July 24, 1928. 1,678,185

R. W. HARPER

TELEPHONE SYSTEM

Filed May 18, 1927 2 Sheets-Sheet 1

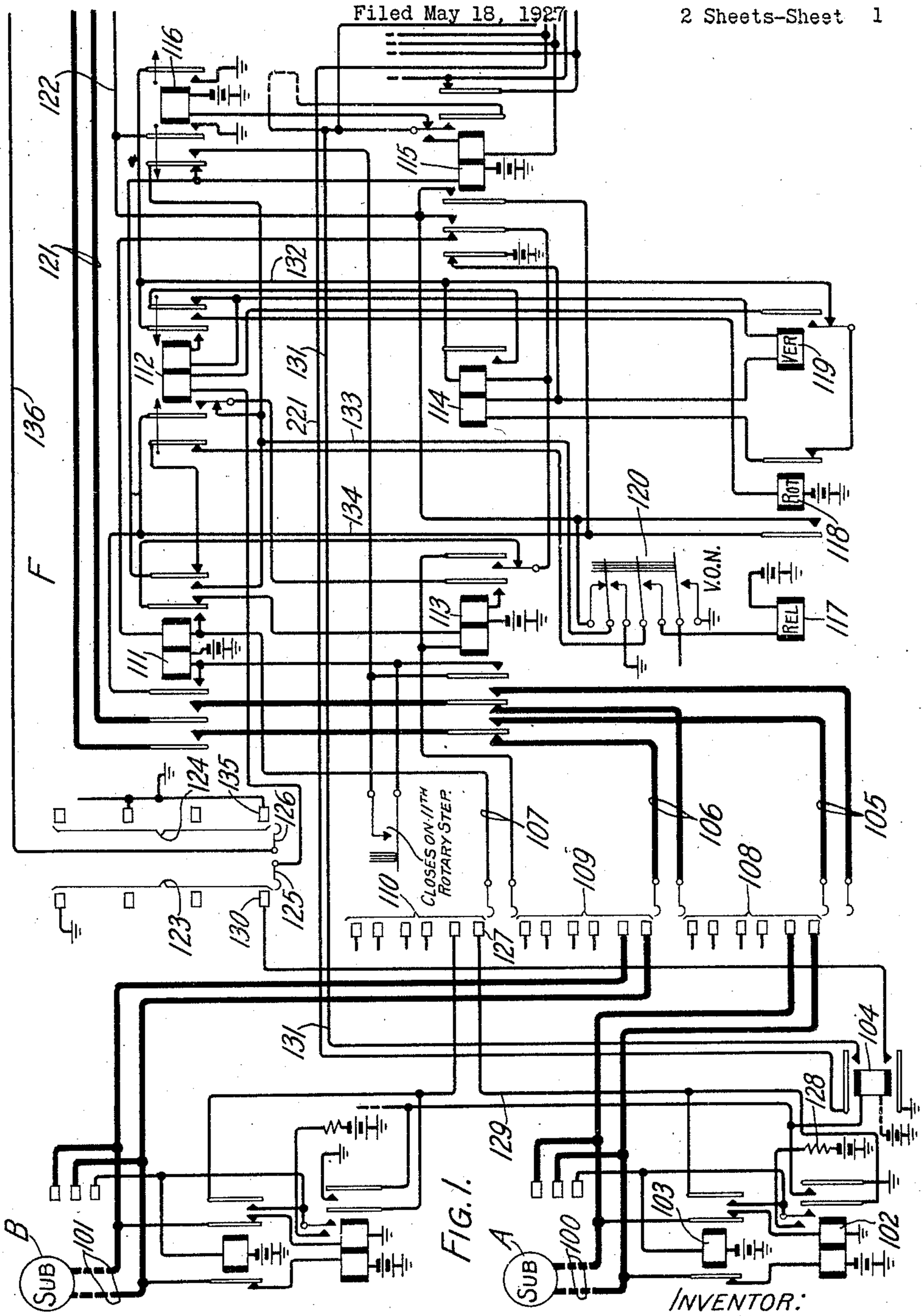

FIG. 1.

