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Bury

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[54] **ALTERNATE ACTION SWITCH MECHANISM**

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[73] Assignee: **Illinois Tool Works Inc.,** Chicago, Ill.

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[52] **U.S. Cl.** ..... **200/153 J,** 200/159 R

[51] **Int. Cl.** **H01h 13/56**

[58] **Field of Search** ..... 200/153 J, 153 R

[56] **References Cited**

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Primary Examiner—Robert K. Schaffer
Assistant Examiner—William J. Smith

[57] **ABSTRACT**

An alternate action switch mechanism is achieved by means of a cam including a cam slot into which a cam follower is inserted to engage a plurality of cam surfaces that are formed as a series of ramps and drop-offs. The cam slot is formed as a closed loop so that the cam follower repeatedly falls into one drop-off after another after it rides up the associated ramp surfaces. The cam follower is thereby prevented from returning to the previous ramp by each drop-off and it, therefore, traverses the cam slot in a single direction. At one position of the cam follower, resulting from a first depression of the plunger, the switch is locked into an actuated position. When the plunger is subsequently depressed, the cam follower returns to its original position, thereby deactuating the switch.

7 Claims, 11 Drawing Figures

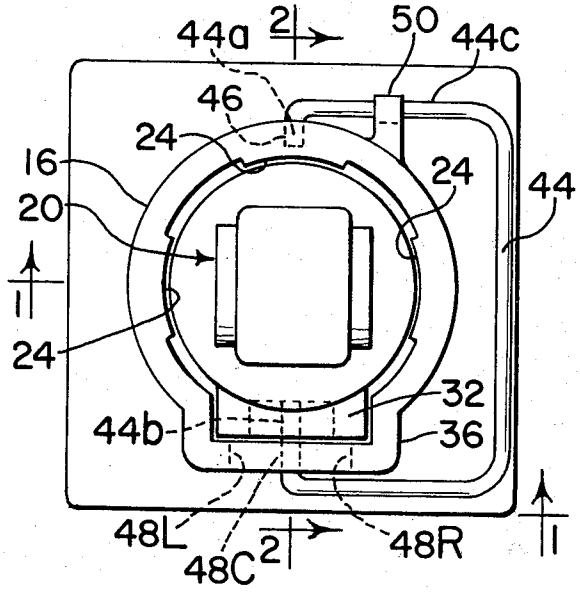


Fig. 1

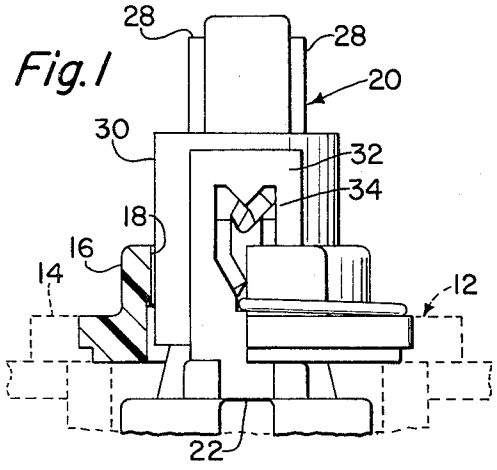


Fig. 2

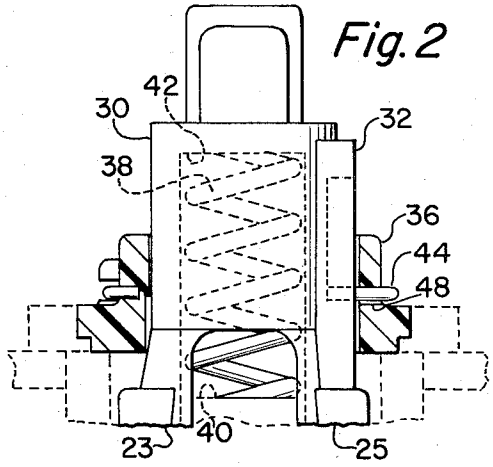


Fig. 3

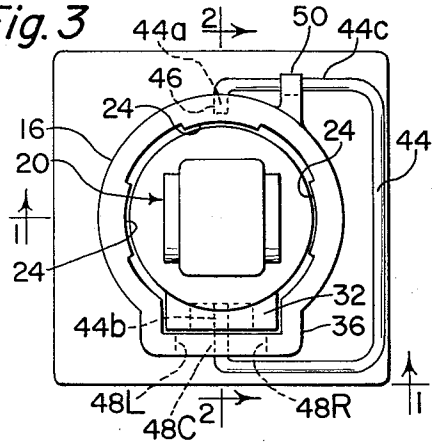
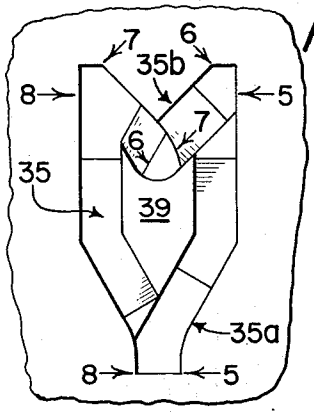


Fig. 4



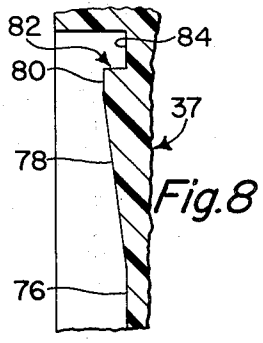


Fig. 8

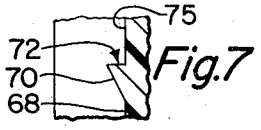


Fig. 7

Fig. 6

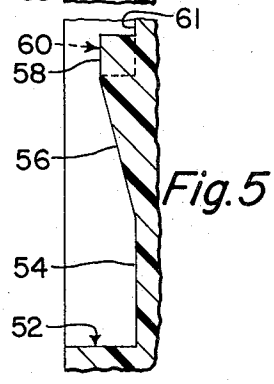


Fig. 5

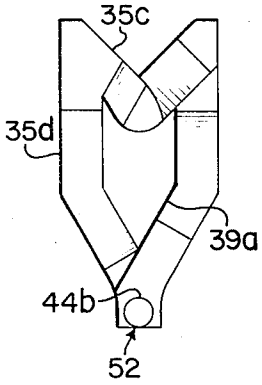


Fig. 9

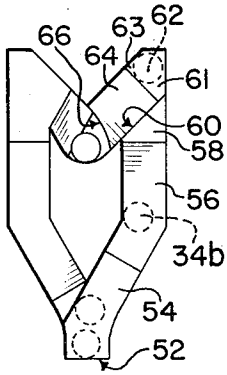


Fig. 10

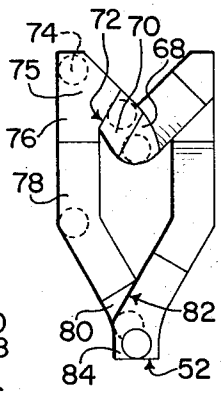


Fig. 11

ALTERNATE ACTION SWITCH MECHANISM

BACKGROUND OF THE INVENTION

