PANEL SYSTEM
SELECTOR CIRCUIT
LINE FINDER AND DISTRICT
SENDER SELECTOR TYPE
FOR TWO PARTY LINES
MODIFICATION OF ES-226614 AND ES-240081
FOR ZONE AND OVERTIME REGISTRATION

CHANGES

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

C.1 Primary non-operate current flow requirements for (Z) relay changed from test .075 amp., readjust .080 amp., to test .095 amp., readjust .100 amp. Test note 7 added to page 4 to record this change.

C.2 Test note 5 on page 3 changed to read:- "Armature need not touch core on operating current". This note formerly read:- "With the relay operated on the specified test or readjust current, no front contact shall make with a .006" gauge inserted between the stop pin and the core and all front contacts shall make with a .004" gauge inserted in place of the .006" gauge.

All other headings, No Change.

BELL TELEPHONE LABORATORIES, INC.

DEPT. 332

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PANEL SYSTEM
SELECTOR CIRCUIT
LINE FINDER AND DISTRICT
SENDER SELECTOR TYPE
FOR TWO PARTY LINES
MODIFICATION OF ES-226614 AND ES-240081
FOR ZONE AND OVERTIME REGISTRATION

CHANGES

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

C.1 Present adjustments of (CS) relay designated A, B and C and rated "Mfr. Disc.", and new adjustment D added, to provide for more reliable operation of this relay. Test note 1 on page 2 removed, test notes 3 to 6 re-numbered, 4 to 7, and new test notes 1 and 3 added, to cover procedure for applying adjustment D.

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 The sequence switch at the number one cutting of the P and Q cams is changed from solid feed to 1/18, which is inscribed by a box. The box around the cutting symbol in conjunction with the solid feed symbol indicates that cams may or may not be solid.

D.2 Working limits added for (CS) relay adj. D.

D.3 Sheets -011 and -012 redrawn on account of poor condition of tracings.

All other headings, No change.

BELL TELEPHONE LABORATORIES, INC.

DEPT. 3340

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PANEL SYSTEM
SELECTOR CIRCUIT
LINE FINDER AND DISTRICT
SENDER SELECTOR TYPE
FOR TWO-PARTY LINES
MODIFICATION OF ES-226614 AND ES-240081
FOR ZONE AND OVERTIME REGISTRATION

CHANGES

A. CHANGED AND ADDED FUNCTIONS

A.1 Optional arrangement added for timed release of district from talking position.

B. CHANGES IN APPARATUS

B.1

Superseded	Superseded by
Sequence Switch D-91289	Sequence Switch D-99969 (when "G" wiring is used)
95E Repeating Coil	94E Repeating Coil

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

C.1 Soak requirements for test operate and test and readjust release of the (CS) relay changed from -.024 and .082 amp. to -.045 and .045 amp. respectively.

C.2 The current flow requirements for the E743 and E908 (F) relays formerly were as follows:

Primary operate test	.041 amp.
Primary operate readjust	.039 amp.
Secondary operate test	.042 amp.

The release requirement for these relays was not shown. Test note 6 added to page 2, and test note 3 added to page 3 to record this change. Former test notes 3 and 4 renumbered 4 and 5.

C.3 On Page 1 test note 5 is added to provide an increased tension on the SS3-P and SS3-Q springs when the sequence switch is equipped with solid springs.

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 "G" wiring is shown for use where timed release of district is required. With "G" wiring cam 0 is changed and the circuit is arranged so that failure of the calling subscriber to hang up causes the district release circuit to function and close ground to relay (F), causing relay to operate and advance the district to position 16. From position 16

the district is restored to normal in the usual manner. Also the (CH) relay locks in position 1 to insure the operation of the time alarm through the district release circuit in case of failure of the district to advance out of position 1.

D.2 The present circuit arrangement to be used when the release of district time alarm is not required is shown as "F" wiring.

D.3 Circuit note 128 is added covering the use of "F" and "G" wiring.

D.4 Circuit note 129 is added covering the change in repeating coil.

D.5 Circuit note 130 is added covering connection of battery to the inner ends of alternate "R" magnets.

D.6 Connection of (OT) relay to battery in Figs. A,B,C, and D, shown as "X" wiring. Optional "Z" wiring added, connecting (OT) relay to battery through contacts of cam V, closed 11/16-1/4. This change is to prevent false advance of the district out of position 1 when relay (OT) is operated on overtime calls. Circuit note 131 added to record this change.

D.7 "FN" and "GN" wiring shown, to be furnished where F and N wiring, or G and N wiring, respectively, are used. Circuit note 132 added, to record this change.

D.8 Designations of winding terminals removed from non-inductive windings of (RC), (RT) and (CH) relays, and circuit note 133 added, covering reference to manufacturing drawings for these designations.

DEVELOPMENT

1. PURPOSE OF CIRCUIT

1.1 This circuit is for use in establishing connections between subscribers of two party message rate lines of a panel office and operators of subscribers in other panel or manual offices. It is a modification of ES-226614 and ES-240081 and is arranged for zone registration and overtime charging.

2. WORKING LIMITS

2.1 This circuit has a maximum external circuit loop range for trunk supervision of 5010 ohms for 20 to 28 volt battery, 5300 ohms for 21 to 26 volt battery, 10220 ohms for 40 to 56 volt battery and 11470 ohms for 45 to 50 volt battery for a minimum insulation resistance of 30,000 ohms. The maximum external subscribers circuit loop resistance is 900 ohms for a minimum insulation resistance of 10,000 ohms.

OPERATION

3. FUNCTIONS

3.01 Hunts for and seizes the calling subscriber's line.

3.02 Hunts for and seizes an idle sender circuit.

3.03 Closes the dialing leads from the calling subscriber's line to the sender circuit.

3.04 Arranged for zone registration for any of six zones.

3.05 Closes the fundamental circuit leads for the selections beyond the district.

3.06 Makes talking selection and establishes the talking connection.

3.07 Tests the (T) relay for operation under its worst circuit conditions before it is connected to the subscriber's line, for party test.

3.08 Tests the calling subscriber's line for the presence or absence of ground for the purpose of identifying the calling subscriber.

3.09 Furnishes talking battery to the calling subscriber.

3.10 Furnishes repeating coil transmission on regular calls.

3.11 Connects the subscriber's line directly to a trunk for a call to an operator.

3.12 Arranged for automatic timing and overtime charging of subscriber's calls in any of six zones.

3.13 Disconnects when the calling subscriber replaces the receiver on the switchhook.

3.14 Operates the selector time alarm or restores the district to normal if the calling subscriber does not disconnect within a predetermined interval after the called subscriber has disconnected.

3.15 Prevents disconnection if the calling subscriber momentarily restores the switchhook.

3.16 Does not restore to normal and gives a selector time alarm if the calling subscriber's line is grounded after the conversation is completed.

3.17 Disconnects the sender and supplies overflow tone to the calling subscriber when the district goes to overflow.

3.18 Operates a "selector group" register to record the number of calls handled by a group of districts.

3.19 Returns to normal after the completion of a call or after an early release.

3.20 Returns to normal if the sequence switch or the timing switch is manually advanced from its normal position.

3.21 Safeguards are provided for preventing false charging and timing due to trouble conditions.

3.22 May be arranged to distinguish between 2 classes of service in same line finder group.

4. CONNECTING CIRCUITS

This circuit will function with:

4.01 Line, trip and start circuit of sender selector type.

4.02 Sender selector type subscriber's sender.

4.03 Any office selector circuit.

4.05 "A" operator's trunk circuit.

