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[54] **INERTIA SENSING SWITCH WITH CONDUCTIVE CATCH RIM MEANS FOR RETAINING MOVABLE CONTACT IN CLOSED POSITION**

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[52] **U.S. Cl.**..... **200/61.45 R,** 200/61.53, 200/163

[51] **Int. Cl.** **H01h 35/14**

[58] **Field of Search**..... 200/61.08, 61.41, 61.45 R, 200/61.5, 61.51, 61.53, 163, 61.47

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[57] **ABSTRACT**

A detector secured to a projectile, which closes a switch at the end of a deceleration period after an initial acceleration period of the projectile. The detector components are housed in a small cylindrical container having two normally open switch terminals. A movable mass is resiliently positioned at one end of the detector to act as an inertia operator to drive a latch through a wall when a deceleration of the projectile is sensed. When the projectile comes to rest, the movable mass is returned to its original position and the switch is closed.

11 Claims, 6 Drawing Figures

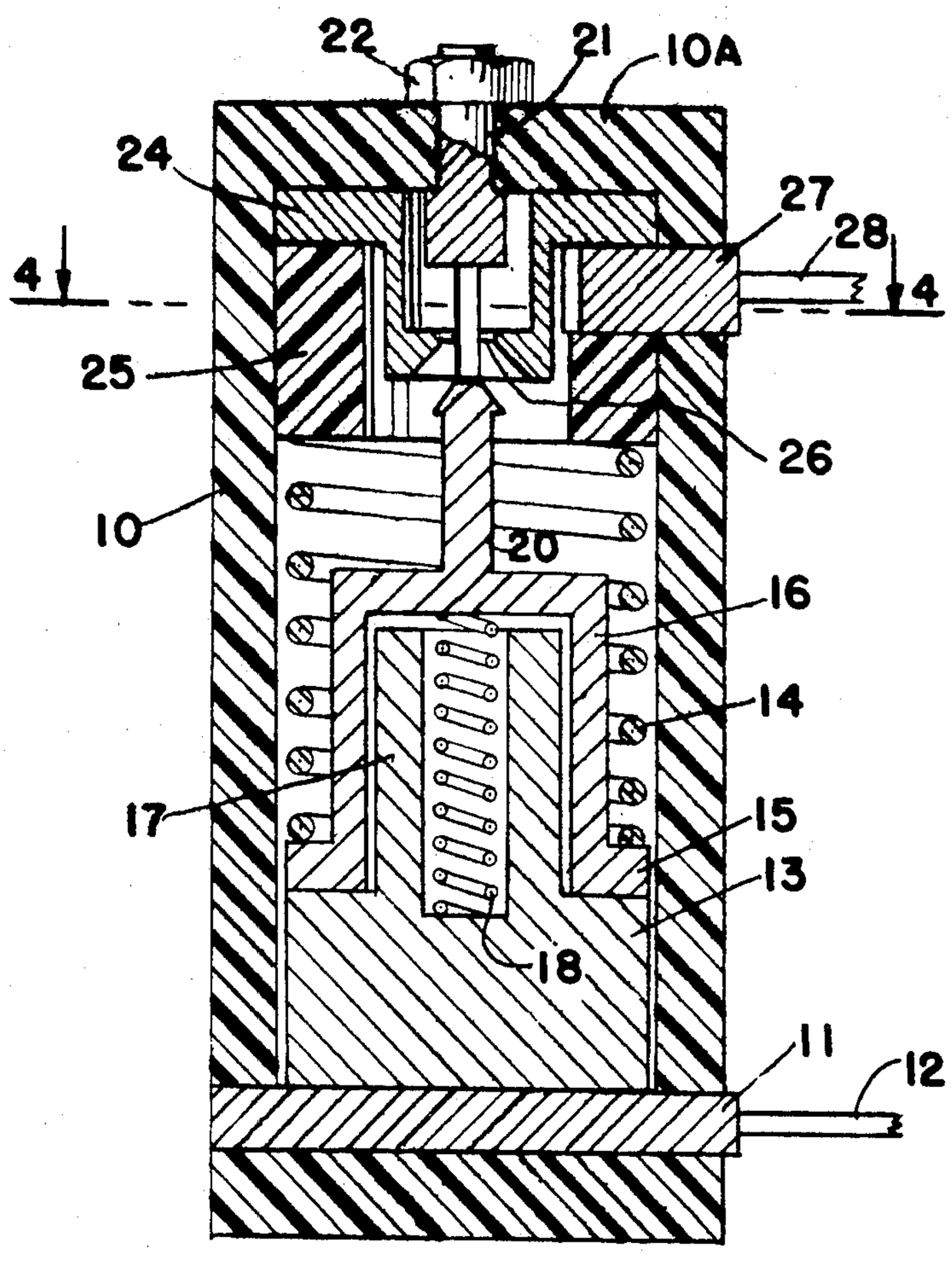


FIG. 1

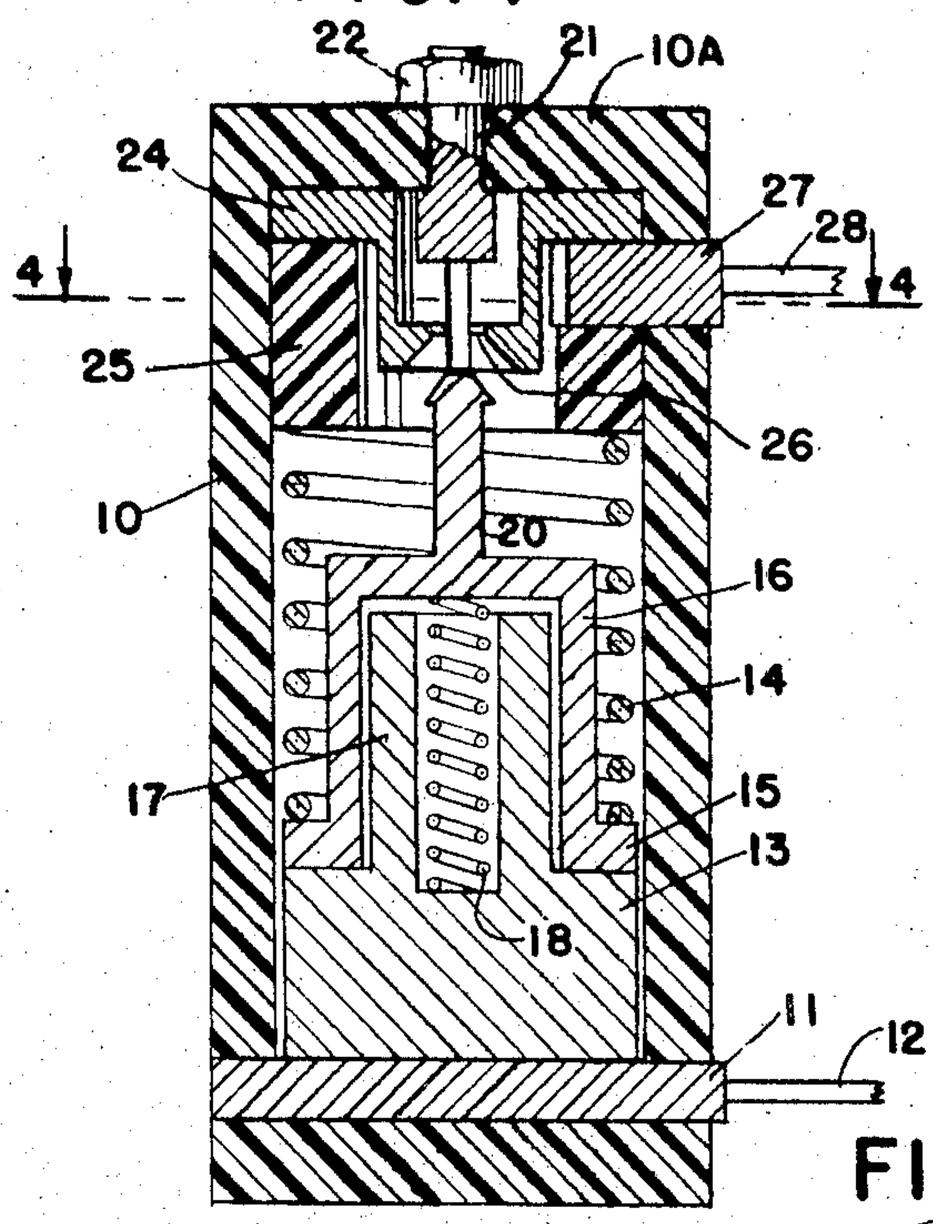


FIG. 2

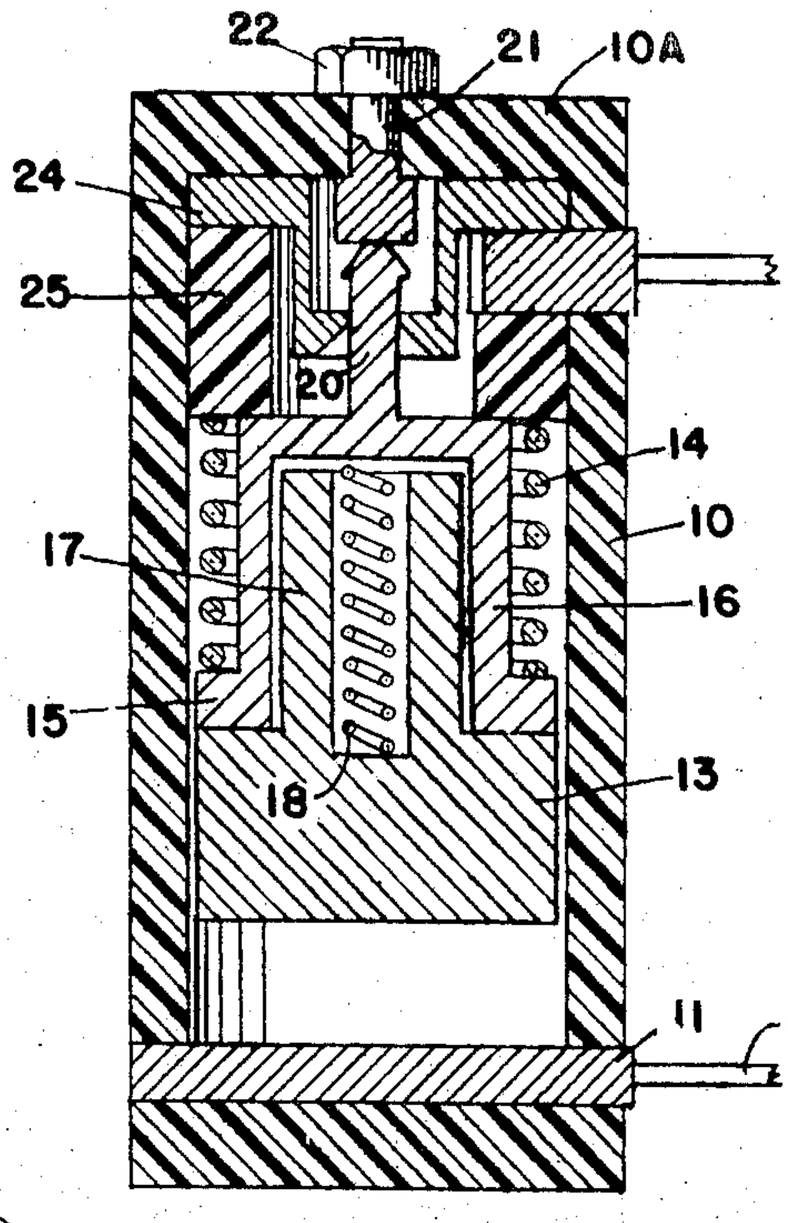


FIG. 6

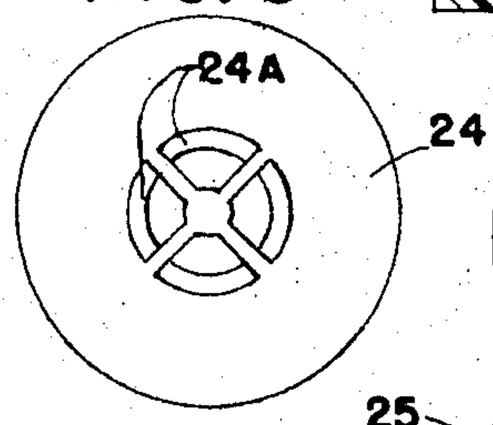


FIG. 3

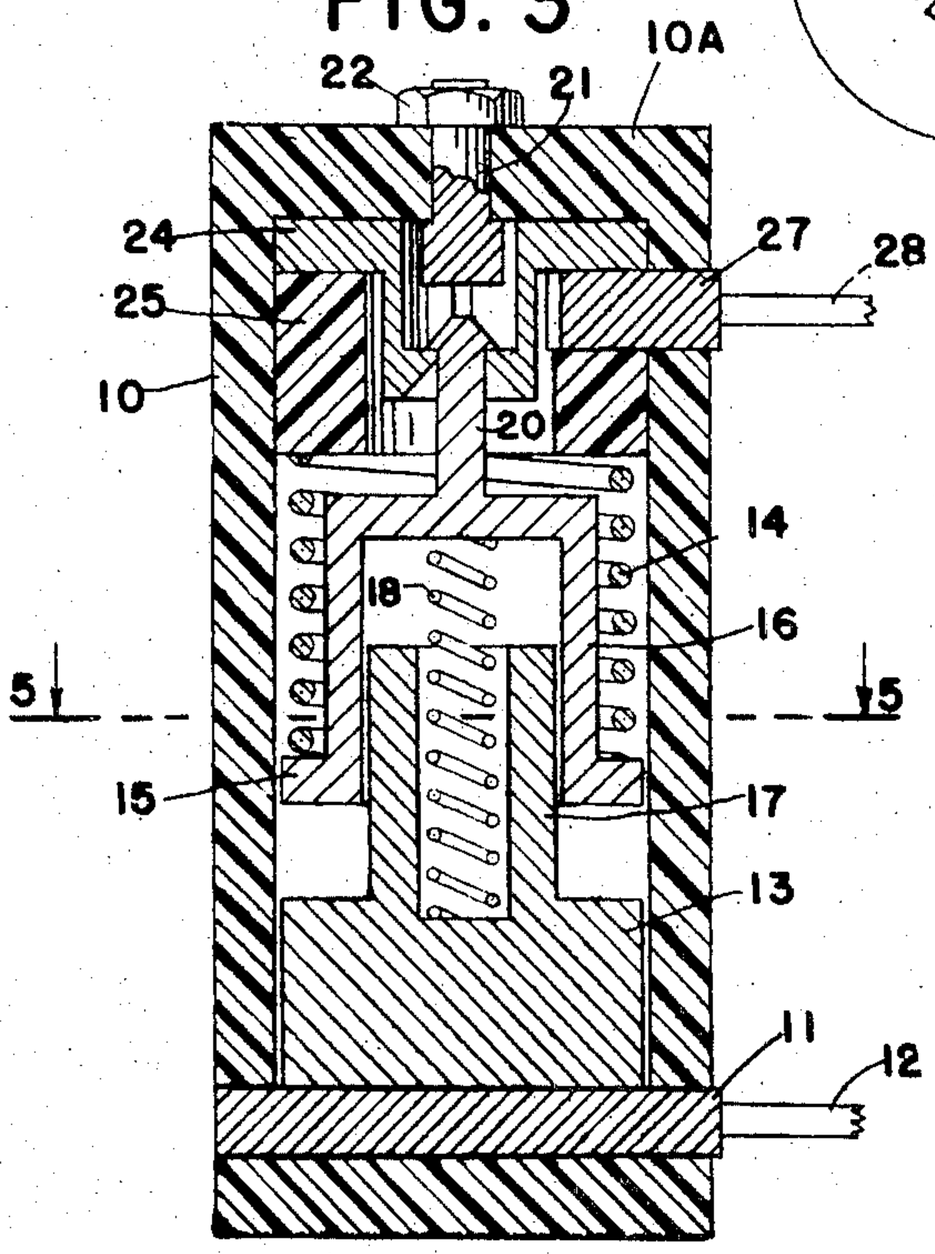


FIG. 4

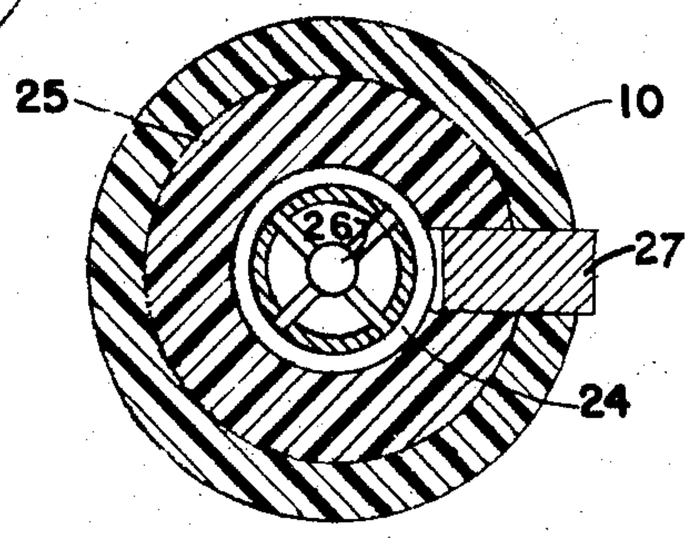
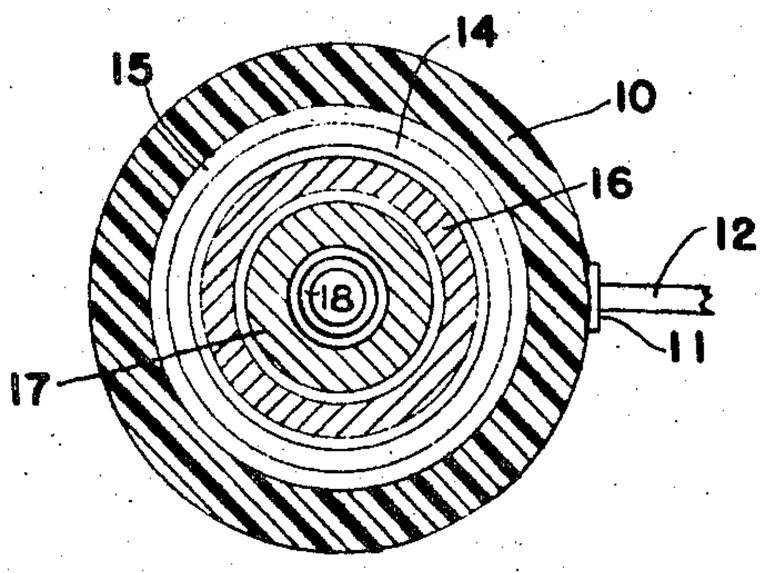


FIG. 5



INERTIA SENSING SWITCH WITH CONDUCTIVE CATCH RIM MEANS FOR RETAINING MOVABLE CONTACT IN CLOSED POSITION

BACKGROUND OF THE INVENTION

There are many applications, especially in projectiles, where it is desirable and necessary to detect the end of a deceleration period after an initial acceleration period. Such an application must fulfill a number of basic requirements. First, the detector must be made insensitive to small accelerations and decelerations (up to 20 G's) to permit rough handling and shipping in cartons which are loaded and unloaded onto cars and trucks. Second, an electrical switch must be kept open until the desired instant when the velocity of the carrier is almost zero. Third, the device must be subjected to a well defined deceleration prior to closing the switch. This means that a definite acceleration is required. Prior deceleration devices have included the firing of a primer loaded with a small quantity of explosive material. The pressure generated by this primer either explodes a main charge or closes a switch which operates a utilization device, such as a valve. Primers are noisy and generate gas. The present invention uses no primers, has no explosive components and generates no gas.

