Jan. 19, 1926. 1,569,936

E. LAND

MACHINE SWITCHING SYSTEM

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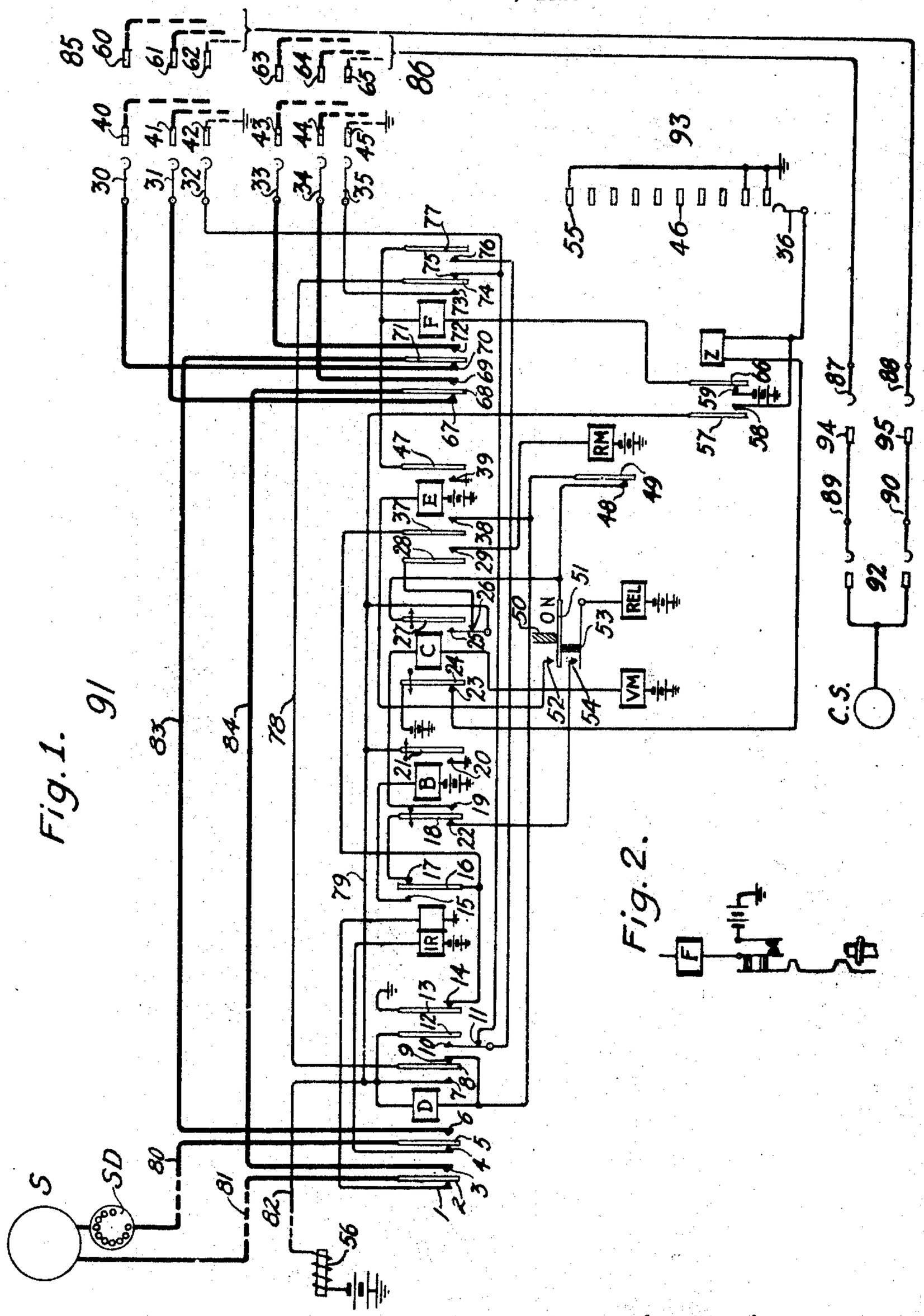

Fig. 1.

Fig. 2.

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MACHINE-SWITCHING SYSTEM.

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To all whom it may concern:

Be it known that I, EDMUND LAND, a citizen of the United States, residing at Ridgefield Park, in the county of Bergen and State of New Jersey, have invented certain Improvements in Machine-Switching Systems, of which the following is a specification.