One type of electrical switch of great utility is the alternate action switch in which the actuating member for the switch may be depressed once to actuate the switch, so that the switch will remain locked "on" in the actuated state following release of the actuating member and, when the switch is depressed a second time the switch will be deactuated. In the manufacture of alternate action switches, it is desirable that the alternate action mechanism be constructed so that it cannot interfere with the switching mechanism of the switch, thereby avoiding possible switch failure. Moreover, it is also desirable to be able to provide an alternate action switch mechanism which may be used with many different types of switches. Since the manufacture and sale of switches is highly competitive, it is necessary that any alternate action mechanism of wide use must be designed to be constructed in a simple and reliable manner at a minimum of additional cost over and above the cost of the other switch parts. It is also desirable that the alternate action switch be constructed so that it can serve as a single action switch by slight modification that does not require disability of the switch or removal of the switch from a circuit assembly.

It is, therefore, an object of the present invention to provide an alternate action switch in which the alternate action mechanism is obtained by a cam that is integrally formed on the actuator or plunger of the switch and a cam follower, which is removably secured to the external housing of the switch body, wherein the interaction of the cam and the cam follower provides an alternate action mechanism that does not interfere with the switching mechanism of the switch.

It is an additional object of the present invention to provide an alternate switch mechanism in which alternate action is achieved by the interaction of a cam and the cam follower in which the cam comprises a continuous closed slot having camming surfaces therein that are formed with a series of ramps and drop-offs and the cam follower is formed of a spring wire member with a cam following end that rides in the cam slot and is controlled by the camming surfaces so that the cam follower traverses around the cam slot in only a single direction wherein the actuator of the switch is preferably a plunger that is depressed a first time to lock the switch in its actuated state, due to interaction of the cam follower and the cam, and is depressed a second time to return the plunger to its initial position, at which position the switch is deactuated.

