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Kaderbek et al.

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[54] PROGRAMMABLE LEVER SWITCH WITH SNAP-IN DETACHABLE CAM DETENT MEANS

[72] Inventors: Charles J. Kaderbek, Winfield;
Frank S. Vojir, Berwyn, both of Ill.

[73] Assignee: Guardian Electric Manufacturing
Company

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[51] Int. Cl. H01h 23/30, H01h 23/02

[58] Field of Search 200/166 SD, 166 J

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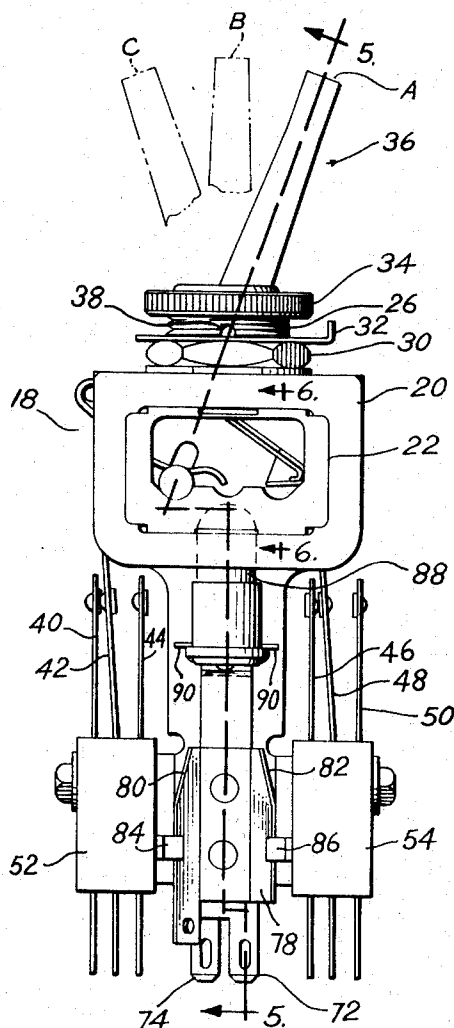
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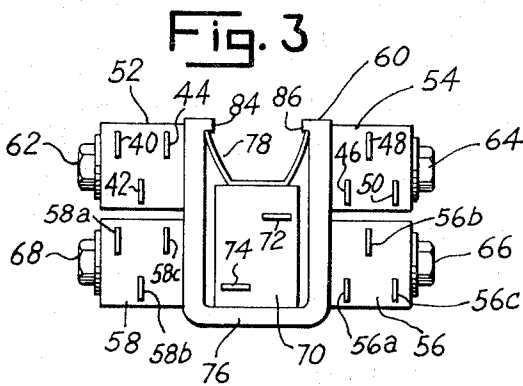
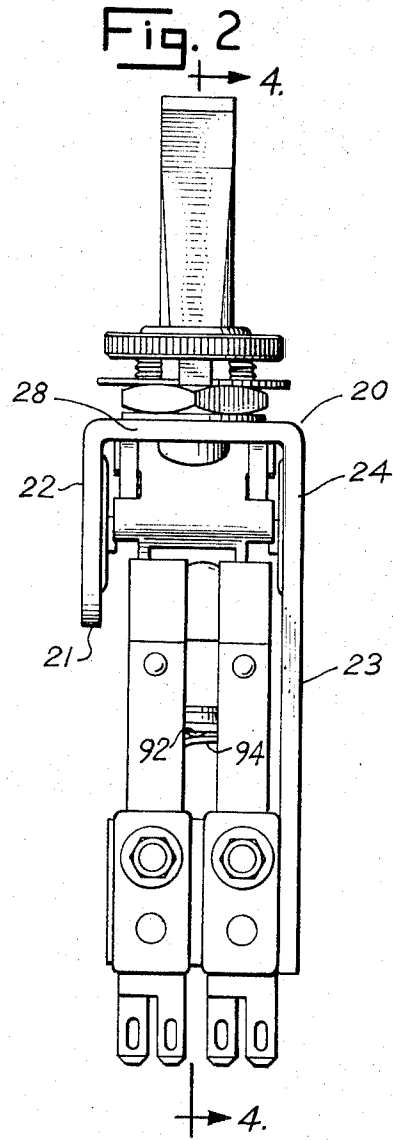
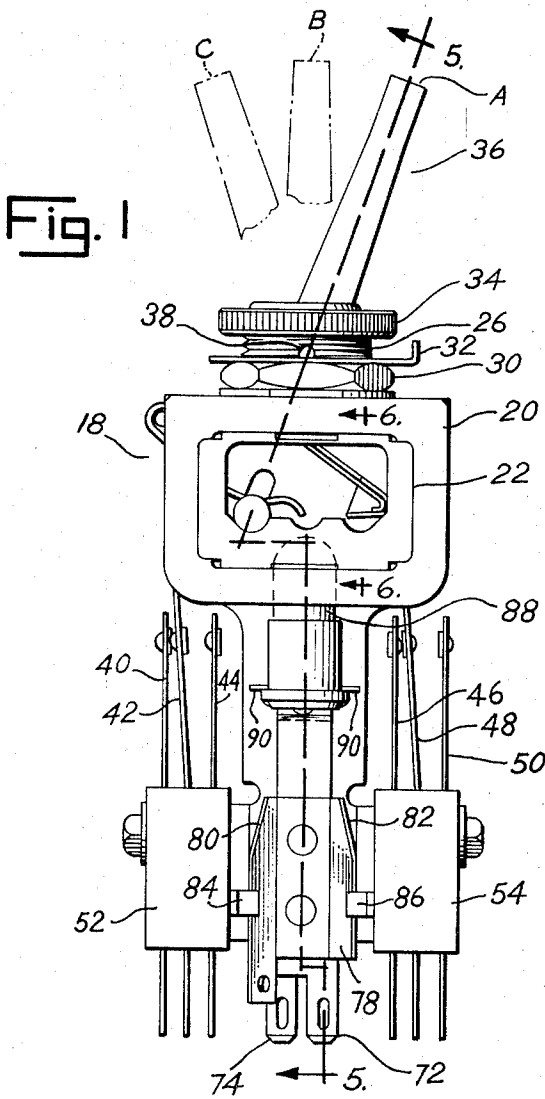
Primary Examiner—Robert K. Schaefer
Assistant Examiner—Robert A. Vanderhye
Attorney—Molinare, Allegretti, Newitt & Witcoff

