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ACCELERATION ACTUATED SWITCH WITH EXPLOSIVE CHARGE AND THERMITIC MATERIAL

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FIG. 1.

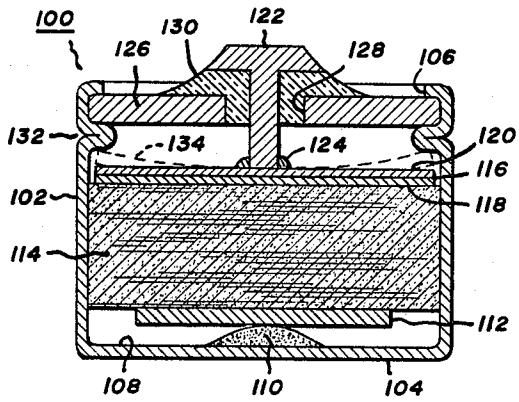
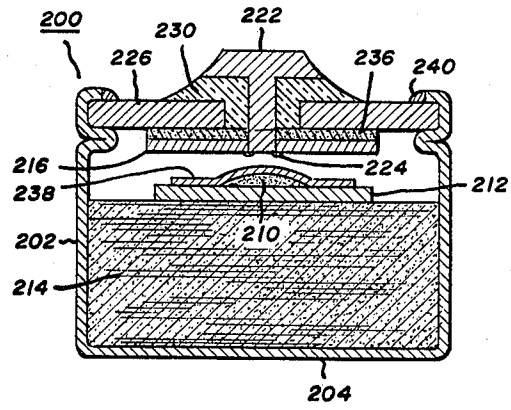


FIG. 2.



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ACCELERATION ACTUATED SWITCH WITH EXPLOSIVE CHARGE AND THERMITIC MATERIAL

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ABSTRACT OF THE DISCLOSURE

An acceleration actuated switch is comprised of a housing including one terminal formed of a casing and a second terminal insulatively spaced from the casing. An acceleration activated igniting means lies within the housing including a striker plate and an explosive. A thermitic material lies adjacent the explosive. A thermally actuated switch lies adjacent the thermitic material. In one form the active element of the switch may be a bimetallic strip and in another a fusible salt.

Our invention is directed to an acceleration activated switch which generates a thermal signal that causes electrical connection between the switch terminals to be made or broken.

In one aspect our invention is directed to an acceleration actuated switching means comprised of a housing including an electrically conductive casing which forms a first terminal. The housing is provided with a second terminal and with means for mounting the first and second terminals in insulatively spaced relation. The switching means also is comprised of an acceleration activated igniting means including a rigid element lying within the housing and moveable relative to a rigid surface within the housing. An explosive lies between the rigid element and the rigid surface. Thermitic material lies within the casing adjacent the explosive, and means are provided for controlling electrical interconnection between the terminals in response to a thermal signal.

Our invention may be better understood by reference to the following detailed description considered in conjunction with the drawings, in which

FIGURE 1 is a vertical section of one form of our switch in which a bimetallic strip is incorporated as the switching element, and

FIGURE 2 is a vertical section of an alternate form of our switch in which a fusible electrolyte is incorporated as the switching element.

In FIGURE 1 an acceleration actuated switch **100** is shown. The switch is shown formed of a metal casing **102** having a closed end **104** and an open end **106**. The casing is formed of metal so as to be electronically conductive and thereby usable as one terminal of the switch. Initially the casing wall is in the form of a right circular cylinder.

The inner surface **108** of the casing provides a rigid support on which a small body of percussion sensitive explosive **110** may be positioned. In a preferred form the explosive may be a gun powder cap. Above the explosive is positioned a striker plate **112**. Immediately above the striker plate is located a body **114** of thermitic material. This material is preferably a quantity of so-called "gasless" heat paper, i.e. layers of paper impregnated with a suitable thermitic composition, e.g. a mixture of barium chromate and zirconium. The paper is, of course, formed of a fibrous non-combustible material, such as fiberglass, for example. The heat generating or thermitic material may take other forms, however, such as a reductant in the form of finely powdered iron and an oxidant, such as a chromate or perchlorate.

