PANEL SYSTEM
AUTOMATIC TEST CIRCUIT
FOR TESTING INCOMING SELECTORS
ARRANGED FOR CONNECTING THRU LINE SWITCH
OR LINE FINDER DISTRICTS
OF THE SENDER SELECTOR TYPE ✓
OR LINE FINDER DISTRICTS
OF THE LINK TYPE OR OFFICE SELECTORS

CHANGES

A. CHANGED AND ADDED FUNCTIONS

A.1 No change.

B. CHANGES IN APPARATUS

B.1

Removed	Replaced by	Added
E1641 Relay (SD)	E6281 Relay (SD)	None

B.2 Sequence switch B337 cam cuttings changed as follows:

Brush	From	To
2	3-1/2 to 4	3-1/2 to 5
3	9-1/2 to 10	9-1/2 to 11
4	15-1/2 to 16	15-1/2 to 17

C. CHANGES IN CIRCUIT REQUIREMENTS OTHER THAN THOSE APPLYING TO ADDED OR REMOVED APPARATUS

C.1 No change.

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 The (SD) relay is changed from E1641 to E6281 and 1-B connected to ground and 2-B connected to 2-T (RL) relay. The cam cuttings of the B337 sequence switch are changed as covered in paragraph B. These changes are made so that ground will be supplied to the (TG) lead for the operation of a relay in the district circuit that has been added in order that the start lead and the all district busy register lead will be open when the district selector is being used as a test selector.

D.2 Notes 131 and 132 are added.

DEVELOPMENT

1. PURPOSE OF CIRCUIT

1.1 No change.

2. WORKING LIMITS

2.1 No change.

OPERATION

3. FUNCTIONS

3.1 No change.

4. CONNECTING CIRCUITS

4.1 No change.

BELL TELEPHONE LABORATORIES, INC.

DEPT. 332-A

GRM)
WHM) BP

CIRCUIT DESCRIPTION
BELL TELEPHONE LABORATORIES, INC.,
SYSTEMS DEVELOPMENT DEPT., NEW YORK
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PANEL MACHINE SWITCHING SYSTEM
AUTOMATIC TEST CIRCUIT
FOR TESTING INCOMING SELECTORS
ARRANGED FOR CONNECTING THROUGH LINE SWITCH OR LINE FINDER DISTRICTS OF THE SENDER SELECTOR TYPE OR LINE FINDER DISTRICTS OF THE LINK TYPE OR OFFICE SELECTORS

CHANGES

A. CHANGED AND ADDED FUNCTIONS

A.1 None.

B. CHANGES IN APPARATUS

B.1 None.

C. CHANGES IN CIRCUIT REQUIREMENTS OTHER THAN THOSE APPLYING TO ADDED OR REMOVED APPARATUS

C.1 None.

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 The circuit has been redrawn on account of poor condition of tracing.

DEVELOPMENT

1. PURPOSE OF CIRCUIT

1.1 No change.

2. WORKING LIMITS

2.1 No change.

OPERATION

3. FUNCTIONS

3.1 No change.

4. CONNECTING CIRCUITS

4.1 No change.

BELL TELEPHONE LABORATORIES, INC.

DEPT. 332-A

GRM)
WHM) YS

PANEL MACHINE SWITCHING SYSTEM
AUTOMATIC TEST CIRCUIT
FOR TESTING INCOMING SELECTORS
ARRANGED FOR CONNECTED THROUGH LINE SWITCH
OR LINE FINDER DISTRICTS OF THE SENDER SELECTOR TYPE
OR LINE FINDER DISTRICTS OF THE LINK TYPE
OR OFFICE SELECTORS

CHANGES

A. CHANGED AND ADDED FUNCTIONS

A.1 A polarized relay is provided to determine when the incoming selector has advanced to the reversed battery position.

B. CHANGES IN APPARATUS

B.1 Removed S-507 (NO) relay, replaced by 206-AS.

C. CHANGES IN CIRCUIT REQUIREMENTS OTHER THAN THOSE APPLYING TO ADDED OR REMOVED APPARATUS

C.1 None.

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 The NO relay is changed from S-507 to AS-206, its winding and contact terminals being wired to corresponding terminals on the S-507 relay.

D.2 The lead from the NO relay winding designated "C" is removed from lead 13 at the NM resistance and is connected to lead 5 at the ME resistance.

D.3 Note 130 is added.

DEVELOPMENT

1. PURPOSE OF CIRCUIT

1.1 No change.

2. WORKING LIMITS

2.1 No change.

OPERATION

3. FUNCTIONS

3.1 Means are provided to determine that the incoming selector has advanced from "selection beyond" position to the "reverse battery" position by means of polarized (NO) relay.

4. CONNECTING CIRCUITS

4.1 No change.

BELL TELEPHONE LABORATORIES, INC.

DEPT. 332-A

JBR)XD

PANEL MACHINE SWITCHING SYSTEM
AUTOMATIC TEST CIRCUIT
FOR TESTING INCOMING SELECTORS
ARRANGED FOR CONNECTED THROUGH LINE SWITCH OR LINE FINDER DISTRICTS OF THE SENDER SELECTOR TYPE OR LINE FINDER DISTRICTS OF THE LINK TYPE OR OFFICE SELECTORS

CHANGES

A. CHANGED AND ADDED FUNCTIONS

A.1 None.

B. CHANGES IN APPARATUS

B.1 None.

C. CHANGES IN CIRCUIT REQUIREMENTS OTHER THAN THOSE APPLYING TO ADDED OR REMOVED APPARATUS

C.1 Armature travel for the (P) relay was .030.

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 Jack B is enclosed in a figure designated "G". Leads to this jack are designated T and R. Connecting information for these leads is optionally shown to Figure G or the incoming selector test misc. circuit.

D.2 Leads A, B and TFA are shown connecting to misc. circuits.

D.3 Note 129 is added.

DEVELOPMENT

1. PURPOSE OF CIRCUIT

1.1 No change.

2. WORKING LIMITS

2.1 No change.

OPERATION

3. FUNCTIONS

3.1 No change.

4. CONNECTING CIRCUITS

4.1 Connections are shown to standard incoming selector test misc. circuit, and standard floor alarm board fuse and time alarm circuit.

BELL TELEPHONE LABORATORIES, INC.

DEPT. 332-A

JBR)
WHM) YM

PANEL MACHINE SWITCHING SYSTEM
AUTOMATIC TEST CIRCUIT
FOR TESTING INCOMING SELECTORS
ARRANGED FOR CONNECTING THRU LINE SWITCH
OR LINE FINDER DISTRICTS
OF THE SENDER SELECTOR TYPE
OR LINE FINDER DISTRICTS
OF THE LINK TYPE OR OFFICE SELECTORS

CHANGES

A. CHANGED AND ADDED FUNCTIONS

A.1 Circuit arranged to permit the use of panel link districts as test selectors.

B. CHANGES IN APPARATUS

B.1

Removed	Replaced By	Added
40-N Res. (NO)	S507 Relay (NO)	R39 Relay (K) R65 " (PR) R882 " (LR) R6001 " (T1) E652 " (TLP) 18J Res. (Q1)

C. CHANGES IN CIRCUIT REQUIREMENTS OTHER THAN THOSE APPLYING TO ADDED OR REMOVED APPARATUS

C.1 The test clip data for the (STP) relay formerly was as follows: "R WDG. (STP)" in the "Conn. Bat." column and "L WDG. (STP)" in the "Conn. Grd." column.

C.2 Test note 14 was added. In the "See Test Note" column for the L500 (STP) relay reference to note 2 was removed and replaced by reference to note 14.

C.3 Test clip data for E6446 (NT) relay changed from "RU (NF)" to "RU (NT)".

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 Formerly "A" and "B" wiring and apparatus were not designated and were part of circuit. "C" and "Z" wiring and apparatus were added.

D.2 Formerly, Figs. B and E were part of main figure and Figs. C, D and F were not shown.

D.3 The "AC" and "B" leads in the main figure were formerly

not designated and were connected together.

D.4 Terminal 19 was added on the (L) relay non-operate cross connection block.

D.5 At the "Busy Ground" cross connection block, leads "AE", "AF" and "AG", and the punchings associated with leads "AE" and "AF" were added.

D.6 Circuit notes 122 to 128 inclusive were added. Reference to notes 122 to 125 was made at the optional "A", "B", "C" and "Z" wiring and apparatus and reference to notes 126 to 128 was made at Figs. B, C, D, E and F.

D.7 Circuit note 115 formerly read as follows: When district selectors are of the line switch type and final multiple test lines are of the synchronizing type, cross-connect to terminal "R" or when final multiple test lines are of the non-synchronizing type, cross connect to "TLR" When district selectors are other than the line switch type and final multiple test lines are of the non-synchronizing type, cross-connect to terminal "TL".

DEVELOPMENT

1. PURPOSE OF CIRCUIT

1.1 This circuit is designed to test 24 volt, 48 volt and three-wire incoming selectors in a panel machine switching exchange. By the operation of a key in the test circuit, a district selector or office selector, which is associated with the test circuit, is connected to the incoming selector that is to be tested. The district selector or office selector, having been connected to the test circuit by means of a connector switch, is connected to the incoming selectors. In turn, the incoming selector is directed to a final test line. When these connections are established, the final test line returns 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 connecting circuits so as to connect to the next incoming selector to be tested. The testing of the incoming selectors will progress automatically until all incoming selectors have been tested, after which a signal, known as the "end of cycle" signal, will be given, indicating the completion of the test on all incoming selectors. In offices large enough to require two test circuits, there will be two "end of cycle" points, one being located at a point approximately

after half of the incoming selectors have been tested and the other at the point corresponding to a complete test of all incoming selectors.

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

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 working off 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 multipled on the district or office frames.

By means of a particular circuit feature, any particular incoming selector can be selected and tested by means of directing the test circuit to any district or office selector used as a connector and, in turn, directing this selector to the individual incoming selector which it is desired to reach.

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

In case that the incoming selector is busy, an automatic or manual pass busy feature is provided.

2. WORKING LIMITS

2.1 This circuit is to be used for testing 48 volt or repeating incomings up to 2600 ohms external cable loop or for testing 24 volt incoming selectors over cable loops up to 1300 ohms.

OPERATION

3. FUNCTIONS

3.01 This circuit will automatically test all present full mechanical incoming selectors working

in conjunction with the office in which the test circuit is installed, under what is approximately worst circuit conditions. 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.

3.02 The test circuit may be directed to connect to any particular incoming selector or group of incoming selectors.

3.03 A selector locating feature is provided, that is, lamps are supplied which will light by the operation of a key showing the particular incoming selector to which the test circuit is connected.

3.04 The subscriber's district or 2-wire office selectors used for connecting purposes are made busy to service 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, a pass busy key 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.

3.06 The circuit will give an alarm in case trouble is encountered. An alarm will also be given when the pass busy key is not thrown after a considerable interval in the event that a district or office selector is busy for too long and also if an incoming selector is busy for too long an interval.

3.07 Registers are provided to indicate the number of circuits tested. the number of repeat tests

made, the number of single tests made, the number of busy selectors passed and the number of troubles encountered.

3.08 The circuit is arranged to regulate the number of incoming selectors tested in one group, this being done by means of cross-connection to relays and arcs on the indicating 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 and start a test on another group of incoming selectors.

3.09 The circuit is arranged to apply a non-operate test on the (L) relay of the incoming selector.

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

3.11 It is arranged to apply an operate test on the (A) relay of the incoming selector. A non-operate test is made on the (A) relay of 24 volt incomings.

