United States Patent

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[54] **SNAP ACTION SWITCH**
8 Claims, 2 Drawing Figs.

[52] U.S. Cl. 337/345, 200/67, 337/365
[51] Int. Cl. H01h 37/52
[50] Field of Search .... 337/59, 60, 347, 345, 365; 200/67 A, 67 B, 67 D, 67

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ABSTRACT: A snap action switch system actuating a movable switch contact into alternative contact with two fixed electrical switch contacts by two longitudinally rigid toggle levers pivotal relative to each other about a pivot actuated to two positions opposite a given plane through which the levers pass. The system has a longitudinally flexible arm so that as the rigid toggle levers pass the given plane the flexible arm is flexed longitudinally and the movable contact transported by the system effects a wiping and release action relative to one of the fixed contacts with which it is in contact before effecting a snap action switching action under control of a spring lever biased for actuating the toggle levers to one of the two positions on opposite sides of the given plane. An operator is provided for overcoming the spring lever and moving the toggle levers across said plane to another position on a side opposite to the plane thereby actuating the movable contact into contact with the other of the fixed contacts than that to it contacts under control of the spring lever.

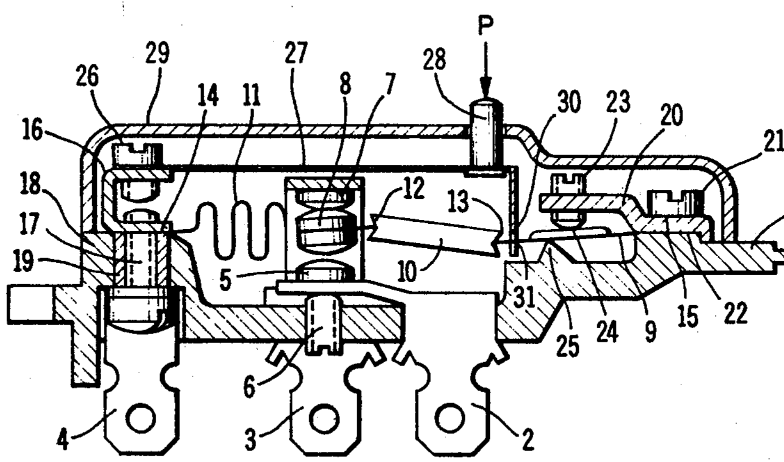

Fig 1

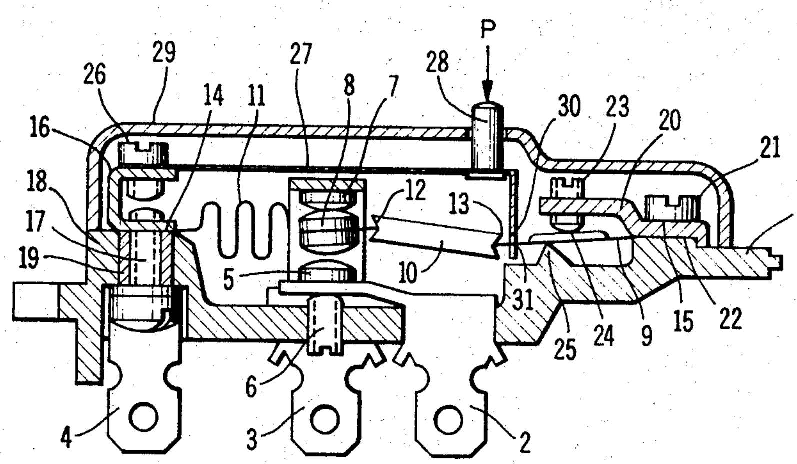
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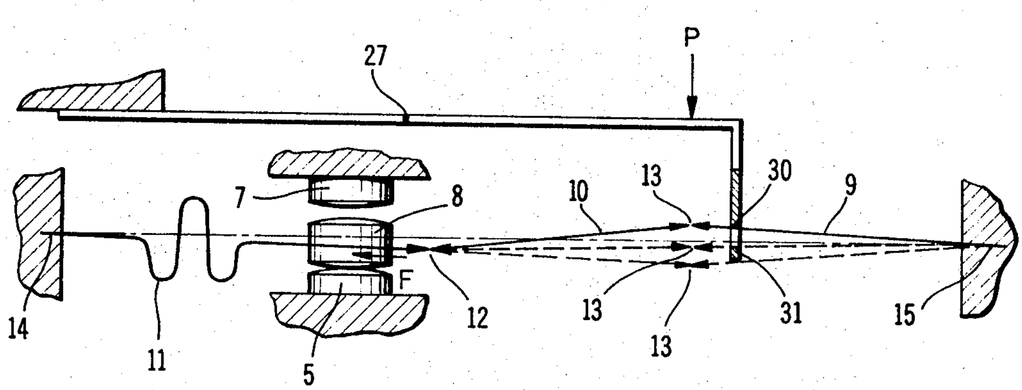
Fig 2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SNAP ACTION SWITCH

This invention relates generally to snap action switches and more particularly to a snap action system for use in such switches.

