

[54] **PUSHBUTTON ALTERNATE ACTION SWITCH WITH PUSHBUTTON SHAFT UNCONNECTED TO ALTERNATE ACTION ACTUATOR BLOCK**

[72] Inventors: **Hiroji Fujimoto; Kenji Nakakura**, both of Kawasaki, Japan

[73] Assignee: **Fujisoku Electric Co., Ltd.**, Kanagawa-ken, Japan

[22] Filed: **May 15, 1970**

[21] Appl. No.: **37,805**

[52] U.S. Cl. .... **200/153 J, 200/67 G**  
 [51] Int. Cl. .... **H01h 13/56, H01h 13/38**  
 [58] Field of Search ..... **200/153 J, 67 G**

**References Cited**

**UNITED STATES PATENTS**

2,978,555 4/1961 Jones .....200/67 G

3,288,973	11/1966	Piber.....	200/153 J X
3,187,602	6/1965	Cousins.....	200/153 J X
2,326,232	8/1943	Krieger.....	200/67 G UX

**FOREIGN PATENTS OR APPLICATIONS**

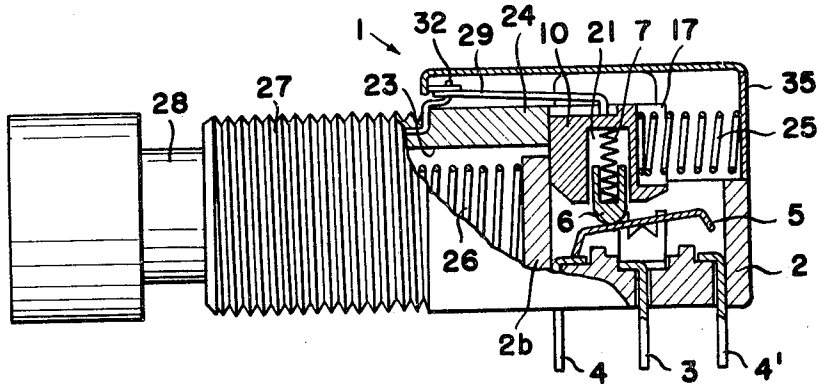
451,287	5/1968	Switzerland.....	200/153 J
593,175	5/1959	Italy.....	200/67 G

*Primary Examiner*—Robert K. Schaefer  
*Assistant Examiner*—Robert A. Vanderhye  
*Attorney*—Pearson & Pearson

[57] **ABSTRACT**

A pushbutton switch of snap-action type completes a circuit on the first push and holds the circuit in locked condition while allowing the pushbutton shaft to return to its original position. On a second push, the switch breaks the circuit and completes another circuit and again allows the pushbutton shaft to return to its original position.