3.12 It is arranged so that variable resistances 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.

3.13 It is arranged so that different condensers may be connected from ground to ring lead for a capacity test for variable trunk loops.

3.14 It is arranged to make a brush continuity test on all brushes of the incoming selector when in any group of the incoming frame multiple, this test being made by the operation of the brush continuity key.

3.15 It is arranged to make a rapid test by directing the incoming selector to a busy line on a final frame, this test being made when the busy line key is operated.

3.16 It is arranged to repeat a test on a given incoming selector by the operation of a key if it is desired to retest a selector.

3.17 At the completion of all tests an "end of cycle" lamp illuminates. This lamp is also illuminated at an intermediate point in case two test circuits are installed in the same office.

3.18 The test cycle may be stopped at any point and restarted at the first selector of the same test group by the manipulation of the start key.

3.19 The test circuit may be restored to normal by the operation of the "restore to normal" key, restarting the test when the (RN) key is released if the start key is reoperated and stopping if the start key is left normal.

3.20 The circuit is arranged to function with sender selector and link type district selectors and with tandem district selectors, also with two-wire or three-wire office selectors.

3.21 It is arranged so that any other district or office selector may be connected, replacing any other district or office that is connected regardless of any sequence and also to permit any position of any connector sequence switch to replace any other position that is in use without the necessity of a sequence of positions.

3.22 It is arranged to make a test to the automatic district test frame for link type districts to determine whether this test circuit is testing the district which is to be used as a connector.

3.23 A timing test is made to indicate the difference between the OK pulse and busy line pulses.

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

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

3.26 This circuit will register failure.

1 - If the supervisory relay is out of adjustment so as to cause appreciable chatter during its operate test.

2 - If the supervisory relay fails to operate or fails to release during the soak test.

4. CONNECTING CIRCUITS

4.1 This circuit is to be used in conjunction with district or office selector circuits of any present type for the purpose of connecting to all incoming circuits which are to be tested.

4.2 It is connected to the automatic test frame for link type districts so that if the district which is to be used as a connector for making the incoming test is being tested by the district test set, the incoming test set will not seize the district selector.

4.3 This circuit functions through the district or office selector to the incoming selector thence to a final selector which is directed to the final test line. If brush continuity tests are to be made, the (BC) key will be operated and, instead of directing the final selector to a test line, the final will be seized but immediately released. If rapid test is to be made the (BL) key will be operated and the final selector will be directed to a busy line.

4.4 This circuit is used in conjunction with the office alarm circuit.

DETAILED DESCRIPTION

5. APPARATUS AND FUNCTIONS

5.01 CONNECTOR SEQUENCE SWITCH - 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.

5.02 DISTRICT OR OFFICE SELECTOR - In a full mechanical office, subscriber 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 terminal or group of terminals in order to gain access to the incoming selectors. In a tandem office, special two-wire office or district selectors not used in service are assigned for this purpose. They are connected to the test circuit, however, in the same manner.

5.03 DIRECTING SELECTORS - Associated with cross-connection terminals are one or more pairs of 200 type 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; fourth, to provide a busy test guard; fifth, to set the proper relays used in conjunction with the test sequence switch for making tests on 24 volt or local incoming selectors; sixth, to make connections for applying non-operate test on the (L) relay; seventh, to supply connections for making a proper (L) relay operate test; ninth, to make the proper connections for making an (A) relay operate test and, tenth, to connect the capacity desired while making selections on the incoming and final frames. The number of pairs 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.

5.04 CONNECTOR CONTROL SEQUENCE SWITCH - This switch controls the district or 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.

5.05 TEST SEQUENCE SWITCH - This switch controls the selections of the incoming and final selectors and controls the test conditions imposed on the selector.

5.06 TROUBLE TIMING SELECTOR (TBL) - This switch, in conjunction with the (B) interrupter, starts counting when the circuit to be tested is connected to the test sequence switch by means of the (TR) relay. The switch takes one step for each closure of the interrupter and the desired time is secured by passing the desired number of terminals on the arc before the switch stops on the trouble alarm terminal.

5.07 BUSY TIMING SELECTOR (BY) - This switch, in conjunction with the (B) interrupter, starts counting when the (ST) key is operated. The switch takes one step for each closure of the interrupter and the desired time is secured by passing the desired number of terminals on the arc before the switch moves on to the one assigned for busy alarm.

5.08 TENS LOCATING SWITCH (T) - The tens locating switch (T) and the units locating switch (U), working together, serve as an indicator to indicate the number of the district bank terminals on which the brushes are resting. These switches illuminate lamps for each position of the switches as an indication of the particular incoming selector under test. The tens and units switches in conjunction with the directing selectors are also used to determine the point at which the test selector will be restored to normal.

5.09 UNITS LOCATING SELECTOR (U) - See paragraph 5.08.

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

5.11 RETURN TO NORMAL KEY (RN) - The operation of this key causes the directing selector switches (DA), (DA-1), (DX), (DX-1), etc., to return to normal after it has caused the connector control switch to return to normal.

5.12 CONTROL ADVANCE KEY (CA) - This 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 the key advances the test switch and also the district elevator unless the (REP) key is operated. The circuit does not resume the test until the key is restored to normal.

5.13 TIME ALARM KEY (TA) - The operation of this key resets the timing period whenever the alarm bell is rung and testing is in progress.

5.14 REPEAT KEY (REP) - The operation of this key causes the test circuit to repeat the test upon a selector.

5.15 AUTOMATIC PASS BY KEY (APB) - The operation of the (APB) key causes the test circuit to pass all terminals that are busy.

5.16 MANUAL PASS BUSY KEY (MPB) - The operation of the (MPB) key steps the district 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.

5.17 PARTICULAR CIRCUIT KEY (PC) - The operation of this key, in conjunction with the other keys, as enumerated below, causes the apparatus to make a test upon the particular group of incoming circuits. The particular test does not proceed until the key is released. For the purpose of testing the particular group or groups, this circuit is provided with units (U) keys, 0 to 9 inclusive; tens (T) keys, 1 and 2, which add 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; and a set of group number (GN) keys, 0 to 9 inclusive, to guide the

district elevator to the number of the particular group to be tested.

5.18 REMOTE CONTROL JACK AND KEY - The purpose of this jack, in connection with the 32-A test set, is to make it possible for a man to watch the functioning of the selector under test at the time the (CA) key is operated.

5.19 TONE JACK (B) - This jack is used for the purpose of receiving tone indications from the final multiple test line circuit, in the event of failure.

5.20 LAMP KEY (LP) - By the operation of this key, certain lamps will be illuminated, from which it is able to determine the incoming selector which is being tested.

5.21 BRUSH CONTINUITY KEY (BC)- By the operation of this key, in conjunction with the group (G) and the brush (B) keys, the test circuit will check the continuity of the brushes in any group desired.

5.22 BUSY LINE KEY (BL) - This key, when operated, will direct the final selector to a busy line and change the connections to the test sequence switch so that the test circuit will advance as soon as the busy line is reached, thus making it possible to make a rapid exercise test of an incoming selector.

5.23 END OF CYCLE LAMP (EC) - This lamp illuminates when all incoming selectors have been tested or at some intermediate point if two automatic incoming test circuits are used in the same office.

5.24 BUSY DISTRICT LAMP (BD) - This lamp illuminates when the district or office selector which is to be used for connecting to the incoming selectors is busy, thus holding the automatic test circuit from proceeding.

5.25 BUSY INCOMING LAMP (BI) - This lamp illuminates when the automatic test circuit encounters a busy incoming selector.

5.26 TROUBLE LAMP (TBL) - This lamp illuminates after a timing interval when a trouble is encountered.

5.27 BUSY ALARM LAMP (BY) - This lamp illuminates 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.

5.28 LOCATING LAMPS - Four sets of lamps are supplied for determining, the frame on which the district or office selector which is being used is located, the brush of the district or office selector which is tripped, and the tens and the units terminal on which the district or office brush is setting. These lamps are illuminated when the (LP) key is operated so that the incoming selector under test may be determined.

5.29 CHATTER LAMP (CHA) - This lamp illuminates in the event the incoming supervisory relay chatters during its operate or soak tests.

5.30 SOAK LAMP (SK) - This lamp illuminates in the event the supervisory relay stays operated during the soak tests.

6. ROUTINE TEST - An automatic test is started on all incoming circuits by the operation of the (ST) key. The (ST) key operated, connects ground through the (V) cams of all the connector sequence switches, when normal, to the (ST) relay. This relay operates and closes a circuit through its make contact to the normal terminal of the first pair of directing selectors for the purpose of moving the selectors to the first terminal. This relay remains operated through its own contact to ground with the (ST) key operated and through any one of the connector sequence switches that is off normal to the (CON) relay operated. The ground supplied from the (ST) relay to the normal terminal of the first pair of directing selectors causes the first selector of the pair to move from the normal terminal. As soon as the (DA) switch reaches the first terminal, it will stop unless the terminal is a spare. This will open the shunt around the (CSA) relay and this relay will operate to ground at the (ST) relay. The operation of the (CSA) relay will close battery to the magnet of the (DA-1) selector and this selector will move from the normal terminal. If the first terminal of the directing selectors is a spare, ground will be supplied through the

winding of the (IR) relay to arc No. 1 and this ground will have the same effect as that supplied to the switch from the (ST) relay when it was in the normal position. The first selector of the pair will advance to a terminal where a test is to be made, the (IR) relay not being connected to this terminal. As soon as the first directing selector moves to this point, the second directing selector of the pair will advance to the point by the same method as it moved from its normal position. When the second directing selector of the pair has stopped, the (SM) relay operates, in turn operating the (CON) and (RN) relays. The operation of the (RN) relay closes ground to the brushes of the No. 6 arc of the (DA-1) directing selector. The terminals of this arc are connected to a cross-connecting block where any terminal may be cross-wired to one of a number of leads which terminate on the various number 1 brushes of cam (B) of the connector sequence switches. If the cross-connection is made to the lead terminating on SS-1-B1A, the connector sequence switch 1-A will move from position 1. When this switch advances to position 2, ground supplied at SS-2-W1A through the (W) cams of all other normal connector sequence switches to SS-4-B1A will move the switch to position 4. If any other switch is off-normal it will be moved to normal.

7. BUSY TEST OF SENDER SELECTOR TYPE DISTRICTS - In position 4 of the connector sequence switch, the (TJ-1) and (TK-1) leads which are connected to the district or office test selector are opened at cam (P1A), but they are still connected together through the back contact of the (SYN) relay. If the test selector is a district of the sender selector type, other than the link type, "T" wiring will be used and the lead terminating on SS-1-B1A will be connected to SS-2-T1A. Ground from this lead will be connected to the winding of the (SYN) relay. This relay will operate, opening the (TK-1) and (TJ-1) leads and connecting ground to the (TJ-1) lead in case the test selector is of the line switch type. If the test selector is of the line finder type, the busy ground supplied from the No. 2 arc of the directing selector will not be connected and the (TJ) lead will be held busy by the 10 ohm ground of the (Q) resistance. The operation of the (SYN) relay will also close the operating circuit for the (TLF) relay. The operation of the (TLF) relay will move the connector control sequence switch from position 1 and also lock itself to the (TK-1) lead which is connected to the test selector. If the test selector is

busy, ground will be supplied over the TK lead, holding the (TLF) relay operated. If ground is not supplied to this lead, the (TLF) relay will be released, its operating circuit having been open when the connector control sequence switch moved from position 1. The release of the (TLF) relay will move the connector control sequence switch from position 2. The connector control sequence switch, moving to position 3, will supply ground from its (H) cam to SS-4-W1A which will move the connector sequence switch to position 5. This will connect all leads from the district test selector through to the test circuit. The (SYN) relay will remain operated as long as the connector sequence switch remains in position 5, the holding ground being supplied through the contacts of the (ST) relay to ground at the (ST) key. This relay will hold the test selector busy.

