Nov. 12, 1968 R. W. FRASER ETAL 3,410,973

MULTI-SPRING LEG APEX-TYPE SNAP ACTION SWITCH

Filed Dec. 6, 1966 3 Sheets-Sheet 1

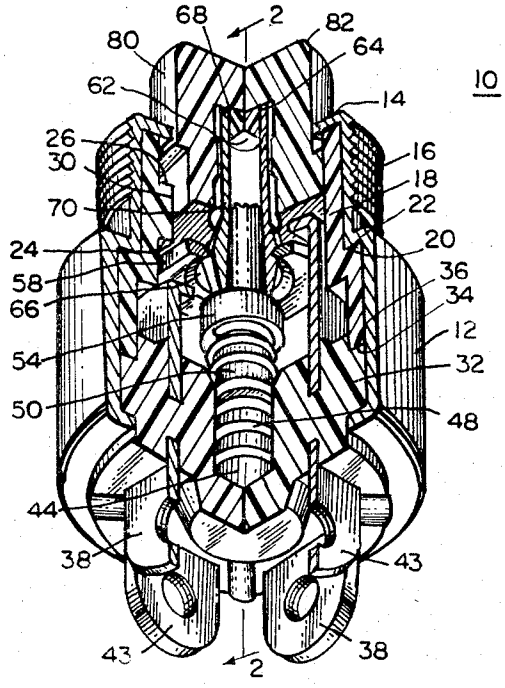


FIG. 1

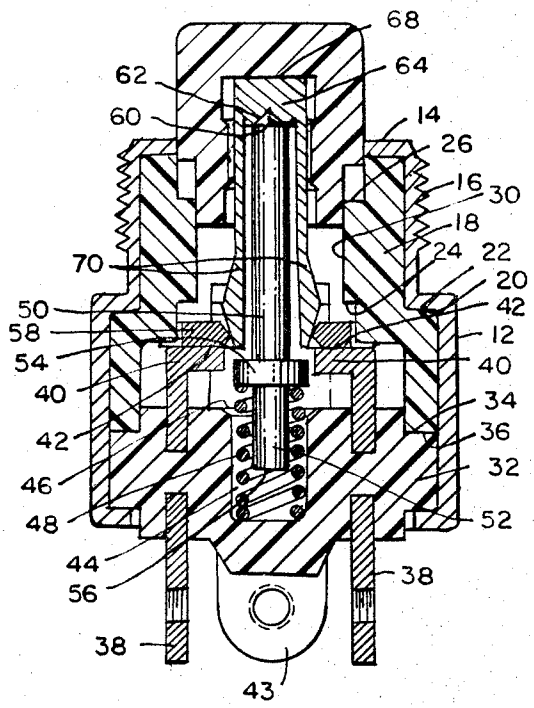


FIG. 2

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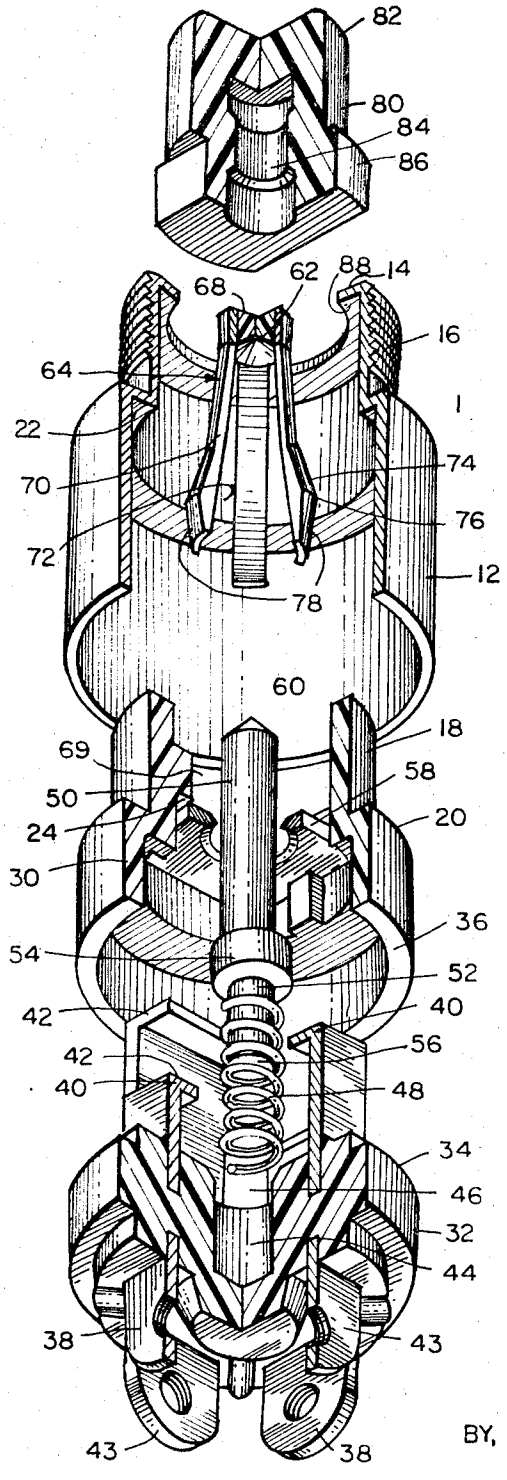


FIG. 3

