

[54] **VIBRATION ACTUATED SWITCH WITH  
MAGNETIC HOLDING MEANS AND  
ARMATURE RESET POSITIONING MEANS**

1,989,277 1/1935 Jeffrey..... 200/61.45 M  
2,981,809 4/1961 Van Horn ..... 200/61.45 M  
3,448,228 6/1969 Munroe..... 200/61.45 R

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[22] Filed: **Nov. 10, 1972**

[21] Appl. No.: **305,403**

[52] U.S. Cl. ... **200/61.45 R**, 200/61.45 M, 200/61.5

[51] Int. Cl. .... **H01h 35/14**

[58] Field of Search ..... 200/61.45 R-61.53;  
73/71, 71.2, 492, 514, 517; 340/262

[56] **References Cited**

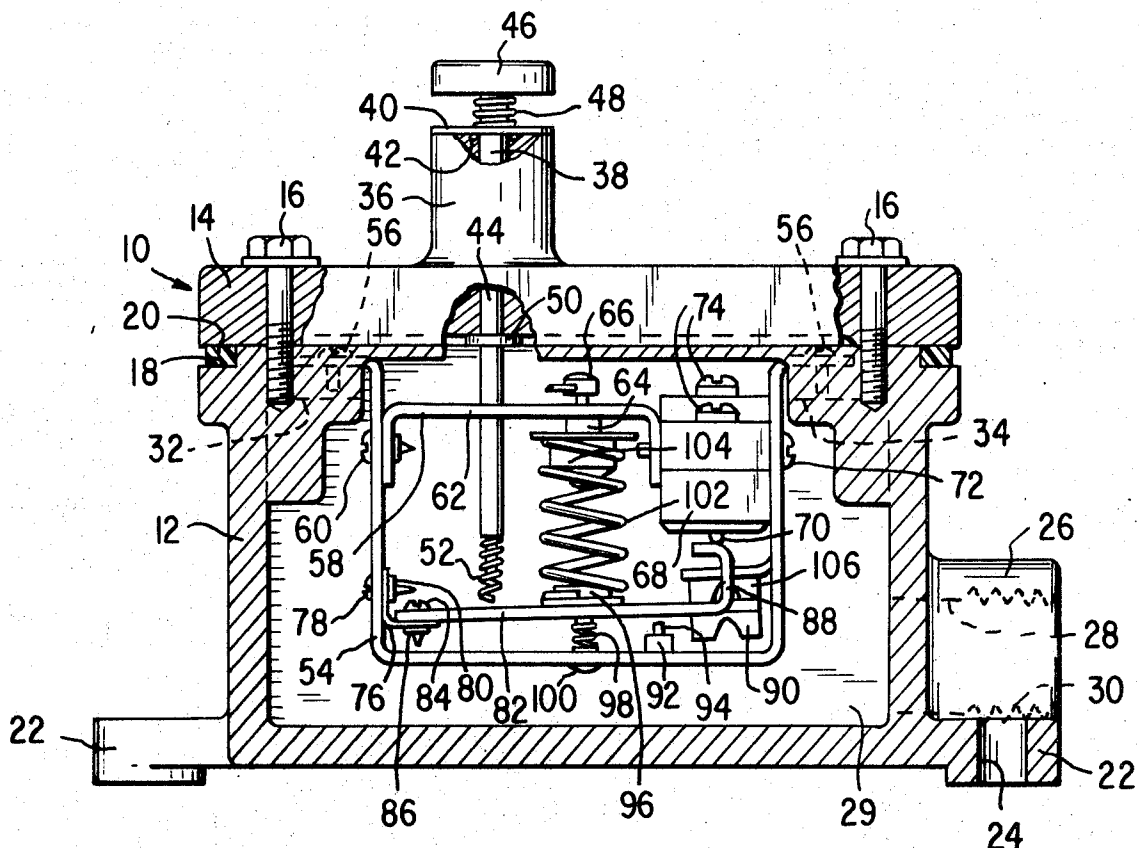
**UNITED STATES PATENTS**

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## [57] ABSTRACT

A vibration actuated switch is disclosed which includes a switch mounted on a support and having a switch actuator located proximate a movable armature and controlled thereby. The armature is retained in position away from the switch actuator by magnetic force from a magnet mounted thereon which is attracted to a portion of the support, and upon the occurrence of vibration of a predetermined extent to overcome the magnetic force, the armature moves toward another magnet and operates the switch actuator.

