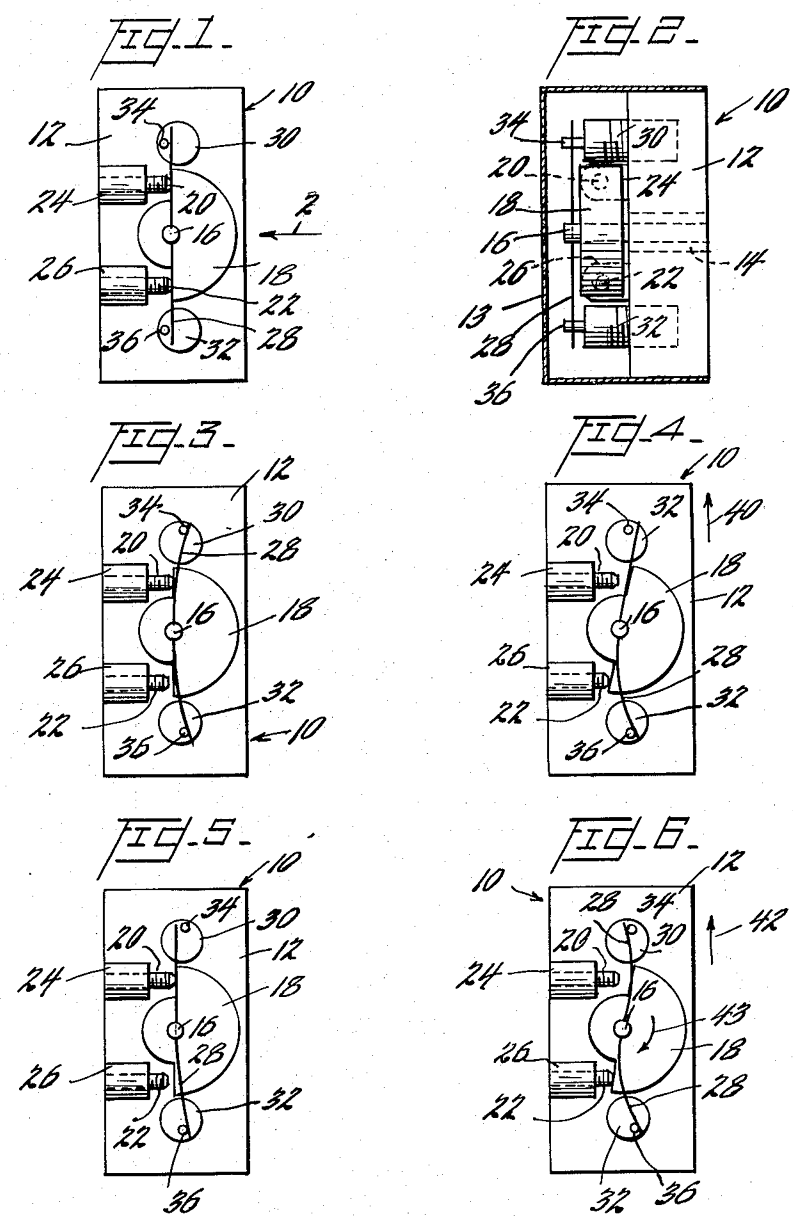
Aug. 11, 1964 L. PINO 3,144,528

ACCELERATION SWITCH

Filed March 29, 1961



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United States Patent Office

3,144,528
Patented Aug. 11, 1964

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3,144,528

ACCELERATION SWITCH

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Filed Mar. 29, 1961, Ser. No. 99,232
4 Claims. (Cl. 200—61.45)

This invention relates to an electrical switch, and more particularly, to an electrical switch which operates in response to acceleration forces.

Acceleration switches are well-known in the art. However, the prior art devices are subject to certain disadvantages. For example, it is difficult to make an adjustable acceleration responsive switch. Further, the prior art devices are subject to creeping action when subjected to vibration, which disadvantage precludes their use in certain installations.

Accordingly, it is an object of this invention to provide an improved electrical switch which is responsive to forces of acceleration.

It is another object of this invention to provide an adjustable electrical switch which operates in response to forces of acceleration.

It is a further object of this invention to provide an acceleration responsive switch which is simple in construction, easy to manufacture, and easy to adjust.

It is another object of this invention to provide an acceleration responsive electrical switch with a minimum of moving elements in which the primary element is purely rotational and is supported by bearings such that no creeping action of the switch components can occur when subjected to vibration.

It is another object of this invention to provide an improved acceleration switch which is encased in a sealed container with damping fluid, which switch when subjected to vibration experiences an effective damping action from the onset of angular movement of the acceleration responsive element, which damping action continues until the switch operation is completed.

