This Appendix was prepared from issue (2) of T-501236.

METHOD OF OPERATION

Automatic Routine Test Circuit - For the Test of Incoming Selector Circuits - Three-Digit With Line Switches and Line Finders - Panel Machine Switching System.

Change Paragraph 7 lines 10 to 14 to read:

"of the (SLO-1) relay, contacts of cam W-2, (PG), (TD-1) and (T) relays to battery, operating the (SLO-1) relay. The operation of the (SLO-1) relay connects battery to the 800 ohm winding of the (TLS) relay which operates. The (SLO-1) relay is slow to release to insure the operation of the (TLS) relay before the (SLO-1) relay is released by the switch advancing to position 2".

Change Paragraph 9 line 2 to read:

"the (SLO-1) and (TLS) relays operate exactly as described in paragraph 7".

ENG.--JJB.
7-2-24
FP

CHK'D.--GFH.

APP'D.-- E. R. COOKE
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(26 Pages) Page #1.
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Replacing all previous issues.(*)

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METHOD OF OPERATION
AUTOMATIC ROUTINE TEST CIRCUIT

For the Test of Incoming Selector Circuits 3 Digit With Line Switches and Line Finders - Panel Machine Switching System.

DEVELOPMENT

1. PURPOSE OF CIRCUIT

1.1 This circuit is designed to automatically test two and three-wire incoming selector circuits which have compensating resistances in the sender rather than in the incoming selector circuit and is also designed to operate with either panel line finder or line switch district circuits.

2. WORKING LIMITS

2.1 This circuit is used when the voltage limit of the battery is from 24 to 25 volts and from 48.5 to 50 volts.

OPERATION

3. PRINCIPAL FUNCTIONS

The principal functions of this circuit are as follows:-

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

3.2 This circuit is arranged to select a particular group of incoming selector circuits when desired and a test may be made on any one of the desired groups.

3.3 The circuit is arranged to distinguish between selector circuits that are idle, terminals that are spare and terminals connected to incoming selector circuits that are busy in regular traffic.

4. CONNECTING CIRCUITS

4.1 This circuit makes use of district selector circuits, the elevators only of which are used. The sequence switch of the district does not move out of position 1. The circuit tests

incoming selector circuits which are used with either line finder or line switch type of district circuits.

DESCRIPTION OF OPERATION

5. PRELIMINARY FUNCTIONS

An automatic test is started upon all incoming selector circuits 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 DA magnet from ground through the FC and TW keys normal, N terminal and brush 1 of the D-A switch contacts of the (TRA) relay (when used) to the 200-M selector. 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 200-M selector magnet to energize and move the brush assembly to the next terminal. The operation of the (T) relay closes a circuit operating the (CO.) relay, which locks. The operation of the (CON) relay operates the (RN) relay, which advances the R-1A switch to position 2 from ground on the (RN-1) relay through the (EC) and (ST) keys brush 6 and terminal 1 of the D-A 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 R-1A to battery through the R-1A magnet.

6. 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, 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 (RN-1) relay through the relay, (EC) key, normal, (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.

7. 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. The operation of the (PG) relay connects ground to the (TD-1) relay, operating the relay. The (TD-1) relay is slow to release, and with the R-1A switch in position 2, locks from ground on (RN-1) relay normal. With the R-1A switch in position 2, the operating circuit for the (PG) relay is opened, releasing the relay and closing a circuit from ground through the 18-BJ resistance, winding of the (SLO) relay, contacts of cam W-2, (G), (TD-1) 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 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 R-2 magnet, advancing the R-2 switch to position 2 and lights the busy district (BD) lamp. With the R-1A and R-2 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 (TJ-1) and (TK-1) leads must be kept closed to prevent the discharge of the district prior to the completion of the regular service call. When the R-1A switch is in a normal position, the closure between the (TJ-1) and (TK-1) leads is through the outer contacts of cam P. As the R-1A switch is passing through positions 1-3/4, the closure between the (TJ-1) and (TK-1) leads is through the lower contacts of cam O-1A, outer contacts of cam (R-2) and lower contacts of cam N-1A. With the R-1A and R-2 switches in position 2, the closure between the (TK-1) and (TJ-1) 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 (TK-1) lead, cam N-1A and 1200 ohm winding of the (TLS) relay, contacts of cams K and W on P-2, (PG) relay normal (TD-1) 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 by the operation of the (MPB) key. When the district selector circuit becomes idle, or if idle when tested,

ground is removed from the (TK-1) 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 R-2 magnet, advancing the switch to position 3, and also closes a circuit from ground through cam N, (TLS) and (TLF) relays normal, cam O-1A, over the (TJ-1) lead, causing the particular district circuit to test busy to all other hunting line switches.

