

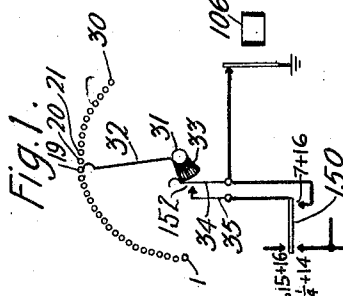
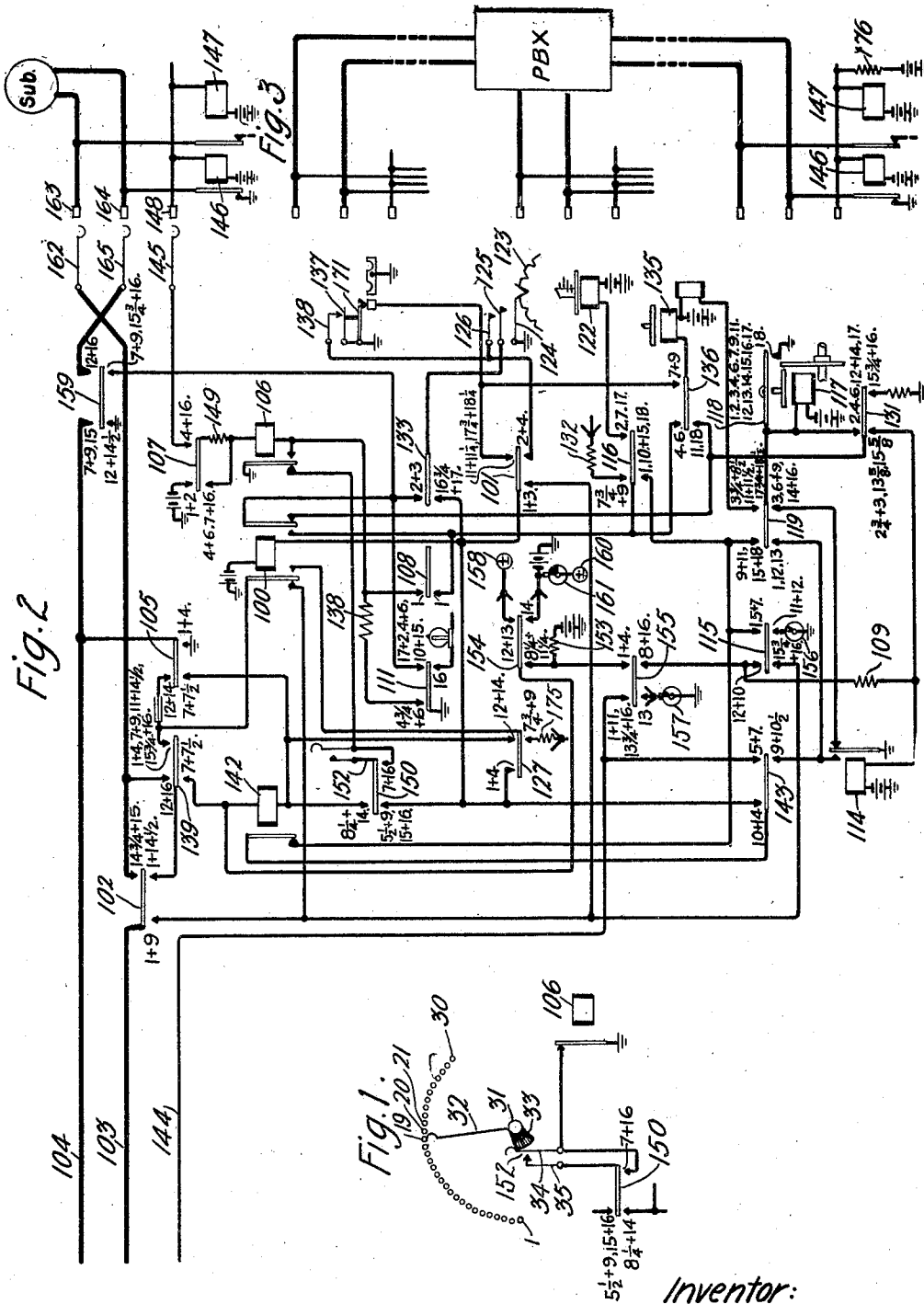
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ROTARY FINAL SELECTOR SWITCH

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Attv.

