United States Patent [19]

Hitchcock

[11] **3,818,160**

[45] **June 18, 1974**

[54] **INERTIA SWITCH WITH BALL ACTUATED DEFLECTABLE CONTACT**

[75] Inventor: **Arthur A. Hitchcock,** Lima, Ohio

[73] Assignee: **A. C. B. Corporation,** Lima, Ohio

[22] Filed: **May 14, 1973**

[21] Appl. No.: **359,781**

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

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

[58] **Field of Search** ..... 200/61.45, 61.53, 61.08, 200/162, 166 J

[56] **References Cited**

UNITED STATES PATENTS

3,493,704	2/1970	Fanes	200/61.45 R
3,621,163	11/1971	Hitchcock	200/61.45 M
3,743,803	7/1973	Roesch et al.	200/61.45 R

Primary Examiner—James R. Scott

[57] **ABSTRACT**

An inertia switch having a two-part housing of electrical insulating material, the lower housing part being provided with a conical ramp surface at its bottom to receive a relatively heavy ball which is adapted to move along the ramp surface in the event of a collision by an automobile, for example, to tilt a segmental disc of electrical conductive material with an upturned peripheral edge portion into contact with a flat electrical conductive ring. The ring is provided with a lead in the form of a tab extending through a notch in the housing part to the outside to receive suitable wires or leads. In engagement with the disc and extending through the center of the ring is an adjustable leaf spring, also of electrical conductive material, the outer end of which extends outside of the housing through a notch in the housing part for connection to a source of electrical energy.

10 Claims, 4 Drawing Figures

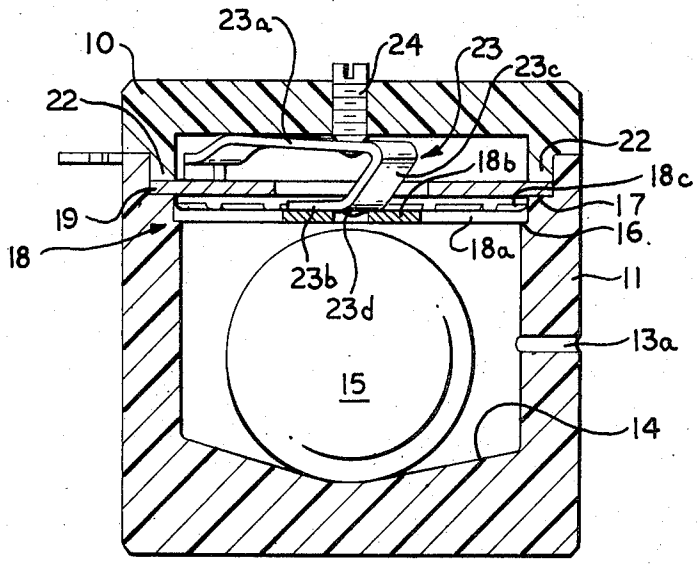
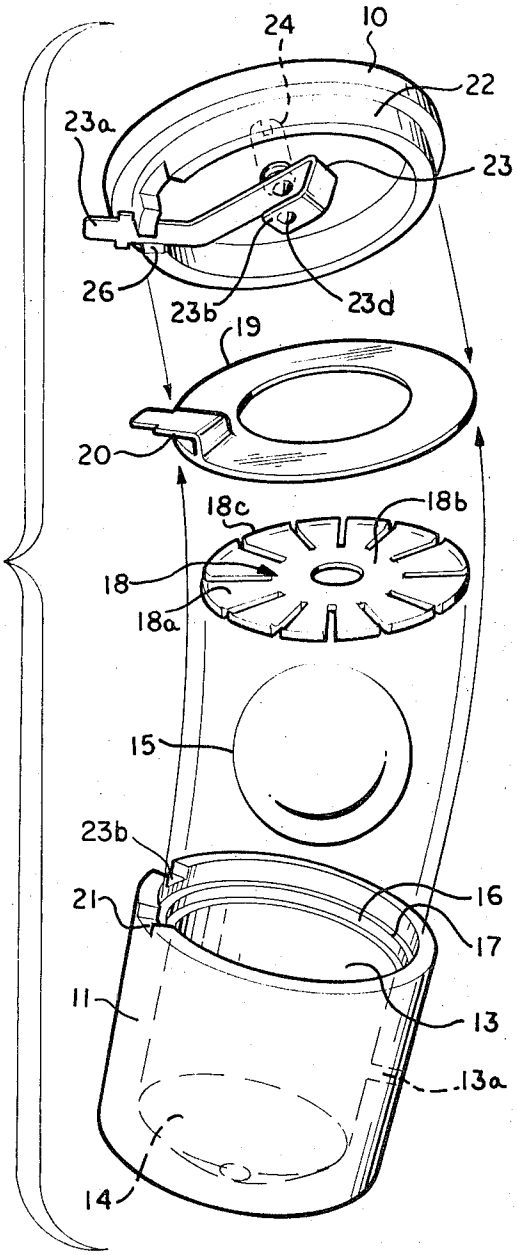


