

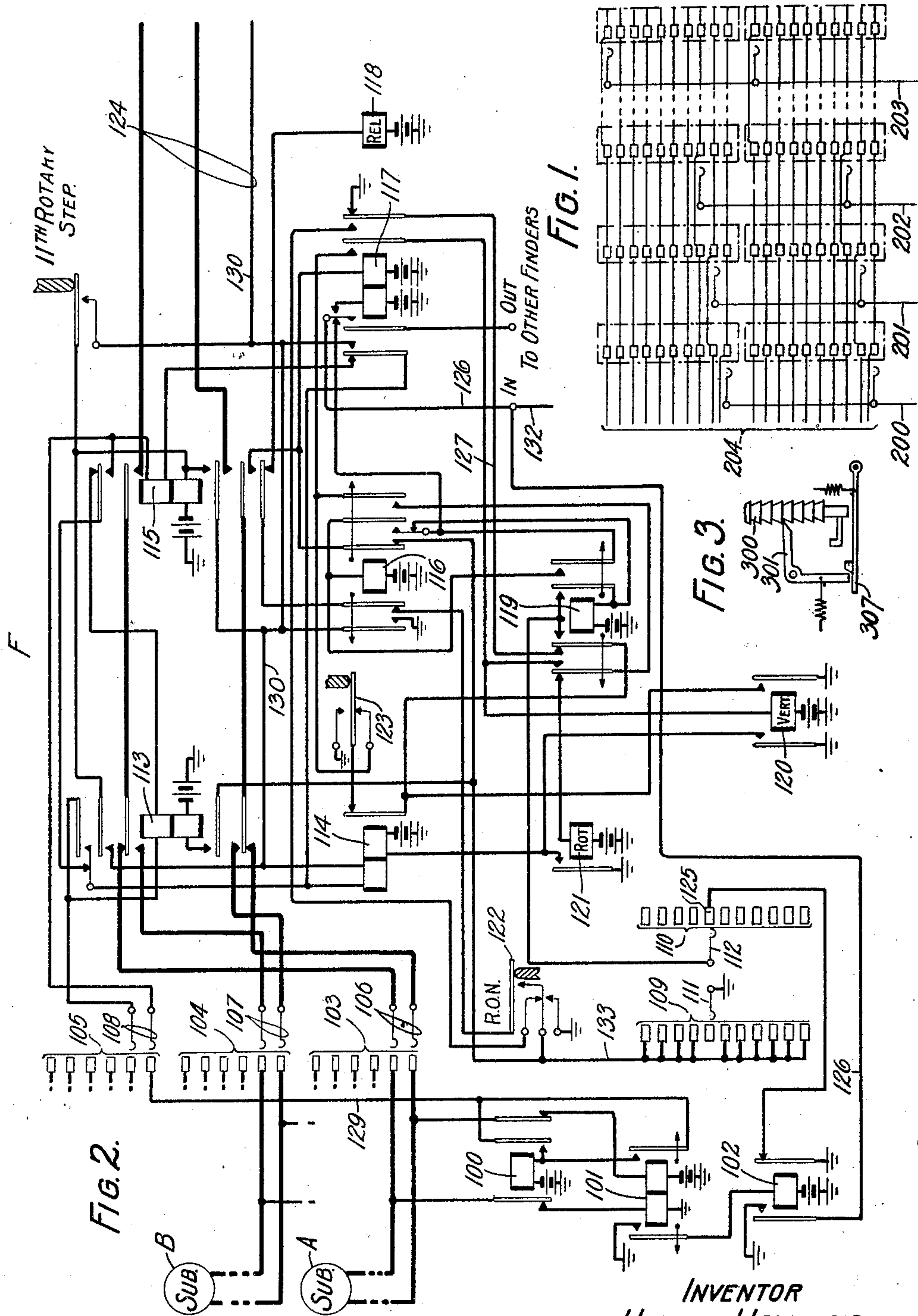
May 7, 1929.