Positioned in thermal proximity to the thermitic material is a bimetallic strip **116** comprised of face joined metal layers **118** and **120** having dissimilar coefficients of thermal expansion. The bimetallic strip is shown welded to a thermal pin **122** at **124** to insure a good electrical contact. The terminal pin is supported by an annular mounting ring **126** having a central aperture **128**, through which the terminal pin extends. The terminal pin is sealed to and insulated from the mounting ring by a seal **130**. It is accordingly apparent that the casing, mounting ring, seal, and terminal pin cooperate to form a sealed housing for the switch. The mounting ring is sealingly supported by the casing on a peripheral crimp **132** that is formed in the casing during assembly. Thereafter the upper edge of the casing is bent over so that the mounting ring is secured between the crimp and the upper edge.

In use, the switch **100** may be positioned in any conventional electrical circuit in which an acceleration actuated switch is desired. The switch could, for example, be positioned in the nose of a small caliber H.E. round of ammunition so that an electrical circuit to an explosive firing device may be closed. In another exemplary application the switch could be utilized in a battery powered alarm circuit incorporated in a packing crate, so that if the crate is dropped with sufficient force to actuate the switch an alarm can be sounded providing warning of possible damages to the goods. A variety of alternate applications can readily be visualized.

In a circuit application the terminal pin **122** serves as one terminal of the switch while the casing **102** serves as the remaining terminal. When the switch is accelerated, as by dropping or firing in a shell, the striker plate **112** presses the explosive **110** against the rigid surface **108** on the interior of the housing so that the explosive is detonated. The flames produced on detonation ignite the thermitic material **114**. The heat given off by the thermitic material provides a thermal signal to the bimetallic strip **116**. By reason of the different coefficients of thermal expansion of the strip layers **118** and **120** the strip is deformed so that it contacts the casing. This is illustrated by dashed lines at **134** in the drawing. Since the terminal pin **122** is welded to the bimetallic strip at **124**, an electrical circuit is provided between the switch terminals through the bimetallic switch. It is readily appreciated if the proposed application required an initially closed electrical circuit which was subsequently opened in response to acceleration, it would be necessary only to configure the bimetallic strip so that it initially contacts the casing but upon heating deforms out of contact therewith. For example, the strip could initially occupy the dashed line position **134** and thereafter deform to the position shown.

In FIGURE 2 a switch **200** is illustrated comprised of a casing **202** identical to casing **102**. A body of thermitic material **214** is positioned within the casing which may be identical to the body of thermitic material **114**. As shown, the thermitic material is positioned adjacent the end wall **204** of the casing. The annular mounting ring **226** and seal **230** are identical to elements **126** and **130**, respectively. The terminal pin **222** is welded at **224** to an annular washer **216**. A fusible electrolyte **236** is mounted between the mounting ring and washer. A preferred form of the electrolyte consists of a woven glass cloth or tape impregnated with a eutectic mixture of alkali halide salt, e.g. an alkali chloride eutectic, such as lithium and potassium chlorides, which have a melting point in the range of 300–400° C. Other fusible salts and salt mixtures having melting ranges may be utilized, if desired. The electrolyte may also comprise a pellitized material having an inorganic binder; but for most applications the impregnated woven fiberglass cloth is sufficient as a separator between the mounting ring and washer. Where a hygroscopic fusible material is employed, it is desirable to

positively seal between the mounting ring and casing as indicated by weld **240**. Other sealing means could of course be employed.

In applications where the electrical circuit in which the switch is to be incorporated is only required to be closed for a near instantaneous duration, i.e. a few milliseconds, the mounting ring and washer may be formed of any electrically conductive metal that is stable in the environment of use—i.e. nickel, stainless steel, copper, brass, etc. In such circumstance the ions will migrate within the electrolyte between the ring and washer to close the electrical circuit between the terminals of the switch as represented by the terminal pin and casing. While polarization will quickly develop between the washer and ring if an attempt is made to pass an electrical current for a prolonged period, electrical continuity is nevertheless available to sustain an electrical pulse. In applications such as where a projectile containing an explosive is to be detonated after firing only a brief signal is required, so this poses no disadvantage in use.

