SELF-CONTAINED REED SWITCH UNIT

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ABSTRACT

A compact and long lived electrical switch has a housing containing reed contacts of ferromagnetic material which are opened and closed by movement of a permanent magnet carried on a pivotable actuator lever. A stationary second magnet within the housing repels the first magnet to generate a force urging the actuator lever towards the unoperated position thereof.

1 Claim, 4 Drawing Figures
SELF-CONTAINED REED SWITCH UNIT

This application is a continuation of Ser. No. 833,126 filed June 13, 1969, now abandoned.

BACKGROUND OF THE INVENTION

This invention relates to electrical switch mechanism and more particularly to sensitive precision switches of the kind which operate in response to movement of an actuator element extending therefrom.

Most switches of the type which are operated by movement of an actuator element of the switch have several moving mechanical parts, are of large size and resist actuation with a sizable and sometimes variable force. These characteristics are not always suitable for certain situations wherein size is a critical consideration or where the cycling rate of the switch is extremely high or where the switch must operate at a precise point in the travel of the actuator element or where some combination of these conditions is encountered. In these situations, it is customary to employ certain specialized switch constructions variously known as reed switches or microswitches, or by other terms. These are small, sensitive to slight forces and reliably operate at a predetermined point in the travel of the actuator. However, as heretofore constructed, this class of switch is still subject to certain of the above discussed disadvantages.

Like many other switch constructions, reed switches or the like include a spring or other resilient mechanical means for urging the actuator towards a predetermined position and to produce a snap action upon opening or closing. Because of metal fatigue in the resilient elements and to some extent as a result of the general mechanical complication, the life expectancy of such switches is undesirably low, typically not more than a few million operations for the most carefully manufactured microswitches. Such switches are still sizable and have a further disadvantage in that only a few thousandths of an inch overtravel of the actuator element is tolerable without damaging or destroying the switch.

The limited life of existing switch constructions is a serious disadvantage in certain usages. The restrictions with respect to permissible overtravel are also undesirable in that these translate into the requirement for very precise positioning and consequent high manufacturing cost. Co-pending application Ser. No. 587,874 filed Oct. 19, 1966 by the present inventor and entitled "Typewriter Baseplate" discloses an example of this situation. The co-pending application describes a baseplate attachment for a typewriter wherein the baseplate carries a series of switches with actuator arms that extend up into the typewriter to detect movement of certain linkages for the purpose of generating electrical signals, indicative of typewriter operations, for transmission to a computer or a remote typewriter. Switches in this context have an extremely high cycling rate. Further, the switch actuators should return to the unactuated position very rapidly but should not exert sizable resistance to movement of the associated typewriter linkage. Preferably, such switches should not require extremely precise positioning. These requirements are not fully met by existing microswitch constructions.

Reed switches are small highly sensitive switching means with a life expectancy approaching one billion cycles. These utilize two flexible contacts formed of ferromagnetic material which may be inductively magnetized to open or close by movement of a magnet in the vicinity of the contacts.

These reed switches utilize actuator return mechanisms of the conventional kind, the limitations and disadvantages of the conventional reed switch or microswitch being present therein. The theoretical life expectancy of the reed contacts for example, cannot be realized because of the probable failure of moving mechanical parts and resilient elements as well as other problems.

SUMMARY OF THE INVENTION

This invention is a compact electrical switch responsive to movement of a self-supported actuator element which is normally biased towards an unoperated position, whereby the actuator is returned to such position in the absence of an external force acting thereon. The invention provides a construction for this kind of switch having an extremely long life expectancy, and which may be made insensitive to sizable overtravel of the actuator. The construction requires no springs or other resilient mechanical elements and in a preferred form may have a single moving part aside from the switch contacts.

In the preferred form, the invention has a housing containing a reed switch capsule together with a permanent magnet carried on an actuator which is movable from an unoperated position to another position at which the reeds are magnetically engaged or disengaged. To generate a biasing force urging the actuator towards the unoperated position, a second permanent magnet is disposed in the housing to resist movement of the actuator magnet and to restore the actuator to the unoperated position the additional magnet being placed to avoid undesirable effects on the reed contacts. Substantial overtravel is tolerable and since the force between the two magnets increases sharply as the separation therebetween decreases, the return time tends to be fairly constant regardless of the amount of travel. The switch construction has other inventive aspects and advantages which will be hereinafter made apparent.

Accordingly, it is an object of this invention to provide a very long lived compact and mechanically simple precision switch of the kind operated by movement of a self-contained actuator element.

The invention together with other objects and advantages thereof will be better understood by reference to the following description of a preferred embodiment in conjunction with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

In the drawing:

FIG. 1 is an enlarged side view of an electrical switch in accordance with the invention with portions of a sidewall broken out to better illustrate internal elements;

FIG. 2 is a view of the switch construction of FIG. 1 taken along line 2-2 thereof;

FIG. 3 is a perspective view of a portion of the reed switch contacts and associated elements of the switch construction of FIGS. 1 and 2; and

FIG. 4 is a perspective view, generally similar to FIG. 3, of a modified form of the switch which is normally closed as opposed to the normally open design of FIGS. 1 to 3.