8. SETTING DISTRICT CONTROL SWITCH

With the R-2 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 200-L selector magnet, and 44-A resistance operating the 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 numbered terminal, depending upon the cross connection of terminal strip 5.

9. 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. 7. If the line finder district is idle ground will be disconnected from the (TH-1) lead and with the R - 2 switch in position 1, a circuit is closed from ground through the winding of the (TLF-1) relay, contacts of cam Y-1, over lead (TH-1) to battery through a winding of a relay in the line finder circuit, operating the (TLF-1) relay. The (TLF-1) 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 R-2 switch enters position 2, the (TLF-1) 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 (TL-1) relays operated, (PG) relay normal, cam K-2, 1200 ohm winding and make contact of the (TLS) relay, cam N-1A 300 ohm resistance to ground on a relay in the district

over the (TK-1) lead, providing the district selector is busy. The (MB) relay of the district is held operated from ground on cam E, over the (TH-1) 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 K-2 (PG) relay normal, (TD-1) and (T) relays operated to battery. When the district selector reaches its normal position, ground from the Y commutator is connected to the (TY-1) lead, cam G-1A winding of the (BOS) relay, (PG) relay normal, (TD-1) and (T) relays operated to battery, operating the (BOS) relay. The (BOS) relay operated, releases the (TLS) relay. The (TLS) relay released, releases the (TLF) relay and advances the switch to position 3. Ground is connected to the line finder district selector holding it busy over the same circuit as described for the Line Switch District Selector (Paragraph 7). With the scheme of cross connection shown on the drawing and with the brush assembly of the D-A switch resting on terminal 1, groups 0 to 8 inclusive in the first frame are tested. The 200-L 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 IC switch. As determined by the cross connection of the D-A switch and terminal strip 5, the 200-L selector magnet is shunted when its brush assembly rests on terminal 3. This circuit is from ground through the break contact of the (PC) key, brush 5 and terminal 1 of the D-A switch, cross connection of terminal strip 1, over lead 9 to terminal 3 and brush 2 of the (DC) switch, contacts of cam 0, to battery through the 44-A 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 R-2 switch in position 3, the (RS-2) relay operates from ground on cam G-2. The operation of the (RS-2) relay closes a circuit operating the (TI) relay and advances the R-2 switch to position 4. The (TI) relay operated in turn operates the (TI-1) relay, from ground on the (EC) relay. The (TI) and (TI-1) relays operated, perform no useful function at this time.

10. DISTRICT BRUSH SELECTION

The district brush selection is determined by the cross connection of terminal strip 3. With the scheme used in the schematic and with the D-A switch resting on terminal 1, the 0 brush on the first district elevator is selected. In position 4 of the R-2 switch, a circuit

is closed from ground through cam H-2 and cam C-1A, advancing the R-1A switch to position 3. In position 3 of the R-1A 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 (TO-1), 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 (POS) relay is opened at the district Y commutator, releasing the relay and ground is connected through the A commutator brush and segment, over lead (TA-1), cam N-2, brush 3 and terminal 1 of the D-A switch, the O relay operating the relay. The operation of the (O) relay connects its winding 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 R-2 switch to position 5 and disconnects ground from the (TU-1) lead, stopping the upward movement of the district selector. When the R-2 switch advances out of position 4-1/4 the operating circuits for the (O') and (O) relays are opened at cam U, releasing relays. As the R-2 switch advances out of position 4, the (TU-1) lead is opened at the upper inner contact of 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 R-2 switch, the district selector trip magnet is energized from ground on cam F-2 through cam 1-1A, over the (TM-1) lead, and the R-2 switch is advanced to position 6 from ground, (O') relay, normal, cam Q, (RS-2) relay operated, and cam D-2.

11. DISTRICT GROUP SELECTION

In position 6, the district (UP) magnet is re-energized, ground on the (O') relay normal, cam Q, (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 the 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.

12. 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 winding. When the incoming selector circuit is busy, the (TI) relay is now held operated from battery through its 800 ohm winding and make contact over the (TS-1) 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 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 to ground on cam G-2. The release of (TI) relay operates the (TR) relay from ground on (ZC) relay normal, 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 to the test circuit, advances the R-3 switch to position 2 and (if fig. 2 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.