8. BUSY TEST OF LINK TYPE DISTRICT SELECTOR

8.1 Rotary Link Type

In case the test selector is of the rotary link type, "S" wiring at the connector sequence switch and Figs. B and E will be used. This will connect the ground from the No. 6 arc of the directing selector to SS-2-U1A. This ground will operate the (LD) relay. The operation of the (LD) relay will illuminate the (BD) lamp and will also connect the (RL) relay to the "TE" lead. This lead is connected to the district in such a way that if the district is in position 2, the battery from the rotor magnet will operate the (RL) relay. The (RL) relay operating, will supply ground to the "TG" lead which will cause the link circuit which is attached to the district to advance, discharging the sender and advancing the district to normal position. With the district in the normal position, the (RL) relay will be released and the "TK" lead will be connected through the contacts of the (LD) relay to the windings of the (D) and (T) relays in Fig. B. Battery from the test selector will operate the (T) and (D) relays. This will supply ground for the operation of the (SYN) relay. The (SYN) relay will perform the same functions as it did in case of the sender selector type districts and, in addition, will cause the (SD) relay to operate. The operation of the (SD) relay will open the circuit to the (LD) relay, permitting this relay to release and will supply a ground for holding the (SYN) relay. The release of the (LD) relay will remove the low resistance ground through the (D) and (T) relays from the district selector. The "TJ" lead will be held busy by ground thru the (Q) 10 ohm resistance (Fig. E). The operation of the (SYN) relay causes the (TLF) relay to operate which advances the connector control switch from position 1.

As the connector control switch moves from position 1, the operating circuit for the (TLF) relay is opened and as there is no holding circuit, this relay releases moving the connector control switch to position 3. In case the district test selector is being tested by the automatic district test circuit, ground will be supplied from that test circuit to the (DT) relay. The operation of the (DT) relay will illuminate the (BD) lamp and open the circuit to the (LD) relay, thus holding the test circuit from making a busy test of the district selector.

8.2 PANEL LINK TYPE - In case the test selector is of the panel link type, "S" wiring at the connector sequence switch and Figs. C and F will be used. The circuit will function the same as in paragraph 8.1 except as hereinafter described: The operation of the (LD) relay will operate the (LR) relay in Fig. C. The operation of the (LR) relay will illuminate the (BD) lamp. When the district is in the normal position, the release of the (RL) relay will connect the "TK" lead thru the contacts of the (LD) relay to the primary winding of the (T1) relay in Fig. C. Battery from the test selector will operate the (T1) relay thru its primary and secondary windings in series, shunted by the tertiary winding connected differentially. The operation of the (T1) relay short circuits its secondary winding, locks thru its primary winding to the "TK" lead, releases the (LR) relay and operates the (SYN) relay. The subsequent release of the (LD) relay will remove the low resistance ground thru the primary winding of the (T1) relay from the district selector. The "TJ" lead will be held busy by ground thru the (Q1) 30 ohm resistance (Fig. F).

8.3 OPERATION WHEN BOTH PANEL AND ROTARY LINK DISTRICTS ARE USED AS TEST SELECTORS - When both panel and rotary link districts are used as test selectors, Fig. D is furnished in addition to Figs. B, C, E and F. In this case, the terminals of arc No. 2 of the directing selectors for positions using panel link districts as test selectors will be cross-connected to terminal "AE" or "AF" on the "Busy Ground" cross-connection blocks. The (PR) relay in Fig. D will therefore operate only when a panel link district is connected as a test selector. With the (PR) relay normal Figs. B and E are connected in the circuit permitting the busy test of rotary link districts to be made. When the (PR) relay is operated, Figs. B and E are disconnected and Figs. C and F are substituted, permitting the busy test of panel link districts to be made.

9. BUSY TEST OF OFFICE SELECTOR - In case the test selector is an office selector, "R" wiring will be used. This will connect the ground from the No. 6 arc of the second directing selector (DA-1) of a pair to the SS-2-Y1A cam as soon as the connector sequence switch moves to the test position. With the connector sequence switch in the testing position, the (TR) and (TJ) leads will be opened at the (P) cam but they will remain closed through the back contact of the (SYN) relay. The ground which is connected to the (Y) cam will be connected to the winding of the (TLF) relay when the (SM) relay has operated after the directing selectors have located. The operation of the (TLF) relay will move the connector control switch from position 1. The primary winding of the (TLF) relay will be connected to the (TJ) lead. As the connector control switch moves from position 1, the operating circuit to the secondary winding of the (TLF) relay will be opened and the relay will remain operated through its primary winding if there is a ground on the office selector. The test circuit, due to the (TLF) relay remaining operated, will not advance and the (BD) lamp will be illuminated due to its connection through the (E) cam of the connector control switch. If no ground is on the sleeve of the office selector, the (TLF) relay will release. The release of the (TLF) relay will close the circuit which will move the connector control switch from position 2. The release of the (TLF) relay will also close a circuit through the (K) cam of the connector control switch which will hold the (TJ) lead busy. The connector control switch, moving to position 3, will advance the connector sequence switch to position 5, its connected position.

10. BRUSH SELECTION - When the connector control switch moves into position 3, ground is supplied from the (Q) cam to the (STP-1) relay winding in series with the primary

winding of the (RS) relay. The operation of the (RS) relay moves the connector control sequence switch out of position 3, provided the (SM) relay is operated, which opens the operating circuit for the (RS) relay but this relay remains operated to a holding circuit through its own contact. (STP-1) relay and 930 ohm resistance to ground at the (Q-2) cam when the switch moves to position 4. In position 4, ground is supplied to the up-drive magnet of the office or district selector used as a connecting selector over the (TU) lead. This will cause the elevator to move upward. The (A) commutator of the district connector is connected by means of lead (TA) to the contact of the (RS) relay. As the commutator passes over the ground segment, the (STP-1) relay is released, thus removing the ground which was connected to the counting relays as designated by cross-connections at the test selector brush connecting block. The operation of the (STP-1) relay operates one of the counting relays, 0 to 4, depending upon the cross-connections at this block. The release of the (STP-1) relay permits the corresponding prime counting relay to operate and lock through the contacts of the counting relays first operated. This switches the operating lead to the next set of counting relays. When the (A) commutator passes from the ground segment, the (STP-1) relay again operates, operating the next set of counting relays. This action continues until the (0') relay is operated. The operation of the (0') relay opens the circuit of the (STP-1) and (RS) relays and they are released. The (RS) relay then releases and removes the ground from the district or office up-drive magnet and it stops. The operation of the (0') relay closes ground to the (C-2) cam, moving the connector control switch to position 5. With the connector control switch in positions 5 and 6, ground is supplied to the (TM) lead which is connected to the district or office selector trip magnet so that the selector brush will be tripped on group selection.

11. DISTRICT OR OFFICE GROUP SELECTION - When the connector control switch moves to position 5, the (RS) and (STP-1) relays are operated in the same manner as they were operated when the connector control switch was in position 3 for brush selection. The operation of the (RS) relay now moves the switch from position 5, provided the locating selectors have been set, the operating circuit being taken through the make contacts of the (TU) and (TS) relays. In position 6, the action on the up-drive of the district or office selector is the same as explained for brush selection except that the shunting of the (STP-1) relay is done by the B commutator over the TB lead instead of the A commutator and the release of the (RS) relay is placed under control of th-

(C) commutator segment rather than the (A). In position 6, the leads TA and TC which are connected to the (Z) and (C) commutator brushes are connected together at the (N-2) cam. As the counting relays are advanced to a point where the (OB) relay operates, these leads are connected to the (RS) relay contact, holding the relay operated until the (C) commutator breaks. This is necessary when two-wire office circuits are used as test selectors, the (Z) commutator being used to hold the (RS) relay until the (C) commutator makes and the elevator finally locating under control of the (C) commutator. The connection which governs the number of the group is made through the tens indicating selector instead of through the directing selectors. The connector control switch is moved from position 6 when the (RS) relay releases, the (O') relay having operated when the proper group has been reached by the district or office elevator.

12. SETTING OF LOCATING SELECTORS - When the connector control sequence switch is in positions 2 to 3, ground is supplied through the (D) interrupter and the (US) relay contacts and also through the (C) interrupter and the (TS) relay contacts to the magnets of the units and tens locating switches respectively. These switches step one terminal for each closure of the interrupters and continue until the (TS) and (US) relays operate. The (US) relay operates when the units locating selector has advanced to the terminal on which ground is supplied from the cross-connection block, used in conjunction with arc No. 4 of the directing selectors or from ground supplied from the (GN) keys in a particular circuit test; likewise the tens locating selector advances to the terminal on arc No. 2 which is supplied with ground from the same source as the units selector. The operation of the (TS) and (US) relays closes ground which advances the connector control to position 6, as explained above. The operation of the (TS) relay also closes a circuit for connecting terminals 10 & 21, arc No. 2 of the tens locating selector to terminals 5 & 16, arc No. 2 of the units locating selector. This circuit is due to the two groups of five trunks on the district selector multiple, the first terminal of the last group being numbered 94 instead of having a number of like digits. As there are two groups in which "4" appears as the units digit in the first selector number, namely, 44 and 94 discrimination must be made between these first two terminals.

13. INCOMING BUSY TEST As the connector control switch moves from position 6, the operating circuit for the (TI) relay is released but battery is supplied at the same time to the primary winding which is closed through the make contact and TS lead to the sleeve of the district or office multiple. If the incoming selector is busy, the (TI) relay will therefore remain operated and the (BI) lamp will illuminate as a signal that the incoming selector is busy. If the incoming selector is not busy, the (TI) relay will release making the selector busy. The release of the (TI) relay will connect the ground for operating the (TR) relay. This relay will connect the tip and ring of the district selector, which is connected to the incoming selector under test, to the test sequence switch by means of the TT and TR leads and this will close a circuit for making a TG test of this incoming selector.

✓14. FIRST (TG) TEST 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. The operation of the (TR) relay will close ground from the connector control switch through the (LUS) and (LTS) relays to the contacts of the (TG) and (MTG) relays. It will also close the tip and ring leads of the fundamental circuit to the test sequence switch. With the test sequence switch in position 1, the (TG) relay, in case of 48 volt incoming selector, or the (MTG) relay, in case of 24 volt incoming selector, will be connected in the fundamental circuit. If the incoming selector, in case of 48 volt type, is returning to normal, the (TG) relay will not operate. As soon as the incoming returns to its normal position, the (TG) relay will operate. In case the incoming is of the 24 volt type, the (TF) relay will be operated and the (MTG) relay will be in the fundamental circuit. This will not operate while the incoming selector is returning to normal but will operate when the incoming returns to normal. The operation of either the (TG) or (MTG) relays will close the ground supplied through the (TR) relay for the operation of the (AT) relay. The (AT) relay will lock in position 1 to ground at the (W-3) cam supplied from the ST key and it will move the test sequence switch from position 1.

