

Description

BACKGROUND OF THE INVENTION

The present invention relates to an impact sensor, which has been specifically designed for application to motor vehicles.

As is known, in the motor vehicle field has been found as necessary to provide motor vehicles with inertial devices, designed for generating a signal for switching-off the fuel supplying pump and for driving other safety supplementary functions, either of an active or of a passive nature, such as an automatic battery selection function, an emergency lamp lighting function, an auxiliary lamp lighting function, a motor vehicle door unlocking function, a safety belt pre-tensioning device actuating function, and so on.

Prior inertial devices usually comprise operating elements having a single operating axis including a mass-spring system moving inside a conventionally cylindric seat.

The displacement of the mass is proportional to the deceleration amount and, if such a displacement exceed a given value, then a temporary electric contact or a "reed" electric contact is closed, depending on the type of device.

These prior systems are conventionally used for the safety belt pre-tensioning sensors, as well as for controlled suspension systems, door unlocking systems, window opening systems and the like.

A second type of inertial device comprises an inertial switch having a stable-type of SPDT contact, provided for driving all those devices requiring an input stable drive.

The main application of this device is that of switching off the fuel supplying apparatus, i.e. this device operates to switch-off the electric power supply to the fuel pump, in the case of an impact.

A further application of this device is that of switching off the motor vehicle battery, i.e. so as to automatically switch-off the motor vehicle battery in the case of an impact, to prevent possible shorts from occurring thereby drastically reducing the possibilities of fire.

This second type of inertial device is essentially provided with three characteristics: it must have two stable positions, i.e. an on and an off position; it must be adapted to be manually reset; and it must not be of a servo-assisted type, i.e. the switching on-off operation must be a true mechanical operation, without the use of solenoids, relays, and so on, to assure the on-off switching operation also in the case of a stopped motor vehicle.

SUMMARY OF THE INVENTION

Accordingly, the aim of the present invention is to provide an improved impact sensor allowing an operation both in the X-Y plane and along the Z-axis.

Within the scope of the above mentioned aim, a

main object of the present invention is to provide such an impact sensor in which the force required for displacing the inertial mass is so designed as to limit in a maximum degree the bouncing of the electric contact.

Another object of the present invention is to provide such an impact sensor which is very simple from a constructional standpoint as well as of reliable operation.

According to one aspect of the present invention, the above mentioned aim and objects, as well as yet other objects, which will become more apparent hereinafter, are achieved by an impact sensor, specifically designed for motor vehicles, comprising an inertial mass housed in a seat and defining a non actuated stable position and an actuated position of an electric contact, characterized in that said seat has a conical configuration and said inertial mass is held in a stable non actuated position by a cup spring.

BRIEF DESCRIPTION OF THE DRAWINGS

Further characteristics and advantages of the present invention will become more apparent hereinafter from the following detailed disclosure of an impact sensor according to the invention which is illustrated, by way of an indicative, but not limitative, example, in the accompanying drawings, where:

Figure 1 is a cross-sectioned view, in elevation, of the impact sensor according to the present invention, in its not actuated position;

Figure 2 is a view analogous to the preceding illustration, but showing the impact sensor in an actuated position thereof, upon an impact;

Figure 3 is a view, similar to the preceding illustrations, but showing the impact sensor in a reset position thereof;

Figure 4 is a top plan view of the cup-like spring associated to the subject sensor;

Figure 5 is a schematic view illustrating the forces acting on the impact sensor in the not actuated condition thereof;

Figure 6 is a schematic view illustrating the forces operating on the impact sensor, in an impact condition;

Figure 7 is a diagram illustrating the relationship between the force and the displacement of the inertial mass; and

Figure 8 is a diagram illustrating the relationship between the switch-on force and the displacement of the impact sensor according to the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

With reference to the number references of the above mentioned figures, the impact sensor, according to the present invention, which has been generally indicated by the reference number 1, is provided to be rigidly

connected to a motor vehicle body, preferably in the passenger compartment, and comprises a box-like body, or bottom 2, provided with fins 16 and closed by a top closing cover 3.

The box-like body 2 comprises a frustum of cone shaped seat or recess 4 for housing therein an inertial mass, constituted by a steel material ball 5.

The steel ball 5 is held in a set position on the bottom of the frustum of cone shaped seat, corresponding to a not actuated position of the impact sensor, by means of a cup or disc like spring 6.

The cup like spring 6 bears against a slot of the conical seat 4 and is held in its set position by the top cover 3.

Advantageously, the conical seat is made of highly resistant to wear and low friction materials, such as metals, teflon or the so-called techno-polymers.

More specifically, the cup spring 6 comprises a centering hole 7 and four radially extending slots 8 provided for receiving four corresponding fins 9 of a push-button 10 constituting means for resetting or recovering the impact sensor.