**14 Claims, 4 Drawing Figures**



SHEET 1 OF 2

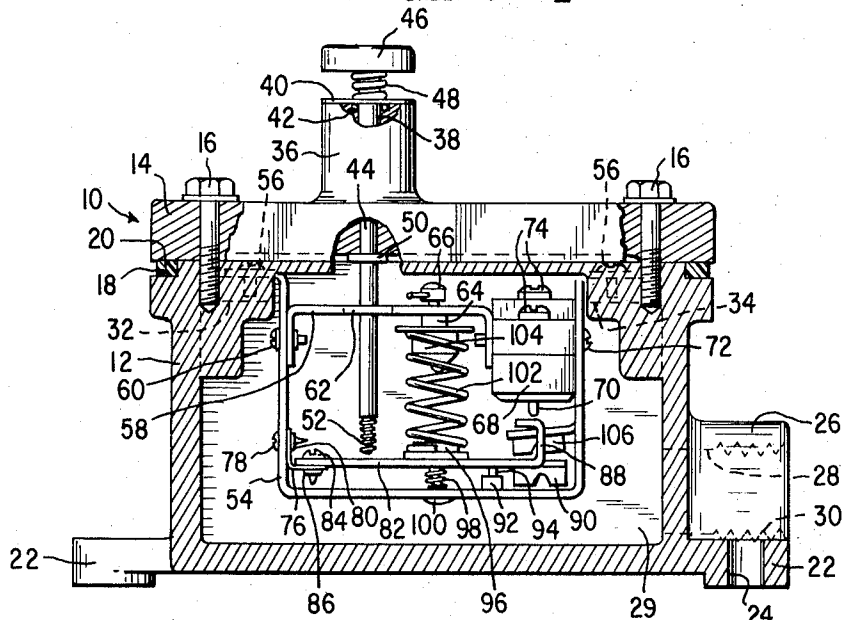


FIG. 1

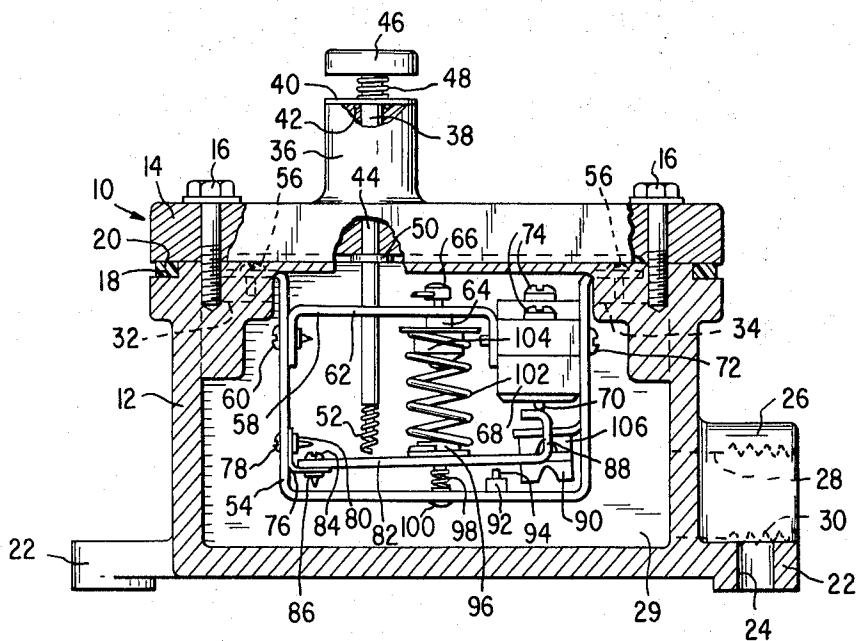


FIG. 2

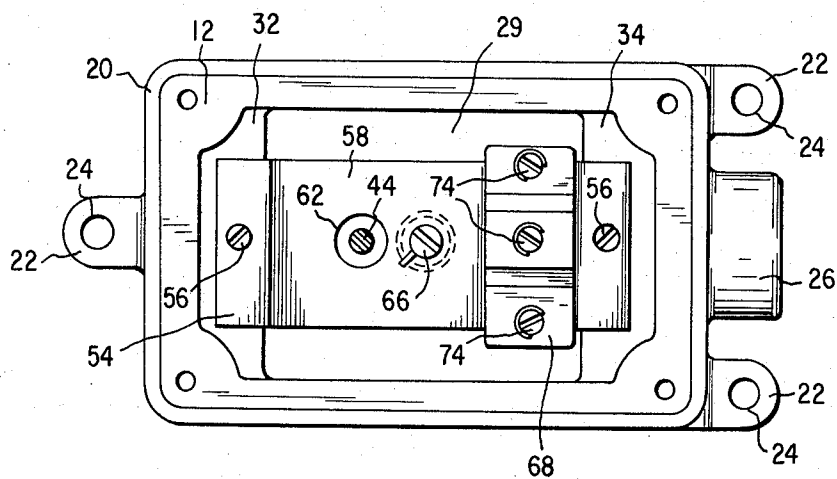


FIG. 3

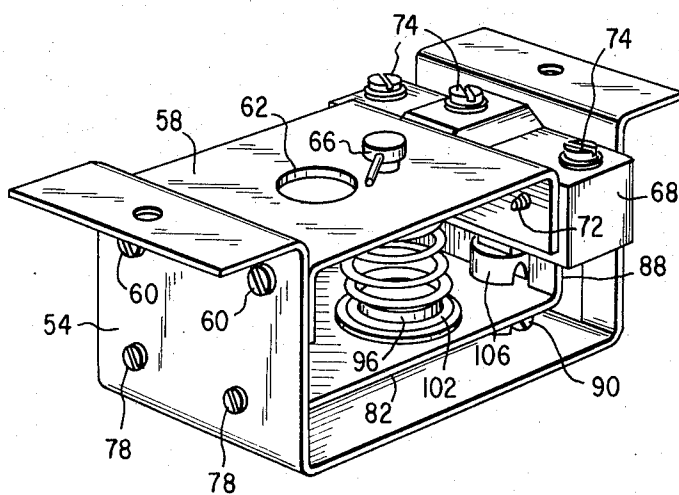


FIG. 4

# VIBRATION ACTUATED SWITCH WITH MAGNETIC HOLDING MEANS AND ARMATURE RESET POSITIONING MEANS

## BACKGROUND OF THE INVENTION

### 1. Field of the Invention

The present invention pertains to vibration actuated switches and more particularly to vibration actuated switches which may be constructed at low cost while exhibiting accurate and reliable response to excess vibration.

### 2. Description of the Prior Art

Vibration actuated switches have been in use for many years for monitoring vibration levels of reciprocating machines such as motors, turbines and the like and effecting a switch closure or the like upon experiencing vibration levels above some predetermined level to thereby energize an alarm indicator or terminate operation of the machine producing the excess vibration. Typical examples of such devices are disclosed in U.S. Pat. Nos. 3,448,228 and 3,641,290. On the whole, devices such as disclosed in the above patents are complex and quite costly to manufacture, and accordingly, their use is restricted only to more important applications. The desirability of a simplified and inexpensive vibration actuated switch which is also reliable and accurate to thereby enable a much wider use as a protective device is readily apparent.

## SUMMARY OF THE INVENTION

Accordingly, it is an object of this invention to construct a simple, inexpensive vibration actuated switch which is also reliable and accurate.

The present invention is summarized in a vibration actuated switch including casing means having internally disposed shoulder means, switch means including a switch actuator in the casing means, armature means having a portion located proximate the switch actuator which is movable into operating contact therewith in response to vibrations, magnet means on the armature means tending to retain the movable portion in position proximate the switch actuator, and bracket means suspended within the casing and having a pair of ends supported by the shoulder means for supporting the switch means and the armature means in the casing.

