

[54] **INERTIA SWITCH WITH RESILIENT CONDUCTIVE SUPPORT ARM IMMERSED IN SILICONE BASE VISCOUS FLUID MEDIUM**

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[51] Int. Cl. **H01h 35/02**

[58] Field of Search..... **200/61.48, 61.52**

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[57] **ABSTRACT**

A force actuated electrical switch which discriminates between forces having varying time duration. A pendulum, including a conductive wire secured at one end and fastened to a conductive bob at the other end. The pendulum is enclosed in a cylindrical insulator containing a thick viscous fluid. At the lower end of the cylinder a metal ring is positioned adjacent to the bob and surrounding it. Under normal conditions the bob remains at the center of the ring and there is no contact. When the cylinder is moved in a horizontal direction for an extended time interval, contact is made between the bob and the ring and the switch is closed.

10 Claims, 6 Drawing Figures

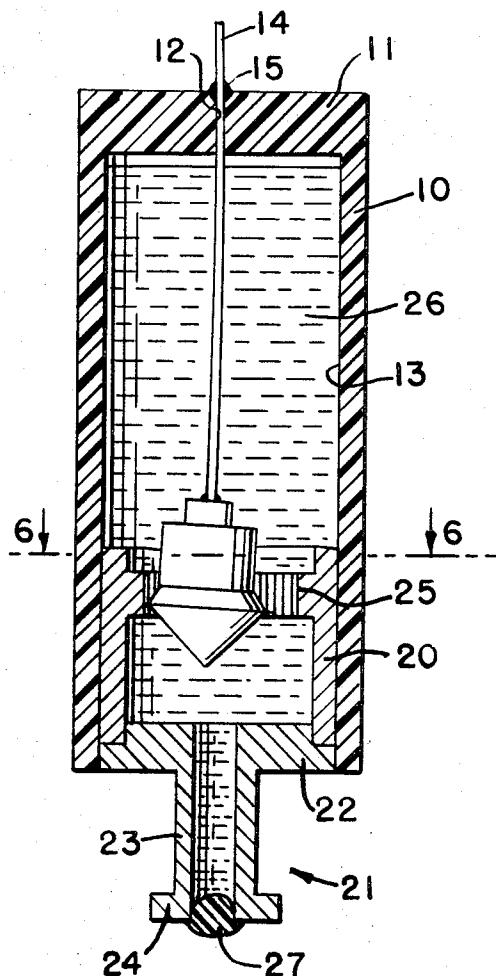


FIG. 1

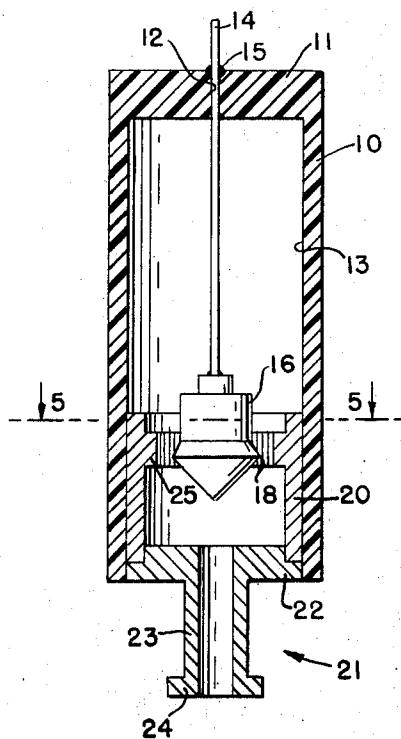


FIG. 2

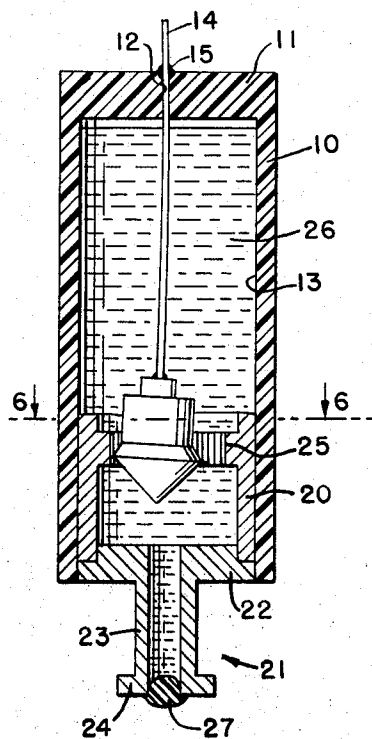


FIG. 3

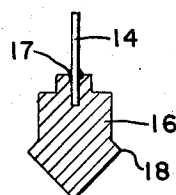


FIG. 4

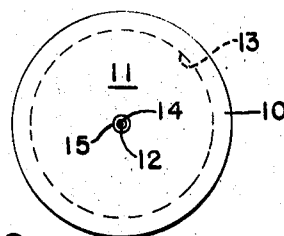


FIG. 5

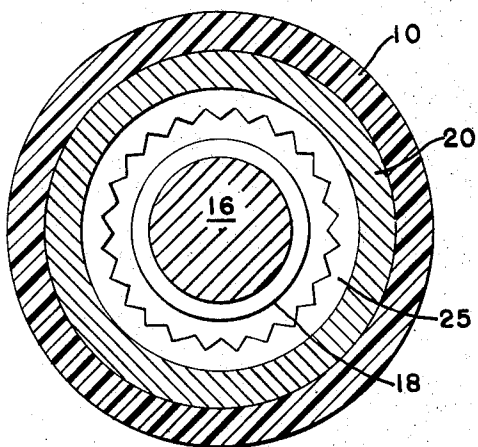
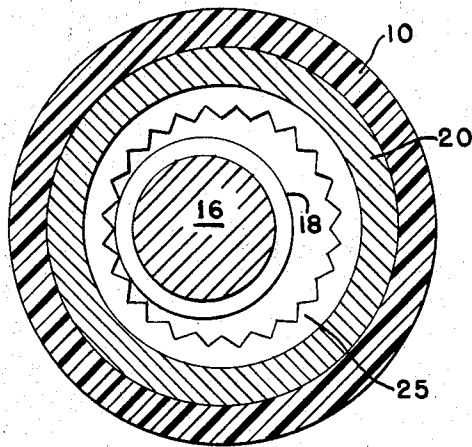


FIG. 6



INERTIA SWITCH WITH RESILIENT CONDUCTIVE SUPPORT ARM IMMERSSED IN SILICONE BASE VISCOUS FLUID MEDIUM

BACKGROUND OF THE INVENTION

This invention relates generally to inertia or tilt switches which are not actuated or closed when at rest or when acted upon by forces of short duration. Continuous forces alternating in direction at a frequency above a predetermined rate will also fail to close the switch. The switch is closed only by a continuous force acting in a single direction for a stated time interval.

A pendulum type arrangement is used having a conductive wire suspension and a pendulum bob as one of the switch terminals. A spaced ring within an enclosing hollow cylinder is the other terminal. A thick viscous fluid covers the bob and the ring and slows the action of the bob to prevent contact and closure of the switch for a designed time interval after the application of a closing force.

Pendulum type contact switches are well known in the art but they have been used without the addition of a viscous fluid and they have responded to vibrational forces having a frequency which is too high to make the switch available as an alarm signal on a moving vehicle.