4.06 P.C.I. local or tandem trunk circuits.

4.07 Stuck sender selector circuit.

4.08 Selector group register circuit.

4.09 Selector time alarm circuit.

4.10 Motor stop alarm circuit.

4.11 District timing circuit.

4.12 Message register connector circuit.

4.13 District Release circuit.

DETAILED DESCRIPTION

5. HUNTING CALLING SUBSCRIBER'S LINE

When the receiver at the calling station is removed from the switchhook, various relays in the line circuit operate and connect battery to the H terminal of the line at the line finder multiple bank. When ground is connected to the ST lead, the (LF) relay operates and (a) locks through its windings in series to ground at the contacts of the (H) relay, (b) operates the UP magnet causing the line finder selector to travel upward and hunt for the terminals of the calling subscriber's line, to which battery is connected by the trip circuit, (c) closes a circuit from commutator segment "M" over lead Y operating a relay in the start circuit when the line finder starts upward and (d) operates the (CI) relay. When "N" wiring and apparatus are furnished, the (LF) relay closes direct ground over lead Y thru the (Z) relay winding. The (Z) relay will not operate in series with the relay in the start circuit alone, but will operate when this relay is shunted by a low resistance, which is the indication that a subscriber in class No. 2 is calling. If the (Z) relay is operated, it locks to battery on the back contact of the (DS) relay and to ground on the front contact of relay (E). When the selector brushes make contact with the terminals associated with the calling subscriber's line, the (H) relay operates from battery in the trip circuit, over lead H, to ground at the contacts of the (DS) relay. When the (H) relay operates a 50 ohm non-

inductive shunt is connected to its winding for the purpose of increasing the current through the winding of a 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 the (LF) relay does not release immediately since a circuit is 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. The (LF) relay released, (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 secondary winding of the (F) relay so that when the circuit through its primary winding is opened, by the release of the (CI) relay, when the district sender selector seizes an idle sender, the (F) relay releases and (c) closes a circuit operating the (SL) relay. Relay (D1) operates as described in paragraph 7. The (SL) relay operated, (a) connects battery to resistance (G) for making the line finder sleeve busy and (b) operates relays (CH) and (L).

6. RELEASING THE TRIP AND START CIRCUITS

As the line finder selector continues upward, at the end of the tripping zone, the K brush makes contact with the K commutator, thus connecting ground to the K lead which short-circuits and releases various relays in the trip and start circuits. The trip and start circuits are released and the circuit over the X lead is opened, but the (MB) relay will not release since it is held operated thru its primary winding.

7. SELECTING AN IDLE 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, (b) operates the (D) relay which in turn operates the (D1) relay, (c) opens the operating circuit of the (CI) relay, thus permitting the relay to release if the test brush of the sender selector is 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 a busy sender, the (CI) relay locks through its secondary winding, to ground on the test brush of the sender selector. With the (CI) relay held operated, the operation of the line finder (E) relay also operates the (F) relay and the sender selector (STP) magnet thereby stepping the sender selec-

tor 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 an idle sender is found the holding circuit of the (CI) relay is opened and the (CI) relay releases. 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 through the contacts of the (CI) and (4) relays. 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. The operation of the (D1) relay (a) partially prepares the circuit for advancing the (MR) selector, (b) prepares the circuit to the "FR" lead for "E" or "H" wiring and for the (C1) and (C2) relays; (c) operates the (SL) relay (d) partially prepares the holding circuit for relay (C) and (e) partially prepares the circuit from the secondary winding of the (C) relay to the "PU" lead.

8. MAKING DISTRICT BUSY

The (MB) relay operated (a) locks to ground on lead X so that the (MB) relay will not release if the selector returns to normal while another call is being established, (b) operates the (F) relay to ground thru the (LF) relay contacts, if it was not previously operated by the operation of the (E) relay, (c) connects ground to the series circuit through the (MB) relays of the other selectors in the same group, thus permitting the operation, over lead (CH) of a relay in the start circuit, when all line finder selectors in the group are off-normal, (d) opens the circuit over lead Y, to start circuit and (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.

9. THE ADJUSTMENT OF THE LINE FINDER "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.

10. ADVANCING THE SEQUENCE SWITCH TO POSITION 2

The (SL) relay operated, operates relays (CH) and (L) from ground on the N commutator brush and segment as described in paragraph 5. When "F" wiring furnished, the (CH) relay operated, connects ground to the selector time alarm circuit. This relay also partially prepares the circuit for advancing the (MR) switch to position 2. When "G" wiring is furnished, the (CH) relay locks in position 1 to insure the operation of the time alarm thru the district release circuit, in case of failure of the district to advance out of position 1. The (L) relay operated, closes a circuit advancing the district switch to position 2. As the switch advances from position 1, the circuits through the (L) and (CH) relays are opened, releasing these relays and disconnecting the selector time alarm circuit. In position 1-1/2 to 2, the associated sender is held busy by ground supplied to lead TR. In position 2 ground is connected to the "TR" lead when "E" wiring is used, or when "H" and "N" wiring are used and the (Z) relay is operated. This signal is useful only when the same sender group serves two classes of subscriber's lines.

11. COMPLETING FUNDAMENTAL CIRCUIT

In position 2, the (CI) relay operates on its secondary winding, and remains operated until the switch advances from position 10. The (CI) relay operated (a) connects ground to the TST brush of the sender selector, thus making the associated sender test busy after the switch advances to position 2, (b) closes the ring side of the dialing circuit through to the sender, and (c) operates the (CI-1) relay. The (CI-1) relay operated, closes the tip side of the fundamental circuit thru to the sender circuit and also closes the sender control SC lead to battery through the secondary winding of the (D) relay. With the (CI) and (CI-1) relays operated and 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 dial 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. After the sender functions, ground from the sender is connected to lead "FT" operating the (L) relay. The (L) relay operated, locks through its primary winding to ground over the FT lead, and advances the switch to position 3. The primary winding of the (CH) relay is also connected in parallel with the winding of the (D) relay. If the (CH) relay operates at this time due to a high resistance ground in the sender cir-

cuit, no useful function will be performed.

12. DISTRICT BRUSH SELECTION

With the switch in position 3, the UP magnet is operated for brush selection. As the selector moves upward in position 3, carrying the commutator brushes over the commutator segments, the A segment and brush intermittently connect ground to the tip side of the fundamental circuit holding the (L) relay operated, but successively short-circuiting the stepping relay in the associated sender circuit, thus releasing and permitting its reoperation 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 advancing the switch to position 4. When two digit senders are used with this circuit, the advance of the sender replaces the high resistance ground on the SC lead with a low resistance ground thus insuring the operation of the (CH) relay. In position 4, the trip magnet is operated and the (L) relay is operated and locks to ground on the fundamental circuit, previously described, advancing the switch to position 5.