13. 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. 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.

14. 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, 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 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 position 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.

15. 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, 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') and (BO') relays release. The release of the (FO') relay advances the switch to position 6.

16. 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 B-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 three 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, 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) lead, to ground in the incoming selector circuit, operating both the (STP) relay and the polarized (STP-1) relay. 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 (SC) relay, which operates. The operation of the (SO) relay connects its winding in series with the windings of the (FO') and (BO') relays in parallel, through the make contact of the (SO) relay, operating the (FO') and (BO') relays. The operation of the (BO') relay opens the fundamental circuit, releasing the (STP) and (STP-1) relays. 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 (O), (BO') and (FO') relays is opened, releasing the relays. The release of the (FO') relay advances the switch to position 14.

17. TEST FOR TRUNK CLOSURE

In position 14, a circuit is established from battery through one winding of 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, cams T and S, winding of the (STP-1) relay, 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 (O) relays. The operation of the (BO') relay performs no useful functions. 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 (O) relays are released. 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 four O.K. pulses.

18. SUPERVISORY RELAY TEST

As the supervisory relay in 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 (TR-1) lead, contacts of cam E-1A (TR) relay, cams R and S, winding of the (STP-1) relay, cam T, (CA) relay, (TR) relay, cam F-1A, (TT-1) lead, tip of the incoming selector to ground, operating the (STP-1) relay. The operation of the (STP-1) relay closes a circuit from ground through cam M, make contact of the (STP-1) relay, cams O and N, the (3') counting relay, winding of the (3) counting relay to battery on cam I, operating the (3) counting relay. The operation of the (3) counting relay connects its winding in series with the winding of the (3') counting relay which operates upon the release of the (STP-1) relay due to the release of

the supervisory relay in the incoming selector circuit. With each operation and release of the supervisory relay in the incoming circuit, a pair of counting relays operate and lock to ground. Upon the fourth operation of the supervisory relay, the (O) relay operates, and upon the release of the supervisory relay, the (FO') and (BO') relays operate. The operation of the (BO') relay performs no useful function. The operation of the (FO') relay closes a circuit from ground through its make contact, cam P, (REP) relay, (M[illegible]) relay, to battery through the winding of the (RS-3) relay, which operates. The (RS-3) relay operated, (a) locks to ground on its armature under control of the (RS-4) relay, (b) operates the (RS-2) relay from ground on cam G, and (c) advances the R-2 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 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 switch passes through positions 17 to 18 a circuit is closed from ground through contacts of cam H, to battery through the winding of the 5-C message register (ST) and 18-AC resistance. The message register operates and records the number of successful tests.

19. The (RS-2) relay reoperated, reoperates the (T1) relay through its 1000 ohm winding. The (TI-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 (TI) relay to ground on the armature of the (ZC) relay. The function of these relays, as previously described under "INCOMING BUSY TEST" paragraph 12 is to test the next incoming trunk for busy conditions.

20. ADVANCING DISTRICT 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 800 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 three O.K. pulses, 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.

21. 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 200-L 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, a spreviously described, the (RS-4) relay operates, connecting ground to the winding of the 200-L selector magnet stepping the brush assembly of the DC switch to terminal 5.

22. 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 terminals 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 terminals 19.

23. DISTRICT 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 the district elevator reaches normal, a circuit is closed from ground through the Y commutator brush and segment over the (TK-1) lead, contacts of cam G-1A, cam C-2 to the R-2 magnet, advancing the switch to position 9.

24. 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 200-M (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 200-L selector magnet advancing the DC switch to terminal 21, where the circuit through the 200-L selector magnet is re-established through terminal 21 and brush 3 of the DC switch, restoring the DC switch to normal. 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.

25. 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 200-M 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.

26. 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, (EC) and (ST) keys, brush 6 and terminal 6 of the D-A switch, cross connection of terminal strip 6, lead 2, contact of cam R-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 district elevator.

27. 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 through the (EC) and (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 W, and cam B-1B, advances the R-1B switch to position 2. 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.