H. HOVLAND

1,711,682

TELEPHONE EXCHANGE SYSTEM

Filed June 8, 1927



INVENTOR
HENRY HOVLAND
BY *W. M. McFenney*
ATTORNEY

UNITED STATES PATENT OFFICE.

HENRY HOVLAND, OF FLUSHING, NEW YORK, ASSIGNOR TO BELL TELEPHONE LABORATORIES, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

TELEPHONE-EXCHANGE SYSTEM.

Application filed June 3, 1927. Serial No. 197,292.

This invention relates to automatic telephone exchanges and has for its object the improvement of line finder switches.

According to this invention the availability of lines to a group of finder switches is increased by causing said switches, when restored to their released positions, to move by relatively differing amounts to assume their normal positions.

A feature of the invention is a finder switch which moves forward to find certain groups of lines and which finds other groups by moving to its extreme forward position, releasing and again moving forward.

Another feature is a finder which in one instance restores to normal by merely releasing to the beginning of its line finding movement and in other cases by first restoring to its fully released position and then advancing to its normal position.

The invention is illustrated in a system using step-by-step line finder switches each having a capacity for 200 lines.

In the drawing, Fig. 1 illustrates in schematic manner a plurality of these finder switches showing the normal positions of the brushes. The lines 204 appear in two 100-point banks in the finder switches and are multiplied, without any slipping arrangement, to a number of finders. The brushes of the finder switch 200, for instance, normally stand in operative relation to the first level of terminals in their respective banks. The brushes of the next switch 201 normally stand in operative relation to the second level of terminals. The brushes of the third switch 202 stand opposite the third level and so on, the brushes of the last switch 203 standing opposite the 10th level of terminals. By arranging each switch with a different normal position the hunting time is sufficiently reduced to allow a straight multiple of the lines thus eliminating the expedient of slipping the lines from one switch to another.

Figs. 2 and 3 show the details of a line finder F. Switch F has two sets of line brushes 106 and 107, each cooperating respectively with banks of terminals 103 and 104. The switch also has a set of test brushes 108 coacting with the test bank 105. In addition the finder is equipped with two sets of commutator segments 109 and 110 over which the brushes 111 and 112 are driven in the vertical movement of the switch.

The subscriber's line A is one of 100 lines

appearing in the bank 103. Likewise the subscriber's line B appears in the corresponding level of the other bank 104. It will be assumed that the brushes of the finder F normally stand opposite the 7th level of terminals in the banks 103, 104 and 105. Accordingly the commutator brushes 111 and 112 normally engage the 7th segments in the commutator strips 109 and 110.

Whenever a finder is taken in use to find a line in its normal group no vertical movement is necessary. The switch merely rotates into the level to find the calling line. If a finder is taken in use to find a line occurring in a level above its normal level the switch first steps to find the calling level and then rotates to seize the calling line. If a finder is taken to find a line located in a level below its normal level it first moves vertically to the top of the bank, releases to the bottom and then steps vertically to find the calling level whereupon it rotates to seize the calling line.

To release a finder, such as the switch F, from a line in its normal level, it is only necessary to energize the release magnet 118. The release magnet withdraws the rotary holding dog, not shown, causing the switch to rotate to its normal rotary position. To release a switch from a line in any level other than its normal level, the magnet 118 is first operated to restore the shaft to its normal rotary position. Thereupon the switch is stepped vertically to the top of the bank, in which position the vertical holding pawl is withdrawn from the ratchet and the switch drops to its fully released position at the bottom of the bank. When the shaft reaches the bottom of the bank the vertical holding dog again engages the ratchet and the switch thereupon steps up to its normal level.

Fig. 3 shows a detail of the shaft 300. When the shaft 300 reaches its uppermost position the vertical holding pawl 301 is mechanically withdrawn from the ratchet permitting the shaft to drop. The dog 301 is held out of engagement with the ratchet by the latch lever 307 until the shaft reaches its lowermost position.