13. ZONE REGISTRATION WHEN FIG. A, B OR C IS USED

When any of Figures A, B or C is used partial zone registration is obtained while the district switch is in positions 4 and 5. In these positions, relays (C1) and (C2) are connected in series to the "FR" lead. The sender circuit then proceeds to connect the proper battery condition to lead "FR" in accordance with the class of call which it has recorded. The (C2) relay is marginal and operates only when low resistance battery is connected to the "FR" lead. The (C1) relay is a sensitive relay and operates when either a high or low resistance battery is connected to the "FR" lead by the sender circuit. When either or both of these relays are operated, they lock to ground supplied at cam I. This record is part of the zone registration. The zone registration is completed when the district makes talking selection as described in paragraph 22. The zone classes are obtained as the result of the following conditions of relays (C1) and (C2) as well as the talking position determined by the talking selection:

ZONE	TALKING SELECTION POSITION OF SEQUENCE SWITCH	CONDITION OF (C1) AND (C2) RELAYS
0	11	(C1) and (C2) non-operated
1	12	" " " " "
2	11	" operated (C2)" "
3	12	" " " " "
4	11	" and " operated
5	12	" " " "

14. 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 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 thus holding the district (L) relay operated, but successively short-circuiting the stepping relay in the associated sender circuit, causing it to release 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 low resistance ground, thus insuring the operation of the (CH) relay. In position 5 to 6-1/4 the (PT) selector magnet is energized. When the switch advances from position 6-1/4, the energizing circuit is opened, releasing the (PT) selector which steps its brushes one terminal. The line test selector remains in position 2 until the sequence switch is advanced to position 9-3/4. With the switch in position 6, a circuit is closed from ground on the line finder N commutator to the secondary winding of the (L) relay, operating the relay. The (L) relay operated, advances the switch to position 7.

15. TRUNK HUNTING WITH FIRST TRUNK IDLE

If the first trunk in the group, in which the selector is hunting is 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 thru contacts of the (L) relays as a busy condition until the switch advances to position 7-3/4.

16. TRUNK HUNTING WITH FIRST TRUNK BUSY

If the first trunk in the group, in which the selector is hunting, is busy, the (L) relay is held operated through its primary winding to ground on the sleeve terminal of the busy trunk. With the switch in position 7, the UP magnet is operated 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 primary winding of the (L) relay is opened but the relay does not release immediately, due to a circuit being closed from battery through its secondary winding to ground through the C commutator. 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 selected trunk. The (L) relay released, also advances the switch to position 8.

17. THE ADJUSTMENT OF THE DISTRICT "C" COMMUTATOR BRUSH

The adjustment of the district "C" commutator brush, with relation to the tripped sleeve multiple brush, is such, that it does not contact with the C commutator, until slightly after the holding circuit through the primary winding of the (L) relay is opened by the sleeve brush, leaving the busy terminal 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 holding circuit through the secondary winding of the (L) relay is opened at the "C" commutator releasing the (L) relay which in turn releases the UP magnet. The selector then drops into place, thus centering the brushes on the trunk terminals. During trunk hunting, in position 7 only the commutator feed ground is supplied under control of the (L) relay. This is to prevent the reoperation of the (L) relay when the C commutator brush and segment reclose on the overthrow of the selector or as it drops into place.

18. SELECTION BEYOND

As the switch advances to position 7-3/4, ground 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 contacts of the (CH) relay, to the secondary winding of the (L) relay, which operates advancing the switch to position 9. In position 9, the tip and ring of the out-going fundamental circuit are closed through for selections beyond the district. After selections beyond have 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 the dialing circuit is opened. In position 9-3/4, the ring lead from the line finder is closed to the (PT) selector switch and in position 10 the tip lead is closed from the line finder to the (PT) selector switch.

19. FIRST TEST OF CALLING LINE

As the district switch enters position 10, the (PT) magnet operates. The (PT) magnet operated, steps the brush assembly to terminal 3. With the line test switch on terminal 3, 4, 5 and 6, 48 volt battery is connected to the tip side of the subscriber's line, through terminal 3 and (T) brush of the selector. The charge in the station condenser is thus

neutralized so that it will not interfere with the proper functioning of the (T) relay as the line is tested when the line test switch enters a test position. A circuit is also closed from battery through one winding of the repeating coil, winding of the (DC) relay, R brush and terminal 2 to 9 inclusive of the test switch, to ground through the non-inductive winding of the (RC) relay, operating the (DC) relay. The operation of the (DC) relay closes a holding circuit for the (D) relay. With the line test switch on terminal 3, battery is connected through its (B) brush and 3 terminal, to ground through the primary winding of the (RT) relay which operates.

20. ROUTINE TEST

The (RT) relay operated, (a) connects ground thru the secondary winding of the (RT) relay, to the winding of the (T) relay which operates and (b) connects ground to the selector time alarm circuit. The function of the (RT) relay is to make a routine test of the (T) relay on each call before it is connected to the line in connection with making two-party tests. If the (T) relay operates satisfactorily in series with the 3400 ohm winding of the (RT) relay, it does so on less current than it would receive under the worst line circuit conditions, thus assuring its operation under the worst circuit conditions. If the (T) relay does not operate in series with the 3400 ohm winding of the (RT) relay, the (PT) selector remains on terminal 3, causing the selector time alarm circuit to function. When the (T) relay operates on a routine test, ground is connected to battery through the primary winding of the (I) relay, which operates. The (I) relay operated, connects ground to terminal 3 and S brush of the party line test switch to the (PT) magnet, operating the selector which steps the brushes to terminal 4. With the line test switch on terminal 4, the operating circuit for the (T) relay is opened, at the C brush, releasing the (T) relay. The (T) relay released, opens the circuit through the (I) relay which releases. The (I) relay released, steps the selector to terminal 5. With the line test switchon terminal 5, a circuit is closed to ground through the (TST) interrupter, operating the (PT) magnet. When the contacts of the interrupter break, the energizing circuit of the (PT) magnet is opened, releasing the magnet, which steps the brushes to terminal 6. The (PT) magnet continues to operate under control of the (TST) interrupter advancing the line test switch to position 8. Position 8 is passby and the selector steps to position 9.

21. TESTING SUB STATION

At terminal 7 of the line test switch the subscriber's line is tested to determine which party on the line has originated the call, in order that the call may be registered correctly. If the call originates at the station whose

ringer is connected to ground through a condenser, the (T) relay does not operate. If, however, the call originates at the station with the grounded ringer, the (T) relay operates in turn operating the (RC) relay. The (T) relay operates in a circuit from ground through the sub-station ringer, over the tip side of the line, through cam P, (T) brush and terminal 7 of the line test selector. The operation of the (T) relay closes a circuit from ground on contacts of the (RT) relay, thru contacts of the (CI-1) relay to the primary winding of the (RC) relay which operates.

22. TALKING SELECTION

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. The (L) relay operated, advances the switch for talking selection. As the switch advances, ground is intermittently connected to the tip side of the fundamental circuit 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. With the line test switch on terminal 9, the (T) relay releases, and 48 volt battery is disconnected from the tip side of the line. With the line test switch on terminal 9 and the district sequence switch in position 10, a circuit is closed energizing the (PT) magnet. As the district switch advances from position 10-1/2, the operating circuit of the (PT) magnet is opened thus releasing the magnet which steps its brushes to terminal 10. With the test switch on terminal 9, the holding circuit of the (DC) relay is transferred from the secondary winding of the (RC) relay to the sub-station loop.

23. DISCHARGING THE SENDER

With the (DC) relay operated a locking circuit is closed for the (D) relay after the switch advances from position 9. The (D) relay is made slow in releasing so that the connection will not be lost if the switchhook at the called station is momentarily depressed. 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. The release of the (L) relay opens the holding circuit through the (CI) relay, disconnecting the sender from the district circuit.

