

Jan. 7, 1964

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3,117,196

ACCELERATION OPERATED SWITCH

Filed Aug. 29, 1960

2 Sheets-Sheet 1

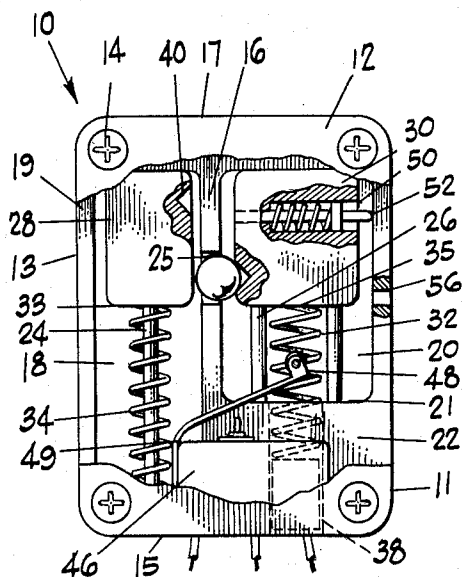


Fig. 1

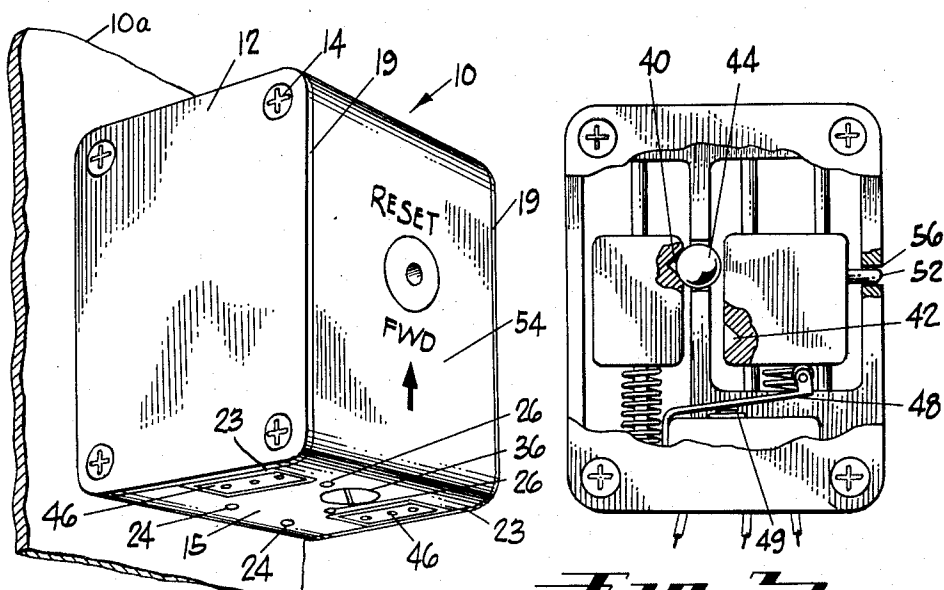


Fig. 2

Fig. 3

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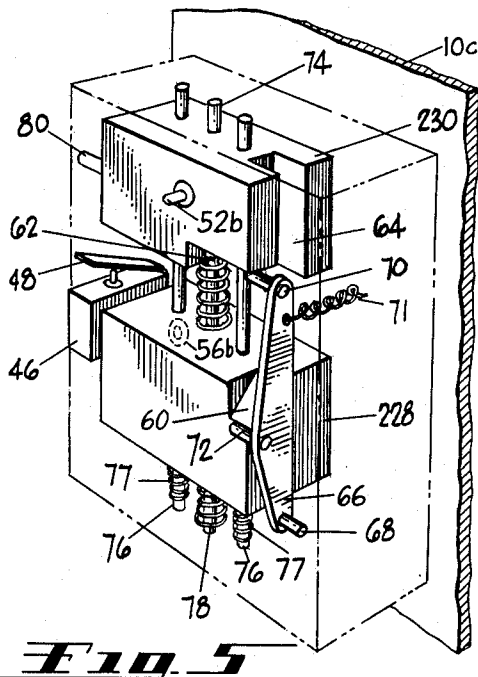
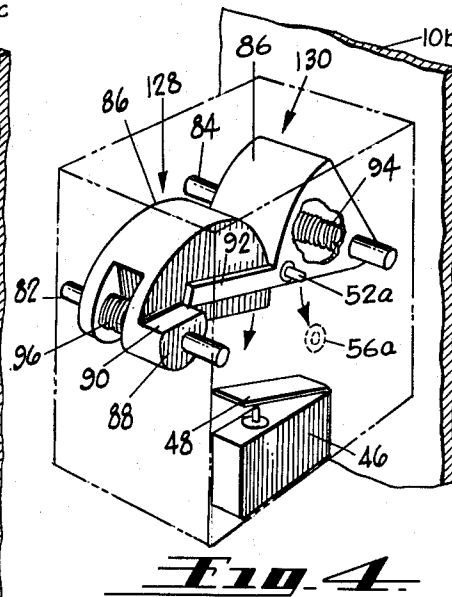
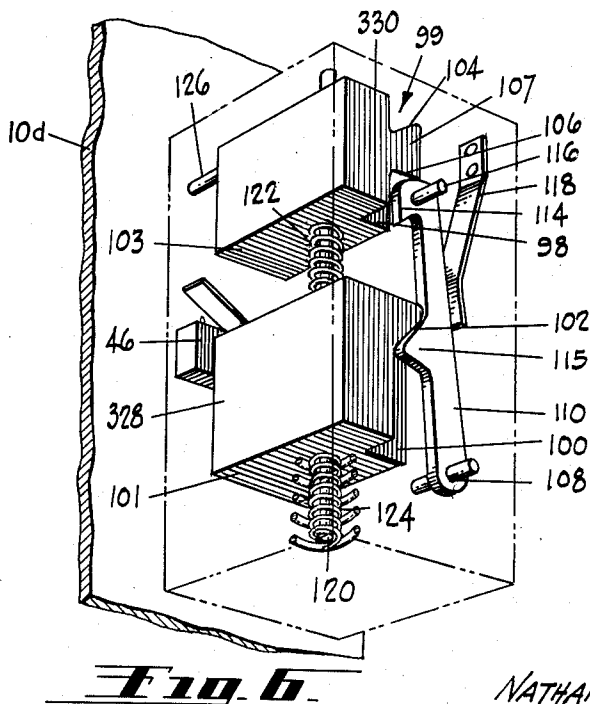
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ACCELERATION OPERATED SWITCH

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This invention relates to inertia operated devices and has particular reference to an inertia operated switch which will only operate to initiate a desired operation after it has been subjected to an acceleration exceeding a critical value determined by the design and/or setting of the switch.

Various forms of inertia operated switches are known to the prior art, but none of them, within the knowledge of the present inventor are free from certain material disadvantages which this invention has been particularly designed to overcome.

Inertia operated devices have proven of great utility on objects which are subjected to large accelerations and decelerations, such as airplanes, rockets and projectiles. For example, they have been used on aircraft to provide, in the event of crash or impact, an automatically operated switch to close an electrical circuit and actuate fire preventing and extinguishing appliances. In addition, such switches have been used on missiles wherein the switch is adapted to be actuated by the large acceleration force encountered during firing of the missile and is arranged to effect a desired operation when this acceleration reaches a predetermined value.

One usual form of inertia operated switch particularly adaptable for missiles use comprises: a metal ball, a permanent magnet to hold the ball in a fixed position, and a non-magnetic member surrounding the ball to guide its movement. In one such device, the non-magnetic member is in the form of a helical track. The ball is held fixed at one end of the track. When the unit is subjected to forces developed by acceleration or shock, inertia of the ball disengages it from the magnetic field and causes it to roll along the track; wherein, at the end of the track, it completes an electrical circuit. In another form, the non-magnetic member is in the shape of an inverted cone. The ball is held in the apex of the inverted cone by the action of the permanent magnet until it is acted upon by a force from acceleration or shock large enough to overcome the magnetic force. The ball then rolls outward on the cone until it completes an electrical circuit at the edge of the cone.

While the above described inertia operated switches have certain distinct advantages, they also have certain disadvantages which limit their scope of operation. Because of the imminent danger to life and property that surrounds the handling of a missile, it has been found desirable to provide a means to prevent arming of the missile until it has been projected away from surrounding objects and people. This is accomplished by using an inertia operated device associated with a normally open switch. The acceleration force of the missile operates the device which closes the switch thereby completing an electrical circuit to arm the missile.