Snap action switches are known which are switched to different operative positions by actuating forces, for example an actuating element of a thermostatic operator or manually controlled operators and the like. The known snap action switches may comprise a resilient arm mounted between two movable bearing points that effects the switching from contact to contact. In a second type two rigid arms are mounted contiguous, i.e. one rigid arm is mounted between two movable bearing points. In the case of the second-type construction it is known to cause the actuating force to be applied to a fixed rigid arm and to operate the switch contact through the other rigid arm. In such constructions the movable contact has either been connected to the other arm by means of a spring or is mounted independently of this arm. Furthermore, in case of this second-type constructicn it is also known to cause the actuating force to be applied to the rigid arm held between the two movable bearing points in which case the movable contact is rigidly connected to the other arm. In the majority of cases the arms are nested one within the other in a zigzag construction or configuration.

A disadvantage with all known snap action switches is that only the force inherent in the system is available for opening or parting the contacts and this is a force that reaches its maximum value shortly before the snap over action takes place. If the contacts being switched become stuck together this force is often insufficient to separate them. The snap action function cannot then be carried out and the switch is then useless. For this reason snap action switches have, heretofore, not been used in conditions wherein the contacts are likely to become stuck together more or less firmly.

It is a principal object of the present invention to provide a snap action switch in which a movable contact engaging a fixed contact can be separated therefrom even if relatively adhered or stuck thereto by use of the normal actuating forces of the snap action system without interfering with or delaying the normal operation of the switch.

A snap action system for a switch according to the invention is provided with two rigid arms forming a toggle lever configuration. A longitudinally or axially resilient arm mounts the movable contact and the toggle levers in moving to the operating positions for effecting the switching action pass through a plane in which the arm carrying the movable contact is displaced longitudinally without delaying or affecting the snap action. The application of the "axial" or "longitudinal" force along this plane effects a "wiping action" or relative sliding movement between the movable contact and a fixed contact with which it is in physical contact before the switching action so that the contacts are kept clean and if in any way have become stuck the wiping action releases them so that the switching function snap action is freely executed.

The axial movement of the lever arm carrying the movable contact must be executed before a return snap action movement takes place. If this axial movement is resisted, e.g. as a result of the contacts becoming stuck together, the axial force developed and applied by the toggle levers is proportional to the actuating force but it is a multiple of this actuating force consequently the contacts that may be firmly stuck together are separated to allow the switching movement having snap action to be executed.

The snap action system is particularly applicable to switches in which a low value actuating force is to be applied for effecting the switching action and the multiplication of the actuating force for releasing the contacts is necessary to separate stuck contacts. For example, the switch is particularly usable in thermostatically controlled systems in which the switch is actuated by a thermostatic operator and is reversed at a given difference in temperature. In such systems, where the invention is not used, if the contacts are stuck or bonded together the difference in temperature value desired would be exceeded to an extent such that the actuating force then suffices to separate the bond between the contacts. The switch then operates at its prescribed temperature differential values.

While it is particularly advantageous if the movable contact is mounted on the end of a resilient arm presented to toggle lever system the "separating effect" or "wiping action" can also be achieved if the movable contact is located on an end of one of the rigid arms of the toggle lever system.

Stops are provided on both sides of the rigid toggle levers or arms to insure that the longitudinally resilient arm is not bent to such an extent that it becomes permanently deformed. One of the stops also prevents the force, whereby the resilient arm presses the rigid toggle-lever arm against the stop, from exceeding the prescribed return force so that a return snap action of the contact system is insured. At least one of the stops is adjustable so that the above-mentioned values can be adjusted.

The actuation of the snap action system is effected by an operator and a resilient spring member preferably engaged near a pivotal point of the two rigid toggle levers. This results in an even division or distribution of force and in optimal conversion of the actuating force into the axially directed force of the snap action system applied to the movable contact effecting the "separating effect" or "wiping action" between the contacts as above described. The snap action system has two stable switching positions and the actuating spring strip is pretensioned and bent so that a self-restoration or self-returning switch is obtained to one of the operative or contact positions. However, the contact pressure can be the same in both switching positions.

