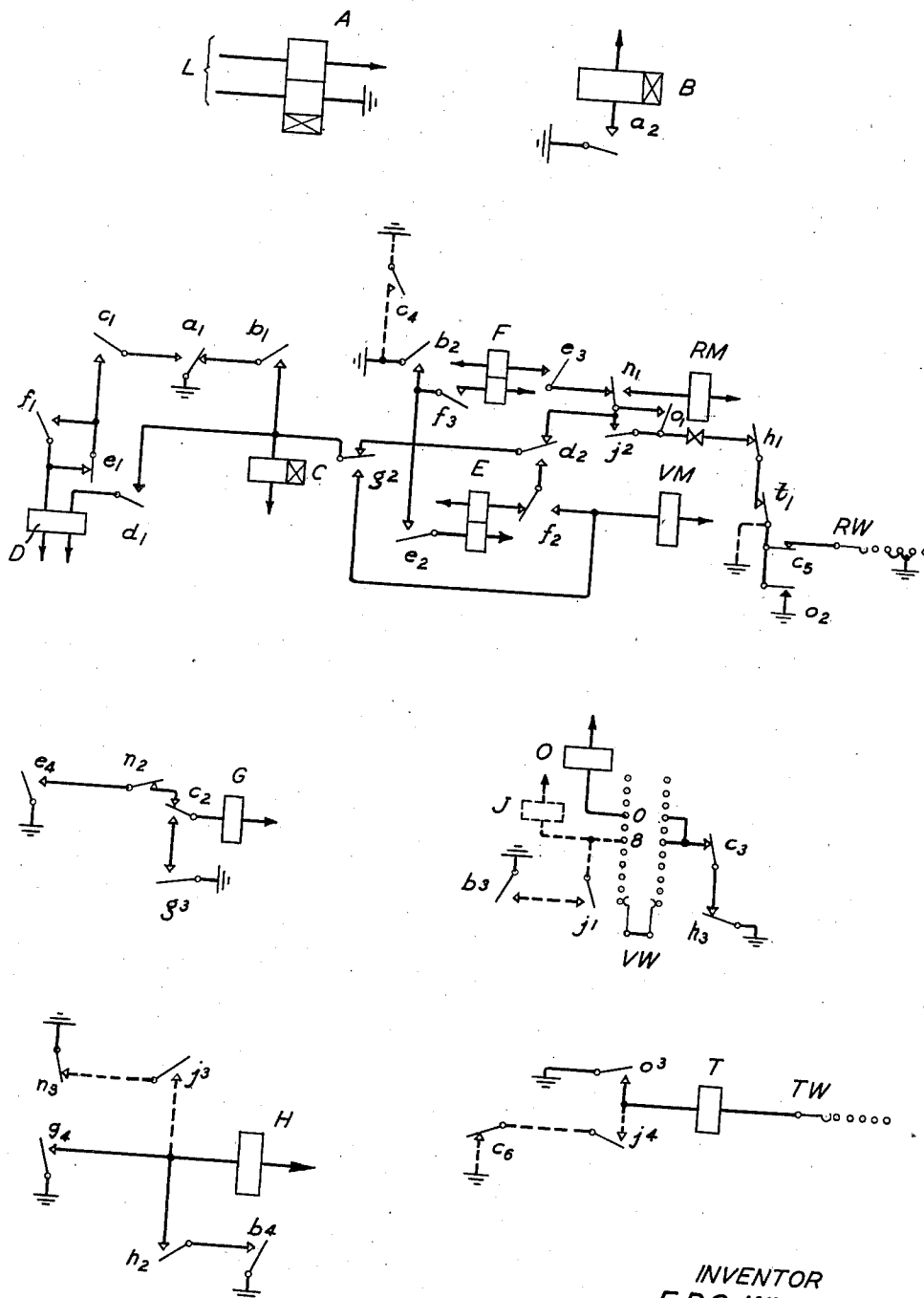


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SELECTIVE SWITCH

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SELECTIVE SWITCH

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This invention relates to selective switching mechanism and particularly to switches of the two-motion step-by-step type common in automatic telephone systems.

It is the object of the invention to increase the adaptability and efficiency of two-motion switches known as the square type, that is switches in which the brushes in their selecting and resetting movements describe a closed rectangle.