It is another object of the present invention to provide a switch which may be converted from an alternate action switch to a single action or a momentary action switch merely by the removal of a cam follower which is secured to the exterior of the switch housing when an alternate action switch is desired.

Further objects and advantages of the present invention will be apparent from the preceding discussion and from the following description, along with the accompanying drawings.

DESCRIPTION OF THE DRAWINGS

FIG. **1** is a partially sectionalized side view taken along the lines **1—1** of FIG. **3** which shows the upper portion of the switch housing and the actuator for the switch;

FIG. **2** is a side sectional view taken along the lines **2—2** of FIG. **3** which shows the actuator plunger portion of the switch mechanism;

FIG. **3** is a top view which shows the top of the switch housing and the cam follower;

FIG. **4** is an enlarged view of the cam that is formed on the depressible actuator plunger of FIG. **1**;

FIGS. **5—8** are cross sectional views which show the profiles of the various cam surfaces of the cam of FIG. **4** in detail, with the Figure number corresponding to the section of FIG. **4** that is designated by the same number;

FIGS. **9–11** are enlarged views of the cam which show the movement of the cam follower in the cam slot during operation of the switch mechanism.

TECHNICAL DESCRIPTION OF THE INVENTION

The alternate action switch mechanism of the present invention is shown in detail in FIGS. **1, 2** and **3** of the drawings. This mechanism can be utilized by many different types of switches in which a moveable actuating member, such as a depressible plunger, is used.

The compact alternate action mechanism of the present invention is referred to generally by the reference numeral **10** in FIG. **1.** Only the upper portion **12** of the switch housing is shown in the figures. The upper portion **12** of the switch housing has an upper surface **14** with an integral boss **16** that projects upwardly from the surface **14.** The boss **16** has a central aperture **18** into which the actuating element or plunger **20** is positioned. The switch housing **12** and the plunger **20** of the present invention are preferably formed of plastics, and the plunger **20** is preferably molded as a single part. The lower end of the plunger **20** may be bifurcated, as shown in FIG. **2,** and the arms **23, 25** may be used to actuate the type of switch which may be turned "on" and "off" by movement of a depressible plunger. This mechanism may also be used to operate special types of switches such as those shown in U.S. Pat. Nos. 3,638,221 and 3,638,222, which are owned by the assignee of the present application.

In order to provide for free motion of the plunger **20** in the boss **16,** the outer periphery of the plunger **20** contacts the boss **16** at only several bearing surfaces **24** in order to reduce friction between the plunger **20** and the boss **16.** The upper portion **26** of the plunger **20** is formed of a generally rectangular shape and has two keycap retainers **28** of a generally rectangular shape which extend from opposite sides of the upper portion **26.** An identification keycap which is unique to the switch may be secured on the portion **26** and the retainers **28.** Below the rectangular section **26** there is a larger section **30** of a generally circular shape. Section **30** has an outwardly extending cam block **32** of a generally rectangular shape. The cam **34** is formed in the cam block **32.** The generally cylindrical boss **16** is constructed with a generally rectangular enclosure **36** which conforms to the shape of the cam block **32.**

In order to return the switch to its initial position upon release of force on the plunger **20,** the internal

portion of the plunger **20** is formed with a hollow shape for receiving a bias spring **38.** The spring **38** is compressible between a surface **40** of the housing **12** and a surface **42** on the plunger **20.** When the plunger **20** is depressed the spring **38** supplies a return force to the plunger **20.** The manner in which the biasing force is supplied to return the plunger **20,** or other actuating member, to its unactuated position may be achieved in a number of different ways within the scope of the present invention.

