C. A. SHORT & H. C. DUNNING.

PERMUTATION SWITCH.

APPLICATION FILED JUNE 2, 1913. RENEWED DEC. 2, 1916.

1,233,133. Patented July 10, 1917.

3 SHEETS—SHEET 1.

Fig. 1.

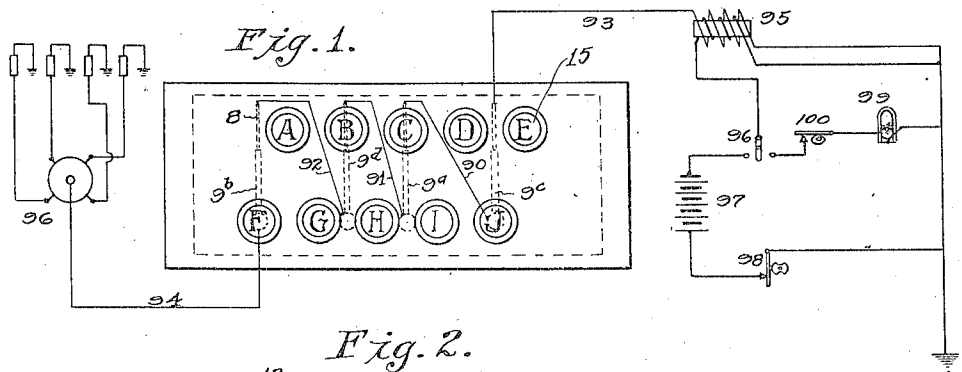


Fig. 2.

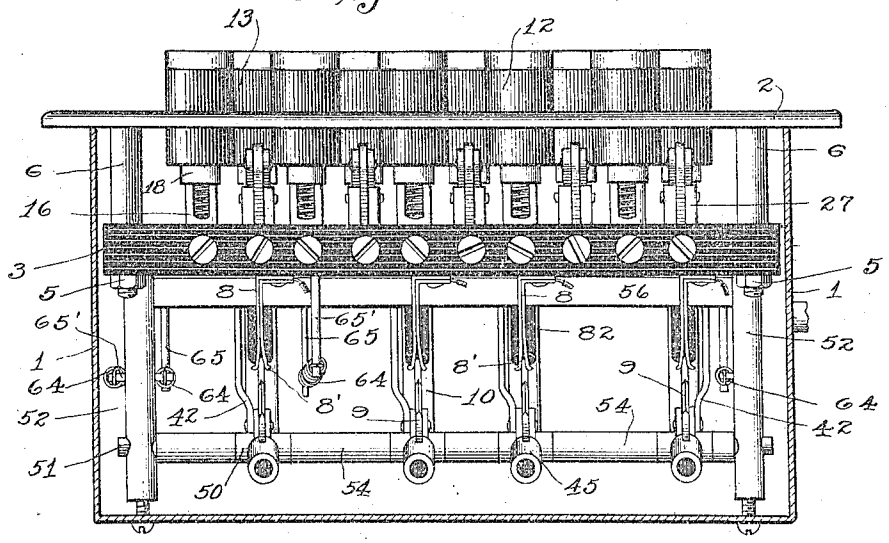
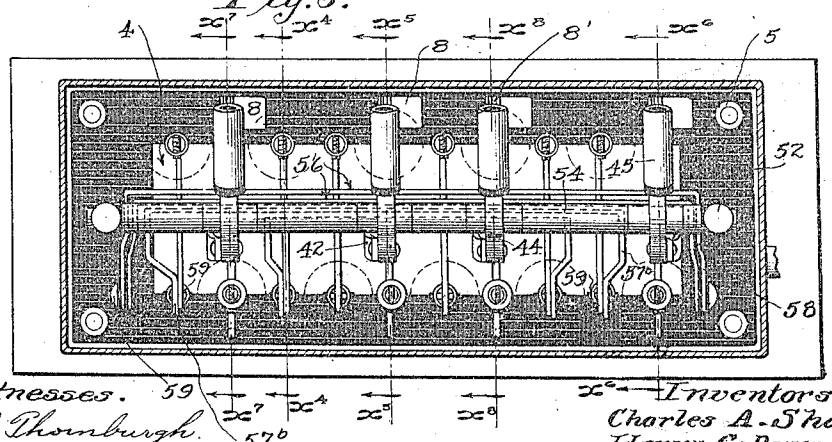


Fig. 3.