This invention relates to machine switching telephone systems.

Its object is to provide an improved circuit arrangement whereby the selectors are capable of hunting over a plurality of trunks simultaneously or over the trunks individually.

In the circuit arrangement of this invention, a plurality of sets of talking-brushes and a plurality of sets of test wipers are provided for each selector. The selector is first set under control of the impulse sender to the desired group of trunks and then automatically rotates and tests either one or more trunks at each step, depending upon the setting previously obtained under control of the impulse sender and in any case seizes the first idle trunk tested.

In the drawing Fig. 1 shows a calling line connected to a selector wired in accordance with this invention forming part of the switching apparatus in a full mechanical telephone exchange system. Fig. 2 shows a modification of the circuit arrangement of Fig. 1, wherein the Z relay and commutator 93 are omitted and the F relay is controlled by a set of contact springs on the switch shaft.

The selector 91 shown in the drawing is provided with two sets of brushes or wipers which move in unison. One set consists of talking brushes 30 and 31 and the testing brush 32; the other set consists of talking brushes 33 and 34 and the testing brush 35. It should be understood that when the lower set of brushes 33, 34 and 35, is set opposite the first trunk level or trunk group, the upper set of brushes, 30, 31 and 32, will be set opposite some other trunk level, for example, the second, third or fourth, etc. depending upon the spacing between the two sets of brushes. For purposes of illustration, the brush sets as shown in the drawing are intended to be spaced so as to function conjointly on alternate levels, such as the first and third levels, second and fourth levels, etc.

The brush 35 passes over the terminals, 46, 55, etc. of the commutator 93 during the primary movement of the switch as will more fully appear. As soon as the secondary movement of the selector switch 91 is initiated the brush 36 is moved away from the commutator 93, so that any circuit therefore established via brush 36 is opened.

The removal of the receiver at substation S causes a line switch (not shown) to seize the selector 91 shown in the drawing, closing a circuit to operate the impulse relay IR as follows: battery, left-hand winding relay IR, 4, 5, 80, substation S, 81, 2, 1, to ground at the right-hand winding of relay IR. The IR relay operated, operates the B relay over an obvious circuit which connects ground by way of 20 and 21 and the lead 79 to the lead 82 to prevent the relay 56 of the preceding switch from releasing in the well-known manner, and to cause the selector 91 to test busy to all other line switches in the group. The selector is now ready to receive the first series of impulses set up by the dial SD at the substation S. The dial SD is operated and released, and as it returns to normal it intermittently opens the circuit of the IR relay, which intermittently releases, and closes the circuit to operate the vertical magnet VM and the relay C as follows: battery, winding of the vertical magnet VM, winding of relay C, 19, 18, 17, 16, 14, 13, to ground. Each time the circuit is opened at the dial SD, the IR relay releases and closes the circuit through the vertical magnet VM and the relay C as previously described. The vertical magnet VM follows the impulses but the C relay, being slow-to-release, remains operated during the impulse period. Each time the vertical magnet VM operates, the