Briefly, in accordance with one illustrative embodiment of this invention, an eccentric mass is mounted on a shaft and the shaft is journaled in one or more suitable bearings in a switch housing. An elongated substantially flat spring member, which may be in the form of a wire, is secured at its midpoint to the shaft to form a dual cantilever beam assembly. Advantageously, a pair of adjusting setscrews are providing in the housing in positions to engage portions of the eccentric mass and thus limit the arc of rotation of the eccentric mass. Also advantageously, a pair of adjustable insulating supports are provided in the regions of the ends of the spring member, which insulating supports have mounted thereon, suitable electrical contact pins. Preferably, the supports are rotatably mounted with their axes of rotation perpendicular to the plane of movement of the flat spring member. Advantageously, the contacts are mounted eccentrically on the supports such that rotation of the supports about their axes controls the position of the contacts relative to opposite ends of the spring member. With this simple arrangement, both contacts can be moved into engagement with the spring member on the same side of the spring member to define a normally closed switch. This embodiment is opened by the application of acceleration forces to the eccentric mass. These forces cause the mass to rotate, developing a torque which produces a stress in that portion of the spring member between the shaft and the one contact towards which the eccentric mass is rotating, which torque moves the opposite end of the spring member away from the other contact pin.

In another illustrative embodiment, the ends of the spring member may be placed on opposite sides of the respective contact pins by bending the spring and/or rotation of the pin supports. In this embodiment, the switch will be normally open and in response to acceleration of the switch housing, the eccentric mass will rotate toward the one contact which normally engages the spring member, thereby developing a torque which produces a stress in one part of the spring which moves the other part of the spring into engagement with the other contact pin.

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Advantageously, in either of these embodiments, the cantilever beam spring, or wire, determines the range of adjustments available to determine the magnitude of the forces required to actuate the switch. Within this range, the adjustment of the switch is achieved by positioning the switch contacts relative to the spring beam. Also advantageously, the entire switch assembly is hermetically sealed in a container which is filled with damping fluid to provide a damping action with respect to vibration.

These and various other objects and features of the invention will be more clearly understood from a reading of the detailed specification in conjunction with the drawing, in which:

FIGURE 1 is a side view in elevation of one illustrative embodiment of this invention with the cover removed;

FIGURE 2 is a view of FIGURE 1 taken in the direction of the arrow 2 with the side of the cover removed;

FIGURES 3 and 4 are side views in elevation of an embodiment of the invention which defines a normally closed switch and is shown in FIGURE 3 in its normal position and in FIGURE 4 in its operated position; and

FIGURES 5 and 6 show another illustrative embodiment of this invention which operates as a normally open switch, shown in FIGURE 5 in its normal position, and in FIGURE 6 in its actuated position.

Referring now to FIGURES 1 and 2, there is depicted one illustrative embodiment of this invention in which a housing **10** contains a suitable support member **12**. The entire housing **10** is preferably hermetically sealed by a metal cover **13**, shown in FIGURE 2, and contains a suitable nonconducting damping fluid. This damping fluid will damp out any externally applied vibrations which would otherwise prevent proper switch operation. Advantageously, this damping action will be continuous throughout the operation of the switch. A journal bearing **14** is mounted in the support member **12** and a shaft **16** is rotatably mounted in the bearing **14**. An eccentric mass **18** is secured to the shaft **16** and this eccentric mass is advantageously in the form of a sector of a circle; for example, a semicircle. A pair of setscrews **20** and **22** are supported in suitable supports **24** and **26** respectively, on the support member **12**. These setscrews are positioned so that their ends engage flat surfaces on opposite sides of the eccentric mass **18** and thus their adjustment controls the arc through which the eccentric mass **18** may rotate. A dual cantilever beam spring **28** is preferably, though not necessarily, secured at its midpoint to shaft **16**. Advantageously, this spring may be a wire of suitable diameter or it may be a flat spring having a relatively rectangular cross section, depending on the particular range of forces to which the switch is to be adjustable.

A pair of insulating supports **30** and **32** are rotatably mounted in support member **12** and these supports have switch contacts 34 and 36 respectively, mounted thereon. As best seen in FIGURE 2, the axes of supports **30** and **32** are perpendicular to the plane of movement of the eccentric mass **18**. Thus the switch contacts **34** and **36** which are eccentricaly mounted on supports **30** and **32** respectively, may be positioned relative to the spring **28** by rotation of the members **30** and **32**. Suitable conductors, not shown, may be connected to contacts **34** and **36** to connect the switch in the circuit to be controlled.

