (R1A) switch to position 2 from ground on the (RN1) relay through the (ST) keys brush 6 and terminal 1 of the DA switch, cross-connection of the terminal strip 6, cam (W) of the last connector switch in the equipment of the circuit, cam (B) on connector switch (R1A) to battery through the (R1A) magnet.

Note: When more than one connector is required to test all the incoming selector circuits in an exchange, each succeeding connector cannot be moved out of normal until the preceding connector used has been restored to its normal position. For instance, if it is assumed that the second connector shown on the schematic is the last of a series of connector units, a 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 connector preceding the one required for the test, is from ground on the (RN1) relay, (ST) key operated, brush 6 and some terminal of a (D) switch unit, cross-connection of the associated terminal strip 6, lower inner and upper outer contacts of cam (W) of the last connector unit used, lower inner contact of the cam (C) of the connector, to battery through the "R" magnet of the connector advancing the connector unit to position 1 or 10. If one of the connector units does not return to normal, the circuit ceases to function and operates the alarm as hereinafter described.

5.2 Busy Test of Line Switch District Selector

As the sequence switch of the connector #1 is advancing from position 1 to position 2, a circuit is closed through the contacts of cam A, winding of the (PG) relay, contacts of cam (U), to battery operating the (PG) relay in parallel with the "R" magnet. In position 2 the (TD1) relay operates from battery thru its windings, (S) cam, cross-connection terminal BLK-6-X term. #1 of arc #6 of (DA) selector brush #6, make contact (ST) key, normal contact of (RN1) relay to ground. With the (R1A) switch in position 2, the operating circuit for the (PG) relay is opened, releasing the relay and closing a circuit from ground through the 18BJ resistance, winding of the (SLO) relay, contacts of cam (W2), (PG), (TD1) and (T) relays to battery operating the (SLO) relay. The operation of the (SLO) relay connects battery to the 800 ohm winding of the (TLS) relay which operates. The (SLO) relay is slow to release to insure the operation of the (TLS) relay before the (SLO) relay is released by the switch advancing to position 2. The operation of the (TLS) relay connects ground on the (ST) key operated to the (R2) magnet, advancing the (R2) switch to position 2 and lights the busy district (BD) lamp. With the (R1A) and (R2) switches in position 2, the district selector circuit assigned for test purposes is tested by the automatic test circuit to find whether it is idle or busy. If the district selector circuit is engaged in regular traffic, the (TJ1) and (TK1) leads must be kept closed to prevent the discharge of the district prior to the completion of the regular service call. When the (R1A) switch is in a normal position, the closure between the "TJ1" and "TK1" leads is through the outer contacts of cam (R2). With the (R1A) and (R2) switches in position 2, the closure between the "TK1" and "TJ1" leads is through the make contact of the (TLS) relay and break contacts of the (TLF) relay. As long as the district selector circuit is busy, the (TLS) relay is held operated from ground supplied over the "TK1" lead, cam (N1A) and 1200 ohm winding of the (TLS) relay, contacts of cams (K) and (W2) (PG) relay normal (TD1) relay operated to battery through the make contact of the (T) relay. If the district selector remains busy for an undue length of time, the time alarm circuit functions as hereinafter described when it may be advanced to the next district. In order to advance to the next district the circuit should be restored to normal by the use of the (RN) key. The particular circuit feature should then be used and functions as hereinafter described. When the district selector circuit becomes idle, or if idle when tested, ground is removed from the "TK1" lead, releasing the (TLS) relay, provided the district elevator has returned to normal. If the district elevator has not returned to normal, the (TLS) relay is held operated through its 800 ohm winding from battery on the make contact of the (T) relay under control of the (BOS) relay. When the district elevator returns to normal the (BOS) relay operates from battery on the make contact of the (T) relay to ground on the (Y) commutator in the district selector circuit. The (BOS) relay operated, releases the (TLS) relay. This feature is to prevent the seizure of a local office selector circuit during the unguarded period on a local office selector circuit when it is released by the district. The release of the (TLS) relay closes a circuit from ground at the operated (ST) key through its contact cam (C), to the (R2) magnet, advancing the switch to position 3, and also closes a circuit from ground through cam (H), (TLS) and (TLF) relays normal, cam (O1A), over the "TJ1" lead, causing the particular district circuit to test busy to all other hunting line switches. With the (R2) switch in position 3 the (RS2) relay will operate and advance the (R2) switch to position 4.

5.3 Setting District Control Switch

With the (R2) switch in position 3, a circuit is closed from ground through contacts of cam (E) to battery under control of the (ST) key, through the break contact and winding of the (DC) selector magnet, and 44A resistance operating magnet. The operation of the magnet opens its operating circuit causing it to release and step the brush assembly of the (DC) switch to terminal 1 or other odd number terminal, depending upon the cross-connection of terminal strip 5.

5.4 Busy Test of Line Finder District Selector

When testing a line finder type of district selector for a busy condition, the (SLO) and (TLS) relays operate exactly as described in par. 5.2. If the line finder district is idle ground will be disconnected from the "TH1" lead and with the (R2) switch in position 1, a circuit is closed from ground through the winding of the (TLF1) relay, contacts of cam (Y1), over lead "TH1" to battery through a winding of a relay in the line finder circuit, operating the (TLF1) relay. The (TLF1) relay operated, closes a circuit through the inner winding of the (TLF) relay which operates and locks through its outer winding under control of the (TLS) relay to ground on the (ST) key. As the (R2) switch enters position 2, the (TLF1) relay is shunted by ground through the lower contacts of cam (E), releasing the relay. In position 2, the (TLS) relay is held operated, from battery, (T) and (TD1) relays operated, (PG) relay normal, cam (K2), 1200 ohm winding and make contact of the (TLS) relay, cam (N1A) 300 ohm resistances to ground on a relay in the district over the "TK1" lead, providing the district selector is busy. The (MB) relay of the district is held operated from ground on cam (E), over the "TH1" lead. When the district becomes idle or if idle when tested, the (E) relay in the district circuit releases, opening the circuit through the 1200 ohm winding of the (TLS) relay, but the (TLS) relay does not release as it is held on a circuit from ground, its 800 ohm winding (BOS) relay normal, cam (K2), (PG) relay normal, (TD1) and (T) relays operated to battery. When the district selector reaches its normal position, ground from the (Y) commutator is connected to the "TY1" lead, cam (G1A) winding of the (BOS) relay, (PG) relay normal, ("AA" wiring), (TD1) and (T) relays operated to battery operating the (BOS) relay. Where "AB" wiring is used, the (BOS) relay circuit is not carried thru the normal contacts of relay (PG). The (BOS) relay operated, releases the (TLS) relay. The (TLS) relay released, releases the (TLF) relay and advances the switch to position 2. Ground is connected to the line finder district selector holding it busy over the same circuit as described for the Line Switch District Selector. With the scheme of cross-connection shown on the drawing and with the brush assembly of the D-A switch resting on terminal 1, group 0 to 8 inclusive in the first frame are tested. The (DC) selector continues to step until the winding of the selector magnet is short-circuited by ground over one of the leads connected to arc 2 of the (DC) switch. As determined by the cross-connection of the (DA) switch and terminal strip 5, the (DC) selector magnet is shunted when its brush assembly rests on terminal 3. This circuit is from ground through the break contact of the (PG) key, brush 5 and terminal 1 of the (DA) switch, cross-connection of terminal strip 5, over lead 9 to terminal 3 and brush 2 of the (DC) switch, contacts of cam (O), battery through the 44A resistance. The position of the (DC) switch determines the number of overflow terminals the district elevator must pass by before it is restored to normal. With the setting just made, the district elevator returns to normal when the elevator brushes have stepped to the ninth set of overflow terminals. Also with the (R2) switch in position 3, the (RS2) relay operates from ground on cam (G2). The operation of the

(RS2) relay closes a circuit operating the (TI) relay and advances the (R2) switch to position 4. The (TI) relay operates in turn operating the (TI1) relay, from ground on the (ZC) relay. The (TI) and (TI1) relays operated, perform no useful function at this time.

5.5 District Brush Selection

The district brush selection is determined by the cross-connection of terminal strip 3. When the scheme used in the schematic and with the DA switch resting on terminal 1, the O brush on the first district elevator is selected. In position 4 of the (R2) switch, a circuit is closed from ground through cam (H2) and cam (C1A), advancing the (R1A) switch to position 3. In position 3 of the (R1A) switch, connector #1 is connected through the cuttings of its cams to the district elevator and circuit is closed from ground on the contact of the (O') relay, over lead "TU1", to battery through the "UP" magnet in the district selector circuit. As the district elevator moves up under control of the "UP" magnet, the circuit through the (BOS) relay is opened at the district (Y) commutator, releasing the relay and ground is connected through the (A) commutator brush and segment, over lead "TA1" cam (N2), brush 3 and terminal 1 of the DA switch, the (O) relay operating the relay. The operation of the (O) relay connects its windings in series with the winding of the (O') relay, but this relay does not operate on account of being shunted at this time by ground. When the brush on the district elevator makes contact with an insulated segment on the (A) commutator bar, ground is removed from one side of the (O') counting relay, allowing it to operate. The (O') relay operated advances the (R2) switch to position 5 and disconnects ground from the "TU1" lead, stopping the upward movement of the district selector. When the (R2) switch advances out of position 4-1/4 the operating circuits for the (O') and (O) relays are opened at cam (U), releasing the relays. As the (R2) switch advances out of position 4, the "TU1" lead is opened at cam (D), preventing the "UP" magnet in the district selector circuit from operating to ground on the break contact of the (O') relay. In position 5 of the (R2) switch, the district selector trip magnet is energized from ground on cam (F2) through cam (I1A), over the "TM1" lead, and the (R2) switch is advanced to position 6 from ground, (O') relay normal, cam (Q), (RS2) relay operated, and cam (D2).

5.6 District Group Selection

In position 6, the district "UP" magnet is reenergized, ground on the (O') relay normal cam (Q2), (RS-2) relay operated, cam (D-2), cam (J-1A), over the "TU-1" lead, to battery through the "UP" magnet moving the selector upward for group selection. As the district elevator moves upward under control of the "UP" magnet ground is connected to the "TB-1" lead through cam (L-1A), cam (M-2), (PC) key normal, brush 4 and terminal 1 of the (D-A) switch, cross-connection of terminal strip 4, lead "O", to the (O) relay operating the relay. The (O) relay operated, connects its winding in series with the winding of the (O') relay, which operates when the (B) brush of the district elevator makes contact with an insulated segment of the commutator. The (O') relay operated (a) opens circuit through the "UP" magnet in the district selector circuit, stopping the upward movement of the elevator, and (b) advances the (R-2) switch to position 7. As the switch advances out of position 6-1/4, the holding circuit for the (O) and (O') relays is opened at cam (U), releasing the relays.