UNITED STATES PATENT OFFICE.

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ROTARY FINAL SELECTOR SWITCH.

Application filed September 13, 1924, Serial No. 737,477, and in Great Britain October 5, 1923.

This invention relates to telephone exchange systems and particularly to final selector or connector switches adapted to establish connections with a desired line.

5 In automatic and semi-automatic systems, it is necessary to provide service for both ordinary individual subscriber's lines and private branch exchange lines. In accordance with well known practice, in extending
10 connections to an individual subscriber's line, the final selector switch moves directly, in accordance with the designation of the line, on to the contacts of the line and there comes to rest. For calls to a private branch exchange,
15 the switch is set in accordance with the designation of the private branch exchange, on the contacts of the first line in the group of equivalent private branch exchange lines and remains there if this line
20 is idle. If, however, it is busy, the switch operates to move its brushes over the lines in the group until an idle line is found, at which time the switch comes to rest. In such an operation if all the lines of the
25 group are busy the switch is arranged to bring its brushes to rest on the last line of the group of trunk lines whether this line is idle or busy.

30 In automatic telephone systems heretofore proposed, the testing arrangement of switches serving both main lines and private branch exchanges, or multi-group lines in the manner indicated, have been complicated and have included either a number of relays with
35 various adjustments or a plurality of test brushes necessitating a plurality of test terminals for each line.

40 It is the object of the present invention to provide means for automatically enabling a switch to serve individual lines or private branch exchange lines in any level of its bank.

45 In accordance with one feature of the present invention, the switch may be positioned on a specific one of twenty terminals in any of its bank levels or may be used for hunting over the remaining terminals of the bank for an idle private branch exchange line.

50 In carrying out this invention, the arm which carries the switch brushes automatically changes the circuit for controlling the movement of the brushes from a selecting

to a hunting movement when the arm reaches a position in which the brushes rest
55 on terminal 20.

These and other features of the invention will be set forth in the following description and claims and will be readily understood by reference to the accompanying drawing
60 where:

Fig. 1 is a diagrammatic sketch of the selector switch, terminals and arm, showing cut-over contacts operated by the switch
65 arm;

In Fig. 1 a single level of a switch embodying the invention has been diagrammatically illustrated as comprising thirty contacts, the first twenty contacts, 1 to 20, inclusive, being the normal contacts of the
70 switch. The last ten contacts, 21 to 30, represent ten additional contacts added to the level, these contacts together with the normal last contact 20 of the level being the terminals of private branch exchange lines.
75 This switch may be of the type disclosed in the patent to F. R. McBerty, No. 1,097,868, issued May 26, 1914 comprising ten bank levels. The shaft 31 of the switch has secured thereto a plurality of sets of brushes, only
80 one of which is shown at 32, these brushes being movable over the contacts in the separate levels. The brush shaft also carries an insulated member 33, which is designed to engage the switch 152 and move spring 34
85 into contact with spring 35 when the brush 32 comes into contact with contact 20. The closure of the springs 34 and 35 changes the circuits of the final selector switch in a manner later on described and adapts the
90 switch to act as a hunting switch for selecting an idle contact among the set of contacts 20 to 30 of any level.

It will, of course, be obvious that the springs 34 and 35 may be arranged to close
95 in any position of the level so as to cause the brushes to hunt automatically over the remaining contacts. This may be the case where the level is provided with additional contacts in the manner illustrated or simply
100 comprising the usual number of contacts in the level. In this way all final selector switches may serve for the extension of calls to private branch exchanges resulting in a greatly increased efficiency of the apparatus
105 used.

Fig. 2 shows a selector switch circuit incorporating the features of the invention, and

Fig. 3 shows a group of three private branch exchange lines, one of which is the last line, connected to terminals of the switch of Fig. 2.

Calls to ordinary direct lines.