As shown, the push-button 10 is held in the top cover 3 and operates on the steel ball 5 by means of the fins 9, as counter-biased by a recovering spring 11.

The bottom of the frustum of cone shaped seat 4 is provided with a hole for receiving the end portion of a slider 12, driven by a resilient element, constituted, in this embodiment, by a snap spring 13.

The slider 12 is operatively connected to a movable contact 14 in turn connected to contact blades 15.

The impact sensor according to the present invention operates as follows. Figure 1 shows the impact sensor in its normal operating condition, i.e. in the running condition of the motor vehicle.

The ball 5 is centered inside the conical seat 4 and is held in this position by means of the cup spring 6.

On the mentioned ball 5 also operates the force provided by the snap spring 13, transmitted through the slider 12.

Under this condition (the not actuated condition), the slider 12 operates on the movable contact 14 so as to hold said movable contact 14 pressed on the fixed contact.

Figure 5 schematically illustrates the forces operating on the system, under static conditions.

In the case of an impact, the cup spring 6 will be upwardly urged and/or displaced, and the steel ball 5 will start to move along the slanted surface of the conical seat 4.

Figure 6 schematically illustrates the forces operating on the system under dynamic conditions, and from this figure it should be apparent that if the impact force has a sufficiently great value, so as to cause a displacement at least corresponding to l_{min} , then the ball will be further urged outwardly by the turning moment caused by the snap force F_M .

This aspect of the impact sensor operation is sche-

matically shown in the diagram of figure 7, in which is shown the relationship between the force and the displacement of the inertial mass, i.e. the steel ball 5.

As is clearly shown, the force necessary for displacing or driving the steel ball is increased up to the point P, where it starts to abruptly decrease.

At this point, will start to prevail the force provided by the snap spring 13.

The switching of the electric contact occurs after the point P, and this in order to limit in a degree as large as possible the bouncing movements of said electric contact.

In this connection it should be apparent that, in the case of an impact, the steel ball will be able of swinging and moving inside the mentioned conical seat or recess.

Accordingly, it is very important that the electric switching mechanism, constituted by the slider 12, the movable contact 14 and the snap spring 13 be so designed to prevent it from reclosing upon opening.

More specifically, the operation diagram of the electric switching mechanism can be schematized by the diagram shown in figure 8, in which the relationship between the snap or switching force and the displacement is shown.

This operation is that typical of a mechanical hysteresis mechanism, where the point A is that point in which is arranged the mechanism during a normal operation, whereas the point B represents a tripped condition.

The switching from the point A to the point B is performed according to the A-B path, requiring a tripping power $E(AB)$, whereas the switching from the point B to the point A occurs according to the B-A path, requiring a tripping energy or power of $E(BA) > E(AB)$.

The provision of the disclosed mechanical hysteresis prevent the contact from undesirably bouncing.

The recovering of the switch, after the operation thereof, is shown in figure 3 and it can be obtained by manually operating the push-button 10 which is restrained by the spring 11.

In this operation, the centering fins 9, by lowering, will allow the steel ball 5 to be urged and guided on the bottom of the conical seat.

During the recentering movement, the ball 5 will press on the slider 12, thereby causing the movable contact 14 to trip to the closing condition thereof.

In this operation, the cup spring 6 will be deflected downwardly, thereby allowing the steel ball 5 to be centered in the centering hole 7 of the cup spring.

As the push-button is released, the impact sensor will be ready for a new operation.

It has been found that the invention fully achieves the intended aim and objects.

A great advantage of the invention is that of using a contact element or microswitch, of very quick operation, adapted to supply both high currents (25-30 A) and weak currents (100 mA).

A further advantage is that the bottom is provided

with a hole, at the snap spring, to be traversed by a sensing or pick-up element, connected to a testing apparatus, in order to control the load of the disc spring, during the automatic assembling operation of the device, so as to provide an end product of a very high quality.

The used materials, as well as the contingent size and shapes of the elements constituting the subject impact sensor can be varied, depending on the requirements and the status of the art.

7. A sensor, according to one or more of the preceding claims, characterized in that said slider resilient means can be traversed by a pick-up element coupled to a testing apparatus, for testing the load on said cup spring as said impact sensor is assembled.