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MULTI-SPRING LEG APEX-TYPE SNAP ACTION SWITCH

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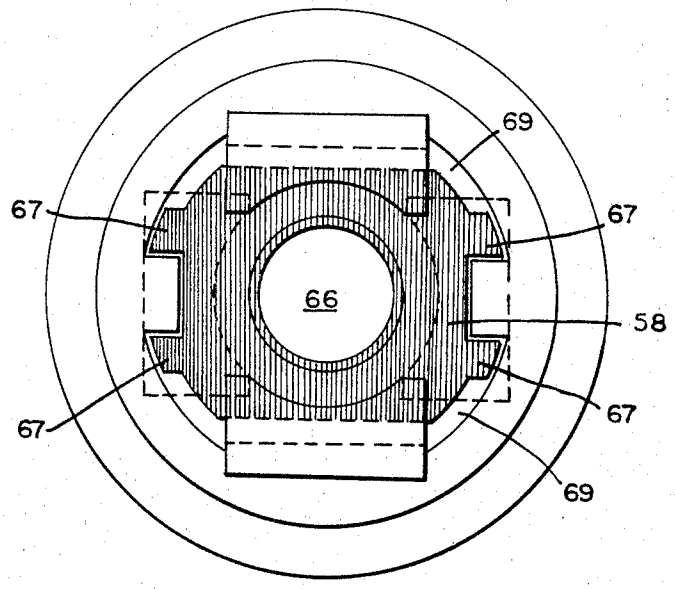


FIG. 4

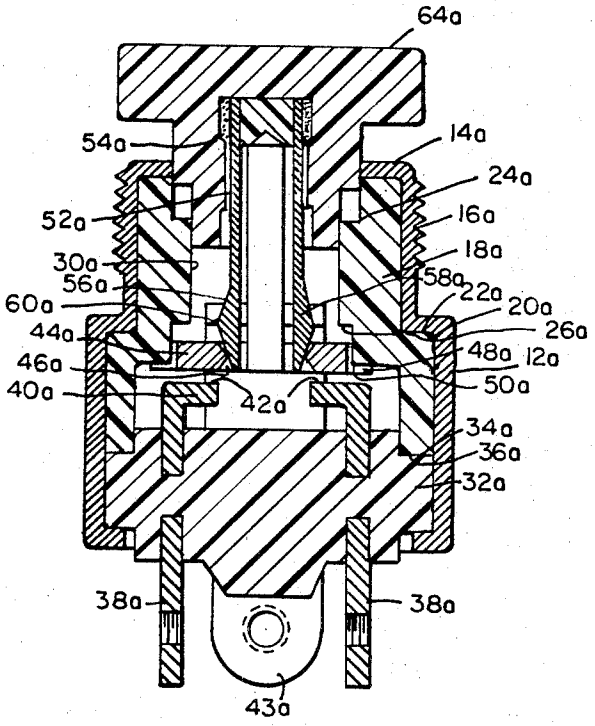


FIG. 5

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MULTI-SPRING LEG APEX-TYPE SNAP ACTION SWITCH

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1 Claim. (Cl. 200—77)

