CIRCUIT DESCRIPTION

CD-21757-01 Issue 8-D Appendix 1-D Dwg. Issue 13-D

PANEL SYSTEMS SELECTOR CIRCUIT LINE FINDER AND DISTRICT SENDER SELECTOR TYPE FOR MRI LINES ARRANGED TO PERMIT LINE FINDER PER ES-240071 TO FUNCTION WITH DISTRICT PER ES-207199

CHANGES

A. CHANGED AND ADDED FUNCTIONS

- A.1 Provision is made for connection to the traffic usage recorder circuit.
- B. CHANGES IN APPARATUS
- B.1 Superseded Superseded By

200B Selector206A Selector10B Bank26A Bank

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 Lead TU, Option "ZC" is added.

D.2 Circuit Notes 132 and 133 are added.

.D.3 Table A is added.

F. CHANGES IN DESCRIPTION OF OPERATION

F.1 Traffic Usage Recording - Option "ZC"

When the District Circuit is selected and goes off-normal, ground is placed on the "M" commutator. The "M" commutator remains grounded until the circuit restores to normal.

When Option "ZC" is provided, ground on the "M" commutator is extended to the "TU" lead. Ground on lead "TU" is an indication to the Traffic Usage Recorder that this circuit is busy.

All other headings, no change

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT. 2731-LFW-PWS-PM



CIRCUIT DESCRIPTION SWITCHING SYSTEMS DEVELOPMENT DEPARTMENT CD-21757-01 Issue 8-D Dwg. Issue 12-D

PANEL SYSTEMS SELECTOR CIRCUIT LINE FINDER AND DISTRICT SENDER SELECTOR TYPE FOR MRI LINES ARRANGED TO PERMIT LINE FINDER PER ES-240071 TO FUNCTION WITH DISTRICT PER ES-207199

CHANGES

A. CHANGED AND ADDED FUNCTIONS

A.1 An optional arrangement is added to distinguish between two classes of service in the same line group.

B. CHANGES IN APPARATUS

B.1 Added

R444 relay (Z), option, "U" KS-13490, L2 - 10,000ω resis-) tor (M))option F 185A network (M))

B.2 Superseded Superseded by

0.5 capacitor (P) 177E network & D-78038 resis- (STF), opt. AB tor (ST), option AA E904 relay (E) El026 relay (E)

- C. CHANGES IN CIRCUIT REQUIREMENTS OTHER THAN THOSE APPLYING TO ADDED OR RE-MOVED APPARATUS
- C.l New parallel requirements are added for relay (E) for use when option "F" is furnished.

C.2 Release requirement is added for relay (LF) when option "G" or "K" is furnished. Note 7 on sheet 3 covers this requirement.

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 Options "U", "G", "K", "H" and "J" are added for use with 2 classes of service in the same line group.

Option "U" consists of a marginal relay (Z) connected to lead "Y" to the start circuit. When a subscriber in class No. 2 calls, relay (CL2) in the start circuit operates, placing low resistance battery on lead "Y" thus operating relay (2) which locks to relay (E) under control of relay (DS).

Option "H" or "J" is furnished to ground or remove ground to lead "FR" to the sender as an indication that a subscriber in class No. 2 is calling.

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Option "G" is furnished to connect relay (Z) when the circuit is arranged for timed alarm (option "Y").

Option "K" is furnished to connect relay (Z) when the circuit is arranged for timed release (option "Z").

D.2 Option "N" is designated to be furnished when the class of service feature is not required.

D.3 Option "F", consisting of bleeder resistor (M) and 185A Network (M), is added to reduce erosion of the G commutator brush.

D.4 Option "AA" is rated Mfr. Disc. and is superseded by option "AB" network to replace the Mfr. Disc. resistor and furnish a resistor which matches the inductive load more closely.

- D.5 (E) Relay E904 is rated Mfr. Disc. and is superseded by relay E1026.
- D.6 Notes 128 to 131 inclusive are added.
- D.7 Reference to Note 128 is shown alongside Note 127.
- D.8 Reference to Note 131 is added in Note 113.