One of the features of the invention is the combination of a heavy pendulum bob to provide inertia and a thick fluid of high viscosity surrounding the bob to provide mechanical resistance to the switch.

Another feature of the invention is the ability of the switch to be operated by any low frequency force providing the force has a component which is perpendicular to the longitudinal axis of the pendulum.

Another feature of the invention is the ability of the switch to maintain its specified performance characteristics over a wide temperature range and at all values of air pressure.

The inertia switch comprises a cylindrical insulator, closed at its lower end by a conductive cup which acts as one of the switch terminals. A pendulum is positioned in axial alignment with the cylinder and comprises a conductive wire, secured to the top end of the cylinder, and a metal bob at the lower end of the wire so that the bob normally is concentric with the brim of the cup. A viscous fluid fills the cup.

Other features and additional details of the invention will be disclosed in the following description, taken in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE FIGURES

FIG. 1 is a cross sectional view of the inertia switch showing the bob in its axial or normal position.

FIG. 2 is a cross sectional view similar to FIG. 1 but showing the bob in contact with the ring and a fluid in the cylinder.

FIG. 3 is a cross sectional view of the bob.

FIG. 4 is a top view of the inertia switch.

FIG. 5 is a cross sectional view, to an enlarged scale, of the switch shown in FIG. 1 and is taken along line 5—5 of that figure.

FIG. 6 is a cross sectional view, also to an enlarged scale, of the closed switch shown in FIG. 1 and is taken along line 6—6 of that figure.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the figures, the switch comprises an outer cylinder 10 made of insulator material preferably Delrin, a polyacetal resin of formaldehyde. Other insulating materials may be used provided they are good insulators and have the required mechanical strength. The cylinder 10 has an integral top closure disk 11 formed with a small hole 12 in the axial position. The remainder of the cylinder 10 is hollow, having a smooth inner surface 13. A suspension wire 14 is positioned in hole 12 and is sealed in position by a small amount of plastic 15. The end of wire 14 which extends above the cylinder is used as one terminal of the switch.