24. CALLED PARTY ANSWERS

When the receiver at the called station is removed from the switchhook, with the switch is position 11 or 12, reversed

battery and ground from the incoming circuit operates the (CS) relay. The (CS) relay operated, connects ground to the (CHG) interrupter. When the interrupter contact F closes, the (I) relay operates and locks to ground at the (CS) relay. The (I) relay operated prepares the operating circuit for relay (CH). When contact B of interrupter (CHG) closes, relay (CH) operates. Relay (CH) operated (a) locks under control of cam 0, (b) operates relay (CH1) if the district sequence switch is in position 12 or if relay (C1) is operated, (c) prepares the stepping circuit for the (MR) switch and (d) prepares the circuit to the selector time alarm. When relay (CH1) operates, (a) it locks thru position 16 1/4, (b) partially prepares the test circuit for the second test of the calling subscriber's line, (c) closes the "TU" lead to the secondary winding of relay (C) (d) closes a holding circuit for holding the (SL) relay operated until the second test is completed and (e) prepares the circuit for energizing the (MR) selector magnet. When contact F of interrupter (CHG) closes, the (MR) selector magnet is energized and when contact F opens, the (MR) selector advances from position 1 to position 2.

25. NON-CHARGE CALL-ZONE 0-FOR FIGURES A, B AND C

A non-charge call corresponds to a call in zone 0. Relays (C1) and (C2) are both normal and the district switch is directed to position 11. Under these conditions timing switch (MR) is not moved off normal. Relay (CS) operates when the called party answers, to ground the interrupter (CHG) as described in paragraph 24. Relay (I) operates when the interrupter closes its contact "F" and locks under control of relay (CS). Relay (CH) operates and locks to ground when the interrupter closes its contact "B". When the calling subscriber replaces the receiver, relay (DC) releases, in turn releasing relays (D) and (D1) and disconnection occurs as described in paragraph 27.

25.1 Charge in Zone 0

If it is desired to arrange the circuit for charging in zone 0, "Y" wiring is used. If "N" wiring and apparatus are furnished and it is desired to charge for zone 0 only when the (Z) relay is operated, "J" wiring is used. Under either of these conditions, the district cannot stop in talking position 11 with the (C1) relay normal but advances to position 12 which is a charge position for zone 1. In this case the charging feature is obtained as described in paragraph 26.

26. AUTOMATIC-TIMING AND CHARGING FOR ZONES 1, 2, 3, 4 & 5 WHEN FIG. A, B OR C IS USED

Figure A, B or C is used when automatic timing and charging are required for multi-zone registration. These figures are practically uniform in operation, the principal differences being the length of the time intervals measured and the associated number of charges made for the various zones. Charging for the call is accomplished during con-

versation through the medium of a common message register connector circuit which is seized by the district when it is needed. The detailed method of operation is given in the following paragraphs:

26.1 Seizing the Message Register Connector Circuit

The (MR) switch advances to position 2 as previously described in paragraph 24. Position 2 is a pass-by position and is used to test the contacts of the (OT), (C1) and (C2) relays, which control the "OC", "Z1" and "Z2" leads, for trouble ground conditions. If these control contacts are not falsely grounded, the (MR) selector does not stop in position 2 but advances immediately to position 3. In position 3 ground is connected thru the secondary winding of the (C) relay to the "PU" lead. When the connector circuit is idle, it connects battery to the "PU" lead for operating all of the (C) relays which may be connected to the "PU" lead by the various district selector circuits waiting to seize the message register connector circuit. These (C) relays then proceed to operate but the only (C) relay which will lock to ground supplied by the connector circuit to lead "C" will be the (C) relay which occupies the preferential position, with respect to the other (C) relays. The (C) relay which locks also causes the associated (CA) relay of the same district selector to operate from the locking ground supplied by lead "C" and connects lead "CH" from the connector circuit to arc 6 of the district selector circuit. Relay (CA) operated (a) operates relay (CB) and (b) closes leads "OC", "Z1", "Z3" and "Z4" from the connector circuit to the district selector circuit. Relay (CB) operated (a) closes leads "P1", "P2" and "Z2" from the connector circuit to the district selector circuit (b) removes the ground supplied to the secondary winding of the (C) relay to the "PU" lead and (c) advances the (MR) selector to position 4. In position 4, ground is supplied for testing the "OC", "Z1" and "Z2" leads if these leads have not been previously grounded by the associated operated contacts of relay (OT), (C1), (C2).

26.2 Testing Connector Leads for Continuity

Leads "OC", "Z1" and "Z2" are grounded either by ground from arc 4 or by ground supplied by the contacts of relays (OT), (C1) and (C2) respectively, if these relays are operated. Ground is also connected to lead "P1" or "P2" depending upon whether the (RC) relay is normal or operated. The (RC) relay setting is obtained as described in paragraph 21. Lead "Z3" or "Z4" is grounded depending upon the talking position selected (either position 11 or position 12). If ground is connected to or absent from both leads "P1" and "P2" or both leads "Z3" and "Z4", the message register connector circuit will recognize this as a trouble condition and will not permit a charge to be made for the call until the trouble has been eliminated. When all of the proper conditions have been obtained over the connector leads, the message register connector circuit functions and

connects ground to lead "CH" thus advancing the (MR) switch to position 5. When the timing switch leaves position 4, (a) the test grounds are removed from the common leads and only those leads with the exception of lead "Z2" will continue to be grounded that have ground connected to them by the district switch or by the (C1), (C2), (OT) or (RC) relays and (b) lead "Z2" is opened at arc 3 as a signal to the connector circuit that (MR) switch has advanced from position 4. Position 5 is pass-by to insure that ground has been definitely removed from lead "Z2". In position 6, the (MR) switch waits for the connector circuit to supply ground to lead "Z2". When this occurs, the (MR) switch advances to position 7. In position 7, the "CH" lead is closed thru in preparation for charging.

26.3 Charging

With the (MR) switch in position 7, charging battery is supplied by the message register connector circuit to lead "CH", to the line finder "H" segment, over the "H" lead of the line circuit to the line message register, the message register connector circuit having previously connected the proper line message register to lead "H" of the line circuit. After the charging function is completed the message register connector circuit removes the holding ground from lead "C" thus causing relay (C) to release. Relay (C) released, releases relay (CA) which in turn releases relay (CB) thus opening all of the common leads to the message register connector circuit and causing the (MR) switch to advance to position 8. Positions 8, 9 and 10 of the (MR) switch are pass-by positions and thus the (MR) switch is advanced to position 11.

26.4 Timing

For the first period, the (MR) switch is advanced from position 11 to position 22 by pulses received at the rate of one pulse every 30 seconds over lead "OT" from the district timing circuit. If the (MR) switch is not advanced thru positions 12 to 19 by means of pulses received over lead "OT", the switch may be advanced thru these positions by interrupter (MR-1) depending upon whether Fig. A, B or C is used. Relay (OT) operates and locks when the (MR) switch reaches position 20 so that for the overtime period with relay (OT) operated, the (MR) switch is advanced thru position 19 by the (MR-1) interrupter. Position 22 is used for checking whether the (OT) and (CS) relays are operated. If the (OT) relay is operated the (MR) switch advances under control of interrupter (MR-1) to position 1. If disconnection has not occurred when the (MR) switch arrives in position 22 and relay (CS) is operated, the timing switch (MR) advances to position 1 under control of the (MR-1) interrupter and the second or overtime period is begun. This sequence of operations is repeated until disconnection occurs.

26.5 Optional Overtime Charge for Zone 1

By means of optional wiring, the overtime charges for zone 1 may be cancelled. "A" wiring provides overtime charging

for zones 1 to 5. "B" wiring provides overtime charging only when relay (C1) is operated which is not the condition for zone 1.