D.9 Option Used table is added.

All other headings under Changes, no change.

1. PURPOSE OF CIRCUIT

1.1 This circuit is arranged to find the calling subscribers line and connect it with the various switching apparatus necessary to complete a call.

1.2 It is designed to connect line finders wired and equipped per ES-240071 with districts wired and equipped per ES-207199.

2. WORKING LIMITS

2.1 Bl relay (DC) maximum subscribers loops 750 to 900 ohms with minimum leak of
10,000 ohms on 21 to 26 volt battery and maximum.
subscribers loop of 1,500 ohms with minimum leak of
10,000 ohms on 45 to 50 volt battery.

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2.3 Maximum conductor loop for remote control zone registration 2640 ohms.
Minimum trunk insulation resistance 60,000 ohms and maximum earth potential of ±20 volts.

3. FUNCTIONS

3.01 Finds calling subscribers line.

3.02 Selects an idle sender.

3.03 Closes the dialing leads from the calling subscribers line to the sender circuit.

- 3.04 Selects proper office, incoming, or trunk circuit.
- 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 Furnishes talking battery to the calling subscriber.

3.08 Furnishes repeating coil transmission on regular calls.

3.09 Connects the subscribers line directly to a trunk for a call to an operator.

3.10 Disconnects when the calling subscriber replaces the receiver on the switch-hook.

3.11 "Y" wiring

Operates the selector time alarm if the calling subscriber does not disconnect within a predetermined interval after the called subscriber has hung up.

"Z" wiring.

Calls in the timed release circuit and advances after 2 to 4 minutes after the called party disconnects.

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

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

3.14 Operates a "selector group" register to record the number of calls handled by a group of districts, either on all calls which are not abandoned before group selection is completed, or on all calls on which the sequence switch is moved off normal, depending on the option furnished.

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

3.16 Disconnects sender and returns district elevator early on early release, before or during group selection.

3.17 Disconnects sender as soon as selections are completed on early release after group selection.

3.18 Operates the overflow register in case the district goes to overflow.

3.19 Operates subscribers line register in case of a charge call on a message rate line.

3.20 Optional arrangement to prevent charging in message register position for first talking position.

3.21 Arranged to operate the subscribers register from impulses received over the trunk from a remote control registration point.

3.22 Arranged to operate the subscribers register once at the beginning of each five minute talking interval (NON-ZONE over-time).

3.23 May be arranged to indicate one of three classes of service to a common group of senders (option "E" & "ZE").

3.24 May be arranged to distinguish between two classes of service in same line finder group (option "U", "G", "K", "H", and "J").

4. CONNECTING CIRCUITS

4.01 Line, trip and start circuits arranged for sender selector operation, ES-240292, ES-240293, SD-21777-01.

4.02 Sender circuit arranged for sender selector operation, SD-20028-02, SD-21193-02, typical.

- 4.03 Any office selector circuit, ES-240252, typical.
- 4.04 District finder circuit, ES-358082.
- 4.05 Any incoming selector circuit to panel office, ES-21036-01, typical.
- 4.06 Selector group register circuit, SD-20141-01.
- 4.07 "A" operator's trunk circuit, ES-239894, typical.
- 4.08 Motor stop alarm circuit, ES-226349.

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4.09 P.C.I. local or tandem trunk or recording trunk, SD-15096-01.

4.10 Miscellaneous tone circuit, ES-20255-01.

4.11 Permanent signal trunk, SD-21442-01.

4.12 Selector time alarm circuit, ES-240206.

4.13 District release circuit, SD-21824-01.

DESCRIPTION OF OPERATION

5. 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 band (b) connect ground to the ST lead operating the (LF) relay. The (LF) relay operates, (a) locks to ground through the back contact of the (H) relay, (b) closes a circuit over lead Y operating a relay in the start circuit, (c) operates the UP magnet causing the line finder selector to travel upward and hunt for terminals of the calling line, (d) closes a circuit to operate the (CI) relay.

