

Western Electric Co., Incorporated,  
Equipment Engineering Branch, Hawthorne

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Issue 1 BT-502733  
Appendix 2  
April 24, 1929  
Replacing all previous  
issues.

This Appendix was Prepared from Issue 28 of Drawing T-502733

METHOD OF OPERATION

Line Finder and District Selector Circuit - Including Line Circuit - Trip  
Circuit, Starting Circuit - Time Alarm Circuit - For Flat or Individual  
Message Rate Lines - Panel System.

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Add the following to paragraph 3.311

"K" WIRING

The opening of the ground on the fundamental ring, H cam 3/7, indicates  
to the sender that trunk hunting is complete.

ENG. E.L.B.

CHK'D. E.L.B.

APP'D. A. PENROD  
F.L.E.

6  
327  
9.54  
Western Electric Company, Incorporated,  
Equipment Engineering Branch, Hawthorne,

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Issue 1 App. 1 BT-502733  
October 22, 1923 (\*)

METHOD OF OPERATION

Schematic for District Selector Circuit - Line Finder Circuit - Line Circuit -  
Trip Circuit - Starting Circuit and Time Alarm Circuit - Arranged for Flat  
Rate or Indicating Message Rate Lines - Panel Machine Switching System.

On Pages 33 to 40 Inclusive, Cancel Circuit Requirements and Test Clip Data.

ENG:-A.F.H.  
October 22, 1923  
HSD

CHKD:-J.I.

APPROVED;-H.L. MOYNES  
E.R.C.

## METHOD OF OPERATION

Schematic For District Selector Circuit - Line Finder Circuit - Line Circuit - Trip Circuit - Starting Circuit and Time Alarm Circuit - Arranged For Flat Rate Or Indicating Message Rate Lines - Power Driven Machine Switching System.

This Method of Operation was prepared from issue 9 of T-502733.

### 1. LINE AND TRIP CIRCUIT

#### 1.1 DEVELOPMENT

##### 1.11 PURPOSE OF CIRCUIT

1.111 This circuit is used in establishing connections between subscribers' stations with the apparatus in the mechanical office.

##### 1.12 WORKING LIMITS

1.121 This circuit has a maximum external loop resistance of 750 ohms and a minimum leak of 10,000 ohms.

#### 1.2 OPERATION

##### 1.21 PRINCIPAL FUNCTIONS - The principal functions of this circuit are:

1.211 To cause the starting circuit to function and start a line finder selector hunting for the calling line.

1.212 To trip the proper line finder brushes.

1.213 To operate the message register on a charge call.

1.214 To operate the line finder time alarm circuit.

1.215 To disconnect battery and ground from the subscribers line on an incoming call.

##### 1.22 CONNECTING CIRCUITS - This line tip circuit will function with:

1.221 Any standard start circuit.

1.222 Any standard district circuit.

1.223 Any standard final circuit.

**1.3 DETAILED DESCRIPTION**

- 1.31 ORIGINATING A CALL - The operation of a call originating in the first ten lines of a group is as follows: - When the receiver at the calling station is removed from the switchhook, the (L) relay in the line circuit operates, through the 200 ohm resistance, winding of the (L) relay, contact of the (CO) relay, over the ring side of the subscriber's loop, back over the tip side to ground on the armature of the (CO) relay. The line relay (L) operated connects battery to the H terminal of the line and operates the (BA) relay through its inner winding. The (BA) relay operated, operates the (TR) relay from ground on the armature of the (BA) relay, break contact of the (K) relay, 700 ohm winding of the (TR) relay, to battery over the TR lead. The (TR) relay operated, operates the two trip magnets, (b) opens the locking series circuit through the (TR) relays in the other bank groups and (c) locks through its 600 ohms winding to battery on terminal 1 and brush of the G group distributor selector in series with the (STA) relay in the start circuit, operating the (STA) relay.
- 1.32 STARTING A LINE FINDER - When the (STA) relay in the start circuit operates it operates the (LF) relay which starts a line finder hunting for the calling line. Each TRIP magnet operates its trip rod, thus tripping the corresponding group brushes of the associated selectors on its respective side of the frame. The operation of the (STA) relay connects ground to the K lead operating the (K) relay. The (K) relay operated (a) locks to ground on the armature of the (BA) relay under control of the (O) relay, (b) opens the circuit through the 700 ohm winding of the (TR) relay, thus preventing another line finder selector from being started by this call (c) closes a circuit from the 1500 ohm winding of the (O) relay, but the (O) relay does not operate at this time on account of insufficient amount of current through the winding. As the line finder selector moves upward and at the end of the tripping zone, ground on the K commutator brush and segment, short-circuits the 600 ohm winding of the (TR) relay releasing the (TR) relay. The (TR) relay released, closes the locking series circuit through the (TR) relay in the other groups and opens the circuit

through the two trip magnets, which release.

- 1.33 RELEASING THE TRIP CIRCUIT - When the selector brushes make contact with the terminals associated with the calling line, ground on the H terminal operates the (O) relay. The (O) relay operated, opens the locking circuit of the (K) relay but the (K) relay is very slow in releasing and holds the (O) relay operated through the 1500 ohm winding in order to permit the (BA) relay to release before the (O) relay, otherwise another line finder may be started by this call. When the line has been found the district functions and connects battery to lead S, operating the (CO) relay. The (CO) relay operated, releases the line (L) relay which in turn releases the (BA) relay thus opening a circuit, releasing the (O) relay. Another call may now start within this same group of ten lines if the starting circuit is ready for the call. The operation for a call originating in the last ten lines of a group of twenty, will be similar to that already described for the first ten lines except that the (BA-1), (K-1), (O-1) and (TR-1) relays are involved instead of the (BA), (O), (TR) and (K) relays.
- 1.34 SIMULTANEOUS CALLS - If there is a simultaneous call in both the first and last ten lines of a group of twenty lines, the relays of both sub-groups will operate as already described, starting two line finder selectors in different sub-groups at the same time. In this case, the line windings of the (O) and (O-1) relays are connected together through the make contacts of the (BA) and (BA-1) relays. The (O) and (O-1) relays will therefore operate in parallel when the H brush of either or both line finder selectors make contact with the H terminals of the calling line.
- 1.35 MESSAGE REGISTER - On message register calls, a message register operates on battery over lead H.
- 1.36 TERMINATING CALLS - When the final selector connects to the tip, ring and sleeve terminals of an idle line at the final multiple, battery through a resistance in the final circuit is connected over the S lead to ground through both windings of the (CO) relay (on individual lines or the last line of a group of consecutive lines) or through the 100 ohm winding of the (CO) relay on an intermediate line of a group of consecutive lines. The (CO) relay operated, disconnects

The L relay battery bridge from across the tip and ring of the line. When the final selector returns to normal, the circuit through the winding of the (CO) relay is opened, releasing the relay and restoring the circuit to normal.

2. STARTING CIRCUIT

2.1 DEVELOPMENT

2.11 PURPOSE OF CIRCUIT

2,111 This circuit is used to control the routing of calls to the respective line finder selectors and to start an idle selector hunting over the line terminals for the calling line.

2.12 WORKING LIMITS

2.121 None.

2.2 OPERATION

2.21 PRINCIPAL FUNCTIONS - The principal functions of this circuit are:

2.211 To route the call.

2.212 To start a selector hunting for the calling line.

2.213 To release the trip relay in the associated trip circuit, thus permitting another call to start in any other group.

2.214 Each regular starting circuit is equipped with an emergency plug and jack for immediately replacing the regular circuit with emergency circuit at any time.

2.215 To test the line finders.

2.216 To return to normal.

2.217 To free the start circuit.

2.22 CONNECTING CIRCUITS - This circuit will function:

2.221 With any standard trip circuit.

2.222 With any standard line finder and district circuit.

## 2.5 DETAILED DESCRIPTION

2.51 ORIGINATING CALL - When the receiver at the calling station is removed from the switchhook, the (L) and (BA) relays operate, operating the (STA) relay from ground over lead 1, terminal 1 and brush of the G group distributor selector, break contacts of the (C), (CA) and (SB) relays to battery through the 18-BH resistance in parallel with the winding of the (STA) relay. The (STA) relay operated, (a) operates the (STP-G) magnet, which remains operated until the (STA) relay releases, (b) short-circuits the 500 ohm winding of the (CA) relay, preventing it from operating and starting a line finder in subgroup "B", while a call is going through, (c) connects ground to lead K operating the (K) relay and (d) closes a circuit over lead ST, operating the (LF) relay thus starting a line finder hunting for the calling line.

2.52 STARTING LINE FINDER - As the line finder starts upward a circuit is closed over lead Y operating the (GA) relay. The (GA) relay operated, removes ground from lead ST, locks to ground on the armature of the (STA) relay and closes a circuit operating the (STP-A) magnet. This circuit is traced from ground on the make contact of the (STA) relay, make contact of the (GA) relay, terminal and brush of the (A-5) arc of the A selector, to battery through the winding of the (STP-A) magnet. The (STP-A) magnet remains operated until the release of the (STA) relay. Ground is also connected to lead CH operating the (CA) or (CB) relay when all line finder selectors in a group are off normal. As the line finder continues upward ground is momentarily connected to lead K, thus releasing the (TR) relay in the trip circuit but holding the (STA) relay operated. When the ground is disconnected from lead K, the (STA) relay releases and (a) opens the locking circuit through the (GA) relay which releases, (b) opens the circuit over lead X, (c) opens the circuit through the (STP-G) magnet, which releases and steps the brushes of the G group distributor selector to the next terminals, (d) opens the circuit through the (STP-A) magnet, which releases and steps the brushes of the A group distributor selector to the next

terminals, (e) removes the short circuit from the 500 ohm winding of the (CA) relay, but the (CA) relay will not operate unless all selectors in the group are busy.

