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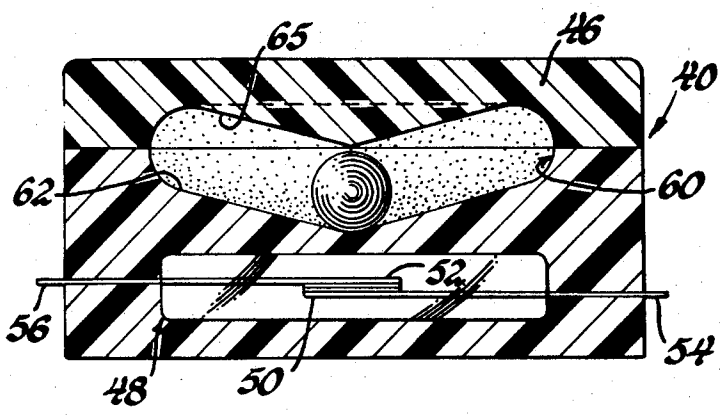
[54] **SWITCH ASSEMBLY**
10 Claims, 7 Drawing Figs.

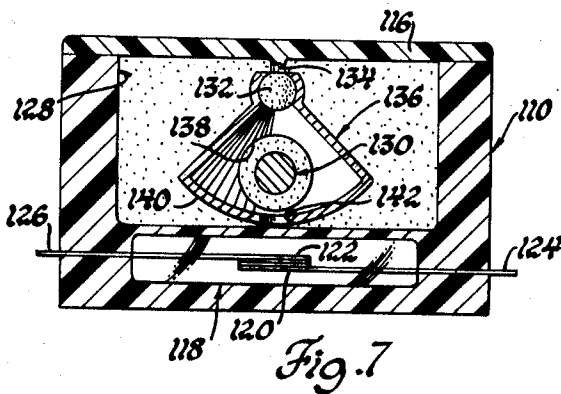
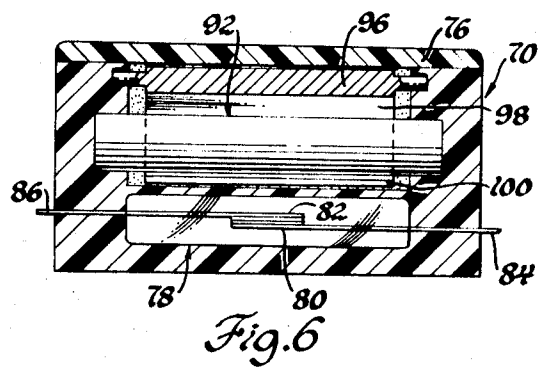
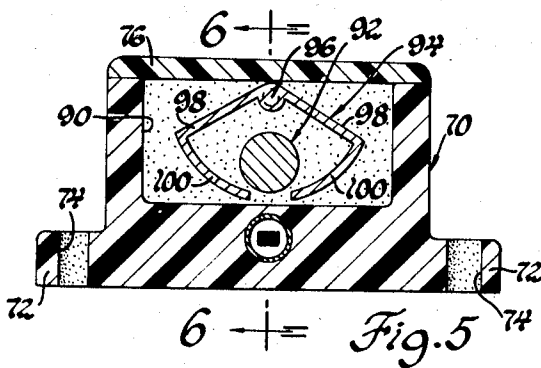
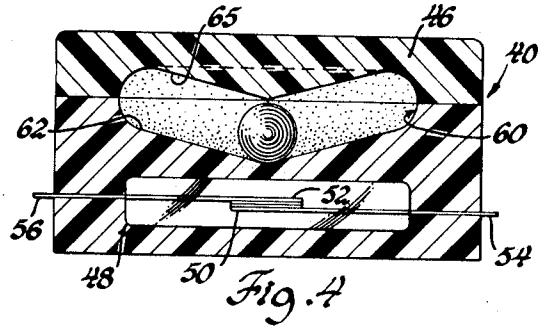
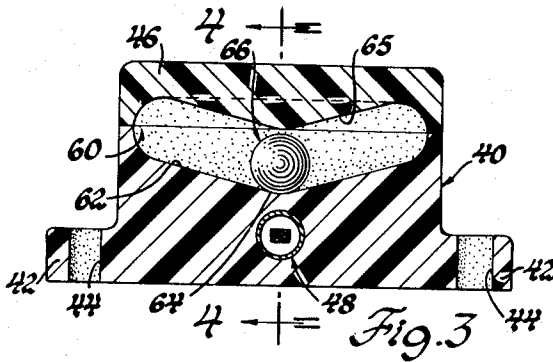
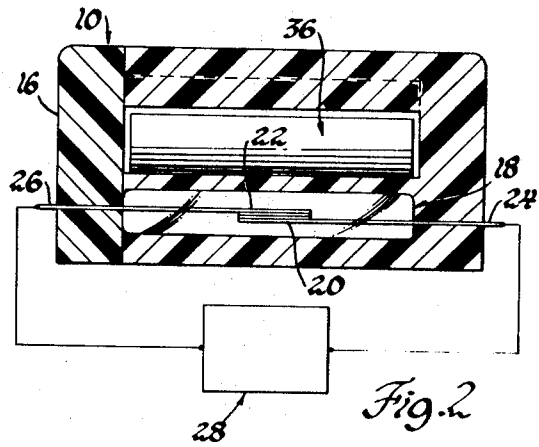
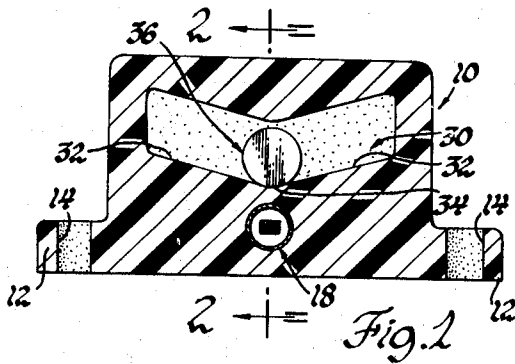
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[56] **References Cited**

