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

(11) Publication number: **0 166 074**
A2

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **85101471.2**

(22) Date of filing: **12.02.85**

(51) Int. Cl.⁴: **F 42 C 19/06**

(30) Priority: **08.03.84 SE 8401289**

(43) Date of publication of application: **02.01.86**
Bulletin 86/1

(84) Designated Contracting States: **BE CH DE FR GB IT LI NL**

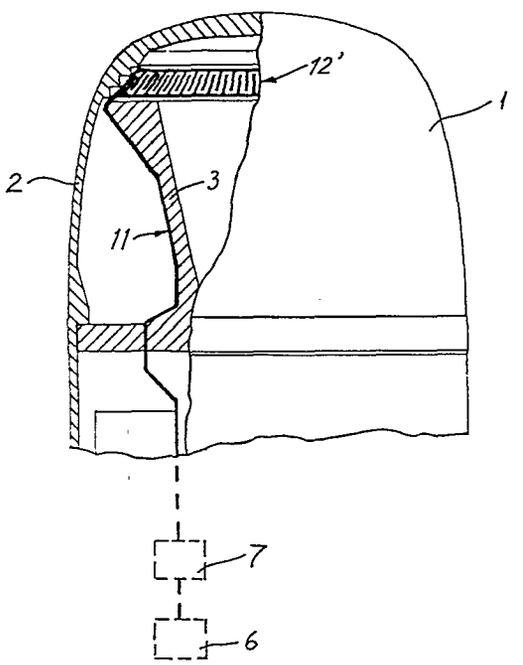
(71) Applicant: **Affärsverket FFV, Tullgatan 8, S-631 87 Eskilstuna (SE)**

(72) Inventor: **Sundvall, Kenneth, Post box 812, S-635 90 Eskilstuna (SE)**

(74) Representative: **Nydell, Peder, Nydells Patentbyra Storgatan 57, S-392 31 Kalmar (SE)**

(54) Impact sensor for a projectile.

(57) Impact sensor for a projectile (1), which comprises a source of power (6) with a normally open circuit (8, 9) and a sensing element (7), for example a fuse pipe, for the purpose of sensing a closing of the circuit. The circuit consists of two conductors (8, 9) embedded in a plastic film (10). A number of edges (13) in the projectile are so arranged as to be capable at the time of the impact by the projectile of penetrating the plastic film and making contact between the conductors.



EP 0 166 074 A2

0166074

Impact sensor for a projectile

The present invention relates to an impact sensor for a projectile, comprising a source of power with an open circuit, which is so arranged as to be closed as the result of a deformation of the projectile at an impact by the projectile on a target, and a sensing element for the purpose of sensing said closing of the circuit.

An impact sensor of this kind is described in US Patent Specification 3,667,393. The thus disclosed sensor exhibits a circuit, the conductors of which are formed from parts of the material of the projectile which are insulated one from another. Such circuits are very sensitive to moisture, dirt and oil, etc., which cause changes in the resistance of the conductors. There is also an increased risk of the short-circuiting of the conductors if they are formed from the material of the projectile.

The object of the present invention is, therefore, to propose an impact sensor of the type described by way of introduction, in which the circuit is insensitive to the surrounding environment, and in which the risk of unintentional short-circuiting is eliminated. This object is achieved by the impact sensor in accordance with the invention having being given the characteristic features indicated in Claim 1.

Further developments of the invention are evident from the subordinate Claims.

The invention is described below in greater detail with reference to the accompanying drawing, which illustrates a preferred embodiment of the invention.

Figure 1 shows a cross-section and a sectioned view of the nose part of a projectile fitted with an impact sensor in accordance with the invention. Figure 2 shows part of Figure 1 on an enlarged scale. Figure 3 shows a modified embodiment of a flexible conductor which forms part of the sensor in accordance with Figure 1.

Figure 1 shows a nose part of a projectile 1, of which the rest is not shown. The reference 2 is used to denote the casing of the projectile. The nose part of the projectile exhibits a centrally positioned, essentially cylindrical cap 3, not described here in any greater detail, which between itself and the casing 2 of the projectile forms an air gap 4; see Figure 2.

The cap 3 exhibits at its front end an annular step 5, which has the form of the generated surface of a truncated cone.

The projectile 1 is fitted with an impact sensor comprising a source of power 6, represented only schematically, and a sensing element, also represented only schematically, in the form of a fuse pipe 7. The source of power 6 may, for example, have the form of a battery capable of being charged by the acceleeration of the projectile, or may be a piezoelectric generator. Since both the source of power 6 and the fuse pipe 7 may be of an arbitrary, conventional nature, they are neither shown nor described here in any greater detail.