- 2.33 EMERGENCY RELEASE OF START CIRCUIT - If either the (STA) or the (STB) relay remains operated, due to the failure of the (TR) or (TR-1) relay in the trip circuit to be shunted out and released, the (KF) relay operates as soon as the interrupter contacts I, III and V close, and locks under control of the (STA) or (STB) relay. If it remains locked for two seconds, interrupter contacts II and IV close and connect ground to winding of either the (TR) or (TR-1) relay in the trip circuit, (depending upon whether the call is through the "A" or "B" sub-group), releasing the (TR) or (TR-1) relay. When ground is removed by the opening of the interrupter contacts II or IV, the (STA) or the (STB) relay releases, releasing the (KF) relay and restoring the circuit to normal.
- 2.34 START CIRCUIT ALARM - The closure of the interrupter contact VI, which occurs at the same time contacts II and IV are closed, while the (KF) relay is operated, operates the (KA) relay. The (KA) relay operated, (a) locks under control of a key at the trouble desk, (b) lights a lamp at the trouble desk, individual to the line finder frame, and operates an alarm. The operation of the key releases the (KA) relay, extinguishing the lamp and silencing the alarm. The operation for a call originating in the last 10 lines of a group of 20 will be similar to that already described for the first 10 lines, except that the (ST-B) and (GB) relays are involved instead of the (STA) and (GA) relays.
- 2.35 ALL SELECTORS IN ONE SUB-GROUP BUSY - If all the selectors in sub-group A, for example, are busy, the (CA) relay operates in a circuit from ground over lead CH, 500 ohm winding of the (CA) relay, to battery through the 600 ohm resistance C. The (CA) relay operated, transfers the circuit over lead 1 from the winding of the (STA) relay, to battery through the winding of the (SA) relay and the break contact of the (SB) relay. When a call is now received, the (SA) relay operates, in turn operating the (STB) relay. This circuit is traced from battery through the winding of the (STB) relay, make contact of the (SA) relay, 600 ohm resistance B, to ground on the armature of the (CB) relay. The (STB) relay operated, operates the (LF) relay in the district thus starting a selector in the "B" sub-group hunting for the calling

line and closes a locking circuit through the 1000 ohm winding and make contact of the (CA) relay. This is to prevent the release of the (CA) relay should a selector become available in the "A" sub-group while a call is going through the "B" sub-group. If all selectors in sub-group "B" are busy, the operation is similar except that the (CB), (SB) and (STA) relays now operate. The (STA) relay operated, starts a selector in the "A" sub-group hunting, as explained before.

- 2.36 ALL SELECTORS IN BOTH SUB-GROUPS BUSY - If all selectors in both sub-groups are busy, both the (CA) and (CB) relays are operated. Should a call be received in either sub-group under these conditions, the corresponding (SA) or (SB) relay operates, but neither the (SIB) nor (STA) relay operates, as the circuits to ground on the armature of the (CA) and (CB) relays are open. When a call is received in the "A" or "B" sub-group, while all selectors are busy, the special message register in the starting circuit operates through the make contact of the (SA) relay to ground on the armature of the (CB) relay, if the call is in sub-group "A", or through the make contact of the (SB) relay to ground on the armature of the (CA) relay, if the call is in sub-group "B". The message register thus indicates the number of times calls were originated while all the line finder selectors were busy.
- 2.37 TESTING LINE FINDER SELECTOR - This circuit, which is shown associated with the starting circuit, enables the testing of any particular line finder selector at any time. The test line used with the test box circuit for making the test is the first or bottom line of the bottom bank in both the "A" and "B" sub-groups, the first line terminal in both sub-groups being connected together. When the 184 plug (shown on the line finder circuit) is inserted in the test jack of the line finder under test, the ST and ST-1 leads are connected together and the circuit that supplies battery to the ST lead is transferred to lead Z. When the plug of the test box cord is inserted in the test jack, the (A) relay operates from ground on the sleeve of the test box cord. The (A) relay operated opens the circuit over lead TR and operates the (B) relay. The (B) relay is slow in operating to prevent a call which has just reached the (STA) or (SIB) relay from being interrupted. The (B) relay operated, (a) locks to battery on its make contact (b) operates the

(C) and (C-1) relays and (c) closes the ring side of the loop through the test box, which operates the (L) relay associated with the test line. The (C) relay operated (a) transfers the circuit for operating the (STA) relay from the G distributor selector bank, (b) opens the normal ST lead (c) connects ground to lead Z, (d) opens the operating circuit for the (ST-B) relay, which would otherwise operate and lock on a call within the last 10 lines in the group. The (CI) relay operated (a) closes a circuit over the TR lead from battery on the armature of the (STP-G) magnet, (b) connects the K lead of sub-group "A" with the K lead of sub-group B, thus connecting the K commutator segments of all the selectors of both sub-groups together, (c) connects the Y lead of sub-group "A" with the Y lead of sub-group "B" so that the (GA) relay will be operated by a selector in either sub-group. When the (L) relay in the test line operates, the (BA) relay in the trip circuit functions and connects ground through the (TR) relay in trip circuit, over lead TR, make contact of the (CI) relay, break contact of the (STA) and (STB) relays to battery on the contact of the (STP-G) magnet, operating the (TR) relay in the trip circuit. When the (TR) relay operates, it locks over lead l, make contact of the (C) relay, break contacts of the (CA) and (SB) relays to battery through the winding of the (STA) relay in parallel with the 18-BH resistance, operating the (STA) relay. The (STA) relay operated, operates the (STP-G) magnet which remains operated until the (STA) relay releases, (b) short-circuits the 500 ohm winding of the (CA) relay (c) connects ground to lead K, (d) operates the (D) relay and (e) closes a circuit from ground through the break contact of the (GA) relay, make contact of the (C) relay over lead Z to battery through the (LF) relay in the district thus causing the line finder to start hunting for the calling line. The (D) relay operated, locks to ground on the armature of the (A) relay. When the (STA) relay releases, the (E) relay operates from ground on the left inner armature of the (STA) relay, make contact of the (D) relay, to battery through the break contact and winding of the (E) relay. The (E) relay operated. (a) locks to ground on the armature of the (A) relay, (b) releases the (C) and (C1) relays, thereby restoring the starting circuit to normal, (c) closes the circuit from battery on the armature of the (STP-G) magnet, which was opened by the operation of the (A) relay and later closed by the operation of the (C1) relay, through to the TR lead. When the plug of the test box cord is removed from the test jack, the (A) relay is released, releasing the (B), (D), and (E)

relays, thereby restoring the test circuit to normal.

3. DISTRICT SELECTOR AND LINE FINDER CIRCUIT

3.1 DEVELOPMENT

3.11 PURPOSE OF CIRCUIT

3.111 This circuit is arranged to find the calling subscriber's line and connect it with the various switching apparatus necessary to complete a call.

3.12 WORKING LIMITS

3.121 This circuit has an external trunk supervisory loop of 5010 ohms at the outgoing end and at the incoming it has an external subscriber's line supervisory loop of 900 ohms maximum with a leak of 10,000 ohms.

3.2 OPERATION

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

3.211 To find the proper line and start the sender hunting for an idle sender selector.

3.212 To establish talking connection.

3.213 To supply talking battery to the calling station.

3.214 To select an idle sender.

3.215 To connect battery for the operation of the message register in the line circuit on a charged call.

3.216 To connect a busy tone to the calling station, if required.

3.22 CONNECTING CIRCUITS - This district selector circuit will function with:

3.221 Any standard line circuit.

3.222 Any standard subscribers sender.

3.223 Any standard incoming circuit.

### 3.3 DETAILED DESCRIPTION

- 3.301 STARTING LINE FINDER** - When the receiver at the calling station is removed from the switchhook various relays in the line, trip and start circuits operate and (a) connect battery to the H terminal of the line at the line finder multiple bank (b) connect ground to the ST lead, operating the (LF) relay. The (LF) relay operated, (a) locks on its contact and windings in series to ground on the make contact of the (H) relay, (b) closes a circuit over lead Y operating the (GA) relay in the starting circuit, (c) operates the UP magnet from ground on the "N" commutator, brush and segment causing the line finder selector to travel upward and hunt for terminals of the calling line, to which battery is connected, as hereinafter described, (d) closes a circuit from the same ground on the "N" commutator brush, and segment, through the break contact of the (E) relay, to battery through the inner winding of the (CI) relay, operating the (CI) relay.
- 3.302 SELECTING A SENDER** - As the line finder selector starts upward, hunting for the calling line, a circuit is closed through the M commutator, slightly after the brushes of the selector move off-normal. Ground on the M commutator brush and segment, operates the line finder (E) relay. The (E) relay operated, (a) operates the (MB) relay from ground on its armature, through the break springs of the MB jack, to battery through the inner winding of the (MB) relay, (b) closes a circuit from ground on the upper inner contact of cam I, make contact of the (E) relay, to battery through the inner winding of the (D) relay, operating the (D) relay, (c) opens the operating circuit of the (CI) relay, thus permitting the relay to release if the test brush of the sender selector be making contact with the test terminal of an idle sender. If the test brush of the sender selector is making contact with the test terminal of the busy sender, the (CI) relay locks through its outer winding, the lower contacts of cam S, make contact of the relay to ground on the (TR) of the sender selector. With the (CI) relay held operated, the operation of the line finder (E) relay also closes a circuit operating the (F) relay in the line finder circuit and the district selector (STP) magnet. This circuit is traced from battery through the 1,000 ohm

winding of the (F) relay and through the windings and break contact of the (STP) magnet, make contacts of the (CI) and (E) relays to ground on cam H, thereby stepping the sender selector brushes. If the next sender circuit is idle the (CI) relay releases, in turn stopping the selector, but if the next terminal is busy, the (CI) relay remains operated and the sender selector continues to step until an idle sender is found. When the (CI) relay releases, the test terminal of the selected sender is immediately made busy to all hunting sender selectors by ground connected to the test brush from cam H, through the make contact of the (E) relay and the break contact of the (CI) relay. This busy ground is connected until the switch advances from position 1 1/4. The operation of the (F) relay opens the tip and ring leads between the line finder commutator and the district circuit, and prevents the district (L) relay from operating and advancing the district switch from normal, if the line finder selector connects to the terminals of the calling line before the sender selector finds an idle sender.