5.7 Incoming Busy Test

When the (R-2) switch advances out of position 6, the (RS-2) and (T) relays release. The release of the (RS-2) relay opens the holding circuit of the (TI) relay through its 1000 ohm primary winding. When the incoming selector circuit is busy, the (TI) relay is now held operated from battery through its 800 ohm secondary winding and make contact over the "TS-1" lead to ground on the sleeve terminal of the busy incoming selector circuit. When Figure "B" is used the (TI) relay is held operated from battery thru its 1000 ohm secondary winding and make contact through normal contacts of the (PC) relay and "K" wiring of (SG) relay when "K" wiring is used over the "TSI" lead to ground on the sleeve terminal of the busy incoming selector circuit. The (BI) lamp also lights to ground over the "TS-1" lead. If the incoming circuit is idle, or becomes idle, the holding circuit for the (TI) relay is opened upon the release of the (RS-2) relay, releasing the (TI) relay. Also the (BI) lamp is extinguished. The release of the (TI) relay opens the holding circuit of the (TI-1) relay to ground on the armature of the (ZC) relay but the (TI-1) relay is still held operated through its make contact normal contact of (RS-3) relay and to ground on cam (G-2). The release of the (TI) relay operates the (TR) relay from ground on (ZC) relay normal contact brush 5 and terminal 3 of the (DC) switch, (TI) relay normal, (TI-1) relay operated, the (MPB) key normal, to the (TR) relay. The operation of the (TR) relay connects the (TT) and (TR) leads through its make contacts to the test circuit, advances the (R-3) switch to position 2 (when Figure A is used) and (if Figure B is used) disconnects the busy alarm circuit and connects the trouble alarm circuit which starts to count time as hereinafter described. The incoming circuit is held busy to other hunting district selectors by ground on cam (E-2) (TI) and (REP) relays normal and lower contacts of cam (D-1A), over the "TS-1" lead.

5.8 When Figure B is used, the operation of the (TR) relay closes a circuit for operating the (TR1) relay, opens the operating circuit to the (BY) relay in the same manner as described above and at the same time opens the circuit to the (TD) relay, causing its release. The (TD) relay is of the slow release type so as to delay the closure of the tip and ring to an incoming selector which has just become idle to the test circuit. During this slow release period the incoming is required to open the tip and ring permitting the incoming (A) relay to release before the tip and ring of the test circuit is closed. The incoming circuit is held busy to other hunting district selectors by ground on cam (E-2), normal contacts of (TI) and (PC) relays and "K" option of (SG) relay to the sleeve lead. When "Q" option or "Q" and "AH" option is used and (CP) key is operated, the operating of (TR) relay, causes the (CP) lamp to light, and go out, see par. 5.52.

5.9 First "TG" Test, Fig. B

If the incoming selector to which the district or office connector is connected is not busy the (TI) relay of the connector control part of the test circuit will release closing ground to the (TR) relay which will operate. With the (TR) relay operated a "TG" test is made to determine if the incoming selected for test is normal. This is accomplished as follows:

5.91 "F" option. With the incoming in normal position, battery is connected to the tip lead, (F-1A) cam of test circuit, make contact of the (TR) relay, back contact of the (TD) and (CA) relays, (T-3) cam, back contact of the (TC-3) relay, through 900 ohm part of the #19-CG resistance, 1700 ohm 18-DS and 3100 ohm 18-DU resistances, windings of the (TG) and (STP-1) relays, (S-3) cam, back contact of (BO') relay, winding of the (STP) relay to the feeder terminal of arc "B" of the directing selector cross-connection block, thru compensating resistance which is regulated in accordance with the external loop (R-3) cam, make contact of the (TR) relay. (TR) lead, (E-1A) cam, ring of the incoming selector under test to ground.

5.10 The (TG) relay operated operates the (TG1) relay. The (TG1) relay closes the circuit from ground on cam (Y-3) and operates the (TG-2) relay. The (TG-1) and (TG-2) relays operated connect ground to the 160-F type interrupter which when closed operates the No. 9 counting relay. The interrupter when on its open period permits the No. 9 counting relay to operate and when closed again allows No. 8 counting relay to operate. This action continues until the (5') counting relay operates.

With the (5') counting relay operated on the next closure of the interrupter, the operating ground for the 9, 8, 7, 6 and 5 pairs of counting relays is connected to the (R-2) cam and (N-3) cam thru the winding of the (TG-4) relay which operates and locks to ground on the make contact of the (TR-1) relay. The (TG-4) relay operated advances the (R-3) sequence switch into position 2. If during the period the test circuit is counting time with the counting relays as described above, the incoming (L) relay operates on the "TG" test, the incoming will advance to position 2 where the "up-drive" magnet will be energized driving the associated selector to tell-tale. The incoming "X" commutator will then advance the incoming sequence switch to a position where the "down-drive" magnet will be energized. During the above sequence of operation the (TG) relay in the test circuit will release due to the tip and ring being opened and in turn permit the (TG-1) relay to release. The (TG-1) relay releasing removes the ground which was shunting the (TG-3) relay permitting its operation. The (TG-3) relay operating opens the tip and ring circuit to the incoming. The (TG-1) relay releasing opens the circuit to the counting relay leaving the test circuit blocked in position 1. By operating and releasing the (CA) key the (R-3) sequence switch will move from position 1 as described in paragraph 5.40.

5.11 First "TG" Test Using Figure 3 and "G" Option

The "TG" test in position 1 of the (R-3) sequence switch is made in the same manner as described above with the exception that the Figure 3 and "G" wiring is used instead of "F" wiring.

5.12 Incoming Brush Selection

In position 2 of the (R-3) switch, the brush which is designated to test the incoming multiple for a final selector circuit is selected. When Fig. "A" is used, the (STP) relay operates from battery through a winding of the line relay in the incoming circuit, over the "TT-1" lead, (TR) relay operated, (CA) relay normal, cam (T-3) winding of the (STP-1) relay, cam (S), (BO') relay normal, winding of the (STP) relay, brush 2 and terminal 1 of the (D-A) switch, cross-connection of terminal strip 2, over lead "3", two 18-AF resistances, cam R-3, make contact of the (TR) relay, over the "TR-1" lead to ground on the ring of the incoming circuit. The polarized (STP-1) relay does not operate at this time. When Figure 3 and "G" wiring are used the artificial cable network is used in the fundamental circuit with the (No Cap) key normal.

5.121 As the incoming elevator moves upward, intermittent ground is connected through the "A" commutator brush and segment in the incoming circuit over the "TT-1" lead, successively short-circuiting the (STP) relay, thus releasing and permitting its reoperation until the proper brush has been selected. For test purposes, brush 4 and group 3 have been assigned requiring five and four pulses, respectively, to satisfy the test circuit. With the (R-3) switch in position 2, a circuit is closed from ground on cam (G-3), (STP) relay operated, cam (F), outer contacts of cam (E), break contact of the (4') counting relay when "D" option is used, or normal contact of (BC) key when "E" option is used, winding of the (4) counting relay, cam (J) to battery on cam (I), operating the (4) counting relay. The operation of the (4) counting relay connects its winding in series with the (4') counting relay, which operates when the "A" commutator brush of the incoming selector makes contact with a grounded segment of the (A) commutator. When this occurs, the (STP) relay releases, removing ground from one side of the (4') counting relay, allowing it to operate and lock through the make contact of (4) counting relay to ground. The operation of the (4') counting relay transfers the pulsing circuit to the (3) counting relay through the make contact of the (4') relay and break contact of the (3') counting relay, causing the (3) counting relay to operate. Upon the next pulse transmitted by the "A" commutator brush and segment, the (3') counting relay operates and locks to ground through the make contact of the (3) counting relay. In a similar manner, the other two sets of counting relays operate and lock. Upon receipt of the fifth and last pulse from the (A) commutator in the incoming circuit, both the (FO') and (BO') relays operate and lock to ground in parallel with each other and in series with the (SO) relay through the make contact of the (SO) relay. The operation of the (BO') relay opens the fundamental circuit, releasing the line relay in the incoming circuit. The operation of the (FO') relay closes a circuit, advancing the (R-3) switch to position 3. As the switch advances out of positon 2 1/4, all the counting relays and the (FO') and (BO') relays release. The release of the (FO') relay advances the switch to position 4.

5.13 Incoming Group Selection

In position 4 of the (R-3) switch, group 3 is selected in a manner similar to brush selection, a circuit being closed from ground cam (F) through the (STP) relay operated, to the winding of the (3) counting relay, operating the relay. When the first pulse is transmitted by the "B" commutator brush and segment in the incoming selector circuit over the "TT-1" lead, the (3') counting relay operates and transfers the pulsing circuit to the winding of the (2) counting relay. With each successive impulse, a pair of counting relays operate and lock, until after the third pulse, the circuit is closed through the make contact of the (1') counting relay, lower contacts of cam (K) winding of the (SO) counting relay, to battery through cam (I). Upon receipt of the fourth pulse, the (BO') and (FO') relays operate. The operation of the (BO') relay opens the fundamental circuit, releasing the line relay of the incoming circuit. The operation of the (FO') relay advances the (R-3) switch to position 5. As the switch advances out of position 4-1/4, all the counting relays and the (FO') relay and (BO') relay release. The release of the (FO') relay advances the switch to position 6.

5.14 Selection Beyond

The incoming selector goes trunk hunting while the test circuit waits in position 6 of the (R-3) switch. When a final trunk has been selected, the test circuit makes final brush selection in a manner similar to incoming brush selection, selecting final brush (4). Upon the operation and release of the (FO') relay, the circuit advances to position 8. In position 8, final tens selection is made in a manner similar to incoming group selection. Tens group 9 is selected requiring the use of all the counting relays. Upon the operation and release of the (FO') relay, the (R-3) switch advances to position 10 for final units selection. Final units selection is made in a manner similar to the other selections selecting the set of terminals which requires the use of four sets of counting relays. The equivalent number selected is 9992. The operation and release of the (FO') relay advances the (R-3) switch to position 12. In position 12, 48 volt battery is connected to the ring through a winding of the line relay in the incoming circuit over the "TR-1" lead, contacts of cam (N-1A), (TR) relay, cam (R), two 18-AF resistances, when "F" wiring is used, lead "3", cross-connection of terminal strip 2, terminal 1 and brush 2 of the (D-A) switch, winding of the (STP) relay, break contact of the (BO') relay, contacts of cam (S), winding of the (STP-1) relay, contacts of cam (T), (CA) relay, (TR) relay, cam (F-1A) over the "TT-1" to ground in the incoming selector circuit, operating both the (STP) relay and the polarized (STP-1) relay. When Figure 3 and "G" wiring are used the fundamental circuit described above is carried thru the contacts of a particular (C) relay for compensating resistance and capacity arrangement or thru the resistance units. The operation of the (STP) and (STP-1) relays closes a circuit from ground cam (F), make contact of the (STP) relay, cam (M), make contact of the (STP-1) relay, cam (O), to battery on cam (I), through the winding of the (SO) relay, which operates. As the incoming sequence switch leaves this position, the (STP) relay and the (STP-1) relay release, permitting the (FO') and (BO') relays to operate. The operation of the (FO') relay advances the (R-3) switch to position 13. When the switch advances out of position 12-1/4, the operating circuit of the (SO), (BO') and (FO') relays is opened, releasing the relays. The release of the (FO') relay advances the switch to position 14.

