Sept. 8, 1970 P. P. SCHWAB 3,527,907

CENTRIFUGAL SWITCH WITH NORMALLY CLOSED CONTACTS

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FIG. 1

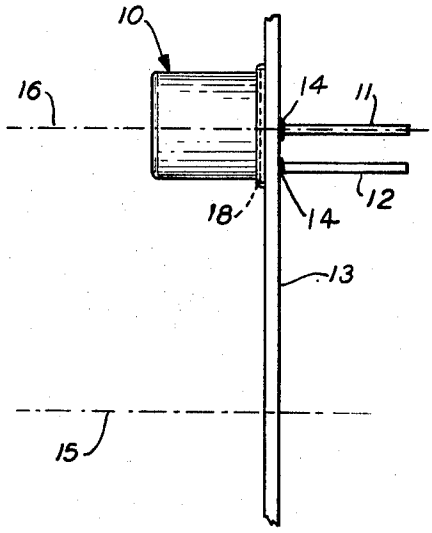


FIG. 2

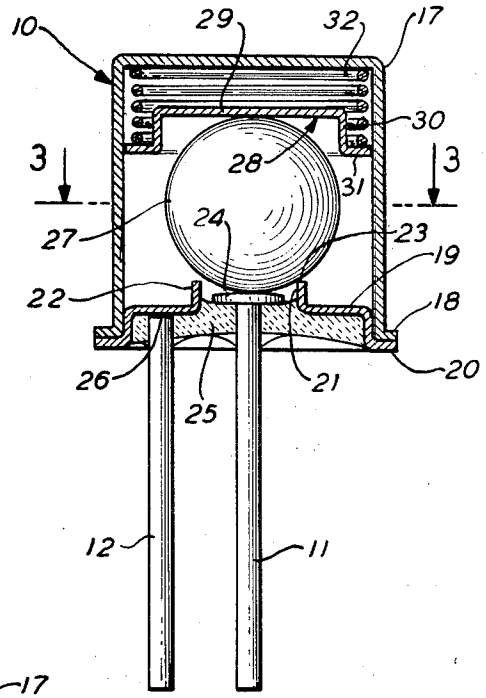
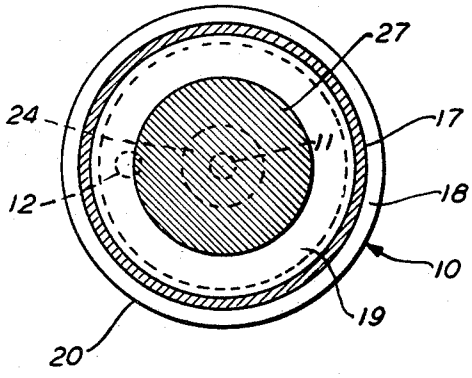


FIG. 3



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CENTRIFUGAL SWITCH WITH NORMALLY CLOSED CONTACTS

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ABSTRACT OF THE DISCLOSURE

A miniature centrifugal switch with normally closed contacts is mounted to revolve about a given axis parallel to its longitudinal axis. The switch comprises a metal case having a circular-edge contact on one end wall, a second contact within the circular contact, a spherical condutive body in the case biased into engagement with the circular-edge contact but wherein the central contact is inset slightly to prevent seating engagement of the spherical body with the circular contact whereby to assure electrical connection with both cotnacts until a predetermined centrifugal force is exerted on the spherical body sufficient to tilt the body sidewise to break connection with the central contact.

Centrifugal switches are used for triggering ballistic fuses or projectiles. In this application the design requirements are very rigid in that the switches must be miniature in size, must be shockproof and vibration proof, must undergo no physical change during years of storage under wide temperature and humidity conditions, and must remain capable of operating dependably at its specified rotational speed.

An object of the present invention is to provide a centrifugal switch with normally closed contacts, which fulfills the above-design requirements.

Another object is to provide such improved centrifugal switch which is of a novel and economical design.

These and other objects and features of my invention will be apparent from the following description and the appended claims.

In the description of my invention reference is had to the accompanying drawings of which:

FIG. 1 is a view showing the mounting of the present centrifugal switch relative to its rotational axis;

FIG. 2 is a sectional view taken along the longitudinal axis of the switch; and

FIG. 3 is a cross-sectional view taken on the line 3—3 of FIG. 2.

The centrifugal switch shown in the accompanying drawings has a cylindrical metal case **10** with two terminal pins **11** and **12** extending from the base end thereof. The switch is mounted on an insulating plate **13** to which the terminal pins are secured as by soldering indicated at **14**. The support **13** has a rotational freedom about an axis **15** parallel to the longitudinal axis **16** of the switch. The switch has normally closed contacts which are to be opened dependably when the switch is revolved at a predetermined speed about the rotational axis **15**. Typically, the overall switch device has a diameter of .21" and a length of .2". The distance of the longitudinal axis **16** of the switch from the rotational axis **15** about which the switch revolves is typically about .5".

The case **10** comprises a cylindrical cup **17** deep drawn as of copper with a flanged edge **18** at its open end. Fitted into the open end of the case is a header **19** of Kovar metal (nickel-iron alloy). This is a shallow cup-shaped member formed also by drawing with a peripheral radially extending rim **20**. The rim **20** is seated against

the flanged edge **18** and welded or braised thereto in air-tight relation. The header has a central opening **21** surrounded by an inwardly extending flange **22**. The inner circular edge **23** of this flange forms one contact member of the centrifugal switch. Centered in the opening **21** is the terminal pin **11** also of Kovar. The inner end of this pin is preferably formed with a cam-shaped head constituting a second contact **24** of the switch. This terminal pin is hermetically sealed to the header **19** by a glass medium **25**. The second terminal pin **12** is welded to the header **19** at **26** and the weld connection is also covered by the glass medium **25**.

