(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 644 568 A1**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **94114007.1**

(51) Int. Cl.[6]: **H01H 35/14**

(22) Date of filing: **07.09.94**

(30) Priority: **17.09.93 IT TO930683**

(43) Date of publication of application:
22.03.95 Bulletin 95/12

(84) Designated Contracting States:
DE ES FR GB IT

(71) Applicant: **IMOS ITALIA S.r.l.**
Via Valdellatorre, 131
I-10040 Caselette (Torino) (IT)

(72) Inventor: **Penna, Giovanni**
Via Condove 88
I-10093 Collegno (Torino) (IT)

(74) Representative: **Lotti, Giorgio et al**
c/o Ing. Barzanò & Zanardo Milano S.p.A.
Corso Vittorio Emanuele II, 61
I-10128 Torino (IT)

(54) Safety switch.

(57) A safety switch inserted in an electric circuit of a vehicle, the switch comprising:

- a housing (1, 1') fixed to the vehicle;
- a spherical inertia mass (22) movable from a first unstable position of normal operation, whereby the spherical mass (22) allows current passage in said circuit, to a second stable position (22a) whereby the current in the circuit is interrupted responsive to sharp acceleration or deceleration in a horizontal plane;
- a first electric contact (11) for opening or closing on a second electric contact (12) responsive to the position of the spherical mass (22);
- resetting means (35, 46) for taking the spherical inertia mass (22) from said second position (22a) to said first position.

In its first position the spherical inertia mass (22) is interposed between a concave retaining seat (26, 44) and a convex retaining means (29, 54) that retain the mass in opposite ways along a substantially vertical axis (a) by means of a spring (30).

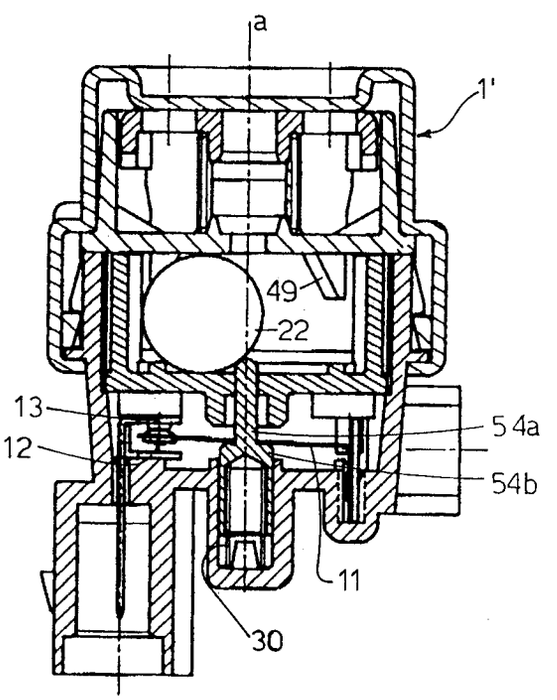


FIG.5

EP 0 644 568 A1

The present invention relates to a safety switch of the normally closed kind for vehicle engines, and more particularly pertains to a safety switch inserted in the fuel pump electric circuit. The function of the switch is to open responsive to acceleration or deceleration exceeding a predetermined intensity to which the vehicle is subjected in a horizontal plane.

At the same time, the switch must not be responsive to jerks or vibration of normal intensity.

Switches of this kind are well known, for example those disclosed in US-A-2 206 067 and EP-A-0 038 328. These devices have a drawback in that they are rather complex and costly from a constructional point of view. Some of them are also rather difficult to reset in their original position after they have been activated.

The object of this invention is to provide a switch that is capable of overcoming the above inconveniences of prior art. The object is attained according to the invention by a safety switch inserted in an electric circuit of a vehicle, the switch comprising:

- a housing fixed to the vehicle;
- a spherical inertia mass movable from a first unstable position of normal operation, whereby the spherical mass allows current passage in said circuit, to a second stable position whereby the current in the circuit is interrupted responsive to sharp acceleration or deceleration in a horizontal plane;
- a first electric contact for opening or closing on a second electric contact responsive to the position of the spherical mass;
- resetting means for taking the spherical inertia mass from said second position to said first position; characterized in that in said first position the spherical inertia mass is interposed between a concave retaining seat and a convex retaining means, the mass being retained by said seat and said means in opposite ways along a substantially vertical axis by means of resilient biasing means.