In two-motion selector switches of the type in which the brushes retrace their selective movement to reach normal position, it is usual to absorb a directive set of operating impulses by releasing the shaft and return of the brushes to normal position immediately after the directive movement which is to be absorbed and before another train of directive impulses is received. In case certain but not all directive digits are to be absorbed, the release of the brushes is effected by the closure of shaft-operated springs in response to these certain digits or by means of an additional brush and associated contacts. These known methods of digit-absorption and discrimination cannot effectively be applied to the square type of selector switch in which the release time may exceed the interval between succeeding trains of directive impulses.

According to this invention the absorption of a directive train of impulses is effected in a two-motion switch by the storing of a part of the impulses of a digit train on relays, the remaining impulses in the train being effective to advance the brushes of the selector. In the case of impulse trains comprising less than a predetermined number of impulses, the absorption is effected without moving the brushes from normal, some of the impulses of the next train of impulses being absorbed and the succeeding impulses being effective to advance the brushes in a selective movement. Following a primary selective movement, the switch may be advanced either by a selective secondary movement in response to another train of impulses or by an automatic secondary movement to hunt for an idle set of terminals.

A feature of the invention is the absorption of the initial impulses of a second digit to extend the interval between digits artificially while the brushes are being returned to normal, only the succeeding impulses of the second digit being effective to selectively position the brushes of the switch.

Further explanation of the invention will be made by describing one embodiment of the invention which is shown schematically in the drawing which forms a part of this specification.

The invention is, of course, not limited to the specific arrangement and structure disclosed but is in general applicable to any selective switch to effect a desired digit absorbing operation.

The drawing shows schematically a two-motion square-type selective switch comprising an impulse receiving relay A, a vertical stepping magnet VM, a rotary stepping magnet RM, the brushes RW, TW and VW, and the associated control relays and circuit connections.

In the drawing, capital letters are used as the reference characters for the relays and magnets and corresponding lower case letters with numerical subscripts are used as the reference characters for the contact springs. Relay J and the associated broken line connections may or may not be provided depending upon the desired operation of the switch. When relay J is not provided the contact spring b2 is connected to ground and contact t1 is connected to contact c5 as shown by the solid line connections. But when relay J is provided contact spring b2 is connected to the front contact of spring c4 instead of being connected directly to ground, and contact spring t1 is connected directly to ground.

The operation of the selector switch shown in the drawing will first be described assuming that relay J is not provided. Upon seizure of the selector switch and closure of the control circuit over the conductors of line L, relay A operates, closing at contact a2 a circuit for operating the release relay B. Relay A thereafter responds to the digit impulses transmitted over line L. Relay B, being slow in releasing, remains operated during the response of relay A to the impulses. The release of relay A, in response to the first impulse, closes a circuit through the back contact of spring a1 and contact b1 for operating relay C; and relay C, being slow in releasing, remains operated until all of the impulses in the train have been received. The reoperation of relay A, at the end of the first impulse, closes a circuit through the front contact of spring a1 and contacts c1 and e1 for energizing the left winding of relay D. The release of relay A in response to the second impulse of the train closes a circuit through the back contact of spring a1, contacts b1 and d1, and the right winding of relay D for holding relay D operated; and closes a circuit through the back contact of spring a1, contact b1, the back contact of spring g2, front contact of spring d2, back contact of spring f2, and the upper winding of relay E for operating relay E. Relay E opens at contact e1 the circuit through the left winding of relay D so that, upon the opening of the circuit through

the right winding of relay D when relay A reoperates at the end of the second impulse, relay D releases. Relay E is held operated by a circuit through its lower winding and contacts *c2* and *b2*. The release of relay A in response to the third impulse of the train closes a circuit through the back contact of spring *a1*, contact *b1*, back contacts of springs *g2* and *d2*, the back contact of the off-normal spring *n1*, contact *e3* and the upper winding of relay F for operating relay F. Relay F closes a locking circuit through its lower winding and contacts *f3* and *b2*. The reoperation of relay A at the end of the third impulse closes a circuit through the front contact of spring *a1*, contacts *c1* and *f1*, and left winding of relay D, for reoperating relay D. If the first train of impulses consists of only two or three impulses, no movement of the switch results; and the release of relay C, when relay A reoperates at the end of the last impulse, closes a circuit through the back contact of spring *c2*, the normally-closed contact *n2* of the off-normal springs of the switch, and contact *e4*, for operating relay G. Relay G closes at contact *g4* a circuit for operating relay H; and relay H locks through contacts *h2* and *b4*. With relay G operated, the second train of impulses incoming over line L is effective to cause the operation of the vertical magnet VM and advance the brushes RW, VW and TW, and other brushes not shown in the drawing, one step for each impulse to the level of the terminal bank which corresponds to the number of impulses in the train. The circuit for operating magnet VM is traced from the back contact of spring *a1*, through contact *b1* and the front contact of spring *g2*. During response to these impulses, relay G is held operated through contacts *c2* and *g3*. When relay C releases at the end of the second train of impulses, relay G also releases; but relay H remains operated so that, if the second digit is zero, the circuit for operating relay O is open at contact *h3*. The third train of directive impulses incoming over line L is then effective to cause the operation of the rotary-stepping magnet RM and advance of the brushes to a corresponding set of contacts in the selected level of the terminal bank. The circuit for operating magnet RM is traced from the back contact of spring *a1*, through contact *b1*, back contacts of springs *g2* and *d2*, and the front contact of off-normal spring *n1*.