ABSTRACT OF THE DISCLOSURE

A multi-legged apex type snap action electrical switch having an apertured contact moveable axially in response to manual operation of a plunger into engagement with fixed contacts.

This invention relates generally to electrical devices and more particularly to improved snap-action plunger switches of the type used for closing and opening of electrical circuits.

Snap-action switches as they are generally known have been utilized in aircraft communications and ordnance equipment and wherever constant pressure on the actuator is required to close or open an electrical circuit. Since the majority of these switches are of the miniature type, extreme care has to be taken with their development to insulate the conductors from the non-conductors by a dielectric. With existing switches it has been determined that after a period of use vapor metallic deposits build up on the non-conductive surfaces as a result of arcing causing the switch to short and become inoperative. Basically this is caused by the miniaturization of the switch itself by reducing the over-surface distance between the stationary and moveable contacts. Since air is an efficient dielectric, this invention represents a new and novel improvement wherein the distance between the conductors at the make and break points and the non-conductors is increased.

Therefore, it is an object of this invention to provide an improved and simple, novel and inexpensive snap-action switch having a longer electrical life than existing switches.

It is another object of this invention to provide a switch in which the actuator is self-aligning and has short radial movement.

It is still another object of this invention to provide an improved type of a plunger switch wherein the camming member is freely rotatable and has a plurality of segmental spring members, thus providing increased pressure in moving the moveable contact into engagement with the fixed contacts.

It is a further object of this invention to provide an improved snap-action plunger switch wherein the moveable contact is of slight mass and resistant to inadvertent closing during moments of vibrational stress.

It is still a further object of this invention to provide an improved miniature switch wherein the conducting contacts are isolated from the non-conducting elements by an air dielectric reducing the metallic vapor deposits on the non-conducting elements.

Other objects of this invention will in part be obvious and will in part appear hereinafter.

Broadly stated the feature of this invention is to provide a snap-action plunger type switch whereby the over-surface difference between the contact points and the insulator is increased so that any metallic vapor build up is remote from the conductors so as to maintain a good and effective dielectric therebetween.

To the accomplishment of this and the foregoing related ends, the present invention then consists of the means hereinafter fully described and particularly pointed out in the claims, the annexed drawings and the following description setting forth in detail certain means in the carrying out of the invention, such disclosed means illustrating, however, but one of the various ways in which the principle of the invention may be employed.

In the drawings:

FIG. 1 is a cut-away view of the switch partly in section illustrating the operational components.

FIG. 2 is a view in section taken on line 2—2 of FIG. 1.

FIG. 3 is an exploded view of the switch.

FIGURE 4 is a top plan view showing the apertured floating contact and the surrounding parts.

FIG. 5 is a view in section of a modified form of the switch.

Referring to the drawings there is shown in FIGS. 1–3 a switch **10** comprising an outer housing **12** having an annular shoulder **14** formed thereon and a male threaded portion **16** adapted to co-operate with a panel or the like (not shown) and to allow the shoulder **14** to be positioned in abutting relationship therewith.

Within the housing **12** there is located a tubular hollow first insulator **18** formed of a dielectric having an external configuration with an annular flange **20** adapted to conform to the interior and cooperating with an interior shoulder **22** of the housing **12**. The insulator **18** has a pair of annular shoulders **24** and **26** axially spaced from each other and formed on the interior wall **30** thereof for purposes to be more fully described hereinafter.

