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SNAP ACTION ELECTRIC SWITCH
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The present invention relates to an electric switch of the type provided with resilient means for urging a contact member into a predetermined position and wherein effective wiping of contacts occurs even during the actual switching operation to ensure proper functioning of said electric switch.

Numerous constructions of electric switches are known, particularly small switches or micro-switches, in which a labile condition is reached by a pivotally movable contact member in the course of the switching movement, whereupon said movable contact member is accelerated from one end position to the other by the action of a resiliently stressed component.

Constructions are known in which a blade spring, which may be formed from the contact member itself, is stressed under flexure, as well as constructions having a tension or coil spring as the resilient member. A tension spring has substantial advantages as compared with a blade spring. On the one hand it offers much greater freedom of design since the wire diameter, the number of turns, the winding diameter and the pre-stressing, can be chosen within wide limits. Moreover, the loading of the wire spring during operation can be clearly seen and is generally held within limits which ensure that the spring has a practically unlimited working life. Generally a coil spring can be more simply mounted than a blade spring and makes adjustment of the electric switch in the course of assembly unnecessary.

One end of the tension spring is anchored in each case to the contact member. To initiate the switch movement or the transit of the contact member across the labile position, various constructions of rocker mechanism are known: either the other end of the coil spring is shifted laterally, or, with a fixed anchorage at the other end, the spring is flexed transversely to its longitudinal axis. In both cases the rocking movement of the contact member is effected about a stationary axis in which the contact member is supported. Indeed these arrangements permit a rapid tipping movement of the contact member but they involve danger of sticking of the contacts since the contact member executes a pure rocking movement and thus is raised perpendicularly from the stationary contact or from a stop on passing the dead center. This danger of sticking, which may be caused by dirt or by light welding of the contacts as a result of excessive current loading, naturally results in a serious faulty operation for the electric switch which in some circumstances may have serious consequences.

A further possibility for effecting the switch movement consists in supporting the contact member on a movably guided member whereby the dead-center position is obtained when the support point reaches the operative line of the spring. With this movable supporting of the contact member it is, in fact, possible to obtain, during the initiation of the switch movement, a so-called wiping movement of the contact surfaces, that is a longitudinal movement of the contact member relative to the stationary contact which can again release a preliminary welding of the contacts.

In the known arrangements the path of the support point of the contact member represents either a circular arc the center of which lies on a working line of the spring, or on a line which intersects the working line at

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a right angle. This means that a wiping movement initiated at the commencement of the switching movement becomes progressively smaller towards the dead-center point and completely disappears when this point is reached.

Now it happens that the rocking mechanism arrangement results in that the contact pressure applied through the spring progressively decreases towards the dead point position during the performance of the switching movement. Thereby the contact resistance considerably increases so that even at normal current loading the heating of the contacts may become so great that they weld together. This is particularly the case with very slow switching movements, such as are often found in those switches intended for operation by clock mechanism, heat responsive devices and so on. Since with the heretofore known electric switches the wiping movement disappears at the same time as the contact pressure is reduced, that is exactly when it becomes most serious owing to the increased danger of welding of the contacts, even with these switches sticking together of the contacts is not effectively avoided.

The present invention has for its primary object to avoid the aforesaid disadvantages while maintaining the advantages of a coil spring and it comprises an electric switch with two stops of which at least one is formed by a stationary contact, an elongated contact member, one end of which is movably mounted between the contacts, and a coil spring extending substantially in the longitudinal direction of the contact member and anchored at one end to the contact member and at the other end to a stationary point and, by the force of which, the other end of the contact member is pivotally supported by a movably guided member for initiating the operation of the switch. The switch according to the invention is characterized by the fact that the path of the support point of the contact member intersects the working axis of the coil spring at an acute angle in the dead-center position so that the movement of the support point at the moment of switching has a component in the longitudinal direction of the contact member.

In the construction of the rocker mechanism according to the invention there is some danger of displacement of the moving parts under the action of external forces especially when the movably guided members are supported by a knife edge. A further feature of the invention therefore consists in the fact that the elements for supporting the contact member embody two parallel limbs and the edges of the limbs facing the knife edges are positioned in each case opposite a fixed stop and the contact member is centered in a notch in each limb and embodies two projections extending beside the limbs for lateral guidance.