15. INCOMING BRUSH SELECTION When the test sequence switch moves to position 2, the fundamental tip and ring

leads will be closed through the (L) operate resistance, the (STP) and (●FL) relay windings and back contact of the (FO') relay. The (STP) relay will operate, closing ground from the (K-3) cam to the pair of counting relays which will govern the selection of the proper brush for reaching the final test line. As the incoming selector elevator advances, the (STP) relay will be released and the counting relays will advance until the (FO') and (BO') relays operate. The (FO') relay will open the fundamental circuit, permitting the incoming selector to advance and the (BO') relay closes ground to the (R) magnet of the test sequence switch, causing it to move to position 3. In position 3, the counting relays will release and the (BO') relay will close its back contact, causing the test sequence switch to move to position 4.

16. INCOMING GROUP SELECTION - When the test sequence switch is in position 4, the connections will be the same as they were in position 2 with the exception that the (STP) relay will close ground to the set of counting relays which govern the incoming group, the ground being supplied from the (J-3) cam instead of the (K-3) cam. As soon as the counting relays have been satisfied by the incoming selector, the test sequence switch will move into position 5 where the counting relays will release and the release of the (BO') relay will move the test sequence switch to position 6.

17. FINAL BRUSH - When the test sequence switch is in position 6, the connections will be the same as described under "Incoming Brush Selection" with the exception that the (STP) relay will close ground to the set of counting relays which govern the final brush selection. As soon as the counting relays have been satisfied by the final selector, the test sequence switch will move to position 7. In position 7, the counting relays will release and the test sequence switch will move to position 8.

18. FINAL TENS SELECTION - When the test sequence switch is in position 8, the connections will be the same as described under "Incoming Group Selection" with the exception that the contact of the (STP) relay will connect ground to the pair of counting relays which govern the group of tens to which the final selector is elevated. As

soon as the counting relays are satisfied by the final selector, the test sequence switch will move to position 9. In position 9, the counting relays will release and the test sequence switch will move to position 10.

19. FINAL UNITS SELECTION When the test sequence switch is in position 10, the connections will be the same as described under "Incoming Brush Selection" with the exception that the (STP) relay will close ground to the pair of counting relays which govern the units terminal to which the final selector is elevated. As soon as the counting relays are satisfied by the final selector, the test sequence switch will move to position 11. In position 11, the counting relays will release and the test sequence switch will move to position 12.

20. NON-OPERATE TEST OF (L) RELAY

20.1 INCOMING SELECTORS OF A TYPE OTHER THAN REPEATING When the test sequence switch is in position 12, the fundamental tip and ring leads will be connected thru the non-operate test resistance for the (L) relay, the (P) relay winding and the back contact of the (FO') relay. The (P) relay will operate, closing ground to the (SO) relay winding and the winding of the (OFL-1) relay. The (OFL-1) relay will operate, opening its operating circuit and locking to the (L-3) cam. The operation of the (OFL-1) relay will close ground from the back contact of the (BO') relay, through the (F) interrupter, to counting relay No. 9. When the interrupter opens, the (9') relay will operate, connecting the No. 8 pair of counting relays, which will operate on the next closure and open period of the interrupter. The counting relays will advance until the (6') relay is operated and, on the next closure, ground will be supplied for the operation of the (ST) relay. This relay will operate and lock to the (J-3) cam. It will also move the test sequence switch from position 12. In case the (L) relay of the incoming selector operates during the time that the counting relays are operating, the (P) relay will be released due to the advancing of the incoming selector. This will permit the (BO') relay to operate, thus removing the ground supplied to the interrupter for advancing the counting relays to the position where the test sequence switch moves from position 12. The test sequence switch, under this condition, cannot move from position 12, permitting the trouble lamp to illuminate as an indication that the (L) relay of the incoming selector operated under its non-operate condition.

20.2 REPEATING INCOMING SELECTORS The operation will be the same as described for other incoming selectors except that the (NO) relay will operate and perform

the same function as the (P) relay since the latter may not receive sufficient current to operate.

21. OPERATE TEST OF (L) RELAY - When the test sequence switch is in position 13, the fundamental leads will be connected through the operate test resistance for the (L) relay, the (STP) and (OFL) relay windings and back contact of the (FO') relay. The (STP) and (OFL) relays will operate while the incoming selector is advancing due to the operation of the (L) relay. Ground will be closed from the (OFL) relay, through the contact of the (STP) relay, to the (SO) relay. While the incoming selector is advancing to a trunk closure position, the fundamental circuits will be opened, permitting the (STP) relay to release, thereby opening the ground which has been shunting the (BO') relay and this relay will operate. When the incoming circuit comes into trunk closure position, the polarity of the battery supplied by it is reversed and the (OFL) relay will continue to release if it has not released on open period and will not reoperate. The operation of the (BO') relay closes ground which will move the test sequence switch from position 13. If the (L) relay of the incoming selector does not operate, the incoming circuit will not be advanced and the (OFL) and (STP) relays will remain operated, thus holding the (BO') relay from operating and the test sequence switch will remain in position 13. This will permit the (TBL) lamp to light as an indication of a trouble condition.

22. SECOND OPERATE TEST OF THREE-WIRE INCOMING (L) RELAY When the test sequence switch moves to position 14, in case the incoming selector is of the three-wire type, the (L1) relay will be operated. At the same time, the (LI) relay will close the fundamental tip and ring leads through the (STP) and (OFL) relay windings and the back contact of the (FO') relay. When the three-wire incoming selector advances to trunk closure position, the (STP) relay will operate, closing ground to the (SO) relay, which operates. As the incoming selector advances from position 11, the fundamental circuit will be opened and the (STP) relay will release, opening the shunt circuit around the (BO') relay. This relay will operate closing a circuit for the operation of the (OFL-1) relay and as soon as it is operated, the same ground through cam M, make contact of (OFL-1) relay interrupter F, cam U will cause the operation of the C1 relay. At the break of the interrupter F, relay (C2) operates closing a ground which operates relay (C). The same ground operates relay (S1) through make contact of (C) and back contact of BL key and (TL1) relay. With the (S1) and (C2)

relays operated, the R3 sequence switch is advanced from position 14. In case the incoming selector is of the non-synchronizing type the (TL1) relay is operated. Ground from the (C2) relay, operated, thru the (C) relay operated front contact of (TL1), operates the (BL) relay. Ground from cam (I3) thru contacts of (OFL-1) and (BL) relay, operates (S1) relay, closing the circuit to the R3 magnet, causing its advance from position 14.

23. OPERATE TEST OF (A) RELAY - When the test sequence switch is in position 15 and the incoming selector is of the 48 volt type, the fundamental tip and ring leads will be closed through the (A) relay operate resistance and the winding of the (P) relay. Battery on the tip lead from the incoming selector and ground on the ring lead will cause the (P) relay to operate. The operation of this relay will supply ground for the operation of the (SO) relay. Ground from the back contact of the (BO') relay will be supplied to the (F) interrupter, through the (OFL-1) relay, which is held locked in positions 14 and 15. This ground through the (F) interrupter will operate the No. 9 pair of counting relays. For each closure of the interrupter, the counting relays will advance until the fifth pair is reached. On the next closure, ground will be supplied for the operation of the (RP) relay and also for the operation of the (AT) relay. The (RP) relay will lock to the (L-3) cam and the operation of the (AT) relay will move the test sequence switch from position 15. In case the (A) relay of the incoming circuit fails to operate, the test circuit will remain in position 16 because the incoming circuit will not advance and therefore O.K. pulses cannot be given. In case the A relay releases while this test is being applied and the incoming advances so that the circuit to the A relay opens or in case the test circuit is in this position and the incoming advances through the reversed battery position the (P) relay will release thus permitting the (BO') relay to operate, thereby removing the ground for advancing the counting relays and the test sequence switch will remain in position 15.

Omit In case the incoming selector is of the three-wire type, the (LI) relay will be operated and ground will be supplied from the (J-3) cam which will operate the (RP) relay. The operation of the (RP) relay will reverse the winding of the (P) relay but this relay will not operate

because the fundamental circuit remains open at the incoming selector. The test circuit will advance as explained above but, in case of the final selector going to a busy line, the fundamental circuit will be closed at the incoming selector and the (P) relay will operate and, when the fundamental circuit at the incoming opens, the (P) relay will release. The action of the (P) relay will cause the (BO) relay to operate and then the (BO') relay to operate, removing the ground which causes the test sequence switch to move from position 15.

24. O.K. PULSES - When the test sequence switch is in position 16, the fundamental tip and ring leads are closed through the (A) relay operate resistance, (P) relay winding and back contact of the (FO') relay. The S and S1 relays operate to ground at the I3 cam. When the incoming selector advances to talking position and the final test line sends pulses, the (P) relay operates and in turn causes the (PH) relay to operate through a make contact of relay (S) and lock to the back contact of the (PH1) relay which released when the P relay operated. The final multiple test line circuit is arranged to send out a limited number of pulses. The first pulse is sent out for the purpose of synchronizing the automatic test circuit with that of the final multiple test line circuit. This pulse is of a certain time duration in order that it may be measured by the automatic test circuit. This time is measured by the operation of the (#9) and (#8) pairs of counting relays as follows: The (P) and (PH) relays operate as previously described. The ground from the back contact of the (AT) relay, through the (PH) and (CD-2) relays interrupter (H) through back contact of (CO) relay operates the (#9) counting relay. The locking ground supplied to the (#8) and (#9) pairs of counting relays is also received from the (AT) relay through the (PH), (CD-1), (C) and (S) relays. As the interrupter (H) opens, the (#9) counting relay operates and on the second operation of the interrupter, the (8) counting relay operates and on its break the (8') and (CI1) relays operate, the (CI1) operating through a make contact of relay (S) which operated in position 16. As the (H) interrupter makes the third time, the (SK1) relay operates and holds the (SK2) relay down as long as the (PH-1) relay stays normal. The (SK1) relay closes a circuit through the (#7) counting relay from ground on the contact of the (P) relay. If the pulse received from

the final multiple test line circuit is not long enough to hold the (P) relay operated until the (9) and (9'), (8) and (8') and (SK1) relays operate the 8 and 9 sets of counting relays will release and the automatic test circuit will not advance until it receives a pulse of the proper duration. Assuming satisfactory circuit operation, with the above relays operated upon the release of the (P) and (PH) relays, the (7') and (SK2) relays operate and the (9), (9') and (8), (8') relays release. The (SK1) and (SK2) lock to ground on cam I3. The final multiple test line circuit is arranged next to send two short soak pulses to the incoming supervisory relay which in turn is registered in the automatic test circuit by the operation of the (P) and (PH) relays over the same circuit as already described. The operation of the (PH) relay causes the (6), (6') relays on the first short soak (5), (5') and (CI) relays to operate on the second short soak. A second synchronizing pulse is received from the final multiple test line circuit which must be of long enough duration to permit the H interrupter to operate the (9), (9'), (8) and (CI2) relays. The (CI) relay being already operated transfers the operating circuit from the (SK) relays to the (CI2) relay which operates and locks to the off normal ground on cam I3. The (CI2) relay operated closes the circuit to the #4 counting relay. At the end of the second synchronizing pulse relay 4' operates. The final multiple test line circuit again advances sending two operate pulses to the incoming supervisory relay which are registered in the automatic test circuit by the operation of the (3), (3') (first operate test) (2) and (2') and (CO) relays (second operate test). The (CO) relay operated cuts in the (CD) relay removing a 500 ohm non-inductive resistance (A). The following operation takes place.