FIG. 1


24
10
22
23a
23
26
23b
23d
19
20
18c
18b
18
18a
15
23b
21
16
17
11
13
13a
14

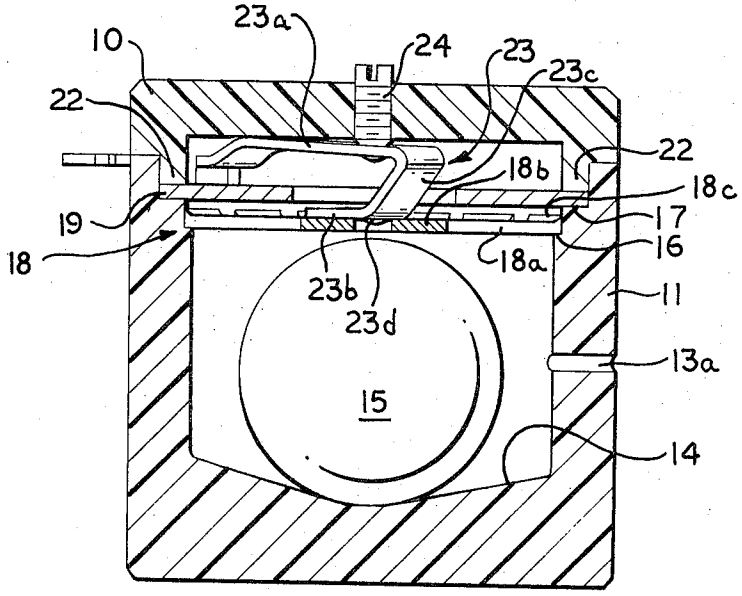


FIG. 2

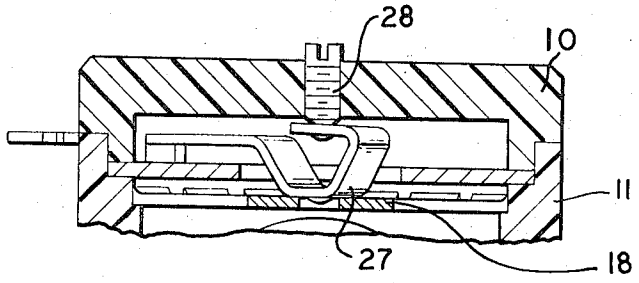


FIG. 3

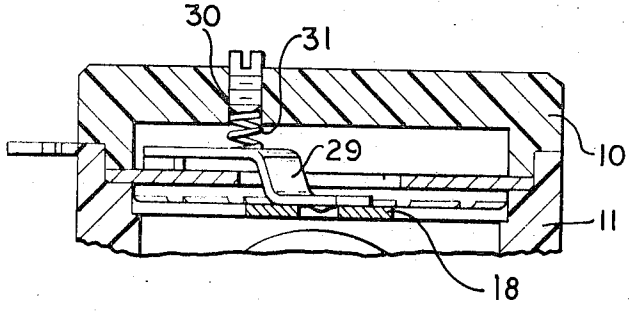


FIG. 4

INERTIA SWITCH WITH BALL ACTUATED DEFLECTABLE CONTACT

BACKGROUND OF THE INVENTION

A desideratum exists for a simple, efficient, and foolproof inertia switch, particularly for automobiles, which is capable of functioning only in major accidents, and not as a result of minor maneuvers. Such switch must be effective in the event of a major collision, for example, to trigger safety devices, such as an air bag, fire extinguisher, or de-energizing devices. Much effort and expense have been expended in this connection, but the results have not been satisfactory. The switches have been too complex, too expensive, or so delicate they will not stand up under normal usage.

SUMMARY OF THE INVENTION

A simple switch mechanism is produced which has the unique ability automatically to determine when the desired combination of G forces and time have been attained, such, for example as may develop in an automobile collision. It can maintain an electric circuit for a time duration during an automobile crash, and reset itself instantly when the G force exerted is reduced to a minimum. The ability to reset itself immediately results that an electric circuit will be maintained only for the duration of the existing G forces. Transitory G forces, no matter how great if they are not maintained longer than the required time, cannot operate the switch.

