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ACCELERATION SWITCH RESPONSIVE TO RADIALY APPLIED FORCES

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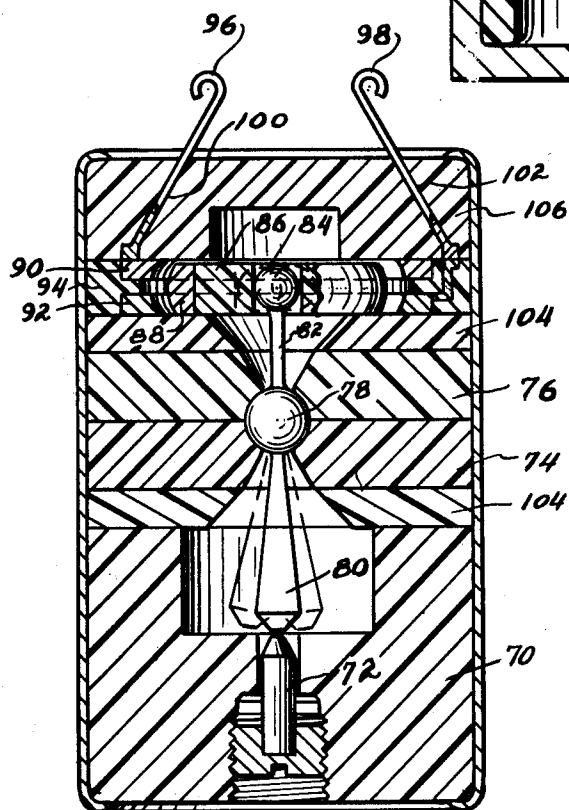
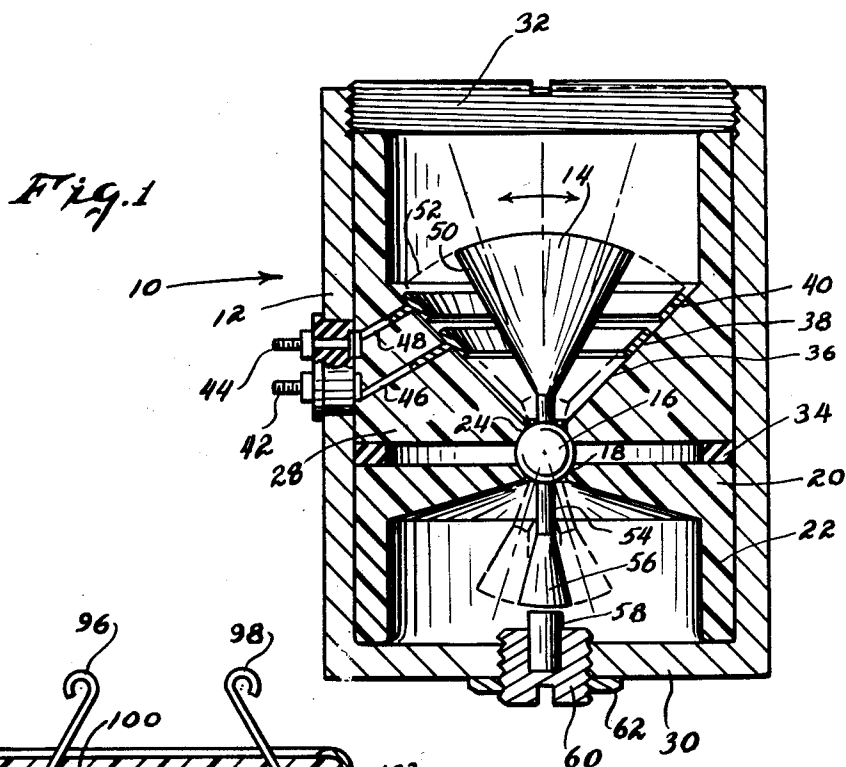


Fig. 2

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ACCELERATION SWITCH RESPONSIVE TO RADIALLY APPLIED FORCES

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4 Claims. (Cl. 200—61.48)

This invention relates to an electric switch and, more particularly, relates to an inertial actuated switch which will close an electric circuit when subjected to acceleration forces of preselected amplitude in any direction along a radius from a central axis thereof.

Acceleration switches which are sensitive to radially applied acceleration forces, that is, forces extending along a radius from the central axis have been desired by the art in order to trip a switch when the acceleration forces exceed a predetermined amplitude in any direction.

Such switches have usually been constructed utilizing a ball of magnetic material which is centered within a conical seat. A magnetic field is established tending to hold the ball in the seat. When the acceleration forces reach an amplitude sufficient to deflect the ball along the conical seat and out of the seat, the ball will bridge electric contacts to close the switch. Such switches, however, require that the ball be of a magnetic material. However, it is most desirable that the material for closing the switch contact be made of a precious metal having low contact resistance. Plating of a precious metal on an iron ball results in etching of the iron surface and the formation of carbon deposits which may cause inadvertent circuit interruption. Further, such balls are subject to deflection of the ball from the seat due to acceleration forces along the axis of the acceleration switch with resultant chattering contact.

It is, therefore, an object of this invention to provide an acceleration switch which will close an electric circuit upon the application of an acceleration force of predetermined amplitude along any radius transverse to the axis of the acceleration switch.

It is a further object of this invention to provide an acceleration switch responsive to radial forces which is compact in size and is insensitive to vibration along the axis thereof.

Other objects and advantages of this invention will be pointed out hereinafter in the following detailed description of this invention which may be more clearly understood by reference to the accompanying drawings, of which FIG. 1 is a cross section view of an acceleration switch constructed in accordance with the present invention.

FIG. 2 is a cross section view of another embodiment of an acceleration switch.

