United States Patent

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[54] ROLAMITE SAFETY AND ARMING MECHANISM

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[52] **U.S. Cl.** .....**102/78**, 102/70 R

[51] **Int. Cl.** **F42c 15/24**

[58] **Field of Search**.....102/78, 70, 70.2, 79, 80

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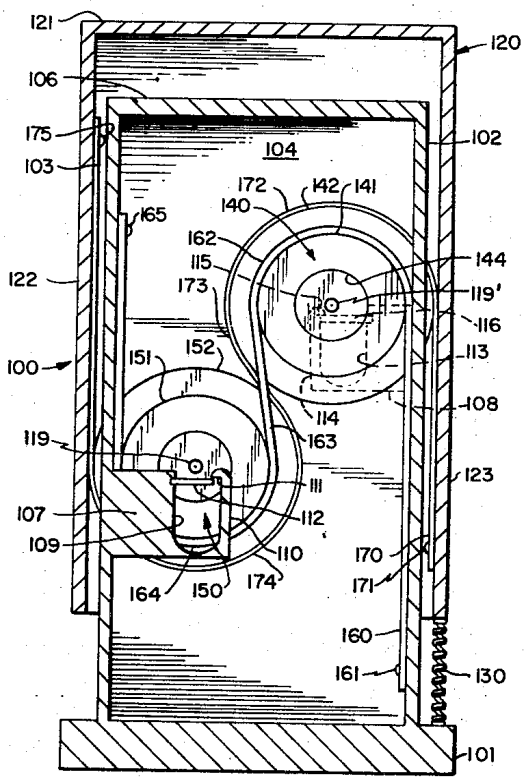
[57] **ABSTRACT**

An inertial operated fuzing and arming mechanism having two telescoping encasing members and a pair of rollers held within said encasing members and a pair of rollers held within said encasing members by a plurality of S-shaped flexible bands, each band engaging different diameter portions of the rollers and the ends of the bands being attached to the inside of said encasing members. A detonator and explosive are associated with one of said encasing members and one of the rollers and the other encasing member has an aperture therein so that when said two encasing members and said roller are aligned, the fuze is activated to detonate the explosive.