The cam **34** includes a cam slot **35** that is formed integrally with the cam block **32.** As can be seen by reference to FIGS. **1** and **4,** the cam slot **35** has a closed loop configuration. When viewed from the front, the bottom portion **35***a* of the cam slot **35** resembles a "Y" while the upper portion **35***b* resembles a "V." The cam follower **44** is formed of a spring wire which is C-shaped. The ends of the cam follower **44** are turned inwardly toward each other with one of the other ends, **44***a*, being substantially shorter than the other outer end **44***b*. The end **44***a* is inserted into a receiving aperture **46** that is formed in the boss **16,** so as to secure the cam follower **44** to the switch housing **12.** The longer end **44***b* of the cam follower **44** serves as the actual cam following portion of the mechanism, and this end is positioned in engagement with the cam surfaces **37** of the cam slot **34.** (FIGS. **5 – 8**). The cam following end **44***b* of the cam follower **44** passes through a retaining slot **48** in the enclosure **36** so that the end **44***b* of the cam follower **44** is allowed to move to the left or to the right, as viewed in FIG. **3,** in the slot **48** but so that the end **44***b* is restrained from moving substantially in a vertical direction by the enclosure **36.** The rear leg **44***c* of the cam follower **44** is restrained from moving upwardly, which it otherwise would do when the cam following end **44***b* is at certain positions in the cam slot **35,** by means of the outwardly projecting post **50** which extends from the boss **16.**

The manner in which the cam follower **44** and the cam **34** interact to provide the desired alternate action feature of the present invention is described in more detail by reference to FIGS. **4** through **11.** As previously mentioned, the cam **34** includes a cam slot **35** in which the cam surfaces **37** are formed. A cam guide **39,** which is surrounded by the cam slot **35,** is also part of the cam **34.** The cam following end **44***b* of the cam follower **44** traverses the cam slot **35** in a closed loop path in a generally counter clockwise direction, as viewed in FIGS. **9 – 11,** when it is in engagement with the camming surfaces **37** of the cam **34.** The camming surfaces **37** are shown in detail in the partial sectional views of FIGS. **5 – 8** which show their profiles with the direction of the ramps **56, 64, 70** and **78** rising away from the plunger **20.** The Figure numbers of FIGS. **5 – 8** correspond to the segments of the cam **34** that have the same reference numerals in FIG. **4.**

In order to described the operation of the alternate action switch mechanism, it is assumed that the plunger **20** is initially in a raised unactuated position. The cam follower end **44***b* will then be positioned in the cam slot **35** at its lowermost position **52.** The position **52** is physically located at the bottom of the cam surface **54** of the cam section of FIG. **5.** The cam surface **54** is slightly angled to the right and is flat. The purpose of having the surface **54** flat is to allow for slight "teasing" or partial operation of the switch which invariably occurs, in some keyboard applications, without beginning actuation of the switch and without running the cam following end **44***b* up the ramp **56.** When the plunger is depressed beyond the point where the cam following end **44***b* has passed the flat section **54,** it begins to run up the ramp **56.** The cam following end **44***b* continues up the ramp **56** until it passes over the short flat section **58** and drops into the drop-off **60.** Once the cam following end **44***b* has dropped into the drop-off **60,** release of pressure on the plunger **20** will not cause the cam following end **44***b* to return along the cam sections **56** and **54** to the initial point **52.** Thus, the cam following end **44***b* is constrained to move in a general counter clockwise direction onto the cam surface **61,** which allows for some over travel of the plunger **20,** to the point **62** and from there onto the flat cam surface **63** and the ramp surface **64.** Once the plunger **20** has been fully depressed release of the force applied to the plunger **20** allows the spring **38** to bias the plunger **20** in the upward direction. This causes the cam following end **44***b* to travel up the ramp **64** and into the drop-off **66** where it is retained against reverse movement, so that the switch is maintained in its actuated position due to locking of the plunger **20** in its depressed condition.

During the depression of the plunge, as the cam following end **44***b* is traversing the cam surfaces **54 – 58,** the cam following end **44***b* is normally positioned so as to be in contact with the right side **39***a* of the cam guide **39.** This is made possible by rotation of the cam follower **44** in a counter clockwise direction, as viewed in FIG. **3,** due to the interaction of the cam following end **44***b* and the cam surfaces **37.** The projecting post **50** on the boss **16** prevents the cam following end **44***a* from being disengaged from the aperture **46** in the boss **16** during rotation of the cam follower **44.** When the switch is fully depressed, and the cam following end **44***b* is in the drop-off **60,** the cam follower **44** will be rotated to its maximum counter clockwise position. The cam following end **44***b* will then be at its right most point **48R** in the slot **48,** as viewed in FIG. **3.** When the pressure on the plunger is released by the operator and the cam following end **44***b* has dropped into the drop-off **66,** the cam following end **44***b* is rotated back to substantially a central point **48***c* in the slot **48.**

Actuation of the switch upon the first depression of the plunger has thus been described. When it is desirable to deactuate the switch, which is maintained actuated by the position of the cam following end **44***b* in the drop-off **66** of the neck of the V-shape portion **35***b* of the cam slot **35,** the plunger **20** is again depressed. Movement of the plunger **20** is possible at this stage because the cam following end **44***b* is now allowed to rotate in a clockwise direction, as viewed in FIG. **3.** The cam following end **44***b* is then driven along the flat surface **68,** which is provided to allow for slight movement or "jiggling" of the plunger **20** without deactuation of the switch. Since the flat surface **68** is substantially shorter than the flat surface **54,** the tolerance for "teasing" of the switch in the actuated position is much smaller than it is in the deactuated position.

