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(54) **Automatic switching system for electrical impact detonator**

(57) A switching system for closing a current circuit of a detonator for flight bodies such as shells, bombs or rockets. The system comprises a pressure chamber 4 which is at least partially defined by a double diaphragm switch 1, 2 and a cover 3 formed from a deformable material. The diaphragm of the double diaphragm switch which bounds the pressure chamber, contains one or more through openings 5. The current circuit is only closed if the flight body in which an impact igniter with such an ignition system is located makes impact, after its flight with hard ground.

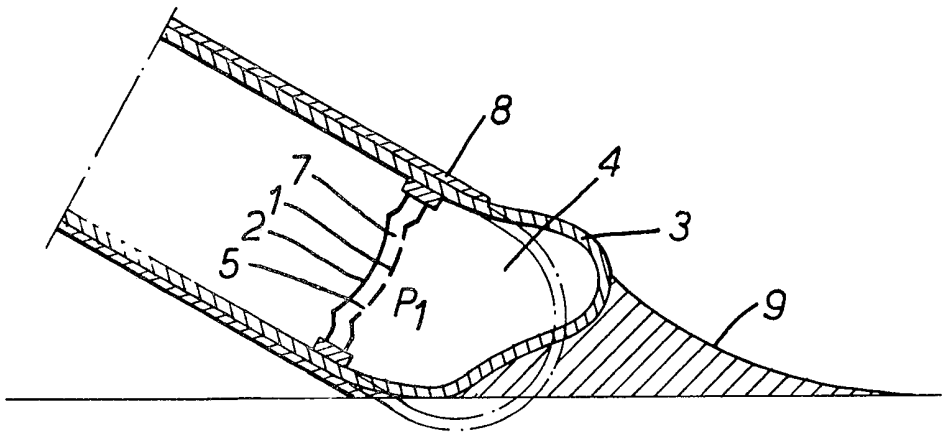

FIG. 3.

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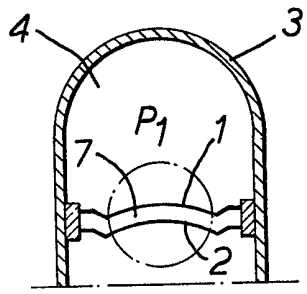

FIG. 1.

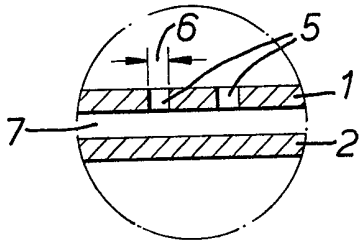

FIG. 2.

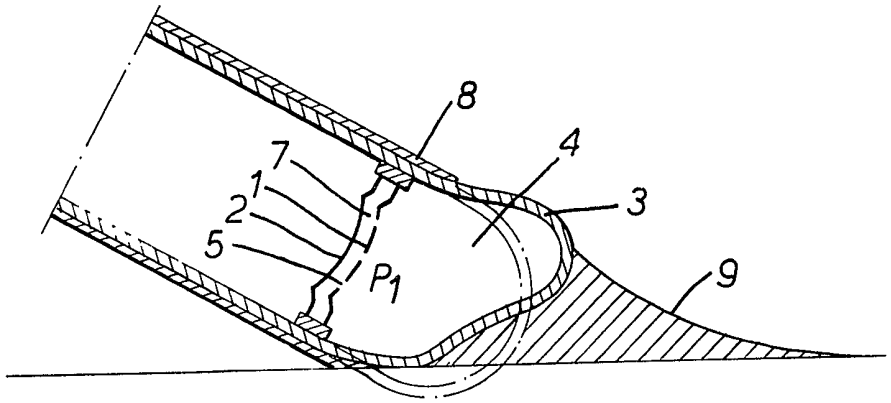

FIG. 3.

SPECIFICATION

Automatic switching system for electrical impact detonator

This invention relates to an automatic switching or release system for electric detonators which operates to close a current circuit at the moment of impact of a flight body containing the switching system with a target. Such a current circuit comprises an ignition pellet or another suitable electrical detonation means which is set off by the current flow which then occurs.

Electrical detonation arrangements which are used for example in flight bodies, such as shells, rockets or bombs generally employ electrical or mechanical switching systems for the release of detonation on impact on a target. Mechanical switches have the disadvantage, however, that they must be initially locked so as to avoid unintentional release on firing and during the high accelerations associated therewith. Because such locking must be very reliable in order that no undesirable permature detonation occurs, such switches are therefore as a rule very expensive.

A simple mechanical switching system is described for example in German Patent Specification No. 11 45 522. There a double-walled cover formed of electrically conductive material, whose walls are electrically insulated from one another, is arranged over the ignition system. At the moment of impact, the two walls enter into contact with one another and close a current circuit, which leads to ignition of an ignition pellet. Unfortunately, such activation of ignition can easily occur when not wanted if the detonator is deformed for example by falling or is otherwise undesirably subjected to pressure. Moreover with the switching system of German Patent Specification 11 45 522 there is included a piezoelectric switch which brings the ignition pellet into the correct position for detonation only after exertion of a pressure, such as built-up directly on firing of the flight bodies followed by a pressure drop. Such a detonation system is expensive and imposes a relatively large space requirement on the flight body which is to house it.

According to the present invention, there is provided a switching system to close a current circuit of an electric impact detonator at the moment it is subject to an impact, which system comprises a pressure chamber whose volume is capable of variation and which is enclosed partially or completely by the combination of a cover formed of a deformable material and a double diaphragm switch whose diaphragm bounding the pressure chamber possesses one or more through openings.