Preferred but not-limiting embodiments of the switch according to the invention are described hereinafter with reference to the accompanying drawings, in which:

Figure 1 is a sectional view of a first embodiment of a switch according to the present invention in a first working position;

Figure 2 is a sectional view of the switch of Figure 1 in a second working position;

Figure 3 is a sectional view of a second embodiment of a switch according to this invention; and

Figures 4 and 5 are sectional views of a third embodiment of the switch of this invention in first and second working positions respectively.

Referring at first to Figures 1 and 2, numeral 1 indicates a housing, preferably made of plastic material, consisting of an upwardly open top portion 2 and a base 3. The base 3 is spring locked to the top portion 2 by means of teeth 5 and corresponding seats 6 obtained in the base 3 and in the top portion 2, respectively.

Locked between the base 3 and projections 7 obtained in the top portion 2 is a plate 9 fitted with connections 10 for connecting the switch to the vehicle electric circuit. The plate 9 is also provided with an electric contact in form of an elastic lamina 11 which is movable between a second fixed contact 12 and a third fixed contact 13.

Resting on top of the lamina 11 is a two-diameter cylinder 14 that forms an abutment 15 and is slidably accommodated in a two-diameter guide 17 which is inserted in a seat 18 obtained in plate 9. The guide 17 forms part of a cylindrical cup 21 inserted in the top portion 2 and providing a tapered surface 20 joining together the cylindrical wall 19 and the guide 17. The cup 21 forms the housing of a metal ball 22 operating as an inertia mass.

Obtained in one end portion 23 of the cylinder 14 is a rounded through seat 24 which accommodates the lamina 11. The opposite end portion 25 of the cylinder 14 has a first tapered seat 26 for receiving the ball 22 and containing it in an unstable position. In a first operating position, the seat 26 is level with the tapered surface 20 and forms a continuous tapered surface with it.

Connected to the upper end of the cup 21 is closed by a circular cap 27 which is provided with a cone-shaped convex axial projection 29 acting as a resting seat for the ball 22. The ball is urged upwardly by the cylinder 14 which is in turn biased by a spring 30 inserted in a seat 33 obtained in the base 3. The position and, consequently, the force of the spring 30 is adjustable through a screw 31.

A cylindrical push-button 35 is positioned between the wall 2 of the housing 1 and the wall 19 of the cup 21. The push-button is biased upwardly by a spring 36 which is kept in position by a projection 37 extending from the cap 27. By means of its side wall 38, the push-button 35 is capable of engaging a transverse peg 38a that is inserted in the cylinder 14. The peg 38a, in co-operation with openings 39 obtained in the guide 17 and wall 19, and the abutment 15, determines the stroke of the cylinder 14.

With reference to figures 1 and 2, the switch of the invention works as follows.

When the vehicle on which the switch is fitted is subjected to a particularly violent crash, the ball 22 comes out of the seats 26 and 19 between which it is normally held by means of the spring 30. The ball 22 moves to an eccentric position like

the one 22a shown in figure 2, allowing the spring 30 to push the cylinder 14 upwards and the lamina 11 with it, thereby interrupting the current feed to the second contact 12 and activating third contact 13. The latter feeds a warning light (not shown) located in the passenger cabin in order to indicate the operation of the switch.

In this way the feeding to the connected apparatus is interrupted (i.e. the fuel pump) in case of an accident. Although the above described switch can be normally used for stopping the pump of fuel injection apparatuses, it may also be utilised for any other device bringing the same advantages.