Upon further depression of the switch the cam following end **44***b* will ride up the ramp **70** and will drop into the drop-off **72** at the end of the ramp **70** to prevent the cam following end **44***b* from returning to the ramp **70.** This again insures that the cam following end **44***b* continues to traverse the cam slot **35** only in a generally clockwise direction. Having dropped into the drop-off **72,** the cam following end **44***b* now traverses

cam surface **75** along the outer wall **35***c* of the cam slot **35** to the point **74.** Then when the pressure on the plunger **20** is released the cam following end **44***b* follows the cam surface **76** downwardly along the outer wall **35***d* of the cam slot **35** to the cam ramp surface **78.** The cam follower **44** will now be rotated to its maximum clockwise position and the cam follower end **44***b* will be at its left-most position **48**L in the slot **48.** When the cam following end **44***b* reaches the cam ramp section **78,** it will follow the cam section **78** upwardly and then it will travel over the flat section **80** and into the drop-off **82.** After falling into the drop-off **82,** the cam following end **44***b* will return to its initial starting position **52** along the flat cam section **84.**

The design switch of the present invention is specially advantageous in that the switch may be converted to a momentary or a single action type of switch merely by removal of the cam follower **44** from the housing **12.** This may be easily achieved since the cam follower **44** is preferably formed of a spring wire of a small diameter which may easily be sprung into position on the switch.

It will be understood that various modifications and embodiments of the present invention may be made without departing from the spirit and scope of the present invention as defined by the following claims.

What is claimed is:

1. An alternate action switch mechanism comprising a switch housing having an outer surface with an aperture therein, a projection extending from said housing parallel to said surface, an actuating member mounted for movement in said aperture between an initial position and a locked position, spring means for biasing said actuating member towards its initial position, said actuating member having a cam associated therewith, an elongated wire cam follower having a portion located under said projection so that said projection limits the movement of said cam follower to prevent said cam follower from being released from said housing during actuation of said switch mechanism, said cam follower also having first and second ends with the major length of said cam follower between said first and second ends being located on the exterior of said housing so as to be readily removable therefrom when momentary switch action is desired, said first end being secured to said switch housing and said second end serving as the cam following portion of said cam follower, which is positioned to interact with said cam, said cam follower rotating under said projection and over said surface of said housing during actuation of said actuating member with said cam and said cam follower being constructed to interact so as to lock said actuating member in its locked position upon a first actuation of said actuating member and so as to release said actuating member to its initial position upon a second actuation of said actuating member when said cam follower is secured to said housing.

2. An alternate action switch mechanism as set forth in claim **1** wherein said actuating member is a depressable plunger and said cam is integrally formed therewith.

3. An alternate action switch mechanism as set forth in claim **2** wherein said cam follower is C-shaped.

4. An alternate action switch mechanism as set forth in claim **3** wherein said cam comprises a cam guide, a cam slot having closed-loop configuration which encircles said cam guide and cam surfaces in said cam slot and wherein said cam following portion of said cam follower is inserted in said cam slot.

5. An alternate action switch mechanism as set forth in claim **4** wherein said cam surfaces comprise a series of flat surfaces, ramp surfaces and drop-offs and said cam following portion rides on said flat surfaces and said ramp surfaces and over said drop-offs said cam following portion thereby undergoing one general direction of travel around said cam slot.

6. An alternate action switch mechanism as set forth in claim **5** wherein said cam following portion engages at least a portion of said cam guide as said cam following portion travels around said cam slot.

7. An alternate action switch mechanism as set forth in claim **3** wherein said cam comprises a cam slot of a closed-loop configuration and cam surfaces in said cam slot and wherein said cam following portion of said cam follower is inserted into said cam slot and moves around said closed loop upon a first and a second actuation of said actuating member while undergoing one general direction of travel.

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