April 27, 1965 G. J. PREISZ 3,180,952

ACCELERATION SWITCH RESPONSIVE TO RADIALLY APPLIED FORCES

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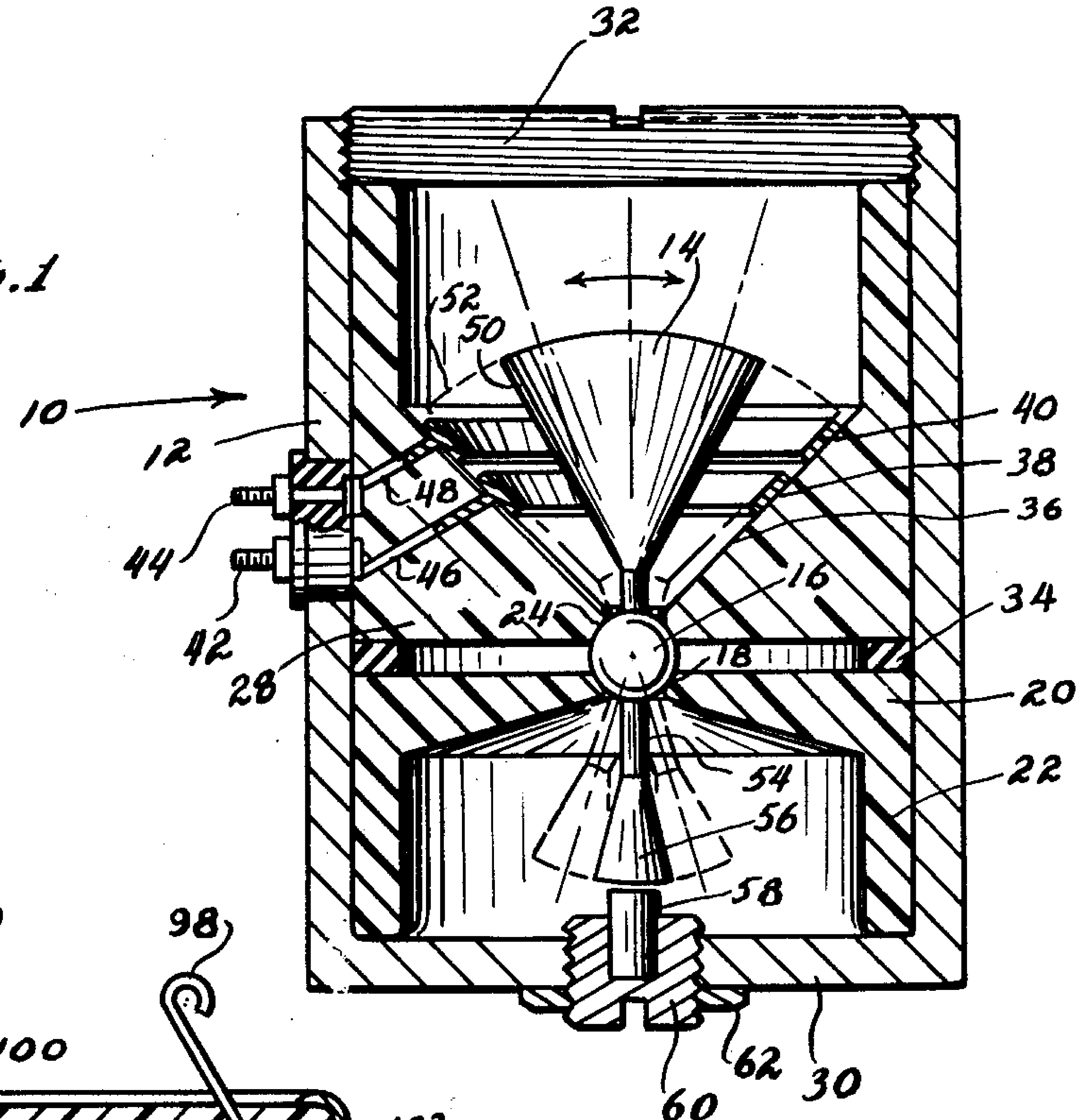
Fig. 1



