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54 Precision snap-action switch.

57 The precision snap-action switch with a three-lever snap-action mechanism comprises an actuated element (4) and an arched spring element (5); the actuated element (4) has on its one end a moving double contact (6) and is fixed on a case (3) of the snap-action switch at its other end and cooperates with an actuator (12) while one end of the arched spring element is supported in a tilting bearing (9). A point-shaped bulge (15) is formed on the actuated element (4) of its own material for cooperation with the actuator (12), and the actuator (12) has at least partially a plane operating surface (14).

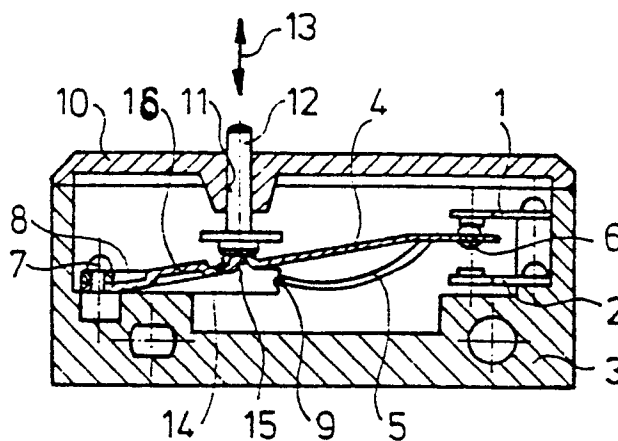


Fig 1

Precision snap-action switch

The invention relates to a precision snap-action switch with a three-lever snap-action mechanism comprising an actuated element and an arched spring element, wherein the actuated element has on its one end a moving double contact and is fixed on a case of the snap action switch at its other end and cooperates with an actuator, while one end of the arched spring element is supported in a tilting bearing.

Snap-action switches, with precision snap-action switches among them, are produced and distributed by many manufacturers with internationally standardized dimensions, therefore, the snap-action mechanism of these switches always have the same dimensions. Constructional and characteristic features of such switches are described e.g. in the Catalogue No. Z-007 of the Firm of OMRON Tateisi Electronics Co., Japan issued on May, 1970, or in any "Basic switches Catalogue" of the Firm of Honeywell, U.S.

The actuated element of the known snap-action mechanism is pre-loaded in the initial position by the arched spring element on both sides of the actuated element. The free end of the spring element is supported in a tilting bearing while the end being opposite to the double contact of the actuated element is fixed on the case of the switch. On the common part of the actuated element and the spring element, the moving contact, generally a double contact, is arranged between a fixed contact N.C. and a fixed contact N.O. of the switch. The actuator with an operating axis being perpendicular to the longitudinal axis of the snap-action switch is provided with a convex, practically point-shaped actuating surface. During the operation the actuator bends the actuated element near to the axis of the tilting bearing of the spring element and after leaving the dead-point position, the actuated element snaps over and the moving contact will lie on the fixed contact N.O. during existence of operating force. After discontinuing the operating force, the snap-action mechanism snaps back from the operating position to its original position.

Another type of snap-action switches is also preciously known, wherein the middle lever of the snap-action mechanism is formed as an arched spring element while both outer actuated elements are bound to each other at the moving contact and in the contacting zone of the actuator.

One of the most problems of the snap-action switches which has to be solved is the realization of a small differential in the movement of the actuator between the two positions of the contacting elements and, at the same time, of a small differential between the operating force and the release force

without decrease in a satisfying contact separation. When the contact separation decreases, the movement differential of the actuator also decreases, so that the force differential will be reduced, since the operating force will be smaller. Reduction of contact separation has disadvantageous effect on the power characteristics of the switch, since decrease in the contact separation results in the decrease of the contact force which increases the possibility of the burning of contact. Burning of contact has a baleful influence on power characteristics of the snap-action switch. Switches of the prior art have the disadvantageous symptom that using the switch in D.C. circuits and on the voltage higher than the arc-striking voltage, the contact of the negative pole tapers because of the arc-striking so that the small contact separation disappears after a relative small number of operations and the switch cannot switch through.

Because of the aforementioned drawbacks, standard specifications prescribe the smallest contact separation, therefore it is impossible to attain more advantageous data of movement differential and force differential with the snap-action mechanism of the known switches than with a snap-action mechanism having a contact separation of e.g. 0,5 mm.

The main object of the invention is to eliminate the enumerated drawbacks of the known snap-action switches and to improve the movement differential and force differential data of snap-action switches and to ensure the same movement differential data with less force differential and to maintain the contact force in case of known double minimum contact separation with the help of a few and easy practicable changes in construction.

The main idea of the invention is in that the main object set in this invention can easily be reached by improving the force dynamics between the actuated element and the actuator when the switch is in operation.