5.15 Test For Trunk Closure

In position 14, a circuit is established from battery through one winding of an "A" relay in the incoming circuit, over the tip of the incoming circuit, "TT-1" lead, contacts of cam (F-1A), (TR) relay, (CA) relay, (TD) relay only when Figure B is used, cams (T) and (S), winding of the (STP-1) relay, thru 580 ohm resistance contacts of cam (R), (TR) relay of cam (E-1A), over the "TR-1" lead, and ring of the incoming selector circuit to ground (through the other winding of the relay) in the incoming circuit operating the (STP-1) relay. The operation of the (STP-1) relay connects ground through cam (M), contact of the (STP-1) relay, cam O to the windings of the (FO') and (BO') relays in parallel with each other and in series with the winding of the (SO) relay to battery on cam (I), operating the (FO'), (BO') and (SO) relays. The operation of the (BO') relay performs no useful function. The operation of the (FO') relay advances the switch to position 15. When the switch advances out of position 14-1/4, the (FO'), (BO') and (SO) relays are released. As the sequence switch advances from position 14-1/4 to 14-1/2 the current through the (STP-1) relay is reversed through cam (T3-2).

The release of the (FO') relay advances the switch to position 16. The test circuit awaits in position 16 until the test of the incoming circuit has been completed by the auxiliary test circuit (not shown) connected to the final multiple. When the auxiliary test circuit is prepared to test upon the supervisory relay in the incoming circuit, the counting relays in this test circuit are ready to take the six O.K. pulses.

5.151 With Figure "B" and two-wire incoming selectors to be tested, when the (R3) switch reaches position 13 the (MO2) relay operates opening the short-circuit from around the winding of the (TWS) relay. Battery from the incoming selector operates the (TWS) relay which in turn operates the (MO) relay. The operation of the (MO) relay closes the advancing path from position 14 which checks that the (MO2), (TWS) and (MO) relays have functioned as intended. Should the "TT" or "FT" leads be opened momentarily due to trouble in the incoming selector the (TWS) relay will release operating the (MO1) relay and blocking the (R3) switch in position 16. If no momentary open is encountered the (R3) switch will leave position 16 in the usual manner by OK pulses from the final multiple test line, the (TWS) relay releasing as the (R3) switch leaves position 16. The release of the (TWS) operates the (MO1) relay closing the advancing path from position 17 to check that the (MO1) relay is capable of operating. When three wire incoming selectors are to be tested the (LI) relay will be connected at the directing selectors and it will operate cancelling the above operations and cause the (R3) switch to advance from pos. 14.

5.16 Supervisory Relay Test - Fig. A

As the supervisory relay of the incoming circuit is operated, and released under control of the auxiliary test circuit connected to the final multiple, a circuit is closed from battery supplied over the ring of the incoming selector and the (TR1) lead contacts of cam (E-1A), (TR) relay, cam (R) thru compensating resistances, (STP) relay, (BO) contact, the #18-BT resistance (STP-1) relay secondary winding, cam S3-3, (STP-1) relay primary winding, (T) cam, (CA) relay and (TD) relay contacts only when Figure "B" is used, (TR) relay contacts tip of the incoming selector to ground. The (STP-1) relay operates. The operation of the (STP-1) relay closes a circuit from ground through cam (M), make contact of (STP-1) relay to the (SA) relay winding. This relay operating closes ground to the number (4') counting relay, winding of the (4) counting relay to battery on cam I operating the (4) counting relay. The operation of the (4) counting relay connects its winding in series with the winding of the (4') counting relay which operates upon the release of the (STP-1) and (SA) relays due to the release of the supervisory relay in the incoming selector circuit. With each operation and release of the supervisory relay on the incoming circuit the pair of counting relays operate and lock to ground. The (4) (4') counting relays are operated during the time the tripping test is applied on the incoming selector under test. The (3) and (3') counting relays are operated d ring the soak current applied to the incoming supervisory relay. As soon as the (3') counting relay operates a parallel circuit is closed to the (ARC) relay through a 16 cutting of the (L-3) cam which operates the (ARC) relay. The (ARC) relay operated closes a .53 make and a .53 break interrupter circuit to the #9 counting relay so that during the time (OK) pulses are being received, the test circuit counts down time. If the incoming (A) relay satisfactorily operates to reverse the current to the (STP-1) relay in the test circuit a sufficient number of times the (BO') and (FO') relays will operate and advance the test sequence switch beyond position 16 whereby the counting relays and (ARC) relay will release and opens the interrupter circuit to the #9 counting relay. In the event that the (A) relay in the associated incoming under test fails to operate during the time the supervisory relay is being tested the particular incoming will advance to normal. The (ARC) relay being operated closes the interrupter circuit to the #9 counting relay and upon the operation of the (5') counting relay at the next closure of the interrupter the (OFL) and (OFL-1) relays operate which applies the short circuit around the two 18-BG resistances and the secondary winding of the (STP-1) relay permitting the incoming (L) relay to operate and advances off normal to "Tell-Tale" due to the tip and ring being held closed by the test circuit. The incoming will therefore ride to "Tell-Tale" and back again and in passing position 9 of the sequence switch, the reversed battery is received which operates the (STP-1) relay. The incoming selector will continue to ride to "Tell-Tale" until sufficient pulses have been received and during the last reversal in current of the incoming in position 9 the (FO) and (BO) relays operate which opens the tip and ring causing the incoming to remain inoperative in position 10 (trunk closures). With the (R-3) sequence switch in position 16, the time alarm signal given by the test circuit will be received. In order to advance the test circuit for resuming the test again, the (CA) key should be operated. This key closes the tip and ring again through a make contact and (OFL) relay contact to operate the (A) relay in the incoming and advance the sequence switch out of (trunk closure) position to normal.

If the repeat key is operated a circuit is closed from ground on (CA) key, make contact of (ARC) relay, 16 cuttings of (P-3) cam, (REP) relay to (B) cam advancing the (R-3) sequence switch beyond position 16. The tip and ring closure is transferred through "SS-2" "R-3" in order to permit sufficient time for the incoming (A) relay to operate. The (R-3) switch is moved out of position 1 by the release of the (CA) key. If it is not desired to make a repeat test on this incoming, the operation of the (CA) key places a ground through the (ARC) relay, 16 cuttings on cam (P-3), back contact of (EP) relay, back contact of (MPB) relay, to (RS-3) relay to battery on cam "SS4-V-2" sequence switch. The operation of the (RS-3) relay advances the district elevator to the next incoming as hereinafter described, advances the (R-3) sequence switch out of position 16 into position 1, where the (CA) key should be normal in order to move the (R-3) sequence switch into position 2. Assuming no failure had occurred during supervisory relay test position 16, the operation of the (FO) relay closes a circuit from ground on the (CA) key normal, back contact of (OFL-1) relay through make contact of (OF) relay (P) cam, (REP) relay, (MPB) relay, through winding of (RS-3) to cam (V) of sequence switch to battery. The (RS-3) relay operated (a) locks to ground on its armature under control of (RS-4) relay (b) operates the (RS-2) relay from ground in the cam (G), and (c) advances the (R-3) sequence switch to position 17 from ground on its armature, cam (B-3), to the (R-3) magnet. As the switch advances out of position 16-1/4, the counting relays and the (SO), (BO) and (FO) relays release. The (R-3) sequence switch advances to position 1 from ground through the make contact of the (ST) key, cam (B), to the (R-3) magnet. As the (R-3) sequence switch passes through position 17 and 18 a circuit is closed through contacts of cam (H) to battery through winding of the (ST) message register and (18-AC) resistances "AA" wiring. The message register operates and records the number of successful tests.

5.17 Supervisory Relay Test Figure B

When figure "B" is used the following action takes place:

In position 16 of the (R-3) sequence switch incoming supervisory relay pulses are received in the same manner as described above. When six pulses have been received by the test circuit the (BO') and (FO') relays will operate. The (BO') relays in operating opens the tip and ring permitting the incoming selector (A) relay to release thus returning the incoming to normal. The (FO') relay operating connects ground through the (P-3) cam position 16 to the 160 type interrupter. Upon the operation of this interrupter the (TG-2) relay operates and locks to the same operating ground through the back contact of the (TR1) relay, back contacts of the (OFL-1) and (CA-3) relays to ground cam (Y3). The release of this interrupter permits the operation of the (TG-3) relay and upon the second operation of the interrupter, the (TG-4) relay operates and locks to the same ground holding the (TG2) and (TG3) relays locked. The (TG-4) relay operated advances the sequence switch to position 17. This time delay is necessary in order to allow the incoming selector under test to advance and remove the (A) relay circuit from the tip and ring before the test circuit reaches position 17 where a second "TG" test is made which is to determine whether the incoming selector under test has returned to normal.

5.18 Second "TG" Test Figure B

The (TG) relay is placed across the tip and ring over the same circuit as described in paragraphs 5.9 to 5.11 inclusive. If the incoming has returned to normal the battery from the (L) relay will be received from the tip of the incoming and ground will be received from the ring of the incoming. The (TG) relay will therefore operate and in turn operate the (TG-1) relay. Ground on the make contact of the (TG-1) relay operates the (RS-3) relay through cam (W-3), back contact of the (REP) relay, normal contact to the (TA) key "AA" option and back contact to the (MPB) relay. Where "AB" wiring is used, ground on the make contact of relay (TG1) causes the (CT) register to operate and it in turn causes the (RS3) relay to operate. The (CT) register records the number of circuits tested. The (RS-3) relay operated locks to ground on its armature under the control of the (RS-4) relay, (b) operates the (RS-2) relay from ground on cam G-2 and (c) advances the (R-3) sequence switch to position 18 from ground on its armature, cam (C-3) to (R-3) magnet. In position 18 ground from the (ST) key operated, advances the (R-3) sequence switch into position 1. In position 16/18 the (ST) meter is energized "AA" wiring and apparatus and records the test made. If the repeat key is operated a circuit is closed from ground on the make contact of the (TG-1) relay through the 17 cuttings of the (W-3) cam make contact of the (REP) relay to cam (C-3) "AA" and "AG" option advancing the (R-3) sequence switch to position 18. The (R-3) sequence switch advances to position 1 in the same manner as described above. With "K" option in position 16 of the (R-3) sequence switch when the (TG-2) relay operates as heretofore described a circuit is closed which energizes the (SG) relay from ground on cam (Y-3) through a make contact of the (TG-2) relay. The (SG) relay operating operates the (SG-1) relay which in turn causes relay (TI) to operate and opens the sleeve ground to the incoming under test. During the time the armature of this relay leaves the back contact and makes the front contact, the ground is removed from the sleeve of the particular incoming under test. This open interval is necessary in order to release the incoming (L) relay when testing local incoming selector circuits. The (L) relay released permits the incoming to advance to normal. The (R-3) sequence switch advances from positions 16 and 17 in the same manner as described above. As the (R3) sequence switch passes position 16 the (SG) relay releases and connects the secondary winding of relay (T1) to the sleeve thru its contact and back contact of relay (SG). Relay (SG1) is sufficiently slow enough in releasing to insure this path. If the sleeve is not busy or grounded, that is, if no district has seized the particular incoming being tested, the (TI) relay will release as soon as relay (SG1) releases. The release of the (TI) relay restores the busy ground to the incoming under test and closes a circuit for operating the (TR) relay which starts another test of the particular incoming. If during the unguarded period of the sleeve the incoming under test is selected by a district, the (TI) relay operating will lock to the sleeve ground from the district through break contacts of (MPB) and (APB) keys, through its own make contact through the contact of the (PO) relay, back contact of the (SG) relay to the sleeve. The (TI) relay operated prevents the (TR) relay from energizing which in turn prevents the (R-3) sequence switch from advancing out of position 1. The (BY) lamp will be received as an indication of a busy incoming. The (TI) relay in the condition described above will stay operated until the busy sleeve ground is removed by the disconnection of the district. When it is not desired to wait for a busy incoming to become idle in the condition noted above the repeat key should be released. The (MPB) key should be operated in order to advance the test circuit from this busy incoming. With the (REP) key normal and (REP) relay operated, relay (RS3) operates, "AB" option, thru make contacts of relays (PB) and (TD) and normal contact of relay (MPB). Relay (RS3) operating causes relay (RS2) to operate which in turn connects ground thru make contact of key (MPB) causing relay (MPB) to operate. The (MPB) relay operating opens the locking circuit of the (REP) relay causing its release and the (MPB) key operated, removes the shunt from the (PB) relay causing its operation.