**8 Claims, 12 Drawing Figures**



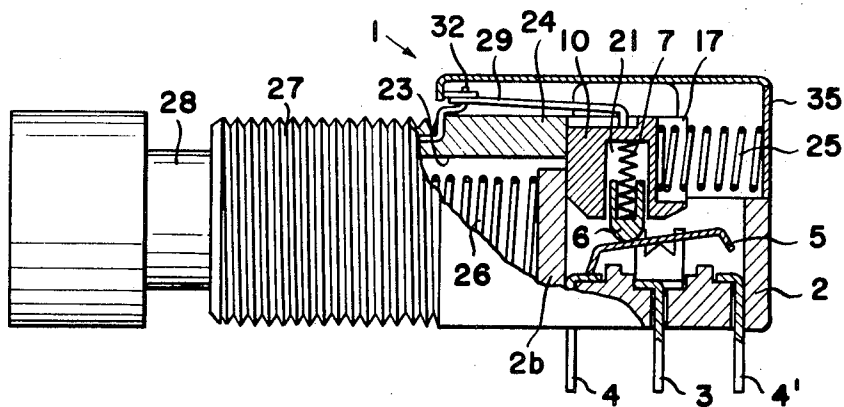


Fig. 1

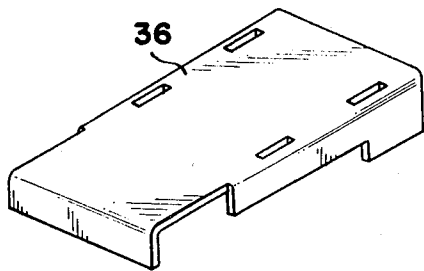


Fig. 2

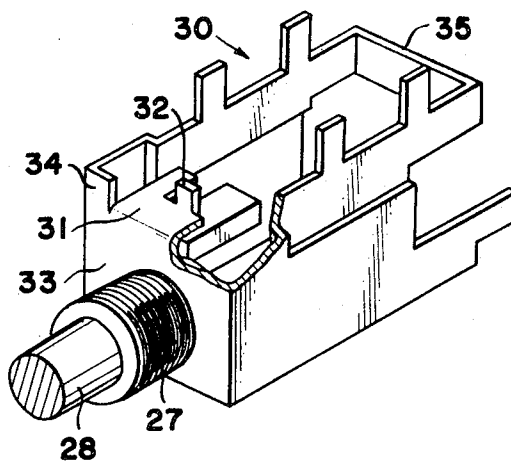


Fig. 3

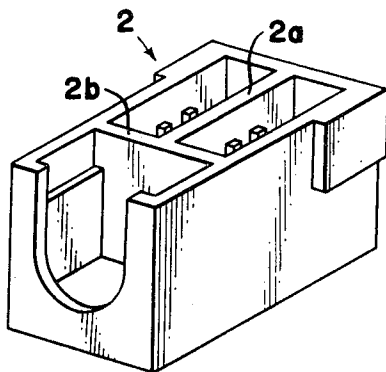


Fig. 4

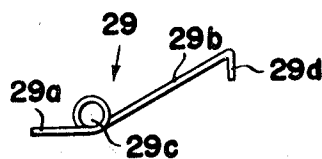


Fig. 6

INVENTOR  
HIROJI FUJIMOTO  
BY KENJI NAKAKURA  
*Pearson + Pearson*  
ATTORNEYS

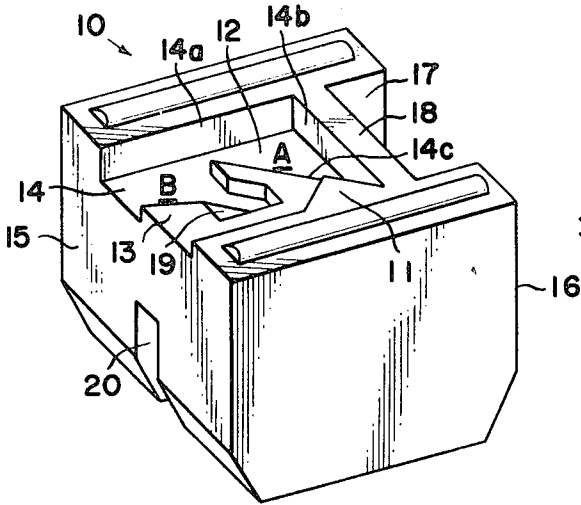


Fig. 5A

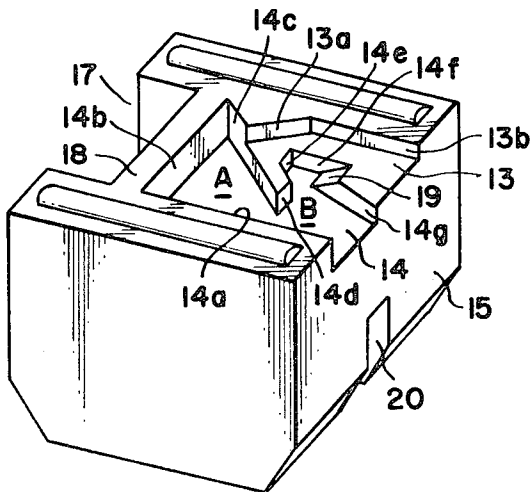


Fig. 5B

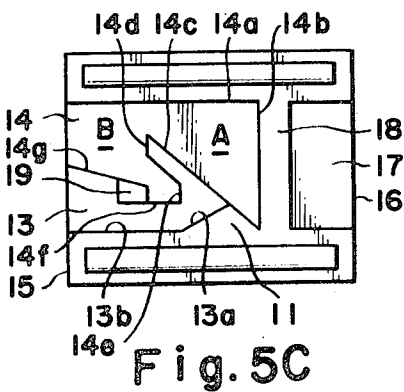


Fig. 5C

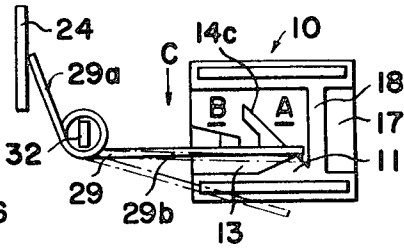


Fig. 7A

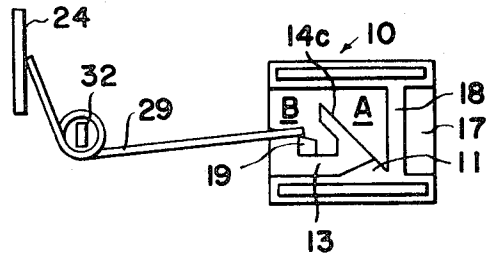


Fig. 7B

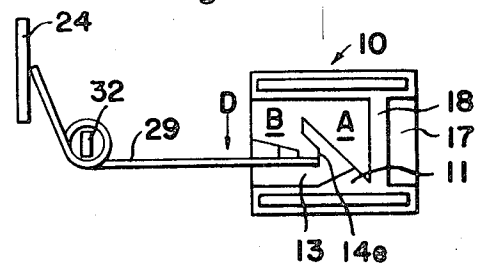


Fig. 7C

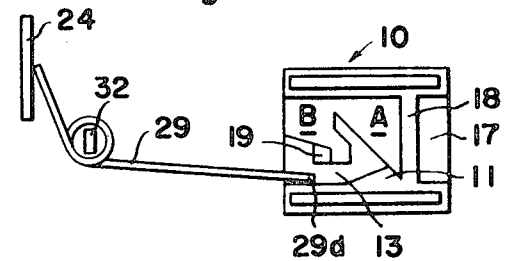


Fig. 7D

INVENTOR  
 HIROJI FUJIMOTO  
 BY KENJI NAKAKURA  
*Pearson + Pearson*  
 ATTORNEYS

# PUSHBUTTON ALTERNATE ACTION SWITCH WITH PUSHBUTTON SHAFT UNCONNECTED TO ALTERNATE ACTION ACTUATOR BLOCK

## BACKGROUND OF THE INVENTION

This invention relates to a pushbutton switch of snap-action type, and more particularly to such a switch wherein a switching mechanism and a locking mechanism are embodied together in one unit, the unit being independent of the pushbutton shaft.

Heretofore, there have been many proposals of a pushbutton switch having a heart-type locking mechanism. Taking a push lock type switch as an example, it has a switching body and a locking mechanism separately, the locking mechanism being fixed to the pushbutton shaft. In this switch, a locking recess is provided on a side surface of a button shaft and a spring is mounted on a pin fixed to a supporting plate of the switch. One end of the spring is turned at right angle to engage with the locking recess, and the bottom of the button shaft makes and breaks contact with a lever mounted on the switch body.