The invention includes a nonconductive housing, a resiliently urged mass at one end of the housing for movement during a first deceleration period, and a resilient means for returning the mass to its original position at the end of the deceleration period. A latching means is coupled to the mass to move with the mass during the first deceleration period and includes a latch head for holding the means in its operated position when the device comes to rest. Switch terminals are positioned in the housing for passage of current only when the latching means has been operated and the mass returned to its original or rest position.

One of the features of the invention is the ability of the device to withstand considerable rough handling, during manufacture and shipping without closing its built-in switch.

Another feature of the invention is its ability to withstand excessive humidity and extreme temperature changes without impairing its operating efficiency in any way.

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 device, taken along a median plane, showing the components in their original nonoperational position.

FIG. **2** is a cross sectional view of the device, similar to FIG. **1**, but showing the components in positions occupied after a severe deceleration of the unit.

FIG. **3** is a cross sectional view of the device after it has come to rest after a deceleration period. In this position the switch terminals are connected to each other.

FIG. **4** is a cross sectional view of the device shown in FIG. **1** and is taken along line **4—4** of that figure.

FIG. **5** is another cross sectional view of the device. This view is taken along line **5—5** of FIG. **3.**

FIG. **6** is a bottom view of the catch disk before assembly showing the split cup.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the figures, the acceleration detector includes a nonconductive cylindrical housing **10** which is preferably made of molded plastic. At the lower end of the housing **10,** a conductive disk **11** is secured, generally made of brass and comprising one terminal of a normally open switch. A connecting conductor **12** leads to a utilization device which may be an explosive cap, a solenoid, or any other operating means which is to be started when the device **10** is finally brought to rest. Directly on top of the conductive disk **11** is a primary metal mass **13** held in place by an outer helical spring **14.** Spring **14** does not engage the upper surface of mass **13** but engages a flange **15** of a secondary mass **16** in the form of an inverted cup. Pressure by the spring **14** on the flange **15** which abuts the primary mass **13** holds the two masses against the disk **11** when in the original rest position (FIG. **1**).

The primary mass **13** is formed with a central hollow cylinder **17,** integral with the base portion, for holding the secondary mass **16** in alignment, and for housing a second less powerful spring **18.** Whenever the two springs are acting against each other, as shown in FIG. **1,** the first spring **14** always compresses the second spring **18.** At the upper end of the secondary mass **16** is a latch rod **20,** having a cap or arrow shaped head at its upper end.

The upper end **10A** of the housing **10** supports a short axial rod **21,** threaded at its outer end and held in place by a nut **22.** A latch retainer or catch disk **24** is mounted adjoining the top end **10A** and is held in place by an insulator ring **25.** Disk **24,** which is normally in a single solid piece, is formed with a depending central bushing which is split into several parts having fingers **24A.** The bushing opening **26,** shown in FIGS. **1** and **4,** is smaller than the latch head **20** and is arranged to enlarge resiliently when the device is subjected to heavy deceleration and both masses **13** and **16** press the latch rod into the opening of the split bushing.

A second switch terminal **27** is mounted in the insulator ring **25** and presses against the disk **24** to make electrical contact therewith. The terminal **27** is connected to a conductor **28** for connection to a load.

The operation of this devive is as follows: When the device is in its normal or static condition, the arrangement of the movable components is shown in FIG. **1.** The primary mass **13** and the secondary mass **16** are both in their lower positions, held by spring **14.** When the device is subjected to a high acceleration, there is no change in the position of the components, and even a small slowing down of the device cannot disturb their positions. When the device comes to a sudden stop, such as would be experienced when an artillery shell or a rocket hits the ground or an object, both masses are moved toward the top of the housing as shown in FIG. **2.** The latch rod **20** pushes its head through the bushing opening **26** and spreads the resilient members of the bushing and limits against rod **21.** There is at this time no electrical connection between terminals **11** and **27** and the switch is open.