24.1 TWO-WIRE INCOMING The (CD) relay operates and in turn operates the (CD1) relay. A circuit is closed to the (#1) counting relay from ground at the (AT) relay through the (PH) relay which operated from ground at the back contact of the (BO') relay when the (CD) relay operated. The interrupter (H) which is in this circuit will cause the operation of the 1 counting relays and the (BO') and (FO') relays. As soon as the (BO') and (FO') relays operate ground is removed from the back contact of the (BO') relay and carried through the front contact to interrupter (F) and then to the (#9) counting relay; the same ground is also carried through the front contact of the (CD1) relay to provide the locking circuit for the (9) and (8) pairs of counting relays.

When the (8') relay operates, upon the next interrupter closure the (AT) relay operates and locks advancing the sequence switch from position 16.

24.2 THREE-WIRE INCOMING The (1), (1'), (FO) and (BO') relays operate over the same circuit as described in paragraph above under heading "Two-Wire Incoming" but upon the operation of the (BO') relay the ground on this front contact is carried to the front contact of relay (LI) which in turn advances the circuit from position 16.

24.3 SUPERVISORY RELAY FAILURES

(a) The supervisory relay may stick on soak and release tests as follows: During the first synchronizing pulse the (#9), (9'), (8), (8'), (SK1), (7) relays operate. The supervisory relay fails to release until after the first short soak has taken place in which case (7'), (SK2) relays operate. On the second short soak (6), (6') operate. During the second synchronizing soak the (9), (9'), (8), (8') and (SK) relays operate and the latter locks. The (SK) lamp lights as an indication of failure.

(b) The supervisory relay may chatter on soak and release tests as follows: During the first synchronizing soak the (9), (9'), (8), (8'), (SK1) & (7) relays operate. On the release of this synchronizing pulse the supervisory relay may chatter causing the (7'), (6), (6') relays to operate. On the first short soak test the (#5) counting relay operates and on its release the (5') and (CI) relays operate. On the second short soak the (CI) operates and on its release the (C2) operates and both relays lock to ground which in turn causes the operation of the (C) relay. The (C) relay operated opens the locking circuit 9 and 8 counting relays so as to prevent any further advance, and closes the circuit to the (CHA) lamp as an indication of the existing trouble.

(c) Failure of Operate Test The circuit functions the same as OK operations till it reaches the first operate test of the supervisory relay. If the supervisory relay does not operate the

required number of times, (normally two), the circuit will remain in position 16, whereby the trouble alarm will sound an indication of failure.

(d) Chatter on Operate Test - The circuit functions the same as OK operations until it reaches the first operate test. During the first operate, chatter is received which operates 3, 3', 2, 2', relays. On the second operate test of the supervisory relay the (C) relay operates and locks directly to ground. The chatter Lamp lights as an indication of failure leaving the circuit blocked. In all of the above failure condition the trouble alarm will be received as an added indication.

(e) Assuming OK circuit operation the (CD) and (CD1) relays operate, (testing the two-wire incoming selector circuit) the final multiple test line is so arranged that after the last two operate tests no more pulses are sent out. If for any reason the incoming (A) relay should release causing its associated selector to restore to normal, the (CD2) relay immediately operates and locks in series with the (CD1). This opens the circuit to the (#1) counting relay causing the test circuit to block. The trouble alarm is the indication of trouble. If for any reason an added pulse was received by the automatic test circuit, during the time the 1, (SO), (BO) and (FO') relays were counting down, the (P) and (C) relays would operate which will open the holding ground for the #9 counting relays causing the circuit to block. In case of a three-wire incoming if an extra pulse were received the (CD) relay would operate and in turn operate the (CD1) and upon its release the (CD2) relay will operate which in turn opens the circuit to the (#1) counting relay. The (P) and (PH) relays may operate if the pulse is long enough which in turn will cause the (CHA) lamp to light as a further indication of trouble.

25. SECOND (TG) TEST - When the (FO') relay operates while the test sequence switch is in position 16, the fundamental circuit is opened, permitting the incoming selector to advance from the talking position except in the case of

three-wire incoming. In this case, the operation of the (TI) relay opens the sleeve circuit, permitting the incoming selector to advance from a talking position. The test sequence switch being in position 17, with the fundamental tip and ring circuit closed through the (TG) or the (MTG) relays, will move from position 17 when the incoming selector returns to normal. This will take place due to the operation of the (AT) relay which will operate the (ST) and (CT) registers. The operation of the (CT) register will move the test sequence switch from position 17.

26. RETURN TO NORMAL - When the test sequence switch is in position 18, ground from the (CT) register, which was operated while the switch was in position 17, will cause the operation of the (ADV) relay. The operation of the (ADV) relay will cause the operation of the (LUS) relay which, in turn, operates the (RS-2) relay. The (TI) relay will operate when the (RS-2) relay operates and the test sequence switch will move from position 18 and return to normal.

27. ADVANCE DISTRICT OR OFFICE SELECTOR - The operation of the (ADV) relay, at the completion of the test of the first incoming selector, closes ground for the operation of the (LUS) relay. The operation of the (LUS) relay causes the (RS-2) relay to operate and also closes ground, energizing the units locating selector magnet. The (RS-2) relay closes a locking circuit for the (ADV) relay and also a circuit for locking itself. It also causes the (TI) relay to operate and closes ground for the operation of the (STP-1) and (RS) relays as soon as the test sequence switch returns to position 1. During the interval that the (RS-2) relay is operated, it is impossible for the (PB) relay to operate in case the (APB) key is operated due to a short circuit being connected across the (PB) relay. The operation of the (RS) relay causes the (RS-1) relay to operate and the up-drive magnet of the office or district selector is energized. The operation of the (RS-1) relay opens the operating circuit for the (STP-1) and (RS) relays but these two relays remain operated to the contact of the (STP-1) relay. As the elevator of the office or district selector passes the ground segment of the (C) commutator, the (STP-1) relay is released. When the (C) segment is broken, the (RS) relay releases, opening the circuit to the up-drive magnet and closing a circuit through the contact of the (RS-1) relay.

which remains operated to a ground at the (ADV) relay, for the operation of the (CR) relay when the (E) interrupter is closed. The operation of the (CR) relay opens the circuit to the (IUS) relay and this relay releases. It also closes a circuit from its own winding through the winding of the (DP) relay to ground. When the interrupter opens the circuit, the (DP) relay operates and, on the next closure of the interrupter, ground is supplied for the operation of the (RS-3) relay. This relay opens the holding circuit of the (RS-2) relay which releases. The (AV) relay then releases and likewise the (RS-3) relay. The release of the (ADV) relay permits the (RS-1) relay to release and this relay permits the (CR) and (DP) relays to release. When the (RS-2) relay releases, the operating circuit for the (TI) relay is opened and this relay will release unless the incoming circuit is busy. In case the incoming selector is not busy, the (TI) relay will release, causing the operation of the (TR) relay and the test on the second incoming selector will proceed.

When more than one group of incoming selectors are tested with a setting of the directing selector switch, it is necessary for the test circuit to pass by the overflow terminals associated with the particular incoming groups tested. The following circuit operation occurs: The (ADV) (IUS) and associated relays operate as described in the above paragraph and advance the district or office selector until an overflow terminal is encountered. The "Z" commutator will be made which supplies a ground operating the (ZC) relay. Arcs #4 of the tens and units locating selectors are arranged so that when an overflow terminal is encountered, the terminal setting of these arcs should correspond with the overflow terminal number on the district or office bank. Assuming this to be correct, a circuit is closed through arcs 4 of the tens and units locating selectors, make contact of (ZC) relay, to ground on a normal contact of the (CR) relay, operating the (ADV) relay. The (ADV) relay operating, operates the (IUS) relay. The operation of the (IUS) relay causes the (RS-2) relay to operate. The district or office selector will advance from the overflow terminal and the tens and units selectors will advance in the same manner as described in the preceding paragraph. The (ZC) relay releases when the district or office selector advances from the overflow terminal which opens the operating path of the (ADV) relay and also supplies ground from the E2 cam in preparation for the operation of the (PB1) relay in the event the next terminal encountered by the district or office selector after the overflow terminal, was busy. In the event the tens and units

selectors are not resting on terminals corresponding to the overflow terminals, due to some fault in the stepping part of the test circuit, the circuit required for the operation of the (ADV) relay will be open causing the test circuit to block as an indication of trouble.

28. DISTRICT OR OFFICE ELEVATOR RETURNED TO NORMAL When the last incoming circuit in a consecutive group has been tested, the office or district selector will step to the overflow terminal above this incoming circuit. This will cause the (ZC) relay to operate over the TA lead and the locating selectors will step to the corresponding overflow terminal. While these selectors are on this point, ground will be supplied to the (OU) and (OT) relays directly from the end of test group connecting block used in conjunction with the (C) arc of the directing selectors or through the (NT) and (NN) relays. The (NT) relay is operated in case the overflow terminal is the 93rd terminal. When the (NT) relay is operated, ground will be connected to the No. 4 terminal of the unit's locating selector and also to the No. 10 terminal of the tens' locating selector. If the overflow terminal is No. 99, the (NN) relay will be operated and ground will be connected to the No. 10 terminal of the tens' locating selector and to the No. 10 terminal of the units locating selector. In case the overflow terminal is No. 43, ground will be supplied directly to the No. 5 terminal of the tens' locating selector and through the back contact of the (NT) relay to the No. 4 terminal of the unit's locating selector. For all other overflow terminals, ground will be supplied directly to the terminals from the test group connecting block.

The operation of the (OU), (ZC) and (OT) relays will close a circuit which will move the connector control switch from position 7. When the connector control switch moves to position 8, the down drive magnet of the office or district selector will be energized over the TD lead and when the selector reaches the (T) commutator, the connector control switch will be moved from position 8 over the TY lead into position 1, provided the (CH) and (CH-1) relays are operated.

29. ADVANCEMENT OF DIRECTING SELECTORS While the connector control switch is in position 8, ground will be supplied for the operation of the (SP) relay and this relay will supply ground to the pair of directing selectors which are connected according to the (DA) to (DX) relay which is operated. The circuits for energizing the directing selectors are carried through the (CH) and (CH-1) relays as a check that the circuits are closed. As the connector control switch moves from position 8, circuit to the (SP) relay is opened and the directing selectors will advance one terminal. This will continue each time a district or office test selector is restored to normal. When the first pair of directing selectors has advanced to the 21st terminal, the (DA) and (DA-1) relays will operate. The operation of these relays will cause the second pair of directing selectors to move from normal and these selectors will complete a number of tests in the same manner as the first directing selector. When this switch reaches the 21st terminal, the (DX) and (DX-1) relays will operate, moving the next directing selector from the normal position. This action will continue until all incoming selectors have been tested and the end of cycle point has been reached.

30. SELECTION OF SECOND DISTRICT ELEVATOR When a directing selector has advanced to a terminal where arc L is connected to a different brush at cam (B) of the connector sequence switch, this switch will move from the first position to another position which is connected to a different district or office test selector or will return to a normal position if a second connector sequence switch is to be used for making connection to the new district or office test selector.

ADVANCING TO DISTRICT OR OFFICE CONNECTED TO THE SAME CONNECTOR SEQUENCE SWITCH Assume that the first connector sequence switch is resting in position 5 and that for the new setting of the directing selector, ground is supplied to SS-2-B1A. This ground will move the connector sequence switch from position 5 to position 8. In position 8, ground will be supplied at cam (W) through the other normal connector switches

to cam (B1A) and the switch will advance to position 10. In position 10, a test will be made of the new district selector as described for the first district selector chosen.