The (RS-2) relay operating also connects ground to the primary winding of the (T1) relay. The (T1-1) relay whose holding circuit was opened by the operation of the (RS-3) relay is now held operated through the make contact of the (T1) relay to ground on the armature of the (ZC) relay. The function of these relays, as previously described under paragraph "INCOMING BUSY TEST" is to test the next incoming trunk for busy conditions. The district or office selector advances to the next trunk as described under paragraph "Advancing District or Office Selector".

5.19 Advancing District or Office Selector

In order to test the next trunk in the group of incoming circuits, the district elevator must advance one terminal. The (R-3) switch in position 1 closes a circuit from ground through the make contact of the (RS-3) relay, cam (L-3), contact of the (RS-1) relay, to battery through the inner winding of the (RS) relay and the outer winding of the (RS-1) relay, operating the (RS) relay. The (RS-1) relay does not receive sufficient current to operate at this time. The operation of the (RS) relay connects ground through the cam (Q-2) (RS-2) relay operated, cam (D-2), cam (J-1A), "TU-1" lead, to battery through the "UP" magnet in the district circuit, causing the elevator to move upward. As the district elevator moves upward, ground supplied through the "C" commutator brush and segment over lead "TC-1" cam (K-1A), cam (I-2), make contact of the (RS) relay to battery through the inner winding of the (RS-1) relay and outer winding of the (RS) relay, operates the (RS-1) relay, and holds the (RS) relay operated. When the "UP" magnet of the district elevator carries the "C" brush past the "C" commutator segment ground is removed from the "TC-1" lead, releasing the (RS) relay. The (RS-1) relay does not release, having locked through its outer winding, cam (L-3), to ground on the (RS-3) relay. The release of the (RS) relay operates the (RS-4) relay, which locks to ground on the (RS-3) relay. The operation of the (RS-4) relay opens the locking circuit of the (RS-3) relay, which releases. The release of the (RS-3) relay in turn releases the (RS-4), (RS-2) and (RS-1) relays. The release of the (RS-2) relay opens the holding circuit through the 1000 ohm winding of the (TI) relay, to test the incoming circuit for a busy condition. The routine test of the second incoming trunk in the group proceeds exactly like the first trunk in the group and upon receipt of four O.K. pulses, or a closure of (CP) and (CP-1) relays. When (CP) key is operated the district elevator advances to the next trunk in the group. This procedure is repeated until the overflow terminals of the first group are reached by the district elevator.

5.20 Overflow Pass By

As it is necessary to test the incoming trunks in the remaining groups of the district frame, the district elevator must pass by the overflow terminal to the first trunk in the next group. With the district elevator brushes resting upon the overflow terminals, ground through the Z commutator segment and brush, over lead "TA-1", cam (N-1A), brush 4 and terminal 3 of the (DC) switch, cam (P) (R-2), operates the (ZC) relay. The operation of the (ZC) relay connects ground through terminal 3 and brush 3 of the (DC) switch to the winding of the (DC) selector switch energizing the magnet which steps the brush assembly of the (DC) switch to terminal 4. With the (DC) brush assembly on terminal 4, the operating circuit of the (ZC) relay is opened, releasing the relay, which connects ground through cam (L), brush 1 and terminal 4 of the (DC) switch, (MPB) key and (MPB) relay, to the (RS-3) relay, which operates. The (RS-3) relay operated, locks on its own armature and also locks through its make contact to ground on the break contact of the (ZC) relay. The operation of the (RS-3) relay in turn operates the (RS-2) relay and closes a circuit operating the (RS) relay. The operation of the (RS) and (RS-2) relays operate the "UP" magnet of the district selector circuit, moving the district elevator upward to the first terminal of the next group in the same manner as the elevator was moved from one terminal to another terminal in the same group. Upon the operation of the (RS-1) relay and release of the (RS) relay, as previously described, the (RS-4) relay operates, connecting ground to the winding of the (DC) selector magnet stepping the brush assembly of the (DC) switch to terminal 5.

5.21 All the trunks in the second group are tested in exactly the same manner as the first trunk in the first group, and when the district elevator brushes rest upon the overflow terminals of the second group, the elevator is moved to the first terminal of the third group in the same manner as just described. At this time, the (DC) brush assembly is resting on terminal 7. This procedure is repeated until all the trunks in the nine consecutive groups have been tested. The brushes of the district elevator are then resting upon the overflow terminals of group 8 and the (DC) brush assembly is resting on terminal 19.

5.22 District or Office Elevator Returned to Normal

With the (DC) switch on terminal 19, the (ZC) relay operates from ground on the "Z" commutator segment and advances the (DC) brushes to terminal 20. At terminal 20, the (ZC) relay is released, closing a circuit to the R-2 magnet, which advances the R-2 switch to position 8. In position 8, ground through cams (F) (R-2) and cam H-1A is connected over the (TD-1) lead, to battery through the (DOWN) magnet in the district selector circuit, operating the magnet and restoring the district elevator to normal. When "E" wiring is used, ground on cam (F-2) is connected to the trip magnet, causing its operation. When the district elevator reaches normal, a circuit is closed from ground through the "Y" commutator brush and segment over the "TY-1" lead, contacts of cam (G-1A), cam (C-2) to the (R-2) magnet, advancing the switch to position 9.

5.23 When the sequence switch is passing through positions 8-3/4 to 9, ground through the contacts of the (ST) key, is connected through cam (S-2), to the winding of the (D-A) selector magnet, operating and releasing the magnet, stepping the (D-A) switch to the next terminal. With the R-2 switch in position 9, ground from the (ZC) relay is connected to the (R-2) magnet, advancing the (R-2) switch to position 10 and ground from cam (G) is connected through terminal 20 and brush 3 of the (DC) switch, the (DC) selector magnet advancing the (DC) switch to terminal 21. With the switch in position 10, a circuit is closed from ground on cam (G) and cam (C-3) to the (R-3) magnet, providing an additional means of returning the (R-3) switch to normal.

5.24 Advance of District Switch

If the terminal upon which the brush assembly of the (D-A) switch rests is wired for a test, the circuit functions as described for the first terminal of the (D-A) switch, until all the groups as determined by the cross-connection scheme for this terminal have been tested, whereupon the (D-A) magnet is again operated, moving the brush assembly of the (D-A) switch to the next terminal. When all the incoming selector circuits available to the first district elevator have been tested, the (R-1A) switch advances from position 3 to position 4, in which position a second district elevator is tested to determine whether it is being used in regular service.

5.25 Selection of Second District Elevator

Assuming that the second district elevator must be used when the brush assembly of the (D-A) switch rests upon terminal 6, a circuit is closed from ground on the (RN-1) relay, (ST) keys, brush 6 and terminal 6 of the (D-A) switch, cross-connection of terminal strip 6, lead "2", contact of cam (B-1A) to the magnet, advancing the (R-1A) switch to position 4. As the switch advances out of position 3, the (TD-1) relay releases. In position 4, the second district selector circuit is tested in a manner similar to the first district selector circuit, for a busy condition, except that leads "TJ-2" and "TK-2" are used instead of "TJ-1" and "TK-1". When the district selector circuit becomes idle, or if it is idle, the (R-1A) switch advances to position 5. From this point the test circuit functions as described with the (R-1A) switch in position 3. When all the groups of incoming selector circuits available to the second district elevator have been tested, the (R-1A) switch advances to position 6 where it tests a third district selector circuit for a busy condition, using leads "TJ-3" and "TK-3". Assuming that a third district elevator must be used when the brush assembly of the (D-A) switch rests on terminal 12, a circuit is closed from ground on the (CON) relay, brush 6 and terminal 12 of the (D-A) switch, terminal strip 6, lead "3", cam (B-1A) to the (R-1A) magnet, advancing the switch to position 6. The switch is advanced to position 7 and connected to the third district elevator in the same manner as it was connected to the first elevator.

5.26 Selection of Fourth District Elevator

The test of the incoming selector trunks in the groups available to the third district elevator proceeds in the same manner as described for the first district elevator. If all the incoming selector circuits have not been tested with the use of three district elevators, a fourth or more district elevator must be used, thus necessitating the addition of a connector for every one to three additional district selectors required. Assuming that the fourth district elevator is required when the brush assembly of the (D-A) switch rests on terminal 13, ground on the (CON) relay thru the (ST) keys terminal 13 of the (D-A) switch, terminal strip 6, lead 4, contacts of cam

(W-1A), and cam (C), to the (R-1A) magnet, advancing the switch to position 8. The (A) cam carries the switch to position 10. In position 10, the same ground on the (CON) relay, through cam (W), and cam (B-1B) advances the (R-1B) switch to position 8. In position 2, the fourth selector circuit is tested for a busy condition over leads (TJ-4) and (TK-4). From this point on the test circuit functions as described for the first district elevator.

5.27 Use of Second District Switch

If all the incoming selector circuits have not been tested by the time the (D-A) switch completes one revolution, a second switch (DB) is required. When the brush assembly of the (DA) switch rests upon terminal 21, a circuit is closed from ground on the (RN-1) relay (RN) relay contacts (ST) key brush 6 and terminal 21 of the (DA) switch, to the (TRA) relay which operates. The (TRA) relay operated, (a) locks over lead (BG-2), (RN) and (CON) relays operated, (b) closes ground through its make contact, "N" terminal and brush 1 of the (DB) switch, terminal 21 and brush 1 of the (DA) switch, contact of the (TRA) relay, to the (DB) selector magnet, stepping the brush assembly of the (DB) switch to terminal 1. From this point the automatic test of the incoming selector circuits associated with this D switch is completed in a manner similar to that described for the first D switch. When the brushes of the (DB) switch rest on terminal 21, and there are further incoming selector circuits to be tested, a third switch (DC) (not shown) is required. This switch is moved off-normal in exactly the same manner as the (DB) switch was stepped to terminal 1.

