

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

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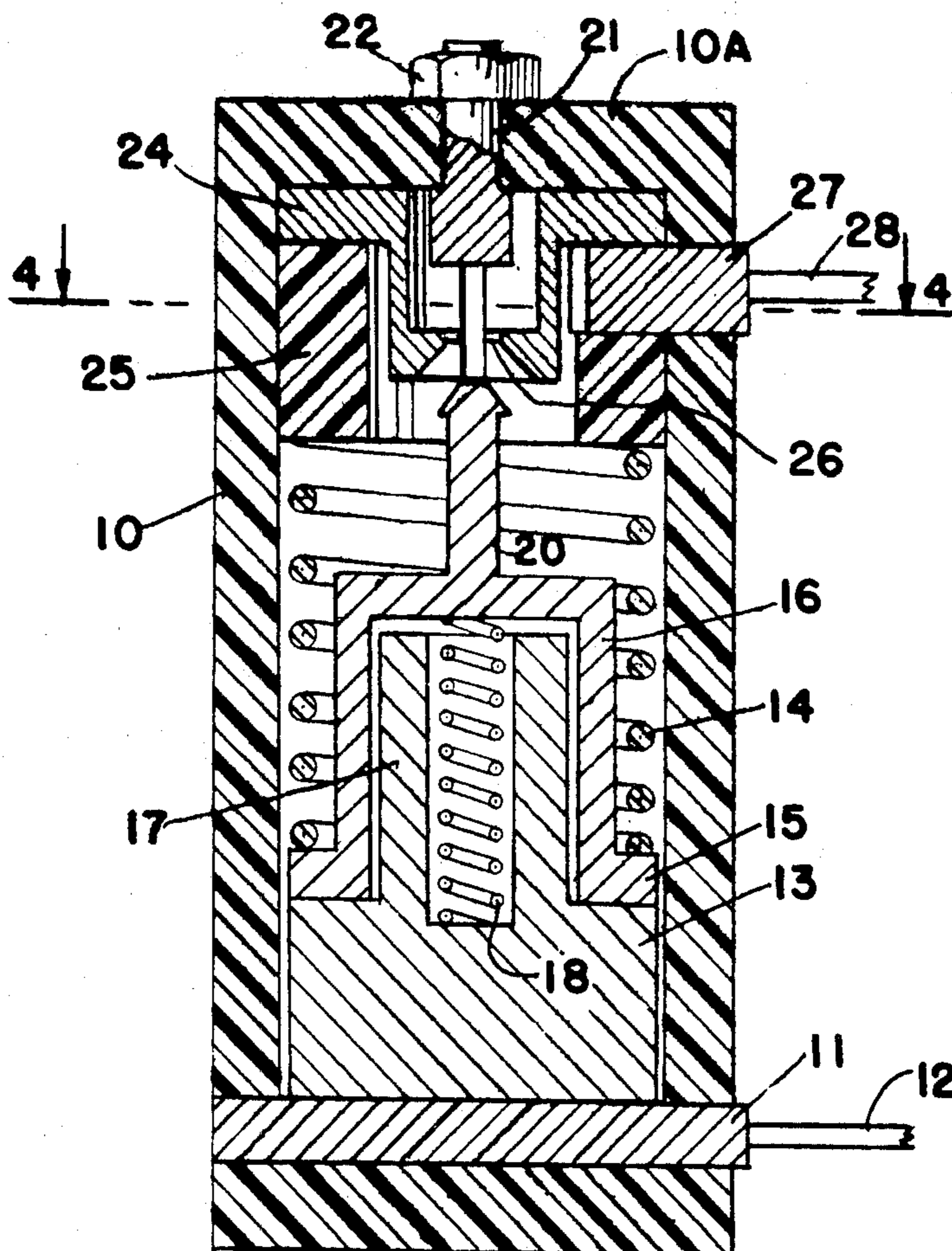
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[57] ABSTRACT

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









# 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 device 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 24A, 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 24A 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 pri-

mary 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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