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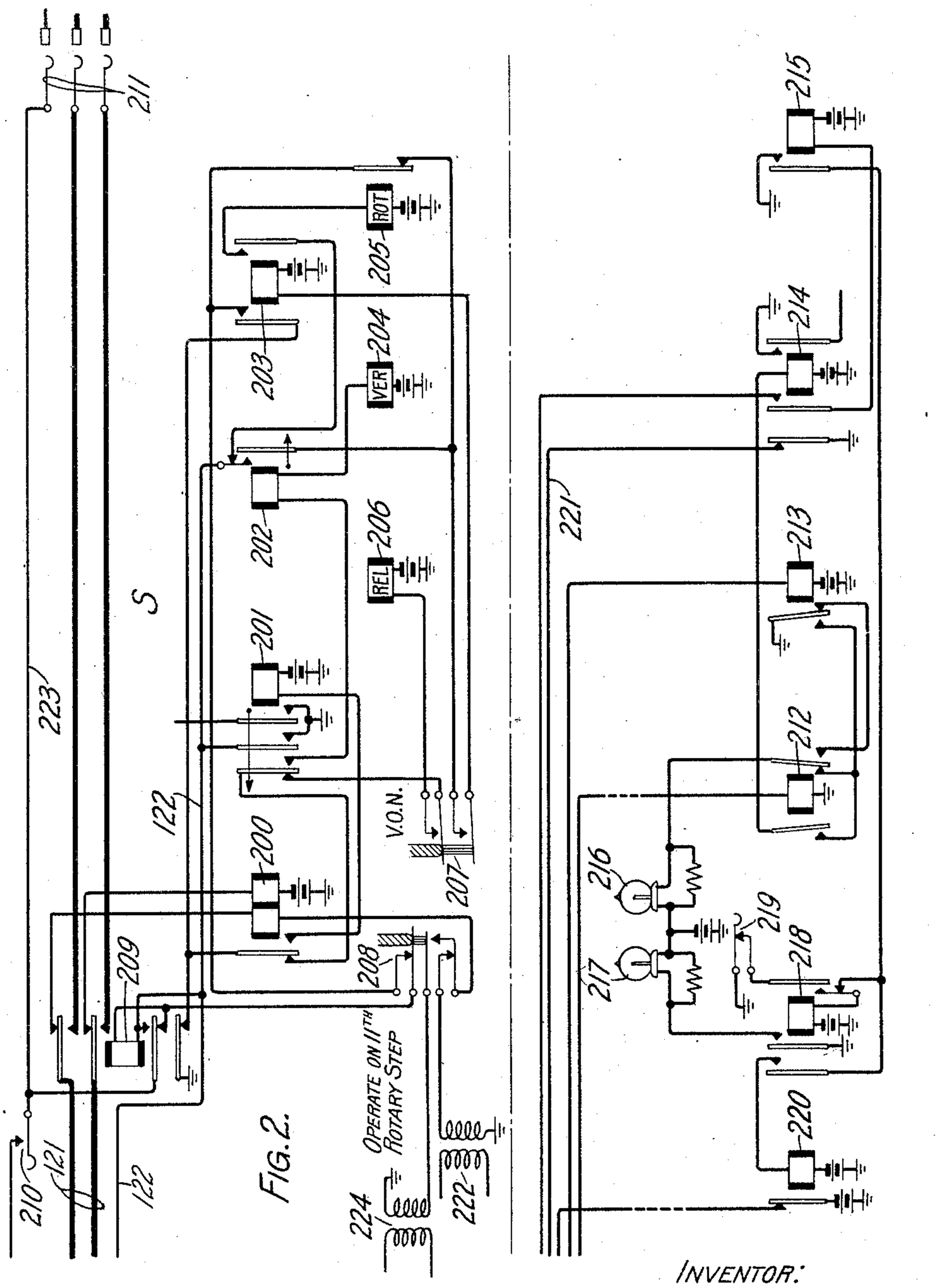

FIG. 2.