5.28 Conclusion of a Routine Test

After a test has been made upon all the incoming selector circuits, ground is connected from the (RN-1) relay thru the (RN) relay, (ST) key "AB" option, brush 6 and terminal 21 of the last D switch unit in the equipment, to the (EC) lamp, which lights "N" option. When only one district switch is used the above circuit in addition passes thru the (R-1A) switch at cam (W), if this switch is normal, ("M" option). This signal lamp, indicates that the end of a complete routine test has been reached, and if another cycle is not desired, the (RN) key is operated, and the (ST) key released. The operation of the (RN) key closes a circuit to the (RN-1) relay which operates and locks to ground on the (RN) relay, and also through terminal 21 and brush 5 of the DA switch, to ground on the (PC) key. At this time the (R-3) and (R-2) switches are returning to normal as described under paragraph "District" or "Office Elevator Returned to Normal". If any "D" switch is not resting on terminal 21, it is advanced to that terminal by a circuit from ground on cam (H2), switch normal, thru the (ST) and (RN) keys, "U" keys, terminals and brush #1 of the (D) switch to terminal 21, (TRA) relay, operated STP magnet associated therewith to battery. The STP magnet operates and releases until the brush assembly rests on terminal 21. With the (ST) key normal, (a) the operating circuit for the (ST) and (CON) relays are opened, but these relays are locked under control of cam (V) of the connector switches and (b) a circuit is closed from ground through cam (T-2) cam (B) of the off-normal connector switches to battery through their respective (R) magnets, restoring the connector switches to normal, when the (R-2) switch enters position 9 to 10 or 18 to 1. When the (R-1) switches return to normal, the (CON) and (ST) relays release. When all the "D" switches are resting on their 21st terminals, the (RN) key is restored to normal. With the (RN) key normal, the (RN) and (TRA) relays release. The release of the (TRA) relay closes a circuit from ground through the contacts of the (PC) key, brush 5 and terminal 21 of the (D-B) switch, break contact of the (TRA) relay, to the (D-B) selector magnet, stepping the brush assembly of the (D-B) switch to the next or normal terminal, and closes a circuit from ground, (RN) key normal, (RN-1) relay operated terminal 21 and brush 1 of the (D-A) switch, break contact of the (TRA) relay, to the (D-A) selector switch, stepping the (D-A) switch to its normal terminal. As the (D-A) switch advances from terminal 21, the holding circuit of the (RN-1) relay is opened, releasing the (RN-1) relay. This completes a single routine test.

5.29 Test of a Particular Incoming Group

In order to enable the test man to make a test upon a particular group of incoming selector circuits, a chart is provided showing the groups of incoming trunks available to a brush on a district frame; and also it shows what keys to operate in conjunction with the (PC) key to cause a "D" switch to step to a terminal which permits the test of a particular group of trunks.

5.291 Assume that the group to be tested is reached by a district selector associated with the (D-B) switch, and also requires the use of a third connector. Further assume that the cross-connection scheme applies to the (D-B) switch as well as the (D-A) switch. If it is desired to test a single group of trunks appearing in the 8th district frame, the PC key must be operated first. Then in the units (U) row, key 7; in the second row, the tens (T) key and the (TWB) key; in the group number (GN) row, key 7, and in the overflow count (OC) row, key 1, after which (ST) key is depressed. With these keys depressed the brush assembly of the (D-B) switch steps to terminal 18, causing an elevator on the 8th district frame to test the 8th group in the 4th bank of the selector. This will necessitate the use of connector #3 (not shown), which, however, is entirely similar to connector #2. For clearness, the (T-5) leads of the second connector will be used to represent the (T-8) leads of the third connector. After testing the 7th group, the district elevator returns to normal upon stepping to the overflow terminals.

5.30 District Selection

The operation of the (ST) key closes a circuit, operating the (ST) relay. The (ST) relay operated, connects ground through its make contact, contacts of the (TWD), (TWC) keys and (TWB) key, over lead (CC01), to the (TRA) relay, operating the relay. The operation of the (TRA) relay connects ground through "N" terminal and brush 1 of the (D-B) switch, over lead (BA-1) (TWB) key, (TWC) and (TWD) keys, N terminal and brush 1 of the (D-A) switch, (TRA) relay, the selector, (D-B) magnet, stepping the brush assembly of the (D-B) switch to terminal 1. With the (D-B) switch on terminal 1, ground through the (PC) key, contacts of units keys 0 to 6, inclusive, over leads 1 to 7, through the 1-7 contacts and brush 1 of the (D-B) switch, lead (BA-1), (TWB) key, (TWC) and (TWD) keys, normal contact and brush 1 of the (D-A) switch, (TRA) relay, to the (D-B) magnet, which steps the brush assembly of the (D-B) switch to terminal 8. The tens (T) key operated closes a path permitting the (D) switch to step by the units terminal associated with the operated (U) key and to proceed to the tens terminal associated with that key. With the (D) switch resting on terminal 8, the operating circuit for the (D-B) magnet is from ground through the (PC) and (T) keys, make contact of units key 7, over lead S, terminal 8 and brush 1 of the (D-B) switch lead (BA-1), (TWB) and (TWC) and (TWD) keys, terminal "N" and brush 1 of the (DA) switch, (TRA) relay, to the magnet stepping the (D-B) switch to terminal 9. Terminals 9 to 17 inclusive of the (D-B) switch are connected over leads 9 to 17, inclusive, to ground on the make contact of the (PC) key through the associated units keys, thereby stepping the brush assembly of the (D-B) switch to terminal 18. When the (D-B) switch steps to position 18, the operating circuit of the (D-B) magnet over lead 18 is opened at the contacts of units key 7, stopping the movement of the (D-B) switch. The removal of ground from the terminal 18 of the (D-B) switch allows the (T) relay to operate from ground on (ST) relay. The (D-B) magnet does not operate in series with the high resistance of the (T) relay. The (T) relay operated, in turn operates the (CON) relay. The (CON) relay operated, operates the (RN) relay.

5.31 District Connector Selection

With the (D-B) switch resting on terminal 18 a circuit is also closed from ground through the make contact of the (RN) relay, (ST) key operated, brush 6 and terminal 18 of the (D-B) switch, cross-connection of terminal strip 6, over a lead (not shown) and lower outer contact of cam B on the third connector switch to battery through the (R-1C) magnet (not shown) advancing the third connector to position 4. Having assumed that connector #2 and the "T-5" leads were representing connector #3 and the "T-8" leads the circuit operating the third connector magnet may be traced over lead 5 from terminal strip 6, and the lower outer contact of cam (B), to battery through the R-1B magnet. With the connector in position 4, the 8th district selector assigned for test purposes is tested for a busy condition. When the district selector circuit becomes idle or if it is idle, the connector switch moves to position 5, in which position this circuit is connected to the district elevator.

5.32 District Brush and Group Selections

Sequence switch R-2 advances to position 2 and then to position 4 in the same manner as described under paragraphs 5.2 and 5.3. In position 4, the district elevator is moved upward for district brush selection, selecting brush 4. Upon receipt of the fifth pulse transmitted by the "A" commutator brush and segment in the district, the R-2 switch advances to position 5, and then to position 6 in the same manner as heretofore described. In position 6, the district elevator moves upward for group selection. Intermittent ground is connected over the (TB) lead, through the contacts of cam (L) on the connector, cam (M-2), break contacts of the (GN) keys 9 and 8, make contact of the (GN) key 7, break contact of counting relay (7') to battery on cam (U) through the winding of counting relay (7), operating the relay. When "E" option is used the circuit for the "TB" lead during district group selection is connected thru the contacts of cam L on the connector cam (M-2), thru contact of (BC) key normal, break contacts of the (GN) keys 9 and 8 make contact of (GN) key 7 to counting relay. When ground is removed from the (TB) lead, relay (7') operates and locks. Upon receipt of the seventh pulse, counting relay (1') operates and locks. The operation of counting relay (1') transfers the pulsing circuit to the (0) and (0') relays through cam (K-3). The circuit for the eighth pulse is through the make contact or counting relay (1') cam (K), winding of the (0) relay to battery on cam (U), operating the (0) relay. When the "B" brush on the district elevator breaks contact with the eighth metal segment, the (0') relay operates and locks. The operation of the (0') relay advances the R-2 switch to position 7, from ground through the (PC) key and cam (R-2). When "E" option is used the operation of the (0') counting relay advances the R-2 switch to position 7 directly and not through the (PC) key normal. The (PC) key operated closes a circuit which operates the (PC) relay. The (PC) relay operated short-circuits the (PB) relay, in order to prevent the (R-3) relay from operating, connects ground to the (OC) keys removes ground from the armature of the (RS4) relay and also connects ground to the armature of the (TI) relay preventing its release. With the (PC) key operated and the (R-2) switch in position 7 the test circuit cannot advance until the (PC) key is released. The (PC) key released releases the (PC) relay which removes the ground from the secondary winding of the (TI) relay and connects the same winding to the sleeve of the incoming under test. If the sleeve of the incoming is idle the (TI) relay releases and in turn closes a circuit for operating the (TI) relay. If the incoming challenged is busy the (TI) relay remains operated when the (PC) key is released and if the (APB) key is normal the test circuit will remain in this position until the ground is removed from the sleeve.

5.33 Setting District Control Switch

When the (R-2) switch enters position 3, the (DC) switch is stepped according to the (OC) key operated. A circuit then is closed from ground through cam (E-2), break contact and winding of the (DC) selector magnet, to battery, successively operating the selector magnet until it is shunted by ground over one of the leads to arc 2 of the (DC) switch. Having operated (OC) key 1, the (DC) switch steps until terminal 19 is reached. Ground through the make contact of the (OC) key 1, over lead "1", terminals 19 and brush 2 of the (DC) switch, cam (O), to battery through the 44-A resistance, shunts the winding of the magnet, thereby preventing its operation. When the (R-2) switch advances out of position 6-1/4, ground is removed from both sides of the stepping magnet. When "E" option is used the ground for the (OC) key is furnished from a make contact of the (PC) relay.

5.34 Test of Trunk Group

In position 7 of the test of the particular group of incoming trunks proceeds in the regular manner as described under "ROUTINE TEST" until the district elevator is stepped to the overflow terminal. Ground is then connected over the (TA) lead, brush 4 and terminal 19 of the (DC) switch, cam (P), to the (ZC) relay, operating the relay. In position 7, a circuit is also closed from battery through cam (V), 149C interrupter, to ground through the windings of the key release magnets, releasing the (U), (GN) and (OC) keys. When "E" option is used the ground for the (GN), (OC) keys is furnished from the (BC) key normal. The operation of the (ZC) relay performs the same function as heretofore described restoring the district elevator to normal and advancing the (DC) switch to terminal 20. From this point the (DC) switch and (R-2) switch are restored to normal as heretofore described. As sequence switch (R-2) passes through positions 8-3/4 to 9, a circuit is closed from ground on the (ST) key, through cam (S), (TRA) relay to the (D-B) magnet, advancing the (D-B) switch to terminal 19. The circuit is restored to normal by operating the (RN) key and releasing the (ST) and (PC) keys. The operation of the (RN) key closes a circuit operating the (RN-1) relay which locks. The release of the (ST) key closes a circuit from ground through the break contact of the key, cam (T-2), and cam (B), to battery through the (R-1C) magnet of the third connector, advancing the switch to position 8, the (A) cam carrying ti to position 10. As the (R-1C) switch enters its normal position, the (ST) and (CON) relays release. From this point, the circuit is restored to normal as heretofore described.