According to the development in this invention, a point-shaped bulge is formed on the actuated element of its own material for the cooperation with the actuator, and the actuator has at least partially a plane operating surface.

The main advantage of this solution is in that the moving differential data are improved and the snap properties of the snap-action switch will be better, because no force has any harmful influence on the actuated element in a direction perpendicular to the longitudinal axis of the actuator.

In a preferred embodiment of this invention a stiffener is provided on the actuated element in the zone between its fixing point formed as a rivet and

the bulge which is formed out of the own material of the actuated element and is parallel to the longitudinal axis of the actuated element. Due to the stiffener the operating place, i.e. the point shaped bulge can be arranged further away from the fixing point. This results in an advantageous contact force and in a smaller load of the actuated element.

In a further preferred embodiment of the invention, the bulge on the actuated element is in contact with an actuator having an axis parallel to the longitudinal axis of the snap-action switch and an operating surface formed as a lateral face of a truncated pyramid merging into a lateral face of a rectangular prism. The actuator can be held in its initial position by a helical spring arranged concentrically around the axle of the actuator and by a ring on the axle of the actuator lying on the inner side of the cover.

It is further advantageous according to the invention when the actuator is formed as a disc pivotally mounted in an opening of the cover, wherein the actuator has on a part of its circumference an operating surface and two detent slots operating with a detent spring fixed on the cover and defining the bistable position of the disk. Due to this feature, the snap-action switch according to the invention is suitable for operation with excessive overtravel without change in the switch characteristics and damage of the snap-action mechanism.

Further features of the invention will be described in detail with reference to the accompanying drawing showing some preferred embodiments of the snapaction switch in this invention. In the drawing,

Fig. 1 shows a longitudinal cross section of a preferred embodiment of the snap-action switch according to the invention;

Fig. 2 is a top view of the snap-action switch according to Fig. 1 without cover;

Fig. 3 shows a longitudinal cross section of an embodiment with a rigid actuator having bistable positions and increased overtravel; and

Fig. 4 is a top view of an embodiment provided with a snap-action mechanism having an inner spring element and a double outer actuated element, without cover.

As may be seen in Fig. 1, a fixed contact N.C. 1 and another fixed contact N.O. 2 of a snap-action switch are arranged in a case 3. An inner actuated element 4 of the three-lever snap-action mechanism lies between two outer spring elements 5 and is provided with a (moving) double contact 6 on its one end while its other end is fixed e.g. by a rivet 7 on case 3 of the snap-action switch. The free ends of spring elements lie in V-shaped flutes of tilting bearings 9 of a support 8.

The spring elements 5 are bent in a manner shown in Fig. 1. Alternatively tilting bearings 9 can be made of the own material of case 3, so the fitting of supports 8 will be unnecessary. An actuator 12 -usually a plunger -is led through a bore 11 formed in a cover 10 of the snap-action switch. The actuator 12 movable in the direction of an arrow 13 has an operating surface 14 being in connection with the actuated element 4, of rather, with a point-shaped bulge 15 with a diameter of maximum 1,0 mm formed out of the own material of the actuated element 4. The bulge 15 has in this case a form of a calotte, but of course, it can be formed as a spherical segment or a cone too. On the actuated element 4, between rivet 7 and bulge 15, a stiffener 16 with a length of e.g. 5 mm is formed out of its own material which is parallel to the longitudinal axis of actuated element 4.

Fig. 2 shows a top view of the snap-action switch without cover 10. A further hole 17 is provided in actuated element 4 between rivet 7 and stiffener 16. This hole 17 locally reducing the cross section of the actuated element 4 determines a bending axle 18 of the actuated element 4.

In the initial position of the snap-action switch according to the invention, no operating force is effective upon actuator 12 so that moving contact 6 is pressed on fixed contact N.C. 1. By pressing actuator 12 in the direction of arrow 13, the snap-action mechanism snaps over and moving contact 6 flies towards fixed contact N.O. 2 very quickly at a constant speed. During that time, the plane operating surface 14 of actuator 12 lies on the point-shaped bulge 15 of actuated element 4 and it can slide and twist on that without causing reaction forces being perpendicular to the direction of movement of actuator 12 (arrow 13) and emerged due to bending of the actuated element 4. Due to the stiffener 16 of actuated element 4, the movement differential, i.e. the hysteresis of the switch can be reduced.