Witnesses.
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3 SHEETS—SHEET 2.

Fig. 4.

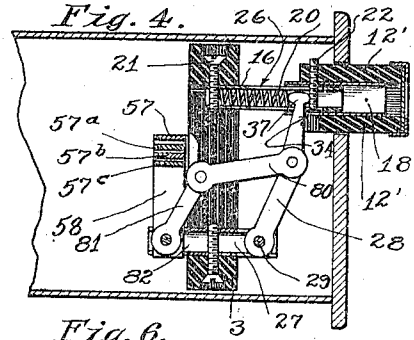


Fig. 5.

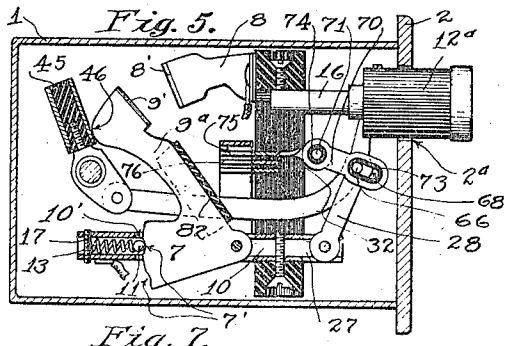


Fig. 6.

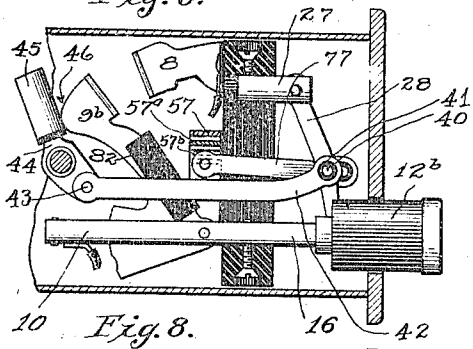


Fig. 7.

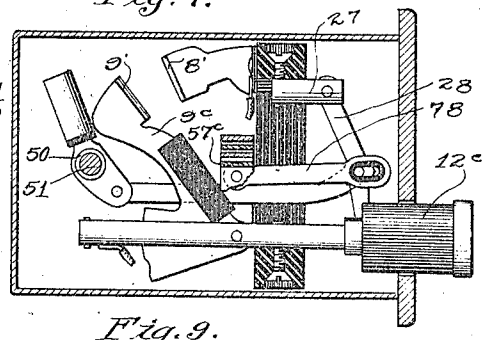


Fig. 8.

Fig. 9.

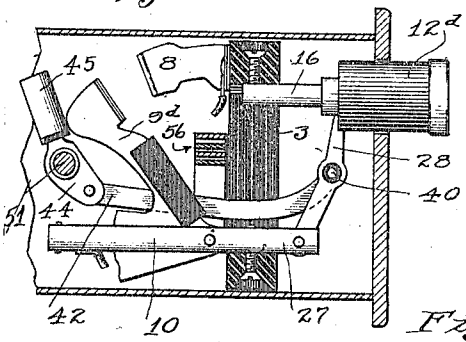
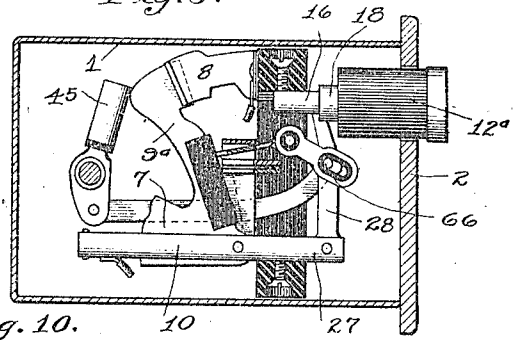
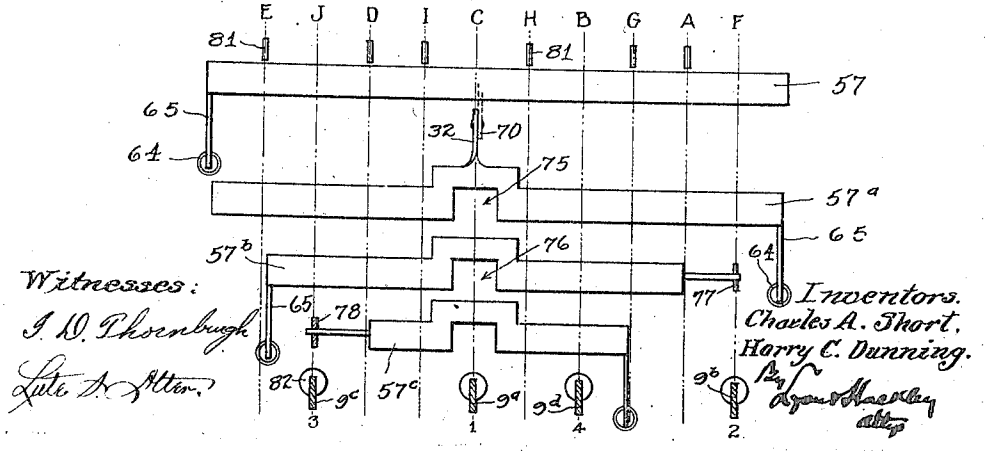