11 Claims, 4 Drawing Figures



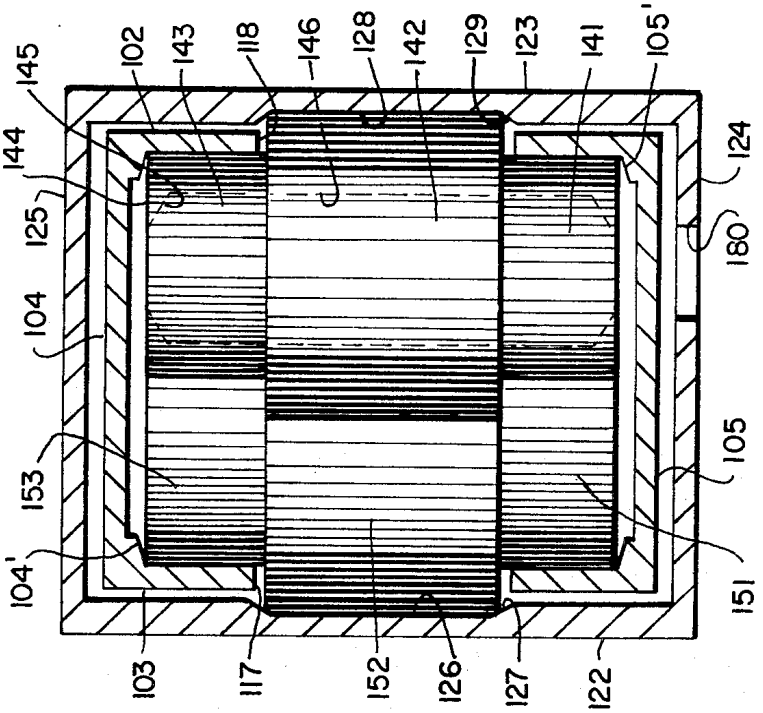


FIG. 3

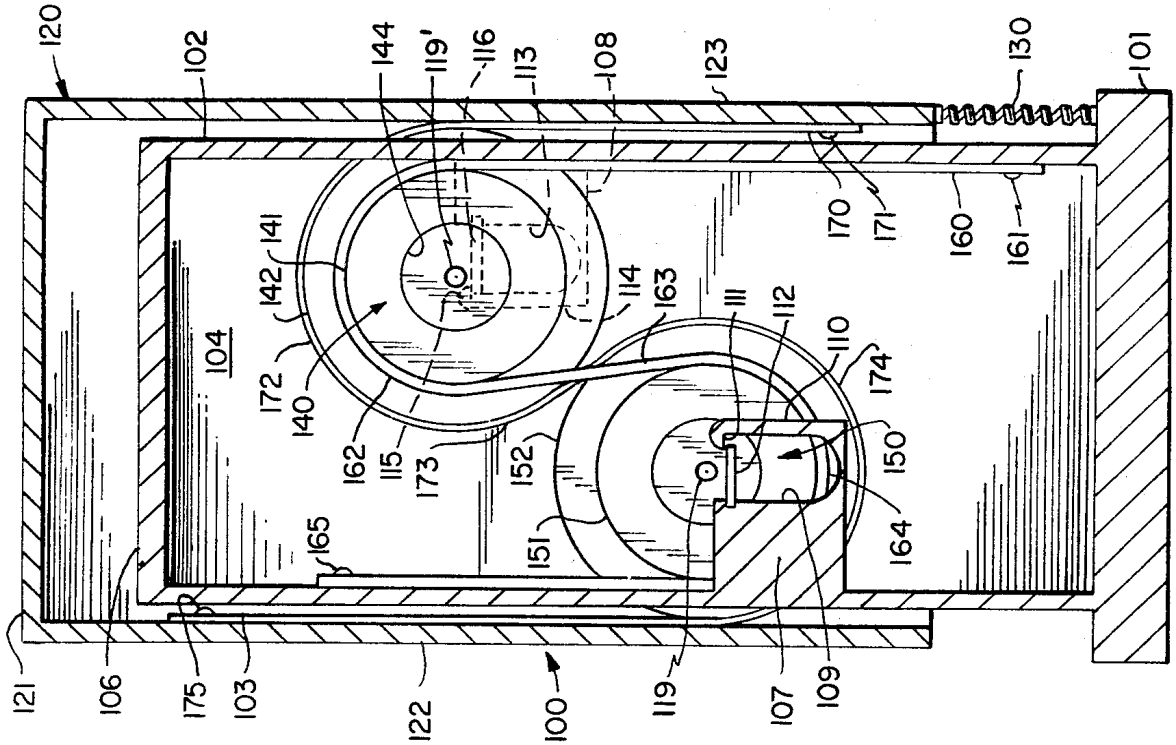


FIG. 1

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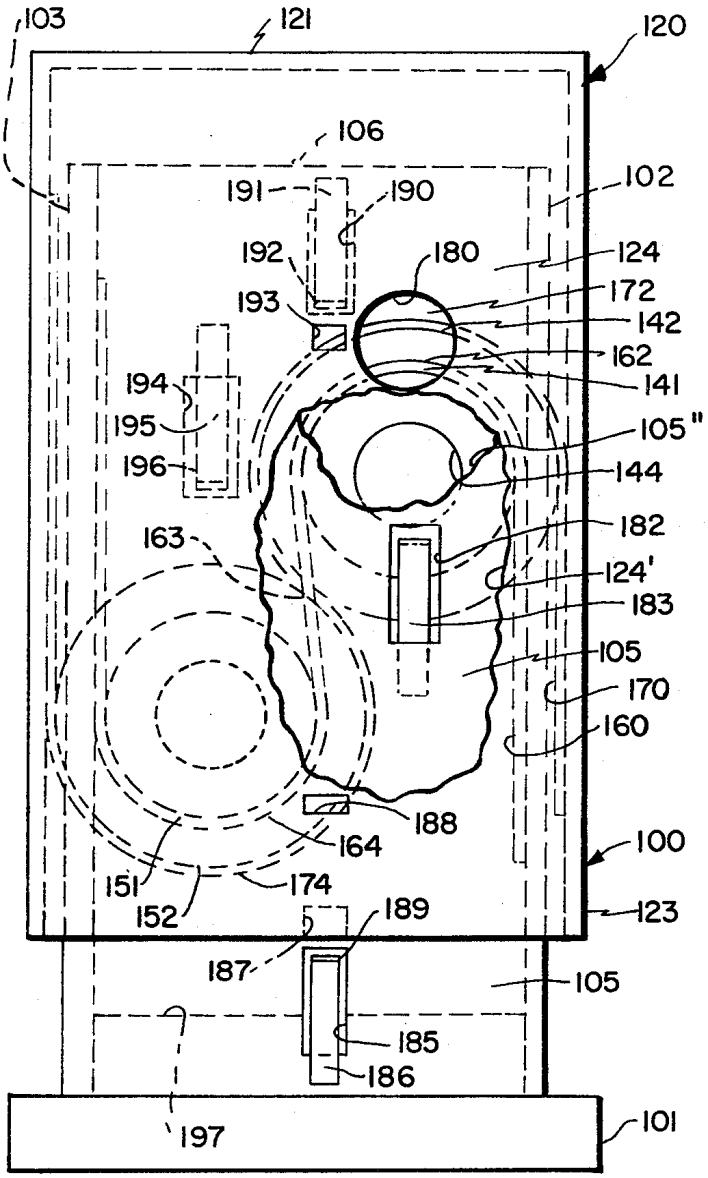