UNITED STATES PATENTS			
1,175,062	3/1916	Johnson	200/61.52 X
3,008,018	11/1961	Hammond	335/205
3,330,016	7/1967	Smith, et al.	335/205 X

ABSTRACT: A switch assembly for use in an environment requiring automatic switch operation under certain conditions, as when the switch assembly, or the body on which the switch is mounted, is tilted or changed in position beyond a predetermined amount. The assembly includes a housing in which is mounted the switch, preferably of the normally open type. A cavity is formed in the housing and has a point adjacent but spaced from the switch contact elements. Actuating means are disposed in the housing cavity and in one modification includes a magnetic member that moves away from the close adjacency to the switch contact elements when the housing is tilted beyond a predetermined amount. Thus, the switch opens until the magnetic member returns to its adjacent position, as when the housing is righted. In another modification, a magnetic member is fixed in the housing and magnetic-flux-deflecting means are pivotally mounted in the housing and in the cavity. As the housing is tilted, the deflecting means pivots into position between the magnetic member and the switch, thus deflecting the magnetic flux field. The magnetic attraction is removed and the switch opens. When the housing is righted, magnetic flux is again established to the switch to close the switch contacts.





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SWITCH ASSEMBLY

This invention relates to switch assemblies, and more particularly to a switch assembly having actuating means therein for operating a switch under conditions of movement of the assembly.

In the design, manufacture and use of any electrically operated devices, it is often necessary to cause a switch to actuate, either to open or to close, under certain conditions of movement of a body. For example, it may be desirous to cause a switch to open when a body is tilted beyond a predetermined angle.

A switch assembly for use in such an environment must be positive in its operation. The mechanism must be so formed that the switch will operate only upon reaching the desired condition, and yet be simple enough in its design, and manufactured and assembled, maintaining cost at a minimum. Such a device should have a long life so that constant replacement is unnecessary and should be formed of a minimal number of parts and parts that move, to keep repairs and wearing out to a minimum.