A second insulator **32** fits within the first insulator **18** and abuts with a shoulder **34** against the distal end **36** of the first insulator. The second insulator **32** is formed of a dielectric such as diallyl phthalate or allyl resins and has molded integral therewith two or more stationary contact members **38**. The first set of stationary contact members **38** have angular bends **40** so as to define surface areas **42** which are laterally spaced from each other but in the same plane. A second set of contact members **43** are disposed in the second insulator **32** in coaxial relationship to said first set of stationary contacts which are normally closed. A longitudinal bore **44** is provided in the second insulator and is open to one surface **46** thereof to receive and retain a coiled spring **48**. A return pin **50** extends downwardly from the tubularly hollow first insulator **18** and has a shank **52** of a diameter less than the internal diameter of the coil spring **48**. An annular shoulder **54** is formed on the return pin **50** at a point spaced from the end **56** of the shank **52** and has an external diameter greater than the diameter of the spring **48** to maintain the shank in a fixed position relative to the spring. The main body of the return pin extends upwardly as shown in FIG. 3 through an apertured floating

contact 58. The upper end 60 of the return pin 50 is tapered to fit within a mating recess 62 of an actuator 64.

The floating contact 58 as shown in FIG. 4 consists of a rectangular conductive plate having a central aperture 66 and laterally extending tongue members 67 adapted to travel in channels 69 formed in the walls of the first insulator. The contact is formed of a light material so as have little mass and be unaffected by shock or vibration. The upward travel of the floating contact 58 is limited by the annular shoulder 24 formed in the wall of the first insulator or by stationary contacts 43. The lower travel of the floating contact is limited by the surface areas 42 of the stationary contacts 38.

The actuator 64 comprises an elongated hollow tubular member having a closed end portion 68. Extending longitudinally therefrom are four segmental spring members 70 separated from one another by gaps 72. Each of the segmental spring members is tapered in opposite directions to form oblique surfaces 74 around the center line of the actuator 64. The oblique surfaces terminate at an annular apex 76 from which the members 70 converge toward the center line of the actuator 74 to form guide surfaces 78. The segmental spring members 70 when fully compressed have a diameter at the apex less than the internal diameter of the aperture 66 of the floating contact 58 for a purpose to be set forth more fully hereinafter. The actuator 64 is rotatable to provide a uniform bearing surface and smoother action.

Completing the switch assembly is a plunger 80 comprising a closed cap portion 82 having a central bore 84 for receiving the closed end 68 of the actuator 64. An external flange 86 causes the plunger 80 to be retained in assembly by abutting against a shoulder 88 in the housing 14.

In operation the plunger 80 upon being depressed forces the actuator downward overcoming the pressure exerted on the return pin 50 by the coil spring 48. The clearance within the segmental members 70 by receiving the return pin 50 allows the leading surfaces 78 to align themselves with the aperture 66 in the floating contact 58. The leading surfaces 78 upon entering the aperture 66 cause the segmental spring members to constrict inwardly toward the center line of the actuator, thereby allowing the leading surfaces 78 to enter the aperture until the apex 76 traverses the aperture and causes the floating contact member to snap upwardly, thereby breaking the electric connection between the two surface areas 42 of the stationary contact members 38 while forcing the moveable contact 58 into electrical contact with the second set of stationary contact members 43. The upward travel of the floating contact member is limited either by the annular shoulder 24 formed in the interior wall 30 of the first insulator 18 or by the stationary contacts 43. Upon release of the pressure on the plunger 80, the coiled spring 48 forces the return pin 50 carrying the actuator 64 upward so that the oblique surfaces 74 are compressed by the aperture 66 until the apex has a diameter less than the diameter of the aperture when the floating contact 58 snaps toward and into contact with stationary contacts 38.

As shown in FIGURE 5, a modified form of the invention may be provided wherein a single throw switch operates on the same principle.

The switch consists of an outer housing 12*a* containing a first insulator 18*a* having an annular shoulder 14*a* at one end and a male threaded portion 16*a* on the housing adjacent the shoulder. The first insulator 18*a* also has an annular flange 20*a* cooperating with a shoulder 22*a* of the housing 12*a*. The insulator 18*a* has annular shoulders 24*a* and 26*a* axially spaced from each other and formed on the interior wall 30*a* for purposes to be more fully described hereinafter.