[57] ABSTRACT

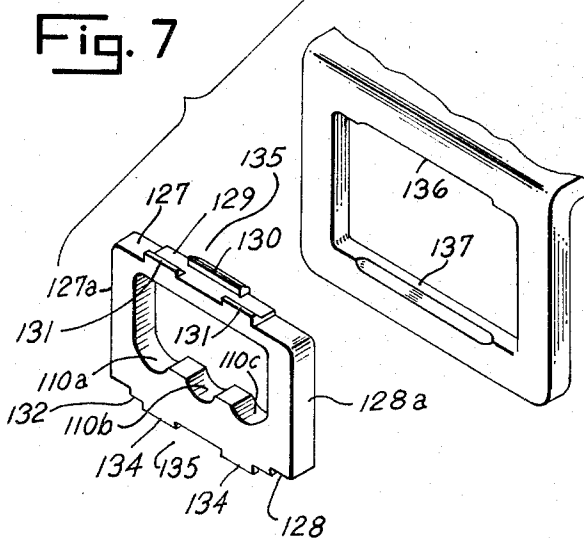
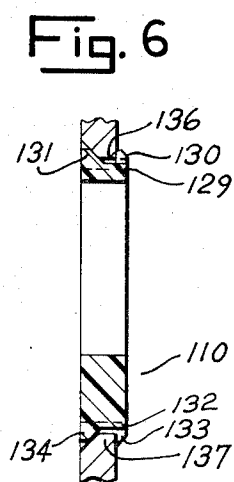
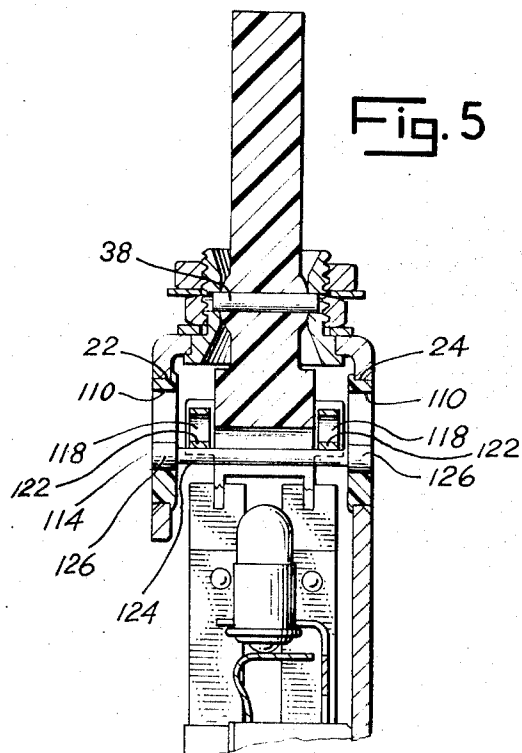
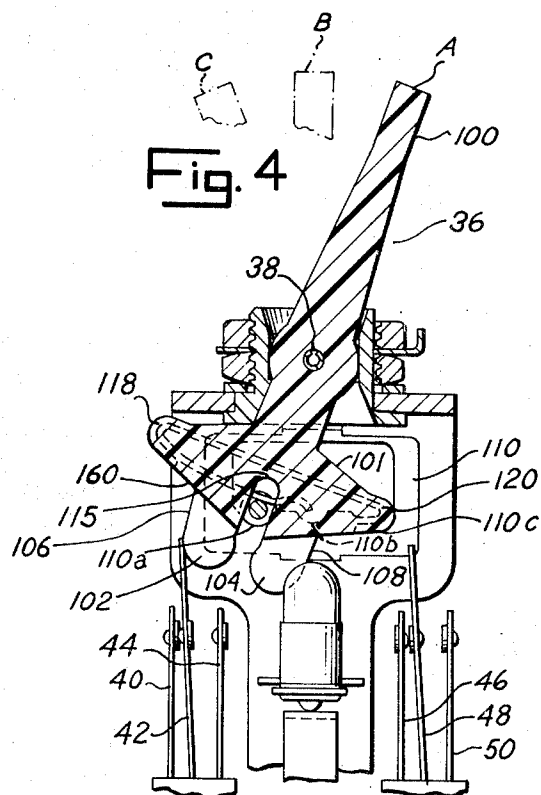
A programmable lever switch has a frame with a pivotally attached lever for manually switching electrical contact leaves by means of switching fingers. The fingers are rigidly attached to one end of the lever. A pair of programmed cam inserts are detachably secured to the frame and engage a detent roller joined between the switching fingers and biased away from the lever. Each pair of cams controls the type of switching action of the lever switch upon displacement of the lever.

8 Claims, 15 Drawing Figures





INVENTORS
 CHARLES J. KADERBEK
 & FRANK S. VOJIR
 BY *Molinaro, Allegretti, Newitt & Witoft*
 ATTORNEYS



INVENTORS
 CHARLES J. KADERBEK
 & FRANK S. VOJIR
 BY *Molinaro, Allegretti, Duvall & Wilcoff*
 ATTORNEYS