Another object of this invention is to produce a vibration actuated switch operable over a wide range of acceleration levels and frequencies.

Still another object of this invention is to provide a vibration actuated switch having a hanging bracket support therein.

Further objects and advantages of the present invention will become apparent from the following description of the preferred embodiment when taken in conjunction with the accompanying drawings.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevation view with parts in cross section of a vibration actuated switch embodying the present invention;

FIG. 2 is a side elevation view similar to FIG. 1 but showing the switch in another of its operational states;

FIG. 3 is a top plan view of FIG. 1 with the cover removed; and

FIG. 4 is a perspective view of the switch assembly of FIG. 1 with the casing removed.

## DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings, a vibration actuated switch in accordance with the present invention includes a casing, generally indicated at 10, which preferably is made of metal. Casing 10 is a substantially rectangular hollow container 12 having a cover 14 affixed thereto by means of a plurality of bolts 16. The outer periphery of container 12 is ridged at 18 to accommodate a continuous sealing gasket 20 made of rubber or any other suitable sealing material. A plurality of mounting tabs or feet 22 each containing a bore 24 therethrough extend from the lowermost part of container 12. A boss 26 on the side of container 12 has a generally centrally disposed bore 28 extending therethrough into a cavity 29 defined by container 12 and cover 14. Bore 28 is threaded at 30 for at least a portion of its length. A pair of shoulders 32 and 34 are disposed on opposite side walls within cavity 29, as best shown in FIG. 3.

Cover 14 is basically planar in shape and has a boss 36, shown partially broken away, extending from its outer surface and containing a centrally disposed bore 38 extending completely therethrough. A plate 40, affixed to the end of boss 36, has an aperture commensurate with bore 38. A sealing ring 42 is seated within boss 36 below plate 40 on a ridge concentrically located with respect to bore 38.

A rod or shaft 44 having a control button 46 affixed to one end is movably disposed in bore 38 of boss 36. A coil retract spring 48 is disposed in compression around shaft 44 between plate 40 and control button 46. Shaft 44 extends through cover 14 into cavity 29 and has a stop washer 50 affixed thereto which may take the form of a C-clip or the like held in place by a circumferential notch (not shown) in shaft 44. The end of shaft 44 which extends into cavity 29 is reduced in size for receiving a coil spring 52 thereon.

A substantially U-shaped bracket 54 including a pair of side walls interconnected by a base hangs suspended by a pair of opposed ends extending from the side walls which are supported by the pair of shoulders 32 and 34 and retained in place by a pair of screws 56. Another shorter U-shaped bracket 58 has an end connected to one of the side walls of bracket 54 by a plurality of screws 60. Bracket 58 has an aperture 62 therein positioned to receive shaft 44 therethrough and additionally retains an internally threaded collar 64 having an adjusting screw 66 extending completely therethrough. A switch 68 which includes internally disposed switch contacts (not shown) which are controlled by an axially movable switch actuator 70 is retainably supported between the other side wall of hanging bracket 54 and the other end of bracket 58 by another pair of screws 72. The internally disposed switch contacts are connected to a plurality of terminals 74 which are connected to electrical wiring (not shown) entering the casing through bore 28 of boss 26 from an alarm system or forming part of the control or power circuit for a machine or the like under observation. Bore 28 will usually be enclosed in some manner such as by the insertion of a threaded wiring conduit therein, a sealing plug or the like enclosing the electrical wiring extending therethrough.

A substantially L-shaped spring steel support 76 has one side affixed to a side wall of hanging bracket 54 by

a pair of screws 78 threaded into a retainer plate 80. The remaining side has an armature 82 attached thereto by another pair of screws 84 threaded into another retainer plate 86, with the intersection of the sides of spring steel support 76 constituting a pivot point for armature 82. Armature 82 includes an extended section 88 positioned adjacent the pressure responsive actuator 70 of switch 68.