It is here proposed to provide a switch assembly for the environment heretofore described which comprises, generally, a housing having a switch member mounted therein and being of the normally open type, such that positive operation is required to close the switch contacts and when such actuation is removed, the switch contacts will open. A cavity is formed in the housing and having a part thereof closely adjacent but spaced from the switch member. Mounted in the cavity is the switch actuation means, which includes a magnetic member so disposed relative to the switch contacts that when the magnetic flux is uninterrupted the switch contacts will be closed and the circuit operative. When the housing is tilted beyond a predetermined angle, the magnetic flux is interrupted, weakened or removed between the magnet and the switch contacts, thus allowing the switch contacts to open and interrupt the electrical circuit. In one preferred embodiment of the invention the magnetic flux is interrupted by means of the magnetic member being movable in the cavity and rolling or sliding away from the point of maximum attraction of the switch contacts so that the flux is weakened or eliminated to a point where the contacts open. In another preferred embodiment of the invention, the magnetic member is fixed in the cavity and flux-deflecting means are pivotally mounted in the housing cavity to swing between the magnetic member and the switch and provide a path of less resistance for the magnetic flux. In either event, the actuating means is located in the cavity and upon excess movement of the housing in a particular direction, the magnetic flux from the magnetic member is disturbed or weakened to such degree as to allow the switch contacts to open.

A switch assembly as heretofore described advantageously needs the requirements of a switch assembly in this type of environment. The magnetic attraction is positive in its operation and so long as the magnetic properties of the magnetic member are retained, the life of the device is long lasting and the assembly need not be serviced. Once movement of the housing past the predetermined degree does occur, the flux interruption quickly and positively removes the magnetic attraction at the switch contacts and causes the switch to open. There are few moving parts in the device which can become fouled or worn out because of constant use, so that the device has little or no need for repair and replacement of the various parts. The overall structure is easily manufactured and assembled maintaining the costs at a minimum.

These and other objects and advantages will become more apparent from the following description, used to illustrate preferred embodiment of the invention when taken with the accompanying drawings, in which:

FIG. 1 is a transverse cross-sectional view of a switch assembly embodying the invention and illustrating the position of the various parts.

FIG. 2 is a transverse cross-sectional view of the switch assembly illustrated in FIG. 1, taken substantially along the line 2—2 of FIG. 1 and looking in the direction of the arrows.

FIG. 3 is a transverse cross-sectional view of a switch assembly in which the invention is embodied, illustrating the position of the various parts.

FIG. 4 is a longitudinal cross-sectional view of the switch assembly illustrated in FIG. 3 and looking in the direction of the arrows.

FIG. 5 is a transverse cross-sectional view of another switch assembly in which the invention is embodied, illustrating the position of the various parts.

FIG. 6 is a longitudinal cross-sectional view of the structure illustrated in FIG. 5, taken substantially along the line 6—6 of FIG. 5 and looking in the direction of the arrows.

FIG. 7 is a transverse cross-sectional view of still another switch assembly in which the invention is embodied, illustrating the position of the various parts.

Referring more particularly to the drawings, where the various showings are for the purpose of illustrating the invention and not for the purpose of limiting same, FIGS. 1 and 2 illustrate a preferred embodiment of the switch assembly which may be used in a circumstance under which tilting of the switch assembly beyond a predetermined degree and in the longitudinal orientation of the switch assembly will cause the switch member to actuate. A switch housing, indicated generally by the numeral 10, may be formed of any suitable material and has mounting flanges 12 extending from the base thereof with mounting apertures 14 extending therethrough. Thus, the housing 10 may be mounted on some other assembly if such is desired.