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UNITED STATES PATENT OFFICE.

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TELEPHONE SYSTEM.

Application filed May 18, 1927. Serial No. 192,176.

This invention relates to automatic telephone exchanges and its object is to improve systems for restricting the service given to telephone lines.

A feature of this invention is a system in which certain subscribers' lines, when attempting to make calls over a restricted group of trunks, cause the finder switch, by reason of their particular location therein, to so affect the selector switch that when operated by the calling subscriber to select said group of trunks it will automatically refuse to seize any one of them although idle.

Other aspects and advantages of the invention will appear fully from the following description and claims.

In the drawing, comprising two sheets, Fig. 1 illustrates a line finder of the type generally known as the Strowger step-by-step switch and two subscribers' lines.

Fig. 2 shows the first selector switch. At the bottom of this figure is shown a controlling circuit for a number of line finder switches.

The line finder switch F is of the step-by-step type having a capacity for 200 subscribers' lines. The group of 200 lines is divided into two parts, 100 lines appearing in the bank 108 and the other 100 lines appearing in the bank 109. The sleeve or test conductors of the entire 200 lines appear in a third bank 110. The switch has two sets of tip and ring brushes mounted on the same shaft, the set 105 having access to the ten levels of contacts in the bank 108 and the set 106 likewise having access to the contacts in the bank 109. The switch also has a pair of test brushes 107, one for each group of 100, mounted on the shaft and cooperating with the test bank 110.

Moreover, the switch is provided with a row of group selecting commutator segments 123 and a brush 125 for stopping the finder in its vertical movement when it has reached the level containing the calling line.

The finder switch is also equipped with a second commutator 124 which has a segment for each vertical group selecting position of the switch together with a cooperating brush 126. By connecting the different segments of the commutator 124 to ground, the group of 20 subscribers' lines corresponding to a grounded segment is restricted as to service.

The subscribers' lines 100 and 101 are seen to appear in corresponding levels of the respective banks 108 and 109. The line 100 and nine other lines comprise a level of 10 lines in the bank 108, whereas the line 101 and nine others comprise the corresponding 10 lines in the bank 109. These 20 lines comprise a group, and any one of them in calling operates the group relay 104 to initiate the movement of a line finder switch.

In Fig. 2 the selector switch S has access to groups or levels of trunks, some of which levels are restricted to certain groups of subscribers. To effect the restriction, the selector has an auxiliary switch 210, which closes whenever a subscriber positions the switch S opposite a predetermined group of trunks.

A detailed description of the system will now be given. Assume the subscriber at substation A initiates a call to extend a connection over a group of trunks which are not restricted to him. The removal of the receiver causes the operation of the line relay 102 in an obvious circuit. Relay 102 at its outer right contact closes an obvious circuit for the group relay 104. Relay 102 also applies battery potential to the test terminal 127 to identify the line as calling. The circuit for this purpose may be traced from battery, through the winding of the cut-off relay 103 and in parallel from the battery through the resistance 128 and thence through the inner contacts of relay 102, conductor 129 to the terminal 127. Relay 104 places ground potential on the corresponding commutator segment 130. Relay 104 also closes the start wire to set the finder switch F in operation, assuming this to be the first idle switch. The start wire may be traced from ground, through the outer left contact of relay 214, conductor 221, through the upper contact of group relay 104, conductor 131, thence through the normal right contact of relay 115, winding of the start relay 116 to battery. Relay 116 operates and at its inner left contact applies ground potential to the sleeve conductor 122 of the trunk 121. Relay 116 also closes an operating circuit for relay 114 traceable from ground, through the outer right contact of relay 116, conductor 132, normal contact of the vertical magnet 119, right contact of the rotary magnet 118, left winding of relay 114, to battery at the outer left contact of relay 115. Relay 114 closes a circuit for the vertical magnet 119 which may be traced from battery, through