Fig. 8

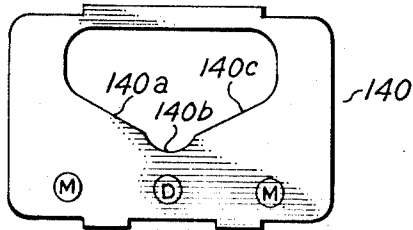


Fig. 9

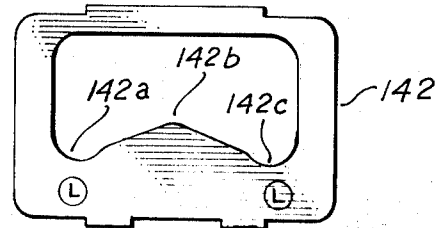


Fig. 10

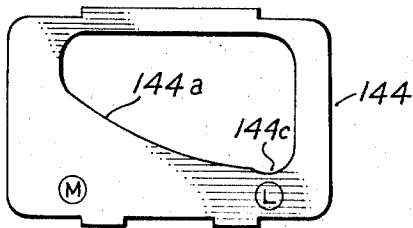


Fig. 11

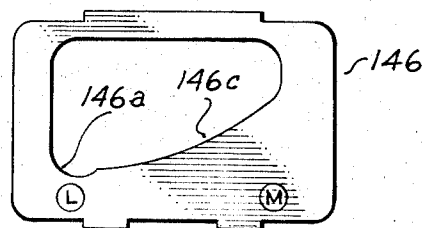


Fig. 12

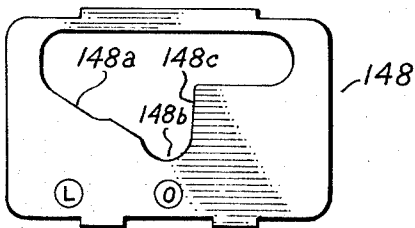


Fig. 13

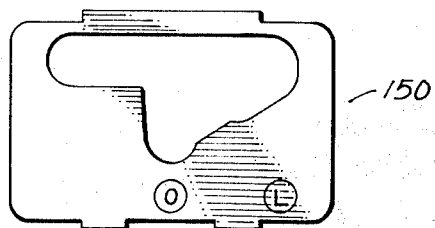


Fig. 14

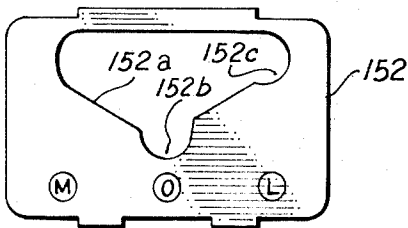
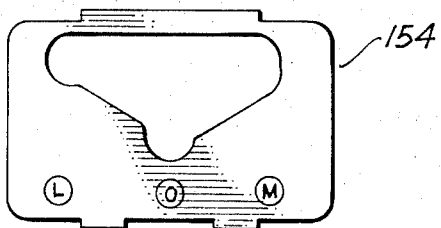


Fig. 15



INVENTORS
CHARLES J. KADERBEK
& FRANK S. VOJIR
BY *Molina, Albrecht, Davis & Witoff*
ATTORNEYS

PROGRAMMABLE LEVER SWITCH WITH SNAP-IN DETACHABLE CAM DETENT MEANS

BACKGROUND OF THE INVENTION

This invention relates generally to a programmable lever switch for momentarily switching or continuing a contact made by the displacement of the lever. Two-way and three-way lever switches can be used in a variety of applications. For example, such a switch may be employed in a machine tool in which it is desirable to have an automatic operation set or an operation manually terminable by an operator. Such a switch may provide momentary making of a circuit when a switch lever is displaced in one direction and a locked or continuous making of another circuit when the switch lever is displaced in another direction. Known prior art switches can provide these functions. However, once a switch has been constructed to respond or operate in a predetermined manner, it is not adaptable for use where a different switch function is required.

Accordingly, it is desirable to provide a new and useful programmable lever switch adapted for momentarily or continuously making and breaking electrical contacts in accordance with a desired program of switching functions. It is also desirable to have such a switch wherein the program or switch functions are easily altered so that a different predetermined program may be provided for the lever switch. It is further desirable to provide such a switch having a programming device which is easy and inexpensive to manufacture and operate.

SUMMARY OF THE INVENTION

In a principle aspect this invention takes the form of a programmable lever switch, comprising, in combination, a supporting frame, a lever pivotally secured to the frame and pivotal to at least two switching positions having a first operable end and a second switching end, electrical contact means on the switch for selective engagement with the second end of the lever, linkage means secured to the contact switching end, and detachable programming cam means in said frame for engaging with the linkage means for controlling the switching action of the lever switch. The cam means include a cam surface upon which the linkage means ride. When the lever is displaced from the equilibrium, the contact switching end displaces the electrical contact means and the cam surface cooperates with the linkage means for alternatively (1) momentarily returning the lever to equilibrium or (2) locking the lever in a position displaced away from its equilibrium or neutral position.

In a preferred embodiment of the present invention, the programming cam means comprise two cam windows molded of self-lubricating plastic having gripping tab means rigidly secured to the cam windows for detachably securing the windows to the supporting frame.