Fig. 10.





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PERMUTATION SWITCH.

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3 SHEETS—SHEET 3.

Fig. 11.

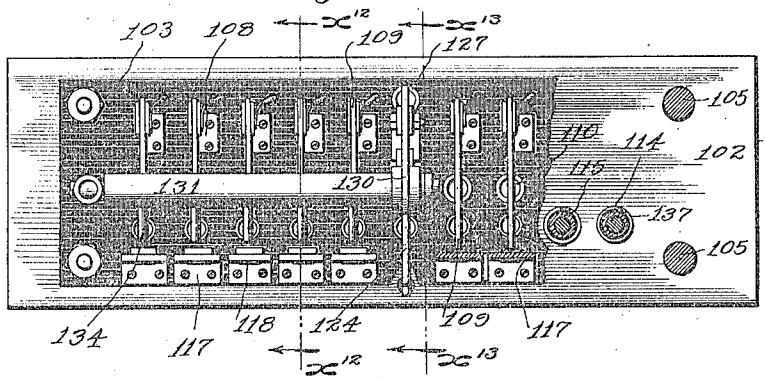


Fig. 12.

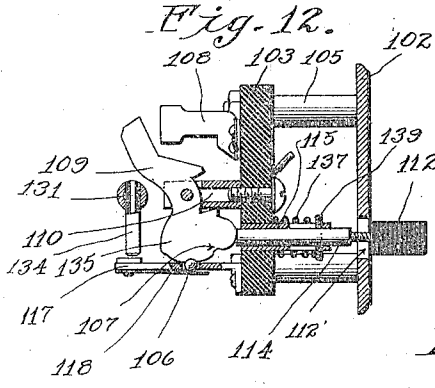


Fig. 13.

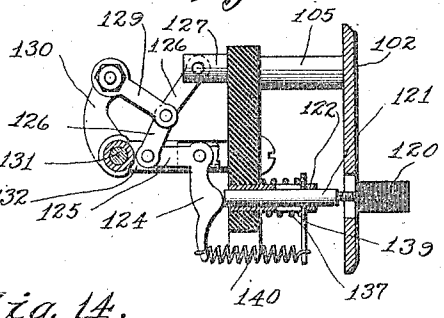
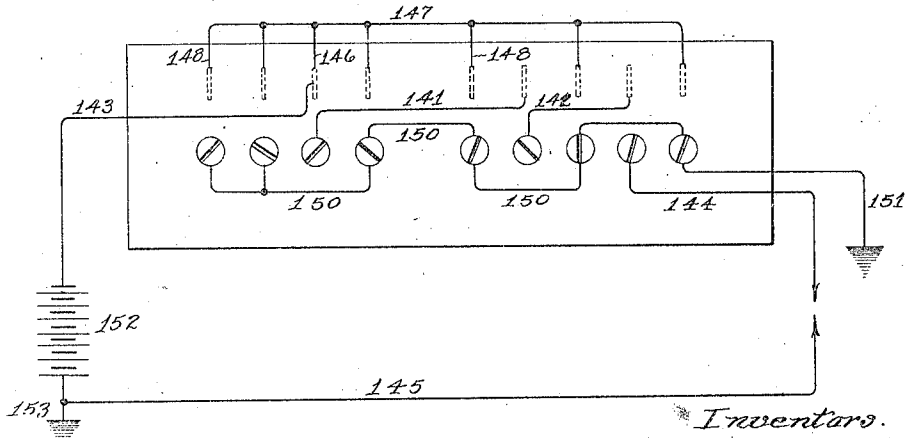


Fig. 14.