Heretofore, commercially available inertia operated devices of the above described type and other types have been proposed broadly. While these operate, upon firing of the missile, to actuate the switch, there are inherent in their design certain disadvantages of complexity and safety. Some of these devices rely upon the magnitude of the force alone to move an inertia element to actuate the switch. This means that they can be caused to operate by shock and impact forces as well as acceleration forces. The result of this is that a careless operator or handler, dropping or jarring the missile, can arm it

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long before it is fired. One of the prime considerations in missile manufacture is safety. Therefore, it is imperative that a simple device be designed that cannot be operated by shock or impact but only by an acceleration force of a minimum predetermined magnitude and duration.

With this object in view, the present invention has been designed to provide a relatively simple electrical switching device adapted to be activated by a force of a minimum predetermined magnitude and duration. Briefly, the preferred embodiment of the device comprises: a housing having two chambers separated by a wall containing an aperture; a trigger mass and a switch mass each movably mounted within one of said chambers, means associated with said masses to hold said switch mass in a fixed position under the influence of said force until said force has displaced said trigger mass a predetermined distance; a plurality of springs associated with said masses to exert a force upon said masses to overcome the effect of said force until it has reached a minimum predetermined magnitude; and an electrical switching means associated with the switch mass for actuation thereby.

In the accompanying drawings, in which like reference numerals are used to designate similar parts throughout, there are illustrated four slightly modified forms of what is now considered to be the preferred embodiment of the idea of this invention. The drawings, however, are for the purpose of illustration only, and are not to be taken as limiting the invention; the scope of which is to be measured entirely by the scope of the appended claims.

In the drawings:

FIG. 1 is a side elevational view of the presently preferred embodiment of the invention wherein a portion of the cover has been removed showing the detents, latching pin and apertures in section.

FIG. 2 is a perspective view of the presently preferred embodiment of the invention showing one side, the front containing the reset aperture and orientation marking, and the bottom showing microswitches, notches and a spring adjustment screw.

FIG. 3 is a cutaway side elevational view similar to FIG. 1 showing the switching device in its actuated position.

FIG. 4 is a diagrammatic view of a first modification of the present invention showing the operating mechanism wherein the casing is represented in broken lines.

FIG. 5 is a diagrammatic view of a second modification of the present invention showing the operating mechanism wherein the casing is represented in broken lines.

FIG. 6 is a diagrammatic view of a third modification of the present invention showing the operating mechanism wherein the casing is represented in broken lines.

Referring now to the drawings wherein like reference characters designate like or corresponding parts throughout the several views, there is shown in FIG. 1 a rectangular shaped casing or housing 10 comprising a pair of side walls 11, 13, end walls 15, 17, and face surfaces 19 wherein, as viewed in FIG. 2, said face surfaces and side walls have a greater longitudinal dimension than said end walls.

Extending through said end walls 15, 17 are a plurality of apertures. In addition to said apertures, one end wall 15 contains a pair of notches 23 and internally threaded bore 38. Extending longitudinally of said casing 10 and partitioning said casing into first and second chambers 18, 20 respectively, is a partition or wall 16. Said wall contains a ball receiving aperture 25. End wall 15 has a web portion 22 which projects into the chamber 20, thereby reducing the longitudinal dimension of said chamber; whereby said chamber has a longitudinal dimension approximately three quarters of that of chamber 18. To

enclose the chambers, a pair of plates or covers 12 are attached by conventional fastening means, such as screws 14, to the face surfaces 19.

Running longitudinally of the chambers 13, 20 and terminating in the apertures in the end walls 15, 17 (as seen in FIG. 2) are a plurality of bars or guide rods 24, 26, respectively, and within said chambers 18, 20 are respectively a first member or trigger mass 28 and a second member or switch mass 30. Said masses 28, 30 each have a pair of longitudinal apertures through which said bars 24, 26, respectively, extend to guide the movement of said masses when they are displaced by the action of the acceleration forces.

In the first chamber 18, circumscribing the bars 24 and contained between the interior surface of end wall 15 and one surface 33 of the trigger mass 28, are a plurality of motion resisting coil springs 34. Extending longitudinally of the second chamber 20 through the bore 33 in the end wall 15 and contained between an adjustment screw 36 mated with said bore and one surface 35 of the switch mass 30, is a second motion resisting coil spring 32.