The actuating member comprising the resilient strip member is provided with actuating surfaces engaging the toggle lever system and actuating it. These surfaces are separated by a space the minimal size or distance of which is equal to the movement distance of the toggle lever or arm engaged by the actuating member, between the top-dead-center position of the engaged toggle lever and the top-dead-center position of the two movable bearing points relative to a plane passing through the fixed bearing point of the resilient arm and one of the toggle levers. An increased dynamic force is thereby obtained when switching over is effected since the toggle lever system itself snaps over between the two engagement surfaces of the actuating member and the snapping over of the rest of the system can follow freely.

Other features and advantages of the snap action system in accordance with the invention will be better understood by referring to the detailed description of the present invention as described in the following specification, and appended claims and with the following drawings in which:

FIG. 1, is a side elevation section view of a snap action switch provided with a snap-action system according to the invention; and

FIG. 2, is a schematic diagram for illustrating the action of the snap action system of FIG. 1.

In the drawing, FIG. 1, a switch, according to the invention, is provided with a baseplate 1 having three electrically conductive tabs or terminals 2, 3 and 4. One terminal 2 has a projection which carries a fixed electrical contact 5. This projection is resilient and the position of the fixed contact can be adjusted by means of an adjust screw 6. The intermediate tab or terminal 3 has an extension supporting a fixed contact 7 juxtapositioned relative to the other fixed contact. The third tab or terminal 4 is connected to a movable contact 8 as hereinafter described. It is, of course, understood that the terminals are electrically insulated from the baseplate 1.

The snap action switch illustrated in FIG. 1 has a snap action system for effecting switching between the two fixed contacts so that the movable contact 8 is moved to two operative positions in which it is in physical contact with these fixed electrical contacts. The snap action system comprises a first longitudinally rigid arm 9 pivotally cooperating with a second longitudinally rigid arm or lever 10 and a resilient arm 11.

These arms are flexibly or pivotally connected at two movable bearing points **12, 13**. The movable bearing points **12, 13** take the form of knife-edge bearings in the arm **10** in which are engaged bladelike edges of the outer two arms or levers **9,11**.

The system is anchored at two fixed bearing points **14, 15**. The fixed bearing or pivot point **14** is formed by a clamping stirrup **16** mounting the resilient arm **11** with screw **17** on a boss portion **18** of the baseplate **1**. The screw **17** is circumferentially enclosed by an electrically conductive sleeve **19** which electrically connects the terminal or tab **4** to the electric contact **8** on the electrically conductive resilient arm **11** as well as enabling the screw **17** to be firmly tightened despite the fact that the baseplate may be made of a soft material, for example a nonconductive material. The other fixed bearing point **15** is formed by a clamping member **20** pressing a fixed end portion of the arm or lever **9** against a boss portion **22** on the baseplate **1** and mounted thereon by means of a screw **21**. The clamping member **20** carries an adjusting screw **23** the end face thereof forms a first stop **24** for adjusting the permitted movement of the lever **9**. A fixed second stop **25**, formed on the baseplate, for stopping the same rigid arm **9** is provided on the opposite side.

A bent spring strip **27** is secured to the clamping stirrup **16** by a screw **26**. This strip is pretensioned in a direction away from the baseplate **1** and tends to restore the snap action system to a position in which the movable contact is engaged with one of the fixed contacts. A plunger or operator **28** is fixed to the actuating member or spring strip **27** and extends outwardly of a cover **29** of the housing for the switch. The actuating member **27** is provided with two spaced-apart faces or surfaces **30, 31** for engaging the toggle lever **9** adjacent the pivotal point **13**.

In the position illustrated in FIG. **1** the switch is in its operative position in which the movable contact **8** is in contact with the fixed contact **7** and a force P of such a magnitude has acted upon the plunger **28** such that the snap action system has switched over. When the force P decreases the system returns to its other position as a consequence of the pretensioning of the bent spring strip **27**.

This other operative position which can be a nonoperative position depending on the outside circuitry, is illustrated schematically in FIG. **2**. If a force P is again applied to the bent spring strip **27** this force is transferred to the rigid arm **9** near the movable bearing point **13**. The actuating surface **30** of the actuating member **27** will move the toggle lever system to a plane in which the fixed bearing points **14, 15** are disposed. As the levers move through this plane, in which the pivot **13** assumes the position **13*a***, and because they are longitudinally rigid, a force F is applied longitudinally or axially of the resilient arm **11** which is flexible longitudinally so that the contact **8** is wiped or moved relative to the fixed contact **5**. The contact **8** is moved toward the left in the drawing.