A permanent magnet 90 is retainably mounted on armature 82 proximate the base portion of hanging bracket 54. A sleeve 82, which is force fitted into an aperture in the base portion of hanging bracket 54, is bored and internally threaded to accommodate an armature position adjusting screw 94 having a hex-head drive. A spring locator 96 has a small diameter portion extending through a cylindrical aperture in armature 82 toward the base portion of hanging bracket 54 and a large diameter portion sealed on armature 82 and facing bracket 62. The large diameter portion of spring locator 96 also has a circumferential shoulder abutting armature 82. A coil spring 98 in compression has one end disposed in a seat 100 recessed into the base portion of hanging bracket 54 and the other end abutting armature 82 and positioned by the small diameter portion of spring locator 96. Another coil spring 102 abuts armature 82 while being seated on the circumferential shoulder of the large diameter portion of spring locator 96. Spring 102 is also in compression with its other end retained by a brim of a generally conical hat member 104 having the internal portion of its crown positioned on the tip of adjusting screw 66.

A permanent magnet 106 is affixed to a section of the other side wall of hanging bracket 54 which has been deformed to underlie switch 68, such as by cutting and bending, and has an exposed generally planar face in alignment with armature 82 when armature 82 is positioned as in FIG. 2.

The operation of the vibration actuated switch will be discussed with particular reference to FIGS. 1 and 2, with FIG. 1 showing the vibration actuated switch in its unactuated or ready state and FIG. 2 showing the vibration actuated switch after actuation due to excess vibration.

Adjustable stop screw 94 is initially pre-set before the hanging bracket 54 is affixed to shoulders 32 and 34 to position the armature 82 such that permanent magnet 90 is slightly off the base of hanging bracket 54 when in the unactuated position of FIG. 1. This expedient eliminates the possibility of torsional mode vibrations produced if permanent magnet 90 is allowed to contact the base portion of hanging bracket 54 in a non-parallel manner resulting in an off-center point of contact.

Adjusting screw 66 is also pre-set to select the force applied to armature 82 via compressed spring 102 and thereby establish a predetermined level of vibration needed to actuate the armature 82 from the position of FIG. 1 to the position of FIG. 2.

Thereafter, cover 14 is bolted down into place on container 12 and the vibration actuated switch will be attached, such as by bolts through the bores 24 of feet 22, to a machine or the like to be monitored. At this time, control button 46 should be depressed to likewise depress shaft 44 to thereby transmit a force through coil spring 52 which is sufficient to reset armature 82 to its unactuated position of FIG. 1 in the event that armature 82 had inadvertently been actuated either before or during installation. The application of the reset

force to the armature by the coil spring 52, rather than directly by a rigid member as conventionally done, prevents deforming of the armature when excessive pressure is applied to the reset control button 46 since the coil spring will have sufficient rigidity to reset the armature but will compress under the excessive pressure. Resetting armature 82 to its unactuated position also causes switch actuator 70 to release to its most extended position. The presence of retract spring 48 insures that after the reset button 46 has been released shaft 44 and spring 52 withdraw from the armature 82 a sufficient distance so as not to interfere with its operation upon being actuated by vibration.

Armature 82 while in the unactuated position of FIG. 1 is subject to forces from coil spring 102 and from magnet 90 which tend to maintain it in its unactuated position. A counteracting force which is usually, but not necessarily, of a lesser magnitude than that from coil spring 102 is applied to armature 82 by coil spring 98. Magnet 106 is positioned far enough from armature 82 while in its unactuated position such that its initial force upon armature 82 is effectively negligible.

In the event that the machine being monitored begins to exhibit a vibration level equal to or in excess of the predetermined vibration level preset by adjusting screw 66 such as due to the initiation of bearing failure or the like, the mass of permanent magnet 90 and armature 82 times the acceleration due to the vibrations produces a force which, when taken with the other above-described forces on armature 82, produces a torque on armature 82 which actuates it counterclockwise about its pivot to depress pressure responsive switch actuator 70, finally assuming the position shown in FIG. 2. Permanent magnet 106 functions as a stop for armature 82 and, in addition, now produces a retaining force on armature 82 when contacted thereby which prevents it from returning to its unactuated position except by use of control button 46, the force due to permanent magnet 90 now being negligible. The depression of switch actuator 70 changes the state of the switch contacts within switch 68 and thereby effects an alarm indication and/or turns off the machine via the electrical wiring (not shown) extending through boss 26 to prevent further damage.