5.35 Overflow While Final Hunting

Should the incoming selector circuit, while hunting a final trunk find all the final selector circuits busy, it will travel to the top of the group and rest upon the overflow terminals. Since the sleeve terminal of the overflow terminals is always open, the line relay in the incoming releases, causing the incoming selector circuit to advance to a position where battery is connected through one winding of the line relay to the ring of the incoming trunk, the (TR) lead associated with the district elevator being used, make contact of the (TR) relay, cam (R-3), one or more 18-AF resistance, through the (D) switch, winding of the (STP) relay, break contact of the (STP) relay, break contact of the (BO') relay, cam (S-3), winding of the (STP-1) relay, cam (T), (CA) relay, (TR) relay, over the (TT) lead to ground in the incoming selector circuit, operating the (STP) and (STP-1) relays. The operation of the (STP) relay performs no useful function. The operation of the (STP-1) relay closes a circuit from ground through cam (M), make contact of the (STP-1) relay, cam (O) to the (OFL-1) relay which operates. The (OFL) relay is held shunted down until the incoming leaves position 9 (incoming advance), whereby the (STP-1) relay releases permitting the (OFL) relay to operate as the shunt is removed. The (CA) relay operates over contact of (OFL) and (ARC) relays to ground on back contact of (SO) relay and opens the fundamental circuit to the incoming selector under test, causing it to remain in trunk closure position with the test circuit stuck in position 6, "final brush" or "Blocked in incoming overflow". If for any reason a particular final selection was "split" due to a premature release of the (L) relay in the associated final or (L) relay in the associated repeating incoming selector under test, the premature reverse battery will cause the test circuit to remain stuck in some selection position with the associated incoming under test stuck in trunk closure position. The alarm is given as an indication of failure as hereinafter described. In order to dismiss both test circuit and selector circuit, the (CA) key is operated. This closes the 2/15 ground circuit to (R-3) magnet from ground on (CA) key contact to (C3) cam advancing the sequence switch. As the sequence switch breaks position 11 the (OFL) and (OFL-1) relays release which opens the tip and ring to the incoming permitting its release. The (SO) relay is also operated so that upon the release of the (CA) key the (FO) (BO) relays operate which advances the test circuit from position 16. In position 17 a circuit is closed from ground from the (ST) key, cam (B) of the (R-3) magnet advancing the (R-3) sequence switch to normal. (When Figure B is used the same action takes place until the (CA) key is operated.) This key upon its operation operates the (CA-1) relay. The (CA-1) relay operated connects ground through cam (V3) operating the (CA-3) relay which locks to ground on cam (X-3). Ground on the (H-3) cam through a make contact of the (CA-3) relay advances the R-3 sequence switch to position 16. The (CA-3) relay operated closes the tip and ring and performs the same action as described above and also connects ground through a make contact and operates the (CA) relay. If the (CA) key is released before the R-3 sequence switch reaches position 16 the (FO), (BO) and (SO) relays operate from ground on cam (X) and make contact of the (CA-3) relay. Ground from the back contact of the (CA-1) relay, which releases when the (CA) relay releases, is connected through a make contact of the (CA) relay to the armature and front contact of the (FO') relay, (P-3) cam, interrupter contact, (TG-2) relay which operates. The release of the interrupter causes the (TG-3) relay to operate and on the next operation the interrupter of the (TG-4) relay operates. The (TG-2), (TG-3) and (TG-4) relays lock from the same operating ground through a back contact of the (TR-1) relay. The (TG-4) relay operating advances the (R-3) sequence switch from position 16 in the regular manner. If the (CA) key is still operated when the R-3 sequence switch reaches position 15 ground on a make contact of the (CA-1) relay is connected through winding of the (SO) relay causing its operation. After the (R-3) switch enters position 16 with the (CA) key still operated ground on cam X is connected through a make contact of the (CA-3) relay to the windings of the (FO') (BO') relays in parallel. The (FO') (BO') relays will therefore remain shunted until the (CA1) key is released.

5.36 Timing Feature - Figure 1

Whenever the (ST) key is operated a circuit is closed from ground through terminal 1 and brush 4 of the (TA) switch, to the (TA) relay, operating the relay. The (TA) relay operated, locks through the (TA) key, cam Q-3, to ground on the (ST) key. Should trouble develop in the test circuit before sequence switch, R-3 reaches position 7, or should a district selector be kept busy in regular traffic for a time sufficiently long to prevent testing an incoming selector circuit completely before the (TA) switch makes one revolution or should an incoming reach the overflow terminals, a circuit is closed operating a message register and lighting an alarm lamp. The operation of the (TA) relay also closes a circuit from ground through the contacts of a 152 type interrupter, (TA) relay (Z) relay (Y option used), to the (W) relay and 450 ohm winding of the (Z) relay in series, operating the (W) relay. The (Z) relay does not operate at this time. At the break of the interrupter contacts, the 190 ohm winding of the (Z) relay is connected in series aiding with the 450 ohm winding of the (Z) relay through the winding of the (W) relay, operating the (Z) relay through the make contact of the (W) relay, cam

Q-3, to ground on the (ST) key. At the next make of the interrupter contacts the winding of the (W) relay and 190 ohms of the (Z) relay are short-circuited by ground, releasing the (W) relay. The (Z) relay is held operated from ground through the contacts of the interrupter, (TA) relay, (Z) relay, to battery through its 450 ohm winding. A circuit is now closed from ground through the interrupter, the (TA) relay, (Z) relay, terminal 1 and brush 3 of the (TA) switch, operating the magnet. At the second break of the interrupter the holding circuit for the (Z) relay and the operating circuit of the (TA) magnet are opened, releasing the relay and magnet, stepping the brushes of the (TA) switch to the next terminal. Upon the next, or third make of the interrupter the (W) relay reoperated, repeating the above described cycle again. If either the district elevator or the incoming selector circuit is kept busy on routine traffic sufficiently long to prevent the completion of the incoming tests in the time interval as determined by the Telephone Company, the (TA) switch advances to terminal 22. With the brush assembly of the switch resting on terminal 22, ground through the make contact of the (TA) relay, brush 2 and terminal 22 of the (TA) switch to battery through the alarm circuit, operates the 5C alarm message register and lights a signal lamp located on terminal 22 until the (TA) key is operated. The operation of the (TA) key releases the (TA) relay. The release of the (TA) relay closes a circuit from ground through terminal 22 and brush 1 of the (TA) switch, to the (TA) magnet, stepping the (TA) switch to normal. The (TA) relay reoperates. With the (TA) switch at normal, over the same circuit as it initially operated and locks to the (TA) key starting another timing interval. Should the test on an incoming selector circuit be completed before the (TA) switch completes a revolution, the holding circuit for the (TA) relay is opened when sequence switch (R-3) advances out of position 18, releasing the (TA) relay. The release of the (TA) relay advances the (TA) switch to normal by means of a ground on its break contact through the contacts of arc 1 of the (TA) switch to battery through the break contact and winding of the magnet.

5.37 Timing Feature - Figure 2

In offices where Fig. 2 is used, two time alarm circuits are provided. These circuits are designated as the "Busy Time Alarm" and the "Trouble Time Alarm". The busy time alarm functions in the same manner as the single time alarm described in paragraph 44, except that the operating circuit is traced through the break contact of the (TR) relay and the winding of the (BY) relay. When an incoming selector is seized, the (TR) relay operates which in turn releases the (BY) relay and operates the (TBL) relay. The (BY) relay released, disconnects the interrupter pulses from the busy time alarm stepping magnet, disconnects the (BY) lamp and 5C message register from the (BY) time alarm switch and restores the (BY) switch to normal from ground on its break contact. The (TBL) relay operated, connects the interrupter pulses to the stepping magnet of the trouble alarm switch, also associates the 5C message register and (TBL) lamp with this switch. If the test circuit encounters trouble the (TA) key is operated, which when operated operates the (TBL-1) relay. The (TBL-1) relay operated, locks to ground on (Q) cam of the (R-3) switch, releases the (TBL) relay, disconnects the interrupter and opens the circuit through the (TBL) lamp and 5C message register. When the test circuit is restored to normal, or the (R-3) switch advanced to its normal position the (TBL-1) relay releases. When Figure B is used the trouble and busy alarm circuits function the same as described in Figure 2 with the exception that the (TA) key is locking and that the circuit for operating the (RS-3) relay is connected through the normal contact of this key for the purpose of inserting the trouble alarm circuit when testing.

5.38 Return to Normal

When it is desired to restore the test circuit to normal at any time, the (RN) key is operated and the (ST) key is released. Upon the completion of the test on the last incoming selector under test, ground on a normal contact of the (ST) key advances the (R2) sequence switch from position 7 thru the (U3) cam in position 18 Fig. A or Fig. B. The circuit advances from position 8 as heretofore described and in position 9 ground on cams (G2) and (F2) advances the (DC) switch to normal. Ground on the back contact of relay (ZC) advances the (R2) switch to position 1 thru cam (L2) and the (DC) switch normal. The circuit from this point on, functions the same as described under paragraph "Conclusion of a Routine Test".

5.39 Control Advance (CA) Key

If trouble develops in either the test circuit itself, or in the incoming selector circuit under test (See also under "Overflow While Final Hunting"), the time alarm lamp will light as described under "TIMING FEATURE". If after the (TA) key is operated, the test circuit does not continue its functions the (CA) key is operated. The operation of the (CA) key closes a circuit from ground through its make contacts (a) to the (CA) relay, (b) to cam (C) and (R-3) magnet, advancing the switch to position 16, (c) to the (SO) relay and contacts of cam (I), operating the (SO) relay, which locks through its make contact in series with the windings of the (FO') and (BO') relays in parallel. The operation of the (CA) relay opens the "T" lead to the incoming selector circuit under test. The (R-3) switch remains in position 16 until the (CA) key is released. The release of the (CA) key removes ground from one side of the (FO') and (BO') relays, allowing them to operate. The operation of the (BO') relay performs no useful functions at this time. The operation of the (FO') relay advances the (R-3) switch to position 17, as described under "OVERFLOW WHILE FINAL HUNTING". The switch is advanced to position 1 by ground on the contacts of the (ST) key, through cam (B) to the (R-3) magnet. In position 1 the test upon the office selector circuits starts anew, providing there is no trouble in the test circuit itself.

Should trouble develop when making "Polarity and Continuity Tests" the operation of the (CA) key will cause the test circuit to function to advance to the next Incoming Selector Circuit.