DESCRIPTION OF PREFERRED EMBODIMENTS

Referring now to FIGS. 1 and 2 in conjunction, there is shown a normally open switch unit 11 of the type which is operated by movement of an actuator element which is a pivoting arm 12 in this instance. Although not limited to such usage, this particular switch 11 is designed for use in the typewriter baseplate of the above identified co-pending application, Ser. No. 587,874 wherein the switch 11 is fastened to the underside of the typewriter baseplate 13 and the actuator arm 12 extends upwardsly through an opening 14 therein in position to be moved in the direction of arrow 16 by movement of certain typewriter linkage.

Switch unit 11 includes a frame means for supporting the other elements, the frame means in this example being a housing 17 of generally rectangular configuration which has a pair of parallel extensions 18 at one corner defining a slot 19 to receive a screw 21 which threadably engages in a bore 22 in the baseplate 13 to secure the switch unit thereto. This provides for adjustment of the position of the switch unit 11 including actuator arm 12 relative to the baseplate 13 if necessary. It will be apparent that other provisions may be made for attaching a switch unit 11 of this general type to other mechanisms.

To facilitate assembly of the switch unit 11, housing 17 may be formed of three laminations including center lamination 23.
and outer laminations 24 on either side thereof which include the projections 18, the three laminations being bonded together by adhesive or the like. The laminations 23 and 24 are formed of non-magnetic material and are spaced in an optimum position over the overlapping ends of reed contacts 26 and 27. It should be understood that the disposition of the North pole of magnet 37 at the lower end thereof in this example is for illustrative purposes only and that it is equally possible to situate the South pole of the magnet at region 31, the operation of the switch being the same as far as practical results are concerned.

Considering now an important aspect of the invention, a switch of this general class requires means for returning the actuator arm 12 to its unoperated position after it has been deflected in the direction indicated by arrow 16. In many circumstances such as the typewriter baseplate application discussed above, this return action should be very fast, strong, and it may be desirable that the return time be fairly constant regardless of the distance which the arm has been displaced along arc 38. This is provided for in the present invention by means which requires no additional moving parts which might wear or malfunction and which provide the desired characteristics more completely than mechanically complex spring mechanisms or the like.

In particular, a second bar magnet 42 is bonded to center lamination 23 and aligned substantially along a radius of the pivot axis of pin 34 in position to be parallel to and contacted by magnet 37 when arm 12 has been pivoted along arc 38 to the maximum extent. The poles of magnet 42 are positioned similarly to those of magnet 37, i.e., with the North pole at the lower end in this example, whereby magnet 44 exerts a repulsive force on magnet 37. Among the other desirable effects of this return means is the fact that the repelling force exerted by magnet 42 on magnet 37 is non-linear with distance and progressively increases at a sharply greater rate as magnet 37 approaches magnet 42 thereby tending to provide a fairly constant return time for the arm 12 for any degree of displacement thereof in the direction of arc 38. Further, this placement of the fixed magnet 42 causes the magnetic flux therefrom to supplement that of the pole at the lower end of magnet 37 when magnet 37 is moved along arc 38 and is therefore more distant from contact 26 than it is at its unoperated position.

While the embodiment of the invention described above is normally open in that contacts 26 and 27 are separated when actuator lever 12 is in its unoperated position, the invention is also applicable to a normally closed construction. As shown in FIG. 4 this may be arranged for by disposing a third bar magnet 43 immediately below the contacts 26 and 27 with the North pole being subjacent contact 27 and the South pole being beneath contact 26, the switch construction being otherwise similar to that previously described.

What is claimed is:

1. In combination with a typewriter having a movable component, an electrical switch means for sensing movement of said component of said typewriter comprising:

an integral switch housing supporting a pair of terminals, a reed switch capsule secured within said housing and containing a pair of ferromagnetic contacts having adjacent ends which close and open in response to magnetic flux changes in the vicinity thereof, each contact being connected to a separate one of said terminals, an actuator lever arm having one end extending into said housing and an opposite end extending exteriorly thereof towards said typewriter component, said actuator arm being pivoted in said housing whereby said one end of said arm is urged away from a normal position thereof by said movement of said typewriter component, stop means in said housing comprising a threaded element rotatably engaged in a threaded bore in said housing and having a surface positioned to stop return motion of said one end of said arm at said normal position thereof and having means for effecting rotation of said threaded element whereby said normal position of said one end of said arm may be selectively changed,
means attaching said housing to said typewriter comprising an extension portion of said housing having a slot therein, a screw received in said slot and threadably engaging said typewriter, said slot providing for selective repositioning of said housing and said actuator arm on said typewriter, a first bar magnet secured to said one end of said actuator arm for movement therewith and having a pole situated in proximity to said ends of said contacts when said arm is at said normal position whereby said movement of said arm away from said normal position thereof operates said contacts, a second bar magnet secured to said housing and having a pole of like polarity to said pole of said first magnet positioned to urge said first magnet and said one end of said arm toward said normal position thereof by magnetic interaction therewith, said magnets having linear facing surfaces which surfaces abut in collinear relationship when said arm is overtravelled away from said normal position by the maximum amount, said second magnet being spaced from said first magnet to provide for said overtravel of said first magnet and said one end of said arm past the position at which said movement of said arm operates said contacts, said overtravel being substantially greater than the amount of arm movement required to operate said contacts.

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