The source of power 6 and the fuse pipe 7 exhibit an open circuit in the form of two extremely thin, strip-shaped, electrical copper conductors 8 and 9. The conductors are embedded entirely in an electrically insulating material, for example in the form of a polyimide or polyester film,

so as to form a so-called flexible conductor 10. The conductors 8 and 9 thus have the form of a thin circuit pattern etched into the plastic foil.

The flexible conductor 10 is generally of the form shown in Figure 3, that is to say with an elongated part 11, in which the two conductors 8 and 9 run parallel with each other, and a sensor part 12, in which the two conductors 8 and 9 are routed adjacent to each other in pairs according to a pre-determined pattern. The sensor part in Figures 1 and 2 has a rather different appearance than it does in Figure 3, where it is denoted by the reference 12′. The sensor part 12′ has the same form as the step 5, and is attached to the latter, for example by means of an adhesive or with the help of tape. The elongated part 11 follows an appropriate inner profile inside the projectile, and is also attached to the latter by means of an adhesive or with the help of tape.

The circuit pattern in the sensor part 12 and 12′ can have many different appearances, with those illustrated being only examples of conceivable patterns.

In the circuit patterns illustrated, the two strip-shaped conductors 8 and 9 lie in the same plane. In an alternative embodiment, not shown here, they may lie one on top of the other, separated from each other by means of a layer of the aforementioned insulating material.

The casing 2 of the projectile exhibits,directly in line with the step 5, a stair-shaped reducing diameter intended to form a number (being three in the example shown) of annular, metallic edges 13, the sharp part of which is situated in the air gap 4 at a distance of up to about 0.5 - 1 mm from the step 5. The edges 13 are best formed

at the same time as the casing of the projectile is being manufactured.

The function of the impact sensor is as follows.

When the projectile strikes a target, the casing of the projectile is deformed in such a way that the edges 13 penetrate the insulating material in the flexible conductor 10 and make a contact between the conductors 8 and 9, causing a current to flow from the source of power 6 to the fuse pipe 7. When this senses an electrical current, a desired function may be actuated in the projectile, for example the priming of an explosive charge (not shown).

If the conductors 8 and 9 are arranged one above the other in accordance with the aforementioned, alternative embodiment, the edge 13 will first cut through one of the conductors, and then through the interjacent insulating layer until the edge reaches the second conductor, causing the circuit to be closed.

It is also conceivable within the scope of the invention to cause the edges 13 and the conductors 8, 9 to exchange places, that is to say to attach the insulated conductors to the inside of the casing of the projectile, and the edges to some component part of the projectile within the casing of the projectile.

It is also obvious that the sensor part 12 or 12′ of the flexible conductor can be arranged in the projectile at any point at which it is wished to provide an impact sensing function. It is also obvious that the edges may have a form other than that shown.

Claims

1. Impact sensor for a projectile (1), comprising a source of power (6) with an open circuit (8, 9), which is so arranged as to be closed as the result of a deformation of the projectile at an impact by the projectile on a target, and a sensing element (7) for the purpose of sensing said closing of the circuit,
c h a r a c t e r i z e d in that the circuit consists of at least two conductors (8, 9) embedded in an electrically insulating material (10), and electrically insulated from the casing of the projectile, and in that at least one metallic edge (13) or similar being electrically insulated from the two conductors and arranged in the projectile (1), is capable as the consequence of said deformation of the projectile, of penetrating said insulating material and of producing an electrical contact between both said conductors for the purpose of producing said closing of the circuit.

2. Sensor in accordance with Claim 1, c h a r a c t e r i z e d in that the insulating material (10) has the form of a film in which the conductors (8, 9) are embedded.

3. Sensor in accordance with Claim 1, c h a r a c t e r i z e d in that the film (10) with the embedded conductors (8, 9) is a so-called flexible conductor.

4. Sensor in accordance with any of the foregoing Claims, c h a r a c t e r i z e d in that the edge (13) and the conductors (8, 9) are so arranged as to be capable as the result of said deformation of moving towards each other in an air gap (4) within the casing (2) of the projectile.