DISTRICT OR OFFICE TEST SELECTOR CONNECTED TO A DIFFERENT CONNECTOR SEQUENCE SWITCH THAN THE FIRST DISTRICT SELECTOR Assume that the first connector sequence switch is resting in position 5 and the district or office test selector corresponding to the new setting of the directing selector is connected to the second connector sequence switch and that ground is supplied to the lead connected to SS-3-B1B. The ground supplied to the (B) cam of the second connector sequence switch will move this switch from position 1 to position 2. In position 2, ground from SS-2-W1B will be connected through other normal connector sequence switches to SS-4-B1A. This switch will advance to position 7, which is a normal position, and the ground will then be transferred to SS-4-B1B and this switch will move to position 4. Ground from the L arc of the directing selector will advance the switch to position 8. In position 8, ground from the (W1B) cam will advance the switch to position 10 and ground from the L arc of the directing selector will advance the switch to position 14. In position 14, a test will be made of the district test selector which is connected to this connector sequence switch.

31. CONCLUSION OF A ROUTINE TEST When all incoming circuits have been tested, the last pair of directing selectors will advance to the 21st terminals when the connector control switch is returning to normal, thereby releasing the district or office test selector. With the last pair of directing selectors in position 21, the end of cycle (EC) lamp will be illuminated, it being connected to terminal 21 of arc H of the last directing selector of the last pair. Due to the 21st terminals of the last switches not being connected for making a test, the test circuit will not advance and the (EC) lamp will be illuminated as a signal that all incoming selectors have been tested. In addition to this final end of cycle point, in offices having two incoming selector automatic test frames,

there will be an intermediate end of cycle point approximately at a point when one-half of the incoming selectors have been tested. In this case, the (EC) lamp will be cross-connected to the terminal of arc H of the directing selector corresponding to this point. All other terminals of this position of the directing selector will be vacant and the test circuit will stop. In order to pass this point, the restore to normal key will be operated and all directing selectors will return to normal. In order to start testing in the second group of office selectors, the particular circuit keys will be operated to direct the test circuit to the first incoming slector in the second group.

If another cycle is not desired, the (ST) key is released and the (RN)key is operated. The operation of the (RN) key operates the (HR) relay in turn operating the (RN-1) and (RN) relays. The operation of the (RN) relay will cause the 1st directing selector of the last pair to step from the 21st terminal to normal where this switch will remain due to the ground which is connected to the normal terminals being open. The (ST) relay, which operated when the (DY) selector was on the 21st terminal will now release and this will connect the circuit for moving the 2nd selector of the last pair to the normal position. The pair of directing selectors preceding the last pair of directing selectors will likewise be moved from the 21st terminal to their normal terminals and the (DX) and (DX-1) relays will release. The release of these relays closes ground which will move the preceding pair of directing selectors to normal and this will continue until all directing selectors are resting on the normal terminals. The operation of the (RN-1) relay will close a circuit for the release of the (D) keys should they be operated when the (RN) key is released. This relay will remain locked until the particular circuit keys are released. In case the intermediate end of cycle point is reached, the (RN) key will be operated. Assuming the intermediate end of cycle point to be on the second pair of directing selectors the operation of the (RN-1) relay, which operated from the contacts of the (HR) relay when the (RN) key was operated, will connect ground through the winding of the (IR) relay to intermediate end of cycle terminals of the No. 1 arc of the 1st of the second pair of directing selectors the (DY-1) relay having operated due to cross-connection at the busy ground block. This will cause the directing selector to return to the 21st terminal and, when

it reaches the 21st terminal the second selector of the pair will return to the 21st terminal, the DX relay having operated due to the strapping at the C arc of the 1st selector and K arc of the second selector. This will cause the (DX-1) relay to operate and the 1st selector of the pair will move to normal releasing the (SX) relay. The 2nd selector of the pair will then return to normal.

32. RESTORE TO NORMAL In case it is desired to restore the test circuit to normal at any time, the (RN) key will be operated. This will cause all directing selectors which are resting on the 21st terminal to restore to normal. The directing selectors which are not on the 21st terminal nor in normal position will remain in this position due to the ground which advances this switch being open when the connector control switch is in all positions except 18, 1, 9 and 10. The test on the incoming circuit under test will be completed and, as the test sequence switch moves to position 1, ground will be supplied from the (RN) key which will move the connector control switch from position 7. This switch, moving from position 7, will release the district or office test selector and when it returns to position 1, the directing selector will advance to position 21. When in position 21, the corresponding (DX), (DX-1) and (SX) relays will operate. This will connect ground to the 21st terminal of the first of the pair of directing selectors. This selector will move from the 21st terminal, releasing the corresponding (SX) relay and ground will be closed to the 21st terminal of arc No. 1 of the second directing selector of the pair and this selector will move to normal.

33. PARTICULAR CIRCUIT TEST When it is desired to test a particular circuit or to start the automatic test at some point other than the fixed automatic starting point, the (PC) key is operated. One of the (U) keys is operated which governs the position to which the directing selector advances. One of the (T) keys is operated if the directing selector is to advance beyond terminal 9, the No. 1 key for terminals 10 to 19 and the No. 2 key for terminal 20. One of the (D) keys is operated in order to select the proper pair of directing selectors if more than one is installed. The (GN) key, corresponding to the district or office multiple group in which the incoming selector which is to be tested appears, is operated so that the district or office elevator will progress to this group.

By the operation of the (TWB) key, ground that is supplied from the (PC) key will be connected to the winding of the (DA) and (DA-1) relays. When the (TWC) key is operated, this same ground will be connected to the (DX) and (DX-1) relays and, when the (TWD) key is operated, this ground will be connected to the (DY) and (DY-1) relays and so on. If the (TWA) key is depressed, this ground will be connected to the normal point of the directing selector the same as for a regular automatic test. Upon the operation of one of the (TWA), (TWB), (TWC), etc., keys will depend which directing selector will move from its normal terminal. In order to reach any incoming selector, it must be known in which group of consecutive selectors it lies and there is a position of each directing selector corresponding to a group of consecutive selectors. This will determine which selector is to be chosen for the start of a particular circuit test. By the operation of the (PC) key, ground is supplied to all the (U) keys and to the (T) keys. With these keys normal, this ground will be connected to the first twenty terminals of arc No. 1 of the directing selector. The operation of any one of the (U) keys and the (T) keys normal will open the ground from the corresponding terminal of the first and second ten terminals of arc No. 1 of the directing selector. The operation of the (T) key No. 1 will close ground from the (PC) key to the terminal of the first nine terminals corresponding to the (U) key which is operated and the switch will pass over this point to the terminal between 10 and 19 inclusive corresponding to the (U) key which is operated. With the (T) key No. 2 operated and the (U) key No. 0 operated, ground will be supplied to the first 19 terminals and the selector will stop on the 20th terminal. The operation of any one of the (GN) keys transfers the ground supplied at SS-1-12 from the brush of arc J of the directing selector to the lead connected to terminal of J arc of the directing selector which corresponds to the operated key. This transfer cancels the district or office group setting as designated by the directing selectors and substitutes therefore a district or office group setting according to the (GN) key which is depressed. The (PC) key, when operated, opens the sleeve lead that is connected to the office sleeve and closes ground to the locking contact of the (TI) relay. When the above keys are set, the operation of the start key will start the test set functioning and it will advance to a point where the district group is selected but will not proceed to test because of the operated condition of the (TI) relay due to the ground supplied by the (PC) key. At this point, the connector control sequence

switch will be in position 7 and the district selector will be resting on the first terminal of the district or office multiple group. In order to reach the particular circuit, the (MPB) key or the (APB) key is operated. This will elevate the district selector to a higher terminal. By the operation of the (MPB) key, the short circuit around the (PB) relay is removed and this relay operates through the primary winding of the (TI) relay to ground through the (PC) key and the back contact of the (ZC) relay. Ground through the contact of the (PB) relay causes the operation of the (PB-1) relay which locks to the back contact of the (DP) relay. The operation of the (PB-1) relay closes ground for the operation of the (ADV) relay, this relay in turn closing ground for the operation of the (LUS) relay. The (LUS) relay supplies ground for the operation of the (RS-2) relay which, in turn, operates the (RS) and (STP-1) relays. The operation of the (RS) relay closes the circuit for the operation of the (RS-1) relay and also closes ground for the operation of the up-drive magnet of the district or office selector. The operation of the (RS-1) relay also opens the operating circuit for the (RS) and (STP-1) relays but these two relays lock to the contact of the (STP-1) relay. When the (C) commutator of the district selector closes ground from the ground segment to the (RS) relay, the (STP-1) relay releases and, as the commutator segment opens, the (RS) relay releases, stepping the up-drive of the district selector. The release of the (RS) relay also closes ground through the (E) interrupter for the operation of the (CR) relay, which releases the (LUS) relay and shunts down the (PB) relay. It also closes a contact which connects the winding of the (DP) relay to a contact of the (RS-1) relay so that when the interrupter breaks, the (CR) relay will remain operated and the (DP) relay will operate. When the (DP) relay operates, the locking ground for the (PB-1) relay is removed and this relay releases, opening the operating ground for the (ADV) relay. On the second closed period of the interrupter, ground is supplied for the operation of the (RS-3) relay provided the (MPB) key has been released. The operation of this relay opens the holding circuit for the (RS-2) relay and it releases. The release of this relay opens the holding circuit for the (ADV) relay, permitting it to release. Upon the release of the (ADV) relay, the holding ground for the (RS-1) relay is removed and this relay

releases, permitting the release of the (DP) and (CR) relays. At the second operation of the (MPB) key, the entire cycle of operation will be repeated and this will be continued until the district selector is resting on the proper terminal in the district or office multiple group. By the operation of the (APB) key, the district selector will be advanced automatically by the same action as with the manipulation of the (MPB) key, the only difference being that if the (MPB) key remains operated, the circuit cannot advance until it is released or the (MPB) key cannot be operated a second time if it has been released before the (DP) relay operates, otherwise the (DP) relay would remain operated due to the (RS-3) relay not being permitted to operate due to its operating circuit being opened at the (MPB) key. The release of the (APB) key will stop the advancement of the district selector. When the district or office selector is properly located on the desired district or office multiple terminal, which can be determined by the operation of the (LP) key, thus illuminating the locating lamps, the (PC) key is released. The release of the (PC) key will remove the ground from the (TI) relay winding and connect this winding to the test selector. If the incoming selector is busy, the (TI) relay will remain operated. If not, this relay will release and permit the test circuit to function the same as in a regular test.

34. ALARM SWITCHES

34.1 BUSY TIMING SELECTOR When the start key is operated, ground is supplied through the (TR) relay rack contact to the (BY) relay winding. This relay operates and locks to the same ground. The operation of the (BY) relay connects interrupted ground to the terminals of arc No. 3 of the busy timing selector switch, which steps the selector one terminal for each closure of ground. The period of the interrupter closed and open periods is one-half minute. Therefore by varying the strapping of arc No. 3, various times may be had before the brush of this arc arrives at an open terminal, stopping this switch. If the selector advances to the open terminal of arc No. 3 before the (TR) relay operates due to the district or office selector being busy, ground from the (BY) relay through No. 2 arc, through the (BY) lamp to

battery at the alarm circuit will cause the lamp to illuminate as a busy signal. The connection at terminals of the No. 2 arc is made on a terminal corresponding to the open terminal of the No. 3 arc. If the district or office selectors are not busy, the (TR) relay will operate before the selector has an opportunity to arrive at the open terminal of arc No. 3. The operation of the (TR) relay will release the (BY) relay and ground from its back contact through arc No. 1 of the selector will cause the switch to return to normal, thereby not closing the circuit to the busy lamp. If the switch advances due to a busy condition, the alarm can be stopped by the operation of the (TA) key. The (BY) relay will release and the switch will return to normal due to the ground being supplied through the back contact of the (BY) relay, through the No. 1 arc to the magnet.