Housing 10 may include an end plate 16 to permit the formation and assembly of the interior parts as will be hereinafter more particularly described. Mounted in the housing 10 is a switch member, indicated generally by the numeral 18, which has switch contacts 20 and 22 so disposed that when the contacts are in the engagement, an electric current can flow from one contact arm 24 to the other contact arm 26 and thus through the electrical circuit or other operated object, indicated generally by the numeral 28. Switch member 18 may be of the type commonly known in the art as a reed switch, or may be of any other suitable variety well known in the art which is provided with contact elements biased in a normally open position and one of which may be attracted by magnetic means to close contact between the two contact elements. While the particular switch structure is not critical to the invention herein described and claimed, the reed switch best typifies the desirable type of switch device. Formed in the housing 10 is a cavity, indicated generally by the numeral 30, such cavity having inclined longitudinal walls 32 terminating at an apex 34 adjacent to but spaced from the reed switch element 18. The inclination of the walls 32 is in a direction away from the switch 18 for purposes to become hereinafter more apparent.

Switch actuation means are disposed within the cavity 30 and shown to be a magnetic member, indicated generally by the numeral 36. Member 36 is cylindrical in form, of slightly less diameter than the depth of the cavity 30, and may be of any suitable material, although it is preferred that the member be a permanent magnet to maintain its long life and magnetic attraction. It will be apparent that if the magnetic properties are properly computed the magnetic member 36, when disposed at the apex 34 of the cavity 30, will be in a position to attract the contact member 20 of the switch 18 and close the circuit through the contact arms 24 and 26. The magnetic attraction of the member 36 will maintain the switch 18 in its closed condition for so long as the magnetic member 36 stays at the apex 34 of the cavity 30. However, when the housing 10 is tilted, or the member on which the housing is mounted is tilted, to such degree that the magnetic member 36 will roll or slide along one of the inclined surfaces 32 and away from the apex 34 of the cavity 30, the magnetic flux field will be so disturbed, weakened or removed that the switch contact arm

20 will no longer be attracted and will separate from the contact 22. The switch 18 will thus remain open until the housing 10 is righted and the magnetic member 36 rolls or slides back down the inclined surface 32 to the apex 34. At such time the magnetic flux field is again established to the contact element 20 to close the switch 18 and restore the electrical circuit.

Referring next to FIGS. 3 and 4, another embodiment of the switch assembly is thereshown in which the housing, indicated generally by the numeral 40, is provided with flanges 42 and mounting apertures 44 in a manner similar to that heretofore described. The housing may be in two parts to include an upper portion 46 for ease in manufacture and assembly of the structure. Mounted in the housing 40 is a switch member, indicated generally by the numeral 48, similar to the switch 18 heretofore described with respect to the FIGS. 1 and 2. The same requirements are necessary of the switch 48 and the well-known reed switch may be used. Contact element 50 and contact element 52 are disposed within the housing 10, the contact arms 54 and 56 extending to the remainder of the electrical circuit, not here shown.

A cavity, indicated generally by the numeral 60, is provided in the housing 40-46 and has a lower wall 62 which is conical in shape. The apex 64 of the conical wall 62 is disposed at a point adjacent to but spaced from the switch member 38. An upper wall 65 is also conically formed at the same angle as the wall 62, for purposes to become hereinafter more apparent.

Disposed in the cavity 60 is a magnetic member, indicated generally by the numeral 66, such member being conveniently spherical in shape and preferably being a permanent magnet. It will be apparent that when the housing 40, or the device on which it is mounted, tilts beyond a particular degree, the magnetic member 66 will roll or slide from its position at the apex 64 of the conical wall 62, thus removing the magnetic attraction from the contact elements 50-52 and allowing such elements to separate and break the electrical circuit. When the housing 40 returns to its righted position, the element 66 returns to the apex 64 of the conical wall 62 and reestablishes the flux field to include the contacts 50 and 52, causing such contacts to close and the restoration of the electrical current through the contact arms 54 and 56.