the left contact of relay 115, winding of magnet 119, outer right back contact of relay 112, contact of relay 114, to the grounded conductor 132. The magnet 119 operates to step the brush shaft of the finder to its first vertical position. Magnet 119 at its contact also opens the circuit of relay 114 which releases, in turn opening the circuit of the magnet which also releases. The magnet on releasing recloses the circuit of relay 114 which operates and again operates the magnet. This process continues until the switch reaches the group containing the calling line.

Since, in the case assumed, the calling line 100 appears in the first group or level, the test circuit is completed at the end of the first vertical step and may be traced from ground, over the segment 130, brush 125, left winding of relay 112, armature and front contact of magnet 119, contact of magnet 118, left winding of relay 114, to battery at the left contact of relay 115. This circuit operates the relay 112 and holds the relay 114 and the magnet 119 energized to prevent further stepping. Relay 112 is slow to operate in order to provide an interval between the vertical and rotary movements of the switch. Relay 112 when operated locks in circuit from ground, over the outer right contact of relay 116, contact and right winding of relay 112, winding of the magnet 119, to battery at the contact of relay 115.

When relay 112 fully operates a circuit is closed for the rotary magnet 118 traceable from battery, through the winding of said magnet, outer right front contact of relay 112, contact of relay 114 to the grounded conductor 132. The magnet 118 advances the brushes on to the first set of terminals in the group and also opens the circuit of relay 114. Relay 114 releases, in turn releasing the magnet 118. Magnet 118 recloses the circuit of relay 114 which operates and recloses the circuit of the magnet. This process continues until the lower brush 107 reaches the calling line. When the calling line is reached, the test circuit is closed from grounded conductor 132, right winding of relay 114, normal right contact of test relay 113, inner right back contact of test relay 111, left winding of relay 113, lower test brush 107 to battery on the test terminal 127. Relay 113 operates in this circuit and relay 114 remains energized to prevent further operation of the magnet 118. Relay 113 operates the relay 111 in a circuit from battery, through the left winding of relay 111, inner left contact of relay 113, outer left front contact of relay 116, conductor 133 to ground through the vertical off normal springs 120. These springs are operated to their alternate positions on the first vertical step of the brush shaft. Relay 111 in operating completes an operating circuit for relay 115. This circuit may be traced from battery, through the left winding of relay 115, outer right front contact of relay 111 to ground on conductor 133. Relay 111 locks in a circuit from battery, through its left winding and contact, inner left contact of relay 115, to ground on conductor 122. Relay 113 locks temporarily in a circuit from battery, through its right winding and contact, inner left front contact of relay 112, to the grounded conductor 134.

Relay 115 in operating releases the relay 116, but before relay 116 can retract its armatures to remove ground from conductor 122 a substitute ground is placed on said conductor from the selector switch S. With relays 113 and 111 operated, the calling line 100 is extended over the tip and ring conductors of trunk 121, through the upper back contacts of relay 209 and the windings of the impulse relay 200 to battery and ground. Relay 200 operates and closes an obvious circuit for slow relay 201 which operates and applies ground potential to the sleeve conductor 122. The grounded sleeve conductor 122 is also extended through the middle left front contact of relay 115, outer right front contact of relay 113, lower test brush 107, thence to battery through the winding of the cut-off relay 103. Relay 103 operates and opens the circuit of the line relay 102. Before the relay 102 can release, however, relay 103 locks through its outer right contact to the grounded conductor 129. Relay 115 at its outer left armature opens the holding circuit of the magnet 119 and relay 112. When relay 112 releases, the holding circuit of relay 113 is shifted and now extends over the left normal contact of relay 112 to the grounded conductor 133. With the relay 113 operated, relay 114 also releases.