FIGURES 3 and 4 show side elevational views of an embodiment of this invention with the cover removed, which embodiment is adjusted to operate as a normally closed switch, its normal position being shown in FIGURE 3 and its operated position being shown in FIGURE 4. As best seen in FIGURE 3, opposite ends of spring **28** are in contact with contacts **34** and **36**. The eccentric mass **18** is in engagement with setscrews **20** while setscrews **22** is displaced from the flat surface of the mass **18**. It is apparent that contacts **34** and **36** are exerting considerable stress on the spring **28** to produce the curvature in the spring **28**, shown in FIGURE 3. When the embodiment of FIGURE 3 is subjected to any force of acceleration in the direction of arrow **40** in FIGURE 4, the eccentric mass or sector **18** will tend to rotate its axle **16** and move until sector **18** engages setscrew **22**. This rotation of sector **18** develops a stress in spring **28** between the axle **16** and the contact pin **36**. This stress will oppose the acceleration force applied to the mass **18**. When a sufficient accelerating force is applied to the mass **18**, it rotates to the position shown in FIGURE 4, in which position the spring **28** has moved away from contact **34**, thus opening the switch. The particular force required to open the electrical circuit between pin **34** and pin **36** will be determined for a given spring by the positions of pins **34** and **36**, which positions may advantageously be adjusted by rotating the contact pin support members **30** and **32** respectively, by any convenient means, not shown.

FIGURES 5 and 6 show another illustrative embodiment of this invention in side elevation, which embodiment acts as a normally open switch and is shown in its normal position in FIGURE 5 and in its actuated position in FIGURE 6. The principal distinction between the normally open embodiment of FIGURE 5 and the normally closed embodiment of FIGURE 3 is the position of spring **28** relative to pin **34**. In FIGURE 3, the spring is to the right of pin **34** and in engagement with the pin, while in FIGURE 5, the spring **28** is to the left of pin **34** and out of contact with this pin. When the embodiment of FIGURES 5 and 6 is subjected to an accelerating force in the direction of arrow **42** in FIGURE 6, the eccentric mass **18** will tend to rotate in the direction of arrow **43** and thus develop a stress in spring **28** between the axle **16** and contact pin **36**. This stress will continue to develop to the limit of the applied force of acceleration or until the mass **18** engages the end of setscrew **22**, whichever is first. Assuming that a sufficient accelerating force is applied to the switch, torque will be applied to the spring **28** until it engages contact pin **34** and thus completes the electrical circuit between contact pin **34** and contact pin **36**. When the accelerating force is removed in each of the embodiments shown in FIGURES 4 and 6, the switch will return to its respective normal position as shown in FIGURES 3 and 5.

While I have shown and described certain illustrative embodiments of this invention, it is understood that the principles thereof may be applied to other embodiments without departing from the spirit and scope of this invention. For example, in FIGURE 3, the positions of the ends of spring **28** relative to contact pins **34** and **36**, may be reversed and the switch will nevertheless open in response to an accelerating force. For example, if the spring **28** in FIGURE 3 were placed on the opposite sides

of the pins **34** and **36**, the switch would be normally closed and the switch would open at the point of contact between spring **28** and contact pin **36** in response to the acceleration forces in the direction of arrow **40** in FIGURE 4.

What is claimed is:

1. An acceleration responsive electrical switch comprising a support member, a shaft rotatably mounted in said support member, an eccentric mass secured to said shaft, means normally maintaining said eccentric mass to one side of said shaft relative to the direction of the force of acceleration to be measured, said last-mentioned means including means for limiting the arc of rotation of said mass, spring means secured to said shaft and extending radially from said shaft, and contact means positioned in the path of said spring means to be engaged thereby during the rotation of said mass in response to an accelerating force.

2. A switch according to claim 1, wherein the contact means comprising one contact eccentrically mounted on a rotatably shaft, and the position of said contact means is adjustable relative to said spring means by rotating the shaft to determine the magnitude of acceleration force required to actuate said switch.

3. A switch according to claim 1, wherein said contact means include a pair of contacts mounted on a dual cantilever spring comprising said spring means, and wherein said contacts on said spring means engage said contact means in the region of opposite ends of said spring means.

4. An acceleration responsive switch comprising a support member, eccentric mass means rotatably mounted in said support member, contact spring means connected to said eccentric mass, means for limiting the arc of rotation of said mass, and contact mens mounted in the path of said spring means, wherein the position of the contact means is adjustable relative to said spring means to determine the magnitude of acceleration force required to actuate said switch and wherein said spring means extends radially in opposite directions from the axis of rotation of said mass, and wherein one end of said spring means normally engages a first contact of said contact means and wherein the other end of said spring means is normally spaced from a second contact of said contact means, whereby rotation of said eccentric mass develops a stress in said spring means between said axis of rotation and said first-mentioned contact and causes said other end of said spring means to engage said second-mentioned contact, thereby defining an electrical path between said contacts.

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