To reset the electric current to pass between the lamina 11 and the contact 12, it is necessary to press down the push-button 35 overcoming the force of the spring 36. The wall 38 urges the peg 38a down compressing the spring 30. Consequently, the peg 38a takes the cylinder 14 back to its starting position, thereby allowing the ball 22 to roll down the tapered surface 20 and return between the seats 26 and 29.

A second embodiment of the switch according g to the present invention is shown in figure 3. For clarity and to conform both the embodiments, like numerals represent like parts or having similar functions, eventually with the addition of an apex (').

Referring to figure 3, the switch comprises a fixed housing 1' consisting of a bottom portion 53 and a downwardly tapered side wall portion 43 on top of which a cap 40 is fitted. The cap 40 forms a cylindrical portion 43 extending upwardly from a base 42, in the centre of which a central dead hole 44 and four openings 45 (of which only two are visible in the drawing) are obtained. A push button 46 is slidably accommodated in the upper part of the cap 40. The push-button 46 rests on the base of the cap by means of a returning spring 47. The openings 45 let through four projections 48 (of which only two are visible in the drawing of figure 3) that are integral with the push-button 46 and have lower outwardly diverging inclined surfaces 49.

An inner cup 50, consisting of a bottom portion 51 and a cylindrical wall 52, is fixed between the frustoconical portion 43 of the lower body 1' and the base 42 of the cap 40. The bottom 51 of the cup 50 provides a central bore for accommodating a floating pin 54 that is interposed between the spherical mass 22 and the contact in form of elastic lamina 11. This lamina is fixed in bottom portion 53 of the body 1' and is movable between a lower fixed contact 12 of normally closed kind and an upper contact 13 of normally open kind fixed to the bottom portion 53. The elastic lamina 11 and the floating pin 54 are biased upwardly by means of a spring 30 resting on the bottom portion 53 of lower body 1'.

The lower body 1' also forms a watertight connector 55 for electric connection to the fixed contact 13.

The top of the switch is covered by a gasket 56 that renders the inner parts of the switch watertight.

Operation of the switch of figure 3 is as follows. In normal conditions, the spherical mass 22 is kept in its unstable position (see full line in the drawing) resting on the bottom of the dead hole 44 biased by floating pin 54. The resistance offered by the ball in this position keeps the lamina 11 onto contact 12.

In case of an accident occurring, the consequent crash causes the ball to move away from of the central position (full line) to a side position 22a (dotted line in the drawing). Therefore, the spring 30 is released and pushes up the floating pin 54 and the lamina 11, thereby disconnecting the fixed contact 12 and interrupting the electric circuit feeding an apparatus, i.e. a fuel pump. At the same time, the contact 13 gets closed so that a warning light (not shown) is lit up to indicate the operation of the switch.

Also in this case, to reset the electric current to pass through the contact 12, it is necessary to press the push-button 46, in order to lower the inclined surfaces 49 and take the spherical mass 22 into its central position, pushing down the floating pin 54 and compressing the spring 30. Upon releasing the push-button, the returning spring 47 pushes it back into its original position as shown.

It should be appreciated that the reset of the switch is very simple to accomplish and it is also possible when the vehicle is considerably slanting, as the inclined surfaces 49 can engage the ball 22a in any place it has ended within the cup 50 after the crash.

The embodiment shown in Figures 4 and 5 differs from that of Figure 3 in that the floating pin 54 is arranged having an upper narrow shaft portion 54a and a lower downwardly open larger cup portion 54b. Floating pin 54 is no longer interposed between the spherical mass 22 and the elastic lamina 11, (as shown in Figure 3), as shaft portion 54a is inserted in a corresponding bore obtained in the elastic lamina 11. Bottom spring 30 is fitted within cup portion 54b and urges the upper end of shaft portion 54a directly against mass 22. Lamina 11 is arranged so as to normally close upon lower fixed contact 12 (Figure 4).

When mass 22 moves away due to a crash, spring 30 biases pin 54 upwardly through the bottom 51 of cup 50. The cup portion 54b engages lamina 11 pushing it up, thereby opening contact 12 and closing contact 13 (Figure 5). Vertical movement of floating pin 54 is stopped by lamina

11. This particular arrangement and the shape of the floating pin prevents it from falling out of its seat in case the vehicle should be slanting or tilted after an accident.