Fig. 3 shows a longitudinal cross section of a further preferred embodiment of the snap-action switch according to the invention which has an actuator 19 formed as a disc with bistable positions. The actuator 19 is arranged in an aperture 20 of cover 10 of the switch and is pivotally mounted on an axle 21. The disc has a circumferential operating surface 23 with a radius larger than the radii of the other circumferential surfaces of the disc. In the initial position of the switch, bulge 15 of actuated element 4 lies on the circumferential but not on operating surface 22 of actuator 19, and, thus, no operating force is effected. After tumbling actuator 19 in the direction of an arrow 22, operating surface 23 of the disc comes in contact and presses actuated element 4 through bulge 15 and, thus, the snap-action mechanism will snap over, i.e.

moving contact 6 will lie on fixed contact N.O. 2. Herein, the disc is in its other stable position. Both stable positions of the actuator 19 are detined by a detent spring 24 fixed on cover 10 or, alternatively, on case 3 and cooperating with one of slots 25 formed in the disc.

A drawback of the known snap-action switches provided with an actuator having an operating axis being perpendicular to the longitudinal axis of the switch is the strictly tolerated and, thus, limited overtravel, i.e. the distance which the actuator is permitted to travel after actuation. Exceeding this value being as small as e.g. 0,13 mm causes a greater deflection of the actuated element that results in its deformation and, thus, in decrease of contact force and shortened lifetime of the switch. This disadvantage is eliminated by the embodiment of the snap-action switch of this invention shown in Figs. 4 and 5.

Fig. 4 shows a longitudinal cross section of the switch wherein an actuator 26 is slidably arranged in a bore of cover 10. The direction of movement of actuator 26 is parallel to the longitudinal axis of the switch. Actuator 26 is held in its initial position by a helical spring 27 which is arranged concentrically around the axle of actuator 26 between a shoulder of actuator 26 and cover 10. A ring 28 provided on the axle of actuator 26 resting on the inner side of cover 10 limits the outward motion of actuator 26. The actuator 26 has an operating surface in a form of a lateral face of a truncated pyramid 30 merging into a lateral face of a rectangular prism 29 which presses actuated element 4 through bulge 15 during operation where upon the snap-action mechanism will snap over. This embodiment has a three-lever snap-action mechanism wherein spring element 5 is the inner lever and the outer levers are parts of actuated element 4. These outer levers are connected to each other at moving contact 6 and at bulge 15.

During the snap action, the operating surface i.e. the lateral face of truncated pyramid 30 presses bulge 15 and the switch will snap over. Thereafter, the lateral face of rectangular prism 29 will be in contact with bulge 15 causing no displacement in direction being perpendicular to the movement of actuator 26. Thus, there will not be any forces effecting the deformation of actuated member even

if the travel of actuator 26 exceeds a predetermined value of e.g. 0,13 mm.

The above mentioned protection against distortion of actuated element 4 can be provided in the embodiment shown in Fig. 3 by that the operating surface 23 of actuator 19 has a constant radius.

Claims

1. Precision snap-action switch with a three-lever snap-action mechanism comprising an actuated element (4) and an arched spring element (5), wherein the actuated element (4) has on its one end a moving double contact and is fixed on a case (3) of the snap-action switch at its other end and cooperates with an actuator (12), while one end of the arched spring element (5) is supported in a tilting bearing (9), characterized in that a point-shaped bulge (15) is formed on the actuated element (4) of its own material for the cooperation with the actuator (12, 19, 26), and the actuator (12, 26) has at least partially a plane operating surface (14).

2. Precision snap-action switch as claimed in claim 1, characterized in that a stiffener (16) is provided on the actuated element (4) in the zone between its fixing point formed as a rivet (7) and the bulge (15) which is formed out of the own material of the actuated element (4) and is parallel to the longitudinal axis of the actuated element (4).

3. Precision snap-action switch as claimed in claim 1 or 2, characterized in that the actuator (26) has an axis parallel to the longitudinal axis of the snap-action switch and an operating surface formed as a lateral face of a truncated pyramid (30) merging into a lateral face of a rectangular prism (29), and the actuator (26) is held in its initial position by a helical spring (27) arranged concentrically around the axle of the actuator (26) and by a ring (28) on the axle of the actuator (26) lying on the inner side of the cover (10).

4. Precision snap-action switch as claimed in claim 1 or 2, characterized in that the actuator (19) is formed as a disc pivotally mounted in an opening (20) of the cover (10), wherein the actuator (19) has on a part of its circumference an operating surface (23) and two detent slots (25) cooperating with a detent spring (24) fixed on the cover (10) and defining the bistable position of the disk.