6. SELECTING A SENDER

As the line finder selector starts up-ward, hunting for the calling line, a cir-cuit is closed through the M commutator, slightly after the brushes of the selector move off-normal. Ground on the M commutamove off-hormal. Ground on the M commuta-tor brush and segment, operates the line finder (E) relay. The (E) relay operated, (a) operate the (MB) relay, (b) closes a circuit to operate 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 terminals of an idle contact with the test terminals of an idle If the test brush of the sender sender. 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 outer winding, to ground on the test brush of the sender selector. With the (CI) relay held operated, the oper-ation of the line finder (E) relay also closes a circuit operating the (F) relay in the line finder circuit and the district the line finder circuit and the district selector (STP) magnet, 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 ter-minal of the selected sender is immediately made busy to all hunting sender selectors by ground connected to the test brush through 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.

7. MAKING THE DISTRICT BUSY

The (MB) relay operated, (a) locks from ground on the armature of the (STA) relay in the START circuit, 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, through the 800 ohm winding of the (F) relay, which operates if the relay was not previously operated, (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 the (CA) or (CB) relays in the start 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.

8. 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 a relay in the trip circuit. When the K brush breaks contact with the K commutator ground is disconnected from the K lead, thus releasing the start circuit.

9. LINE FINDER FINDS LINE

When the selector brushes make contact with the terminal associated with the calling line, battery on the H terminal operates the (0) 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 ahunt in 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 (0) relay in the trip circuit thus speeding its operation. This is necessary on account of the very short time 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

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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 seizes an idle sender the (F) relay releases (c) closes a circuit operating the (SL) relay.

10. 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 center 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.

11. ADVANCING THE DISTRICT & CLASS OF SERVICE REGISTRATION

The (SL) relay operated, (a) connects battery to the S lead thus making the line test busy at the final frame and releasing the trip circuit (b) closes a circuit which operates the district (L) and (CH) relays, (c) opens the locking circuit through the outer winding of the (MB) relay. The (CH) relay operated, closes a circuit through the selector time alarm circuit or district release circuit operating the selector time alarm if the district sequence swithe fails to move 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 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.

When one of three classes of service is required with indications to a common group of senders over lead "FR", provide as follows:

of Service	Option	On Lead "FR" In Pos. 2/3
First	None	Open
Second	"E"	Ground
Third	"ZE"	Resistance-ground

When it is necessary to distinguish between two classes of service in the same line-finder group, the marginal relay (Z), option "U" is furnished. When a subscriber in class no. 2 calls, relay (CL2) in the start circuit operates, placing low resistance battery on lead "I" to operate relay (Z) which locks to relay (E) under control of relay (DS). Option "H" or "J" furnish ground to the contact of relay (Z) and should be applied as indicated by the telephone company. Option "G" or "K" is also furnished as follows: Furnish option "G" when option "Y" is provided for timed alarm, furnish option "K" when option "Z" is provided for timed release. When this feature is not required, option "N" is furnished. The "Z" relay is marginal and operates when a class 2 subscriber is originating a call. The class of service indication is placed on the FR lead to the sender in position 2 and 3 of the sequence switch.

12. 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, to the tip brush of the sender selector. The ring side of the dialing circuit is closed to the R brush of the sender selector. In position 2, the (CI) relay operates and remains operated until the switch advances from position 10. The (CI) relay operated, (a) connects ground 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) lead to battery through the outer winding of the (D) relay. After the sender functions, the fundamental circuit is established for the fundamental circuit is established for the operation of the district (L) relay and the stepping relay in the sender. The (L) re-lay operated, locks through its 1200 ohm winding over the FT lead and advances the switch to position 3. The 500 ohm winding of the (CH) relay is also connected in parallel with the winding of the (D) relay to the SC lead. Should the (CH) relay oper-ate at this time due to a high resistance ground in the sender circuit no useful funcground in the sender circuit no useful function will be performed.

13. 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 connects ground to the tip side of the fundamental circuit holding the (L) relay operated, but successively short-circuiting the stepping relay in the associated dender 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 advances the switch to position 4. 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 oper-ated and the (L) relay is operated and locked to ground on the fundamental circuit previously described, advancing the switch to position 5.