If a preliminary single impulse is received it is absorbed without affecting the subsequent operation of the switch. The release of relay A in response to this impulse causes the operation of relay C and when relay A reoperates relay D is operated; but since relay C releases before the first directive train of impulses is received, relay D also releases leaving the switch ready, as before, to respond to the first directive digit.

If the first train of impulses consists of more than three impulses, the release of relay A in response to the fourth and all succeeding impulses of the digit closes a circuit through the back contact of spring *a1*, contact *b1*, back contact of spring *g2*, front contact of springs *d2* and *f2* and winding of the vertical-stepping magnet VM, the operation of magnet VM in response to each of these impulses being effective to raise the brushes of the switch one step for each impulse. Relay D remains operated, during the response of relay A and magnet VM, since its left winding is energized each time the front contact of spring *a1* closes and its right winding is energized each time the back contact of spring *a1* closes. When relay A remains energized after receiving the last impulse of the digit, relay C releases thereby causing the release of relay D. Relay G does not operate since contact *n2* of the off-normal springs is opened when the switch moves out of normal position in response to the fourth impulse. The brushes of the switch are, therefore, raised to a level corresponding to the first directive digit, the number of the level being three less than the number of impulses in the train. That is, if the first directive digit is 4, the brushes are stepped up to the first level of the terminal bank; and if the first directive digit is 5, 6, 7, 8, 9 or 0, the brushes are stepped up to level 2, 3, 4, 5, 6 or 7. If the brushes are stepped up to any one of levels 1, 2, 3, 4, 5 or 6, the response of relay A to the next train of directive impulses received over line L is effective to operate the rotary-stepping magnet RM and thereby rotate the brushes of the switch into engagement with the terminals in the selected level and to select the set of terminals corresponding to the number of impulses in the second directive train. If, however, the first directive digit is 0, relay O is operated when relay C releases, the circuit for operating relay O being traced through brushes VW and seventh off-normal terminals of the associated vertical bank, and through contacts *c3* and *h3*. Relay O closes a circuit for operating the rotary-stepping magnet RM to advance the brushes into engagement with the first and succeeding sets of terminals in the seventh level of the terminal bank. This circuit is traced through the front contact of off-normal spring *n1*, contact *o1*, the interrupter contacts of magnet RM, and through contacts *h1*, *t1* and *o2*. At contact *o3*, a test connection is closed through the winding of the test relay T and test wiper TW so that, as soon as the wiper TW encounters an idle set of terminals, relay T operates. At contact *t1*, relay T opens the circuit for operating magnet RM so as to stop the brushes of the switch on the first idle set of terminals in the level.

If now it is desired that the switch be arranged to return to normal if a particular digit such as 8 is dialed, relay J is provided, its winding being connected to terminal 5 of the vertical bank. In this case contact spring *b2* is connected to the front contact of spring *c4* instead of being connected directly to ground, and contact spring *t1* is connected directly to ground. Other added contacts and wiring are indicated by the broken lines. If the first digit is 2 or 3, no movement of the switch results, relays A, C, D, E and F being operated as hereinbefore described. When relay C releases, relays E and F also release so that a train of more than three impulses must be received before vertical movement of the switch results. As soon as a train of more than three impulses is received by relay A, the vertical magnet VM is operated by the fourth and all succeeding impulses in the train to raise the brushes up to one of levels 1 to 7 depending upon the number of impulses in the train. If, in response to a train of impulses, the brushes are raised to one of levels 1, 2, 3, 4 or 5, the response of relay A to the next train of impulses is effective to operate magnet RM and rotate the brushes into engagement with the desired set of terminals in the selected level as hereinbefore described. If the brushes are raised to level 7 in response to a train of ten impulses, the operation of relay O causes the switch to hunt for an idle set of terminals in level 7 as hereinbefore described. If the brushes are raised to level 5 in response to a train of eight impulses, relay J operates when relay C releases,