A vibration actuated switch has been disclosed which is simplified and inexpensive to produce, yet is reliable and accurate in operation, and accordingly, has broad utility as a protective device.

Inasmuch as the present invention is subject to many variations, modifications and changes in detail, it is intended that all matter contained in the foregoing description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. A vibration actuated switch comprising:

casing means including means defining a cavity therein and opposed shoulder means in said cavity; switch means including a switch actuator in said cavity;

armature means having a portion located proximate said switch actuator which is movable into operating contact therewith in response to vibrations; magnet means on said armature means tending to retain said movable portion in position proximate said switch actuator; and

substantially U-shaped bracket means suspended in said cavity and supporting said switch means and

5

said armature means thereon including a pair of opposed ends extending therefrom and supported by the respective shoulder means.

2. The invention as claim 1 wherein said substantially U-shaped bracket means includes a base having a pair of opposed, substantially parallel side walls extending therefrom and said armature means and said switch means are mounted on respective side walls of said bracket means.

3. The invention of claim 2 including a bracket extending from one of said side walls of said substantially U-shaped bracket means toward the other side wall and further including means retaining said switch means between said bracket and said other side wall.

4. The invention of claim 3 wherein said armature is pivotally affixed to said one side wall, and including biasing means tending to bias said movable portion of said armature means into operating contact with said switch actuator, said biasing means including a first spring disposed in compression between said armature means and said base and a second spring disposed in compression between said armature means and said bracket.

5. The invention of claim 1 including another magnet means supported by said substantially U-shaped bracket means for retaining said movable portion of said armature means in operating contact with said switch actuator upon its being moved in response to vibrations.

6. The invention of claim 1 including reset means for retracting said movable portion of said armature means to said position proximate said switch actuator comprising a rod movable toward said armature means and spring means extending from said rod and contacting said armature for transmitting a reset force thereto in accordance with movement of said rod.

7. The invention of claim 1 wherein said casing means includes a body portion having means thereon for being affixed to a machine or the like under observation for excessive vibrations, a cover portion disposed over said body portion, a sealing gasket between said body and cover portions and further including means for rigidly retaining said cover portion onto said body portion.

8. The invention of claim 1 including stop means preventing said magnet means on said armature means from contacting said substantially U-shaped bracket means.

6

9. The invention of claim 1 including a spring steel support having a pair of sides defining a substantially L-shape with one side affixed to said substantially U-shaped bracket means and including means affixing said armature means to the other side, the intersection of the sides forming a pivot for said armature means.

10. A vibration actuated switch comprising:  
casing means including means defining a cavity therein;

switch means including a switch actuator in said cavity;

armature means having a portion located proximate said switch actuator which is movable into opening contact therewith in response to vibrations;

magnet means on said armature means tending to retain said movable portion in position proximate said switch actuator;

bracket means within said cavity supporting said switch means and said armature means thereon; and

reset means for retracting said movable portion of said armature means to said position proximate said switch actuator comprising rod means extending through said casing means into said cavity and movable toward said armature means and a spring means extending from said rod means toward said armature means for contacting said armature means and transmitting a reset force thereto in accordance with movement of said rod means.

11. The invention of claim 10 including a bracket connected to said bracket means, and said switch means being supported between said bracket and bracket means.

12. The invention of claim 11 wherein said bracket includes means defining an aperture therein, and said rod means extends through said aperture toward said armature means.

13. The invention of claim 10 including a stop member preventing said magnet means from contacting said bracket means.

14. The invention of claim 10 including a spring steel support having a pair of intersecting sides defining a substantially L-shaped configuration with one side affixed to said bracket means and the other side carrying said armature means, with the intersection of the sides forming a pivot for said armature means.

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