With the construction as above mentioned, the locking mechanism is complicated and thus a number of associated parts are required. This enabled only limited simplification and miniaturization of a switch. Necessity of numerous assembly steps is also one of the drawbacks of the prior switch.

## SUMMARY OF THE INVENTION

In the present invention, a locking recess is provided on an actuator block which is a main part of the switching mechanism, said locking recess guiding a locking spring, thereby unifying the switching mechanism and the locking mechanism, thus eliminating the drawbacks of the prior art locking mechanism. The combined switching and latching, or locking, unit is unconnected to the pushbutton shaft but pushed as a unit by the shaft, one push depositing it at the end of the path, while the shaft returns, and the next push releasing it to return with the shaft.

It is therefore an object of this invention to provide a pushbutton switch of snap-action type having a simplified locking mechanism, thereby permitting reduction of overall size of the switch and simplification of the assembly thereof.

For a better understanding of the invention as well as other objects and further features thereof, reference is made to the following detailed description of the invention to be read in conjunction with the accompanying drawings wherein:

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a partially sectional side view of a pushbutton switch of this invention;

FIG. 2 is a perspective view of a cover for use with a frame of the pushbutton switch;

FIG. 3 is a perspective view of a frame of the switch with a sleeve and a pushbutton shaft assembled therewith;

FIG. 4 is a perspective view of a case for the switch;

FIGS. 5A and 5B are perspective views of an actuator block of the switch, and FIG. 5C is a plan view of the actuator block;

FIG. 6 is a perspective view of a locking spring for use in the switch; and

FIGS. 7A to 7D are explanatory views showing the operation relationship between the actuator block and the locking spring.