BRIEF DESCRIPTION OF THE DRAWINGS

There is shown in the attached drawing, a presently preferred embodiment of the present invention, wherein like numerals refer to like elements, and wherein:

FIG. 1 is a front view of the programmable lever switch of the present invention showing the lever displaced from its central or neutral position;

FIG. 2 is a side view of the device of FIG. 1;

FIG. 3 is an end view of the device of FIG. 1;

FIG. 4 is a cross-sectional view of the upper portion of the programmable lever switch taken substantially along the line 4—4 of FIG. 2;

FIG. 5 is a cross-sectional view of the upper portion of the programmable lever switch taken substantially along the line 5—5 of FIG. 1;

FIG. 6 is a cross-sectional view of the frame of the lever switch and programming cam inserted therein taken substantially along the line 6—6 of FIG. 1;

FIG. 7 is a perspective view of the frame and a particular detachable programming cam of the present invention; and

FIGS. 8 - 15 are frontal views of alternative preferred embodiments of the detachable programming cam of this invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 and FIG. 2 show front and side view respectively of a programmable lever switch 18 embodying the principles of the present invention. Referring principally to these figures, the device includes a supporting frame or mounting bracket 20 which may be formed from cold rolled carbon steel. Bracket 20 is U-shaped having two legs 21 and 23 and connecting run 28. First window 22 and second window 24 symmetrically opposite thereof are defined on legs 21 and 23 respectively. A threaded mounting bushing 26 is rigidly secured to the connecting run 28 of the bracket 20. Hex nut 30, lock ring 32, and knurled nut 34, are provided only for positioning and mounting of lever switch 18 to a panel.

A switching lever 36, shown displaced in lever position A in FIG. 1, is pivotally secured to bushing 26 by lever pivot pin 38. The lever 36 may be displaced in an arc about the axis of lever pivot pin 38 from lever position A through lever position C. As shown in FIG. 1, the lever 36 assumes a position perpendicular to connecting run 28 in lever position B or neutral position. Lever 36 is angularly displaced to one side of lever position B in lever position A and to the other side of lever position B in lever position C.

As will be more fully described, the displacement of the lever 36 causes selective displacement of electrical contact means including particular flexible electrical conducting leaves 40, 42, 44, 46, 48 and 50 thereby making and breaking electrical circuits between predetermined leaves. The leaves 40, 42, 44, 46, 48 and 50 are preferably formed of a flexible metal having high conductivity. Leaves 40, 42, and 44 are secured in socket 52 and leaves 46, 48 and 50 are secured in socket 54.

Referring to FIG. 3, there are shown non-conducting sockets 52, 54, 56 and 58. Non-conducting socket 56 is provided for receiving electrical conducting leaves 56 a, b and c and non-conducting socket 58 is provided for receiving electrical conducting leaves 58 a, b and c. A U-shaped member 60 is secured to leg 23 of the bracket 20 for receiving sockets 52, 54, 56 and 58. Any or all of these sockets 52, 54, 56 and 58 may be con-

nected in any combination to the lower U-shaped member 60 of the bracket 20 by means of hexagonal headed screws 62, 64, 66 and 68 respectively. Thus, different combinations of these sockets provide different switching functions which may be performed by the programmable lever switch 18. For example, an arrangement of four-pole double throw switching may be provided by the attachment of all four sockets 52, 54, 56 and 58.

A lamp socket 70 for securing lamp conductors 72 and 74 is rigidly secured in the base run 76 of the U-shaped member 60 by metal clamp 78. The metal clamp 78 has tapered ridges 80 and 82 defined thereon for exerting pressure between protruding flanges 84 and 86 of the U-shaped member 60 and the lamp socket 70. This pressure secures the lamp socket 70 to the base run 76 of the U-shaped member 60.

Lamp conductors 72 and 74 conduct power to a lamp 88. The lamp 88 is secured to prongs 90 of the conductor 74. The circuit from the conductor 74 through the lamp 88 is completed through the lower conducting surface 92 of the lamp 88 and upper conducting surface 94 of the conductor 72 as shown in FIG. 2. The programmable lever switch 18 may be electrically connected to a device (not shown) to be controlled by mating the lower portions of the conduction leaves 40, 42, 44, 46, 48 and 50 and lamp conductors 72 and 74 with the device to be controlled.

The Operation Of the Lever Switch

Referring principally to FIG. 4 and FIG. 5, lever 36 includes a first operating end 100 and a second contact switching end 101. Rigidly secured to second end 101 are contact switching fingers 102 and 104. Contact switching fingers 106 and 108 of identical shape and construction as fingers 102 and 104 are also rigidly attached to second end 101. Fingers 106 and 108 are not seen because they are shadowed behind fingers 102 and 104. The operation of the lever 36 will be explained with reference to fingers 102 and 104. The operation of the lever 36 will be explained with reference to fingers 102 and 104 and conducting leaves 40, 42, 44, 46, 48 and 50. It is to be understood, however, that contact switching fingers 106 and 108 operate the electrical conducting leaves 56 a, b and c and 58 a, b and c shown in FIG. 3 in a manner identical to that of fingers 102 and 104.