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 set of brushes trip the finger which was previously oper-ated 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 funda-mental circuit, 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 impul-ses 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 posi-tion 6, a circuit is closed from ground on the line finder N commutator brush and segment to battery through the 800 ohm winding (L) relay operated, advances the switch to position 7. The

15. TRUNK HUNTING WITH TRUNK IDLE

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Should the first trunk in the group in which the selector is hunting be idle, the (L) relay releases and 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 the break contact of the (L) relay as a busy condition until the switch advances to position 7-3/4.

16. TRUNK HUNTING WITH FIRST TRUNK BUSY

Should the first trunk in the group in which the selector is hunting be busy, on the sleeve terminal of the busy trunk. With the switch in position 7, the UP mag-net is reoperated 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 imme-diately due to a circuit being closed through its outer winding 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 or magnet, which stops the selector brushes on the terminals of the selected trunks. The (L) relay released, also advances the switch to position 8. If the call is not abandoned before or during trunk hunting, ground through the make contact of the (SL) relay (W wiring) operates the selector group register as the switch advances through position 7 1/2.

17. "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.

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 armature and make contact of the (CH) relay, to battery through the outer winding of the (L) relay which operates advancing the switch to po-sition 9. In position 9, the tip and ring sides of the outgoing fundamental circuit are closed through the tip and ring termi-nals of the selected trunk for selection beyond, through the FT and FR brushes of the sender selector. 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 1/2 the dialing circuit is opened. In position 9 3/4, the tip and ring leads from the line finder are closed to 24 volt battery and ground in the dis-trict, 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 9. This circuit is traced from battery through the inner winding of the (D) relay, make con-tact of the (DC) relay, make contact of the (D) relay to ground. The (D) relay is made slow in releasing in order that the connec-tion 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 oper-ate and lock through its inner winding over the tip of the fundamental circuit previ-ously 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 intermit-tently 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 When sufficient impulses have circuit. been sent back to satisfy the sender, the 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 position 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 under the control of the (L) relay. The release of the (L) relay opens the holding circuit through the (CI) relay, disconnect-ing the sender from the district circuit.

19. 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 through the winding of the (I) relay, to battery through the #F contact of the (CHG) interrupter. When the interrupter contact closes, the (I) relay operates and locks on the same ground. When the #B contact of the interrupter closes, the operation of the (I) relay closes a circuit from ground on the interrupter contact to battery through the 500 ohm winding of the (CH) relay, operating the relay.

On flat rate districts arranged for time alarm (R wiring furnished, and V wiring and apparatus omitted), the (CHG) interrupter and the (I) relay are not furnished and the (CS) relay operating when the called subscriber answers, operates the (CH) relay direct.

The (CH) relay operated, locks and, when "Y" wiring is furnished, closes a circuit for holding the (SL) relay operated. When "Z" wiring is furnished, the (SL) relay is held operated from battery through cam T in position 11/16 1/4. The (CHG) interrupter is so connected in the circuit that the operation of the (CH) relay 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.

20. REMOTE CONTROL CHARGE CALL ("B" WIRING) (CHARGE DURING CONVERSATION)

For calls which are routed to the remote control registration point the sequence switch is set in position 11 or "rst talking selection position. This position is used so that the (CH) relay will release as the sequence switch advances from position 11, thereby preventing the operation of the subscribers register after disconnect. The positive potential impulses may be received over the trunk conductors from the remote control registration point at any time after talking selection is completed. These positive impulses cause the 346A tube to breakdown which results in the operation of the (SI) relay. The potentials applied, however, to the tip and ring conductors are so proportioned between the tip and ring so as to cause the (CS) relay to hold for the duration of the charge impulse. The operation of the (SI) relay connects 115 ohm battery to the "H" lead through cam T causing the subscribers line register to operate once for each charge impulse received from the remote control registration point.

21. NON-ZONE OVERTIME CHARGE CALL - "T" WIRING AND FIGS. 4 AND 5

Fig. 4 and "T" wiring are used when timing of non-zone messages is required.