the circuit for operating relay J being traced through brushes VW and fifth off-normal vertical back contacts, contact c3 and contact h3. Relay J locks through contacts j1 and b3. Rotary magnet RM is now automatically operated in a circuit through the front contact of off-normal spring n1, contact j2, interrupter contacts of magnet RM, and through contacts h1 and t1 to ground. The brushes are advanced by magnet RM to the eleventh rotary position of level 8 and then drop to the normal level. When the shaft reaches normal, the circuit for operating magnet RM is opened at the off-normal spring n1; and the closure of off-normal contact n3 completes a circuit, which includes contact j3, for operating relay H. Relay H locks through contacts h2 and b4. The next train of impulses consisting of more than three impulses is effective to select one of the vertical levels 1 to 7, inclusive, as hereinbefore described. The first three impulses of the digit are absorbed so that there is ample time for the switch to be returned to normal before the fourth impulse is received and the switch begins its vertical movement. And the next succeeding train of impulses received by relay A effects the operation of rotary-stepping magnet RM and advance of the brushes to a desired set of terminals in the selected level.

If, instead of absorbing the digit 8, it is desired that there be both selective and hunting movements on level 5, relay J is provided but contact spring t1 is not connected to ground. In this case brush RW is used to effect the advance of the brushes over any selected group of terminals in level 5 until an idle set of terminals is engaged or the last set of terminals in the group is reached. When relay J operates, magnet RM is connected through contacts n1, j2, interrupter contacts of magnet RM, contacts h1, t1 and c5 to brush RW; but, the normal terminal being free of ground potential, magnet RM is not operated until relay A responds to the next set of digit impulses. The operation of magnet RM in response to these impulses advances the brushes to the first terminal of the desired group in level 5; whereupon, when relay C releases, magnet RM is operated through brush RW and the grounded terminals of the group. Relay J being operated the test circuit through relay T and brush TW is closed at contact j4 so that relay T operates as soon as an idle set of terminals is reached. If the brushes are advanced to the last set of terminals in the selected group, magnet RM cannot again reoperate since brush RW finds no ground potential on the last terminal of a group.

Other variations and modifications of the switch may be made without departing from the spirit of the invention.

What is claimed is:

1. In an automatic telephone system, a selector switch comprising a set of brushes, a bank of terminals, and a stepping magnet for advancing the brushes, an impulse relay associated with said switch for receiving directive impulses from subscribers' impulse senders, circuit means controlled by said relay in response to a train of more than a certain number of impulses from a subscriber's impulse sender for absorbing said certain number of the impulses without movement of the brushes and for operating said magnet in response to the succeeding impulses of the train to effect a desired selective movement of the brushes.

2. In a combination according to claim 1, circuit means rendered effective after receipt of a first train of impulses by said impulse relay for preventing the absorption of any impulse of the next train received by said impulse relay.

3. In combination, a selector switch comprising a vertical-stepping magnet, a rotary-stepping magnet, a set of brushes and an associated bank of terminals, an impulse relay responsive to directive impulses, circuit means controlled by said impulse relay for absorbing one or more impulses of a train received by said impulse relay without movement of the switch out of normal position and effective in response to succeeding impulses in the same train for causing the operation of said vertical-stepping magnet to select a desired level of the terminal bank, and circuit means including said rotary-stepping magnet effective in response to the next succeeding train of impulses received by said impulse relay to select a desired set of terminals in the selected level.

4. In combination, a selector switch comprising a stepping magnet, a set of brushes and an associated bank of terminals, an impulse relay responsive to directive impulses, circuit means controlled by said impulse relay for absorbing a first train of impulses of not more than a predetermined number of like directive impulses without movement of the brushes of the switch and for absorbing said predetermined number of impulses of a train consisting of more than said predetermined number of like directive impulses and for causing the operation of said vertical-stepping magnet in response to the succeeding impulses in the train, and circuit means effective if no movement of the switch results from the first train of impulses received by said impulse relay for causing the operation of said vertical-stepping magnet in response to the next succeeding train of impulses received by said impulse relay.