It is thought that the invention will be best understood from a detailed description of the circuits. When the fundamental circuit is closed by the usual registering and controlling or sending equipment (not shown) line relay 100 operates in a circuit from battery through the lower left contact of cam 101, lower left contact of cam 102, conductor 103 over the fundamental circuit, through the winding of the stepping relay and contacts of relays in the sender, back over conductor 104, lower right contact of cam 105 to ground. Relay 100 energizes and closes a circuit for operating test relay 106 which may be traced from battery, upper left contact of cam 107, resistance 149, winding of relay 106, contacts of cam 108, right front contact and armature of relay 100, upper right contact of cam 111 to ground. Relay 106 energizes and locks to ground through its front contact and armature. A circuit is also closed when relay 100 energizes for operating relay 114 from battery through the winding of relay 114, through resistance 109, upper contacts of cam 115, lower left contact of cam 116, right front contact and armature of relay 100 through the right upper contact of cam 111 to ground.

Relay 114 upon energizing, closes a circuit for moving sequence switch 117 out of position 1, which may be traced from battery through the winding of sequence switch magnet 117, lower left contact of cam 119 through the front contact and armature of relay 114 to ground. The circuit of relay 114 is opened when sequence switch 117 leaves position 1. In position 2 of sequence switch 117, relay 100 is held operated over the fundamental circuit over the left contact of cam 127, left front contact of relay 100 and closes a circuit for the trip spindle magnet 122 which is closed from battery through the winding of magnet 122, upper right contact of cam 116, right front contact and armature of relay 100, upper right contact of cam 111 to ground. The trip spindle now rotates, closing the interrupter springs 124, 125 and 126 once for each step of the interrupter, thereby closing a circuit from ground through the said springs, lower right contact of cam 101, upper left contact of cam 127, left front contact and armature of relay 100, right contact of cam 139, lower right contact of cam 102 over conductor 103 to the sender. The interrupter springs 124,

125 and 126 are normally open when the switch is in the normal position but after the trip spindle is moved from its normal position, springs 124 and 125 are closed and remain closed until the trip spindle returns to normal. During the movement of the trip spindle, spring 126 is moved into contact with spring 125 and as the latter is in engagement with spring 124, ground is intermittently connected to the upper spring 126. This ground connection intermittently short circuits the stepping relay in the sender, in the well known manner, one impulse being given for each step taken by the trip spindle. After the tens register of the sender has been satisfied and the controlling relay of the sender is energized to open the fundamental circuit, relay 100 deenergizes and the circuit for the trip spindle magnet 122 is opened whereby the trip spindle is stopped in a position corresponding to the setting of the sender register and in position to trip the correct set of brushes on the final selector. With relay 100 deenergized, sequence switch 117 is advanced to position 3 by a circuit extending from battery through the winding of sequence switch magnet 117, left upper contact of cam 131, right back contact and armature of relay 100, upper right contact of spring 111 to ground. On leaving position 2, the circuit of the test relay 106 is opened. In position 3, a circuit is closed for relay 114 which may be traced from battery through the winding of relay 114, lower left contact of cam 131, right back contact and armature of relay 100, upper contact of cam 133, springs 125 and 124 of interrupter 123 to ground.

When the sender circuit is in position for units selection, the fundamental circuit is again closed. Relay 100 is operated thereby deenergizing relay 114 and closing a circuit for sequence switch 117 from battery through the sequence switch magnet 117, lower right contact of cam 119 to ground on the back contact and armature of relay 114. Sequence switch 117 thereupon moves into position 4 in which position relay 100 is locked over the fundamental circuit as previously described. The brush carriage magnet 135 is now energized in a circuit from battery through the power magnet 135, upper left contact of cam 136, right front contact and armature of relay 100 to ground through the upper right contact of cam 111. The brush carriage magnet 135 thereupon operates to rotate the brush carriage, the selected set of brushes determined by the setting of the trip spindle magnet, being tripped and thereafter wiping over the contacts in the bank of the switch corresponding to such set of brushes. During this operation, the interrupter contacts 137 and 138 are closed intermittently, thereby connecting ground through