- 3.303 MAKING THE DISTRICT BUSY - The MB RELAY OPERATED(a)  
Looks from ground on the armature and make contact of the (STA) relay in the START circuit, lead X, make contact, and outer winding of the (MB) relay, to battery on the break contact and armature of the (SL) relay, so that the (MB) relay will not release should the selector return to normal while another call is going through, (b) closes a circuit from ground on the M commutator, make contact of the (LF) and (MB) relays, to battery through the 800 ohm winding of the (F) relay, which operates if the relay was not previously operated, (c) connects ground on its armature to the series circuit through the (MB) relays of the other selectors in the same group, thus permitting the operation, over lead CH of the (CA) or (CB) relays in the starting circuit, when all line finder selectors in the group are off-normal, (d) opens the circuit over lead Y, to prevent the (GA) relay from reoperating, (e) transfers the ST lead to the next line finder, which, if busy, transfers the call over the ST lead in the same manner until an idle line finder is found.
- 3.304 RELEASING THE START CIRCUIT - As the line finder selector continues upward, at the end of the tripping zone, the K brush makes contact with the K commutator and connects ground to lead K, thus releasing the (TR) relay in the trip circuit. When the K brush breaks

contact with the K commutator ground is disconnected from the K lead, thus releasing (STA) relay which in turn releases the start circuit.

**3.306** LINE FINDER FINDS LINE - When the selector brushes make contact with the terminals associated with the calling line, battery on the H terminal operates the (O) relay in the trip circuit and the (H) relay in the line finder circuit over lead H. With the (H) relay operated, a 50 ohm non-inductive shunt is connected around its winding, to ground on its armature for the purpose of increasing the amount of current through the 500 ohm winding of the (O) relay in the trip circuit thus speeding its operation. This is necessary on account of the very short time period during which the H brush makes contact with the H terminal before the circuit over the H lead is opened by the overthrow of the selector. The (H) relay operated, opens the circuit which holds the (LF) relay operated, but (LF) relay does not release immediately on account of a circuit being closed from ground on the C commutator brush and segment, to battery through both windings of the (LF) relay in series. The (LF) relay is thus held operated until the brushes are centered on the terminals of the calling line. When the circuit through the C commutator segment is opened, the (LF) relay releases, and (a) opens the circuit through the UP magnet, which stops the selector brushes on the terminals of the calling line, (b) opens the circuit through the 800 ohm winding of the (F) relay so that when the circuit through its 1,000 ohm winding is opened, by the release of the (CI) relay when the district sender selector seizes an idle sender, the (F) relay releases, (c) closes a circuit operating the (SL) relay. This circuit is traced from ground on the H commutator break contact of the (LF) relay, make contact of the (E) relay, winding of the (SL) relay, cam T, make contact of the (D) relay, to battery on the break contact of the (DS) relay.

**3.306** THE ADJUSTMENT OF THE "C" COMMUTATOR BRUSH - The adjustment of the "C" commutator brush, with relation to the tripped "H" multiple brush, is such that it does not break contact with the "C" commutator segment until slightly after the holding circuit through both windings of the (LF) relay is opened by the operation of the (H) relay when the H brush makes contact with the H

terminals to which battery is connected. The UP magnet, therefore, remains operated and the selector continues to travel upward until the brushes are carried slightly above the center of the line terminals, allowing the locking pawl to enter the notch on the rack attached to the brush support rod. At this time, the holding circuit through both windings of the (LF) relay is opened at the "C" commutator, releasing the relay. The (LF) relay released, releases the UP magnet. The selector then drops into place, thus centering the brushes on the line terminals.

**3.307** ADVANCING THE DISTRICT - The (SL) relay operated, (a) connects battery to the S lead thus making the line test busy at the final frame and operating the (CO) relay thus releasing the trip circuit (b) closes a circuit which operates the district (L) relay and (CH) relay. This circuit is traced from ground on the N commutator brush and segment, through the break contact of the (F) relay, make contact of the (SL) relay, cam O, to battery through both windings of the (CH) relay. The same ground is then connected through cam R to battery through the 800 ohm winding of the district (L) relay. The (CH) relay operated, closes a circuit from ground on cam I, break contact of the (CS) relay, make contact of the (CH) relay to battery through the selector time alarm circuit not shown, which performs no useful function at this time. The (L) relay operated, closes a circuit advancing the district switch to position 2. This circuit is traced from battery through the R magnet, cam B, make contact of the (L) relay, to ground through cam M. As the switch advances from position 1, the circuits through the (L) and (CH) relays are opened, releasing the relays and disconnecting the selector time alarm circuit. In position 1 1/2 to 2, the associated sender is held busy by ground through cams H and C.

**3.308** COMPLETING THE FUNDAMENTAL CIRCUIT - With the switch in position 2, the tip and ring leads are closed from the calling line to the tip and ring leads of the associated sender circuit, thus permitting the dialing tone to be transmitted back over the dialing circuit from the associated sender, as an indication that the apparatus is ready to receive

the call by the operation of the station dial. The tip side of the dialing circuit is closed from the tip of the line, through the break contact of the (F) relay, cam P, to the tip brush of the sender selector. The ring side of the dialing circuit is closed from the ring lead of the line, through the break contact of the (F) relay, winding of the (DC) relay, cam Q to the R brush of the sender selector. In position 2, the (CI) relay operates through its outer winding to ground on cam S, and remains operated until the switch advances from position 10. The (CI) relay operated, (a) connects ground through the inner contacts of cam S, to the test brush of the sender selector, thus making the associated sender test busy after the switch advances from position 2, (b) closes the tip side of the fundamental circuit through to the sender and (c) closes the sender control (SC) through cams V and U, to battery through the outer winding of the (D) relay. After the sender functions, the fundamental circuit is established for the operation of the district (L) relay and the stepping relay in the sender. This circuit is traced from ground in the sender circuit, through the FT brush, make contact of the (CI) relay, cam L, to battery through the 1,200 ohm winding of the (L) relay, which operates. The (L) relay operated, locks through its 1,200 ohm winding and make contact to the same ground over the FT lead and advances the switch to position 3 from ground on cam M. The 500 ohm winding of the (CH) relay is also connected through cam U, in parallel with the winding of the (D) relay to the SC lead. Should the (CH) relay operate at this time due to a high resistance ground in the sender circuit, no useful function will be performed.

**3.509 DISTRICT BRUSH SELECTION** - With the switch in position 3, the UP magnet is operated for brush selection over a circuit traced from battery through the winding of the magnet, cam C, make contact of the (L) relay, to ground through the cam M. As the selector moves upward in position 3, carrying the commutator brushes over the commutator segments, the A segment and brush intermittently connects ground to the tip side of the fundamental circuit through cams K and L, holding the (L) relay operated, but successively short-circuiting the stepping relay in the associated sender circuit, thus releasing and permitting its re-operation until the proper brush has been selected. When sufficient impulses have been sent back to satisfy

the sender, the fundamental circuit is opened, releasing the (L) relay. The (L) relay released, opens the circuit through the UP magnet, thereby stopping the upward movement of the selector, and advances the switch to position 4. This circuit is traced from ground through cam M, break contact of the (L) relay, cam B, to battery through the R magnet. When two digit senders are used with this circuit, the advance of the sender replaces the high resistance on the SC lead with a 500 ohm ground, thus insuring the operation of the (CH) relay. In position 4 the trip magnet (TM) is operated from ground through cam S, and the (L) relay is operated and locked to ground on the fundamental circuit previously described, advancing the switch to position 5.

**3.310** DISTRICT GROUP SELECTION - With the switch in position 5, the UP magnet is reoperated and, the trip magnet being operated, causes the previously selected set of brushes to trip when the selector starts upward as the set of brushes trip the finger which was previously operated by the trip magnet. As the selector moves upward for group selection, carrying the brushes over the commutator segments, the B segment and brush intermittently connects ground to the tip side of the fundamental circuit through cam L holding the district (L) relay operated, but successively short-circuiting the stepping relay in the associated sender circuit, thus releasing and permitting its operation until the proper group has been selected. When sufficient impulses have been sent back to satisfy the sender, the fundamental circuit is opened, releasing the (L) relay which in turn opens the circuit through the UP magnet and advances the switch to position 6. When three digit senders are used with this circuit, the advance of the sender replaces the high resistance ground on the SC lead with a 500 ohm ground, thus insuring the operation of the (CH) relay. With the switch in position 6, a circuit is closed from ground on the line finder N commutator, brush and segment, through the break contact of the (F) relay, make contact of the (SL) relay, inner contacts of cam O, cam R, to battery through the 800 ohm winding of the (L) relay, operating the relay. The (L) relay operated, advances the switch to position 7 in a circuit from battery through the R magnet, cam B, make contact of the (L) relay, cam M, make contacts of the (D) relay, to ground through cam I.