In applications where it is desired that the switch remain conductive for some appreciable length of time, it may be desirable to associate with the electrolyte, the ring, and the washer chemically consumable materials. For example, a known anode material such as magnesium or calcium may be associated with either of the ring or washer surfaces next adjacent the electrolyte. A cathodic depolarizer material may then be associated with the remaining surface or dispersed in the electrolyte, as is well understood. Exemplary of suitable cathodic depolarizer materials are ferric oxide, vanadium pentoxide, and potassium chromate.

In the switch **200** the striker plate **212** is shown resting on the upper surface of the thermitic material. An explosive **210** is positioned on the upper surface of the striker plate and held in position by a thin, frangible layer **238**, such as a thin layer of paper. When the switch **200** is accelerated rapidly downwardly, it is noted that the striker plate will press upwardly against the rigid lower surface of the washer to cause detonation of the explosive. If the arrangement of the striker plate, explosive, and thermitic material were modified to the arrangements shown in the switch **100**, detonation of the explosive would occur upon rapid upward acceleration. If desired, the striker plate could also be positioned with the explosive bearing against an upstanding wall of the casing, in which case the explosive would be detonated by rapid acceleration in a lateral direction. It can be readily appreciated by providing multiple explosive charges and/or multiple striker plates the switches could be made to operate in response to rapid acceleration in any combination of directions.

Our acceleration activated switches posses a number of distinct advantages. One very important feature of the switch is that the contacts are not opened or closed in response to acceleration directly, but are opened or closed in response to a thermal signal that is developed shortly after acceleration. Where the switch is to be incorporated in an explosive projectile in the detonating circuit, for example, this delay between acceleration and closing of the contacts is critical to allow the shell to clear the barrel of the gun before exploding. The delay in actuating the switching element allows the cell to reach the desired point in its trajectory before firing. At the same time, however, the switch may be actuated within seconds or fractional seconds of acceleration so that no noticeable delay would be noted in applications where a signal approximately contemporaneous with acceleration is required. For example, where the switch is actuated by dropping a shipping crate, a signal would be produced within seconds after impact.

A very important advantage of our switches is their compact construction. Heretofore acceleration activated igniters for thermitic materials incorporated in sealed devices such as cells have displaced a large volume. In our novel cell construction the striker plate and explosive occupy only a small volume, which is to some extent exaggerated for purposes of illustration. We also recognize the weld between the terminal pin and the washer or bimetallic strip to constitute a distinct advantage in assuring a good electrical contact between the elements. Further, it is noted that the weld may be achieved at a location remote from the thermitic material at or before assembly so that the risk of creating a flash fire is avoided.

It is appreciated that numerous variations of our invention will occur to those skilled in the art, accordingly it is intended that the scope of the invention be determined by reference to the following claims.

What we claim and desire to secure by Letters Patent of the United States is:

1. Acceleration actuated switching means comprising
a housing including
an electrically conductive casing forming a first terminal,
a second electrically conductive terminal, and
means for mounting said first and second terminals in insulatively spaced relation,
means for controlling electrical interconnection between said terminals in response to a thermal signal,
thermitic material lying within said housing capable of generating a thermal signal, and
an acceleration activated igniting means lying within said housing adjacent said thermitic material including
a rigid element lying within said housing and moveable relative to a rigid surface within said housing and
an explosive lying between said rigid element and said rigid surface.

2. An acceleration actuated switching means according to claim **1** in which said interconnection controlling means is comprised of a bimetallic strip.

3. An acceleration actuated switching means according to claim **1** in which said interconnection controlling means is comprised of a fusible eletrolyte.

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102—70.2; 337—362, 401