the lower right contact of cam 101, left upper contact of cam 127, left front contact and armature of relay 100, upper right contact of cam 139, lower right contact of cam 102, over conductor 103. This ground intermittently short circuits the stepping relay in the sender circuit in the well known manner and the selection being completed, the fundamental circuit is opened, relay 100 is deenergized and the circuit for the brush carriage magnet 135 is opened, causing brushes 162, 165 and 145 to come to rest upon contacts 163, 164 and 148, respectively, of the called line. Sequence switch 117 is now energized in a circuit which may be traced from battery, winding of sequence switch magnet 117, right upper contact of cam 131, right back contact and armature of relay 100 to ground through the upper right contact of cam 111. Sequence switch 117 moves from position 4 into position 6 by means of ground on master contact 118, after which, the circuit above traced is again closed, moving sequence switch 117 from position 6 into position 7. Contact 118 carries the switch into position 8. In passing through positions 5 to 7, relay 114 is again energized in a circuit from battery through the winding of relay 114, resistance 109, upper contacts of cam 115, back contact and armature of relay 142, upper right contact of cam 143, conductor 144 to ground in the incoming selector circuit. In positions 7 to 7½ of sequence switch 117, relay 142 is connected across conductors 104 and 103. This circuit may be traced from conductor 104, lower left contact of cam 105 through the winding of relay 142, lower left contact of cam 139, lower right contact of cam 102 to conductor 103. Relay 142 is energized from battery and ground in the incoming circuit and opens the circuit for relay 114, allowing it to deenergize. The deenergization of relay 114 closes a circuit for sequence switch 117, extending from battery, winding of magnet 117, lower right contact of cam 119 to ground on the back contact and armature of relay 114, thereby moving the switch into position 9.

In position 6 of sequence switch 117, the test relay 106 is connected to the test brush 145 and as the called line is assumed to be idle, relay 106 is energized in a circuit from battery through the cut-off relay 146 and service meter 147 of the called line in parallel, test terminal 148 brush 145, upper right and lower left contacts of cam 107, winding of relay 106, resistance 138 to ground through the upper left contact of cam 111. When the sequence switch 117 moves between positions 6 and 7, resistance 149, which may be 700 ohms, is introduced into the circuit of relay 106, as the lower left contact of cam 107 is opened. As the called line is assumed to be idle, the battery potential on terminal 148 will be such that the introduction of this resistance in the circuit will not cause relay 106 to deenergize. Relay 106 therefore remains energized and locks to ground on its front contact and armature. Relay 106 opens the circuit which would otherwise exist in position 7 for relay 100, from battery through the winding of relay 100, lower contacts of cam 150 to ground on the back contact of relay 106. Relay 106 also disconnects ground from switch 152, comprising contacts 34 and 35 of Fig. 1, thereby insuring that the switch be used at this time for individual lines only.

Sequence switch magnet 117 is energized in position 9 over a circuit extending from battery through the winding of magnet 117, upper left contact of cam 119, back contact of relay 142, lower right contact of cam 143 to ground on the front contact and armature of relay 114. Relay 114 was energized in a circuit from battery through the winding of relay 114, lower right and upper left contacts of cam 155 over conductor 144 to ground at the incoming selector. Sequence switch 117 moves from position 9 into position 11 under control of its master contact 118. In position 10, relay 100 is energized in a circuit from battery through the winding of relay 100, upper left and lower right contacts of cam 143, to ground on the front contact and armature of relay 114. Relay 100 upon energizing, closes a locking circuit for itself extending from battery, winding of relay 100, left upper contact of cam 143, back contact and armature of relay 142, lower left contact of cam 116, right front contact and armature of relay 100 to ground through the upper right contact of cam 111. In position 11 of sequence switch 117 a circuit is also closed from battery through the winding of sequence switch magnet 117, upper left contacts of cam 119, lower left contact of cam 116, right front contact and armature of relay 100 to ground through the right upper contact of cam 111. Sequence switch 117 thereupon moves from position 11 into position 12.