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UNITED STATES PATENT OFFICE.

CHARLES A. SHORT AND HARRY C. DUNNING, OF LOS ANGELES, CALIFORNIA, ASSIGNORS TO AUTO PROTECTION COMPANY, OF LOS ANGELES, CALIFORNIA.

PERMUTATION-SWITCH.

1,233,133. Specification of Letters Patent. Patented July 10, 1917.

Application filed June 2, 1913, Serial No. 771,326. Renewed December 2, 1916. Serial No. 134,741.

To all whom it may concern:

Be it known that we, CHARLES A. SHORT and HARRY C. DUNNING, citizens of the United States, residing at Los Angeles, in the county of Los Angeles and State of California, have invented a new and useful Permutation-Switch, of which the following is a specification.

This invention relates to switches for electric circuits which it is desired to control in such manner as to prevent operation thereof by unauthorized persons. The invention is particularly designed for use in connection with the sparking circuit of an automobile, so as to prevent operation of the automobile except by the owner or other party having the right to such operation, but it is applicable also to any circuit where the use or operation of the circuit is to be safeguarded as stated.

One object of the present invention is to provide permutative controlling means for the switch which will dispense with the necessity of the chauffeur or owner carrying a key for the switch and which will control the switch by a permutative sequence of operations to be performed on a set or series of controlling devices.

Another object of the invention is to provide a switch of the above stated character in which the controlling operations consists of selective operation of push buttons so as to provide for convenience and quickness of operation.

Other objects of the invention will appear hereinafter.

The accompanying drawings illustrate embodiments of our invention, and referring thereto:

Figure 1 is a front elevation of the switch showing diagrammatically the circuit connections for controlling the sparking circuit of an internal combustion engine by means of such switch.

Fig. 2 is a plan of the switch.

Fig. 3 is a rear elevation of the switch.

Fig. 4 is a transverse section on line x^4—x^4 in Fig. 3, showing one of the dummies.

Fig. 5 is a section on line x^5—x^5 in Fig. 3, showing the operating device for the first operation in the permutation.

Fig. 6 is a transverse section on line x^6—x^6 in Fig. 3, showing the second operating device for a permutation.

Fig. 7 is a section on line x^7—x^7 in Fig. 3, showing the third operating device for a permutation.

Fig. 8 is a section on line x^8—x^8 in Fig. 3, showing the fourth operating device for a permutation.

Fig. 9 is a transverse section showing the same parts as shown in Fig. 5, said parts being in normal position in Fig. 5, and in operated position in Fig. 9.

Fig. 10 is a diagrammatic elevation of the restoring bars, showing the relation thereof to the operating arms.

Fig. 11 is a front elevation of a modified form of the invention with parts broken away.

Fig. 12 is a section on line x^{12}—x^{12} in Fig. 11.

Fig. 13 is a section on line x^{13}—x^{13} in Fig. 11.

Fig. 14 is a diagram showing the circuit connections for the form of the invention shown in Figs. 11 to 13.

The switch constituting the present invention may be mounted in a suitable case adapted to be supported in convenient position, for example, on the dashboard of an automobile, said case comprising a back member 1 adapted to be inset into the dashboard and a front plate 2 adapted to be removably attached to the dashboard to serve as a cover for the case, the switch parts being attached to the front plate so as to be removable therewith. The switch parts are mounted on an insulating member 3 formed, for example, as a plate of suitable insulating material having a longitudinal slot 4 therein, said plate being attached by bolts 5 to spacer posts 6 extending rearwardly from the front plate 2. A series of switches are supported on the plate 3, each switch comprising a fixed contact member 8 secured to the plate 3 and a movable contact arm or member 9^a, 9^b, 9^c or 9^d pivotally mounted on a post 10 secured to plate 3, said movable contact member having switch blade portion 9′ adapted to enter between contact portions 8′ of the contact member 8 when said movable switch member is depressed. Said post 10 is preferably tubular and is slotted as at 10′ to receive and guide a flat shank 7 for arm 9, and a ball 11 in the tubular post is pressed against the outer edge of said shank by a spring 13 held within the tube by a screw

17. Said shank 7 has notches 7′ into which said ball 11 rolls to hold the switch arm 9^a, etc., in either open or closed position.