Immediately after coming to rest, the force of the two springs **14** and **18** operates to reposition the two masses **13** and **16.** Spring **14** moves the secondary mass **16** toward the base but its motion is stopped by the latch head catching the returned resilient edge of the four

spring fingers of the well or cup. Obviously, two resilient fingers or even a single longitudinal cut in the well would also be satisfactory. The primary mass **13** is moved to the base of the device by the smaller spring **18** and into contact with the electrical terminal **11.** The condition of the components is shown by FIG. **3** and is the second rest position taken by the device. An electrical circuit is now completed between the two terminals, and can be traced from lower terminal **11,** through mass **13,** spring **18,** secondary mass **16** and its latch rod **20,** through ring **24** and the upper terminal **27.**

The design illustrated in the figures is a preferred embodiment but it is obvious that many changes can be made in the size and shape of the components without changing the inventive concept. Instead of the well portion of disc **24** being split into separate sectors **24**A, the latch rod **20** including its head may be split by one or more longitudinal cuts to make the latch rod more resilient or more flexible and to permit penetration of the latching bushing. Also solid disc **24** and its depending bushing and fingers **24**A could be made in two or more identical pieces spaced slightly apart so that the head of the latch rod could pass thereby.

Alternately, solid disc **24** with its depending split latching bushing could be replaced by a prescored diaphragm mounted on a cylindrical extension extending downward from disc **24** such that the latch rod could penetrate and break open the prescored diaphragm during a period of strong deceleration, but could not be extracted therefrom by the force of spring **14.** Spring **14** must, however, always be stronger than spring **18** in order to maintain the first rest position shown in FIG. **1.**

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

1. An inertia operated switch for connecting two contacts mounted in spaced relation after the switch has been stopped comprising: a housing made of insulative material and including first and second electrical terminals secured in spaced relation; a primary conductive mass axially movable within the housing and normally in contact with said first terminal; said primary conductive mass having an axial cavity therein; a secondary conductive mass also axially movable within the housing; a first resilient expansion means mounted between an insulator ring in the housing and a flange on said secondary conductive mass to normally maintain the two masses in contact with each other and the primary mass in contact with the first electrical terminal; a second electrically conductive resilient expansion means disposed in the axial cavity of the primary conductive mass and mounted between the two masses for moving them apart, said second resilient means having less force than the first resilient means; a conductive latch secured to said secondary mass in axial alignment with the housing; a conductive ring secured to one end of the housing and connected to the second electrical terminal; said conductive ring including a resiliently deformable catch rim adapted to retain the latch in its operated position whenever the latch is forced through the rim due to the deceleration of the housing above a predetermined value.

2. A switch according to claim **1** wherein said first and second electrical terminals are connected to conductors external to the housing for connection to a utilization device.

3. A switch according to claim **2** wherein said catch rim comprises a series of inwardly extending fingers longitudinally separated from each other for at least a portion of the distance toward the conductive ring.

4. A switch according to claim **1** wherein said secondary conductive mass is formed with an axial cavity for containing a portion of the primary mass and said second resilient means.

5. A switch according to claim **1** wherein said first resilient means is a helical expansion spring.

6. A switch according to claim **1** wherein said second resilient means is a helical expansion spring.

7. A switch according to claim **1** wherein said latch is mounted on an axial rod secured to the secondary mass and is formed with a frusto-conical surface of revolution.

8. A switch according to claim **1** wherein said conductive ring is formed with an axial recess, supporting said catch rim at the bottom thereof.

9. A switch according to claim **1** wherein said catch rim comprises a series of inwardly extending fingers longitudinally separated from each other for at least a portion of the distance toward the conductive ring.

10. A switch according to claim **9** wherein an insulator ring is mounted adjoining said conductive ring and surrounds the axial recess therein, said ring forming a limit for the secondary mass during a deceleration operation.

11. A switch according to claim **1** wherein said catch rim is a prescored deformable diaphragm.

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