A heavy metal bob 16 is fastened to the lower end of the suspension wire 14. The wire 14 is pushed into a central hole and soldered in place by a small drop of solder 17. The bob is generally cylindrical but there is an annular sharp ridge or knife edge 18 formed near its lower end. The bottom portion is cone shaped. The knife edge 18 makes the electrical contact which closes the switch.

A hollow cylindrical plug 20 forms the second terminal of the switch. It is force-fitted into the lower portion of cylinder 10 and is fitted to a metal plug 21 which includes a disk 22, a tube 23, and a flanged terminal 24. An inwardly extending rim 25 is formed opposite the knife edge 18, and its inner face is serrated by the formation of a plurality of saw-toothed edges. The edges make contact with the knife edge 18 on the bob 16 to make the contact. The two edged portions positively cut through the film of the heavy fluid in the cylinder and assure a firm conductive contact whenever the bob is forced against the rim 25.

The switch is assembled by first placing the bob 16 and its suspension wire 14 in position and adding the plastic cement 15. Then the plug assembly 20, 21 is pressed into place. The switch is next turned upside down, and a viscous fluid 26 is poured into the switch through the hollow tube 23. When filled, the switch is stoppered by the addition of a cork 27 of self-setting plastic material (see FIG. 2). The switch is now ready for use, tube 23 or flange 24 serving as the second electrical terminal.

A sustained motion in any horizontal direction will not close the switch. It is necessary to apply a sustained force which will result in a steady acceleration or steady increase in velocity to move the bob 16 through the viscous fluid and establish electrical contact. A sustained deceleration or steady decrease in velocity will give the same results. The switching action may be varied over a wide range by changing the composition of the fluid which surrounds the bob 16. The fluid used must have certain basic characteristics such as: small temperature coefficient of viscosity; be non-corrosive; and chemically stable. Two or more fluids may be mixed to obtain the desired viscosity value, provided they are compatible and operate in a single phase over the required temperature range. Many materials are available from which to choose, such as halogenated hydrocarbons, silicones, and solutions of polymers. Three satisfactory mixtures are shown below; percentages in volume.

EXAMPLE I

Silicone Fluid
Silicone Fluid

SF-96-200
SF-96-350

18. %
50. %

3

Silicone Fluid

DC-210-1000

32. %

EXAMPLE II

Silicone Fluid

DC-200-100

41.6 %

Silicone Fluid

DC-210-1000

57.4 %

Bromo-Fluorocarbon

Oil

1.0 %

EXAMPLE III

Silicone Fluid

SF-96-200

36. %

Silicone Fluid

DC-210-1000

64. %

The above described switch has been found useful as a safety device in all types of moving vehicles and can be used as a signalling device on an airplane when the vehicle crashes, sending out a distress signal which can aid in locating the wrecked plane.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. An inertia actuated electrical switch comprising; a hollow cylindrical insulative container for supporting all the switch components; a pendulum including a conductive suspension and a metal bob, the suspension secured to one end of the container and forming one of the switch terminals, the bob formed with an annular knife edge and normally in axial alignment with the cylinder; an annular contact ring also mounted in the container adjacent to the bob and having a serrated inwardly extending surface for contact by the knife edge of the bob when the switch is actuated; a quantity of viscous fluid positioned in the container and covering the pendulum bob and the contact ring; and a stoppered conductive tube being disposed within the con-

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tainer and connected to the contact ring for filling the container with fluid, said conductive tube forming the other terminal of the switch.

2. A switch according to claim 1 wherein the container is made of plastic.

3. A switch according to claim 1 wherein the suspension is secured to the bob by soldering and the bob is terminated at its lower end by a cone.

4. A switch according to claim 1 wherein the serrated contact ring is part of a tubular insert, force-fitted into the lower portion of the container.

5. A switch according to claim 1 wherein the suspension is made of beryllium copper wire.

6. A switch according to claim 1 wherein the conductive tube is closed by a plug made of a self-setting plastic composition.

7. A switch according to claim 1 wherein the viscous fluid is a fluid silicone oil.

8. A switch according to claim 7 wherein the viscous fluid consists of three types of silicone fluid, neither of which comprises more than 50 percent of the total fluid.

9. A switch according to claim 7 wherein the viscous fluid consists of two types of silicone fluid, neither of which comprises more than 65 percent of the total fluid.

10. A switch according to claim 1 wherein the viscous fluid consists of two types of silicone fluid and bromo-fluoro-carbon oil.

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