The displacement of the lever switch 36 into lever position A causes first contact switching finger 102 to displace conducting leaf 42 into contact with conducting leaf 40. Displacement of the lever 36 to central lever position B causes contact switching finger 102 to move out of contact with conducting leaf 42, thus allowing the conducting leaf 42 to return to its normally biased position in contact with conducting leaf 44. Likewise, displacement of the lever 36 to lever position C causes contact switching finger 104 to displace conducting leaf 48 from its normally biased position in contact with conducting leaf 46 into contact with conducting leaf 50.

Programming detent cam means comprise a pair of cam windows 110 detachably secured in bracket windows 22 and 24 as will be more fully described. Linkage means for linking the lever 36 to the programming cams 110 includes a roller 114 and two springs 118. The construction and operation of each of the springs

118 is identical. The detent roller 114, is journaled in a channel 115 defined in second end 101 of the lever 36 for movement therein. A pair of unconnected loop springs 118 are rigidly secured at ends 120 to the contact switching end 101 of the lever 36 and ride in spring-loaded fashion at the other ends 122 against the axle connecting segment 124 of the detent roller 114. In this fashion, the detent roller 114 is biased away from the lever 36 by springs 118 and is counter-biased towards the lever 36 by the detachable cam windows 110 which act supportably on roller heads 126 of the detent roller 114.

The particular programming detent cam 110 employed in a preferred embodiment shown in FIG. 7, is one of the type entitled "Lock-Off-Lock". This title may best be understood by an explanation of the action of the programming cam 110 with the detent roller 114. The cams 110 define cam surface means having indentations 110a, b and c. When the lever 36 is displaced into lever position A, the roller heads 126 of the detent roller 114 are thereby biased into indentations 110a of cams 110. As has been described, the movement of the lever 36 into lever position A effects the making of a circuit between the electrical conducting leaves 42 and 40. In this position, the spring 118, biases the roller 114 into the indentation 110a and the ridges between indentations 110a and indentations 110b act on the roller heads 126 preventing the lever 36 from the moving out of lever position A. Thus, electrical conducting leaves 40 and 42 are caused to be "locked" into contact.

By the application of pressure to the first end 100 of the lever 36, an upward force is exerted by the indentations 110a on the roller heads 126. The detent roller 114 moves responsively within channel 115 toward the first end 100 of the lever 36. When the detent roller 114 rises to a sufficient level within the channel 115, the lever 36 is caused to jump into lever position B where the roller heads 126 are again biased away from the lever 36 into cam indentations 110 b. This is the "off" position of the switch in which the conducting leaves 40, 42, 44, 46, 48 and 50 retain their normally biased positions. By a second application of pressure on the first end 100 of the lever 36, the roller heads 126 of the detent roller 114 are caused to rise towards the first end 100 of the lever 36 and out of the cam indentations 110 b. When the lowest portion of the roller heads 126 reach the level of the ridges between indentations 110b and indentations 110 c, the lever 36 is caused to jump into lever position C where the springs 118 bias roller heads 126 of the detent roller 114 into contact with cam indentations 110 c. In this position, contact switching finger 104 displaces electrical conducting leaf 48 away from its normally biased position and into contact with conducting leaf 50. The circuit made between conducting leaves 48 and 50 is "locked" such that it will not be broken without application of pressure on the first end 100 of the lever 36.

Detachable Programming Cam

The following description will refer to a single cam 110. It is to be understood, however, that the programmable lever switch 18 of this invention includes a pair of cams 110 inserted into windows 22 and 24 respectively and that second cam 110 is a mirror image of first cam 110. Thus, the following description will be applicable to both cams 110.

Referring to FIG. 6 and FIG. 7, the cam 110 of this invention has tab means 135 for detachably securing the cam 110 to window 22. The cam 110 includes an upper horizontal run 127, lower horizontal run 128 and vertical runs 127 *a* and 128 *a*. Rigidly secured to run 127 is a raised surface 129. Abutment tab 130 and inclined gripping tabs 131 are molded to the raised surface 129. The lower run 128 also has a raised surface 132 rigidly secured thereto and abutment tab 133 and gripping tabs 134 molded to the raised surface 132.