brush rod (not shown) carrying the brushes 30 to 36, inclusive, is raised one step, until when the impulses cease the brushes are raised opposite the terminals of the first trunks in the selected levels. On the first step of the selector rod the insulating cam 50 is raised sufficiently to allow the off-normal contact springs ON to close, thus operating the E relay over the following circuit; battery, relay E, 52, 51, 27, 25, 21, 20, to ground. The E relay operated, locks as follows: 52, 51, 48, 49, 38, 37, 14, 13 to ground. The E relay operated, operates the F relay over an obvious circuit. At the end of the impulse period, relay C releases. Let us assume that the digit dialed was 5, in which case the brushes 30 to 35, inclusive, will now be resting opposite the terminals of the first trunks in the third and fifth levels. The brush 36 will now be resting upon the terminal 46, but as the terminal 46 is not grounded, the circuit through relay Z is not closed. Hence, the selector will hunt simultaneously over the third and fifth levels as hereinafter described. When the C relay releases, a circuit to operate the rotary magnet RM was closed as follows: battery, rotary magnet RM, 29, 28, 26, 25, 21, 20, to ground. The rotary magnet operated, rotates the brush rod (not shown) carrying the brushes 30 to 35, inclusive, to the terminals 40 to 45, inclusive, of the first pair of trunks in the third and fifth levels. Brush 36 is secured to the brush rod in a manner not shown, and, as soon as the brush rod starts to rotate under control of the rotary magnet RM, brush 36 breaks contact with terminal 46. When the rotary magnet RM has completed the stepping of the brushes 40 to 45, inclusive, to the terminals associated with the first pair of trunks, the holding circuit for the E relay is opened by the rotary magnet at 48 and 49 and the E relay releases, opening at 39 and 47 the operating circuit for the F relay, and releasing the rotary magnet RM by opening at 28 and 29 its operating circuit previously described. We will assume that the first pair of trunks in each level is busy, in which case ground will be connected to the terminals 42 and 45 and a circuit will be closed as follows to prevent the F relay from releasing when the operating ground at 39 is removed by the release of relay E: battery, 59, 66, winding of relay F, 77, 76, 10, 11, 32, 42, to ground. When the rotary magnet RM releases, the E relay operates under control of the relay F over a circuit as follows: battery, winding of relay E, 52, 51, 48, 49; 9, 8, 78, 74, 73, 35, 45, to ground. The E relay operated, connects ground at 39 to the relay F, preventing relay F from releasing, and closes the circuit previously described to operate the rotary magnet RM, thus stepping the brushes 30 to 35, inclusive, to the terminals of the second pair of trunks in the third and fifth levels. This cycle of operations continues until an idle trunk is found. Let us assume that the brushes 30 to 35, inclusive, finally come to rest upon the terminals 60 to 65, inclusive, of the trunks 85 and 86, and that trunk 85 is busy, in which case ground supplied from terminal 62 will be connected by way of brush 32 to the winding of the F relay as before, to prevent it from releasing when the E relay releases due to the opening of its holding circuit by the operation of the rotary magnet RM. Assume, however, that the trunk 86 is idle; in that case when the rotary magnet RM releases, the E relay will fail to re-operate because the terminal 65 is free from ground. As long as there was ground on the lead 78, by way of either brush 32 or 35, the D relay which is in series with the E relay, was short circuited at 8 and 9. Hence, relay D remained normal. However, when the brush 35 rests upon the terminal 65, which is free from ground, the short circuit is removed from the winding of relay D, which operates as follows: battery, winding relay E, 52, 51, 48, 49, winding relay D, 79, 21, 20, to ground. Relay E will not operate at this time due to the high resistance of the winding of relay D in series with it. Relay D operated, closes a circuit to hold relay F operated as follows: battery, 59, 66, winding relay F, 77, 76, 10, 12, 79, 21, 20, to ground. Relays D and F operated, extend the line of the substation S to the selector 87 over a circuit as follows: selector 87, terminal 63, 33, 72, 71, 83, 6, 5, 80, 81, 2, 3, 84, 68, 69, 34, 64, to selector 87. Relay 56 is also connected to the terminal 65 as follows: 56, 82, 7, 8, 78, 74, 73, 35, to 65. The D relay operated, opens at 1 and 4 the circuit through the IR relay which releases, in turn releasing the B relay. Meanwhile, the selector 87, of which only a part is shown, functions and connects ground to the terminal 65 to prevent relays 56, D and F from releasing when the B relay releases and to cause the selector 87 to test busy to all other selectors in the group. The dial SD is operated and released, and the selector 87 is connected by way of terminal 94 to the connector 89, of which only a part is shown, thence by way of one of the terminals 92 in the connector multiple, thus extending the calling station S to the called station CS. When the receiver at the substation S is replaced on the switchhook, ground is removed from the terminal 65, thus opening the holding circuit for relay 56 and the D and F relays. The release magnet Rel now operates over a circuit as follows: battery, release magnet Rel, 53, 54, 22, 18, 17, 16, 14, 13, to ground. The brush rod carrying the brushes 30 to 36, inclusive, is restored to normal and with the brush rod in the normal

position, the insulating cam 50 separates the off-normal springs ON, thus opening at 53 and 54 the circuit through the release magnet Rel, restoring the selector switch to normal.