In the FIG. 1, there is shown an acceleration switch 10 consisting of a generally cylindrical casing 12 within which is mounted an acceleration mass 14 which is deflectable about the center of the ball 16.

The inertial mass 14 is constructed of a precious metal such as gold to afford low contact resistance. The ball 16 is rotatably contained in a lower seat defined by the circular aperture 18 in the conical portion 20 of the lower bearing and spacer assembly 22. The ball is similarly journaled by the aperture 24 in the conical arm 26 of the switch assembly 28. The assemblies 22 and 28 are preferably formed from a lightweight insulator material such as a linen-phenolic such as the XXXP phenolic used for the fabrication of printed circuit boards. The assembly 22 is preferably formed and inserted within the casing 12 so that it abuts the end wall 30 thereof. The upper assembly 22 may then be inserted and held in place by an end cap 32 which thread-

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ably engages the wall 12. Suitable spacers 34 may be inserted such as annular shims. It will be recognized that the spaced 34 may, if fabrication techniques permit, be integrally formed with either assembly 22 or 28. On the conical surface 36 of the assembly 28, ring contacts 38 and 40 are applied as, for example, by conventional printed circuit techniques. For example, the ring contacts may be sensitized through conventional masking and the contacts formed by electro-depositing copper plating on the sensitized surface. The ring contacts are joined to terminals 42 and 44 by respective lead 46 and 48. The mass is so formed that the conical sides 50 thereof will engage both ring contacts when the mass deflects in the application of acceleration forces as indicated by dotted outline 52.

In order to provide a restraining force holding the mass upright, there is provided a lower arm 54 to which is appended a magnetic mass 56 such as a soft iron permeable material. A magnet 58 such as an alnico permanent magnet is mounted within a fitting 60 which is adjustably positioned with respect to the mass 56 by the threaded engagement of the fitting 60 with the aperture in the end wall of the casing. The magnet position may be locked by a lock nut 62.

Thus, the magnetic coupling between the magnet and the mass may be simply and easily adjusted merely by movement of the magnet 58. The switch will not be disturbed by acceleration forces acting along the central axis of the switch since there is no unbalanced mass on which to act. However, it will be responsive to acceleration forces along a radius transverse to the central axis. The mounting of the mass on an arm away from the pivot point will make the switch responsive to very low acceleration forces if desired. Since the mass can be made of precious metal, closure of the switch can be effected with low contact resistance.

In many applications, it is desirable that the switch be responsive to acceleration forces of higher amplitude. Further it is often desirable due to assembly conditions that the switch contacts be self-centering. In such applications the embodiment shown in FIG. 2 may advantageously be employed.

In FIG. 2 there is shown an acceleration switch comprising an insulator sleeve 70 within which a magnet is adjustably positioned. Discs 74 and 76 are provided with a shaped central aperture to form a socket within which a ball 78 is rotatably mounted. An inertial mass 80 is mounted on the ball 78 and is held in the axially centered position by magnet 72, the force of the holding being adjustable by magnet movement. Also mounted on the ball is arm 82 terminating in a ball joint 84. The ball joint enters the central aperture of insulator disc 86, having an annular ring contact 88 on the periphery thereof. The contact is preferably of precious metal as for example gold and is pressed on the disc.

Annular contacts 90 and 92 are mounted on an insulator ring 94 and are respectively coupled to terminals 96 and 98 by leads 100 and 102.

Spacers 104, 106 of insulator material position the ring contacts in the desired orientation. The assembly is completed by case which is spun over at each end to sealedly encase the switch.

In operation, as the mass deflects from the axial position under a radial force of sufficient amplitude to break the magnetic attraction between magnet and mass, the arm 82 will move the contact 88 into engagement with annular contacts 90, 92. It will be noted that the contact 88 is free to deflect slightly to ensure bridging between contacts 90, 92 despite slight misalignment or deviation of contacts from the desired shape and placement.

This invention may be variously embodied and modified within the scope of the subjoined claims.

What is claimed is:

1. In combination, an inertial mass, said inertial mass formed from a precious metal, a ball suspension, means for mounting said mass on said ball for rotation about the axis thereof, a magnetic mass axially aligned with said inertial mass and mounted upon said ball, a magnet, said magnet being adjustably positioned within the magnetic field interacting with said magnetic mass, a first and second ring contact positioned about said inertial mass and means coupling said ring contacts to a circuit so that said inertial mass will bridge said contacts to close said circuit when acceleration forces are applied in any radial direction transverse to the axis of an amplitude in excess of that determined by the breakaway attraction between said magnet and said magnetic mass.

2. In combination in accordance with claim 1, which includes a first assembly having a cylindrical wall and an inwardly tapered conical wall, said conical wall having a central aperture therein, and which includes a switch assembly having a cylindrical wall and inwardly extending conical wall having a central aperture therein, said ball being mounted for rotation within the central apertures of said first and second switch assemblies.

3. An acceleration switch responsive to radial acceleration forces, comprising: a socket; a ball rotatably mounted in said socket; an acceleration mass mounted on said

ball and rotatable about the ball center; magnetic means to hold said mass in an axially centered orientation in the absence of acceleration forces exceeding a predetermined magnitude, means for adjusting the attractive force of said magnet means, and switch means carried in such relation to said ball to be closed by deflection of said mass from said axially centered position, said switch means comprising; a first and second annular contact, a disc having a conductive peripheral band, an arm mounted on said ball and engaging said disc to drive said disc into engagement with said contacts when said inertial mass is deflected from the axially centered position.

4. An acceleration switch in accordance with claim 3 in which the disc is rockably mounted on said arm.

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