26.6 Timing Without Zoning - Figure D

When Figure D is used five minute intervals are measured for all charge calls. When "Y" wiring is used, the district sequence switch will not stop in position 11 but will be advanced automatically to position 12. In this case no free calls will be obtained since the "no-charge" position 11 is cancelled. When "Y" wiring is not used, all calls for which the district switch stops in position 11 will be no-charge calls.

27. DISCONNECTION FOR REGULAR CALL

When the receiver at the calling station is replaced on the switchhhook, the (DC) relay releases, in turn releasing the (D) relay. The (D) relay released releases the (D1) relay and advances the district sequence switch to position 16. The (D1) relay released, (a) releases the (SL) relay if the (CH1) is not operated, (b) opens the circuits to the "C" and "PU" leads and (c) advances the (MR) switch to normal. When the sequence switch advances relay (I) releases. The (PT) switch goes into position 11 as the sequence switch passes position 13-1/2. As the sequence switch enters position 14-3/4 ground is connected through to the winding of the (PT) magnet and terminal 11 and the (B) brush of the test switch, energizing the (PT) magnet. When the switch leaves position 15-1/4 the energizing circuit for the (PT) magnet is opened releasing the magnet and advancing the (PT) switch to terminal 12. The (TST) interrupter steps the switch to terminal 16.

28. SECOND TEST OF CALLING LINE

As the line test switch passes over terminals 12 and 13 with the district switch in position 16, battery is connected through the (T) brush and cam P to the tip side of the line to discharge the sub-station condenser. On terminals 14, 15 and 16 of the line test switch, a second test is made on the line. With the district switch in position 16, the (I) relay operates on its primary winding to ground on terminal 12 and (C) brush of the (PT) switch, and remains operated until the (PT) switch advances from position 15. During this test the tip and ring of the line are short-circuited through the contacts of the (CH1) relay in order to test for a foreign ground on either side of the line. If the (T) relay operates in positions 14 to 16 of the test switch, the (I) relay is held operated and the line test switch steps to terminal 16. With the (I) relay operated, the test switch is held on this terminal and a circuit is closed operating the selector time alarm circuit. When the alarm is investigated the sequence switch must be advanced to position 17. If,

however, the line is free from ground when the second test is made, the (T) relay does not operate and the (I) relay releases thus closing a circuit from ground to terminal 16 and (S) brush of the test switch, to the (PT) magnet, stepping the brushes to terminal 17. The selector then steps to position 20.

29. RESTORING LINE FINDER TO NORMAL

As the line test switch steps to terminal 20, a circuit is closed through the (R) magnet, advancing the district switch to position 17. When the district switch leaves position 16-1/4 relays (CH) and (CH1) release if these relays were operated in position 16. Ground from the normal position of the (MR) switch advances the sequence switch to position 18. As the switch enters position 17, a circuit is closed operating the (DS) relay. The (DS) relay operated, locks and closes a circuit through the outer winding of the (F) relay, thus insuring the holding of this relay until both the line finder selector and the district selector have returned to normal. If the (Z) relay is not operated, the operation of the (DS) relay also operates the line finder DOWN magnet which restores the line finder selector to normal. If the (Z) relay is operated the line finder DOWN magnet is not operated until the district is restored to normal and the sequence switch advanced to position 1. The (Z) relay then releases, operating the line finder DOWN magnet. When the line finder selector returns to normal, ground is disconnected from the M commutator segment, releasing the (E), (DS) and (MB) relays.

30. RESTORING DISTRICT TO NORMAL

With the district switch in position 18, a circuit is closed through the winding of the (PT) magnet which operates and advances the switch to terminal 21. With the line test switch on terminal 21, a circuit is closed through the DOWN magnet, restoring the selector to normal. When the district selector reaches the bottom of the frame, a circuit is closed from ground through the Y commutator brush and segment, D brush and terminal 21, S brush and terminal to the (PT) magnet, stepping the brushes to terminal 22. With the (PT) switch on terminal 22 a circuit is closed from ground on terminal 22 and S brush to the (PT) magnet, stepping the switch to terminal 1. With the (PT) switch on terminal 1, ground through the Y commutator brush and segment, D brush and terminal 1 of the (PT) switch, to the R magnet, advances the district switch to position 1. As the switch leaves position 18, the circuit through the DOWN magnet is opened, and after position 18-1/4 the circuit through the secondary winding of the (F) relay is opened, causing the (F) relay to release.

31. DELAYED DISCONNECT

31.1 Selector Time Alarm "F" Wiring

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 from ground thru the I cam, thereby notifying the switchman of th existing conditions.

31.2 Timed Release of District "G" Wiring

Should the calling subscriber fail to replace the receiver on the switchhook after the called subscriber has disconnected, the release of the (CS) relay connects ground to lead 1 of the district release circuit. After an interval, the district release circuit functions to connect the same ground to lead 2, operating relay (F). The operation of relay (F) opens the T and R leads, releasing relays (DC) and (D), which advances the switch to position 16. Party test is made in position 16 as covered in paragraph 28. If the ring party is on the line, and there are no false grounds, the district is restored to normal as described in paragraphs 29 and 30. If the tip party is on the line, the (T) relay operates on ground thru the tip party's bell, holding the district in position 16 and operating the time alarm, as covered in paragraph 28.

32. CALL TO OPERATOR

The district switch advances to position 13, as described in paragraph 22 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 operating the (L) relay, advancing 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, and in position 14, the locking circuit through the primary winding of the (D) relay is transferred from the contacts of the (DC) relay to the contacts of cam S. In position 14, a checking tone circuit is closed over the sleeve of the operator's trunk, contacts of the (L) relay, cam Y, condenser (A), cam X, the S brush and terminal at the line finder bank to ground through the winding of the cut-off relay of the line circuit for number checking.

33. DISCONNECTION FOR CALL TO OPERATOR

With the plug of the answering cord in the trunk jack at the incoming end, ground is connected to the sleeve terminal 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 operates, 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 thru the primary winding of the (D) relay is opened thus causing relay (D) to release. The (D) relay released, releases the (D1) relay which in turn releases the (SL) relay and then advances the switch to position 16. With the (PT) switch in position 20, a circuit is closed thru the R magnet, advancing the switch to position 17, the normal ground at terminal 1 of arc 1 of the (MR) selector advancing it to position 18. From this point on, the line finder and district selectors are restored to normal as described in paragraphs 29 and 30.

34. 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 terminal at the multiple bank. The selector therefore travels to the top of the bank and the H brush of the selector makes contact with the terminal of the H comb at the top of the multiple bank. The (H) relay operates from ground on the contacts of the (DS) relay to battery at the H comb. The (H) relay operated, releases the (LF) relay, which in turn releases the (F) relay and opens the circuit thru the UP magnet. The N commutator segment is opened with the selector brush resting on the H comb to prevent the district switch from advancing from normal when the (F) relay is released by the release of the (LF) relay. When the (F) relay releases, the (DS) relay operates from ground on the X commutator brush and segment, thru its primary winding. The (DS) relay operated, releases the (Z) relay, if operated, and operates the DOWN magnet restoring the selector to normal.