A Z cam is provided on the sequence switch in order to close the battery circuit to the NON-ZONE timer only in the second talk-ing selection position. When the (CH) relay operates as previously described, a (2) cam to the magnet of the timer. Ground from a make contact of the (CS) relay is Ground connected to the other side of the magnet of the local timer. This causes the timer to engage with the drive shaft that is being driven by the telechron motor. This motor shown in Fig. 5 furnishes the driving This power for the timers of 20 district selec-tor circuits. When the (ROT) magnet is energized, contacts 6 and 7 and (CH) func-tion immediately. Contacts 6 and 7 remain closed as long as the magnet is energized and connect ground to the normally closed contacts (HD) as a holding circuit for the timing device to guard against the possibil-ity of interference with the timing by re-lease of the (CS) relay due to switchhook (CH) connect battery through resistance (R1) to the "H" lead, operating the message register of the calling subscriber. Contacts (CH) are closed only for a brief interval which is, however, sufficiently long to operate the message régister and these contacts open as the timing device advances from its normal position. Contacts (CH) close once for each interval of 5 minutes and 7 seconds of conversation. As the timer approaches the end of each interval, the (HD) contacts open and the timer will advance to the next timing cycle only if re-lay (CS) is operated. This insures that charging for any interval will not occur un-less both the calling and the called subscribers are still connected to the talking circuit at the start of each interval. If this condition exists the timer will continue its function until the (HD) contacts reclose prior to the start of a new timing interval and from this point on the opera-tion for each overtime interval is the same as described for the initial interval. In this manner the call is metered until dis-connection occurs. The circuit is arranged so that no charge occurs after disconnection.

22. 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 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. As the switch enters position 13 1/2, the (L) relay locks to ground over lead S of the selected trunk, 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, through the 2 mf condenser, to ground through the winding of the (CO) relay in the line circuit for number checking.

23. DIBCONNECTION - REGULAR CALLS

When the receiver at the calling station is replaced on the switchhook, the (DC) relay releases, in turn releasing the (D) relay. When "Y" wiring is furnished, the (D) relay released, operates the (F) relay. The (F) relay operated, disconnects the tip and ring of the trunk from the line and closes a circuit through the R magnet, advancing the switch to position 16. When "Z" wiring is furnished, the (D) relay releasing, advances the switch to position 16, and the (F) relay does not operate.

24. MESSAGE REGISTERING - CIRCUITS NOT ARRANGED FOR NON-ZONE OVERTIME

On message register district circuits, with the switch in position 16, a circuit is closed from battery, make contact of the (CH) relay, through a resistance, over lead H, to ground through the line 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 MR interrupter "B" contacts close, a circuit is closed through the outer winding of the (L) relay, operating the (L) relay. The (L) relay operated, locks thru its inner winding. Ground on the F make contact of the interrupter is closed through the inner winding of the (D) relay, which operates. The (D) relay operated, advances the switch to position 17. In position 17 the A cam advances the switch to 18.

When this circuit is arranged to operate the selector group register on abandoned calls, ground thru cams E, L and K operates the selector group register as the switch advances through position 16 1/2.

When this circuit is arranged to prevent charging in position 16 for talking position 11 the locking path of the (CH) relay is opened between positions 11 and 12 so that on disconnect from position 11 the (CH) relay releases as the switch leaves 11, thereby preventing the operation of the message register.

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When this circuit is arranged for nonzone overtime (T wiring), battery is not closed to the message register in position 16, ground on cam R operates relay (L), and ground on cam Y operates relay (D) advancing the switch out of position 16.

25. RESTORING LINE FINDER TO NORMAL

As the switch advances from position 16 to 18, the circuits thru 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. The (DS) relay operated, (a) locks and closes a circuit thru the outer winding of the (F) relay thus holding the relay operated until the line finder has returned to normal and (b) operates 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.