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Claims

1. An impact sensor, specifically designed for motor vehicles, comprising an inertial mass, housed in a seat, and defining a stable not actuated position and an actuated position of an electric contact, characterized in that said seat has a conical configuration and said inertial mass being held in said not actuated stable position by a cup spring. 15 20
2. A sensor, according to Claim 1, characterized in that said sensor comprises a slider provided with a resilient means and operating on said inertial mass, against the biasing of said cup spring, said slider being provided for engaging said conical seat in an actuated position of said electrical contact, to prevent said inertial mass from returning to the not actuated position, said slider operating on a movable electric contact at an actuated positions. 25 30
3. A sensor, according to Claim 1 or 2, characterized in that said sensor further comprises a means for recovering the not actuated position, said recovering means comprising a push-button operating on said cup spring in order to cause the inertial mass to be driven to the not actuated position, against the biasing of said slider. 35 40
4. A sensor, according to one or more of the preceding claims, characterized in that said cup spring is provided with radially extending slots for allowing centering fins, rigid with said recovering means, to pass therethrough, said centering fins being provided for centering said inertial mass in said conical seat at said not actuated position. 45 50
5. A sensor, according to one or more of the preceding claims, characterized in that said cup spring comprises a central hole for centering said inertial mass at a not actuated position, said inertial mass having a ball-like configuration. 55
6. A sensor, according to one or more of the preceding claims, characterized in that the force necessary for displacing said inertial mass increases to a set point, and then quickly decreases in order to prevent said electric contact from bouncing.