A detailed description will now be given, assuming that the subscriber of line A initiates the call. The initiation of the call results in the operation of the line relay 101 in an obvious circuit. Relay 101 operates the group relay 102. The group relay 102 re-

moves ground potential from the commutator segment 125. Relay 102 also closes the start circuit 126 to initiate the movement of the line finder F. The start circuit may be traced
 5 from ground, contact of relay 102, conductor 126, normal contacts of relays 117 and 116, winding of slow release relay 119 to battery. Relay 119 operates and closes a circuit for slow release relay 116. The circuit for relay
 10 116 leads from battery through its winding, outer right contact of relay 119, normal contact of relay 117 to the grounded start wire 126. Relay 116 locks in a circuit from battery through its winding and middle right
 15 front contact to the start wire 126 as traced. Relay 116 opens the circuit of relay 119 and the latter relay releases.

The rotary stepping magnet 121 is now operated to step the brushes over the terminals
 20 of the normal level to search for the calling line A. The operating circuit of the magnet 121 may be traced from battery through its winding; left back contact of relay 119; outer right front contact of relay 116; lower con-
 25 tacts of the combination 123; back contact of relay 114; inner left back contact of relay 119; conductor 127; to ground at the outer right back contact of relay 117. The magnet 121 steps the brushes 106, 107 and 108 to the
 30 first set of terminals. Magnet 121 in operating closes an obvious circuit for relay 114. Relay 114 operates and releases the magnet 121. Magnet 121 in turn releases relay 114 which recloses the operating circuit of the
 35 magnet. The switch operates in this manner until the calling line is reached.

When the lower test brush 108 engages the test terminal of the calling line, a circuit is closed from battery through the winding of
 40 the cutoff relay 100; contact of relay 101, conductor 129, lower brush 108; upper winding of relay 115; outer left back contact of relay 117; left winding of relay 114; conductor 130; outer left contact of relay 116 to ground. Re-
 45 lay 115, which is arranged to close its inner lower contact before any of its other contacts are operated, locks in a circuit from battery through its lower winding and contact to ground at the contact of relay 116. Relay
 50 115 extends the calling line A over the tip and ring conductors of the trunk 124 to the line relay associated with a first selector switch, not shown. In the well-known manner the first selector switch applies ground potential
 55 to the sleeve conductor 130 to hold the switch after the relay 116 releases, which it will do presently.

The test circuit above traced, leading through the left winding of relay 114, main-
 60 tains this relay operated to prevent further stepping of the switch by the rotary magnet 121. After relay 115 operates the test circuit is shifted and may now be traced from battery through the cutoff relay 100 thence
 65 through the lower brush 108, upper front con-

tact of relay 115, normal contact of relay 113, left winding of relay 114 to the grounded sleeve conductor 130. The cutoff relay 100 operates releasing the relays 101 and 102. Relay 102 releases relay 116. Relay 116
 70 closes a circuit for the relay 117 traceable from battery through the right winding of relay 117, lower front contact of relay 115, inner left contact of relay 116, contacts 122 to ground. Relay 100 is now held in a circuit
 75 from battery through its winding and its contact over the lower brush 108; upper front contact of relay 115, normal contact of relay 113, outer left front contact of relay 117, to the sleeve conductor 130. Relay 114 is shunt-
 80 ed and releases.

The line finder is now ready for the conversation to take place as soon as the connection is completed by succeeding switches. The circuit from the calling line A extends
 85 over the back contacts of relay 113 and the front contacts of relay 115 to the tip and ring conductors of the trunk 124.

At the end of conversation, the subscribers replace their receivers and ground potential
 90 is removed from conductor 130. Relay 115 releases and closes a circuit for the release magnet 118 from battery through the winding of the magnet, lower back contact of relay 115, inner left contact of relay 116, to ground
 95 through the springs 122. The magnet 118 withdraws the rotary holding pawl and the switch shaft restores to its normal rotary position. The springs 122 are opened and the magnet 118 deenergizes. The springs
 100 122 also open the circuit of relay 117. The switch is now in its normal position with the brushes 106, 107 and 108 standing opposite the 7th level of terminals in the bank.