Referring now to FIG. 1, there is shown as an example a pushbutton switch 1 having double poles according to this invention. The switch has two units of switching mechanism symmetrically juxtaposed therein with respect to the centerline of the switch, one of which units however is not visible in the drawing. In the specification, therefore, only one unit of the switching mechanism will be described hereinafter.

In each drawing, 2 indicates a case for the switch of this invention; 3 is a support terminal for supporting the switch body and serving as an electrical terminal; 4 and 4' are electrical terminals; 5 a movable contact; 6 an actuator tip; 7 a contact

spring; 10 an actuator block; 25 a return spring; 26 an auxiliary spring; 27 a sleeve; 28 a button shaft; 29 a locking spring; 30 a frame and 36 a cover associated with the frame 30.

In the present invention, the switching mechanism is not a subject matter of the invention, and hence any conventional mechanism can be employed.

Referring at first to FIG. 5A, the actuator block 10 which is the main portion of the invention will be described hereunder.

The actuator block 10 is made in an inverted trapezoid form on the top surface 11 of which is provided a top recess 12 comprising two levels forming a middle face 13 and a bottom face 14 which is deeper than the face 13. The front face 15 of the block 10 provides a vertical front wall with the lower part thereof cut off obliquely. On the backface 16 of the block 10, a back recess 17 is provided leaving a ridge around the recess. The top recess 12 is separated from the back recess 17 by a ridge 18 and opens to the front face 15. The bottom face 14 comprises two areas A and B, the former being an approximately triangular area surrounded by vertical walls 14a, 14b and 14c, and the latter being an area surrounded by vertical walls 14a, 14d, 14e, 14f and 14g. The area B of the bottom face 14 continues to the middle face 13 through a slope 19. The actuator block 10 is provided with a groove 20 at the bottom face thereof. On either side of the groove 20, there are vertical holes 21 pierced from the bottom face but not penetrating the actuator block 10 (See FIG. 1).

The assembly of the pushbutton switch according to this invention is effected as follows.

As can well be seen from FIGS. 1 and 4, the movable contact 5 is placed on the support portion of the support terminal 3 in the case 2 with both ends of the contact resting on the terminals 4 and 4' which are molded or pressed in the case. Then the case is mounted in the frame 30. The actuator tip 6 and the contact spring 7 are inserted into a hole 21 of the actuator block 10, and in turn the actuator block 10 is so placed on the case 2 which is mounted in the frame 30 that the groove 20 of the block can slidingly receive a central wall 2a of the case 2, and that the actuator tip 6 can be pressed onto the movable contact 5 by the contact spring 7. Alternately, the actuator block may be made in the form of a T and slide on the lateral shoulders provided on the case. The return spring 25 is disposed in a compressed condition between the back recess 17 and the end portion 35 of the frame 30.

A locking spring 29 (FIG. 6) comprises a shorter portion 29a and a longer portion 29b, the latter being looped at 29c and bent with respect to the former and having a hook end 29d bent at a right angle. After engaging the loop 29c of the locking spring 29 with a tongue 32 formed on a top surface 31 of the frame 30, the tip of the shorter portion 29a of the locking spring 29 is pressed against the inside of the top upright shoulder 34 of the front face 33 of the frame 30, and the hook end 29d of the locking spring 29 is pressed against the sharp angle corner of the area A on the bottom face 14 of the actuator block 10 by somewhat bending the lower portion 29b from the position as shown by broken line to that shown by solid line in FIG. 7A. With the locking spring 29 thus arranged, the frame 30 is covered by a cover 36.

The auxiliary spring 26 is disposed between the ceiling (not shown) of the interior 23 of the button shaft 28 and the partition 2b of the case 2 (FIG. 4). The button shaft 28 is adapted to reciprocate slidingly inside the sleeve 27 to make the shaft end 24 of the button shaft 28 contact with or separate from the front face 15 of the actuator block 10.

Next, the operation of the actuator block and the locking spring will be described below referring to FIGS. 7A through 7D. The drawings show the actual position of the actuator block 10 in each steps of one cycle of the operation. For simplification of the drawing, only the reference numbers necessary for explanation of the operation are used in FIGS. 7B, 7C and 7D.