Assume, however, that the selector 88 is not busy at the time the selector 91 is hunting for an idle trunk, then when brushes 30 to 35, inclusive, rest upon the terminals 60 to 65, inclusive, there will not be any ground on terminal 62. Hence, when the relay E releases, relay F will no longer find a holding ground to keep it operated and will accordingly immediately release. When relay F releases, relay D operates because there is no longer a ground connected to lead 78 to short circuit relay D. Relay D will now operate and lock; first under control of relay B, and then under control of ground connected to lead 78 from terminal 62 of selector 88 by way of 74, 75 and 32. Relay F remains normal and the circuit from the substation S is extended to selector 88 as follows: from selector 88, by way of terminal 60, 30, 70, 71, 83, 6, 5, 80, 81, 2, 3, 84, 68, 67, 31, 61, to selector 88. The dial SD is operated and released, and the selector switch 88, and the connector 90, of which only a part are shown, function to extend the calling station S to the called station CS by way of one of the terminals 92 in the multiple bank of the connector 90. When the receiver at the substation S is replaced on the switchhook, ground is removed from terminal 62 and the circuit is restored to normal in the manner previously described.

Assume, however, that instead of dialing digit 5 so that the brush rests upon terminal 46, the digit 0 is dialed so that the brush 36 comes to rest upon the terminal 55 after the vertical magnet VM has stepped the brush rod (not shown) in the manner previously described. The E and F relays will have operated in the manner previously described and upon the release of the C relay, the circuit to operate the rotary magnet RM, also previously described, will be closed. However, when the C relay releases, a new circuit was closed to operate relay Z as follows: battery at armature 24 of relay C, 23, winding relay Z, 36, 55, to ground. The relay Z operated, locks to ground by way of 58, 57, 21, and 20 and opens at 59 and 66 the battery feed to relay F, thus releasing the relay F. Relay Z is first to operate so that the circuit to relay F is opened, and relay F releases before the rotary magnet RM rotates the brushes 30 to 35, inclusive, to the terminals of the first pair of trunks in the eighth and tenth levels. Let us now assume that terminals 40 to 45, inclusive, represent the terminals associated with the first pair of trunks in the eight and tenth levels, and the terminals 60 to 65, inclusive, represent the terminals associated with another pair of trunks in the eighth and tenth levels. Let us also assume that the first trunk in the tenth level is busy, in which case ground will be connected to the terminal 42. The rotary magnet RM will now operate, and rotate the brushes 30 to 35, inclusive, into contact with the terminals 40 to 45, inclusive, and when this movement is concluded the locking circuit through the E relay will be opened at 48 and 49 of the rotary magnet RM, releasing the E relay. When the brush rod rotates, brush 36 breaks contact with terminal 55 of the commutator 93, opening the operating circuit of the Z relay. Relay Z does not release, however, as it is locked by way of 58, 57, 21 and 20, to ground under control of relay B. The E relay released, in turn opens at 28 and 29 the circuit through the rotary magnet RM, which releases. A circuit is now closed to operate relay E as follows: battery, winding relay E, 52, 51, 48, 49, 9, 8, 78, 74, 75, 32, 42, to ground. Relay E operated locks under control of relay D and closes the circuit to operate the rotary magnet RM which rotates the brushes to the terminals of the next pair of trunks in the eighth and tenth levels all of which has been previously described. Since the relay F is normal, the brush 35 is disconnected from the circuit at 73 and 74. Hence, the busy or idle condition of trunks on the eighth level will not affect the trunk hunting in any way. Again, since the relay F is normal, the brushes 33 and 34 are disconnected from the circuit at 72 and 69, respectively. Hence, in passing over the terminals of busy trunks, the selector 91 will not in any way affect connections which have previously been established upon the busy trunks in question. The cycle of operations continues until an idle trunk is found in the tenth level, which we will assume to be the selector 88, in which case terminal 62 will be free from ground. Hence, when the rotary magnet RM releases, the E relay will not re-operate, but the D relay will now function in the manner previously described. When the B relay releases as previously described the Z relay will hold by way of 58, 57, 79, 7, 8, 78, 74, 75, 32, 62, to ground. From this point on, the circuit will function to extend the station S by way of selector 88, the terminal 95, and the connector 90 to the called station CS, and disconnection will take place, all of which has been previously described.

It is obvious that the connections at the vertical commutator 93 may be arranged as desired and the various terminals grounded or insulated depending upon whether a particular level is intended to constitute a ten-trunk group or is to be associated with some other level as a part of a twenty-trunk group.