5.40 Advancement of Test Sequence Switch by (CA) Using Figure B

In case the test sequence switch stops in any position between 1 and 15 and in 17 due to a failure of the test circuit itself or the incoming under test, the (CA) key is used to advance the test circuit to a position where a retest may be made or to a position where the test circuit may advance to the next incoming to be tested. The operation of the (CA) key will cause the (CA1) relay to operate. If the (R3) sequence switch is stuck in position 1, the (CA1) relay operated operates the (CA2) relay through cam (V3) which locks on its secondary winding to ground on the start key through cam (Q3) and front contact of the (TR) relay. Upon the release of the (CA) key the (CA1) relay releases and ground from its back contact is connected through a make contact of the (CA2) relay, make contact of the (TR) relay through cam C3 advancing the R3 sequence switch to position 2. In position 2 of the (R3) sequence switch after the (CA) key operation out of position 1, the test circuit should start functioning in the usual manner. If trouble is encountered during the time the (R3) sequence switch is in any position between 2 and 15 the (CA) key is operated again. The (CA) key operated, operates the (CA1) relay and in turn operates the (CA3) relay through cam (V3) which locks to ground on cam (X3). Ground on the (Y3) cam through a make contact of the (CA3) relay through cam (C3) advances the (R3) sequence switch to position 16. If the (CA) key is not released when the R3 sequence switch reaches position 15 ground of the (CA1) relay operated is connected through cam V3 in positions 15/16 to winding (SO) counting relay to battery. The (SO) relay operates and shunts the (FO') and (BO') relays. When the (CA3) relay operated ground was connected through a make contact of the (CA3) relay to the windings of the (FO') and (BO') relays. Upon the release of the (CA) key the (CA1) relay releases and removes the ground from the winding of the (SO) relay permitting the (FO') and (BO') relays to operate. If the (CA) relay is released before the (R3) sequence switch reaches position 16 the circuit to the (SO) relay will be open but the circuit to the (FO'), (BO') and (SO) relays remain closed permitting them to operate as soon as the (R3) sequence switch reach position 16. With the (FO') and (BO') relays operated, the (CA) key released, ground on the back contact of the (CA1) relay is connected to the armature of the (FO) relay through a make contact of the (CA) relay which is operated to ground on the make contact of the (CA3) relay. The (R3) sequence switch advances from position 16 in the regular manner. If the (R3) sequence switch fails to advance from position 17 due to a trouble condition the (CA) key is operated again. The (CA1) relay operates and in turn operates the (CA2) relay which locks to ground cam (X3) from battery through its secondary winding. The release of the (CA) key releases the (CA1) relay which connects ground from its back contact, make contact of the (CA-2) relay through cam (C-3) advancing the (R-3) sequence switch to position 18. In position 18 the (R-3) sequence switch advances to position 1 from ground to the (ST) key to the (R-3) magnet through cam (C-3). With the (CA-3) relay operated the tip and ring is shorted to the incoming through cam (W-3) for the purpose of advancing the incoming to normal. Where "AB" wiring and apparatus are used, this short circuiting path is carried thru the normal contacts of relay (TG2). This will permit the (A) and (D) relays in the incoming circuit to release when relay (TG2) operates, permitting the incoming to return to normal. When "Q" option is used the (CA) advances the test ckt. to the next Incoming and blocks the test ckt.until the (CA) key is released.

5.41 Remote Control Advance - Figure B

Associated with the (CA) key is a jack which is located in the jack box at each incoming selector frame. By inserting a plug with the tip sleeve or ring sleeve short on it, the (CA-1) relay will operate and the action that takes place is the same as explained under "ADVANCEMENT OF TEST SEQUENCE SWITCH BY (CA) KEY - FIGURE B". The circuit is so arranged that the repeat key must be operated in order to use the remote control feature.

5.42 Listening In Punchings - Figure B

In the position 16 of the R-3 sequence switch (ringing and supervisory relay tests) a pair of terminals is connected to the tip and ring of the test circuit through cam (H3). The purpose of these terminals is to determine by the use of the telephone receiver the position of the final multiple test line circuit during a trouble condition. The final multiple test line circuit is arranged to send two different tones at different sequence switch positions which are connected through to the tip and ring of the test circuit.

5.43 Brush Continuity Test - Figure B

In order to make a test of the continuity of the brushes on the incoming selector the (BC) key is operated. The operation of this key in conjunction with the (GN-IB) and (OC-IG) keys, will transfer the leads which are connected to the counting relays for incoming brush and incoming group selectors to any desired set of counting relays so that any incoming brush may be connected in any corresponding incoming multiple bank group. During the circuit operation of the brush continuity test the (R-2) sequence switch functions the same as on a regular test. The (TG) test in position 1 of the (R-3) sequence switch is also the same except that the timing interval is cancelled by the (BC) key. In position 2 (Incoming brush) the ground from cam G-3 through the (STP) relay contact and (F-3) cam make contact with the (BC) key through contacts of a (GN IB) key operated, operates the desired counting relay for incoming brush selection. The same action takes place in position 4 (incoming groups) with the exception that the (OC-IG) keys are used. In position 6 (final brush selection) the connection is transferred to counting relay #1 (AQ) option or counting relay 5 (AR) option. In this way the continuity of the tip brush is insured since a false ground on the tip would cause the test circuit to block in position 6 due to only one pair of counting relays being operated. After the selections are made the test circuit advances through positions 7 to 12 of the (R3) switch by ground from the (BC) key. As the (R3) switch advances to position 12 the fundamental "T" and "R" leads are held open at the (BC) key. When the (R3) switch reached position 12, the fundamental "T" and "R" leads are closed through the (STP1) relay causing the final (in final tens selection position) to go to tell-tale. The (STP1) relay does not operate until the final leaves position 7-1/4 releasing the incoming (L) relay and causing the incoming to advance to "awaiting sender" position. The advance from position 12 to 15 is in the usual manner. The continuity of the ring brush is checked by the holding of the incoming (L) relay during final brush selection. In position 16 a circuit is closed from ground on cam (X) through a normal contact of the (CA-3) relay, make contacts of the (BC) key to battery through windings of the (FO'), (BO') and (SO) relays causing their operation. The (R3) sequence switch advances from this position 16 to normal in the regular manner.

5.431 If a particular circuit operation is required during brush continuity test, the (GNIB) and (OCIG) keys are used to serve the test circuit for "Group Number" and "overflow Count" first. When the (R2) sequence switch reaches position 7 or 16 the keys noted above should be reset for incoming brush and incoming group selections before the (PC) key is released. The release of the (PC) key permits the test circuit to function in the usual manner.

5.432 Where it is desired to by-pass crossbar terminals when making brush continuity test Fig. 5 and option "AY" is provided. Key (BC) operated operates relay (XBP) and relay (XBP1) which ground crossbar terminals at the directing selector block causing the test circuit to by-pass the crossbar incomings.

5.44 Brush Continuity Retest (Figs. 4 and B)

When the BC and BCR keys are operated the test circuit will release automatically and apply a single repeat test if the incoming selector under test is picked in an off normal position or if the incoming selector under test fails for any reason during the brush continuity test. This test is made to prevent the test circuit from blocking when it encounters an incoming selector in an off normal position, during the brush continuity test, and to restore off normal incomings automatically.

When an incoming selector under test fails for any reason during the brush continuity test, the TBL selector will advance to positions 3, 7, 11, 15 or 19 under control of the trouble timing interrupter. When the TBL selector reaches any one of the above positions, relay BCR will operate. Relay (BCR) operated, operates relay (CA1). If the (R3) switch is in position 1 the (CA2) relay operates and the (R3) switch is advanced to position 2 in which position the (CA3) and (BCR1) relays operate and the (BCR) relay releases. With the (R3) switch in positions 2 to 17 the operation of the CA1 relay causes the circuit to function as described in the paragraph covering "Control Advance (CA) key", the (BCR) relay functions as the (CA) key. The BCR1 relay operated locks under control of the TG4 relay normal and the BCR2 relay operated and operates the REP relay and releases the BCR relay. The operation of relay REP causes the circuit to advance as described in paragraph 5.47 covering repeat tests - Fig. B. Relay BCR does not release till past pos. 2 so that relay CA1 remains operated to operate the (CA3) relay in position 2. The (BCR) relay is made slow release to insure that the CA1 relay will operate. When the R3 switch reaches position 16, the CA relay will operate and in turn operate relay BCR2. Also in position 16, the TG2, TG3 and TG4 relays will operate under control of the interrupter as described in paragraph 5.17 to restore the incoming selector to normal. The operation of the TG4 relay will advance the R3 switch to position 17 which in turn will release the TG4 and BCR2 relays. The BCR2 relay is slow release to insure that the TG4 relay will release before the BCR2 relay releases thus prevent opening the locking circuit of the BCR1 relay and cause its false release. The R3 switch then advances to position 18 and to 1 on a retest call. A second brush continuity test is then made on the same incoming selector. If the incoming selector performs satisfactorily on the second test, the test circuit will advance as described in paragraph 5.43 covering the brush continuity test and will advance to the next incoming selector. The BCR1 relay will release when the TG4 relay operates. If the incoming selector fails on the second BC Test, the test circuit will block, and the TBL selector will advance to position 4, 8, 12, 16 or 20 to operate the time alarm. The BCR relay cannot operate on the second test call as the TBL selector passes positions 3, 7, 11, 15 or 19 because its circuit is open at the operated contact of the BCR1 relay.

5.45 No Capacity Key - Figure B

With "F" option with this key normal a .3 MF condenser is bridged across the TT&TR leads to test the release of the (L) relay during selections. With the key operated this capacity is removed with "G" wiring and Fig. 3 and the key normal, an artificial cable loop is in circuit for all selections when testing repeating incomings and for only incoming selections for other non-repeating incoming selectors. With the key operated all capacity is removed from the loop and a straight resistance loop is substituted.

5.46 Repeat (REP) Key - Fig. A

When it is desired to repeat the test upon a certain incoming selector circuit, the (REP) key is operated. The operation of the (REP) key closes a circuit operating the (REP) relay, which locks to ground on cam (H3), if the (REP) key is momentarily operated to make a single repeat test. When the (REP) key is operated to repeat a test upon an unsuccessfully tested incoming, the circuit functions as described below. The (CA) key is operated operating the (SO) relay which in turn operates the (FO') relay when the key is released. The (CA) relay and (FO') relay advances the (R3) switch to position 17. In position 17 the switch is advanced to position 1 by ground on the (ST) key, the operation of the (FO') relay does not operate the (RS3) relay as described under paragraph 5.16, due to the operating circuit of the (RS3) relay being opened at the contracts of the (REP) relay. In positions 17 and 18 a circuit is closed through the 1000 ohms winding of the (TI) relay, cam (P3) to ground through the make contact of the (REP) relay, operating the (TI) relay. If the incoming selector has not been seized in the meantime by a second district selector, the operation of the (TI) relay performs no useful function. If, however, the incoming selector circuit has been seized by a district selector, the (TI) relay is held operated through its 800 ohm winding to ground on the (TS) lead. When the incoming selector circuit becomes idle, the (TI) relay releases, the operating circuit through the 1000 ohm winding of the relay being opened at cam (P) when sequence switch (R3) advances to position 1, and performs its usual functions. In position 1, the second test upon the incoming selector circuit proceeds in exactly the same manner as the first test upon the circuit. This test is repeated until the release of the (REP) key which releases the (REP) relay, allowing the operation of the (RS3) relay at the conclusion of the test. From this point, the test circuit functions and steps the district elevator to the next set of incoming selector circuit terminals.