Engaging the circular-edge contact **23** is a spherical ball **27** preferably of a conductive metal such as copper. This spherical ball has clearance from the sides and inner end wall of the case. The ball is pressed by a spring means **28** into a seating relationship with the circular-edge contact **23** but the central contact **24** is set slightly inwardly relative to an arc which the ball would describe were it seated on the circular-edge contact **23** so that the ball is tilted slightly to one side making positive engagement with both the central contact **24** and a portion of the circular-edge contact **23**. Preferably, the diameter of the circular-edge contact is from one-half to three-quarters the diameter of the spherical ball **27**.

The spring means **28** is made preferably of a type which will press the ball **27** longitudinally of the case towards the circular-edge contact **23** without exerting any substantial restraint to prevent the ball from being deflected sidewise by centrifugal force due to the coupling engagement of the spring means with the ball. This spring means must also fit within the space limitations of the case **10** and must therefore have a diameter not greater than about $\frac{3}{16}$" and an overall height not greater than about .060". The spring means should also have a low spring rate so that it exerts about a constant force on the ball as the ball is deflected sidewise. A spring means which meets these rigid requirements comprises a cap **29** seated against the inner tip of the ball at right angles to the longitudinal axis of the case. This cap is provided with a deep peripheral flange **30** terminating in an outwardly extending rim **31** having a clearance fit with the inside wall of the case. The cap is set into the case with the flange **30** and rim **31** disposed in the annular corner space between the ball **27** and the side and end walls of the case. Surrounding the flange **30** and disposed between the rim **31** and the inner end wall of the case is a helical spring **32**. This spring is permitted to have a relatively long length and a relatively low spring rate because it is disposed between the end wall of the case and the rim **31** offset considerably from the cap **29** away from the end wall of the case. Since the spring **32** exerts a force longitudinally of the case on the spherical ball **27** via the flat cap **29**, the coupling per se between the spring **32** and the ball **27** imposes no restraint against sidewise deflection of the ball from centrifugal force other than the sliding frictional contact which the ball has with the flat surface of the cap **29**.

In the mounted position of the switch device the ball **27** is retained within the circular-edge contact **23** by the spring **32**. The force exerted by the spring **32** against the ball **27** is set in conjunction with the mass of the ball and the incline along which the ball moves as it breaks contact with the central contact **24** so that the switch operation will occur at a predetermined speed of revolving movement of the switch device about the rotational axis **15**. The incline along which the ball is moved as it is deflected sidewise by centrifugal force is dependent on the diameter of the circular-edge contact **23** relative to the diameter of the spherical ball **27**. For a preset speed of 1800 r.p.m. at which the switch contacts are to open,

the switch may have the following parameters: diameter of spherical ball **27** .125", diameter of circular-edge contact **23** .070", weight of spherical ball **27** .13 grams, and force of spring means **28** against the spherical ball of 4 grams.

The electrical circuit between the terminal pins **11** and **12** is completed via the center contact **24**, ball **27**, circular-edge contact **23** and header **19**. In order that a positive connection of low resistances is obtained between the ball **27** and associate contacts the ball and these contacts are plated with nickel and gold. Although the ball is preferably made of a conductive metal as described it could be of other material, even non-conductive material, provided it is formed with a good surface conductivity. Further, in order that films may not form on the contacts to reduce the conductivity the switch case **10** is evacuated of air and filled with inert nitrogen gas which may also include some helium gas for easy leak detection.

I claim:

1. A normally closed centrifugal switch comprising a metal case mounted for revoling movement about a given axis parallel to the longitudinal axis of the case, said case including a cylindrical cup and a header fitted into and sealed to the open end of said cup, said header having a central opening surrounded by an inwardly turned rim flange, a terminal pin extending into said opening and provided with a contact tip, an insulating medium sealing said terminal pin to said header, a spherical body in said case having a conductive surface and having clearance from the side wall and inner end wall of said case, spring means in said case exerting a biasing force on said spherical body tending to seat it on said rim flange, said contact tip being inset slightly to prevent said body from seating evenly on said rim flange whereby to assure an electrical connection between said contact tip and said rim flange via said body when said switch is in a rest condition, said body being deflected sidewise by centrifugal force to break contact with said tip when said switch is revolved about said given axis at a predetermined speed, and a second terminal pin connected to said case.

2. The centrifugal switch set forth in claim **1** wherein said spring means comprises a flat cap seating against the innermost tip of said spherical body, and a spring between said cap and the inner end wall of said case pressing said cap against said body while tending to maintain said cap at right angles to the longitudinal axis of said case.

3. The centrifugal switch set forth in claim **2** wherein said cap has a peripheral rim flange offset from the inner end wall of the case away from said cap and provided with clearance from the side wall of the case, and wherein said spring is a helical spring interposed between said rim flange of said cap and said end wall of the case.

4. The centrifugal switch set forth in claim **1** wherein the rim flange of said header has a diameter from one-half to three-fourths the diameter of said spherical body.

5. The centrifugal switch set forth in claim **1** wherein said case is evacuated of air and filled with inert nitrogen gas, and wherein said contact tip and said rim flange of said header and the surface of said spherical body are nickel and gold plated.

6. The centrifugal switch set forth in claim **1** wherein said spherical body is made of copper which is nickel and gold plated, and said header and central terminal pin are nickel-iron alloys also plated with gold.

7. The centrifugal switch set forth in claim **1** wherein said contact tip is cone-shaped.

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