35. DISCONNECTION DURING POSITIONS 2 TO 6

If the receiver is replaced on the switchhook at the calling station while the district switch is in positions 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 operating the (CH) relay and causing the (D) relay to release on account of the increased current flow thru 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, releases the (D1) relay and advances the switch to position 6. In position 6 the DOWN magnet operates restoring the district selector to normal. When the selector reaches the bottom of the bank a circuit is closed from ground

through the Y commutator to battery through the R magnet, advancing the switch to position 7. In position 2/10 a circuit is closed through the outer winding of the (DS) relay, to ground on the M commutator, operating the (DS) relay which operates the line finder DOWN magnet in positions 18/1 returning the line finder to normal. As the district switch enters position 5, the (PT) selector is operated. When the district switch advances from position 6 1/4, the (PT) magnet releases, stepping the (PT) switch to position 2. Ground on the Y commutator through the D and S brushes steps the (PT) switch to position 4. The (PT) selector steps to terminal 5 in a circuit from ground on the contacts of the (I) relay and steps to terminal 8 under control of the (TST) interrupter. Ground on terminal 8 causes the test selector to step to terminal 9. Ground on the Y commutator through terminals 9 and 10, advances the district to position 14. As the district switch passes through position 10 to 10-1/2 the (PT) magnet operates. With the (PT) switch in position 9, a circuit is closed from ground on the Y commutator advancing the district switch to position 11. As the district switch advances from position 10-1/2, the (PT) magnet releases, stepping the (PT) switch to terminal 10. When the district switch advances to position 10, a circuit is closed thru the normal contacts of the (D) relay to the R magnet, advancing the switch to position 16. As the district switch passes through position 13, the (PT) magnet operates and when the district switch advances from 13-1/2 the (PT) magnet releases, stepping the (PT) switch to terminal 11. In position 14 3/4 the (PT) magnet again operates and releases when the district switch advances from position 15 1/4. The release of the (PT) magnet advances the test switch to terminal 12. Ground through the (TST) interrupter is connected through the (PT) magnet, advancing the (PT) switch to terminal 16. On terminal 16, ground on the normal contacts of the (I) relay advances the test switch to terminal 17. The switch advances to terminal 20 and closes a circuit from ground thru the C brush and terminal 20, advancing the district switch to position 17, the normal ground at terminal 1 of arc 1 of the (MR) selector advancing it to position 18. Ground thru the S brush and terminal 20 of the test selector advances the switch to terminal 21. The Y segment advances the switch to terminal 22. On terminal 22 ground through the S brush steps the (PT) switch to terminal 1, where a circuit is closed advancing the district switch to position 1. When the line finder selector returns to normal, ground is disconnected from the M commutator, thus releasing the (E), (DS), and (MB) relays. The (DS) relay released, releases the (F) relay, restoring the circuit to normal.

36. DISCONNECTION DURING POSITIONS 7 TO 10

If the receiver at the calling station is replaced on the switchhook while the district switch is in position 7 to 10,

the switch advances until selection beyond is completed, when ground is disconnected from the SC lead in position 10. After subscriber's line is tested and line test selector steps to position 9, the (DC) relay releases, releasing the (D) relay which closes a circuit through the R magnet, advancing the switch to position 16. As the switch advances to position 16, the (PT) switch steps to terminal 20, and in position 16, the (L) relay being released, advances the switch to position 17. From this point on the district returns to normal as covered in paragraphs 29 and 30, except that if the (Z) relay is operated, it releases as the switch leaves position 10, allowing the line finder DOWN magnet to operate in position 18.

37. TELL-TALE - LINE FINDER SELECTOR BRUSHES NOT TRIPPED

37.1 "R" WIRING

Should the line finder 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 tell tale circuit, giving a visual signal to the attendant. As the N commutator segment is open at 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.

37.2 "S" WIRING

With the circuit connected per "S" wiring the (LF) relay releases when the line finder reaches tell-tale, due to the N and C segments being opened. The release of the (LF) relay releases the UP magnet, and also releases the (F) relay provided a sender has been found. The release of the (F) relay operates the (DS) relay which locks, operates the down drive magnet and reoperates the (F) relay, returning the line finder to normal.

38. TELL-TALE - LINE FINDER SELECTOR BRUSHES TRIPPED

Should the selector travel to the tell-tale position while hunting, with the multiple brush tripped, a circuit is closed from battery in the trip circuit, terminal of the H comb at the top of the multiple bank (shown on TRIP circuit), H multiple brush of the line finder selector, winding of the (H) relay, to ground on the contacts of the (DS) relay, operating the (H) relay. The (H) relay operated, releases the (LF) relay, which in turn releases the (F) relay and the UP magnet. The (F) relay released, opens the circuit through the tell-tale alarm if furnished and connects ground through the X commutator brush and segment to battery through the primary winding of the (DS) relay, which operates in turn operating the DOWN magnet, restoring the selector to normal.

39. "T" WIRING

With the circuit connected per "T" wiring, the operating circuit for relay (DS) is held open for tell-tale conditions until relay (LF) has released thus preventing simultaneous operation of the UP and DOWN magnets.

40. TELL-TALE DISTRICT SELECTOR

Should the district selector travel to the tell-tale position during brush selection, ground on the X commutator brush and segment is connected through cam B to the R magnet, advancing the switch to position 8. Under this condition the resistance of the circuit over the "SC" lead is not sufficient to operate the (CH) relay, and the district remains in position 8 until it is restored to normal manually. If the district goes to tell-tale during group selection, ground on the X commutator advances it to position 8. In position 8, ground on the "SC" lead holds the (CH) relay operated, which in turn operates the (L) relay. The (L) relay operated, advances the switch to position 9. The (CH) relay and (L) relay remain operated and the district remains in position 9 until it is restored to normal manually.

41. DISTRICT OVERFLOW

If all the trunks in the group are busy, the district selector, while trunk hunting in position 7, travels to the top of the group and rests on the overflow terminals. As the sleeve terminal at overflow is open, the (L) relay releases, in turn advancing the switch to position 8. In position 8, the (L) relay reoperates from ground on the contacts 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, to the R magnet advancing the switch to position 10. In position 10, (L) relay operates, through the primary winding. The (L) relay operated, locks through its primary winding and advances the switch to position 14. As the switch advances from position 13, the (L) relay releases, and in position 14 advances the switch to position 15. The release of the (L) relay also releases the (CI) and (CI-1) relays, disconnecting the sender from the district circuit. With the switch in position 15, a circuit is closed to the "Miscellaneous Tone Circuit" over lead C, condenser (T), winding of the repeating coil, condenser (A), contacts of the (D) relay, to ground. A tone is therefore induced in the other winding of the repeating coil, thus causing the "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 paragraphs 29 and 30.

42. "0" COMMUTATOR

The function of the "0" commutator segment is to maintain an idle condition on the multiple overflow terminals, so that more than one selector may stop on overflow at one time, otherwise, the first selector reaching overflow would make the sleeve multiple terminals busy, thus causing succeeding selectors to continue upward into the next group of trunks. The "0" commutator segment is open at overflow, but the "S" bar is continuous. Both the "0" and "S" commutator brushes are permanently strapped together and wired to the multiple sleeve brush. When the selector is at overflow, the "0" commutator brush is resting on an open (dead) segment, and as the busy ground is supplied through the "0" commutator bar only, this arrangement maintains a non-busy condition of 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 "made busy" terminals into the next group.

43. PREVENTION OF FALSE REGISTRATION

To prevent false registration due to trouble crosses, grounds or opens, safe-guards have been incorporated that employ wires, apparatus and cam cuttings not required in the normal operation of the circuit. The following description of these safeguards lists the wires, apparatus and cam cuttings involved and outlines the troubles guarded against, together with the resultant circuit reactions.

43.1 For Fig. 1

43.11 SS1-D cutting 1/2
SS2-D cutting 18/2
Lead between SS2-D and (LF) relay winding.

To guard against registering for zone 2 or 3 instead of zone 0 or 1, should the (C1) relay be falsely operated.