In each surface of the masses 28, 30 adjacent to the partition 16 is a detent or notch 40, 42 respectively. In respect to the orientation of the device as shown in FIGS. 1 and 3, the notch 40 is located in the upper portion of the trigger mass 28 and notch 42 is located in the lower portion of the switch mass 30. Contained within the aperture 25 in the partition 16 is a sphere or ball 44 which is freely movable and of sufficient diameter to be inserted into the notch in either the trigger or the switch mass when one of said notches is in line with the aperture.

A latch bore 50 is provided in the side of the switch mass 30 opposite to that containing the detent 42. Contained within the latch bore 50 and bearing against the interior surface of side wall 11 is a spring loaded latch pin 52. Extending through the side wall 11 in line with the longitudinal path of movement of the switch mass and near the terminus of said path is a latch detent or aperture 56.

Attached to the casing 10 by conventional means (not shown) and located within the notches 23 are a plurality of microswitches 46. Said switches are of any appropriate type to operate a desired system, or systems, such as a single pole, single throw, switch used to actuate, under predetermined conditions of acceleration, the arming system of a missile. Said switches are mounted to the casing each within a notch 23 for contact by the switch mass and corresponding actuation prior to the latching of the device.

In FIG. 1, the device is depicted in the deactivated state. To actuate the device, it must be primarily accelerated in the direction as indicated by the orientation arrow 54 shown in FIG. 2. Device 10 can be attached by any suitable means to an object 10a (fragmentarily shown in FIG. 3) which can be the structure of an aircraft or missile, for example. The acceleration of the object 10a and hence device 10 exerts a force on both the trigger mass and the switch mass, which attempts to displace the masses toward end wall 15. However, the switch mass 30 is prevented from moving by the engagement of ball 44 within detent 42 and the trigger mass 28 will not move until the acceleration force exerted by said mass 28 upon springs 34 is sufficient to overcome the force exerted by springs 34. When the mass 28 has moved sufficiently to bring the detent 40 in line with the aperture 25 in the partition 16, the cam action of notch 42, under the influence of the acceleration force acting upon switch mass 30 causes the ball 44 to move out of engagement with the detent 42 and into engagement with the detent 40 in the trigger mass. This movement of the ball frees the switch mass 30 and it will move toward end wall 15. When, as seen in FIG. 3, the switch mass reaches its terminal point of movement, the lower surface 35 of the mass contacts the actuating arms 48 of the microswitches 46 causing the switch arm 48 to be displaced thereby actuating the switches through engagement of the arms

48 with the switch buttons 49. Subsequent to the actuation of the switches, the latch pin 52 drops into aperture 56, thereby preventing the mass from additional displacement when the acceleration force is increased or decreased.

To reset the device, the latch pin 52 must be depressed from in contact with the aperture 56 in the side wall 11, thereby freeing switch mass 30, whereafter the force of springs 32 and 34 will cause the masses 30, 28 respectively to return to their deactivated position within the casing as shown in FIG. 1.

By proper choice of retention springs 32, 34 the displacement of the corresponding masses can be controlled to produce activation of the switches only by an acceleration force of a predetermined minimum magnitude and duration.

Shown in FIGS. 4, 5 and 6 are modifications of the present invention. The housing or casing of each modification is represented in broken lines for clarity of illustration.

In the modification shown in FIG. 4, the trigger and switch masses 128, 130 are rotatably mounted on shafts 82, 84 respectively. Each mass has a curved face 86. Said faces 86 allow each mass to rotate under predetermined conditions without interference with the other mass. Projecting from one side of the trigger mass is a ringlike portion 88 having a flat cam surface 90.

Extending from one edge of the curved surface of the mass 130 into engagement with the flat surface 90, when the device is in the deactivated state, is a switching arm 92.

Circumscribing the shafts 82, 84 are force resisting springs 96, 94 respectively. Each spring has one of its free ends inserted into an aperture in the adjacent mass and the other free end inserted into the circumscribed shaft (not shown). Mounted to the casing within the path of rotation of the switch mass arm 92, so that it will be contacted thereby, is a microswitch 46.