Accordingly, it is an important object of the present invention to provide a novel electric switch arrangement wherein a wiping action of contact member and one or more contacts is carried out from initial actuation of said electric switch at least until a switching operation occurs.

It is another important object of the present invention to provide means for mounting a contact member of an electric switch in such a manner that the path of the support point of the contact member intersects the working axis of a resilient member so that the movement of said support point at the instant of switching has a component in the longitudinal direction of the contact member.

A further object of the present invention is the provision of a novel arrangement of an electric switch so that the pivot point about which a rocker arm is adapted to rotate is located outside of a working axis of a resilient member for moving a contact member.

Yet a further object of the present invention is to provide a novelly constructed electric switch highly reliable in operation, yet simple and economical in its construction.

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These and still further objects of the present invention and its entire scope and applicability will become apparent from the detailed description given hereinafter; it should be understood, however, that the detailed description and specific examples, while indicating preferred embodiments of the invention, are given by way of illustration only, since various changes and modifications within the spirit and scope of the invention will become apparent to those skilled in the art from this detailed description.

In the drawings:

FIG. 1 is a plan view of the switch with the cover removed;

FIG. 2 is a cross sectional view taken along line II—II in FIG. 1;

FIG. 3 is a fragmentary sectional view taken along the line III—III of FIG. 1; and

FIG. 4 graphically illustrates the geometric conditions in the arrangement of FIG. 1.

Referring now to the drawings, the electric switch shown is arranged in a housing 1 preferably pressed or molded from synthetic resin, having a cover 12 shown in FIG. 2 only. Mounting apertures 2 are provided in the housing 1 for fastening the electric switch to a support. Three connecting elements or support arms 3a, 3b, 3c are provided in one side wall 1a of the housing, two of which, 3b, 3c, carry the stationary contacts 4 and 5 respectively. These contacts serve as limit stops for an elongated contact member 6 punched from strip material, one end 6b of which is movably arranged between the contacts 4 and 5. One or the other of the connecting members 3b, 3c with its corresponding contact can naturally be omitted or replaced by another fixed stop if the electric switch is intended as a one-way switch rather than as a change-over or two-way switch. A pre-stressed tension spring 7 extending substantially in the longitudinal direction of the contact member 6, is anchored at one end 7a to said contact member 6 and at the other end 7b to a third and also stationary support arm or connecting element 3a. The end 3 of this connecting element 3a has a knife edge against which rests, in a recess, at pivot point 10, a pivotable pressing or rocker arm 8 having two bent parallel limbs or protrusions 9 provided with two notches 9a against which the other end of the contact member 6 is supported at the shoulder 11 under the action of the tension spring 7. The rocker arm 8 is also engaged by a plunger 13 slidably accommodated in an aperture 13a provided in the housing 1 and by means of which the electric switch may be operated from the outside.

On depressing the plunger 13 for effecting the switch movement the rocker arm 8 and with it the knife edge support or shoulder 11 is rocked about the recessed pivot point 10. As soon as the support 11 reaches the lines adjoining the working axis or anchorage points of the ends of the spring 7 the contact member 6 reaches a labile position (dead-center position) and immediately thereafter rocks or shifts under the action of the tension spring 7 to its other end position in which it engages the contact 5. This position of the switch is retained as long as the plunger 13 is depressed. When it is released the parts return to the starting position as a result of the torque exerted about the pivot point 10 by the spring 7 through the contact member 6 and the arms 9 on the rocker arm 8. Accordingly, the contact member 6 rocks to its starting position shown on passing the dead-center position.

FIG. 4 shows the geometric conditions more accurately; the rocker arm 8 with its pivot point 10 defined by a recess and the contact member 6 with its support point or shoulder 11 are drawn in the position shown in FIG. 1. At the start of the switching movement the point 11 moves along a circular arc k of radius r centered on or concentric with the point 10. The momentary movement B of the support point 11 is in the direction of the tangent t perpendicular to the radius r which, however, makes an acute angle α to the longitudinal direction p of the contact

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member 6. It may be divided into a component B_1 in the longitudinal direction p of the contact member 6 and a component B_2 perpendicular to it. While the component B_2 moves across the point 11 in the direction towards the labile position the component B_1 displaces the contact member 6 in this longitudinal direction and thus secures a wiping movement over the contact or stop 4. This wiping movement remains during the whole operating path of the support point 11 and in particular is also operative at the dead-center position, due to the fact that the path of the support point 11 intersects the axis of the tension spring 7, defined by a connecting line drawn between the support points of said spring, at an acute angle which in the dead-center position is identical with the direction of the contact arm 6.