Referring at first to FIG. 7A, the actuator block 10 is positioned at the left extremity by the return spring 25 to press the front face 15 thereof against the plate 24 attached to the end

of the button shaft 28 and the partition 2b of the case 2. The hook end 29d of the locking spring 29 is in the corner of the area A and the left end of movable contact 5 is inclined to its lowest position, thereby short circuiting the support terminal 3 and the terminal 4.

In this condition, when the button shaft 28 is pushed rightward against the auxiliary spring 26 and the return spring 25, the auxiliary spring 26 is compressed and at the same time the plate 24 will press the actuator block 10 to the right and the return spring 25 is thereby compressed. In FIG. 7A, as the actuator block 10 is caused to move to the right, the hook end 29d is forced to move along the vertical wall 14c of the bottom surface 14 of the actuator block 10. This results in increasing the bending force which will exert in the direction indicated by an arrow C on the longer portion 29b of the locking spring 29, and hence in increasing the return force of the locking spring 29.

With further push of the button shaft 28, the actuator block 10 is further moved rightward, and finally the hook end 29d will disengage from the wall 14c to contact with the vertical wall 14g surrounding the area B of the bottom surface 14. This is shown in FIG. 7B. While the actuator block 10 is moved astride the central wall 2a of the case 2 to the right, the actuator tip 6 slides on the surface of the movable contact 5 to make its right end incline to its lowest position, thereby short circuiting the support terminal 3 and the terminal 4' to switch on or off the electrical circuit to which this switch is applied.

In FIG. 7B, when the pushing force applied to the button shaft 28 is released, then the actuator block 10 returns somewhat leftward by restitution force of the return spring 25 while keeping the hook end 29d of the locking spring 29 in contact with the vertical wall 14g of the top recess 12. At the final stage, the hook end 29d disengages from the wall 14g and newly engages with the vertical wall 14e where the hook end 29d comes to rest as shown in FIG. 7C. In this state of the actuator block 10, however, the support terminal 3 is maintained in a condition to electrically contact with the terminal 4', and only the button shaft 28 returns to the original position as shown in FIG. 7A by the restitution force thereof.

Thus, when the actuator block 10 is again moved rightward by applying a force to the button shaft against the auxiliary spring 26 and the return spring 25, the hook end 29d of the locking spring 29 will move upwards on the slope 19. As the locking spring 29 is still bent and therefore stores the restitution force, the hook end 29d is rapidly moved in the direction D on the middle face 13 of the actuator block 10 until the hook end 29d butts against the vertical wall 13b surrounding the middle face 13, just when the hook end 29d has finished moving upward on the slope 19. This is shown in FIG. 7D.

When the force applied to the button shaft 28 is released, the shaft and the actuator block 10 are made to move leftward by the auxiliary spring 26 and the return spring 25. While the actuator block 10 is moving to the left, the hook end 29d of the locking spring 29 also moves keeping in contact with the angularly disposed vertical walls 13a and 13b. When the hook end 29d reaches the extremity of the wall 13a, it finally falls down into the sharp angle corner of the area A on the bottom face 14 of the actuator block 10 to engage therewith. This is the position of FIG. 7A. Then the left end of the movable contact 5 is inclined to its lowest position, thereby short circuiting the support terminal 3 and the terminal 4. Thus, the switching mechanism returns to its original state.

The above is the operation of one cycle of the actuator block 10, the operation which is attained in the two-level recess 12 provided on the top surface 11 of the actuator block 10.

With the construction as above mentioned, the pushbutton switch according to this invention has the following advantages:

- a. Number of parts can be minimized, because a switching mechanism and a locking mechanism are united on an actuator block, the switching mechanism including an actuator block with a recess cooperating with a locking spring provided thereon.

b. Miniaturization of the overall size of the switch is attainable to the full extent.

c. Assembling becomes easy, because step-by-step system can be employed, resulting in reduction of labor cost and price.

d. As the locking spring is set in the bent condition, into the sharp angle corner of the area A on the top recess the short vertical wall 14c enables the spring to produce a force returning itself to the position as shown in FIG. 7C. This is useful in reducing in size the actuator block and therefore the switch.

Although the invention has been described with reference to specific embodiments thereof, many modifications and variations may be made by one skilled in the art without departing from the inventive concepts disclosed. Accordingly, all such modifications and variations are intended to be included within the spirit and scope of the appended claims.