The invention is not limited to the aforegoing description, which is to be considered purely as an illustration of the best mode of implementing the switch, and modifications are possible in the terms of the shape, dimensions and arrangement of the parts and of the constructional and operational details. The invention includes all modifications which fall within its scope, as defined by the following claims.

Claims

1. A safety switch inserted in an electric circuit of a vehicle, the switch comprising:
- a housing (1, 1') fixed to the vehicle;
- a spherical inertia mass (22) movable from a first unstable position of normal operation, whereby the spherical mass (22) allows current passage in said circuit, to a second stable position (22a) whereby the current in the circuit is interrupted responsive to sharp acceleration or deceleration in a horizontal plane;
- a first electric contact (11) for opening or closing on a second electric contact (12) responsive to the position of the spherical mass (22);
- resetting means (35, 46) for taking the spherical inertia mass (22) from said second position (22a) to said first position;

characterized in that in said first position the spherical inertia mass (22) is interposed between a concave retaining seat (26, 44) and a convex retaining means (29, 54), the mass being retained by said seat and said means in opposite ways along a substantially vertical axis (a) by means of resilient biasing means (30).

2. A switch according to claim 1, characterized in that said concave seat (26) is movable and that said resilient biasing means (30) is interposed between said movable seat (26) and the housing (1); said convex means (29) being fixed with respect to the housing (1).

3. A switch according to claim 1, characterized in that said convex means (54) is movable and that said resilient means (30) is interposed between said movable means (54) and the housing (1'); said concave seat (44) being fixed with respect to the housing (1').

4. A switch according to claims 1 and 2, characterized in that said convex means (54) is cone-shaped with an end point facing the mass (22), while said seat (26) is shaped as a tapered cup on which the spherical mass rests.

5. A switch according to claim 1, characterized in that it further comprises adjusting means (31) for setting said resilient biasing means (30).

6. A switch according to claims 1, 2 and 4, characterized in that the inertia mass (22) is contained in a cylindrical support (21) having a downwardly tapered lower wall (20) the central part of which is occupied by said seat (26).

7. A switch according to claims 1, 2 and 4, characterized in that said seat (26) is obtained in one end portion of a cylinder (14) coaxially movable along axis (a) between two positions against the action of said resilient means (30); said cylinder (14) being movable between said two positions by means of a push-button (35).

8. A switch according to claim 1, characterized in that when the spherical mass (22) is in its first position, said first contact (11) is closed on said second contact (12), and when the mass (22) is in its second position (22a), the first contact (11) is closed on a third contact (13).

9. A switch according to claims 1 and 3, characterized in that said resetting means (46) comprises an upper push-button provided with at least three appendixes (48) having lower outwardly diverging inclined surfaces (49).

10. A switch according to claim 1, characterized in that a floating member (54) engaging said first contact (11) is interposed between the spherical mass (22) and said resilient biasing means (30).

11. A switch according to claim 10, characterized in that said floating member (54) comprises:
- an upper narrow shaft end portion (54a) normally engaging said mass (22),
- a lower downwardly open larger portion (54b) engaged by said resilient biasing means (30), said larger portion (54b) being capable of engaging said first contact (11) for opening said second electric contact (12) responsive to movement of the spherical mass (22).

12. A switch according to claim 11, characterized in that said narrow shaft end portion (54a) is inserted in a corresponding bore obtained in

said first contact (11).