- 3.311 TRUNK HUNTING WITH TRUNK IDLE - Should the first trunk in the group in which the selector is hunting be idle, the (L) relay releases as the switch leaves position 6 1/4. When the switch enters position 6 1/2, ground is connected to the sleeve of the selected trunk through cam M, break contact of the (L) relay, cam E, as a busy condition until the switch advances to position 7 3/4.
- 3.312 TRUNK HUNTING WITH FIRST TRUNK BUSY - Should the first trunk in the group in which the selector is hunting be busy, the (L) relay is held operated in a circuit from battery through its inner winding and make contact, cam E to ground on the sleeve terminal of the busy trunk. With the switch in position 7, the UP magnet is reoperated from ground, cam M under control of the (L) relay and the selector travels upward until an idle trunk is found. When the idle trunk is found, the locking circuit through the inner winding of the (L) relay is opened but the relay does not release immediately, due to a circuit being closed from battery through its outer winding, cam R to ground through the C commutator brush and segment. When the brushes are centered on the trunk terminals, the circuit through the C commutator segment is opened and the (L) relay releases and opens the circuit through the UP magnet, which stops the selector brushes on the terminals of the selector trunk. The (L) relay released, also advances the switch to position 8.
- 3.313 "C" COMMUTATOR - The adjustment of the "C" commutator brush, with relation to the tripped sleeve multiple brush is such, that it does not break contact with the "C" commutator, until slightly after the holding circuit through the inner winding of the (L) relay is opened, by the sleeve brush leaving the busy terminals and making contact with the sleeve terminal of the idle trunk. The UP magnet, therefore, remains operated and the selector continues to travel upward until the brushes are carried slightly above the center of the trunk terminals, allowing the locking pawl to enter the notch on the rack attached to the brush support rod. At this time, the other holding circuit through the outer winding of the (L) relay is opened, at the "C" commutator, releasing the relay which disconnects ground from the commutator feed bar, (G), releasing the UP magnet. The selector then drops into place, thus centering the brushes on the trunk terminal. During trunk hunting, in position 7 only, the commutator feed ground is supplied from ground on cam M under control

of the (L) relay. This is to prevent the reoperation of the (L) relay by the closing of a circuit between the C commutator brush and segment on the overthrow of the selector or as it drops into place.

3.314 SELECTION BEYOND - As the switch advances to position  $7 \frac{3}{4}$ , ground through cam E is connected to the sleeve of the selected trunk as a busy condition. With the switch in position 8., a circuit is closed from ground on the armature and make contact of the (CH) relay, through cam O, cam R to battery through the outer winding of the (L) relay which operates, advancing the switch to position 9. In position 9, the tip and ring sides of the outgoing fundamental circuit are closed through the tip and ring terminals of the selected trunk for selection beyond, through the FT and FR brushes of the sender selector, and cams F and G respectively. After the selection beyond has been completed, ground in the sender is removed from the SC lead, releasing the (CH) relay, in turn releasing the (L) relay. The (L) relay released, advances the switch to position 10. As the switch leaves position  $9 \frac{1}{2}$ , the dialing circuit is opened at cams P and Q, in position  $9 \frac{3}{4}$ , the tip and ring leads from the line finder are closed through cams P and Q respectively to 24 volts battery and ground in the district, holding the (DC) relay operated, under control of the station switchhook. With the (DC) relay operated, a locking circuit is closed for the (D) relay after the switch advances from position 10. This circuit is traced from battery through the inner winding of the (D) relay, make contact of the (DC) relay, make contact of the (D) relay to ground through cam I. The (D) relay (178-AK) is made slow in releasing in order that the connection will not be lost if the switchhook at the called station is momentarily depressed. With the switch in position 10, the sender circuit functions and connects ground to the FT lead, causing the (L) relay to operate and lock through its inner winding over the tip of the fundamental circuit previously described. The (L) relay operated, advances the switch to the talking selection position until the relay is released by the operation of the sender circuit. As the switch advances, ground is intermittently connected to the tip side of the fundamental circuit, through cam E, holding the (L) relay operated, but successively short-circuiting and permitting the reoperation of the stepping relay in the

sender circuit. When sufficient impulses have been sent back to satisfy the sender, the fundamental circuit is opened, releasing the (L) relay. The (L) relay released, opens the circuit through the R magnet, stopping the switch in positions 11, 12 or 13, depending upon the class of call. As the switch leaves position 10, the holding circuit of the (CI) relay is transferred from ground on cam S to ground on cam E under the control of the (L) relay. This circuit is traced from battery through the outer winding of the (CI) relay, inner contacts of cam U, make contact of the (CI) relay, cam V, make contact of the (L) relay to ground through cam E. The release of the (L) relay opens the holding circuit through the (CI) relay, disconnecting the sender from the district circuit.

3.315  CALLED PARTY ANSWERS - When the receiver at the called station is removed from the switchhook, with the switch in position 11 or 12, reversed battery and ground from the incoming circuit operates the (CS) relay. The (CS) relay operated, closes a circuit from ground on cam I, through cam N, winding of the (I) relay, to battery through the #3 contact of the 149-J interrupter. When the interrupter contact closes, the (I) relay operates and locks on the same ground through its make contact. When the #4 contact of the interrupter closes, the operation of the (I) relay closes a circuit from ground on the interrupter contact to battery through both windings of the (CH) relays operating the relay. The (CH) relay operated, locks through its windings, cam O, to ground on its make contact and armature and closes a circuit from battery on its make contact for holding the (SL) relay operated. The 149-J interrupter is so connected in the circuit that the operation of the (CH) relays is delayed for at least two seconds after the (CS) relay operates. This delay is to prevent the false operation of the (CH) relay should the (CS) relay operate momentarily before the called party answers due to any line disturbances.

3.316  OPERATOR ANSWERS - The switch advances to position 13, as described above and when the operator inserts the plug of an answering cord in the answering jack of the trunk the (CS) relay operates on reverse battery and ground, over the trunk. The (CS) relay operated, closes a circuit from the same ground on cam I, through cam R, to battery through the outer winding of the (L) relay,

which operates and advances the switch to position 14. With the switch in position 14, the repeating coil and battery are disconnected and the T and R leads are connected directly to the T and R brushes of the selector through cams P and Q respectively. As the switch enters position 13 1/2, the (L) relay locks in a circuit from ground over lead S of the selected trunk, through cam E, to battery through the make contact and inner winding of the (L) relay, and in position 13 3/4 the locking circuit through the inner winding of the (D) relay is transferred from the contacts of the (DC) relay to the contacts of cam J. In position 14, a checking tone circuit is closed over the sleeve of the operator's trunk, cam E, make contact of the (L) relay, cam V, 2 mf condenser, cam W, the S brush and terminal at the line finder bank, to ground through the winding of the (CO) relay in the line circuit for number checking.

- 3.317 DISCONNECTION - REGULAR CALLS - When the receiver at the calling station is replaced on the switchhook, the (DC) relay releases, in turn releasing the (D) relay. The (D) relay released, closes a circuit operating the (F) relay. The (F) relay operated, disconnects the tip and ring of the trunk from the line and closes a circuit from ground on the N commutator brush and segment, through its make contact, contact of cam D, to battery through the R magnet, advancing the switch to position 16. On individual lines the (SL) relay releases when the switch leaves position 15 and advances the switch to position 17, the A cam advancing it to position 18.
- 3.318 MESSAGE REGISTERING - On message register district circuits, with the switch in position 16, a circuit is closed from battery, make contact of the (CH) relay, cam T, through the three 18-AM resistances in parallel, H brush and terminal at the line finder bank over lead H, to ground through the message register (MR) operating the message register. During the message registering period, another line finder selector hunting over the line terminals in the same group will not stop its brush on the multiple terminals of this line at this time on account of its (H) relay being shunted by the 5 ohm message register, while the H brush of the hunting selector is passing over the H terminal of the line. When the 149-C interrupter contacts close, a circuit is closed from ground, through cam R, to battery through the outer winding of the (L) relay, operating the (L)

relay. The (L) relay operated, locks through its inner winding and make contact to ground on cam E. Ground on the II make contact of the interrupter is closed through cam X, make contact of the (L) relay, outer contacts of cam J, to battery through the inner winding of the (D) relay, which operates. The (D) relay operated, advances the switch to position 17 in a circuit from battery through the R magnet, cam B, make contact of the (L) relay, cam M, make contact of the (D) relay, to ground on cam I. In position 17 the A cam advances the switch to 18.

3.319 RESTORING LINE FINDER TO NORMAL - As the switch advances from position 16 to 18, the circuits through the (D), (SL), (CH) and (L) relays are opened, releasing the relays and disconnecting battery for operating the message register from lead H. The release of the (SL) relay disconnects battery from lead S, releasing the (CO) relay in the line circuit, thus restoring the line circuit to normal. As the switch enters position 17, the release of the (D) relay closes a circuit operating the (DS) relay. This circuit is traced from ground on the M commutator, brush and segment, through the 350 ohm winding of the (DS) relay, inner contacts of cam N, break contact of the (D) relay, to battery on the break contacts of the (DS) relay. The (DS) relay operated, (a) locks through its make contact and 350 ohm winding to the same battery (b), closes a circuit through the outer winding of the (F) relay, thus insuring the relay to hold until both the line finder selector and the district selector have returned to normal, and (c) operates the line finder DOWN magnet, from ground on its armature, restoring the line finder selector to normal. When the line finder selector returns to normal, ground is disconnected from the M commutator segment, releasing the (E), (DS) and (MB) relays.