0156074

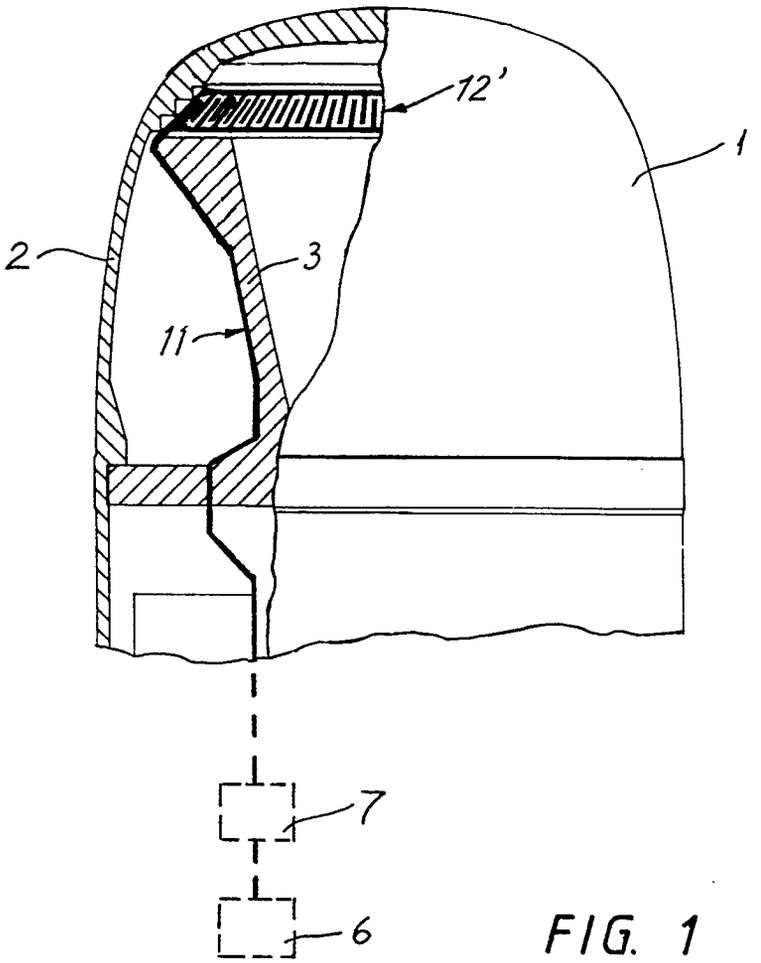


FIG. 1

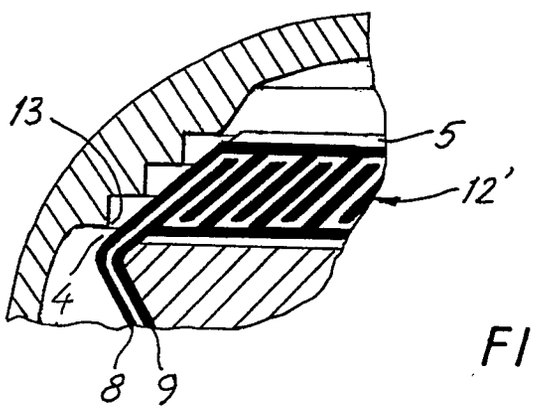


FIG. 2

0166074

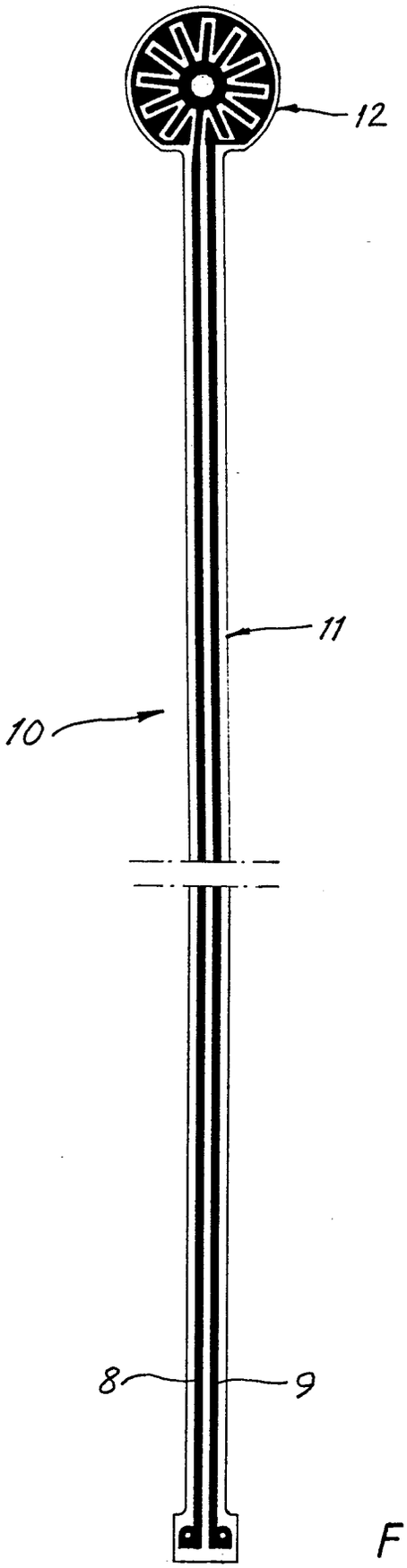


FIG. 3