Similar conditions apply also during the return switching movement wherein the movement B , or the components thereof, operates in the opposite direction from the starting position of the support point 11 concerned. This wiping movement of the contacts which is imparted to the contact members 6 before reversal satisfactorily prevents any sticking of the contacts even for extremely slow switch operation.

For producing such a wiping movement it is only necessary that the member on which the end of the contact member 6 is supported shall be so guided that at least at the moment of switching there is a component of movement in the longitudinal direction of the contact member 6. There are naturally many ways of constructing and guiding the support member 8, of which the arrangement shown in the drawing represents only a convenient example. It would naturally be possible to have a purely translatory movement of the support member for initiating the switching movement; it must, however, be directed obliquely to the direction of operation of the coil spring in its dead-center position, in order that the required component of movement is produced. Also, the position of the axis about which the rocker arm 8 rotates at the pivot point 10 in the example shown can be chosen within wide limits. It is only necessary to ensure that this axis lies outside the axis of operation of the coil spring in the dead-center position since otherwise the momentary movement of the point 11 would be directed perpendicularly to the contact member 6 and thus the wiping movement would not be obtained.

In the arrangement described the coil spring 7 exerts a continuous torque on the rocker arm 8 through the knife edge support at the point 11, which continuously maintains its direction and provides a bias towards the rest position of the parts shown. This is a result of the fact that the pivot axis 10 of the rocker member 8 lies always on the same side of the contact member 6 so that on changing of the contact member from one end position to the other it does not cross the direction of the working axis of the coil spring.

The switch described with its double knife edge mounting involves a certain sensitivity to impact in that for sudden sharp impacts from the outside, for example during transport or upon dropping the switch and so forth there is the danger that the knife edges may be displaced against the action of the coil spring 7. In order to make this impossible the following provisions are made in the switch shown.

Two lateral abutments 3a' project from the stationary connecting member 3a carrying the knife edge 10 (FIG. 3) which overlie the edges of the limbs 9 facing said knife edge.

The spacing between the edges and abutments is quite small, preferably in the order of 0.2 mm., so that, with the range of movement of the rocker arm 8 possible in the assembled condition of the electric switch, displacement of the knife edges 10 cannot occur. Assembly and disassembly are possible only outside of the casing or housing 1 and before the contact member 6 has been inserted.

In certain embodiments of the electric switch a relatively soft tension spring 7 may be inserted, especially when the operating force available for the plunger 13 is very small. In these particular cases the contact member 6 may receive a small longitudinal displacement under the action of external impacts, which, however, is limited within the switch to the amount s (FIG. 2). However, the aforesaid edges of the limbs 9 each embody a notch 9a, the depth of which is greater than the distance s and in which the contact member 6 is centered at the support point 11. Moreover, the contact member 6 is continued by two projecting lugs or ribs 6a which are also longer than the distance s and extend practically over the whole remaining width of the limbs or protrusions 9. With these provisions the contact member 6 may indeed be lifted from the support point 11 by the action of a powerful impact, but under the action of the tension spring 7 always returns to the correct position owing to the centering in the notches 9a and the lateral guiding by the lugs or ribs 6a, and misplacement of the contact member 6 within the electric switch is quite impossible. It is readily to be appreciated that the limit stops 4, 5 may be formed as part of the housing 1 and under certain circumstances only one may be necessary. Similarly, the end 7b of the spring 7 may also be fixed to the interior of the housing 1. These and still further modifications may be made and are intended to be within the spirit and scope of the present invention.

Having thus described the present invention what is desired to be secured by United States Letters Patent is:

1. In an electric switch including a housing having inner walls, a plurality of support means, at least one of which forms a stationary contact, an elongated movable contact member having a free end adjacent said stationary contact and adapted to move into surface contact therewith, means for pivotally supporting the other end of said elongated contact member to move the same through a predetermined path of travel, resilient means supported between the inner walls of said housing and said free end of said elongated contact member for urging the other end of said elongated contact member into operable engagement with said supporting means, and means carried by the electric switch position to cooperate with said supporting means for actuating said supporting means so that said other supported end of said elongated contact member moves through said predetermined path of travel, said other supported end of said contact member traverses the working axis of said resilient means at an acute angle, and said resilient means applies a force component in a longitudinal direction of said elongated contact member so that a wiping action occurs when said stationary contact and said elongated movable contact member are in surface contact and at least during such time when switching occurs.