5.47 Repeat (REP) Key - Fig. B

When it is desired to repeat the test upon a particular incoming selector the (REP) key is operated. The operation of the (REP) key causes the (REP) relay to operate which locks to ground on cam (Y3). The (REP) relay operated (a) opens the operating circuit to relay (RS3) preventing its operation so that the test selector cannot advance, (b) prepares a circuit for the operation of relay (REP 1) as hereinafter described, (c) prepares a circuit for the operation of relay (RS3) when it is desired to advance the test circuit from a busy incoming selector which was seized in service during the unguarded interval of the test circuit, "AB" option and (d) transfers the circuit from relay (RS3) to cam (C3) advancing the sequence switch to position 18, "AA" option.

Where "AB" option is used instead of "AA" and "AG" options, the (RST) register operates and it in turn advances the sequence switch from position 17 from ground on cam (M3). The operation of the repeat single test register records each repeat test made. In position 18 the test circuit functions as heretofore described. In position 1, the second test upon the same incoming selector circuit proceeds in exactly the same manner as the first test upon the circuit. This test is repeated until the release of the (REP) key which remains operated until its locking ground on cam (Y3) opens. The (CT) register and (RS3) relay operate in the regular manner when relay (REP) releases and the test circuit functions and steps the district or office elevator to the next incoming to be tested.

When the Polarity and Continuity test is used the Repeat key should not be used, or the (REP) relay will lock up, requiring the release of (CP) or (ST) key.

5.48 Pass-By

5.481 Automatic Pass-By (APB) Key

The operation of the (APB) key causes the automatic test circuit to pass by all busy terminals and stop the district elevator upon the first idle incoming selector terminals. The operation of the (APB) key, with option "BD", removes or, with option "BC", prevents relay (PBA) from applying the short circuit from around the winding of the (PB) relay allowing it to operate in series with the 800 ohm winding of the (TI) relay if the incoming selector circuit to be tested is busy. The operation of the (PB) relay closes a circuit from ground through the contacts of the (RS-4) relay, when Figure A is used, thru back contacts of (PC) key when Figure B is used, (PB) relay, (MPB) relay to the (RS3), relay, operating the (RS3) relay. The (RS3) relay operated, operates the (RS2) relay. The (RS2) relay is made slow release to prevent the premature release of the (TI) relay in case the momentum of the district elevator carries it momentarily beyond the last terminal of a series of busy terminals. The premature release of the (TI) relay would cause the test circuit to seize a busy trunk. The (RS3) relay in turn operates the (RS) relay. From this point, the (RS1) and (RS4) relays operate and advance the district elevator to the next terminal in exactly the regular manner. Should this incoming selector circuit also be busy, the (PB) relay reoperates, repeating the just described operations of the (RS) relays, until an idle incoming selector circuit is found. Should the district elevator step to a set of overflow terminals with the (APB) key operated, the (TI) and (PB) relays release, and the (ZC) relay advances the (DC) switch to an even numbered terminal, from which point it advances to the next odd numbered terminal by the release of the (ZC) relay and the operation of the (RS-4) relay as heretofore described. If the first trunk in the next group is busy, the (TI) and (PB) relays operate, performing the same functions as described above. When the terminals of an idle selector circuit are found, the automatic test proceeds in the usual way, until the next busy terminal is found, which causes the (PB) relay to operate, unless meanwhile the (APB) key is restored to normal.

5.482 Unequipped Terminal Pass-By, Fig. 7 and Option "BD"

With (APB) key operated the circuit functions as described in par. 5.481. With (APB) key normal vacuum tube (PUT) is able to distinguish between equipped and unequipped incomings. If the incoming is equipped there will be a voltage change at grid 3 of tube (PUT) permitting a current flow through the tube and relay (PBA) secondary winding to operate relay (PBA). Relay (PBA) operated shorts out relay (PB). If the incoming is busy the test circuit waits for it to become idle and then proceeds with the test.

If the incoming is unequipped there will be no voltage change at grid 3 of tube (PUT) therefore relay (PBA) will remain normal. The incoming selector will test busy and the relay (PB) will operate causing the test to function as described in par. 5.481.

5.49 Manual Pass Busy (MPB) Key

When it is desired to move the district elevator from the terminals of a busy incoming selector circuit to the next set of incoming selector terminals which may or may not be busy, the (MPB) key is operated. The operation of the (MPB) key removes the shunt from around the winding of the (PB) relay allowing it to operate in series with the (TI) relay to ground over the (TS) lead. The operation of the (PB) relay connects ground to the (RS3) relay which operates, in turn operating the (RS2) relay to ground on cam G. The (RS2) relay operated, holds the (TI) relay operated through its 1000 ohm winding and connects ground to the (MPB) relay, operating the (MPB) relay. The (MPB) relay operated, locks through its outer winding of the (MPB) key. The operation of the (RS3) relay causes the district elevator to move upward to the next terminal as heretofore described. The operation of the (MPB) relay prevents the reoperation of the (RS3) relay should the terminals test busy and reoperate the (PB) relay. When the (MPB) key is released, the automatic test proceeds if the incoming selector circuit is idle, or the test circuit waits until the incoming selector circuit becomes idle. The release of the (MPB) key releases the (MPB) relay. If it is desired to step by the second busy incoming selector circuit the (MPB) key is reoperated, causing the circuit to function as just described and step the district elevator to the next set of terminals. Should the operation of the (MPB) key step the district elevator from the last terminals of the group to the overflow terminals, the (ZC) relay operates, stepping the (DC) switch to the next even numbered terminal. The (ZC) relay operated, locks to ground on the (RS4) relay. Upon the release of the (RS4) relay, the (ZC) relay releases. Upon the release of the key, the (MPB) relay releases, allowing the (RS3) relay to operate from ground on the (ZC) relay. From this point, the circuit functions as heretofore described advancing the district elevator to the first terminals of the next group. When the overflow terminal happens to be the last of the series of groups to be tested, the district elevator is returned to normal. The test then proceeds on another district elevator which is used to continue the automatic test.

5.50 Busy Line Key

The operation of this key changes the incoming and final selectors so that a permanently busy line in the final multiple is seized instead of the final multiple test line.

5.51 Figure 3 - Artificial Cable - and (No Cap) Key

An artificial cable in two steps of 150 and five steps of 300 ohm is provided for testing repeating incoming selectors and nonrepeating selectors where the repeating type is also tested. Two arrangements are provided for this purpose making it possible to have the cable in circuit either for incoming selections only or for both incoming and final selections. The latter is for the repeating incomings and the former is for the nonrepeating type and the discrimination between the two methods being accomplished by cross-connecting the required number of 150 ohm or 300 ohm steps by using leads numbered 41 to 48 for incoming selections only and leads 49 to 56 for incoming and final selections. The (SS) relay operates when leads 49 to 56 are cross-connected operating the (CAP) relay for final selections. The (CAP) relay is operated for all incoming selections with the (NO CAP) key normal. This relay switches the fundamental circuit thru the artificial cable when operated and thru resistance only when released. In addition to the function described above, the (SS) relay when operated short-circuits the first two half steps of resistance and the first whole step (300 ohms) of resistance only. Thus on repeating incoming selectors when the (NO CAP) key is operated a minimum loop of resistance only is provided while for nonrepeating selectors the resistance only loop is not less than the cable loop.

5.52 (REP-1) Repeat Once Key

When the (REP-1) key is operated the test is made twice on each selector before proceeding to the next selector to be tested. The (REP) relay operates as the (R3) sequence switch reaches position 2 and locks in the usual manner until the (R3) switch passes position 1 of the next revolution. As the (R3) switch reaches position 16 the (REP-1) relay is operated, opening the operating path of the (REP) relay. The (REP-1) relay locks thru position 4 of the next revolution preventing the (REP) relay from operating again thus allowing only one repeat test to be made. The (CD) relay operates in position 17 of the first test. As the (R3) sequence switch leaves position 1-1/4 the battery supply to this relay is opened. It however, does not release for a definite time interval. When the (R3) switch reaches position 2, a circuit is closed thru the (BE), (BF) and (BG) resistances and (TG) relay thru make contact of (CD) relay to discharge the capacity of the incoming selector and the cable loop. When the (CD) relay releases, the fundamental is closed for brush selection for the second test.

5.53 Automatic Polarity and Continuity Test ("Q" or "U" Option)

When this test is required and "AB" option is furnished, the (CP) key is operated. When the (TR) relay Fig. B operates (see paragraph 5.8) the (CP) lamp will light if the battery and ground closure from the (A) relay of the Incoming Selector circuit under test, is open or the polarity reversed. If the circuit from the Incoming Selector Circuit is satisfactory the (CP) relay will operate in turn operating the (CP1) relay. The operation of the (CP1) relay opens the (CP) lamp circuit, closes ground to operate the (CT) register ("AB" option) and also closes a ground circuit through the operated contacts of the (CT) register ("AB" option) for operating the (RS-3) relay. The (RS-3) relay in operating will cause the test circuit to advance the District or Office Selector to the next Incoming Selector as described in detail under paragraph 5.19. The high resistance of the (CP) resistance and (CP) relay in series, will prevent the operation of the Incoming Selector (L) relay to avoid advancing the Incoming Selector off normal. See paragraph 5.46 for repeat operation.

In case of trouble and the test circuit blocks with the (CP) lamp lighted, operate and release the (CA) key, which will operate the (CP1) relay in turn operating the (CT) register, when "AB" option is used, and (RS3) relay to advance the test circuit to the next Incoming Selector Circuit.

When "AA" and "AH" options are used the (ST) register is operated by one contact of (CP1) relay in turn operating the (RS3) relay thru the closed contact of (ST) register from another ground closure of (CP1) relay.

To stop the progression of this polarity and continuity test, release the start key and operate the (RN) the same as for other tests.

5.531 Where continuity and polarity tests are made on tandem incomings Fig. 6 and option "BA" is provided. On other than continuity and polarity tests ground from the back contact of relay (TCP) or relay (TCP1) causes the test circuit to bypass tandem incomings. When continuity and polarity tests are made key (CP) operated operates relay (TCP) and relay (TCP1) and the tandem incomings are tested in the same manner as other incomings.

5.54 Figure D is provided for operation with the timing test set circuit. When sequence switch (R3) reaches position 2, a ground from cam SS2-Z3 is connected over lead ST through jack (TM1) to the timing test set to initiate the timing cycle. If the incoming and group selection is completed within approximately three seconds, ground from cam SS1-Z3 is connected to lead ET when sequence switch (R3) reaches position 5. This ground is connected through jack (TM1) to the timing test set to cancel timing. A lockout ground is provided from cam SS4-X3 over lead LO through jack (TM1) when the sequence switch (R3) is in positions 2 through 16. This prevents the initiation of the timing cycle except during final brush selection.

If the incoming and group selection is not completed within approximately three seconds, the timing test set times out and applies ground through jack TM2 over lead BL to operate the (BL) relay. Relay (BL) in operating opens the ground path for the rotary magnet of sequence switch (R3), thus, preventing the advance of switch (R-3) from position 5. The timing test set lights an alarm lamp to indicate the blocking of the final selector test circuit.

This circuit is released by momentarily operating the (CA) key to apply ground over the CA lead through the TM2 jack to recycle the timing test set.

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