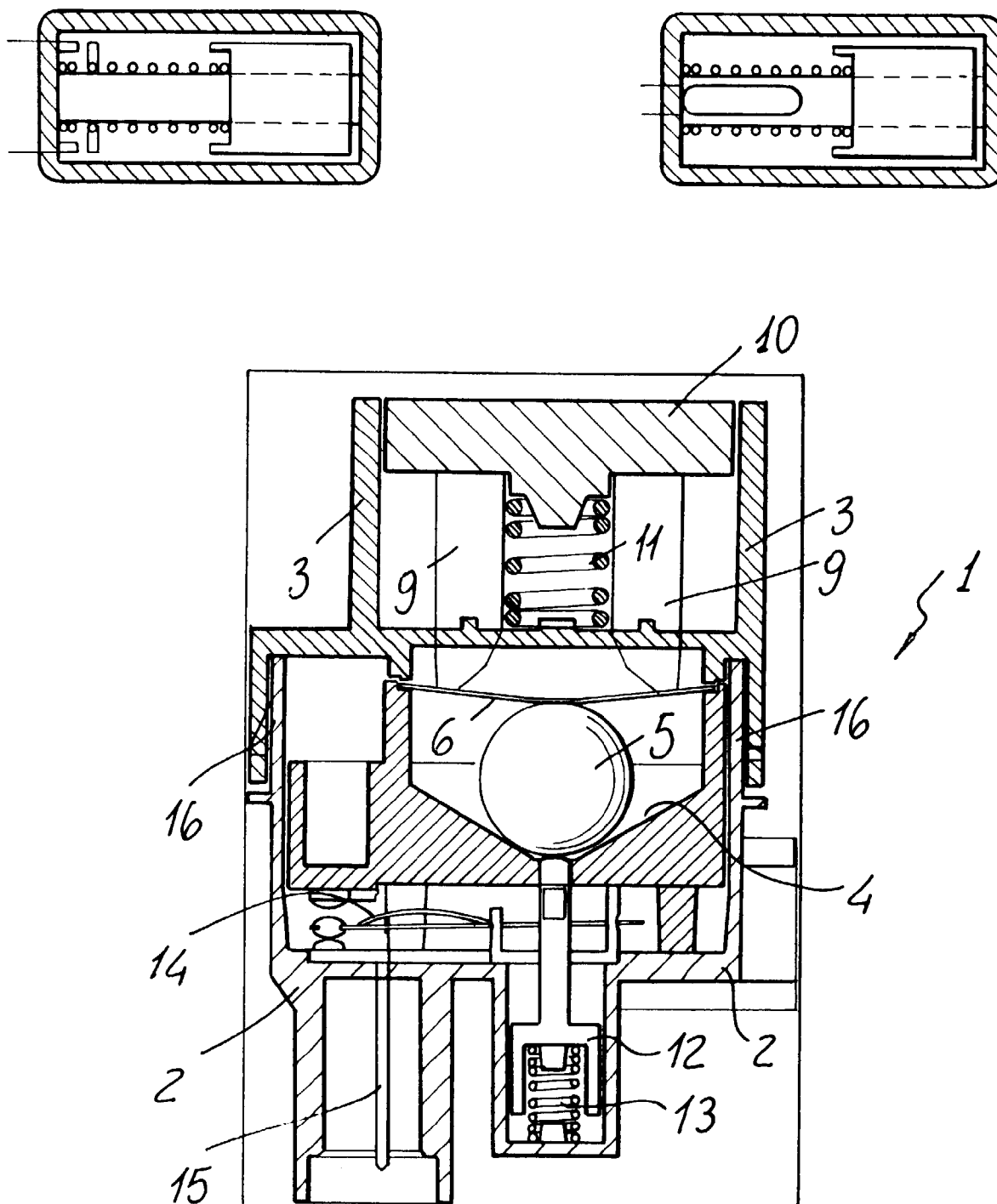


FIG. 1

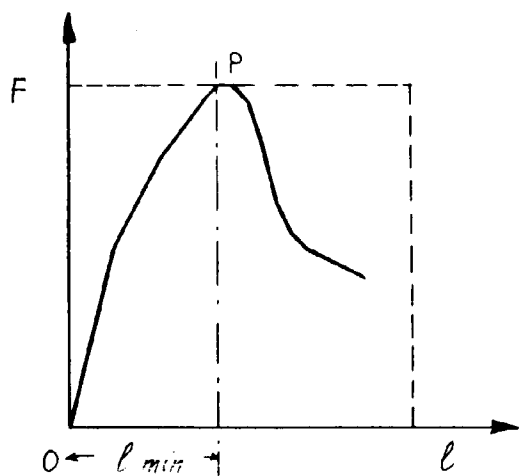


FIG. 7

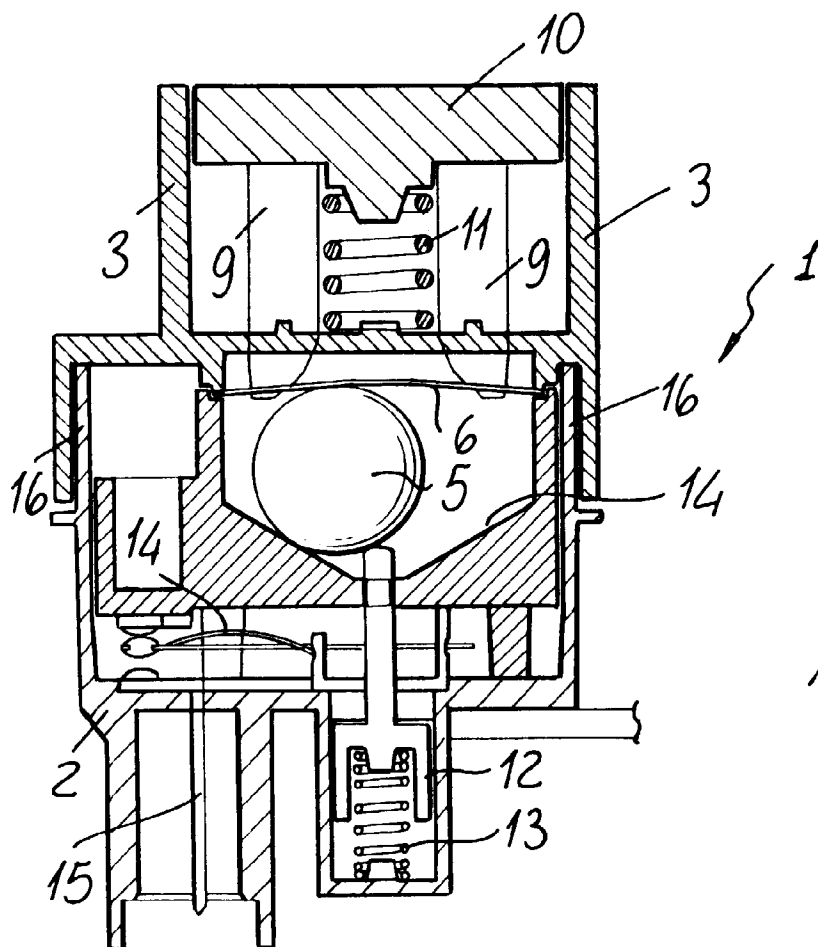
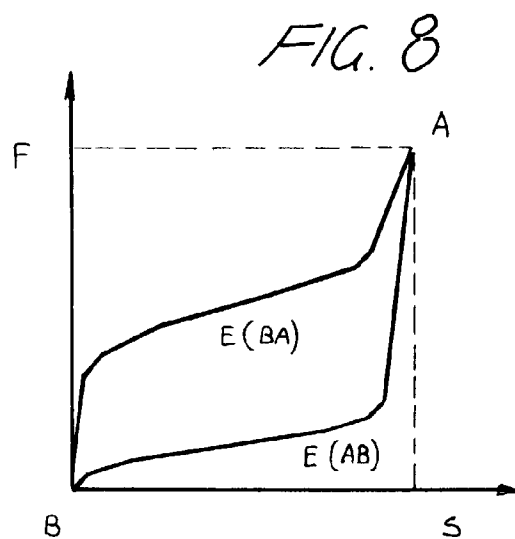


FIG. 2