3.320 RESTORING THE DISTRICT TO NORMAL - With the district switch in position 18, a circuit is closed from ground on the N commutator, brush and segment, make contact of the (F) relay, cam D to battery through the district DOWN magnet, which operates and restores the district selector to normal. As the district selector returns to normal, a circuit is closed from ground on the Y commutator brush and segment, cam B to battery through the R magnet, advancing the switch to position 1 or normal. As the switch leaves position 18, the circuit through the DOWN magnet is opened and in position 18 1/4

the circuit through the outer winding of the (F) relay is opened, releasing the relay and restoring the circuit to normal.

- 3.321 DELAYED DISCONNECT - Should the calling subscriber fail to replace the receiver on the switchhook, after the called subscriber has disconnected, the release of the (CS) relay, due to the incoming trunk functioning, operates the selector time alarm circuit from ground through cam I, thereby notifying the switchman of the existing conditions.
- 3.322 DISCONNECTION TALKING TO OPERATOR - When the plug of the answering cord is in the trunk jack at the incoming end, ground is connected to the sleeve of the trunk to hold the district (L) relay operated. If the plug of the cord is removed from the trunk jack before the receiver at the calling station is replaced on the switchhook, the line relay in the trunk circuit will operate, thereby holding the ground on the sleeve terminal of the trunk. When the receiver at the calling station is replaced on the switchhook, and the plug of the answering cord is removed from the trunk jack at the incoming end, the (DC) relay releases and ground is disconnected from the sleeve of the trunk, releasing the (L) relay, thus advancing the switch to position 15. As the switch advances from position 14-1/4, the locking circuit through the inner winding of the (D) relay is opened at cam J, releasing the relay. The (D) relay released, opens the circuit through the (SL) relay, which releases and operates the (F) relay, which advances the district switch to position 16 from ground on the <sup>N</sup> commutator brush and segment. In position 16, ground on the armature of the (SL) relay through cam D advances the switch to position 17, the A cam advancing it to position 18. In position 16, the (CH) relay being normal, battery is not connected over lead H to operate the message register in the line circuit as the call is not chargeable. From this point on, the line finder and district selectors are restored to normal as described in paragraphs 3.319 and 3.320.
- 3.323 DISCONNECTION ON ABANDONED CALLS
- 3.3231 DISCONNECTION BEFORE LINE FINDER SELECTOR FINDS LINE - Should the calling subscriber replace the receiver on the switchhook before a hunting selector finds the line, the (L)

relay in the line circuit releases, removing battery from the H terminals at the multiple bank, assuming the calling line to be in sub-group "A". The trip circuit and start circuits operate and in turn operate the (LF) relay which starts the selector hunting. The selector will, therefore, travel to the top of the bank and when the H brush of the selector makes contact with the terminal of the H combination at the top of the multiple bank, the (H) relay operates. The (H) relay operated, releases the (LF) relay, which in turn releases the (F) relay and opens the circuit through the UP magnet, stopping the selector. The N commutator segment is opened with the selector brushes resting on the "H" combination terminal to prevent the district switch from advancing from normal when the (F) relay is released by the release of the (LF) relay. With the (F) relay released, the (DS) relay operates from ground on the X commutator brush and segment, through its 1,000 ohm winding. The (DS) relay operates the DOWN magnet, restoring the selector to normal.

3.3232 POSITIONS 2 TO 6 .- If the receiver at the calling station is replaced on the switchhook while the district switch is in position 2 to 6, the dialing circuit is opened at the calling station, causing the sender circuit to function and connect a direct ground, to the (SC) lead, causing the (D) relay to release on account of the increased current flowing through the outer winding of the relay. The (D) relay is connected differentially, but does not release when its inner winding is connected directly to ground and its outer winding connected to ground in series with a resistance. The (D) relay released, operates the (DS) relay, which restores the line finder selector to normal as described in paragraph 3.319. The (D) relay released, also opens the circuit through the (SL) relay which releases. The (SL) relay released, disconnects battery from lead S, releasing the (CO) relay in the line circuit.

and advances the district switch to position 6 from ground on the armature and make contact, through the lower contact of cam D. With the district switch in position 6, a circuit is closed from same ground through cam D to battery through the DOWN magnet, operating the district DOWN magnet restoring the selector to normal. When the selector reaches normal, ground on the Y commutator brush and segment, advances the switch to normal.

3.3233 POSITIONS 7 to 10 - Should the receiver be replaced on the switchhook while the district switch is in any of these positions, the line finder circuit is restored to normal as described in paragraph 3.319. Trunk hunting and selection beyond will take place in the same manner and the advance of the sender circuit advances the switch to position 10. In position 10, the release of the (D) relay operates the (F) relay which closes a circuit from ground on the N commutator brush and segment, advancing the switch to position 16. As the switch leaves position 15, the (SL) relay releases. The (SL) relay released advances the switch to position 17, the A cam advancing it to position 18. From this point on the district switch is restored to normal as described in paragraph 3.320.

3.324 TESTING LINE FINDER SELECTORS - When the 184 plug (shown on the line finder circuit) is inserted in the test jack of the line finder under test, the ST and ST-1 leads are connected together. The 1,000 ohm winding of the (LF) relay is disconnected from the break contact of the (MB) relay and connected to lead Z through the strapped ring and sleeve of the test plug. From this point on the line finder functions as described for a regular call.

3.325 TELL TALE - LINE FINDER SELECTOR WITH BRUSHES NORMAL - Should the selector travel to the tell tale position while hunting, due to the multiple brush not being tripped, the (F) relay remains operated through its outer winding. Ground on the X commutator brush and segment is thereby connected to the lead "To tell tale circuit", giving a visual signal to the attendant. As the N commutator segment is open at the tell tale, the district is prevented from advancing from its normal

position. The selector in this case is restored to normal, manually by the attendant.

- 3.326 TELL TALE - LINE FINDER SELECTOR - WITH BRUSHES TRIPPED - Should the selector travel to the tell tale position while hunting, with the multiple brush tripped, a circuit is closed from battery through the (O) relay in the trip circuit, terminal of the H combination at the top of the multiple bank, H multiple brush of the line finder selector, cam X, winding of the (H) relay to ground on the armature of the (DS) relay, operating the (H) relay. The (H) relay operated, releases the (LF) relay, which in turn releases the (F) relay and UP magnet. The (F) relay released, opens the circuit through the tell tale alarm and connects ground through the X commutator brush and segment, to battery through the 1,000 ohm winding of the (DS) relay, which operates, in turn operating the DOWN magnet restoring the selector to normal.
- 3.327 TELL TALE DISTRICT SELECTOR - Should the selector travel to the tell tale position during brush selection, it will stop in position 8 since the sender does not furnish the 500 ohm ground over the SC lead to operate the (CH) relay. If the district selector goes to tell tale during group selection, the district will stick in position 9, since the sender does furnish the 500 ohm ground to operate the (CH) relay under this condition. In either position, the district will be held with its sender.
- 3.328 OVERFLOW - If all the trunks in the group are busy, the district selector while trunk hunting in position 7 will travel to the top of the group and rest on the overflow terminal. As the sleeve terminal at overflow is opened, the (L) relay releases, in turn advancing the switch to position 8. With the switch in position 8, the (L) relay operates from ground on the armature of the (CH) relay, advancing the switch to position 9. In position 9, a circuit is closed from ground on the Z commutator, brush and segment, through cam K to battery through the R magnet and advancing the switch to position 10. In position 10 a circuit is closed from ground on the Z commutator brush and segment through cam K, to battery through the 1,200 ohm winding of the (L) relay, operating the (L) relay. The (L) relay operated, locks through its 1,200 ohm winding and make contact to the same ground, through cam L, advancing the switch to position 14, from ground on cam M. As the

switch advances from position 13, the (L) relay releases and in position 14 it advances the switch to position 15. The release of the (L) relay also releases the (CI) relay, disconnecting the sender from the district circuit. With the switch in position 15, a circuit is closed from the miscellaneous tone circuit over lead C to 2 mf condenser, cam G, winding of the repeating coil, 2 mf condenser, cam V, cam J, make contact of the (D) relay to ground on cam I. A tone is therefore induced in the other winding of the repeating coil, thus causing an "all trunks busy" tone to be sent back to the calling subscriber. When the receiver at the calling station is replaced on the switchhook, the (DC) relay releases, opening the locking circuit through the (D) relay, which releases. From this point on, the switch is advanced to position 1 as described in paragraph 3.320.

3.329 "O" COMMUTATOR - The function of the "O" commutator segment is to maintain an idle condition on the multiple overflow terminal so that more than one selector may stop on overflow at one time; otherwise the first selector reaching overflow will make the sleeve multiple terminals busy, thus causing the succeeding selectors to continue upward into the next group of trunks. The O commutator segment is opened, at overflow but the S bar is continuous. Both the O and S commutator brushes are permanently strapped together and are wired to the multiple sleeve brush. When the selector is at overflow, the O commutator brush is resting on an open (dead) segment and as the busy ground is fed through the C commutator bar only, this arrangement maintains a non-busy condition on the sleeve terminals. When necessary to combine two or more groups of trunks, the multiple sleeve overflow terminals between the combined groups are made permanently busy by being connected to ground. As the S commutator bar is closed at overflow, the (L) relay is held operated, at this time, and the selector therefore hunts past the "make busy" terminals into the next group.