The structure involved consists of a two-part housing, and the housing parts are held together by frictional engagement. In the lower housing part is a conical ramp on which a relatively heavy ball, such as a steel ball, can freely roll. The lower housing part has two vertically spaced ledges of different diameters, the lower ledge having the shorter diameter and receiving a flat electrical conductive disc. The flat disc is segmental, having a circular row of segments whose outer or peripheral edges are upturned. The upper ledge receives a flat electrical conductive ring, which has a lead in the form of a tab extending through a notch in the casing to the outside to receive a suitable wire. In the upper housing part is an adjustable leaf spring of electrical conductive material, which is in constant engagement with the upper face of the flat disc at one end. The opposite end of the leaf spring extends through a notch in the upper housing part to the outside to receive the suitable lead.

INCORPORATION BY REFERENCE

There is incorporated by reference the U.S. letters Pat. No. 3,621,163, dated Nov. 16, 1971, and entitled INERTIA SWITCH. The present invention constitutes an improvement on the switch shown and described in such patent with the view of effecting a more abrupt action thereof, as well as augmenting the electrical surge when the switch is closed.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an exploded perspective view on an enlarged scale showing the several parts of the inertia switch,

FIG. 2 is a vertical sectional elevation of the switch on an enlarged scale in assembled condition,

FIG. 3 is a fragmentary sectional view on an enlarged scale of a portion of the switch assembly showing an alternative form of leaf spring, and