Such a switching system is insensitive to undesired deformation, operates trouble free on an impact and independently of additional ignition systems, and occupies a small volume.

With such a switching system, the pressure in the pressure chamber at the moment of impact is greater than in the intermediate chamber between the two diaphragms so that these can contact each other and accordingly close a current circuit which leads for example to an electrically actuated ignition pellet. However, with the relatively slow pressure build-up in the pressure chamber, such as occurs for example in the firing phase of the flight body, no such large pressure difference exists betwen the pressure chamber and the intermediate chamber between the diaphragms, so that the diaphragms cannot touch and no undesired detonation current is released. According to the invention the contacting of the two diaphragms of the double diaphragm switch therefore is achieved only if, within a short time, there builds up in the pressure chamber a high pressure which is greater than the pressure in the chamber between the two diaphragms of the double diaphragm switch. Such high pressures building up in a short time exist, in practice, only after a flight of the above-indicated flight bodies, on their impact with solid ground.

The cover or hood which limits the pressure chamber at least on one side should be made of a material which is deformable so that, on impact, a pressure wave can build up or the volume of the pressure chamber can be deformed or compressed in a short time. It is preferred to use a resilient material such as silicone rubber. However a relatively stiff material such as for example a metal foil may also be employed provided that this material is deformed on impact and is then not destroyed. The cover fits firmly on the double diaphragm switch or holding elements for the switch.

The double diaphragm switch which further limits the pressure chamber is not itself new. Its mode of operation is principally the same as with other usages of such double diaphragm switches. On contact of the two diaphragms, a current circuit which in the present case includes an electrically releasable ignition source, preferably to an ignition pellet, is closed.

The diaphragms of the double diaphragm switch must obviously be made of electrically conductive material and be spaced apart from one another so that they can contact on pressure impact. The diaphragm which faces the pressure chamber contains one or more through openings whose number and diameter depend *inter alia* on the volume of the pressure chamber and the separation of the two diaphragms which are arranged parallel to one another.

The two diaphragms should possess as far as possible like masses. This guarantees that

they undergo uniform bending with constant residual separation if acceleration forces, such as encountered on firing of the flight bodies act on the diaphragms. When the two diaphragms are made of like material and possess like area, they will also possess a like oscillation property so that even with great impact stresses which give rise to vibration of the diaphragms, a contacting of the two diaphragms is not possible. The contacting of the diaphragms – and therefore a switching effect – is only achieved if one diaphragm is set in motion with a different force to the other; this is for example the case if at the time rapid pressure changes act on the diaphragms, the pressure in the main pressure chamber is greater than in the pressure chamber between the two diaphragms.

For a better understanding of the invention and to show how the same can be carried into effect, reference will now be made to the accompanying drawings by way of illustration only. In the drawings:

Figure 1 shows a longitudinal section through a complete impact switch embodying this invention;

Figure 2 is an enlarged scale view of the encircled portion P of Fig. 1, and

Figure 3 is a section through a modified switch which has made impact with soft ground.

Referring to the drawings two diaphragms between which an intermediate chamber 7 is located are denoted by the numerals 1 and 2. A pressure chamber 4 is furthermore limited by a cover 3.

The two diaphragms 1 and 2 which are shown in Fig. 2 in enlarged scale have through openings 5. These openings experience the pressure balancing between the pressure chamber 4 and the intermediate chamber 7 when a slow pressure build-up occurs in the pressure chamber 4. Only at the time of rapid pressure changes in the pressure chamber 4, such as can exist only on impact at the end of the flight, do these balancing passages not operate. They are then in effect, blocked by the rapid pressure change.

A special constructional form of switch is shown in Fig. 3. In this constructional form, a reinforcing casing 8 is arranged around the switching systems in the region of the double diaphragm switch. This casing can take the form of a sleeve or a ring which encompasses the pressure chamber at least in the part which bounds the diaphragm switch 1, 2. It can also be provided separately over the diaphragm switch; it should however still leave free a part of the cover 3.

The material of this reinforcing casing should be firm and stiff. Both metals or alloys and also hard plastics are suitable. The reinforcing casing gives rise to a digging in of this material on impact when the detonator meets soft target 9 in a very small impact angle. The soft ground material, such as for example water, sand or snow is therefore, in effect, dug into, as a result of which the resistance with respect to the cover is increased so that this is deformed better and quicker and the desired pressure is exerted on the diaphragm of the double diaphragm switch facing the pressure chamber.

CLAIMS

1. A switching system to close a current circuit of an electric impact detonator at the moment it is subject to an impact, which system comprises a pressure chamber whose volume is capable of variation and which is enclosed partially or completely by the combination of a cover formed of a deformable material and a double diaphragm switch whose diaphragm bounding the pressure chamber possesses one or more through openings.

2. A switching system as claimed in claim 1, wherein the diaphragms of the double diaphragm switch possess the same mass.

3. A switching system as claimed in claim 1 or 2, wherein the cover consists of an elastomer.

4. A switching system as claimed in claim 3, wherein the elastomer is silicone rubber.

5. A switching system as claimed in claim 1 or 2, wherein the cover is formed of impact deformable metal foil.

6. A switching system as claimed in any one of the preceding claims, wherein the cover is surrounded by a reinforcing casing at least in the region of the double diaphragm switch.

7. A switching system to close a current circuit of an electric implact detonator, substantially as hereinbefore described with reference to Figs. 1 and 2 or Fig. 3 of the accompanying drawings.

8. An electric impact detonator which comprises a a switch system as claimed in any one of the preceding claims.

9. A flight body which is equipped with an electric impact detonator as claimed in claim 8.

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