#### 4. TIME ALARM CIRCUIT

##### 4.1 DEVELOPMENT

##### 4.11 PURPOSE OF CIRCUIT

4.111 This circuit is used to provide a timing feature on signals to the attendant, when an originating

call is not connected to a line finder in a specified time period.

4.12 WORKING LIMITS

4.121 None.

4.2 OPERATION

4.21 PRINCIPAL FUNCTIONS - The principal functions of this circuit are:

4.211 To provide a time interval of 35 seconds before a signal is given on calls where a line finder fails to find the calling line.

4.212 To return to normal.

4.213 To advance to the next normal terminal when the key is operated.

4.22 CONNECTING CIRCUITS - This circuit will function with:

4.221 Any standard trip circuit.

4.3 DETAILED DESCRIPTION

4.31 LINE FINDER TIME ALARM - If a line finder does not find the subscribers' line within 35 seconds after the receiver at the calling station is removed from the switchhook, an alarm is given in the following manner: When the receiver at the calling station is removed from the switchhook, the (L) and (BA) or (BA-1) relays in the line and trip circuits operate and connect battery through winding of the (B) (frame) relay, brush and terminal 1 of the START arc of the time alarm selector, break contact of the A frame relay, to the interrupter contact. When the interrupter contact closes, the (B) relay operates. The (A) (frame) relay does not operate, however, on account of its winding being short-circuited by ground on the interrupter. When the interrupter contact opens, the short-circuit is removed from the winding of the (A) relay, which now operates in series with the winding and make contact of the (B) relay, to ground on the armature of the (B) relay, thus holding both relays operated. The next operation of the interrupter operates the STP magnet, over a circuit from ground on the make contact of the interrupter, make contact of the (A)

relay, terminal 1 and brush of the STEP arc of the selector, to battery through the winding of the (STP) magnet. When the interrupter contact opens, the STP magnet releases and steps its brushes one step on its back stroke. The selector brushes advance one step for each make and break of the interrupter contact, which is of an interval of 7 seconds, until the fifth terminal of the selector is reached when the circuit through the interrupter is opened. When the fifth terminal of the selector is reached, the BA-1 lamp in the trip circuit lights from battery on the armature of the (A) (frame) relay, terminal 5 and brush of the LAMP arc of the selector through the make contact of the (BA) or (BA-1) relay, BA-1 lamp, to ground through the winding of the (B) (aisle) relay in the time alarm circuit, which operates. The (B) relay operated, operates the (A) (Aisle) relay. The (A) relay operated, lights the aisle pilot and main or monitoring board lamps through their respective auxiliary alarm circuits. When the source of trouble is removed and the (BA) relay, in the trip circuit has released, the circuits are opened, in turn releasing both the frame and aisle (A) and (B) relays, extinguishing the aisle and main or monitoring board lamps and silencing the alarm. The release of the (B) (frame) relay also closes a circuit from ground on its armature, through terminal 5 and the bridging brush of the RETURN arc of the selector to battery through the break contact and winding of the STP magnet, which operates and steps the selector brushes to terminal 6, in which position it awaits the next simultaneous closure of the 152-D interrupter and (BA) or (BA-1) relay.

- 4.32 RESTORING TO NORMAL - Should the (BA) or (BA-1) relay release before the fifth terminal is reached by the selector, the (A) and (B) frame relays release. The (B) relay released, causes the selector to advance to the next normal position. The operation of the (NL) key steps the selector brushes to the next normal position by way of the STEP bridging brush and 5, 10, 15, or 20 terminal, as the case may be. If the selector has been at normal position 6, 11, or 16, when the (BA) relay operated, the operation would have been the same as described for position 1.

5. WIRING OF GROUP DISTRIBUTOR BANK FOR PANEL LINE FINDER

5.1 DEVELOPMENT

5.11 PURPOSE OF CIRCUIT - The purpose of this circuit is to show in detail, the manner in which calls are routed through the trip circuit to the start circuit without giving any trip circuit a permanent preference over the other trip circuits.

5.12 WORKING LIMITS - None

5.2 OPERATION

5.21 PRINCIPAL FUNCTIONS - The principal function of this circuit is:

5.211 To distribute calls uniformly to the start circuits.

5.22 CONNECTING CIRCUITS

5.221 None.

5.3 DETAILED DESCRIPTION

5.31 WIRING OF GROUP DISTRIBUTOR BANK - The wiring of the group distributor arc of the regular "G" distributing selector bank, shown on the regular starting circuit, and of the emergency G distributor selector bank, is shown in detail in the circuit associated with the series circuit through the emergency jack and the contacts of the (TR) and (TR-1) relays for the 15 groups of a panel line finder frame. For a complete frame of 300 lines, the wiring of the terminals for both arcs of each (G) distributor selector is shown. As a trip circuit is divided into two units, (A) and (B), calls originating in the first 10 lines of a group of 20 lines are connected through trip unit (A) and a terminal and brush of the (G) arc normally having access to the line finders in sub-group (A). Calls originating in the last 10 lines of a group are connected through trip unit (B) and a corresponding terminal and brush of the other arc normally having access to the line finders in sub-group (B). This arrangement permits the distributing of the 15 trip circuit (A) and (B) units to sub-groups (A) and (B), respectively, in the starting circuit, so as to give each group an equal preference, thus preventing any one group from having a permanent preference over the other groups. This is accomplished by the (G) selector being advanced one step to the next group after each call. The series circuit through the contacts of the (TR) and (TR-1) relays permits the passing of a call through a number of idle groups with the same speed as though the call originated on a line

within the group having the preference at that time. Should two or more calls start in two or more groups at the same time, the group nearest the one having the preference at that time will be completed first, because of the series locking arrangement of the (TR) or (TR-1) relay holding the relay of this group locked and releasing the other relays.

- 5.32 LOCKING CIRCUIT THROUGH (TR) RELAYS - The (TR) relay in any group locks from ground through its 600 ohm winding and make contact, jack 10, terminal and brush of the associated arc of the (G) selector, to battery in the starting circuit through jack 15. The (TR-1) relay locks through its 600 ohm winding and make contact, jack 12, corresponding terminal and brush of the associated (G) arc, to the starting circuit through jack 16. Jacks 10 and 12 of each group circuit are wired to the selector arc terminals and jacks 9 and 11 loop to the next group circuit, so that though the selector may be giving preference to one group, this group being idle, and a call originates in some other group, a circuit is closed back through the intervening and break contacts of the intervening relays of each group until the terminal which the distributor brush is resting on is reached. Assume a call originates in group 15, and is passing through trip unit (A) and the brushes of the (G) distributor selector arc are resting on the first group terminal, which is terminal 1. The locking circuit for the (TR) relay will be as follows: Through the 600 ohm winding and make contact of the (TR) relay and jack 10 of group 15, jack 11, break contacts of the (TR-1) and (TR) relays, and jack 10 of group 14 (not shown), through all other groups in the same manner to jack 10 of group 1, terminal 1, and brush of the selector, to jack 15 of the starting circuit. It will be seen that if two calls start at the same time in two different groups causing the (TR) relays in the two groups to operate together, the call originating in the group nearest the one having the preference of the starting circuit will be completed first. For example, if a call started in group 10, trip unit (A), and other in group 15, trip unit (A), the operation of the (TR) relay in the former group would release the (TR) relay in the latter circuit, but remain locked itself. The magnet of the (G) selector is operated by ground in the start circuit and the brushes advance one step on the release of the selector armature when the start circuit releases after each call.

6. ARRANGEMENT OF SELECTOR START CIRCUIT

6.1 DEVELOPMENT

6.11 PURPOSE OF CIRCUIT - The purpose of this circuit is to show more in detail the method used to distribute calls to the line finder selectors in sub-groups A and B respectively.

6.12 WORKING LIMITS - None.

6.2 OPERATION

6.21 PRINCIPAL FUNCTIONS - The principal function of this circuit is to distribute calls uniformly to the line finder selectors.

6.211 Returning to normal.

6.22 CONNECTING CIRCUITS - None

6.3 DETAILED DESCRIPTION

6.31 LINE FINDER DISTRIBUTOR - The distributing selectors A and B are used for distributing calls uniformly to the line finder selectors in sub-groups A and B respectively.

6.32 LESS THAN 40 SELECTORS FOR 300 LINES - When the number of line finder selectors for a group does not exceed 40 selectors for each 300 lines, the starting circuit shall be equipped with two 200-R distributor selectors. Figure 1 shows these selectors wired and equipped for 16 line finder selectors for each sub-group. When the operation of the (ST-A) relay in the starting circuit connects ground on the start (ST) lead, the (LF) relay that operates depends upon the terminal on which the (A-1) bridging brush is resting. Assume the (A-1) brush is resting on terminal 1 in the regular start circuit of sub-group A. In this case if the first selector is not busy the associated (LF) relay operates and starts a line finder hunting for the calling line. If the first selector is busy, the associated (MB) relay will be operated and the circuit through the (LF) relay will be opened. In this case the (LF) relay associated with the next idle selector will operate. Assuming this to be the tenth selector, a circuit is then closed from ground on the (ST-a) relay through the break contacts of the (GA) and (C) relays, the (A-1) bridging brush and terminal 1 of the (A-1) arc of the distributor selector, the ST

lead, make contact of the first (MB) relay, the series make contact of the succeeding operated (MB) relays, break contact of the tenth (MB) relay, to battery through the inner winding of the (LF) relay which operates. The operation of the (GA) relay, operates the (STP-A) magnet from ground on the armature of the (ST-A) relay, through terminal 1 and the (A-3) brush, to battery through the winding of the magnet, so that when the (GA) relay releases on the completion of a call, the (STP-A) magnet releases, in turn stepping the selector brushes one step and giving the next selector the preference. When the brushes of the distributor selector advance from the terminals of the last line finder selector terminal 16, the selector is advanced over the spare terminals to the first terminal from ground on the strapped spare terminals through the (A-2) brush. While the selector is advancing over the spare terminals, a call at this time will be routed to the first selector through the (A-1) brush and strapped spare terminals by the strap from terminal 22 to terminal 1 on the (A-1) arc.