28. 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, D-B, is required. When the brush assembly of the D-A switch rests upon terminal 21 a circuit is closed from ground on the (CON) relay, brush 6 and terminal 21 of the D-A 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 D-B switch, terminal 21 and brush 1 of the D-A switch, contact of the (TRA) relay, to the 200-M (D-B) selector magnet, stepping the brush assembly of the D-B switch to terminal 1. From this point the automatic test of the incoming selector circuits associated with this D switch unit is completed in a manner similar to that described for the first D switch unit. When the brushes of the D-B switch rest on terminal 21, and there are further incoming selector circuits to be tested, a third switch (D-C not shown) is required. This switch is moved off normal in exactly the same manner as the D-B switch was stepped to terminal 1.

29. 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 through the (RN) relays, (EC) and (ST) keys, brush 6 and terminal 21 of the last D switch unit in the equipment, to the (EC) lamp, which lights "N" wiring. When only one district switch is used the above circuit in addition passes through the R-1A switch at cam W, if this switch is normal ("M" wiring). 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 depressed, 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 in paragraph 23. If any D switch is not resting on terminal 21, it is advanced to that terminal by a circuit from ground on cam H-2, switch normal, through the ST and RN keys, U keys, terminals and brush #1 of the D switch of terminal 21, 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. The (EC) lamp remains lighted in a circuit traced from battery, (EC) lamp, 21 terminal and 6 brush of DB and DA switches, (TRA) relay operated, (ST) and (EC) keys normal, (RN) and (RN-1) relays operated, (RN) key operated to ground. 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 200-M (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 200-M (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.

30. 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.

31. 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 following keys must be depressed. 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 the (PG) and (ST) keys are 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.

32. 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 (EC), (TWD), (TWC) keys, and (TWB) key, over lead (CC-1), 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 200-M 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 200-M (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 200-M (D-B) magnet is from ground through the PC and T keys, make contact of units key 7, over lead 8, 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.

33. 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 (CON) relay, break contact of the (EC) key, (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 visually 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.

34. 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 8 and 9. 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 described under paragraphs

8 and 9. In position 6 the district elevator moves upward for group selection. Intermittent ground is connected over the (TH) 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 ground is removes 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 of 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 8th 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 B-2.

35. 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 200-L 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, terminal 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.

36. TEST OF TRUNK GROUP

In position 7 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, 149-C interrupter, to ground through the windings of the key release magnets, releasing the (U), (GN) and (OC) keys. The operation of the (ZC) relay performs the same function as described in paragraph 21, 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 described in paragraph 23. 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 200-M 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 (PN-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 it 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 described in paragraph 29.

37. 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 S 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, over the (TR) lead associated with the district elevator being used, make contact of the (TR) relay, cam R-3, one or more 18-AF resistances, through the D switch, winding 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) relay, operating the relay. The (OFL) relay operated, locks to ground on cam M. The operation of the (OFL) relay closes a circuit from ground on the (CA) key, to the (FO') and (BO') relays in parallel and in series with the (SO) relay, to battery on cam I, operating the three relays and also closes the tip and ring of the incoming circuit through its make contact thereby releasing the (STP) and (STP-1) relays. The (BO') relay operated, opens the fundamental circuit through the (STP) and (STP-1) relays preventing their re-operation. The operation of the (FO') relay advances the R-3 switch to position 7. As the switch advances from position 6-1/4 the (FO'), (BO') and (SO) relays release. The release of the (FO') relay advances the R-3 switch to position 8, where the circuit through the (BO'), (FO') and (SO) relays is re-established to ground through the contact of the (OFL) relay. The (FO') relay alternately operates and re-

leases until the R-3 switch enters position 12. The (OFL) relay releases after position 11, preventing further operation of the (FO') relay. The R-3 switch waits in position 12 until the operation of the time alarm, as hereafter described. The (CA) key is then operated, which operates the (CA) relay. The (CA) relay operated, locks to ground on cam M and prevents the incoming from advancing out of normal on a repeat test. The operation of the (CA) key also closes a circuit from ground through cam C, to the R-3 magnet, advancing the switch to position 16. In position 16 the (REP) key is operated, operating the (REP) relay which locks to cam H. The operation of the (CA) key also closes a circuit from ground to battery on cam I, through the winding of the (O) relay which operates and connects its windings in series, with the windings of the (BO') and (FO') relays connected in parallel. When the (CA) key is released, ground is removed from one side of the (FO') and (BO') relays allowing them to operate to ground through the make contact of the (O) relay. With the operation of the (FO') and (REP) relays a circuit is closed through cam B-3 to the R-3 magnet, advancing the switch to position 17. In position 17 a circuit is closed from ground on the (ST) key, cam B to the R-3 magnet, advancing the R-3 switch to normal. Upon the release of the (REP) key, the (REP) relay releases, and permits the test circuit to make a new test upon the particular incoming trunk circuit as hereinafter described under "REPEAT KEY" (Paragraph 41).