It can be seen that if the movable contact **8** should have become stuck with the fixed contact **5**, i.e. if this axial movement is not possible, the two toggle lever arms **9, 10** act in the sense of reinforcing the toggle lever action in such a manner that the transverse force F is applied to the moving contact **8** as a multiple of the actuating force P. This multiplication is in the order of eight to 10 times as great as the actuating force applied by the operator **28**. This transverse force or multiplied force F suffices to cause a sliding movement between the contacts to separate the contacts that may have become bonded quite firmly together. Furthermore, the axial movement of the resilient arm **11**, and therefore the movement of the contact **8**, provides an advantage in that the contact surfaces are automatically cleaned during each switching operation because of the "wiping action" that takes place.

If the movable bearing point **13** is actuated downwardly past the point **13*a***, in the plane of the fixed bearing points **14, 15**, the toggle levers will snap downwardly under the influence of the axial return spring force of the spring arm **11**. This snapping movement is possible because of the space or distance between the actuating surfaces **30, 31** of the actuating member **27**. If during this snap action movement the bearing point **13** moves beyond a point **13*b*** which lies on a plane or straight line within which two bearing points **14** and **12** are disposed then that part of the system consisting of the lever arms **10, 11** snaps over, i.e. the switch moves momentarily into its other switching position. This mode of operation assumes that the actuating surface **31** is spaced from the other actuating surface **30** by at least a distance such that the snapping movement of the toggle lever arrangement is possible as far as the point **13*b***. This results in a relatively short actuating distance for the bent spring strip **27** since part of the distance necessary for the movable contact to snap over is provided by the snap action movement of the toggle lever system.

Modifications to the embodiment illustrated are possible, for example, the movable contact can also be located adjacent an end of the rigid arm **10** near the bearing point **12**. The actuating force can be applied to the rigid arm **10** near the bearing point **13** and the resilient arm **11** can be made as a tension spring and may extend within the length of the toggle lever arms **9, 10**.

While a preferred embodiment of the invention has been shown and described it will be understood that many modifications and changes can be made within the true spirit and scope of the invention.

What I claim and desire to be secured by letters patent is:

1. In a snap action switch two spaced, fixed electrical contacts juxtapositioned relative to each other, a movable electrical contact, the improvement which comprises a snap action system for actuating said movable contact to a first operative position in which said movable electrical contact is in contact with one of said fixed contacts and for actuating said movable contact to a second operative position in which said movable electrical contact is in contact with the other of said fixed electrical contacts thereby in operation alternately opening and closing electrical circuit means established through said fixed contacts, said snap action system comprising a flexible arm fixed at one end and having a free end portion mounting said movable contact, two longitudinally rigid toggle levers pivotal relative to each other for toggle movement and having a pivot therebetween operable to positions on opposite sides of a selected plane, one of said toggle levers having a fixed end and a free end for movement, the other of said toggle levers being disposed pivotally between the free end of said arm and the free end of said one toggle lever, the fixed ends of said arm and of said one toggle lever being disposed in said selected plane, and actuating means including a movably mounted spring strip having means therein defining an aperture receiving therethrough said one toggle lever to alternately actuate said snap action system causing actuation of said flexible arm to move said movable contact with a snap action movement to said first and second operative positions when said pivot of said levers is moved to respective positions on opposite sides of said plane in response to movement of said spring strip.

2. A snap action system according to claim **1**, in which said flexible arm is electrically conductive.

3. A snap action system according to claim **1**, in which said flexible arm is flexible longitudinally, and in which said longitudinally rigid toggle levers are dimensioned to flex said arm longitudinally when in said selected plane thereby to effect a relative sliding movement between said movable contact and one of said fixed contacts.

4. A snap action system according to claim **1**, in which said means to actuate said snap action system comprises an operator.

5. A snap action system according to claim **1**, in which said means to actuate said snap action system comprises means actuated in response to a thermally responsive actuator.

6. A snap action system according to claim **1**, in which said spring strip has one fixed end and engages said toggle levers adjacent said pivot therebetween.

7. A snap action system according to claim **6**, in which said flexible arm is flexible longitudinally and in which said spring strip comprises an end portion engaging said toggle levers allowing a snap action movement of said toggle levers from said selected plane to said positions on opposite sides of said selected plane.

8. A snap action system according to claim **6**, in which said means to actuate said snap action system comprises an operator for applying a force to said spring strip to overcome biasing force thereof and cause it to actuate said pivot of said toggle levers to the other of said positions on opposite sides of said selected plane.