34.2 TROUBLE TIMING SELECTOR When the (TR) relay operates, ground is supplied to the (W) cam of the test sequence switch in position 1 and when the test sequence switch moves from normal, ground is supplied to the (W) cam by the No. 4 brush. Thes grounds are connected through the (TA) key to the (TBL) relay. The (TBL) relay will operate and lock to the same ground and will also close interrupted ground, whose period of open and closed circuit is one-half minute, to the No. 3 arc terminals to the stopping magnet and the switch will step one point every half minute. By varying the number of terminals connected consecutively on the No. 3 arc, the total time for the switch to step to an open terminal will be regulated. If the selector advances to an open terminal of arc No. 3 before the test sequence switch has made complete tests of the office selector, ground from the (TBL) relay through arc No. 2 will operate the (TBL) register which, in turn will cause the lamp to illuminate as a trouble indication and also cause the alarm circuit to function. The register will record that a trouble has been encountered. The connection at the terminal of the No. 2 arc is made on terminals corresponding to the open terminals of arc No. 3. When the switch has advanced to a trouble position, it can be released by the

operation of the (TA) key. This will cause the operation of the (TBL-1) relay, thus opening the circuit to the (TBL) relay. This relay will release and close ground through its back contact to the No. 1 arc terminals which are strapped, except in the normal positions of the switch, to the interrupter contact of the stepping magnet and the switch will return. If the test circuit is advanced without the operation of the (TA) key, the (TBL) relay will be released when the test switch returns to normal and the trouble timing selector will return to normal in the same manner as if the (TA) key had been operated. When an O.K. test is made, the test sequence switch will return to normal before the trouble timing selector has advanced to an open terminal on arc No. 3. The (TBL) relay will therefore release, closing ground from its back contact, through the No. 2 arc to the stepping magnet and the timing selector will return to normal.

35. ADVANCEMENT OF TEST SEQUENCE SWITCH BY (CA) KEY - In case the test sequence switch stops in any position between 2 and 15, due to failure of the district, office or incoming selectors to properly function, the operation of the (CA) key will cause the (CA) relay to operate, thereby moving the test sequence switch directly to position 16. The operation of the (CA) relay will also close the circuit for the operation of the (CA-1) relay and also close a circuit for the operation of the (SO) relay when the test sequence switch is in position 16. The (CA-1) relay having operated, will remain operated as long as the test sequence switch remains in position 16. The (CA-1) relay, when operated, will close the fundamental tip and ring leads, by passing all equipment. The test sequence switch will remain in position 16 until the (CA) key is released, permitting the (CA) relay to release. This will remove the ground from the winding of the (SO) relay which will permit the (BO') relay to operate. The operation of this relay will close ground through the interrupter to the (#9) counting relay. Upon the operation of the (8') relay as the interrupter circuit closes its contact, the (AT) relay operates through a make contact of the (CA1) relay. This advances the sequence switch from position 16. The switch will remain in position 17 until the (TG) or (MTG) relays operate, causing it to move to position 18. The test sequence switch will then move to normal in the ordinary way.

In case a closure is not given, which will operate the (TG) or (MTG) relays, upon the second operation of the (CA) key, the (CA) and (CA-1) relays will again operate and the (AT) relay will operate over a circuit through the (CA-1) relay. When the (CA) relay releases upon the release of the CA key the switch will move from position 17. The switch will move from position 18 over the regular circuit through the (TI) relay.

36. REPEAT TEST In case it is desired to repeat a test on a given incoming selector, the (REP) key will be operated before the test sequence switch arrives in position 17. With the (REP) key operated, ground will be supplied for the operation of the (REP) relay. If the (REP) key is released, after once being operated, before the test sequence switch returns to normal, the (REP) relay will remain operated until the test sequence switch moves from position 18. The operation of the (REP) relay transfers the lead for the operation of the (CT) register in case of regular test to the (RST) register in order to register a repeat test. This register operates when the test sequence switch is in position 17 and its operation connects ground to the rotor magnet and the test sequence switch will move from positions 17 and 18 to normal. In case a three-wire incoming is being tested with the (APB) key and the (REP) key operated, when the (TI) relay is operated while the test sequence switch is in position 16 so that the incoming selector will be released, it will be impossible for the test circuit to advance to the terminal higher up because of a short circuit which is placed around the (PB) relay while the (REP) relay is operated.

37. BRUSH CONTINUITY 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 (B) and (G) keys, will transfer the leads which are connected to the counting relays for incoming brush and incoming group selections to any desired set of counting relays so that any incoming brush may be connected in any incoming multiple bank group. It will also transfer the lead connected to the counting relays governing final brush selections to the counting relays which will select the #1 final brush. The lead which is connected from cam (U-3) to the ninth pair of counting relays as a counting device when the test sequence switch is in position 15 will be connected to the fifth pair instead, thus cancelling the

period of time that is required in a regular test. The lead over which the closure is made for the fundamental tip and ring leads in a regular test, while final tens and final units selections are being made, will be opened. A closure will be made for the operation of the rotor magnet when the test sequence switch is in positions 8 to 12 and it will therefore move from position 8 directly into position 13. In position 13, the operate test for the (L) relay of the incoming will be applied and the test sequence switch will move to position 15, the action being the same as in a regular test. In position 15, the time element will be cancelled and the switch will move from position 15 as in a regular test with this exception. The (SO) relay will be operated. The operating circuit for this relay will open as the switch moves from position 15 and the (SO') relay will operate. In position 16 the #9 counting relay is in circuit as already described, but the locking ground supplied to the (9) and (8) pair of counting relays is received from the (BC) key, which is operated. As soon as the (8') relay operates upon the next interrupter closure the (AT) relay operates through the BC key operated and in turn advances the test circuit from position 16.

38. AUTOMATIC PASS BUSY If it is desired to pass all incoming selectors which are busy rather than to wait for them to become idle, the (APB) key will be operated so that the test set will automatically pass a busy selector. By the operation of the (APB) key, a circuit which normally short-circuits the (PB) relay is opened. Therefore, in case an incoming selector is busy when the test circuit is making the test for busy, the (PB) relay will operate. The operation of the (PB) relay will close a ground for the operation of the (PB-1) relay. The operation of the (PB-1) relay will close a contact for operating the (BY) register. It will also cause the (ADV) relay to operate and will lock itself to the back contact of the (DP) relay. The operation of the (ADV) relay will close the operating circuit for the (LUS) relay and lock itself to the make contact of the (RS-3) relay when this relay operates. The operation of the (LUS) relay will supply ground for operating the (RS-2) relay which, will operate the (RS) and (STP-1) relays. The operation of the (RS) relay will supply ground for the operation of the (RS-1) relay and, when this relay operates, the up-drive of the office or district selector will be connected to ground. When the district selector has

stepped one terminal, the (RS) relay will be released, closing ground through the interrupter for the operation of the (CR) relay when the interrupter contacts are made. The operation of the (CR) relay will release the (LUS) relay, permitting the locating switch to step and will also place a short circuit around the (PB) relay, causing it to release. When the interrupter breaks its contact, the (DP) relay will operate, opening the holding ground from the (PB-1) relay, which will release, in turn removing the operating ground from the (ADV) relay. At the second closure of the interrupter, the (RS-3) relay will operate, opening the holding circuits for the (RS-2) relay. The release of the (RS-2) relay will permit the (ADV) relay to release, in turn releasing the (RS-1) relay. The (RS-1) relay releasing, will release the (CR) and (DP) relays. At the time the (RS-2) relay releases, the operating circuit for the (TI) relay will open and this relay will release unless the incoming selector to which the district or office selector advances is busy. This relay will release and a test of this circuit will be made. If the incoming selector is busy, the (TI) relay will not release but the (PB-1) relay will operate and the district selector will advance to the next terminal. If the (REP) key is operated while the (APB) key is operated, the function of the (APB) key is cancelled so that the district or office selector will not advance to the next office selector. This cancellation is made when the (REP) relay operates.

39. MANUAL PASS BUSY When the test circuit is advanced so that the district selector is resting on a busy incoming, the (TI) relay will remain operated. The operation of the (MPB) key will remove a shunt circuit around the (PB) relay which is in the holding circuit for the (TI) relay. This will cause the (PB) relay to operate. The operation of the (PB) relay will cause the operation of the (PB-1) relay. This relay will function all other relays, as explained under "Automatic Pass Busy", advancing the district selector to the next higher terminal. However, the circuit cannot advance when the (CR) and (DP) relays and interrupter have completed their function because of the operating circuit for the RS-3 being open. When the (MPB) key is released the (RS-3) relay will operate, releasing all other operated relays.

40. RAPID TEST TO BUSY LINE INSTEAD OF FINAL TEST LINE When it is desired to make a rapid test by calling a busy

line rather than the final test line multiple, the (BL) key will be operated. The operation of this key prepares a circuit for the operation of the (BL) relay and also transfers the leads which are connected to the counting relays for directing the incoming and final selectors to test line multiple to different counting relays which will direct the incoming and final selector to a busy line. It will open the fundamental tip and ring circuits when the test sequence switch is in position 15 except in the case of a 24 volt incoming when the (TF) relay will be operated. With 24 volt incomings, due to a transfer at the (BL) key, a non-operate test of the incoming (A) relay will be made. It will close ground for the operation of the (RP) relay when the test sequence switch comes into position 15 and also for the operation of the (AT) relay. In position 14 upon the operation of (C), (C1) and (C2) relays, the ground on the make contact of the (C2) relay operates the (BL) relay instead of the (S1) relay. This closes a ground from cam 13 position 14 through a make contact of the (BL) relay which operates the (S1) relay and the sequence switch then advances from position 14 in the regular manner. In case the incoming selector is of the three-wire type, the (AT) relay will not be operated in position 15, and, in case the incoming selector is of the 24 volt type, neither the (RP) nor (AT) relays will be operated in position 15. The test circuit will function the same as for an automatic test until it reaches position 15. At this point, there will be three different ways of operation according to the type of incoming. For a 48 volt incoming selector, the fundamental circuit will be opened. Ground will be supplied from the (J-3) cam through the (BL) key for the operation of the (AT) and (RP) relays. The operation of the (AT) relay will move the test sequence switch from position 15 and the operation of the (RP) relay will reverse the (P) relay. When the test sequence switch moves to position 16 the fundamental circuit will be closed to the (P) and the (S1) relay will release. The (P) relay will operate on the reversals from the busy line in turn operating the #3, #2 and #1 pairs of counting relays and the SO, BO', and FO' relays. When the (BO') relay is operated, the operation of this relay closes a path to the (#9) counting relay and a ground is supplied to the (#9) and (8) counting relays for their locking path from the (BL) relay. Upon the operation of (8') relay and on the next closure of interrupter F a circuit is closed through the front contact of the (BL) relay to operate the (AT) relay whereby the circuit advances

out of position 16 as already described. It will remain in position 17 until the incoming has returned to normal, satisfying the (TG) test. The test sequence switch will then move to normal position the same as in a regular automatic test.