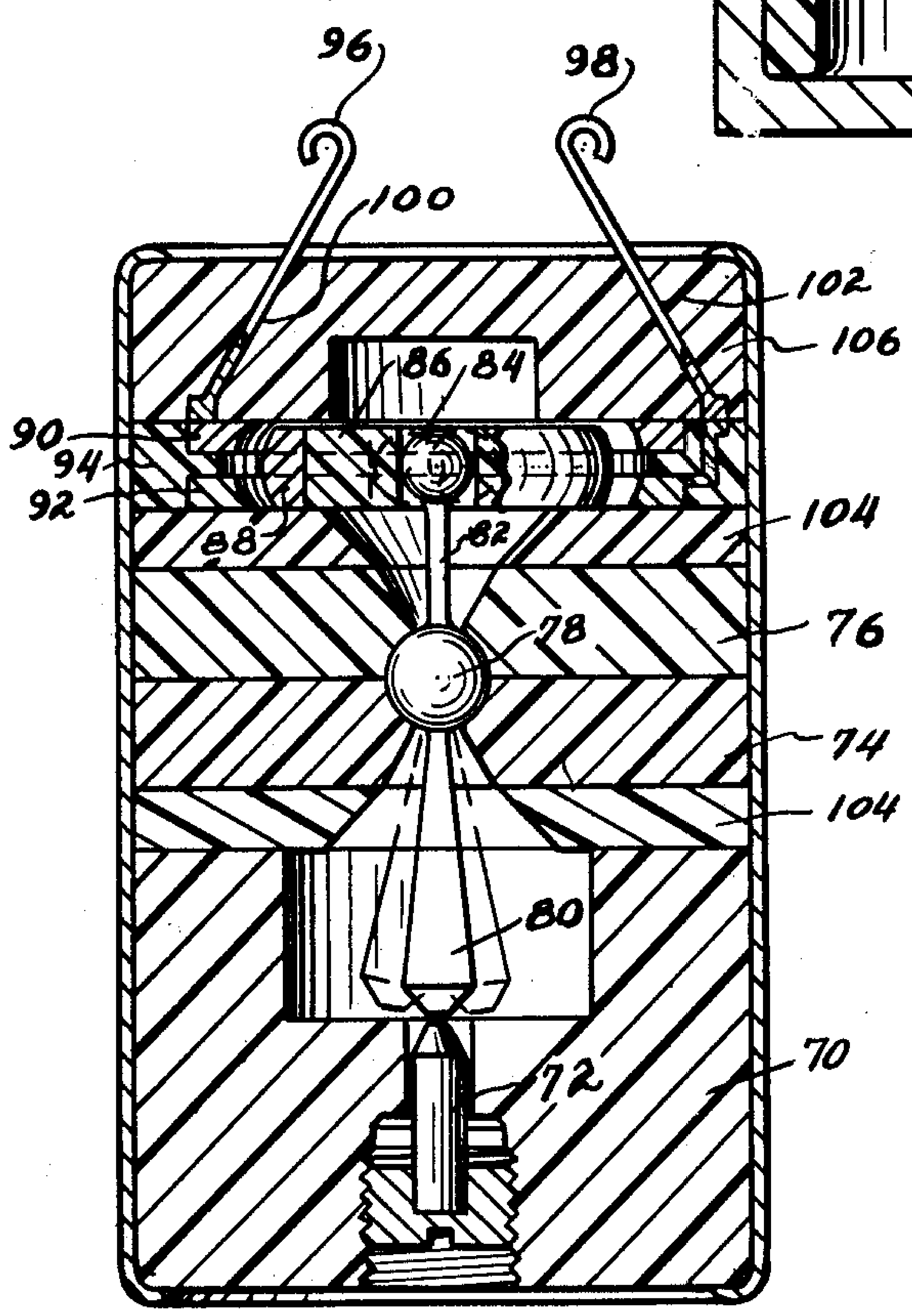


Fig. 2

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ACCELERATION SWITCH RESPONSIVE TO RADIALLY APPLIED FORCES

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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 journalled 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 threadably 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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