In the modification shown in FIG. 4 the device is in a deactivated state. The device can be attached by any suitable means to an object 10b (fragmentarily shown in FIG. 4) which can be structure of an aircraft or missile, for example. An acceleration of the object 10b and hence the device upward, as oriented in FIG. 4, causes the trigger mass 128 to rotate about shaft 82 when the acceleration force is sufficient to overcome the resisting force exerted on the mass by spring 96. As the mass rotates, the arm 92 will remain in contact with the cam surface 90 until the surface has rotated to a position approximately parallel with the longitudinal axis of the device. Thereafter, arm 92 is freed and the switch mass 130 rotates towards the switch 46 until the arm 92 has engaged the switch arm 48 and actuated the switch. Subsequent to this operation, the device will be latched as described above in the preferred embodiment. That is, the latch pin 52a which is similar to latch pin 52 drops into an aperture 56a that is similar to the aperture 56, in the casing of FIG. 4 to latch the device.

In a second modification shown in FIG. 5, the switch and trigger masses 228, 230 are located in an inline relationship. In this modification, the motion of the masses 228, 230 is guided by guide rods 74, 76 and resisted respectively by springs 77, 73. The trigger mass 228 is provided with an inclined edge or kerf 60 and the switch mass is provided with a notch and a groove 62, 64 respectively. Engageable respectively with the inclined surface 60, and the notch and groove 62, 64 are a pair of pins 72, 70. Said pins are mounted on a rotatable lever 66. The lever 66 is rotatably mounted (not shown) to the casing by a pin 68. Extending laterally from the surface of the switch mass opposite to that containing the groove 64 is a switch contact pin 80.

In the modification shown in FIG. 5 the device is shown in a deactivated state. The device can be attached by any suitable means to an object 10c (fragmentarily shown

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in FIG. 5) which can be structure of an aircraft or missile, for example. When the object 10c and hence the switch is accelerated upward, as orientated in FIG. 5, the trigger mass 228 remains stationary until the force of acceleration exceeds the restraining force of spring 77. When the mass has been acted upon by sufficient force to overcome this spring force the mass moves downward, as orientated in FIG. 5, against the action of the spring and the pin 72 under the force of spring 71 moves into contact with the inclined surface 60. Additional movement of the trigger mass causes the pin to move relatively along the inclined surface, thereby resulting in a rotation of the arm 66 clockwise about the pin 63. As the pin 72 reaches the upper portion of the inclined surface 60 the arm 66 has rotated sufficiently to allow the pin 70 to move into alignment with the groove 64, thus freeing the switch mass and allowing it to move downward until the contact pin 80 has activated the switch 46 and the device is latched as described in the preferred embodiment. That is, the latch pin 52b which is similar to latch pin 52 drops into an aperture 56b that is similar to the aperture 56, in the casing of FIG. 5 to latch the device.

In a third modification shown in FIG. 6, the trigger and spring masses 323, 330, respectively are located in an inline relationship and are guided during their movement by a single guide rod 120. The trigger mass 323 includes a notched section 100 extending longitudinally of said mass along one side of corner thereof and having an inclined portion or cam 102. The switch mass 330 includes a pair of notches 93, 99 extending along the same side as the section 100 of said trigger mass. Each of the notches 93, 99 extends from one of the transverse surfaces of said mass along said corner to a depth sufficient to provide a web 107 therebetween. Circumscribing said rod 120 are force resisting springs 122, 124. Both springs have one end in contact with the casing. However, the free end of spring 124 (which is sectionally cut away for clarity of illustration) is in contact with one surface 101 of the trigger mass and the free end of the other spring 122 passes through a bore in the trigger mass and is in contact with one surface 103 of the switch mass. Adjacent to the longitudinal surfaces of said masses containing said notches 93, 99, 100 and engageable therewith is a rotatable rocker arm 110. Said arm has at its free end, a hooked portion 114 and intermediate thereof a protuberance 115 and is rotatably attached to the casing (not shown) by a pin 108. Extending outward from the hooked portion 114 of said arm 110 is a manual reset pin 116. Extending outward from the surface of the switch mass opposite to that containing the said notches 93, 99 is a switch contact pin 126 and located in line therewith, for contact thereby, is a microswitch 46. Bearing against the surface of the rocker arm 110, opposite to that containing the hooked portion 114 and protuberance 115, is the free end of a leaf spring 113. Said spring 113 has its other end attached to the casing (not shown).