A second insulator 32*a* fits within the first insulator 18*a* and has a shoulder 34*a* on the exterior surface thereof which abuts against the distal end 36*a* of the first insulator. The second insulator is formed of a dielectric such as diallyl phthalate or one of the allyl resins and has molded integral therewith two stationary contact members 38*a*. The stationary contact members 38*a* have angular bends 40*a* so as to provide surface areas 42*a* which are laterally spaced from each other but in the same plane.

A floating contact member 44*a* positioned within the tubular hollow first insulator 18*a* has a central aperture 46*a* and laterally extending tongue members 48*a* adapted to travel in channels formed in the walls of the first insulator to prevent rotation. The upward travel of the floating contact member 44*a* is limited by the annular shoulder 26*a* or by the bent ends of stationary contacts 43*a*. The downward travel of the floating contact is limited by the surface areas 42*a* of the bent ends of stationary contacts 38*a*.

The actuator 52*a* comprises an elongated hollow tubular member having a closed end portion 54*a*. Extending longitudinally therefrom are four segmental spring members 56*a* separated from one another by gaps (not shown). Each of the segmental spring members 56*a* is tapered in opposite directions to form oblique surfaces 58*a* around the center line of the actuator 52*a*. The oblique surfaces terminate at an annular apex 60*a* from which the members 56*a* converge toward the center line of the actuator 52*a* to form guide surfaces 62*a*. The segmental spring members 56*a* when fully compressed have a diameter at the apex 60*a* less than the internal diameter of the aperture 46*a* of the floating contact 44*a* for a purpose to be set forth more fully hereinafter.

The actuator 52 is secured by any suitable means such as a pin or as shown in the drawing by an epoxy adhesive material to the interior bore 62*a* of a closed plunger 64*a*. It will be seen by referring to the drawing that the plunger is shaped so as to allow it to be grasped and pulled as well as depressed.

In operation the modified form of the invention operates similarly to the basic form in that the plunger 64*a* upon being depressed causes the leading surfaces 62*a* to align themselves with the aperture 46*a* of the floating contact 44*a*. The leading surfaces 62*a* upon entering the aperture 46*a* cause the segmental spring members to constrict inwardly toward the center line of the actuator allowing the leading surfaces 62*a* to enter the aperture until the apex 60*a* traverses the aperture and causes the floating contact to snap thereby breaking the electric connection between the stationary contacts 38*a*. The reverse operation, i.e., by pulling on the plunger 64*a* causes the oblique surfaces 58*a* to enter the aperture, thereby constricting the segmental members until the diameter of the apex is less than that of the aperture when the floating contact snaps downwardly into contact with the stationary contact members.

While there have been described herein what are at present considered preferred embodiments of the invention, it will be obvious to those skilled in the art that modification and changes may be made therein without departing from the essence of the invention. It is therefore to be understood that the exemplary embodiments are illustrative and not restrictive of the invention the scope of which is defined in the appended claims, and that all modifications that come within the meaning and range of equivalency of the claims are intended to be included therein.

We claim:

1. An electric switch comprising a housing having an axially moveable plunger at one end, a plurality of fixed contact members positioned within said housing having their contact surfaces in spaced relation to each other, an actuator having an end portion disposed within said plunger with a plurality greater than two of downwardly and diverging axially extending segmental spring mem-

bers, said spring members having oblique surfaces extending away from the center line of said actuator and leading surfaces extending in the direction of said center line, the junction of said oblique surfaces and said leading surfaces defining a limit of camming action in one direction, a return rod biased in the direction of said plunger by spring means and positioned within and extending axially and into abutting relation with a closed end of said actuator, an axially moveable contact member positioned in axial relation to said fixed contact members, said actuator moveable in response to plunger pressure to axially cam said moveable contact member.

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