Also to guard against reducing the overtime period for zone 1 Fig. A, or the initial and overtime periods for zone 1, Fig. B, by 2 minutes, should contacts 1 and 2T of the (C1) relay become crossed.

The line finder goes to tell tale during line finder hunt due to the (LF) relay being locked thru the check paths.

43.12 SS4-R cutting 3
SS2-X cutting 2/3

To guard against registering on "busy back" and "don't

answers" calls, due to the false operation of the (I) relay from the incoming, should spring 1 and outer winding terminals of the (CS) relay become crossed.

The district goes to tell tale during brush selection, due to the (L) relay being held operated in position 3 thru the check paths.

43.13 SS3-J cutting 9.
Terminals 2 and 4 of arc E of (PT) switch.

Lead between terms. 2 and 4, arc E (PT) switch and spring 4T (I).

To guard against registering on "busy back" calls, should the (I) relay be falsely operated.

The district is blocked in position 9, due to the (L) relay being held operated from ground thru the check paths, and it is held in this position with the sender attached until released by maintenance or until the trouble disappears. If the subscriber disconnects, the (D) relay releases and frees his line.

43.14 SS3-R cutting 9.
SS4-R cutting 9.
Spring 5T of the (I) relay.

To guard against registration on "busy back" calls, should a cross occur between contacts 3 and 4T of the (I) relay.

The district is blocked in position 9 due to the (L) relay being held operated from ground thru the check paths, and it is held in this position with the sender attached until released by maintenance or until the trouble disappears. If the subscriber disconnects, the (D) relay releases and frees his line.

43.15 SS3-D cutting 11.
SS4-D cutting 11.
Lead 27.

To guard against reducing the overtime period for zone 2 or 4 by one minute, for Fig. A, should terminals 14 and 15 of arc 2 become crossed.

Ground is connected to the stepper magnet of the timing switch in position 17 thru the check paths, holding the magnet operated and stopping the timing switch in position 17.

43.16 Springs 1 and 2T (RC)

Lead between 1T (RC) and secondary winding of (LF) relay.

Lead between 2T (RC) and line finder "N" commutator segment.

To guard against registering for the tip party on a call made by the ring party, due to the false operation of the (RC)

relay, should contacts 3 and 4T (RC) become crossed.

The line finder goes to tell tale during line finder hunt, due to the (LF) relay being locked thru the check paths.

43.17 Contacts 3 & 4B (Z) ("N" wiring).

To guard against giving a false class indication, should the (Z) relay fail to release.

The line finder will not return to normal after a call, as the circuit of the line finder down magnet is opened at the relay contacts. The line finder will be held busy until released by maintenance.

43.2 For Figs. A, B, C and D

43.201 Terminal 2 of arc 2. (Fig. A, B, C and D)

Lead between terminal 2 of arc 2 and spring 5T of the (C1) relay. (Figs. A, B and C).

Lead between terminal 2 of arc 2 and terminal 4 of arc 4. (Figs. A, B, C and D).

To guard against registering for zone 2 or 3 instead of zone 0 or 1 respectively, should contacts 3 and 4T of the (C1) relay become crossed. (Figs. A, B and C).

Also to guard against omitting the test of the connecting leads to the message register connector circuit, should terminals 4 and 5 of arc 4 become crossed. (Figs. A,B,C and D)

Also to guard against registering for zone 4 or 5 instead of zone 2 or 3 respectively, should terminal 7 of arc 3 become crossed with terminal 7 of arc 4. (Figs. A, B and C).

Ground is connected to the stepper magnet of the timing switch thru the check paths, holding the magnet operated and stopping the timing switch in position 2.

43.202 Terminal 9 of arc 2. (Figs. A, C and D).

Lead between terminal 9 of arc 2 and contact "B" of (MR1) interrupter. (Figs. A, C & D).

To guard against reducing the initial period to approximately the length of the overtime period for all zones, when Fig. A is used, or reducing the initial period by 1/2 minute when Fig. C or D is used, should contact "B" of the (MR1) interrupter become grounded.

Ground is connected to the stepper magnet of the timing switch thru the check paths, holding the magnet operated and stopping the timing switch in position 9.

43.203 Terminal 8 of arc 2. (Fig. B)

Lead between terminal 8 of arc 2 and contact "B" of (MR1) interrupter. (Fig. B).

To guard against reducing the initial period for all zones by 1/2 minute, should contact "B" of the (MR1) interrupter become grounded.

Ground is connected to the stepper magnet of the timing switch thru the check paths, holding the magnet operated and stopping the timing switch in position 8.

43.204 Terminal 10 of arc 2 (Fig. B).

Spring 4T of the (OT) relay (Fig. B).

Terminal 10 of arc 6. (Fig. B).

Lead between terminal 10 of arc 2 and spring 4T of the (OT) relay. (Fig. B).

Lead between terminal 10 of arc 6 and terminal 19 of arc 2.

To guard against reducing the overtime period for zone 1 by 2 minutes, should a cross occur between terminals 18 and 19 of arc 2.

Ground is connected to the stepper magnet of the timing switch thru the check paths, holding the magnet operated and stopping the timing switch in position 10.

43.205 Terminal 1 of arc 3. (Figs. A, B, C & D).

Lead between terminal 1 of arc 3 and lead 29. (Figs. A, B, C and D).

Lead 29. (Figs. A, B, C and D).

To guard against omitting the test of the connecting leads to the message register connector circuit, should contact 1B of the (CB) relay become grounded.

The line finder goes to tell tale during line finder hunt due to the (LF) relay being locked thru the check paths.

43.206 Terminal 2 of arc 3 (Figs. A, B, C & D).

Terminal 2 of arc 5 (Figs. A, B, C & D).

Lead between terminal 2 of arc 3 and terminal 2 of arc 5. (Figs. A, B, C and D).

To guard against omitting the test of the connecting leads to the message register connector circuit, due to false ground on the Z2 lead, should the brush and terminal 1 of arc 3 become crossed.

Ground is connected to the stepper magnet of the timing switch thru the check paths, holding the magnet operated and stopping the timing switch in position 2.

43.207 Terminal 12 of arc 4. (Figs. A, B, and C).

Terminal 22 of arc 5. (Figs. A, B, and C).

Lead between terminal 22 of arc 5 and terminal 12 on arc 4. (Figs. A, B and C).

To guard against registering falsely for overtime on zone 1 when "B" wiring is furnished, should terminals 21 and 22 on arc 1 become crossed.

Ground is connected to the stepper magnet of the timing switch thru the check paths, holding the magnet operated and stopping the timing switch in position 12.

43.208 Terminal 14 of arc 4. (Fig. A).

Spring 5T of the (C2) relay (Fig. A).

Lead between terminal 14 of arc 4 and spring 5T of the (C2) relay. (Fig. A).

To guard against reducing the overtime period for zone 3 by one minute, should terminals 12 and 13 of arc 2 become crossed.

Ground is connected to the stepper magnet of the timing switch thru the check paths, holding the magnet operated and stopping the timing switch in position 14.

43.209 Terminal 14 of arc 4. (Fig. B).

Spring 4T of the (OT) relay. (Fig. B).

Lead between terminal 14 of arc 4 and spring 4T of the (OT) relay. (Fig. B).

To guard against reducing the overtime period for zone 2 or the initial period for zone 3, 4 or 5 by 2 minutes, should terminals 14 and 15 of arc 2 become crossed.

Ground is connected to the stepper magnet of the timing switch thru the check paths, holding the magnet operated and stopping the timing switch in position 14.