In the modification shown in FIG. 6 the device is shown in the deactivated state. The device can be attached by any suitable means to an object 10d (fragmentarily shown in FIG. 6) which can be structure of an aircraft or missile, for example. When the object 10d and hence the device has been accelerated forward or upward as orientated in FIG. 6, and said acceleration force has reached a minimum magnitude sufficient to overcome the restraining force of spring 124, the trigger mass 323 moves downward. This causes the inclined cam portion 102 of notch 100 to bear against the protuberance 115 of the rocker arm 110, thereby rotating the arm clockwise. As the displacement of the trigger mass increases the arm will rotate about pin 108 thus removing the hook 114 from engagement with the notch 93. This allows the switch mass 330 to move downward until the contact pin 126 has activated the switch 46 and the hooked portion 114 is engaged in notch 99.

To reset the device the rocker arm 110 is rotated clock-

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wise sufficiently to remove the hook 114 from engagement with notch 99 resulting in an upward movement of the switch mass under the force of spring 122.

Obviously, many modifications and variations of the present invention are possible in light of the above teachings. It is therefore to be understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically described in respect to the aforesaid preferred embodiment and modifications thereof.

I claim:

1. An electrical switching device adapted to be activated only by an acceleration force of a predetermined minimum magnitude and duration, comprising: first and second movable members mutually arranged for relative movement in response to said force; means adjacent to both of said movable members for holding said second movable member in a solidly engaged, fixed position under the influence of said force until said force has caused said first member to be displaced a first predetermined distance at which said second member is quickly and fully released by said holding means to be free to be displaced a second predetermined distance wherein displacement thereof is effectively limited independently of the displacement of said first member to said first predetermined distance; force resisting means in contact with said movable members to exert a counteracting force upon said members, thereby resisting the movement of said members until said acceleration force has reached a minimum predetermined magnitude and duration; and an electrical contact means in juxtaposition with said second movable member and adapted to be contacted thereby when said force has reached said minimum predetermined magnitude and duration whereby an electrical circuit is actuated.

2. An inertia-type electrical switch adapted to be actuated only by an acceleration force of a minimum predetermined magnitude and duration, comprising: a trigger mass and a switch mass adapted for respective movements in response to said force; means adjacent to said masses adapted to hold said switch mass in a solidly engaged, fixed position under the influence of said acceleration forces until said trigger mass has been displaced a first predetermined distance by said force, whereafter said switch mass is quickly and fully released to be free to move a second predetermined distance wherein displacement thereof is effectively limited independently of the displacement of said first member to said first predetermined distance; electrical contact means adapted to be contacted by said switch mass when said mass is displaced by said force, thereby actuating an electrical circuit; and spring biasing means adapted to exert a force on said masses tending to offset the effect of the acceleration force until said force has reached a minimum predetermined magnitude and duration.

3. An inertia-type electrical switch adapted to be fixedly mounted in an object subject to acceleration for actuation only by an acceleration force of a minimum predetermined magnitude and duration, comprising: a housing secured to said object and having its longitudinal axis parallel with the longitudinal axis of the object; first and second movable members arranged in said housing for movement parallel with the longitudinal axis thereof; means adjacent to said movable members to hold said second member in a solidly engaged, fixed position under the influence of acceleration forces until said first member has been displaced a minimum first predetermined distance at which said second member is quickly and fully released by said holding means to be free to be displaced a second predetermined distance wherein displacement thereof is effectively limited independently of the displacement of said first member to said first predetermined distance; force resisting means in contact with said movable members adapted to exert a counteracting force upon said movable members tending to offset the

effect of said acceleration forces until said acceleration forces have reached a minimum predetermined magnitude and duration; and electrical contact means adapted to be contacted by said second member to actuate an electrical circuit when said second member is displaced by said acceleration force.

4. An inertia-type electrical switch adapted to be mounted in an object subject to acceleration for actuation only by an acceleration force of a minimum predetermined magnitude and duration, comprising: a housing secured to an object and having its longitudinal axis parallel with the longitudinal axis of the object; movable members arranged in said housing for movement parallel with the longitudinal axis thereof, said movable members including a trigger mass and a switch mass; means adjacent to said masses adapted to hold said switch mass in a solidly engaged, fixed position under the influence of said acceleration force until the trigger mass has been displaced a first predetermined distance by said force at which distance said switch mass is quickly and fully released by said holding means to be free to be displaced a second predetermined distance wherein displacement thereof is effectively limited independently of the displacement of said trigger mass to said first predetermined distance; a plurality of coil springs each contained between said housing and one of said masses to exert a counteracting force upon said masses tending to offset the acceleration force until said acceleration forces have reached a minimum predetermined magnitude and duration; and electrical contact means adjacent to and in the path of movement of said switch mass whereby said contact means will open and close an electrical circuit when it is contacted by said switch mass.