In case a 24 volt incoming is being tested, the (TF) relay will be operated. This will open the lead which operates the (RP) and (AT) relays when the test sequence switch moves to position 15, as was the case with the 48 volt incoming selector. It will close the fundamental tip and ring circuit through an 8000 ohm resistance. This will act as a non-operate test on the (A) relay of the incoming circuit. In position 15, the (P) relay will operate, in turn operating the (SO) relay. The (OFL-1) relay will operate in position 14 and remain operated in position 15 and therefore ground from the back contact of the (BO') relay will be supplied through the interrupter to the No. 9 pair of counting relays. The counting relays will advance for each closure of the interrupter and finally a ground will be supplied to the (H-3) cam for the operation of the (RP) and (AT) relays. This interval required for the operation of the counting relays will permit the incoming selector to advance, in case the (A) relay operates falsely, sufficiently to permit the reverse battery to cause the release of the (P) relay, thereby allowing the (BO') relay to operate, opening the ground from the interrupter and prohibiting the test sequence switch from moving from position 15. If the (A) relay does not operate, the ground which will be supplied to the (AT) relay will cause its operation and the switch will move from position 15. The operation of the (RP) relay will reverse the (P) relay. When the test sequence switch moves to position 16, the action will be the same as for 48 volt incoming selector. In case the incoming selector is a three-wire type, the (LI) relay will be operated. The action under this condition will be the same to position 15 as for any three-wire incoming. When the test sequence switch is in position 15, ground will be supplied to the (RP) relay which will reverse the (P) relay. Ground will be supplied from the back contact of the (BO') relay to the interrupter for the operation of the No. 9 pair of counting relays. The counting relays will advance until ground is supplied for the operation of the (AT) relay. The operation of the (AT) relay will move the test sequence switch

from position 15. When the test sequence switch is in position 16, the ground which was supplied for advancing the other two types of incomings is transferred for the operation of the (T1) relay. The operation of the (T1) relay will release the incoming circuit and advance the test sequence switch from position 16. From this point, the action is the same as for a regular automatic test.

41. MEANS FOR DIFFERENTIATING BETWEEN SYNCHRONIZING OR NON-SYNCHRONIZING FINAL MULTIPLE TEST LINE CIRCUITS By means of cross-connections at the busy ground block used in conjunction with the directing selectors, the TL-1 relay will be controlled. Where final multiple test lines are of the synchronizing type and the associated district test selector is of the sender selector type, cross-connections should be made to the "R" terminal. If the associated district selector is of the panel link type cross connections should be made to the "AE" terminal. Where final multiple test lines are of the non-synchronizing type and associated with sender selector type districts, cross-connections should be made to terminal "TLR". When associated with rotary link districts, cross connections should be made to terminal "TL" and when associated with panel link districts cross-connections should be made to terminal "AF". The circuit functions the same as described above up to position 16. In position 16, with the (TL1) relays operated, a circuit is closed for the operation of the (BL) relay, the circuit to (S1) relay being opened. The (P) and (PH) relays will pulse from the final multiple test line circuit and upon the first operation the (#3) counting relay operates. The second pulse operates (#2) counting relay and continues on until the (FO') and (BO') relays operate. Ground from the (BO') relay closes the circuit for operating the 9 and 8 pair of counting relays in order to advance the circuit from position 16, as already described.

42. TEST TO BE STOPPED If it is desired at any time to stop the automatic advancement of the test circuit, the (ST) key will be released. This will open the ground which moves the connector control sequence switch out of position 1. It will close a ground which will move the connector control sequence switch from position 7 when the test sequence switch has returned to normal. When the connector control sequence switch moves to position 8, the district or office selector down-drive will be connected and will return to normal. The district or office selector, returning to normal, moves the connector control sequence switch from position 8. In position 9/10 the connector sequence

switches will return to a normal position. The holding ground for the (CON) and (ST) relays will be opened and these two relays will release. The directing selector, however, will remain in the position where it was when the (ST) key was released. The test circuit cannot proceed because of the circuit being opened which moves the connector sequence switch from position 1. However, if an incoming selector is being tested, the test on this circuit will be completed because the release of the (ST) key has no control over the test of an incoming circuit once it has started and the connector control switch cannot return to normal until the test sequence switch has returned. If it is desired to start the test again, the (ST) key will be operated and the test circuit will start to test on the first trunk in the consecutive group as designated by the directing selector setting.

43. RETURN OF TEST CIRCUIT TO NORMAL If is is desired to return the test circuit to normal, the (RN) key will be operated. This will cause the operation of the (HR) relay and in turn the (RN-1) relay. The (HR) relay is locked to the (IR) relay which operates through the magnet winding of the (D) switches while they are returning to normal, and also to the (D) keys if they should be operated for a particular circuit test. The operation of the (RN-1) relay will close a circuit for the release of the (D) keys, the action taking place when the (RN) key is released. It will also open the operating circuit which moves the directing selectors from normal. The operation of the (RN) key will close ground for moving the connector control switch from position 7 when the test sequence switch returns to normal at the completion of the test on the incoming selector which is being made at the time the (RN) key has operated. The (RN-1) relay will also supply ground for restoring the directing selector switches from the 21st terminal and open the circuit which moves all directing selectors, except the first, from their normal positions. The (HR) relay, when the (RN-1) relay operates will supply ground for the operation of the (RN) relay which may have released if the (ST) key was released, permitting the release of the (CON) relay before the (RN) key was operated. The circuit which moves the connector sequence switches will be open and ground through the winding of the (IR) relay will be supplied for moving any directing selector, which is not on the 21st terminal, to the 21st terminal.

When the connector control sequence switch moves to position 9, the connector sequence switch, which is off-normal will return to normal. Before the connector control switch can return to normal, the test sequence must have completed the test of the incoming selector to which it was connected. Therefore, all parts of the equipment will be in a normal position except the (D) keys if they are operated. Upon the release of the (RN) key, the (D) keys will release.

44. RELEASE OF UNITS, TENS, TWENTIES AND GROUP NUMBER KEYS When the test circuit is advanced so that the connector control sequence switch is in position 7, the (U) and (T) and (GN) keys will be released through the contacts of the (A) and (G) interrupters. The (D) keys will release at the release of the (RN) key, it having been operated to restore the test circuit to normal. In case any (U) or (GN) keys are operated when the (PC) key is normal, they will release with the connector control switch in position 1.

45. REMOTE CONTROL ADVANCE If it is desired, a jack may be located in the jack box at each incoming selector frame as shown in Figure "A". In case this figure is used, the jack will be connected to ground at the repeat key and to the (CA) relay winding so that the keys in the 3-A test set may be used in place of the (CA) key of the test circuit. It is possible to use this remote control only when the (REP) key is operated. The action of the key is the same as explained under "Advancement of Test Sequence Switch by (CA) Key".

46. TEST CIRCUIT ADVANCED FROM BUSY DISTRICT OR OFFICE In case the district or office selector which is to be used as a connector is busy, the connector control circuit will remain in position 1 or 2, depending on the type of district. The test circuit may be released from this position by the release of the (ST) key. This key closes ground through the (S) cam of the connector control switch to the (B) cam of the connector sequence switch which is off-normal, causing that switch to return to a normal position. When this switch comes to normal position, the holding ground of the (ST) relay is opened and the relay releases, the holding ground at the (ST) key having been removed when the key was released. The release of the (ST) relay will permit the (SM) relay to release, removing the operating current from the (CON) relay and the release of

the (ST) key and (ST) relay will remove the holding ground from this relay and the relay will release. The release of the (CON) relay will close ground to the (B) cam of the connector control switch and this switch will move to position 9, which is a pass-by position, and then into the normal position. The directing selectors will be restored to normal by the (RN) key. By the operation of the (PC) key and the (U), (T), (TW) and (GN) keys, the test may be started with some other district.

47. END OF CYCLE POINTS In case one test circuit is used in an office, there will be an "end of cycle" point after all incoming selectors have been tested. An "end of cycle" lamp, in this case, will be connected to the 21st terminal of the last directing selector as a signal that the test is completed. The test circuit will not advance from this point but will remain until returned to normal for another cycle of test. When two test circuits are installed in the same office, there will be an intermediate end of cycle point as well as the final end of cycle point. This intermediate end of cycle point will be at a point where approximately half of the incoming selectors have been tested. In this case, the (EC) lamp will be connected to the 21st terminal of the last directing selector and, likewise, connected to some point on one of the other directing selectors by means of a cross-connecting block used in conjunction with the (H) arc of the directing selectors. On all arcs of the directing selectors, the terminals corresponding to the position where this lamp is connected will remain open except the (K) and (G) arcs. In the case of the (K) arc, a connection will be run from the terminal to the 21st terminal of arc (K) for the operation of the (TY-1) relay. It is necessary to operate this relay so that, when returning to normal, ground will be supplied to the terminal on arc (G) corresponding to the intermediate end of cycle point. When the test circuit has progressed over approximately half of the incoming selectors, the test circuit will stop on the intermediate end of cycle point. It will be returned from this point by the operation of the (RN) key and a new test started in the second half by means of the particular circuit keys.

48. OVERFLOW TERMINAL CHECK The terminals of arc No. 4 of the locating selectors are so connected that when the selectors are setting in positions corresponding to the overflow terminals on the district or office frame multiple, a circuit is closed for advancing the R-2 switch from

Pos. 7 as a check that the test elevator is on an overflow terminal. If the locating selectors are not on terminals corresponding to an overflow terminal of the district or office multiple and the district selector is on an overflow terminal, the test circuit will fail to advance. This will show that the test selector has either overstepped or understepped and that all failures in the group just passed over cannot properly be recorded from the locating lamps as the lamps would not show the exact terminal on which the district elevator was resting when the failure occurred.

49. INDICATION OF TERMINALS TO WHICH THE DISTRICT CONNECTOR IS CONNECTED By the operation of the (LP) key, battery is closed to the frame locating lamps which are connected through the brushes of (X) cam of the connector switch to a 240 ohm ground. There is a frame lamp corresponding to each frame on which a connecting test selector is used.

Battery is supplied to the brush locating lamps which are connected to contacts of the (BR) and (BR-1) relays, these relays operating when the (LP) key is operated and switching the leads from the cross-connection block used in conjunction with arc No. (I) of the directing selectors to the leads from the brush lamps. The (BR) relay also supplies ground through the (P) 240 ohm resistance to the arc (I) brush of the directing selector for completing the locating lamp circuit.

Battery is also supplied to the tens and units lamps which are connected in series according to the positions of the tens and units locating selectors by means of the No. 1 arc. The frame lamp will designate the frame on which the connecting test selector is located; the brush lamp will designate the brush which is tripped on the test selector and the tens and units lamps will designate the terminal on which the brush is resting. It is therefore possible to derive which incoming selector is under test.

50. TEST OF INCOMING SELECTORS WHEN ASSOCIATED WITH FINAL SELECTORS REQUIRING FINAL ADVANCE CLOSURE When testing incoming selectors used with final selectors requiring a closure of the "T" and "R" leads for final advance after selections, the (K) relay will be provided and this relay will operate when the test sequence switch is in position 12. The operation of the (K) relay will cause the test sequence switch to advance without making a non-operate test of the (L) relay in these incoming selectors.

BELL TELEPHONE LABORATORIES, INC.

DEPT. 332-A-4

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