The tab means 135 of this invention provide a cam 110 which may be easily inserted into and detached from bracket window 22 by the application of pressure. When the cam 110 is inserted into window 22, tabs 130 and 133 provide abutments for the cam 110 against window 22. Tapered shoulders 136 and 137 are defined in window 22 and are complementary to inclined tabs 131 and 134 respectively. The tapered shoulder 136 is held securely intermediate abutment tab 130 and inclined tabs 131. Tapered shoulder 137 is held securely intermediate abutment tab 133 and inclined tabs 134. The raised segments 129 and 132 facilitate the depression of programming detent cam 110 against shoulder 137 for easy insertion into and detachment from window 22 of cam 110.

Types of Programming Cams

A variety of interchangeable programming detent cams or plastic inserts are shown in FIG. 8 through FIG. 15 constructed according to the principles in this invention. Each of the programming detent cams 140, 142, 144, 146, 148, 150, 152 and 154 employ tab or interlocking means 135 as described above in relation to programming detent cam 110, and differ from cam 110 only in respect to the cammed surface indentations. Cams 110, 140, 142, 144, 146, 148, 150, 152 and 154 may be conveniently, and inexpensively produced from molded plastic, preferably of the self-lubricating type. For example, a material known as Delrin AF produced by E. I. DuPont de Nemours & Co. or the engineering equivalent thereof may be employed. Such a material provides a degree of lubricity, thus facilitating movement of the roller 114.

Cam 140 shown in FIG. 8 provides "momentary-off-momentary" switching functions. Inclined surfaces 140 *a* and 140 *c* and indentation 140 *b* are defined in cam 140. Inclined surfaces 140 *a* or 140 *c* exert a lateral component of force on roller 114 when the lever 36 is displaced into lever position A or C respectively. This force component causes the lever 36 to return to neutral lever position B where roller 114 is biased into indentation 140 *b*. From the foregoing it should be appreciated that cam 140 causes electrical contact between leaves 40 and 42, or between 48 and 50 to be made as long as the lever is displaced into lever position A or C respectively.

The cam 142 of FIG. 9 is "locked-locked" cam. Indentations 142 *a* and 142 *c* at opposite ends of the cam 142 lock the lever 36 in lever position A when the lever 36 is displaced into position A and in lever position C when lever 36 is displaced into position C. The ridged surface 142 *b* of the cam 142 prevents the lever 36 from remaining in lever position B by causing a condition of unstable equilibrium. The slightest deflection of the lever 36 causes the lever to lock into lever position A or C.

Cam 144 of FIG. 10 provides a two-position "momentary-locked" program. Displacement of the lever 36 into lever position A causes the contact switching finger 102 to effect a "momentary" electrical circuit between electrical conducting leaves 40 and 42. The inclined surface, 144 *a* exerts a lateral force component on the detent roller 114 causing the lever 36 to return to "locked" lever position where roller 114 is biased into indentation 144 *c*.

The cam 146 of FIG. 11 is the symmetric opposite of cam 144 having a "locked-momentary" program. Accordingly, the equilibrium position of the lever 36 having programming cam 146 inserted in the switch 18 is lever position A. In this position the detent roller 114 is biased into indentation 146 *a*. Displacement of the lever 36 into lever position C effects "momentary" contact between electrical conducting leaves 48 and 50 by contact switching finger 104. The inclined surface 146 *c* exerts a lateral force component on detent roller 114 causing the lever 36 to return to equilibrium in lever position A.

Cam 148, shown in FIG. 12, provides a two-way switch having a "locked-off" program. The vertical surface 148 *c* prevents the lever 36 from being displaced into lever position C. In neutral or "off" lever position B, the detent roller 114 is biased into indentation 148 *b*. Displacement of the lever 36 into lever position A causes contact switching finger 102 to effect a circuit between electrical conducting leaves 40 and 42. In this position the lever 36 is "locked" by indentations 148 *a*. The cam 150, shown in FIG. 13, is the symmetric opposite of cam 148. Accordingly, this cam provides a two-way switch having an "off-locked" program.