In position 12, relay 114 is connected to interrupter 156 in a circuit extending from battery through the winding of relay 114, resistance 109, left upper and right lower contacts of cam 115 to ground through interrupter 156. Relay 114 energizes when the circuit is closed at the interrupter and closes a circuit for sequence switch 117 from battery through the winding of switch magnet 117, lower left contact of spring 119 to ground on the front contact and armature of relay 114. This circuit moves sequence switch 117 from position 12 to position 13 in which position a circuit for energizing relay 114 is again closed from battery, wind-

ing of relay 114, resistance 109, lower contacts of cam 155 to ground through interrupter 157. Sequence switch 117 is now moved from position 13 in a circuit from battery, winding of sequence switch magnet 117, lower left contact of cam 119 to ground on the front contact and armature of relay 114. In positions 12 and 13 of sequence switch 117 a ringing circuit is completed from a source of ringing current 158, upper right contact of cam 154, winding of relay 142, upper right contact of cam 127, left front contact and armature of relay 100, upper contacts of cam 139 to brush 162, contact 163 and thence through the bell magnets at the called subscriber's station, back over contact 164, brush 165 to ground through the upper right and lower left contacts of cam 159.

This application of ringing current results in the immediate ringing of the called subscriber's bell, relay 142 being adjusted so as not to be energized by this ringing current. When sequence switch 117 reaches position 14 under the control of interrupters 156 and 157, intermittent ringing current is supplied to the called station from source 160 through the interrupter 161 lower right contact of cam 154 and thence over the circuit previously described.

The ringing current passing through relay 142 is not sufficient to energize it but upon the response of the called subscriber, direct current is superimposed upon the ringing current causing relay 142 to energize whereupon the circuit for relay 100 is opened at the back contact and armature of relay 142. A circuit is now closed from battery through the winding of sequence switch magnet 117, left upper contact of cam 131, right back contact and armature of relay 100 to ground through the upper right contact of cam 111. When sequence switch 117 moves into position 15, which is the talking position, the talking circuit is completed from conductor 103, right upper contact of cam 102 brush 162, contact 163 through the subscriber's station contact 164, brush 165, upper contacts of cam 159 over conductor 104.

When the calling subscriber replaces the receiver upon the switch hook, relay 114 which was held energized over conductor 144, is deenergized and a circuit is closed from battery through the winding of sequence switch magnet 117, lower right contact of cam 119 to ground through the back contact and armature of relay 114. This causes sequence switch 117 to move out of position 15 into position 16 and if the called subscriber has replaced his receiver upon the switchhook, relay 114 remains deenergized in this position and sequence switch 117 continues to rotate into position 17. Relay 100 is now energized in a circuit from

battery through the winding thereof, lower contact of cam 133 to ground through the springs 125 and 124 of interrupter 123. The circuit for the trip spindle magnet 122 is now closed from battery, winding of magnet 122, upper right contact of cam 116, right front contact and armature of relay 100 to ground through the upper right contact of cam 111. The trip spindle returns to normal in this circuit. When springs 124 and 125 of interrupter 123 are opened, relay 100 is deenergized and the circuit for magnet 122 is opened. The trip spindle then comes to rest. When relay 100 deenergizes, the circuit for sequence switch 117 is closed from battery, magnet winding thereof, upper left contact of cam 131, right back contact and armature of relay 100 to ground through the upper right contact of cam 111 and sequence switch 117 is moved into position 18. The circuit of the brush carriage magnet 135 is now closed from battery through the winding thereof, lower left contact of cam 136, right back contact and armature of relay 100 to ground through the upper right contact of cam 111. The brush carriage is rotated by magnet 135 and is returned to normal when the circuit of relay 100 is closed from battery, winding of relay 100, upper right contact of cam 101 to ground on spring 171. Relay 100, upon energizing, opens the circuit before traced for magnet 135 and stops the movement of the brush carriage. Sequence switch 117 is returned to normal over a circuit which may be traced from battery, winding of sequence switch magnet 117, left upper contact of spring 119, lower left contact of cam 116 right front contact and armature of relay 100 to ground through the upper right contact of cam 111. When the sequence switch reaches normal, relay 100 deenergizes. Relay 106 is at this time deenergized since its locking circuit opened at cam 107 when sequence switch 117 left position 16.