38. TIMING FEATURED - FIG. 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-2 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 wiring 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-2, to ground on the

(ST) key. At the next make of the interrupter contacts the winding of the (W) relay and 190 ohm 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, to the 200-R (MM) magnet, 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 re-operates, repeating the above described cycle anew. 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 5-C alarm message register and lights a signal lamp located in the test desk. The switch brushes remain 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 (MM) magnet, stepping the (TA) switch to normal. The (TA) relay re-operates. 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 (MM) magnet.

39. 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 38, 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 5-C 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 5-C 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 5-C 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.

40. END OF CYCLE (EC) KEY

When one cycle of routine tests has been completed upon all the incoming selector circuits, the (EC) lamp lights as previously described under "CONCLUSION OF A ROUTINE TEST". At this time all the sequence switches are normal, the brush assemblies of the D switches are resting on the last terminal of each unit, awaiting the operation of the (EC) key, the (TRA), (CON) and (RN) relays are operated and the (ST) key depressed. If it is desired to start another cycle of routine tests, the (FC) key is operated momentarily. The operation of the (EC) key opens the circuit through the (EC) lamp, extinguishing it, opening the holding circuit through the (TRA) relay which releases. The (TRA) relay released, closes a circuit from ground through break contacts and windings of the DA, DB magnets to battery, advancing the D switches to normal. The operation of the (EC) key also connects battery to the winding of the key release magnet associated with the second row of keys, restoring any operated key in the row to normal. When the DA switch is restored to normal, a circuit is closed from ground through the make contact of the (ST) relay, normal contact and brush 1 of the D-A switch to the 200-M (D-A) selector magnet stepping the switch to terminal 1. From this point another automatic test of all incoming selectors proceeds as described under "ROUTINE TEST".

41. 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" (paragraph 38). 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 which locks to ground on cam M, (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 function 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 circuit starts anew, providing there is no trouble in the test circuit itself.

42. REPEAT (REP) KEY

When it is desired to repeat the test upon a certain incoming selector circuit, the (REP) key is operated, (See also under "OVERFLOW WHILE FINAL HUNTING") paragraph 37. The operation of the (REP) key closes a circuit operating the (REP) relay, which locks through the contact of the key as long as the key is operated to ground on cam M on R-3, 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 as described under the previous paragraph operating the (SO) relay which in turn operates the (FO') relay when the key is released. The (CA) relay and (FO') relay advance the R-3 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 (RS-3) relay as described under paragraph 18, due to the operating circuit of the (RS-3) relay being opened at the contacts of the (REP) relay. In positions 17 and 18 a circuit is closed through the 1000 ohm winding of the (TI) relay, cam R-3 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 R-3 advances to position 1, and performs its usual functions as described in paragraph 20. 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 (RS-3) 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.

43. 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 removes 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, (PB) relay, (MP3) relay, to the (RS-3) relay, operating the (RS-3) relay. The (RS-3) relay operated, operates the (RS-2) relay. The (RS-2) 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 (RS-3) relay in turn operates the (RS) relay. From this point, the (RS-1) and (RS-4) relays operate and advance the district elevator to the next terminal in exactly the same manner as described in paragraphs 18 and 19. Should this incoming selector circuit also be busy, the (PB) relay re-operates, 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 described in paragraph 21. 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.

44. 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 (RS-3) relay which operates, in turn operating the (RS-2) relay to ground on cam G. The (RS-2) relay operated, holds the (TI) relay operated through its 1,000 ohm winding and connects ground to the (MPB) relay, operating the (MPB) relay. The (MPB) relay operated, locks through its outer winding to the (MPB) key. The operation of the (RS-3) relay causes the district elevator to move upward to the next terminal as described under paragraph 20. The operation of the (MPB) relay prevents the re-operation of the (RS-3) relay should the terminals test busy and re-operate 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 re-operated, 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 (RS-4) relay. Upon the release of the (RS-4) relay, the (ZC) relay releases. Upon the release of the key, the (MPB) relay releases, allowing the (RS-3) relay to operate from ground on the (ZC) relay. From this point, the circuit functions as described under paragraph 21, advancing the district elevator to the first terminal 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 in the same manner as described under paragraph 23. The test then proceeds on another district elevator which is used to continue the automatic test.