FIG.3

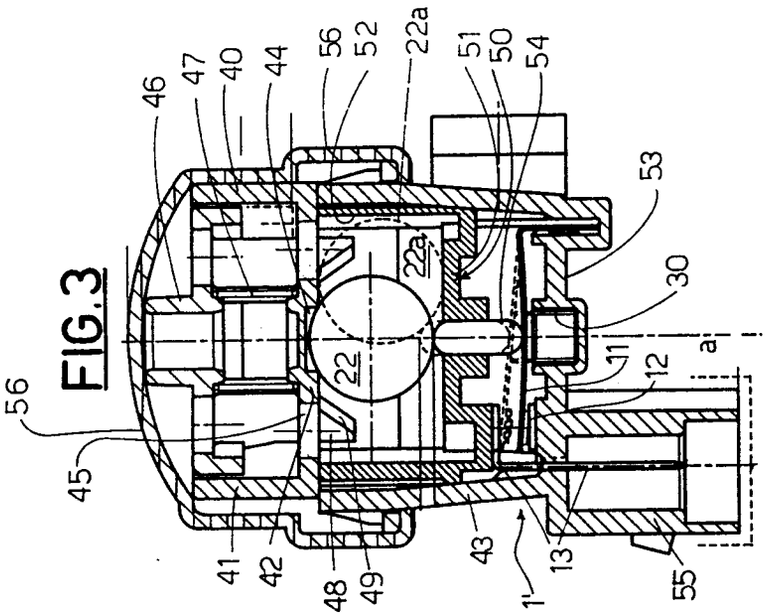


FIG.2

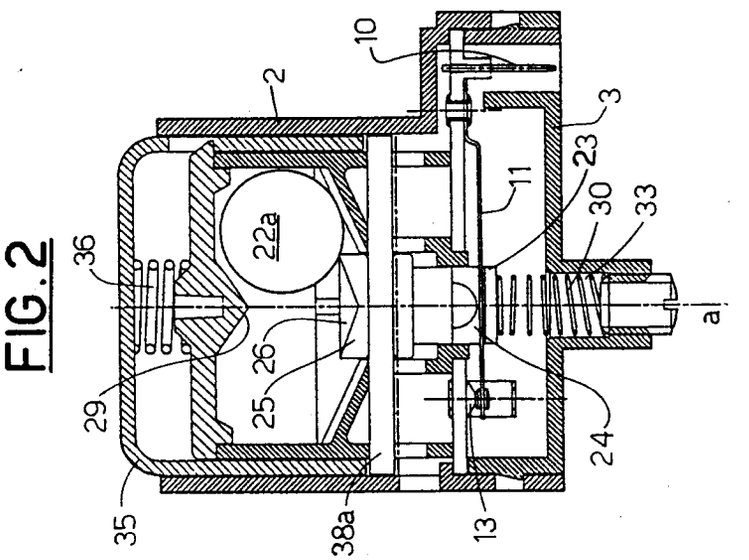
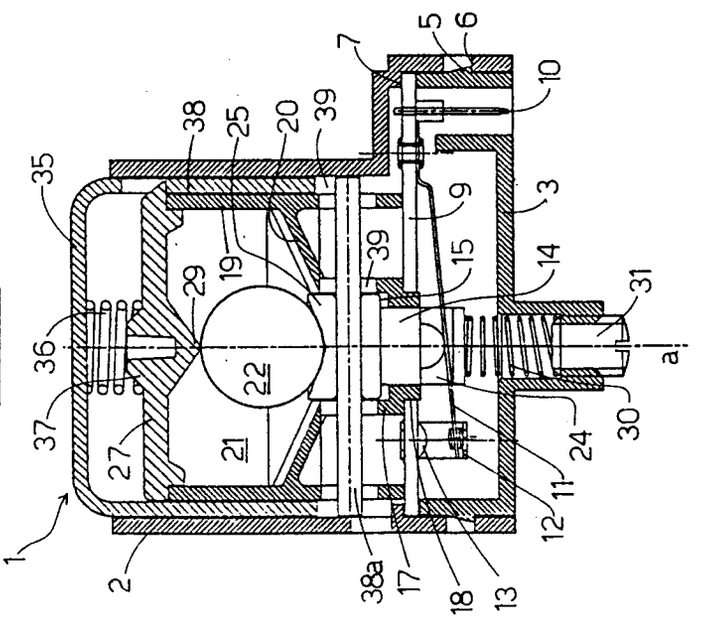