FIG. 4 is a view similar to FIG. 3 showing a further alternative form of leaf spring, and with a coil spring interposed between the adjusting screw and the leaf spring.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The illustrated embodiment of the invention shown in FIGS. 1 and 2 comprises a vertically disposed housing which is of an electrical insulating or non-conducting material, such as molded plastic material. The housing consists of two parts, an upper part or cover **10**, and a lower part **11**. In the lower housing part **11**, which is in the shape of a cup, there is a chamber having a cylindrical side wall **13** vented at **13***a*, and a conical ramp surface **14** constituting the bottom wall. Disposed within the chamber and normally resting upon the ramp surface **14** is a ball **15** constituting a spherical mass of high density material, such as steel. At the upper portion of the chamber are two circular ledges **16** and **17** of different diameters, the lower ledge **16** being of less diameter than the upper ledge **17**, and receiving a flat circular disc **18** of electrical conductive material. The disc **18** is relatively thin, has a hole in the center and is formed with an annular row of wedge-shaped segments **18***a*, which extend from a central core or ring **18***b*. The segments **18***a* are spaced from each other so as to flex independently, and the outer or peripheral edge **18***c* of each segment is bent upwardly at substantially right angles. The disc **18** rests loosely on the ledge **16** so that it can be canted or tilted readily into engagement with a flat ring **19** also of electrical conductive material, which rests on the upper ledge **17**. The segmental form of the disc **18** is important because it eliminates chattering, which was found to be an objection to the one piece imperforate disc. Furthermore, the foraminated form of the disc militates against air turbulence since air can pass relatively freely from one side of the disc to the other, thereby enabling instant disc movement with a minimum of resistance. The upturned edges **18***c* have two important functions; one being to afford a better electrical contact with the ring **19** since an improved wiping or brush-like action takes place when the disc **18** is tilted. The other function of the upturned edges **18***c* is to militate against foreign matter, such as lint or dust, from gathering on the contact surface of the disc and interfering with electrical contact, such as would be the case where the flat surface of the disc is depended upon for effecting electrical contact. The flat ring **19** has a lead in the form of a lateral tab **20** to fit a notch **21** in the upper portion of the housing part **11**. The tab extends outside of the housing to receive a suitable lead wire.

Engaging a central portion of the flat disc **18** is a leaf spring **23** of electrical conductive material. One end portion of the spring passes freely through the opening in the ring **19**, and bears against the central portion of the disc **18**. The leaf spring **23** has an upper portion **23***a* abutting against the upper housing part on cover **10**, and a lower portion **23***b* which abuts flatwise against the upper central portion **18***b* of the disc **18**, and these portions are connected by an inclined connecting portion **23***c*. A dimple **23***d* in the spring portion **23***b* extends into the hole in the disc **18** for locational pur-

poses. An adjusting screw **24** extends through the cover **10** and enables the force urged by the spring **23** to be regulated. The upper leaf spring portion **23***a* has a lateral lead-receiving extension provided with a reduced neck to fit a notch **26** formed in a circular flange **22** which depends from the cover part **10.** Such extension also fitting a notch **23***b* in the housing part **11.** The flange **22** snugly and frictionally engages the lower housing part, as shown in FIG. **2,** the lower edge of the flange abutting against the rim portion of the ring **19** to hold it properly in position.

The leaf spring **23** must have superior electrical conducting properties, and for this purpose it may be of silver or gold, for example. It is found that a leaf spring constitutes a distinct improvement over an helically coiled spring for this purpose, because in the latter case, the convolutions create an electrical resistance which limits the current-carrying capacity and retards the surge of current when required. In an inertia switch of this character, the time element is of great importance.

In response to an effective G force, the ball **15** forces the circular disc **18** away from its ledge and into contact with the flat ring **19,** thereby to close the switch. When the G force has been reduced to the preset minimum, the ball **15** moves down the ramp assisted by the weight of the disc **18** and the pressure exerted by the leaf spring **23.** As soon as the ball starts to move back down the ramp **14,** contact is broken between the disc **18** and the ring **19,** thereby opening the switch. It will be manifest that opening of the switch is not retarded by friction so that there is no chance of the switch sticking in closed position. As above mentioned, the diameter of the disc **18** is considerably less than the outer diameter of the ledge **16** on which it rests, and this militates against sticking or jamming of the disc **18** in the housing. This also affords a wiping action by the disc **18** against the flat ring **19** as the switch is closed and opened, which assures clean contacts with good conductivity.

It should be understood that the switch will not operate even though a severe impact takes place so long as the forward motion of the vehicle does not continue at least to a small degree. It is important that there be at least some slight motion whether it be forward, rearward, or lateral after the impact for this switch to function. If there is some bending action in either the moving vehicle or the object struck causing a resistance slightly greater than that experienced in a severe braking maneuver and existing for a split second of time, the electrical contacts will then be established.