In the embodiment of FIGS. 1 and 2 and in the embodiment of FIGS. 3 and 4, the design parameters are such that when the magnetic member 36 or 66 is disposed at a point closely adjacent the switch 18 or 48, the magnetic flux field is sufficiently directed and is of sufficient strength to attract the contact arm 20 or 50 in engagement with the arm 22 or 52. When the magnetic element 36 or 66 is moved away from the apex point 34 or 64, the magnetic flux field is sufficiently weakened or redirected through the housing 10 to no longer attract the contact arm 20 or 50 and thus cause the circuit to open. The angle of the inclined wall 32 or the conical wall 62 relative to the horizontal axis of the housing 10 is computed to be at such angle as desired so that a small amount of movement may not be sufficient to cause opening of the switch 18 or 48. It will be apparent that in the modification of FIGS. 1 and 2, tilting or rotation of the housing 10 only in a plane normal to the axis of the cylinder 36 will cause the cylinder 36 to move away from the apex 34. In the modification of the FIGS. 3 and 4, movement in any direction beyond the predetermined angle will be sufficient to move the magnetic member away from the apex 64.

Referring next to FIGS. 5 and 6, yet another embodiment of the invention is thereshown. A housing, indicated generally by the numeral 70, is provided with mounting flanges 72 and mounting apertures 74, should such be desirable. An upper housing member 76 is provided for ease in manufacture and assembly of the device. Disposed within the housing 70 is a switch member, indicated generally by the numeral 78, which is again preferably of the reed switch variety having an attractable contact element 80 and a contact element 82 on contact arms 84 and 86. A cavity 90 is formed in the housing 70, and disposed in the housing and extending longitudinally through the cavity 90 is a magnetic member, indicated

generally by the numeral 92. Magnetic member 92 may be of any suitable material, although it is preferred that the member be a permanent magnet for long life of the device. Magnet 92 is so disposed as to be closely adjacent the switch 78 and in such position to cause attraction of the contact element 80 into engagement with the contact element 82. The magnetic flux field from the magnetic member 92 passes through the airgap between the magnet and the lower surface of the cavity and through the material of the housing 70 to the switch member 78.

Disposed within the cavity is a deflector indicated generally by the numeral 94. Deflector 94 includes a pivot portion 96, suitably mounted in the end walls of the housing cavity 90 for purposes to become hereinafter more apparent. Arms 98 extend downwardly from the pivot portion 96 and terminate in arcuately inwardly directed deflector elements 100, which themselves terminate in spaced relation and adjacent the magnetic member 92. The elements 100 are formed of a material which is more permeable to the passage of magnetic flux than the airgap between the magnetic member 92 and the switch 78. Such material may be soft iron or any other suitable material.

When the deflector elements 100 are in the position shown in the FIG. 5, the magnetic flux path from the magnetic member 92, through the airgap and the housing, encompasses the switch contact element 80 and 82 and causes the elements to close into current carrying condition. When the housing 70, or the device on which it is mounted, tilts beyond a predetermined degree the deflector 94 is caused by gravity to pivot about the pivot portion 96 and one of the elements 100 swings between the magnetic member 92 and the switch 78. When thus interposed in the flux flow path, the more permeable element 100 deflects or redirects the flux flow away from the switch member 78, thus interrupting the magnetic flux path to the switch 78 and causing the contact elements 80 and 82 to separate and break the electrical circuit. When the housing 70 is restored to its normal position, the deflector 94 pivots about the pivot portion 96 so that the gap between the two deflector elements 100 is again disposed directly between the magnetic member 92 and the switch 78. The flux flow path is reestablished to the switch member 78 and the switch contacts 80 and 82 will close.

Referring next to FIG. 7, yet another embodiment of the switch assembly is illustrated in which a housing, indicated generally by the numeral 110, may be provided with mounting flanges 112 and apertures 114 as heretofore described and which includes an upper cover member 116 for manufacture and assembly purposes. The switch member, indicated generally by the numeral 118 and again being of the reed switch variety as heretofore described, contains contact elements 120 and 122 on the contact arms 124 and 126. A cavity, indicated generally by the numeral 128, is formed in the body portion 110. Extending across the cavity 128 and mounted in the end walls of the housing 110, is a magnetic member, indicated generally by the numeral 130, preferably being a permanent magnet.