Calls to ordinary direct lines. Line busy.

If the called line should be busy when sequence switch 117 reaches position 6, battery potential on the test terminal 148 is insufficient to allow test relay 106 to energize. In position 9 of the sequence switch 117, relays 100 and 142 are energized, the former in a circuit from battery through its winding, lower contacts of cam 150 to ground on the back contact and armature of relay 106. Relay 142 is energized in a circuit from battery through resistance 153, lower left contact of cam 154, winding of relay 142, upper left and lower right contacts of cam 150 to ground on the back contact and armature of relay 106. The circuit for moving sequence switch 117 out of position 9, hereinbefore traced, is opened at

the back contact and armature of relay 142 so that the sequence switch remains in position 9. In this position, relay 100 being energized, a busy tone is applied to the calling line from the source of busy tone current 175, lower right contact of cam 127, left front contact and armature of relay 100, upper right contact of cam 139, lower right contact of cam 102 over conductor 103 to the calling subscriber's line back over conductor 104, upper left and lower right contacts of cam 159, right front contact and armature of relay 100 to busy potential 132 on the upper left contact of cam 116. This busy tone current produces a tone informing the calling subscriber that the called line is busy.

When the calling subscriber replaces his receiver upon the switchhook, the preceding switches are released and relay 114 is de-energized. A circuit is thereupon closed from battery, winding of sequence switch magnet 117, lower right contact of cam 119 to ground on the back contact and armature of relay 114. Sequence switch 117 moves into position 10 and then into position 11 under control of master contact 118, opening the circuit of relay 100. In position 11 the brush carriage magnet 135 is energized in a circuit extending from battery through magnet 135, lower left contact of cam 136, right back contact and armature of relay 100 to ground on the upper right contact of cam 111. The brush carriage thereupon returns to normal position. When contact 171 closes, ground is connected through the right upper contact of cam 101 through the winding of relay 100 to battery, energizing relay 100 and opening the circuit of magnet 135, causing the brush carriage to come to rest. Sequence switch 117 is energized over a circuit from battery through the winding of sequence switch magnet 117, upper left contact of cam 119, lower left contact of cam 116, right front contact of relay 100 to ground through the upper right contact of cam 111. This causes sequence switch 117 to move into position 12 and as hereinbefore described into position 17 where the trip spindle magnet 122 is energized and the trip spindle is rotated to its normal position. Sequence switch 117 is then moved to position 1.

Call to P. B. X. Line group.

The operation of the switch to extend a connection to the lines of a private branch exchange group will now be explained. With such a group of private branch exchange lines, it is necessary to cause the brushes to hunt automatically over the group of lines to select an idle line. If the first line is busy, the brushes must pass on to the second, etc., and stop upon the last line of the group whether idle or busy as explained

hereinbefore. All but the last line of the group are arranged with the resistance of their sleeve circuit the same as for an individual line. The last line of the group has its sleeve or cut-off relay shunted by a resistance such as shown at 176, Fig. 3.

Should the brushes of the switch be moved upon the first contact set of the group of private branch exchange lines and this line be idle, the test relay 106 is energized in position 6 when brush 145 makes contact with terminal 148 and this relay remains energized. When the sequence switch passes from position 6 to position 7, the resistance 149 is included in this circuit, but the relay is so adjusted that it does not deenergize and the call proceeds in the regular manner as before explained for a call to an individual line.