2. In an electric switch, a pair of limit stops, at least one of said limit stops forming a stationary contact, an elongated movable contact member having a longitudinal axis and provided with a free end located between said limit stops and normally in surface contact with one of said limit stops, rocker arm means for pivotally carrying the other end of said elongated contact member to move the same through a predetermined path of travel, resilient means supported at its ends and cooperable with said free end of said elongated contact member, said resilient means having a working axis defined by a connecting line taken between said supported ends thereof, said longitudinal axis of said elongated contact member and said working axis of said resilient means being coincident in one position to define a dead-center position of a switching operation, and means provided at said electric switch for actuating said rocker arm means so that said other end of said elongated contact member moves through said predetermined path of travel to form a tangent with said path of travel which intersects said working axis of said resilient means at an acute angle at least during said dead center position so

as to apply a force component in the direction of the longitudinal axis of said elongated contact member so that a wiping action occurs when one of said limit stops and said elongated movable contact member are in surface contact and at least during said switching operation.

3. In an electric switch according to claim 2, wherein said rocker arm means is pivotally supported about an axis which lies outside of said working axis of said resilient means at least in said dead-center position.

4. In an electric switch according to claim 3, wherein said axis of said rocker arm means always lies to one side of said working axis of said resilient means.

5. In an electric switch according to claim 2, wherein said rocker arm means includes a pair of extended limb members provided with recesses, said other end of said elongated contact member being carried by said recesses.

6. In an electric switch according to claim 5, wherein lug means are provided adjacent said limb members, said other end of said elongated contact member being provided with rib means cooperable with said recesses, said rib means and said lug means cooperating with said elongated contact member to prevent mispositioning of the latter.

7. In an electric switch according to claim 6, wherein said recesses are of a depth greater than any degree of freedom of said elongated contact member when assembled in said electric switch.

8. In an electric switch according to claim 2, wherein said resilient means is a tension spring.

9. In an electric switch according to claim 2, wherein said electric switch is a micro-switch.

10. In an electric switch, a pair of limit stops, at least one of said limit stops forming a stationary contact, an elongated movable contact member having a longitudinal axis and provided with a free end disposed between said limit stops and normally in surface contact with one of said limit stops, rocker arm means for carrying the other end of said elongated contact member to move the same through a predetermined path of travel, resilient means supported at its ends and cooperable with said free end of said elongated contact member, said resilient means having a working axis defined by a connecting line taken between said supported ends thereof, said longitudinal axis of said elongated contact member and said working axis of said resilient means being coincident in one position to define a dead-center position of a switching operation, and means provided for said electric switch positioned for actuating said rocker arm means so that said other end of said elongated contact member moves through said predetermined path of travel to form a tangent with said path of travel which intersects said working axis of said resilient means at an acute angle so as to apply a force component in the direction of the longitudinal axis of said elongated contact member so that a wiping action occurs when one of said limit stops and said elongated movable contact member are in surface contact and at least during said switching operation.

11. In an electric switch, a plurality of support means, two of which define a pair of limit stops, at least one of said limit stops forming a stationary contact, an elongated movable contact member having a longitudinal axis and provided with a free end located between said limit stops and normally in surface contact with one of said limit stops, rocker arm means for carrying the other end of said elongated contact member to move the same through a predetermined path of travel, resilient means supported between another of said support means and said free end of said elongated contact member, said resilient means having a working axis defined by a connecting line between its points of support, said longitudinal axis of said elongated contact member and said working axis of said resilient means being coincident in one position to define a dead-center position of a switching operation, and means provided at said electric switch for actuating said rocker arm means so that said other end of said elon-

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gated contact member moves through said predetermined path of travel to form a tangent with said path of travel which intersects said working axis of said resilient means at an acute angle at least in said dead-center position so as to apply a force component in the direction of the longitudinal axis of said elongated contact member so that a wiping action occurs when one of said limit stops

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and said elongated movable contact member are in surface contact and at least during said switching operation.

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