43.210 Terminals 15 and 16 of arc 4, (Figs. C & D)

Lead between terminal 16 of arc 4 and terminal 19 of arc 2. (Figs. C & D).

To guard against reducing the overtime period for all zones to approximately 20 seconds, should contacts 19 and 20 or contacts 21 and 22 of arc 2 become crossed.

Ground is connected to the stepper magnet of the timing

switch thru the check paths, holding the magnet operated and stopping the timing switch in position 15.

43.211 Terminal 17 of arc 4. (Fig. A).

Lead 27 (See also 43.15).

SS3-D cutting 11. (See also 43.15).
SS4-D cutting 11. (See also 43.15).

To guard against reducing the overtime period for zone 2 or 4, Fig. A, by one minute, should terminals 14 and 15 of arc 2 become crossed.

Ground is connected to the stepper magnet of the timing switch thru the check paths, holding the magnet operated and stopping the timing switch in position 17.

43.212 Terminal 17 of arc 4. (Fig. B).

Terminals 20 and 21 of arc 2. (Fig. B).

Lead between terminal 17 of arc 4 and terminals 20 and 21 of arc 2. (Fig. B).

To guard against reducing the overtime period for zones 2, 3, 4 and 5 by approximately one minute, should terminals 19 and 20 or terminals 21 and 22 of arc 2 become crossed.

Ground is connected to the stepper magnet of the timing switch thru the check paths, holding the magnet operated and stopping the timing switch in position 17.

43.213 Terminal 21 of arc 4. (Fig. A).

Lead between terminal 21 of arc 4 and terminal 19 of arc 2. (Fig. A).

Strapping of terminals 20 and 21 of arc 2. (Fig. A).

To guard against reducing the overtime period for all zones by approximately one minute, should terminals 19 and 20 or terminals 21 and 22 of arc 2 become crossed.

Ground is connected to the stepper magnet of the timing switch thru the check paths, holding the magnet operated and stopping the timing switch in position 21.

43.214 Terminals 11, 13, 15, 16, 18, 19, & 22 of arc 4 (Fig. A).

Terminals 11, 13, 15, 16, 18, 19, 21 & 22 of arc 4 (Fig. B).

Terminals 11, 13, 14, 17, 18, 19, 21 & 22 of arc 4 (Figs. C & D).

Lead between terminal 21 or 22 and brush of arc 4.

To guard against sticking the timing switch beyond the first timing position, should one of these terminals become crossed with any of terminals 11 to 21 inclusive of arc 5.

Also to guard against reducing the timing intervals for the various zones should terminal 10 of arc 4 become crossed with any of the above terminals.

Should one of these terminals become crossed with terminals on arc 5, ground is connected to the stepper magnet of the timing switch in position 11 thru the check paths, holding the magnet operated and stopping the timing switch in position 11.

Should one of these terminals become crossed with terminal 10 of arc 4, the timing switch will advance from position 2 thru the registering and timing positions without waiting for the message register connector circuit.

43.215 Terminal 1 of arc 6. (Figs. A and B).

Lead between terminal 1 of arc 6 and spring 1T (C1), (Fig. A) or spring 4T (C2) (Fig. B).

SS1-D cutting 1/2 (See also 43.11).
SS2-D cutting 18/2 (See also 43.11).

To guard against registering for zone 2 or 3 instead of zone 0 or 1, should the (C1) relay be falsely operated. (Fig. A).

Also to guard against reducing the overtime period for zone 1, Fig. A by 2 minutes, should contacts 1 and 2T of the (C1) relay become crossed. (Fig. A).

Also to guard against registering for zone 4 or 5 instead of zone 2 or 3, should the (C2) relay be falsely operated. (Fig. B).

Also to guard against reducing the initial or the overtime period for zone 2 by 2 minutes, should contacts 3 and 4T of the (C2) relay become crossed. (Fig. B).

The line finder goes to tell tale during line finder hunt, due to the (LF) relay being locked thru the check paths.

43.216 Terminal 20 of arc 6. (Figs. A, B, C & D).

Lead between terminal 20 of arc 6 and terminal 1 of arc 5. (Figs. A, B, C & D).

To guard against reducing the initial and overtime periods

for all zones to approximately one minute, should the brush and terminal 1 of arc 5 become crossed.

Ground is connected to the stepper magnet of the timing switch thru the check paths, holding the magnet operated and stopping the timing switch in position 20.

43.217 Terminal 21 of arc 6. (Fig. B).

Lead between terminal 21 of arc 6 and terminal 19 of arc 2. (Fig. B).

To guard against reducing the overtime period for all zones by approximately one minute, should terminals 19 and 20 or terminals 21 and 22 of arc 2 become crossed.

Ground is connected to the stepper magnet of the timing switch thru the check paths, holding the magnet operated and stopping the timing switch in position 21.

43.218 Terminal 22 of arc 6 (Fig. A).

Spring 5T of the (C2) relay. (Fig. A).

Lead between terminal 22 of arc 6 and spring 5T (C2). (Fig. A).

To guard against reducing the overtime period for zones 2 and 3 by one minute, should springs 3 and 4T of the (C2) relay become crossed.

Ground is connected to the stepper magnet of the timing switch thru the check paths, holding the magnet operated and stopping the timing switch in position 22.

43.219 Terminal 22 of arc 6. (Fig. B).

Terminals 20 and 21 of arc 2. (Fig. B) (See also 43.212)

Lead between terminal 22 of arc 6 and terminals 20 and 21 of arc 2. (Fig. B).

To guard against reducing the overtime period for all zones by approximately one minute when "B" wiring is furnished, should terminals 21 and 22 of arc 2 become crossed.

Ground is connected to the stepper magnet of the timing switch thru the check paths, holding the magnet operated and stopping the timing switch in position 22.

43.220 Springs 1 and 2B of the (C2) relay (Figs. A, B & C).

Leads between spring 2B (C2) and lead 28. (Figs. A, B and C).

Lead between spring 1B (C2) and lead 29. (Figs. A, B & C).

Lead 29. (See also 43.205).

To guard against registering for zone 4 or 5 instead of zone 2 or 3 respectively, should the (C2) relay be falsely operated.

The line finder goes to tell tale during line finder hunt, due to the (LF) relay being locked thru the check paths.

43.221 Springs 5 and 6T of the (OT) relay.

(Figs. A, C and D).

Lead between spring 5T (OT) and lead 29. (Figs. A, C and D).

Lead between spring 6T (OT) and lead 28. (Figs. A, C and D).

Lead 29. (See also 43.205).

To guard against registering and timing for the overtime period instead of the initial period, should the (OT) relay be falsely operated.

The line finder goes to tell tale during line finder hunt due to the (LF) relay being locked thru the check paths.

43.222 Spring 5B of the (OT) relay. (Figs. A, B, C & D).

Lead between spring 5B (OT) and terminal 19 of arc 2. (Figs. A, B, C & D).

To guard against reducing the initial period for all zones by 1/2 minute, should springs 3 and 4B (OT) become crossed.

Ground is connected to the stepper magnet of the timing switch, holding the magnet operated and stopping the timing switch in position 19.

43.223 Springs 5 and 6B (CA). (Figs. A, B & C).

To guard against causing registration for zone 3 instead of zone 1 on other districts in the group, should contacts 1 and 2B of the (CA) relay become crossed.

The path for grounding the Z1 lead is thru contacts 1 and 2B and 5 and 6B of the (CA) relay in series, so that a cross between contacts 1 and 2B will not ground the Z1 lead until the message register connector circuit is seized by the district.

LBS)
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