Push buttons are provided for controlling the operation of said switches, the number of said push buttons being greater than the number of said switches, so that in order to operate the switches it is necessary to select for operation, certain of said push buttons indicated at 12^a, 12^b, 12^c, 12^d, and to operate the same in a certain order, the other buttons indicated at 12′ being simply dummy buttons. Said push buttons pass through openings 2^a in the front plate 2 and are provided at their outer ends with head portions of insulating material suitably marked, as by letters indicated at 15. For the sake of compactness, the push buttons 12^a, etc., and 12′ are preferably arranged in a plurality of rows, for example, two rows extending longitudinally at opposite sides of the slot 4 in the plate 3. Each push button is provided with a metal sleeve 18 slidably mounted on a post 16 and is normally held in outermost position by means of a spring 20 extending within the post 16 and pressing at one end against a fixed cross pin or screw 21 and at the other end against a lever head 37 which bears against a cross pin or screw 22 which is secured to the push button. The cross pin or screw 21 also serves for securing the post 16 in the insulating plate 3 and the cross pin or screw 22 may serve as a convenient means for attaching the insulated head 12 of the push button to the metal sleeve 18, said post 16 being slotted as at 26 to receive the pin or screw 22, which slides in said slot.

Each of the switch push buttons is connected to a lever 28 which is pivotally mounted at 29 on bearing posts 27 on the plate 3, the outer end of said lever 28 extending through a slot 34 in the sleeve 18 of the push button and through slot 26 in the guide post 16 therefor, and being provided with a head 37 extending between the spring 20 and pin or screw 22 aforesaid. The head 37 is rounded so as to always present a central bearing against the spring and pin, directly in line with the axis of the button. For compactness in construction, the push buttons 12 and 13 are staggered, alternate levers 28 being pivoted at opposite sides of the slot 4 in plate 3, and each lever 28 extending across the slot 4 to engage a push button on the other side. The switch posts 10 may for convenience be formed as continuations of certain of the posts 16, or as continuations of certain of the posts 27, as shown in Fig. 5, when the posts happen to be in alinement, as shown in Fig. 6.

The construction of the push buttons and of the levers 28 connected thereto being substantially uniform, any two or more of push buttons may be selected for the permutative control of the switches. In the present case, four switch devices are shown and four of the push buttons are connected to operate the respective switch devices. The lever 28 for each of such operating push buttons is connected by a pivot 40 insulated from said lever by insulating bushings 41 to a link or bar 42 which is pivotally connected at 43 to one arm of a depressing lever 44 whose other arm carries an insulated sleeve or member 45 adapted to engage a rounded face 46 on the corresponding switch arm 9^a, 9^b, 9^c or 9^d. When the push button 12 is pushed in, the depressing lever 44 will be operated to bring the insulated sleeve 45 thereon into contact with the face 46 on the switch lever and press such switch lever into position to close contact with switch member 8. The push buttons or keys for operation of the switches may be selected from either row of push buttons. Thus in the present case two have been selected from the upper row and two from the lower row. The several depressing levers 44 are carried by sleeves or hubs 50 rotatably mounted on a rod or shaft 51, supported on posts 52 on the plate 3, said sleeves 50 being separated by spacing sleeves 54, this construction permitting of shifting of the depressing levers when it is desired to change the permutation.

In order to prevent the switch from being effectively operated except by pressing the keys or buttons in proper order, means are provided for throwing out or open circuiting any key on operation of a button out of the proper sequence. Said means, consist, for example, of a plurality of bails 56 provided respectively with bars 57, 57^a, 57^b, 57^c, extending in front of the switch levers which are to be controlled thereby, and having arms 58 at their ends which are pivoted in fixed supports or posts 59, and operating means for said bails connected to the levers 28 for certain of the push buttons as hereinafter set forth. Springs 64 connected to arms 65 on the respective bails 56 and to fixed support 65′ tend to draw the bails to normal position in which they are removed from the switch arms 9^a, etc., allowing said arms to move to closed position. The lever 28 for the first button of the permutation is provided with a pivot pin 66 slidably engaging in a slot 68 in a link 70 connected by a pivot 71 to a projection 32 projecting from the second bar 57^a, the pivot pins 66 and 71 being insulated from the link 70 by insulation indicated at 73, 74. Said bar 57^a is provided with a notch 75, directly in front of the first switch arm 9^a, so that when said bar is pushed back, it does not prevent movement of this switch arm to closed position, said bar, however, extending in front of all of the other arms, so as to move them to open position on operation of this first operating push button in case