FIG.1



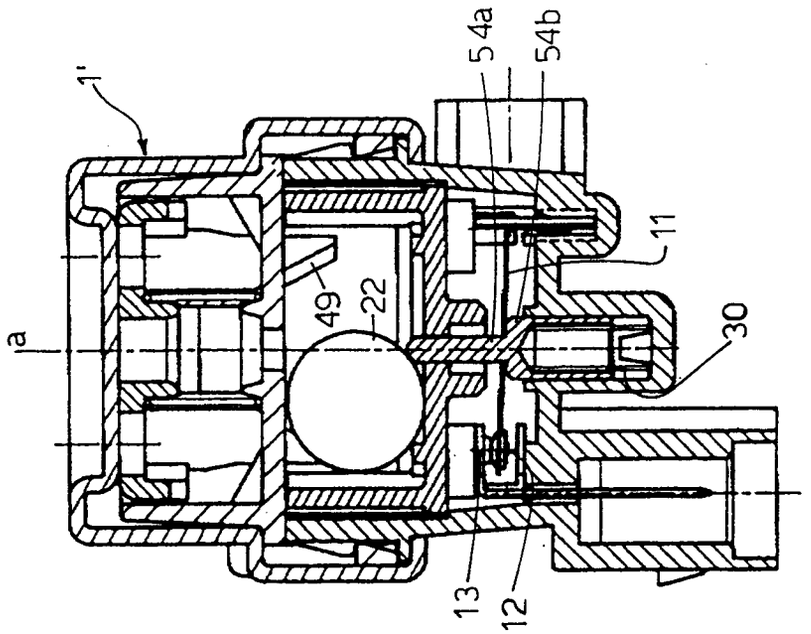


FIG.5

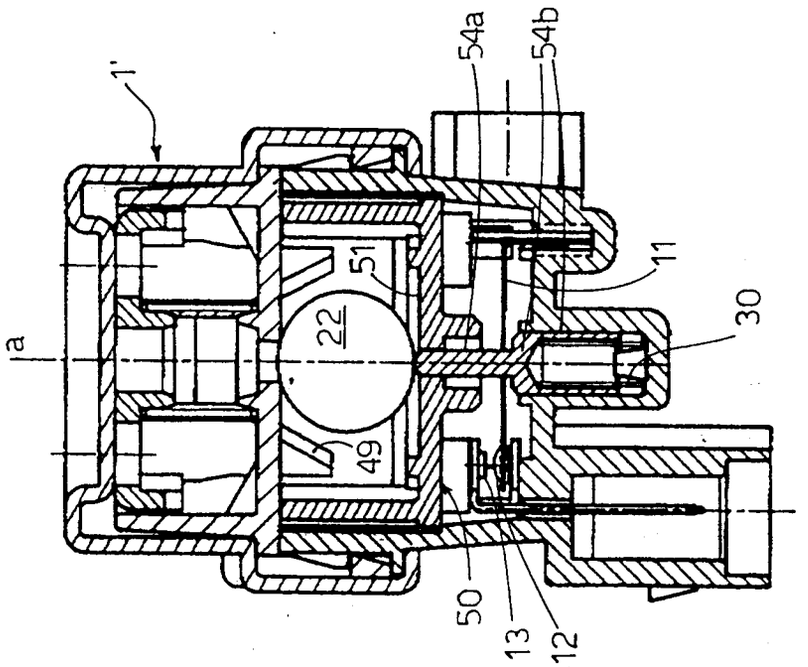


FIG.4

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 94 11 4007

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	FR-A-2 620 855 (J. WERMUTH) * page 2, last paragraph; figure 4 *	1,3	H01H35/14
X	CH-A-351 011 (HYDROMÉCANIQUE DE PRÉCISION) * claims; figure 1 *	1,2	
A	DE-A-31 28 594 (DAVO) * abstract; figure 1 *	1	
A	CH-A-486 345 (ALBERT HERZOG) * figures *	1	
A	FR-A-2 151 585 (J. CORPORANDY) * figure *	1	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

H01H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	4 November 1994	Janssens De Vroom, P

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)