5. In combination, a selector switch comprising a vertical-stepping magnet, a rotary-stepping magnet, a set of brushes and an associated bank of terminals, an impulse relay responsive to directive impulses, circuit means controlled by said impulse relay for absorbing a first train of impulses of not more than a predetermined number of impulses without movement of the brushes of the switch and for absorbing said predetermined number of impulses of a train consisting of more than said predetermined number of impulses and for causing the operation of said vertical-stepping magnet in response to the succeeding impulses in the train, circuit means effective if no movement of the switch results from the first train of impulses received by said impulse relay for causing the operation of said vertical-stepping magnet in response to the second succeeding train of impulses received by said impulse relay, and circuit means effective in response to the first train of impulses received by said impulse relay following a vertical movement of the brushes for causing the operation of said rotary-stepping magnet.

6. In a combination according to claim 5, circuit means effective if the level selected by the vertical movement of the switch is a particular level for rendering the rotary-stepping magnet automatically operative to advance the brushes to hunt for an idle set of terminals in the selected level.

7. In a combination according to claim 5, circuit means effective following a directive rotary

movement of the brushes for automatically operating said rotary-stepping magnet to advance the brushes to hunt for an idle set of terminals in the selected group of terminals.

- 5 8. In combination, a selector switch comprising a vertical-stepping magnet, a rotary-stepping magnet, a set of brushes and a bank of terminals, an impulse relay responsive to directive impulses, circuit means including said vertical-stepping magnet for advancing the brushes in response to a train of impulses received by said impulse relay, circuit means including said rotary-stepping magnet for thereupon advancing the brushes automatically beyond the last set of terminals in the selected level to cause the return of the brushes to normal position, and circuit means for absorbing a predetermined number of the impulses of the next train received by said impulse relay and for causing the operation of said vertical-stepping magnet in response to the succeeding impulses of the train to select a desired level of the terminal bank.
9. In combination, a selector switch comprising a vertical-stepping magnet, a rotary-stepping magnet, a set of brushes and a bank of terminals, an impulse relay responsive to directive impulses, circuit means for absorbing a predetermined number of impulses of a train received by said impulse relay without movement of the brushes of the switch, circuit means including said vertical-stepping magnet for raising the brushes step by step in response to a train of impulses received by said impulse relay and consisting of more than said predetermined number of impulses, circuit means including said rotary-stepping magnet rendered effective if the brushes are stepped up to one particular level for automatically advancing the brushes in the level to hunt for an idle set of terminals, circuit means including said rotary-stepping magnet rendered effective if the brushes are stepped up to another particular level for selectively advancing the brushes in response to the next train of impulses received by said impulse relay, circuit means including said rotary-stepping magnet rendered effective if the brushes are stepped up to a certain level for automatically advancing the brushes beyond the last set of terminals in the level to return the brushes to normal, said circuit means for absorbing a predetermined number of impulses being again effective after return of the switch is initiated to allow time for the brushes to reach normal position before the vertical-stepping magnet is again operated.
10. In a selector switch having a primary mag-

net for advancing the brushes in a primary movement and a secondary magnet for advancing the brushes in a secondary movement, an impulse relay for responding to directive impulses, circuit means for absorbing a certain number of impulses without movement of the brushes and for rendering said primary magnet responsive to succeeding impulses, and circuit means including said secondary magnet rendered effective by a primary movement of the brushes for advancing the brushes to normal, said circuit means for absorbing impulses being effective in response to said certain number of impulses of the next succeeding train of more than said certain number to again render said primary magnet responsive to the impulses of the train in excess of said certain number.

11. In a selector switch according to claim 10, circuit means for preventing a second advance and return of said brushes to normal in response to a primary movement of the brushes.

12. In a selector switch comprising a vertical-stepping magnet, a rotary-stepping magnet, a set of brushes and a bank of terminals, an impulse relay responsive to directive impulses, circuit means for absorbing trains of impulses of not more than a certain number of impulses and for absorbing said certain number of impulses of a train consisting of more than said certain number, circuit means including said vertical-stepping magnet for selectively responding to the impulses of a train in excess of said certain number to select any one of a plurality of levels of said bank, circuit means including said rotary-stepping magnet effective upon selection of a first certain level of the bank to advance the brushes to select an idle set of terminals in said first certain level, circuit means including said rotary-stepping magnet effective upon selection of a second certain level of the bank to advance the brushes in response to the next succeeding train of impulses to select a desired set of terminals in said second certain level, and circuit means including said rotary-stepping magnet effective upon selection of a third certain level of the bank to automatically advance the brushes in said level to return said brushes to normal, said circuit means for selecting a level of the bank being responsive to the first train of impulses of more than said certain number following said return to normal and said circuit means for selecting a desired set of terminals being responsive to the next train of impulses following selection of a level.

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