5. An electrical switching means adapted to be actuated only by an acceleration force of a minimum predetermined magnitude and duration, comprising: a housing; first and second movable members arranged in said housing for movement therein only by said force; means adjacent to said movable members adapted to hold said second member in a fixed position under the influence of said force until said force has displaced said first member a predetermined distance; force resisting means in contact with said movable members for preventing movement of said members until said force has reached said minimum predetermined magnitude and duration; electrical contact means adapted to be contacted by said second movable member for opening and closing an electrical circuit; and means carried by said second movable means and engageable with said housing to maintain a continuous contact between said second member and said electrical contact means when said acceleration force reaches said minimum predetermined magnitude and duration.

6. An inertia-type electrical switch adapted to be mounted in a translatable object for actuation only by an acceleration force of a minimum predetermined magnitude and duration, comprising: a housing having two chambers separated by a wall containing an aperture, said housing being mounted in a translatable object so that its longitudinal axis is parallel with the longitudinal axis of the object; a trigger mass and a switch mass each mounted in one of said chambers and adapted for movement therein parallel with the longitudinal axis of said housing, and each mass having a detent in a first side adjacent to said wall; a ball movably mounted in said aperture and engageable with the detent in said switch mass to hold said switching mass in a fixed position under the influence of acceleration forces until the trigger mass has been displaced sufficiently to engage said ball in the detent in said trigger mass whereby said switching mass will be rendered free to move under the influence of acceleration forces; at least one coil spring in each of said chambers each being in contact with one of said masses and said housing to exert a counteracting force upon said masses which tends to offset said acceleration forces until said force has reached a minimum predetermined magnitude

and duration; and electrical contact means adjacent to and in the path of movement of said switching mass whereby said contact means will actuate an electrical circuit when said switching mass is freed by the engagement of said ball into the detent in said trigger mass.

7. An inertia-type electrical switch adapted to be mounted in an object susceptible to acceleration for actuation only by an acceleration of a minimum predetermined magnitude and duration, comprising: a housing having an aperture in one side thereof and two chambers separated by a wall, said wall including an aperture therein, and said housing being mounted in said object with its longitudinal axis parallel to the longitudinal axis of the object; a trigger mass and a switch mass each movably mounted within one of said chambers and adapted for movement therein parallel to the longitudinal axis of said housing; means adjacent to said masses to hold said switch mass in a fixed position under the influence of said force until the trigger mass has been displaced a predetermined distance by said force; a plurality of coil springs in said chambers each in contact with one of said masses and said housing to exert a counteracting force upon said masses which tends to offset the acceleration forces until the acceleration force has reached a minimum predetermined magnitude and duration; electrical contact means positioned in the path of movement of said switch mass and adapted to actuate an electrical circuit when contacted by said switching mass; and a spring loaded latching means positioned in and extending from one side of said switch mass and adapted to engage said aperture in the housing subsequently to the activation of said switch whereby said electrical contact means is maintained in a constant activated position.

8. An inertia-type electrical switch adapted to be actuated only by an acceleration force of a minimum predetermined magnitude and duration, comprising: a trigger mass and a switch mass adapted for respective rotational movements in response to said force; said trigger mass including a ringlike portion having a flat cam surface thereon and said switch mass including a switching arm in contact with said flat surface whereby said switch mass is held in a fixed position under the influence of said acceleration forces until said trigger mass has been rotated sufficiently to free said switching arm; spring biasing means adapted to exert a force on said masses tending to offset the effect of the acceleration force until said force has reached said minimum predetermined value; and electrical contact means adjacent to said switch mass and adapted for contact by said switching arm when said switch mass rotates under the influence of said acceleration forces.