26. RESTORING THE DISTRICT TO NORMAL

With the district switch in position 18, a circuit is closed thru 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, thru the R magnet, advancing the switch to position 1 or normal. As the switch leaves position 18 the circuit thru the DOWN magnet is opened and in position 18-1/4 when "Y" wiring is furnished, the circuit thru the outer winding of the (F) relay is opened releasing the relay.

27. DELAYED DISCONNECT

27.1 "Y" 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 circuit from ground through cam I, thereby notifying the switchman of the existing condition.

27.2 "Z" Wiring

Should the calling subscriber fail to disconnect after the called party has done so, the release of the (CS) relay connects ground thru the operated (CH) relay and over lead 1 to the "District Release Circuit". After an interval leads 1 and 2 are connected together, operating relay (F), which opens the T and R leads releasing relays (DC) and (D). Relay (D) releasing, advances the district to pos. 16 from where it advances as usual. Lead 3 also receives ground from the release circuit to operate the selector time alarm, if the timed release does not function.

28. 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 11000 p. tion 14 1/4, the locking circuit thru the inner winding of the (D) relay is opened releasing the relay. When "Y" wiring is As the switch advances from posifurnished, the (D) relay released opens the circuit thru the (SL) relay, which releases and operates the (F) relay which advances wiring is furnished the (D) relay releas-ing advances the switch to pos. 16, the (F) relay is not operated, and the (SL) relay remains operated until the switch passes remains operated until the switch passes pos. 16 1/4. In position 16, with "Y" wir-ing, the (SL) relay advances the switch to position 17, the A cam advancing it to pos. 18. With "2" wiring the advance of the switch out of pos. 16 is under control of the (D) and (L) relays and the "MR" interrupter, as covered in paragraph 24. In pos. 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 para-graphs 25 and 26.

29. DISCONNECTION OF ABANDONED CALLS

29.1 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. The trip 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 comb., 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" comb. 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.

29.2 Positions 2 To 6

If the receiver at the calling station is replaced on the switchhook 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, causing the (D) relay to release on account of the increased current flowing through the outer winding of the re-lay. The (D) relay is connected differen-tially, 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 re-leased, operates the (DS) relay, which re-stores the line finder selector to normal as described in paragraph 25. The (D) re-lay released, also opens the circuit through the (S) released The constant of the 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. With the district switch in position 6, a circuit is closed 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.

29.3 Positions 7 To 10

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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 29.2. 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 releases the (SL) relay and, when "Y" wiring is furnished, operates the (F) relay which closes a circuit from ground on the N commutator brush and segment, advancing the switch to position 16. When "Z" wiring is furnished, the release of the (D) relay advances the switch direct to position 16, the (F) relay having released when the line finder was restored to normal. 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 26.

30. 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 1000 ohm winding of the (LF) relay is disconnected from 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.

31. 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 (LF) relay releases, 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, operating the down drive magnet and reoperates the (F) relay, returning the line finder to normal.

32. 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 in the trip circuit, to the winding of the (H) 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, 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.

33. 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 furnishes the 500 ohm ground to operate the (CH) relay

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under this condition. In either position, the district will be held with its sender.

34. 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 over-flow is opened, the (L) relay releases, in turn advancing the switch to position 8. With the switch in position 8, the (L) re-lay operates advancing the switch to position 9. In position 9, a circuit is closed from ground on the Z commutator, brush and seg-ment, to battery through the R magnet adto battery through the R magnet adment. vancing the switch to position 10. In position 10 a circuit is closed from ground on the Z commutator brush and segment to battery through the 1200 ohm winding of the (L) relay, operating the (L) relay. The (L) relay operated, locks through its 1200 ohm winding, advancing the switch to posi-tion 14. 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 render 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 through a winding of the repeating coil and the 2 MF condenser to ground. A tone is therefore induced in the other windings 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

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circuit through the (D) relay, which releases. From this point on the circuit is restored to normal as described in paragraphs 25 and 26.

As the switch advances thru position 13 1/2, ground from the Z segment operates the overflow register over the tip overflow terminal.

35. "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 suc-ceeding 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 0 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 "made busy" terminals into the next group,

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