they have been previously moved to closed position. The lever 28 for the second push button of the combination, see Fig. 6, is connected by a link 77 to the bar 57^b and the lever 28 for the third button of the permutation is connected by link 78 to the bar 57^c. The last button of the permutation requires no resetting bar and is, therefore, not provided with any connecting link. Bar 57^b is provided with a notch 76 registering with the first switch arm 9 and is pivoted at one end to one of the intermediate posts 59 so that said bar does not extend under the second switch 9^b. The bar 57 serves as a universal bar for all of the dummies, the lever 28 for each of the dummy push buttons 12′ being connected by link 80 to a lever 81 pivoted on a fixed post 82 and extending beneath the said bar 57. Each of the switch arms 9^a, 9^b, 9^c, 9^d is provided with an insulating shield 82 which is adapted to engage with one or more of the resetting bars 57, 57^a, etc.

In applying the invention to protecting the sparking circuit of an automobile, the connections may be as shown in Fig. 1, the several switches 9^a, etc., being connected in series by wires or connections 90, 91, 92 and said series of switches being connected at one end by wires 93 and 94 at any suitable point in the sparking circuit, for example, between the timer and distributer. The connections shown are adapted for use with a high tension distributer indicated at 96, said distributer being connected to said wire 94 and the wire 93 being connected to the secondary of a transformer 95 whose primary winding is connected through a switch 96 alternatively with the battery 97 and breaker 98, or with magneto 99 and timer 100. It will be understood, however, that any other suitable circuit arrangement may be used. In order to prevent tampering with the device, the inclosing case is preferably sealed and the wires leading therefrom are inclosed or armored in any suitable manner.

The operation of this form of our invention is as follows: Assuming that all of the switch arms 9^a, 9^b, 9^c, 9^d are in open position, as shown in Figs. 5, 6, 7 and 8, and it is desired to close the circuit by means of the switch, the first button 12^a is pushed in, thereby operating through its lever 28 and link 42 to turn the corresponding depressing lever 44 so as to bring the member 45 thereof against the first switch 9^a and force said switch into contact with its fixed contact member 8. This movement of the push button 12^a also raises or pushes forward the first resetting bar 57^a, but as this bar is notched in front of the first switch arm, it does not prevent the operation of this switch arm and on the return movement of the push button under the action of spring 20, said bar 57^a is returned to normal position by its spring 64, the switch arm 9^a remaining, however, in closed position. The second push button 12^b is then pushed, causing the second switch arm 9^b to be moved to closed position and lifting the second resetting bar 57^b by means of its link 77. This lifting of the second resetting bar 57^b does not disturb the first switch arm 9^a for the reason that the said bar has a notch 76 opposite said arm and it does not affect the operation of the second switch arm 9^b for the reason that the said bar does not extend under said arm. Similarly, the operation of the third push button 12^c closes the third switch arm 9^c without disturbing the previously operated switch arms and the operation of the last push button 12^d closes the last switch 9^d of the permutation without affecting any of the previously closed switch arms, since the last push button has no resetting bar. The several switch devices being in series relation, this closure of all of the switches closes the circuit controlled by the permutation switch.

If any one of the dummy buttons 12′ is pushed, it operates through the lever 81 to move the bar 57, so as to cause said bar to engage any switch arm which has been previously operated and move the same to open position. If any one of the operating buttons is pushed out of its proper order, the resultant operation of the corresponding resetting bars 57^a, etc., will cause such bar to engage any switch arm which has been previously operated to move the switch arm to open position. In order therefore, to close the circuit, it is necessary that the selected push buttons be operated in proper order.