An alternate form of leaf spring **27** is shown on FIG. **3,** in which one end portion is engaged by an adjusting screw **28** extending through the cover **10.** In this form, the intermediate portion of the spring bears flatwise against the disc **18,** and the other end portion is disposed substantially parallel to the first end portion.

FIG. **4** shows an alternate form of leaf spring indicated at **29,** in which the adjusting screw **30** operates through a coil spring **31** interposed between the screw **30** and the upper face of the leaf spring **29.** When the screw **30** is turned in one direction or the other, the coil spring **31** is forced with greater or less intensity against the leaf spring. The leaf spring inclines downwardly and, thence, outwardly for flatwise engagement with the disc **18.** This coil spring arrangement makes possible the use of a less resilient leaf spring which then can tilt without substantial sliding action over the surface of the disc **18.**

What I claim is:

1. An inertia switch comprising a two part housing of electrical insulating material, one part having an open mouthed chamber having as its bottom wall a conical ramp surface, a relatively heavy ball in said chamber for movement along said ramp surface, a pair of vertically spaced ledges adjacent the open mouth of said chamber with the lower ledge of less diameter than the upper ledge, a disc of electrical conductive material seated loosely upon said lower ledge, a ring of electrical conductive material on said upper ledge, a tab rigid with said ring and extending laterally from the rim thereof, a notch in said one housing part adjacent said upper ledge to receive said tab and enable the latter to extend outside of said housing, a depending flange on the other housing part to fit said first housing part and bear against said ring for holding same in place, a leaf spring of electrical conductive material having a portion disposed above said ring, and a portion extending axially through said ring for imposing spring pressure against the central portion of said disc, said first leaf spring portion lying generally parallel to said disc and extending laterally outside of the housing, and a notch in one of said housing parts through which said first leaf spring portion extends.

2. An inertia switch as claimed in claim **1,** in which said leaf spring comprises a one-piece structure having an upper portion to extend outside of the housing, and a lower portion bent to be approximately parallel to said upper portion for engagement with the central part of said disc.

3. An inertia switch as claimed in claim **1,** comprising means for regulating the tension of said leaf spring, thereby to adjust the pressure thereof against said disc.

4. An inertia switch as claimed in claim **3,** in which said tension regulating means comprises an adjusting screw in said other housing part and a coil spring for engagement with said leaf spring.

5. An inertia switch as claimed in claim **1,** comprising cooperative means on said disc part and leaf spring part for insuring seating of said spring upon said disc and militating against relative displacement.

6. An inertia switch as claimed in claim **5,** in which said cooperative means comprises a dimple on one of said parts and a hole on the other of said parts to receive the dimple.

7. An inertia switch as claimed in claim **1,** comprising upturned edges on the peripheral surface of said disc for affording effective electrical contact with said ring and militate against foreign matter on the disc interfering with electrical contact.

8. An inertia switch as claimed in claim **1,** in which said disc comprises separated radial segments for militating against air turbulence in operation and effect a wiping action upon engagement with said ring.

9. An inertia switch as claimed in claim **8,** comprising upturned edges on each segment.

10. An inertia switch comprising a two part housing of electrical insulating material, one part having an open mouthed chamber having at its bottom wall a conical ramp surface, a relatively heavy ball in said chamber for movement along said ramp surface, a pair of vertically spaced ledges adjacent the open mouth of said chamber with the lower ledge of less diameter than

the upper ledge, a disc of electrical conductive material seated loosely upon said lower ledge, said disc having a circular row of wedge-shaped segments capable of flexing relative to each other, upturned edges on said segments respectively, a flat ring of electrical conductive material on said upper ledge, a tab rigid with said ring and extending laterally from the rim thereof, a notch in said one housing part adjacent said upper ledge to receive said tab and enable the latter to extend outside of said housing, a depending flange on the other housing part to fit said first housing part and bear against said ring for holding same in place, a spring of electrical conductive material imposing pressure against said disc through said ring, and a lead for said spring extending outside of said housing.

* * * * *