If, however, this first line of the group is busy, the test relay 106 is not energized in position 6 as the potential on the test terminal 148 is not sufficient for its energization. Relay 100 is therefore energized in position 6 of the sequence switch 117 in a circuit from battery, winding of relay 100, lower left contact of cam 150, switch 152 which is closed by the arm of the selector to ground at the back contact of relay 106. Relay 100, upon energizing, closes the circuit of the brush carriage magnet 135, through the upper left contact of cam 136, right front contact and armature of relay 100 to ground on the right upper contact of cam 111. The brush carriage magnet thereupon rotates until the brushes engage the contacts of an idle line, at which time brush 145 will encounter a test terminal such as 148 with sufficient potential thereon to energize the test relay 106. This relay upon energizing, opens the circuit for relay 100, before traced, which, upon deenergizing, opens the circuit for the brush carriage magnet 135 and brings the brushes to rest on the terminals of such idle private branch exchange line. Should the brushes of a switch hunt over all the lines of the group and find them busy and reach the last line in the group, the test relay 106 will be energized in position 6, in which position this relay is energized or deenergized owing to the potential of the test terminal. In the case of a last line this potential is increased by a connection from battery through resistance 176 in parallel with the cut-off relay 146 and the service meter 147 which are connected to the test terminal of the last line of the private branch exchange group. This connection is illustrated in Fig. 3. If the last line of the private branch exchange group is busy, test relay 106 is deenergized when the sequence switch moves between positions 6 and 7 as resistance 149 is included in the circuit of the test relay at this time. When relay 106 deenergizes, relay 100 will be energized in a circuit extending from

battery through the winding of relay 100, lower left contact of cam 150, switch 152 to ground at the back contact of relay 106.

The energization of relay 100 causes the sequence switch 117 to stop in position 9, as before explained, at which time the busy tone is connected to the calling line to inform the calling subscriber that all the lines in the group are busy. The release of the connection will then take place, as described.

If, however, the last line of the group is idle, the potential of the test terminal 148 is higher and the relay 106 is so adjusted as not to deenergize when the resistance 149 is included in its circuit, when the sequence switch moves between positions 6 and 7. This energization of the test relay controls relays 142 and 100, which are deenergized in position 9 and the call progresses in the manner explained above.

Having thus described my invention I claim:

1. In a telephone exchange system, a selector switch comprising a plurality of line terminals, brushes for cooperation with said terminals, means for moving said brushes to select a desired one of a plurality of said terminals, and means operated once only when said brushes are positioned upon a particular one of said terminals to cause said brushes to be moved in a hunting movement over succeeding terminals.

2. In a telephone exchange system, a selector switch comprising a plurality of line terminals, a brush arm, brushes carried by said arm for cooperation with said terminals, means for moving said brushes to select a desired one of a plurality of said terminals, and a switch operated once only by said arm when said brushes are positioned upon a particular one of said terminals to cause said brushes to be moved in a hunting movement over succeeding terminals.

3. In a telephone exchange system, a selector switch comprising a plurality of line terminals, the first ones of said terminals being individual to subscribers' lines, and the last ones of said terminals being associated with private branch exchange trunks, brushes for cooperation with said terminals,

means for moving said brushes to select a desired one of said first terminals, and means operated once only when said brushes are positioned upon the first one of said last terminals to cause said brushes to be moved in a hunting movement over succeeding terminals.

4. In a telephone exchange system, a selector switch comprising a plurality of line terminals, the first ones of said terminals being individual to subscribers' lines and the last ones of said terminals being associated with private branch exchange trunks, a brush arm, brushes carried by said arm for cooperation with said terminals, means for moving said brushes to select a desired one of said first terminals, a cam on said arm, and a switch operable once only by said cam when the brushes are engaged with any of said last terminals, to cause said brushes to be moved in a hunting movement over said last terminals.

5. In a telephone exchange system, a selector switch comprising a plurality of rows of line terminals, brushes for cooperation with said terminals, means for moving said brushes to select a desired one of a plurality of said terminals, and means operated once only when said brushes are positioned upon a particular one of said terminals in any selected row of terminals to cause said brushes to be moved in a hunting movement over the succeeding terminals of the selected row.

6. In a telephone exchange system, a selector switch comprising a plurality of rows of line terminals, a set of brushes for cooperation with each row of terminals, means for selecting a particular set of brushes and for moving the selected set of brushes to select a desired one of the terminals of the selected row, and means operated once only when said brushes are positioned upon a particular one of the terminals of a selected row to cause said brushes to be moved in a hunting movement over the succeeding terminals of the row.

In witness whereof, I hereunto subscribe my name this 21 day of August A. D., 1924.

GERALD DEAKIN.