It will next be assumed that the finder
 105 F is taken in use to seize a calling line in some level other than its normal level. For example, assume the calling line appears in the third level. The initiation of the call places a ground potential on the incoming start wire
 110 132 originating in the calling group. This causes the operation of relay 119 in a manner described. Relay 119 locks in a circuit from battery through its winding and inner right contact, brush 112, segment 125 to ground at
 115 the contact of group relay 102. Relay 119 operates the relay 116 in the manner above described and relay 116 locks independently of the contact of relay 119.

The switch is now stepped by the magnet
 120 120 to search for the calling level of lines. The circuit for the magnet 120 leads from battery to the winding thereof, outer left front contact of relay 119, outer right contact
 125 of relay 116, lower contact 123, contact of relay 114, inner left front contact of relay 119, brush 112, terminal 125 to ground at the contact of relay 102. It will be noted that relay 102 is deenergized since this group has not
 130 initiated a call. The magnet 120 sets the

shaft up one step and closes an obvious circuit for relay 114. Relay 114 opens the circuit of the magnet which releases and in turn opens the circuit of relay 114. If the group
 5 opposite which the brushes are now standing contains no calling line the corresponding segment of commutator 110 is grounded and relay 119 remains energized. The magnet 120 is again operated and steps the switch up
 10 another step. This procedure continues until the shaft reaches its uppermost position where the lower contacts 123 are opened and the upper contacts closed. Also as previously explained, the brush shaft 300 is automati-
 15 cally restored to its fully released position. During the release of the switch and while the commutator brush 112 is moving down, the relay 119 is held in a circuit from battery through its winding and inner right and inner
 20 left contacts, contact of relay 114 to ground through the upper contacts 123. As the brush shaft reaches its lowermost position the upper contacts 123 are opened and the lower con-
 25 tacts again closed. If the first and second levels contain no calling lines, the corresponding commutator segments 110 are grounded and relay 119 remains energized to close the operating circuit from magnet 120. Since it
 30 was assumed that the calling line appears in the third level, the brush 112, on reaching this level finds the segment ungrounded. This permits the release of relay 119 which opens the circuit of the stepping magnet 120.

The rotary magnet 121 operates to advance
 35 the brushes of the finder switch over the third level of lines to search for the calling line. When the line is found the rotary movement ceases and the calling line is extended through to the first selector in the manner hereinbe-
 40 fore described.

To release the finder F from the third level of contacts, the release magnet 118 is first energized in the manner above explained to restore the brushes to the beginning of their
 45 rotary movement. It will be noted that the segments of the commutator 109 are all connected to the conductor 133 with the exception of the normal position segment. Accordingly the brush 111 applies ground po-
 50 tential to the conductor 133 in all positions other than the normal position of the finder. The grounded conductor 133 extends to the inner right contact of relay 116 and the right winding of relay 117 holding the relay 117 op-
 55 erated after the rotary contacts 122 have restored to the position shown. The stepping magnet 120 is again energized in a circuit from battery through its winding, inner right contact of relay 117, lower contacts 123, con-
 60 tact of relay 114, inner left back contact of relay 119, conductor 127, outer right front contact of relay 117, closed contacts of the spring combination 122 to the grounded con-
 65 ductor 133. The magnet 120 operates in this circuit to step the finder switch up to its nor-

mal position where ground is removed from conductor 133 to prevent further stepping of the switch and to release relay 117.