The locking device for the several switch arms 9^a, etc., is substantially noiseless, as the ball 11 rolls into or out of the notches 7′ in the shank 7 of the switch arm with a smooth action, giving sufficient resistance to hold the switch in position either open or closed, but without jumping, so that it is not possible for an unauthorized party to ascertain which one of the push buttons is a part of the permutation, all of the buttons being substantially noiseless, and the frictional resistance being substantially noiseless in operation. When any one of the push buttons, whether operating or dummy button is released, it springs back to normal position so that when the switch has been operated, the push buttons are always left in outermost position and it is not possible for any person inspecting the device from the outside to determine which one of the buttons is a part of the combination or permutation. By providing a series of buttons considerably greater in number than the number of buttons used in the combination or permutation, a large number of different

permutations will be secured with the same number of buttons, with a correspondingly small chance of any person happening to hit on the right permutation for operating the switch.

Figs. 11 to 14 illustrate a modification of the invention in which the interlocking or mutual control of the push buttons is effected electrically instead of mechanically, the operation of the dummy buttons serving to close the short or ground which disables the operating circuit. In this form of the invention, a switch indicated at 109 is provided for each push button 112, but only certain ones of said switches are connected in series to form part of the operating circuit which it is desired to control. Each of said switches is mounted on a post 110 on an insulating base 103 which may be carried by posts 105 supported on the front plate 102 of the device. The push buttons 112 pass through slots 112′ in said front plate and are provided with stems 114 slidable in posts 115 and engaging the switch levers 109 to move the same into position to contact with switch members 108, secured in fixed position on the insulating base 103. Each switch lever 109 is provided with notches 107 engaged by a ball 106, supported in a bracket 117 mounted on the insulating base 103 and pressed by a spring 118 into engagement with said notches so as to hold the switch in either closed or open position. A special resetting button 120 is provided in this case, said button being provided with a stem 121 slidably mounted in a post 122 on the base 103 and engaging with a lever 124 having one arm 125 connected to one end of a toggle 126 pivoted at the other end to a post 127 on the base 103, the knuckle of said toggle being connected by link 129 to an arm 130 on a shaft 131 which is rotatably mounted on posts 132 on the base 103, said shaft 131 being provided with arms 134 adapted to engage projections 135 on the switch levers to reset the same to open position on pressing the button 120 aforesaid. Springs 137 are provided for restoring each of the buttons 112, 120 to normal position, said springs engaging with the base 103 and with pins 139 on the stems 114, 121 of the respective buttons. Lever 124 is held in normal position by spring 140.

The circuit connections for this form of the invention are shown in Fig. 14, the several switches 109 which have been selected for the permutation being connected in series 141, 142, and this series of switches being connected by wires 143, 144 to the circuit indicated at 145 which is to be controlled. A branch connection leads from wire 143 by wire 146 to a wire 147 having branches 148 leading to one side of each of the switches 109 for the dummy push buttons, the other side of said switches being connected together by wires 150 and grounded by wire 151, the source of current 152 in the circuit 145 being also grounded at 153 so that operation of any one of these dummy push buttons will close the ground connection or short circuit for the circuit 145 and disable said circuit.

What we claim is:

1. A permutation switch for an electric circuit, comprising a plurality of switch elements for connection to said circuit, so that operation of a plurality of such switch elements is required for closing said circuit, a plurality of operating devices, each adapted to operate one of said switch elements, means tending to move each of said operating devices to normal position, means for retaining each switch element in operated position when the corresponding operating device is restored to normal position, and means for disabling said circuit on operation of said switch elements except in a given order.

2. A permutation switch for an electric circuit, comprising a plurality of switch elements connected to said circuit so that operation of a plurality of such switch elements is required for closing said circuit, push buttons adapted to operate the respective switches aforesaid, dummy push buttons, means tending to retain each of said switch elements in operated position when a corresponding button is restored to normal position, and means controlled by said dummy push buttons for preventing operative closure of said circuit when any of said dummy push buttons is operated.

3. A permutation switch comprising a plurality of switch devices for controlling an electric circuit, a plurality of controlling devices greater in number than said switch devices, means tending to restore each of said controlling devices to normal position, certain of said controlling devices being connected to operate said switch devices, and others of said controlling devices being connected to disable said switch devices, means acting on each switch device to retain the same in operated position when the operating device is restored to normal position, and means for resetting said switch devices to normal position.