9. An inertia-type electrical switch adapted to be fixedly mounted in an object subject to acceleration for actuation only by an acceleration force of a minimum predetermined magnitude and duration, comprising: a hollow box-like housing secured to said object and having its longitudinal axis parallel with the longitudinal axis of the object; a pair of shafts, secured in opposite walls of said housing; a trigger and a switch mass each rotatably mounted on one of said shafts for respective rotational movements in response to said force; said masses each having a notched section adjacent to said shaft; means on said trigger and switch mass adapted to hold said switch mass in a fixed position under the influence of acceleration forces until said trigger mass has been rotated through a minimum predetermined arc; a pair of springs each circumscribing one of said shafts and extending transversely of one of said masses in the notched section thereof, said spring having one end secured to the inscribed shaft and the other secured to said adjacent mass wherein said springs exert a counteracting force upon said masses tending to offset the effect of said acceleration forces until said acceleration forces have reached a minimum predetermined magnitude and duration; and elec-

trical contact means adjacent to and in the path of rotation of said switch arm whereby said means will be contacted by said arm when said switch mass rotates under the influence of acceleration forces thereby opening or closing an electrical circuit.

10. An inertia-type electrical switch adapted to be fixedly mounted in an object subject to acceleration for actuation only by an acceleration force of a minimum predetermined magnitude and duration, comprising: a housing secured to said object and having its longitudinal axis parallel with the longitudinal axis of the object; a trigger mass and a switch mass arranged in an in-line relationship within said housing and adapted for respective movements in response to said forces, said trigger mass having a portion of a first edge notched into an inclined surface; said switch mass including a notch in the surface adjacent to said trigger mass and a groove in a first surface corresponding to the first surface of said trigger mass and a contact pin extending from the surface opposite to that containing the groove; a rotatable lever mounted to said housing adjacent to the first surfaces of said trigger and switch masses, including a first and second pin respectively adapted to make contact with said trigger and switch masses; electrical contact means mounted to said housing in the path of movement of said contact pin and adapted to be contacted thereby only when said acceleration force has reached a minimum predetermined magnitude and duration; and spring biasing means adapted to exert a force upon said masses tending to offset the effect of the acceleration force until said force has reached said minimum predetermined magnitude and duration, whereafter said trigger mass moves under the influence of said force thereupon, and said lever rotates sufficiently to bring said first pin into contact with said inclined surface, and said second pin moves into alignment with said groove, and said pin in said switch mass makes contact with said switch mass, resulting in an opening or closing of an electrical circuit.

11. An inertia-type electrical switch adapted to be fixedly mounted in an object subjected to acceleration for actuation only by an acceleration force of a minimum predetermined magnitude and duration, comprising: a housing secured to said object and having its longitudinal axis parallel with the longitudinal axis of the object; a trigger mass and a switch mass arranged in an in-line relationship within said housing and adapted for respective movements in response to said forces, said trigger mass having a portion of a first edge notched into an inclined surface; said switch mass including a notch in the surface adjacent to said trigger mass and a groove in a first surface corresponding to the first surface of said trigger mass and a contact pin extending from the surface opposite to that containing the groove; a rotatable lever mounted to said housing adjacent to the first surfaces of said trigger and switch masses, including a first and second pin respectively adapted to make contact with said trigger and switch masses; electrical contact means mounted to said housing in the path of movement of said contact pin and adapted to be contacted thereby only when said acceleration force has reached a minimum predetermined magnitude and duration; and spring biasing means adapted to exert a force upon said masses tending to offset the effect of the acceleration force until said force has reached said minimum predetermined magnitude and duration whereafter said masses will move in sequence to open or close an electrical circuit.

ation only by an acceleration force of a minimum predetermined magnitude and duration, comprising: a housing secured to said object and having its longitudinal axis parallel with the longitudinal axis of the object; a trigger mass and switch mass arranged in an in-line relationship within said housing and adapted for respective movement in response to said forces, said trigger mass having a notched section in one side thereof and included therein an inclined portion, said switch mass including a first and second notched section in a first side corresponding to that of the trigger mass, and an unnotched portion remaining between said notches; said switch mass also including a contact pin protruding from the side opposite to said first side; a spring loaded rotatable lever mounted to said housing adjacent to said first sides of said masses, said lever including a protuberance in contact with said inclined portion of said groove in said trigger mass and a hooked portion in contact with said first notched section in said switch mass; electrical contact means mounted to said housing in the path of movement of said contact pin and adapted to be contacted thereby only when said acceleration force has reached a minimum predetermined magnitude and duration; and spring biasing means adapted to exert a force upon said masses tending to offset the effect of the acceleration force until said force has reached said minimum predetermined magnitude and duration whereafter said masses will move in sequence to open or close an electrical circuit.

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