The circuit for the left winding of the relay 200 leads through the dial tone coil 222. The subscriber at substation A hearing the dial tone proceeds to operate his dial in accordance with the first digit of the called number. At each interruption of the line, relay 200 releases and closes a circuit from ground, through the lower contact of relay 209, back contact of relay 200, outer front contact of relay 201, winding of slow release relay 202, winding of the vertical stepping magnet 204 to battery. Magnet 204 operates to step the brushes 211 opposite the first level of terminals. When relay 202 operates and when the shaft takes its first step to shift the off-normal springs 207, a circuit is closed from battery through the winding of relay 203, springs 207, front contact of relay 202 to the grounded conductor 122.

At the end of the first series of impulses, the brushes 211 have been driven to a given group of trunks which, as assumed, are not restricted to the calling subscriber. Accordingly, the switch 210 is open with the brush shaft standing in this position. After

an interval following the first series of impulses, relay 202 releases and opens the original operating circuit for relay 203. Relay 203 is held, however, in a circuit from battery, through its winding, off-normal springs 207, contact of the rotary magnet 205, left armature of relay 203, to ground at the lower contact of relay 209. When relay 202 releases, a circuit is closed from battery, through the stepping magnet 205, right contact of relay 203, normal contact of relay 202, to the grounded conductor 122. The magnet 205 rotates the brushes to the first set of terminals in the level and at its right contact opens the holding circuit of relay 203. The relay releases, in turn releasing the magnet 205. If the first trunk is busy, relay 203 reoperates in a circuit over the springs 207, contact of the magnet 205, upper set of springs 208, inner lower back contact of relay 209, conductor 223, to the busy sleeve terminal. Relay 203 again closes the circuit of the motor magnet 205 and the switch takes another step. This procedure continues until an idle trunk is found having no ground potential on the sleeve terminal. During the stepping movement of the switch, a circuit in parallel to the test circuit is closed through the winding of relay 209 to the grounded conductor 122. As long as busy trunks are encountered, relay 209 is shunted and does not operate. When, however, an idle trunk is found, the shunt being removed, relay 209 operates and closes the talking conductors of the trunk 121 through to the brushes of the switch S. Due to the resistance of relay 209, the relay 203 does not operate. Relay 209 releases the relay 200 which opens the circuit of relay 201. Before relay 201 can release ground is returned over the sleeve conductor from the switch beyond to hold the relay 209 and to maintain ground potential on the sleeve conductor 122.

Other switches may be positioned to complete the extension of the connection in any well known manner.

When it is desired to release the connection, ground potential is removed from the sleeve conductor 122 causing the release of relay 209. The release magnet 206 is operated in a circuit through its winding, springs 207, back contacts of relays 201, 200 and 209 to ground. Magnet 206 restores the selector S which, on reaching its normal position, shifts the springs 207 to open the circuit of magnet 206.

The removal of ground potential from conductor 122 releases relay 111. Relay 111 operates the release magnet 117 in a circuit from battery, through said magnet, springs 120, outer left contact of relay 112, outer right contact of relay 111, left back contact of relay 116, to the grounded conductor 133. Magnet 117 restores the finder switch F to normal, in which position the springs 120 are shifted and the circuit of magnet 117 is opened. The shifting of springs 120 also opens the holding circuit of relays 113 and 115.

Next it will be assumed that the subscriber at substation A attempts to extend a connection over a restricted group of trunks. The line finder and selector switch are operated in the same manner as already explained with the exception that the selector S on being positioned opposite the restricted group closes the switch 210 at the end of the vertical movement. With switch 210 closed and with the brush 126 engaging the grounded segment 135, a circuit may be traced from ground over brush 126, conductor 136, contact 210 to the sleeve conductor 223. Ground potential on the sleeve conductor 223 automatically renders all trunks in the level non-selective. The switch, therefore, rotates over the entire group to its 11th rotary position where the springs 208 are shifted. The busy tone source 224 is connected in a circuit over the springs 208 to the windings of relay 200 in series with the calling line. A tone is sent back to the subscriber notifying him that the connection cannot be obtained.