It should be understood that while for purposes of illustration the invention has been shown applied to a simple selector circuit, it is not so limited but may be applied to more complicated circuit arrangements including a selector arranged for eleventh rotary step operation, or even to a connector circuit, if desired. Switches arranged for eleventh rotary step operation are well-known in the art and a switch of this type is shown in "Automatic Telephony" by Smith and Campbell (Second Edition) Fig. 63, and its operation is more fully described therein at pages 63 and 65.

While for purposes of illustration, the Z relay has been used for controlling the operation of the F relay, it is obvious that the circuit of the F relay could be controlled directly from contact springs and cams upon the brush shaft of the selector, as shown in Fig. 2, without departing from the spirit of the invention.

What is claimed is:

1. A switch comprising a plurality of sets of brushes and rows of terminals, there being one test brush in each set of brushes, and means for rendering all test brushes effective on certain terminal rows and a lesser number effective on other rows.

2. A switch comprising two sets of brushes and rows of terminals, each set of brushes including a test brush, and means for rendering both test brushes effective on certain terminal levels and only one brush effective on other levels.

3. A selector switch comprising a pair of brushes and rows of terminals, and means operated by the brush shaft for rendering both brushes effective on certain terminal levels during trunk hunting and only one brush effective on other levels.

4. A selector switch comprising a pair of brushes and rows of terminals, and a relay controlled by the brush shaft for rendering both brushes effective on certain terminal levels during trunk hunting and only one brush effective on other levels.

5. In a telephone system, a telephone line, an impulse sender for said line, automatic switching mechanism controlled thereby, means for associating said mechanism with said line, trunks terminating in rows in said switching mechanism and adapted to be selected thereby, and means determined by the setting of said mechanism by said sender for determining whether said mechanism shall test for an idle trunk in one row or simultaneously for an idle trunk in a plurality of equivalent rows.

6. In a telephone system, telephone lines, automatic switches comprising groups in a train of switches for interconnecting the same, the switches in one or more groups accessible to any switch in the preceding group over a pair of levels in the switch of the preceding group, each switch in the preceding group having a pair of brush sets, and means in each switch of the preceding group for causing it to test the switches accessible to it in pairs on certain levels and singly on other levels and to seize an idle one.

7. A selector switch having both a group selecting and a trunk hunting movement, characterized in this that means is provided which is dependent upon the trunk group selected for causing the switch to trunk hunt either on a plurality of equivalent trunk levels simultaneously or on one trunk level only.

8. A selector switch having a trunk hunting movement comprising a plurality of rows of trunks divided into trunk groups, there being one or more rows allotted to a group, characterized in this that means is provided which is dependent upon the number of rows of trunks in the group for causing the switch to trunk hunt over one trunk row individually or over a plurality of trunk rows simultaneously.

9. A selector switch capable of trunk hunting, means for causing said switch to trunk hunt over one group of trunks individually or over a plurality of equivalent trunk groups simultaneously, and means for causing said switch to seize the first idle trunk found.

10. A selector switch having a trunk hunting movement, means dependent upon the trunk group selected for causing said switch to trunk hunt over one group of trunks individually or over a plurality of equivalent trunk groups simultaneously, means effective during trunk hunting for preventing interference with connections previously established, and means for seizing the first idle trunk found.

11. A selector switch having a trunk hunting movement, means dependent upon the trunk group selected for causing said switch to trunk hunt over one group of trunks individually or over a plurality of equivalent trunk groups simultaneously, means for causing said switch to seize the first idle trunk found and means for preventing interference with those trunks not seized before which the switch is then positioned.

12. A selector switch having a trunk hunting movement, means dependent upon the trunk group selected for causing said switch to hunt over one group of trunks individually or over a plurality of equivalent trunk groups simultaneously, means effective during trunk hunting for preventing interference with those connections previously established, means for causing said switch to seize the first idle trunk found, and means for preventing any interference with the trunks not seized before which the switch is then positioned.

13. A selector switch having both a group selecting and a trunk hunting movement which is provided with means dependent upon the trunk group selected for causing the switch to trunk hunt either on two equivalent trunk levels simultaneously or on one trunk level only.

14. A selector switch having a trunk hunting movement comprising a plurality of rows of trunks divided into trunk groups, there being either one or two rows allotted to a group, which is provided with means dependent upon the number of rows of trunks in the group for causing the switch to trunk hunt over one trunk row individually or over two trunk rows simultaneously.

In testimony whereof, I have signed my name to this specification this 22nd day of October 1923.

EDMUND LAND.