Cam 152 of FIG. 14 provides a three-position switch having a "momentary-off-locked" program. With cam 152 inserted into window 22, the lever 36 is in neutral or "off" mode in lever position B and the detent roller 114 is biased into indentation 152 *b*. Displacement of the lever 36 into lever position A causes contact switching finger 102 to effect a "momentary" circuit between electrical conducting leaves 40 and 42. The inclined surface 152 *a* of the cam 152 exerts a lateral component of force on the detent pin 114 causing the lever 36 to return to lever position B. Displacement of the lever 36 into position C causes contact switching finger 104 to effect "locked" contact between electrical conducting leaves 48 and 50. In this position, the detent roller 114 is locked into indentation 152 *c*.

Cam 154 of FIG. 15 is the symmetric opposite of cam 152. Accordingly, cam 154 provides a three position switch program having a "locked-off-momentary" program.

The indentations of the above-described cams determine the number of lever switching positions and their effect on the electrical conducting leaves. The angular variations between inclined surfaces and indentations in the cams prevent the lever 36 from being accidentally displaced. The operator must exert a certain minimum force on the operating end 100 of the lever 36 in order to displace it from an equilibrium position. This arrangement not only prevents accidental displacement of the lever 36, but insures a smooth and quick lever switching action because of the impulse force which is released when the detent pin 114 rides out of an indentation in response to a force on the operating end 100 of the lever switch 36.

The programmable lever switch of this invention is available with an illuminating lamp 88 as has been described. An additional feature of the invention is the embossing of a letter code representing the cam program on the translucent surface of the programming cam. For example, the cam 152, shown in FIG. 14, has the embossed letter M as an abbreviation for "momentary" beneath the inclined surface 152a, the embossed letter O as abbreviation for "off" beneath the indentation 152b, and the embossed letter L, as abbreviation for "locked" beneath the indentation 152c.

To better enable the operator to determine the particular program mode of the switch in a given lever position, the undersurface 160 of contact switching end 101 of the lever 36 is available with a predetermined color treatment which reflects a predetermined color from the illuminated lamp 88 when the lever 36 is in a predetermined position.

It is to be understood that the embodiment of the invention which has been described is merely illustrative of one application of the principles of the invention. Numerous modifications may be made to the disclosed embodiment without departing from the true spirit and scope of the invention.

What is claimed is:

1. A programmable lever switch comprising, in combination:

- a supporting frame having an opposing pair of windows defined in said frame,
- a lever pivotally secured to said frame and pivotal about a fixed point with respect to said frame to at least two switching positions having a first operable end and a second contact switching end,
- electrical contact means on said frame for selective engagement with said second end of said lever,
- linkage means secured to said contact switching end, and,
- detachable programming cam insert means detachably secured by snap in locking tab means in said windows, in said frame for engaging with said linkage means for controlling the switching action of said lever switch.

2. The device of claim 1 wherein said programming

cam means comprise two cam windows of self-lubricating molded plastic having said tab means rigidly secured to said cam windows for detachably securing said cam windows within the frame windows defined in said frame.

3. The device of claim 1 wherein said programming cam insert means include a cam surface insert means for a momentarily returning said lever to a central lever position when said lever is displaced away from said central lever position.

4. The device of claim 1 wherein said programming detent cam insert means includes a cam surface insert means for locking said lever into lever position distinct from the central lever position such that a predetermined locked contact is effected between said contact means.

5. The device of claim 1 including lamp means for illuminating said programming cam insert means detachably secured to said supporting frame.

6. The device of claim 1 including a letter code embossed on said programming cam means such that the program of such said switch in a particular lever position may be easily identified by reference to said letter code.

7. In a lever switch of the type having a frame having a pair of opposing windows defined in said frame and a contact engaging lever mounted for pivotal motion on said frame about a fixed point with respect to said frame, the improvement comprising, in combination, linkage means for said lever, interchangeable cam insert means comprising a pair of cams of self-lubricating molded plastic having tab means rigidly secured to said cams for snap in locking of said cams to permit engagement of said cams with said lever through said linkage means and provide for interchangeable combinations of momentary and locked switching actions by said lever switch.

8. The improvement of claim 7 including cam surface means defined in said cams engaging said linkage means and controlling movement of said lever such that said lever may not be moved without application of a minimal switching force.

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