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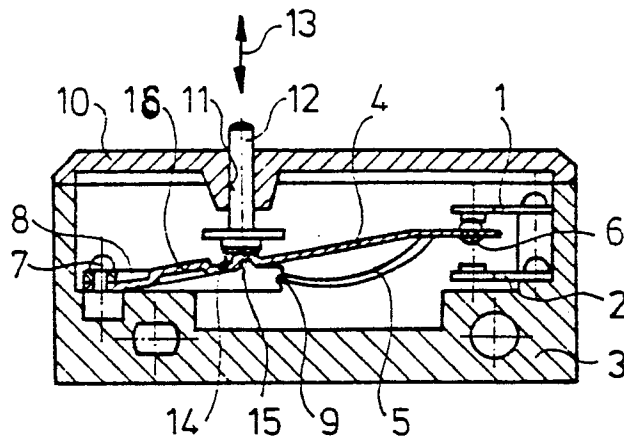


Fig 1

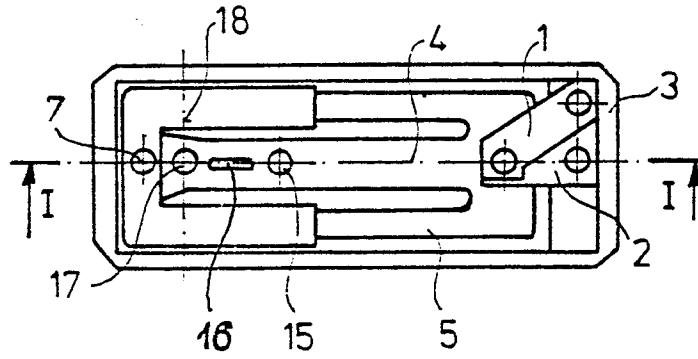


Fig 2

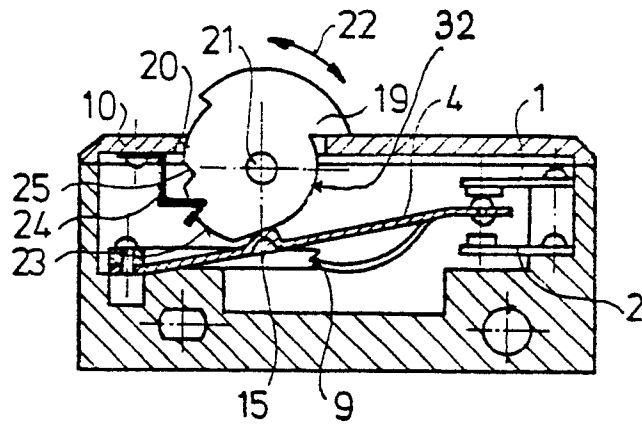


Fig 3

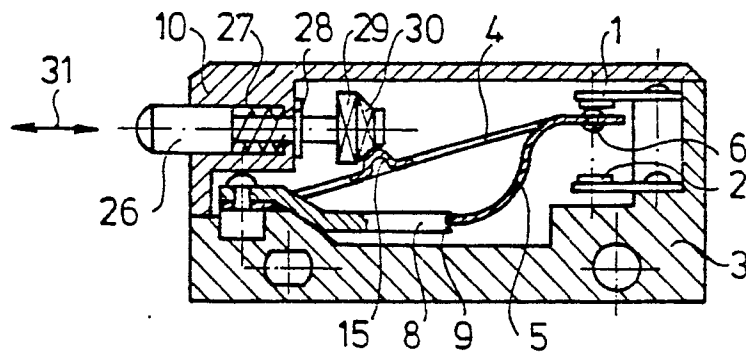


Fig 4

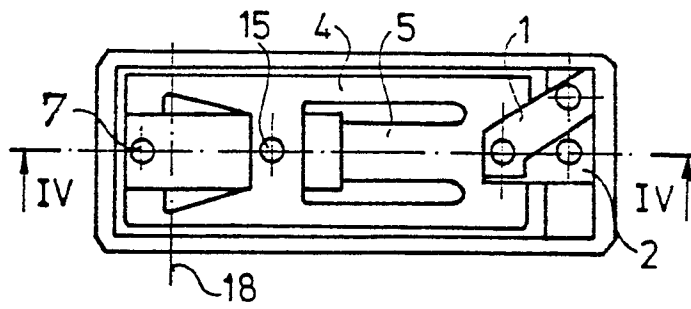


Fig 5



DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
X	US-A-4 209 677 (BROWN) * Column 2, lines 8-15 *	1	H 01 H 5/18
Y		2-4	
Y	--- US-A-2 529 881 (MILLER) * Column 1, lines 48-54 *	2	
Y	--- GB-A- 805 683 (DOWTY) * Figure 3; page 2, lines 84-98; page 3, lines 95-102 *	3	
Y	--- CH-A- 454 999 (SPERRY) * Figures; column 6, lines 32-42 *	4	
X	--- US-A-3 019 312 (LEUPOLD) * Column 3, lines 10-15,23-27 *	1,2	TECHNICAL FIELDS SEARCHED (Int. Cl.4)
X	--- US-A-2 469 686 (EATON) * Column 3, lines 7-24,45-60 *	1	H 01 H 5/00 H 01 H 21/00 H 01 H 13/00 H 01 H 15/00

The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 25-06-1986	Examiner DESMET W.H.G.
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	