Had the call originated at the substation B, the finder would have operated in substantially the same manner except that the test circuit through the upper brush 107 is used instead of the one described. In this case, the test relay 111 operates and the relay 113 remains inert.

A brief description will now be given of the control circuits shown at the bottom of Fig. 2. Normally the relays 212 and 213 are both operated over the back contact of one or more relays similar to relay 115. In case battery or ground potential accidentally appears on the start conductor, either the relay 212 or 213 is released according to the nature of the trouble. With either of these relays released, and the other relay energized, an obvious circuit is completed for lighting the lamp 216.

If a permanent ground potential is applied to the start wire, each finder will be started in operation and relay 115 individual to each finder is energized and locked in a circuit from battery, through the contact of relay 220, right winding and front contact of relay 115 to the grounded start wire 131. When all finders have been operated, the circuit of relays 212 and 213 is opened and both of these relays release. A circuit is now completed over the back contacts of relays 213 and 212 for the relay 214. Relay 214 opens the start wire 221 and operates the relay 215 in a circuit from battery, through the winding of the latter relay, contact of relay 214, thence to the grounded start conductor 131. Relay 215 operates the relay 218 which locks to the key 219. Relay 218

also lights the lamp 217 as a signal and completes a circuit for relay 220. Relay 220 opens the holding circuit of all relays 115.

What is claimed is:

1. In a telephone system, a line finder having groups of terminals, lines appearing in said terminals, groups of trunks, a selector having access to said trunks, means for operating the finder to extend a calling line to said selector, means for operating the selector to select a group of trunks and to seize an idle one, an auxiliary switch driven by said finder and closed in certain group selecting positions thereof, and means controlled by the auxilary switch for rendering said selector ineffective to seize an idle trunk.

2. In a telephone system, a line finder, a plurality of groups of lines appearing in said finder, groups of trunks, a selector, means for operating the finder to extend a calling line to said selector, means for operating the selector to choose a group of trunks and to seize an idle one, an auxiliary switch mounted on the brush shaft of said finder and closed in certain group selecting positions thereof, and means controlled by said auxiliary switch for rendering the selector switch ineffective to seize an idle trunk.

3. In combination, a line finder switch, groups of subscribers' lines appearing in said switch, a selector switch, groups of trunks, means for operating the finder to extend a calling line to the selector switch, means controlled by the calling subscriber for actuating the selector to choose a desired group of trunks, means for operating the selector automatically to seize an idle trunk in the group, a group commutator associated with the finder switch, and means controlled by the commutator if the calling line appears in a certain group for rendering the trunks of the desired group non-selective.

4. In combination, a primary switch, groups of lines appearing therein, groups of trunks, a selector, means controlled by the subscriber for operating the primary switch and selector to extend his line in the direction of a desired group of trunks, an auxiliary switch driven by the primary switch, and means controlled by said auxiliary switch and dependent on the group of trunks chosen by the selector to render the selector ineffective to seize an idle trunk.

5. In a telephone system, a line finder having levels of lines appearing therein, groups of trunks, a selector switch, means controlled by a calling subscriber for operating the line finder and selector to extend his line toward a chosen group of trunks, an auxiliary switch driven by said finder, an auxiliary switch on said selector, and means controlled by said auxiliary switches in predetermined positions of the finder and selector for rendering the individual trunks of the chosen group artificially busy.

6. In combination, a line finder switch, subscribers' lines appearing in groups in said switch, groups of trunks, a selector switch, means controlled by a subscriber for operating the finder and selector to extend the calling line to a chosen group of trunks, a commutator and a circuit closed thereby whenever the finder chooses any line in a given group, and means controlled by said circuit to render the selector ineffective to seize any idle trunk in certain groups.

In witness whereof, I hereunto subscribe my name this 28th day of April, A. D., 1927.

ROBERT W. HARPER.