6.33 MORE THAN 40 SELECTORS FOR 300 LINES - When the number of line finder selectors for a group exceeds 40 selectors for each 300 lines, the starting circuit shall be equipped with two 200-P distributor selectors. Figure 2 shows these selectors wired and equipped for 26 line finder selectors for each sub-group. It will be noted that the ST leads from the first 15 line finder selectors of each sub-group are connected in their respective order to the first 15 terminals of the (A-1) and (B-1) arcs and the ST leads of the last 11 line finder selectors of each sub-group are connected in their respective order to the first 11 terminals of the (A-4) and (B-4) arcs. It will also be noted that the brushes of the first three arcs of each selector are in the opposite position from the brushes of the last three arcs, so that only three brushes of a selector will be making contact with terminals at the same time, the other three brushes being open at that time. On a regular call in sub-group A, the circuit functions, as described for Figure 1, until the first three brushes of the A distributor selector advance from terminals 22. At this time the first three brushes are open and the last three brushes are now resting on the first terminal of the (A-4), (A-5) and (A-6) arcs. The next call in this sub-group will then start 16 selector, if idle, hunting for the calling line. Assume the last three brushes are resting on terminal 11 of the associated arcs and the 26 line finder selector is idle. The operation

of the (ST-A) relay in the starting circuit closes a circuit from ground on its armature, break contacts of the (GA) and (C) relays, (A-4) brush and terminal 11, over the ST lead, through the break contact of the (MBO) relay of the last or 26 line finder selector in the sub-group, to the associated (LF) relay. The operation of the (GA) relay operates the (STP-A) magnet through the (A-6) brush and terminal 11. The release of the (ST-A) relay releases the (STP-A) magnet, advancing the brushes to the next or terminal 12. Ground on spare terminals 12 to 22 through the (A-5) brush advances the brushes of the selector until the first three brushes are resting on the first terminal of the (A-1), (A-2), and (A-3) arcs. While the selector is advancing over the spare terminals a call at this time will be routed to the first selector through the (A-4) brush and strapped spare terminals by the strap to terminal 1 of the (A-1) arc. The number of line finder selectors for a sub-group may thus be arranged by changing the necessary strapping on the selector arcs. The operation for the emergency selector for sub-group "A", and the regular and emergency selectors for sub-group "B" are similar.

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SEE SPECIFICATION X-70087 FOR EXPLANATION OF FORM

APPARATUS		SPEC. NO.	APPARATUS		SPEC. NO.	APPARATUS		SPEC. NO.							
Interrupter 149 & 152 Types		X-70018	200-R Selector		X-71215										
Commutators 1, 2 & 3 Types		X-70013	200-P Selector		X-71214										
200-B Selector		X-71202	Trip Magnets 1-A or 1-B		X-70109										
200-E Selector		X-71204	Sequence Switch B155		X-70126										
RELAYS			DIRECT CURRENT FLOW REQ.			CIRCUIT PREPARATION									
MECHANICAL REQ.						TEST SET									
PEC. NUMBER	SKETCH NUMBER	CONT. PRESS.	ARM. TRVL	TEST WDG.	TEST AFTER FOR SOAK	TEST AMPS.	READJ. AMPS.	S.S. POS.	BLOCK	TEST CLIP DATA	CONN. BATT.	CONN. GRD	TEST PREP	SEE TEST NOTE	REMARKS
178-AK (D)	X-70069	C	Spl.	P P/S	O R	.047 .054	.044 .057						G G	1/2 1/3	A A
206-L (CS)	X-70055	3			O O O O R R	<del>.045</del> -.024 -.024 -.024 .045 .082	.006 .004 .0032 OC OC		(CH)NO (CH)NO (CH)NO (CH)NO (CH)NO (CH)NO	SS2-W SS2-W SS2-W SS2-W SS2-W SS2-W	SS4-V SS4-V SS4-V SS4-V SS4-V SS4-V	B/G B/G B/G B/G B/G B/G	1/4 1/4 1/4 1/4 1/4 1/4		B C D
B1 (DC)	X-70056	1			O O R	<del>.03</del> <del>.03</del> <del>.150</del>	<del>.017</del> <del>.018</del> .0037	.0175 .018 .150		SS1-Q SS1-Q SS1-Q	2-B(F) 2-B(F) 2-B(F)	B/G B/G B/G	1 1 1		E F G
B9 (B)	X-70056	1			O R	.065 .015	.051 .016		(A)NO (A)NO	2Wdg(B) 2Wdg(B)			Bat. Bat.		
E106 (SA)	X-70037	8/7	20	.020	O	.036	.030				RU(SA)		G	5	
E106 (SB)	X-70037	8/7	20	.020	O	.036	.030				RU(SB)		G	5	
E399 (D)	X-70037	14/1	20	.035	O	.040	.013			RL(D)	RU(D)		B/G	5	H
E428 (C)	X-70037	7/3	20	.020	O O	.019 .040	.016 .034				RU(C)		G	5 5	I J

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RELAYS CODE	DESIG.	MECHANICAL REQ.			DIRECT CURRENT FLOW REQ.				CIRCUIT PREPARATION			TEST SET		REMARKS	
		SPEC. NUMBER	SKETCH NUMBER	CONT. PRESS	ARM. TRVL	TEST WDG. FOR	TEST AFTER SOAK	TEST READJ. AMPS.	S.S. POS.	BLOCK	TEST CLIP DATA CONN. BAT. CONN. GRD.	PREP	TEST NOTE		
E461	(A)	X-70037	3/1	20	.020		0	.013	.012		RL(A)	RU(A)	B/G	6	K
E461	(B)	X-70037	3/1	20	.020		0	.013	.012		RL(B)	RU(B)	B/G		
E533	(L)	X-70037	8/3	20	.020	P	0	.0178	.017			RU(L)	G	1/7	L
						P	NO	.0114	.012			RU(L)	G	1	
						S	0	.045	.043			LL(L)	G	1/8	L
E555	(A)	X-70037	1	20	.015		0	.013	.009			RU(A)	G		
E555	(I)	X-70037	1	20	.015		0	.013	.009	(CH)NO		RU(I)	G	1	M
E568	(C-1)	X-70037	11/3	20	.020		0	.020	.015					5	I
							0	.040	.031			RU(C-1)	G	5	J
E632	(TR)	X-70037	8/7	20	.020	S	0	.048	.045		LU(TR)	LL(TR)	B/G	9	L
						P	H	.034	.032			RL(TR)	Bat.	9	L
E632	(TR-1)	X-70037	8/7	20	.020	S	0	.048	.045		LU(TR-1)	LL(TR-1)	B/G	9	L
						P	H	.034	.032			RL(TR-1)	Bat.	9	L
E637	(CA)	X-70037	8/7	Spl.	.020	P	0	.037	.025			RU(CA)	G	5	N
						P	NO	.014	.015			RU(CA)	G	5	
						S	H	.040	.037			LL(CA)	G	5	
E637	(CB)	X-70037	8/3	Spl.	.020	P	0	.037	.025			RU(CB)	G	5	N
						P	NO	.014	.015			RU(CB)	G	5	
						S	H	.040	.037			.LL(CB)	G	5	
E638	(STB)	X-70037	22/10	20	.030		0	.026	.025					5	I/L
							0	.042	.039	(G)Sol.NO		RU(STB)	G	5	L/O

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CODE	DESIG.	SPEC. NUMBER	SKETCH NUMBER	CONT. PRESS	ARM. TRVL	TEST WDG.	TEST FOR	AFTER SOAK	TEST AMPS.	READJ. AMPS.	S.S. POS.	BLOCK	TEST CLIP CONN. BAT.	DATA CONN. GRD.		SET PREP	TEST NOTE
E686	(SL)	X-70037	10/3	20	.020		O		.040	.015		(CH)NO	RL(SL)	RU(SL)	B/G	1	
E725	(KF)	X-70037	11	20	.015		O		.020	.018		(G)Sol.NO		RU(KF)	G	5	I
							O		.270	.243						G	5/10
E748	(LF)	X-70037	11/3	Spl.	.020	P	O		.027	.025		(H)O	RU(LF)	G	1/11		L/H
						P	NO		.015	.016		(H)O	RU(LF)	G	1/11		
						P	H		.018	.017		(H)O	RU(LF)	G	1/11		L
E750	(MB)	X-70037	8	Spl.	.020	P	O		.040	.028			RU(MB)	G	12		N
						P	NO		.013	.014			RU(MB)	G	12		
						S	H		.042	.040			LL(MB)	G	12		
E868	(E)	X-70037	23/10	20	.030		O		.040	.024		(D)NO	RU(E)	G	1		
E895	(E)	X-70037	10/14	20	.035		O		.040	.016			RU(E)	G	5		
E896	(B)	X-70037	9/11	20	.035		O		.050	.047			RU(B)	G	5		
E897	(A)	X-70037	10/11	20	.015		O		.040	.013			RU(A)	G	5		H
E899	(STA)	X-70037	22/7	20	.030		O		.028	.026					G	5	I
							O		.044	.041		(G)Sol.NO	RU(STA)	G	5		Q
E901	(L)	X-70037	3/1	20	.020		O		.019	.018		(CO)O	RU(L)	G	13		R
							R		.0049	.0052		(CO)O	RU(L)	G	13		R
							O		.019	-		(CO)O	RU(L)	G	13		S
							R		.0046	-		(CO)O	RU(L)	G	13		S
E915	(F)	X-70037	7	20	.020	P	O		.041	.039			RU(F)	G	1/14		
						S	O		.042	.040			LL(F)	G	1/14		