Depending from the upper cover member 116 is a ball 132, secured to the cover member 116 by a stem 134. Mounted on the ball 132 in any suitable manner and for universal movement, is a conical deflector, indicated generally by the numeral 136, having aligned apertures 138 formed therein and through which pass the magnetic member 130. The size of the apertures 138 is such as to permit substantially universal movement of the conical deflector 136 about the ball 132 as the housing 110 is tilted. At the bottom of the conical deflector 136 is an arcuate permeable member 140, having an aperture 142 formed therein and disposed between the magnetic member 130 and the switch 118 when the housing 110 is in the proper righted position. In such position, magnetic flux passes through the aperture 132 and the portion of the housing 110 between the switch 118 and the cavity 128. Under such condition, the switch contacts 120 and 122 will be magnetically held in closed and current-carrying condition. When

the housing is tilted, the conical deflector will pivot about the ball 132 and a portion of the member 140 will be disposed between the magnet 130 and the switch 118. The magnetic flux field will thus be deflected, or redirected, allowing the switch contacts 120 and 122 to open. When housing 110 is righted, the conical member 136 will again pivot about the ball 132 to place the aperture 142 between the magnet 130 and the switch 118, reestablishing the flux field and closing the contacts 120 and 122.

In the event the switch assembly is used in an environment in which small changes in orientation are often occurring, it may be desirable to fill the chamber 90 or 128 containing the flux deflecting means 94 or 136 with a suitable fluid to damp movement thereof. Such fluid will prevent cycling of the switch contact with minor changes of such deflecting means.

Thus, a switch assembly is provided that is simple in design, easily and economically manufactured and produced, is positive in its operation, and has few moving parts subject to wear or replacement. The proper selection of materials and proper design are easily made from materials well known in the art and the degrees of allowable movement flux field strengths required and other such parameters provide great design versatility for many applications.

What I claim is:

1. A switch assembly comprising:

a housing having a vertical axis;
switch means in said housing and located on said vertical axis, said switch means being operable from a normally open condition to a closed condition;

a cavity in said housing and spaced along said vertical axis from said switch means and having a portion on said vertical axis adjacent said switch means and extending from said vertical axis in opposite directions;

and magnetic switch actuation means including a moveable portion, said magnetic actuation means being disposed in said cavity and having a position on said vertical axis generating a magnetic flux field enveloping said switch means and holding said switch means in said closed condition, and said moveable portion moving in said cavity to remove said flux field from said switch means when said vertical axis of said housing tilts beyond a predetermined amount to permit said switch means to operate to said

closed condition.

2. The switch assembly set forth in claim 1, wherein said magnetic actuation means includes a permanent magnet moveable in said cavity from said position on said vertical axis.

3. The switch assembly set forth in claim 2, wherein said cavity includes a wall having a point on said vertical axis and adjacent said switch means, said wall being angularly directed away from said switch means.

4. The switch assembly set forth in claim 3, wherein said wall is a cone having the apex thereof adjacent said switch means.

5. The switch assembly set forth in claim 4, wherein said permanent magnet is spherical and adapted to move along said wall from a position at said apex when said housing is tilted more than a predetermined amount.

6. The switch assembly set forth in claim 1, wherein said magnetic actuation means includes magnetic-flux-deflecting means moveable in said cavity for operating said switch means.

7. The switch assembly set forth in claim 1, wherein said magnetic actuation means includes a permanent magnet fixed in said housing and extending into said cavity, and magnetic-flux-deflecting means adapted to move into a position for deflecting magnetic flux from said magnet away from said switch means.

8. The switch means set forth in claim 7, wherein said magnetic-flux-deflecting means includes a portion moveable between said permanent magnet and said switch means, and pivot means in housing and secured to said portion to permit movement of said portion when said housing is tilted.

9. The switch assembly set forth in claim 8, wherein said portion extends longitudinally of said housing.

10. The switch assembly set forth in claim 7, wherein said magnetic-flux-deflecting means includes a conical member pivotally secured to said housing and in said cavity for universal movement, said cone having aligned apertures therein receiving said permanent magnet, and an apertured member secured to said conical member and extending between said permanent magnet and said switch means when said housing is in a nontilted position and said apertured member pivoting to deflect magnetic flux flow when said housing is tilted more than a predetermined amount.

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