Should the calling line occur in the other group of 100 lines the switch operates in sub- 70 stantially the manner described except that the brushes 107 are used and both relays 113 and 115 are operated. The test circuit for a line in this group may be traced from the upper brush 108, upper winding of relay 113, 75 upper back contact of relay 115, normal contact of relay 113, left winding of relay 114 to the ground conductor 130. Relay 113, which is arranged to close its inner lower con-
 80 tact before any of its other contacts operate, locks to ground through the spring combination 122. Relay 113 closes an operating circuit from battery to the lower winding of re-
 85 lay 115, upper middle contact of relay 113 to the grounded conductor 130. The tip and ring conductors of the calling line, such as the line B, are thus extended over brushes 107 through the front contacts of relays 113 and 115 to the corresponding conductors of the trunk 124. 90

For a further description of line finder switches of the general type illustrated in this disclosure, reference is made to the patent to Carpenter No. 1,567,240, granted December 29, 1925. 95

While the invention has been disclosed in connection with finders of the 200-point type it is obvious that it may be embodied in switches of other types. 100

What is claimed is:

1. In a telephone system, lines arranged in groups, automatic switches for making connection with said lines, means for releasing the switches to the same position relative to said groups of lines, and means for setting 105 said switches in different normal positions with respect to said groups.

2. In a telephone system, finder switches, lines appearing in groups in said finders, means for releasing said finders after use to 110 the same position relative to said groups of lines, and means for advancing said finders to different normal positions with respect to said groups.

3. In combination, finder switches, tele- 115 phone lines appearing in said switches in groups, means for releasing each finder to the same position as the other finders relative to said groups, and means for setting each finder in a normal position which differs from 120 the normal positions of the remaining finders relative to said groups.

4. In a telephone system, finders, each having a brush set, lines appearing in levels in said finders, means for releasing all brush 125 sets to the same level, and means for setting said brush sets in normal positions each in operative relation to a different level.

5. In a telephone system, automatic switches, lines appearing in levels in said 130

switches, a brush for each switch, means for releasing all brushes to a position adjacent the first level, and means for setting said brushes each in a normal position adjacent
5 a different level of lines.

6. In combination, an automatic switch, lines appearing in levels in said switch, a brush set for the switch normally standing opposite a given level, means for operating said
10 brush set in a single movement to seize a line in said given level, and means for operating the brush set in a plurality of movements to seize a line in another of said levels.

7. In combination, an automatic switch,
15 lines appearing in levels in said switch, a brush set for the switch normally standing opposite a given level, means for operating said brush set to seize a line in said given level, and means for operating the brush set to
20 seize a line in any other level whether above or below said given level.

8. In combination, an automatic switch, lines appearing in levels in said switch, a brush for the switch normally standing opposite a given level, means for rotating said
25 brush to seize a line in said given level, and means for moving the brush vertically and then rotating it to seize a line in a level above said given level.

9. In combination, an automatic switch,
30 lines appearing in levels in said switch, a brush for the switch normally standing opposite a given level, means for rotating said brush to seize a line in said given level, means

for moving the brush vertically to a given
35 position, means for releasing said brush to its extreme lower position, and means for causing said brush to move vertically and to rotate to seize a line in a level below said given level.

10. In combination, an automatic switch,
40 lines appearing in levels in said switch, a brush for the switch normally standing opposite a given level, means for moving said brush in a single motion to seize a line in said given level, means for moving said brush in
45 two different motions to seize a line in any other level, means for releasing said brush from a line in the given level by restoring it in a single motion, and means for releasing the brush from any other line by restoring it
50 in two separate motions.

11. In combination, a finder switch, lines appearing in levels in said switch, a brush for the finder switch normally standing opposite a given level, means for rotating said brush
55 to seize a line in the given level, means for moving said brush vertically and rotating it to seize a line in any other level, means for releasing the brush from the given level by a rotary movement only, and means for releasing
60 the brush from any other level by restoring it in a rotary movement, restoring it to its fully released vertical position and advancing it in a vertical movement to its normal position.
65

In witness whereof, I hereunto subscribe my name this 4th day of June, A. D. 1927.

HENRY HOVLAND.