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		SPEC. NUMBER	SKETCH NUMBER	CONT. PRESS	ARM. TRVL	TEST WDG.	TEST FOR	AFTER SOAK	TEST AMPS.	READJ. AMPS.	S.S. POS.	BLOCK	TEST CLIP DATA CONN. BAT. CONN. GRD.		SET PREP	TEST NOTE	
E996	(DS)	X-70037	12/8	20	.035	P	0		.042	.040		RU(DS)	G	1/15			
						S	0		.115	.086						1/15	I
						S	0		.160	.119		LL(DS)	G	1/15	T		
E1027	(CI)	X-70037	8/11	20	.020	P	0		.051	.040		RU(CI)	G	16			
						S	0		.051	.041		LL(CI)	G	17			
E1148	(BA)	X-70037	8/11	20	.020	P	0		.040	.022	(K)0	RU(BA)	G	18			
E1148	(BA-1)	X-70037	8/11	20	.020	P	0		.040	.022	(K-1)0	RU(BA-1)	G	18			
E1149	(O)	X-70037	2	Spl.	.015	P	0		.016	.015					9/19	I	
						P	NO		.0095	.010						9/19	I
						P	0		.034	.032		RU(O)	G	9/19	U		
						P	NO		.020	.021		RU(O)	G	9/19	U		
						S	H		.0285	.027		LL(O)	G	9/19			
E1149	(O-1)	X-70037	2	Spl...	.015	P	0		.016	.015					9/19	I	
						P	NO		.0095	.010						9/19	I
						P	0		.034	.032		RU(O-1)	G	9/19	U		
						P	NO		.020	.021		RU(O-1)	G	9/19	U		
						S	H		.0285	.027		LL(O-1)	G	9/19			
E1187	(CO)	X-70037	2	20	.015	P/S	0		.017	.011		LU(CO)	Bat.	13	R		
						P/S	NO		.007	.0074		LU(CO)	Bat.	13	R		
						P	0		.078	.074		RL(CO)	Bat.	13	R		
						P	NO		.039	.041		RL(CO)	Bat.	13	R		
						P/S	0		.017	-		LU(CO)	Bat.	13	S		
						P/S	NO		.0066	-		LU(CO)	Bat.	13	S		
						P	0		.078	-		RL(CO)	Bat.	13	S		
P	NO		.037	-		RL(CO)	Bat.	13	S								

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RELAYS CODE DESIG.	MECHANICAL REQ.				DIRECT CURRENT FLOW REQ.				CIRCUIT PREPARATION			TEST SEE		REMARKS	
	SPEC. NUMBER	SKETCH NUMBER	CONT. PRESS	ARM. TRVL	TEST WDG. FOR	AFTER SOAK	TEST AMPS.	READJ. AMPS.	S.S. POS.	BLOCK	TEST CLIP DATA CONN. BAT. CONN. GRD.	SET PREP	TEST NOTE		
E1521 (CH)	X-70037	11	20	.015	P P P/S	O R H	.027 .0028 .018	.025 .003 .017		(CS)O (CS)O (CS)O	RU(CH) RU(CH) LL(CH)	G G G	8 8 8		
E1525 (H)	X-70037	3	20	Spl.		O NO O NO	.0095 .0064 .114 .077	.009 .0068 .108 .082						1/20 1/20 Bat. 1/20 Bat. 1/20	I/L I/L L/V L/V
E1626 (KA)	X-70037	1	20	.015		O	.020	.010			RU(KA)	G		W	
E6000 (GA)	X-70037	9/14	20	.035		O	.019	.018			RU(GA)	G	5/21	L	
E6000 (GB)	X-70037	9/14	20	.035		O	.019	.018			RU(GB)	G	5/22	L	
F10 (K)	X-70104	14/3									2-T(O)	G	5/23		
F10 (K-1)	X-70104	14/3									2-T(O-1)	G	5/23		
12F - 5-M Mess. Reg.	(MR)					O NO	.037 .032				2-T(SB) 2-T(SB)	G G			
5-8 Mess. Reg.	(MR)					O NO	.350 .270			(L)O (L)O	3-T(L) 3-T(L)	Bat. Bat.			

Per Letter Nov 27-1944 File 22-20

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

## TEST NOTES:-

1. - Before making any tests or readjustments on the district circuit, insulate SS2-B and make the circuit busy by inserting an (MB) plug in the (MB) jack.
2. - The normally closed contacts shall have minimum 15 grams contact pressure.
3. - Requirements for release with windings connected parallel differentially. Two test sets are required to obtain this condition. One set between 1-B (E) and ground for primary winding and the other between SS3-U and ground for secondary winding. With specified current flowing through primary winding, relay should release when current of same strength is passed through secondary winding.
4. - A negative )-) sign preceding a current value means that this current shall flow in the direction opposite to the direction of the operating current. The difference between the readjust and test soak requirements has no electrical effect on the relay and is only specified to prevent the "Automatic District Test Circuit" to test all types of (CS) relays in the office with the same requirements.
5. - Before making any tests or readjustments on the start circuit, remove the start circuit from service and replace by the emergency start circuit.
6. - Block (STP) selector in position 2.
7. - Relay shall be equipped with removal stop pin (piece part 163914).
8. - Insulate SS1-R.
9. - Before making any tests or readjustments on the (O), (O-1), (K), (K-1), (TR) or (TR-1) relays, remove the trip circuit from service and replace by the emergency trip circuit.
10. - Strap 1-T and 2-T spring terminals.
11. - Block the line finder UP magnet non-operated.
12. - Remove the (MB) plug from the (MB) jack. Insert the "Test" plug in the "Test" jack and strap 1-T and 2-T spring terminals.
13. - Special requirements to meet testing conditions.
14. - Block (STP) selector operated.

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

TEST NOTES: - (Continued)

15. - Block line finder "DOWN" magnet non-operated.
16. - Insulate 4-B(E).
17. - Insulate SS2-S.
18. - Make all tests and readjustments during periods of light traffic loads.
19. - (a) Special requirements due to circuit conditions and to insure fast operation.  
(b) There shall be a perceptible follow of the #2 spring when the relay operates, but it will not be necessary to have a visible stud gap.  
(c) No definite contact pressure specified.
20. - The 1-T spring shall have at least 30 grams tension against the spoolhead. No definite tensions specified for the other springs. The armature need not touch the core when in the operated position.
21. - Block the (A) selector in position 20.
22. - Block the (B) selector in position 20.
23. - After operating on .047 amp., relay must remain operated when the circuit is broken for a minimum period of 0.1 second and release on open circuit within a time interval of 0.35 seconds.

REMARKS:-

- A. - Requirements to insure slow release.
- B. - Maximum external circuit loop 3000 ohms.
- C. - Minimum external circuit loop 3000 ohms - maximum external circuit loop 4400 ohms.
- D. - Minimum external circuit loop 4400 ohms - maximum external circuit loop 5600 ohms.
- E. - Maximum external circuit loop 750 ohms.
- F. - Maximum external circuit loop 900 ohms.
- G. - Minimum line leak 10,000 ohms.

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CODE	DESIG.	SPEC. NUMBER	SKETCH NUMBER	CONT. PRESS	ARM. TRVL	TEST WDG. FOR	TEST AFTER SOAK	TEST READJ. AMPS.	S.S. POS.		BLOCK	TEST CLIP DATA	CONN. BAT.	CONN. GRD.	PREP NOTE

REMARKS: - (Continued)

- H. - Insulate 2-B(STA).
- I. - Requirements for relay winding alone.
- J. - Requirements for circuit combination of (C) and (C-1) relays
- K. - Insulate contacts of 152-D interrupter.
- L. - Requirements to insure fast operation.
- M. - Strap 1-B and 2-B spring terminals.
- N. - No definite contact pressure specified.
- O. - Requirements for circuit combination of (STB) relay and 18-BH resistance.
- P. - Requirements for circuit combination of (KF) relay and (G) selector.
- Q. - Requirements for circuit combination of (STA) relay and 18-BH resistance.
- R. - Requirements with relay cover off.
- S. - Requirements with relay cover on.
- T. - Requirements for circuit combination of (DS) and (E) relays. Strap 3-T and 4-T spring terminals.
- U. - Requirements for circuit combination of (O) relay and (O) resistance.
- V. - Requirements for circuit combination of (H) relay and 18-T resistance. Strap 1-T and 2-T spring terminals.
- W. - Operate alarm release key.

ENG. WB-GL

CHKD. WCD-CWP

APPROVED J.L. DOW - GML