4. A permutation switch comprising a plurality of movable switch devices, each switch device including a movable switch member, circuit connections including such normally open switch devices in series relation, operating push buttons for the respective switch devices, means tending to restore each push button to normal position, means for holding the movable switch member of each switch device in operated position when a corresponding push button is restored to normal position, resetting devices for the said movable switch members,

and means engaged by the push buttons corresponding to certain of said switch members for operating the resetting devices for certain other of said switch members, so that the switch members will only remain closed when the operating push buttons are operated in a certain order.

5. A permutation switch comprising a plurality of switch devices, each including a movable switch member and connected in series relation, operating devices engaging said movable switch members to close the same, and movable back to normal position independently of said switch members, resetting devices adapted to engage certain of said switch members to open the same, and means controlled by operating devices corresponding to certain of said switch members for operating the resetting devices for certain other of said switch members, so that the switch members will only remain closed when the operating devices are operated in a certain order.

6. A permutation switch comprising a plurality of switch devices, each including a movable switch member and connected in series relation, operating devices engaging said movable switch members to close the same, and movable back to normal position independently of said switch members, resetting devices adapted to engage certain of said switch members to open the same, means controlled by operating devices corresponding to certain of said switch members for operating the resetting devices for certain other of said switch members, so that the switch members will only remain closed when the operating devices are operated in a certain order, and dummy operating devices in addition to the said switch operating devices and connected to operate said resetting devices.

7. A permutation switch comprising a plurality of circuit closers, operating means for moving the respective circuit closers to closed position to establish the circuit, and resetting means operated by a certain plurality of said operating means and engaging the circuit closers corresponding to other of said operating means, to move the same to open position and thereby prevent effective operation of the circuit closers except in a certain order.

8. A permutation switch comprising a plurality of circuit closers, operating means for causing said circuit closers to close the circuit, and a plurality of circuit closer resetting members operated by certain of said operating means to reset the circuit closers except when operated in a certain order.

9. A permutation switch comprising a plurality of circuit controllers, operating devices for causing said circuit controllers to control the circuit, and a plurality of circuit controller resetting members operated by certain of said operating devices to reset the circuit controllers except when operated in a certain order.

10. A permutation switch comprising a plurality of circuit controllers, operating devices for moving the respective circuit controllers to a position to control the circuit, and resetting means operated by a certain plurality of said operating devices and engaging the circuit controllers corresponding to other of said operating devices to reset said controllers and thereby prevent effective operation of said circuit controllers except in a certain order.

11. A permutation switch comprising a plurality of switch devices, each including a movable switch member and connected in series relation, operating devices engaging said movable switch members to operate the same and movable back to normal position independently of said switch members, resetting devices adapted to engage certain of said switch members to reset the same, means controlled by operating devices corresponding to certain of said switch members for operating the resetting devices for certain other of said switch members so that the switch members will only remain in operated position when the operating devices are operated in a certain order, and dummy operating devices in addition to said switch operating devices and connected to operate said resetting devices.

12. A permutation switch comprising a plurality of switch devices each including a movable switch member and connected in series relation, operating devices engaging said movable switch members to operate the same and movable back to normal position independently of said switch members, resetting devices arranged to engage certain of said switch members to reset the same, and means controlled by operating devices corresponding to certain of said switch members for operating the resetting devices for certain other of said switch members so that the switch members will only remain in operated position when the operating devices are operated in a certain order.

13. In a permutation switch for electric circuits, a series of switch members in said circuit capable of being operated independently of each other, a series of operating devices for said switch members arranged to be operated in sequent order in accordance with a given combination, and mechanism interposed between said switch members and operating devices arranged to prevent the effective circuit establishing operation of said switch members until said operating devices are operated in proper sequence.

14. In a permutation switch for electric circuits, a series of switch members in said circuit, capable of being operated inde-

pendently of each other, a series of operating devices for said switch members arranged to be operated in sequent order in accordance with a given combination and other similar operating devices disassociated from said switches, and mechanism interposed between said switch members and all of said operating devices arranged to prevent the effective circuit establishing operation of said switch members until said first mentioned operating devices are operated in proper sequence.

In testimony whereof, we have hereunto set our hands at Los Angeles, California, this 24th day of May, 1913.

CHARLES A. SHORT.
HARRY C. DUNNING.

In presence of—
ARTHUR P. KNIGHT,
LORA M. BOWERS.