What is claimed is:

1. In a pushbutton switch of the snap-action type having a spring-biased actuator block reciprocable in a longitudinal path within a switch housing, at least one seesaw-type switch armature extending below said path within said housing and at least one spring-biased pin recessed in said block with its tip in sliding engagement with said armature to tilt the same on the pivot thereof at each opposite end of said block path, the improvement comprising:
  - a pushbutton shaft, reciprocable independently of, and unconnected to said actuator block;
  - locking mechanism including a grooved cam face of predetermined configuration on said actuator block and a resilient, wire, locking, spring follower, having one end secured in said housing and having a free terminal tip received and guided in the grooves of said cam
  - said locking mechanism locking said block at the far end of said path when pushed thereto by said button shaft and permitting said shaft to be fully spring returned and releasing said block for spring return to the near end of its path, with said button shaft when said button is next pushed and spring returned.
2. A pushbutton, snap-action switch as specified in claim 1 wherein:
  - said free terminal tip of said follower is downturned to depend therefrom and ride on the floor of said grooved cam face in a position normal thereto
  - an intermediate portion of said follower is looped around a tongue integral with said housing, and
  - said one end abuts against a wall of said housing whereby said spring may be merely dropped in place during assembly.
3. A pushbutton snap-action switch as specified in claim 1 wherein:
  - said grooved cam face includes a flat, horizontal, lower face, divided into two areas separated by an obliqued upstanding wall, a flat horizontal upper face and a sloped face joining said upper and lower faces,
  - whereby said follower tip normally rests in one area of said lower face, becomes locked in the other area of said lower face on the first push and retraction of said button shaft to retain said block as said shaft fully retracts and is lifted up said sloped face to said upper face for return to said first area upon the second push and retraction of said button to release said block to retract with said shaft.
4. A pushbutton, snap-action switch as specified in claim 1 wherein the terminal tip of said spring follower is downturned at right angles into said grooved cam face and said grooved cam face includes a lower face and an upper face joined by a sloped face, said lower face having a hooked, oblique wall upstanding therefrom to retain said block against retraction on the first stroke of said button while said button shaft fully retracts.
5. A pushbutton, snap-action switch as specified in claim 1 wherein:
  - said grooved cam face includes a lower face and an upper face joined by a sloped face, said upper face having angu-

larly disposed vertical walls upstanding therefrom to guide the tip of said spring follower onto the lower face.

6. A pushbutton snap-action switch as specified in claim 1 wherein:

said switch includes an insulative case, within said housing, said case having a central, longitudinal upstanding wall with one of said seesaw switches in a compartment on each opposite side of said wall;

said actuator block includes a central, longitudinal groove in the bottom thereof for slidably receiving said wall, and includes one of said spring-biased pins and pin recesses on each opposite side of said groove;

the grooved cam face of said block being integral with the upper face thereof, and cooperable with said locking spring follower to jointly control both of said seesaw switches.

7. In a pushbutton, snap-action switch of the type having a slidably mounted actuator block for opening and closing circuits,

a slidably mounted spring return pushbutton shaft independent of, and unconnected to, said block for pushing said block along a path in said switch, and combined snap-action and locking detent means integral with said block, said means including:

a cam face recess in said block having an oblique hooked detent dividing a lower face into two areas, an upper face and a sloped face joining said upper and lower faces, and flexible resilient wire means fixed in said switch and having a free terminal tip received in said cam face recess,

said tip being locked in the depression defined by said hooked detent and said sloped face on the first stroke of said pushbutton to fix said block in a first position at the far end of said path while said shaft fully retracts and being released from said depression by said sloped face on the next stroke of said pushbutton to retract with said pushbutton shaft to the near end of said path.

8. A pushbutton snap-action switch of the type having a housing in which an insulative block is slidable longitudinally along a path, astride the central wall of an insulative casing to tilt a pair of seesaw switch armatures from one position to another, the combination of:

a pushbutton shaft, independent of, and unconnected to said block for pushing said block along said path within said housing,

a combined camming and latching recess in one exterior wall of said block, said recess having a central, upstanding, hooked, obliqued detent dividing a lower face into two areas, an upper face and a sloped face joining said upper and lower faces,

and a spring fixed in said housing and having a right angularly bent tip guided in said recess to snap into the hook of said detent on a first pushbutton stroke to retain said block in one position on said path while said shaft retracts, and to be released from said hook by said sloped face on a second pushbutton stroke to release said block to retract with said shaft to another position on said path.

\* \* \* \* \*

5

10

15

20

25

30

35

40

45

50

55

60

65

70

75