FIG. 2

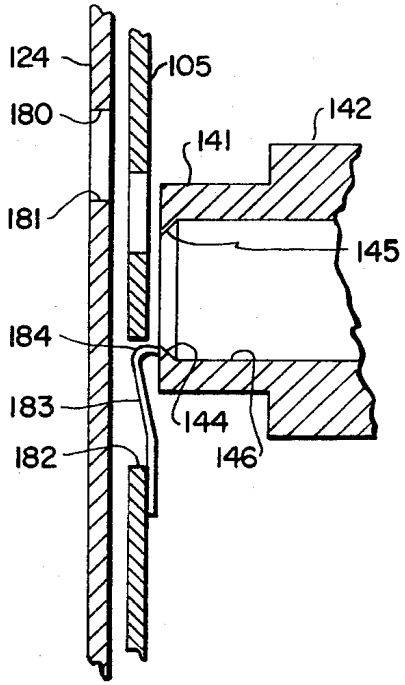

FIG. 4

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ROLAMITE SAFETY AND ARMING MECHANISM

The invention described herein may be manufactured, used and licensed by or for the United States Government for governmental purposes without the payment to me of any royalty thereon.

This invention relates to a new fuzing and arming mechanism which utilizes the roller-band method of energy transfer to arm a fuze.

Prior art fuzes have employed various means and methods to arm fuzes used to detonate explosives in projectiles, canopy releases and similar applications. These means have included accelerometers and G-switches which have been limited in their accuracy, sensitivity and efficiency by the degree of sliding friction inherent in these devices or due to structural inaccuracies in the elements used in the device.

Attempts to increase their sensitivity by decreasing sliding friction in accelerometers tends to decrease the force applied between the electrical contacts closed by the mechanisms reaction to an acceleration force. These mechanisms generally may not be adjusted to accurately respond to a relatively wide range of acceleration forces due to the unpredictable and variable frictional losses between the components of the mechanism.

Other attempted solutions to minimize sliding friction involve lubricants, both gaseous and liquid. Such lubricants can create forces detrimental to the operation of certain mechanisms under highly sensitive operating conditions. There is always the danger of contamination of critical areas within the housing thus creating the need for packing and sealing means.

The use of bearings has been limited by the manufacturing problems in fabricating precision surfaces and attaining close tolerances. Resulting misalignment and rough surfaces minimize overall efficiency.

The present device is only involved with rolling friction, the coefficients of which are considerably lower than a sliding coefficient of friction. Due to the low coefficients of friction, it is possible to construct the instant mechanism according to microminiaturization techniques.

Accordingly, it is an object of this invention to provide a fuzing and arming mechanism having low friction losses.

It is a further object of this invention to provide a fuzing and arming mechanism having only rolling friction losses.

It is a further object of this invention to provide a fuze mechanism for employing two telescoped members within which a pair of rollers are encased for movement therein.

It is a further object of this invention to provide a fuzing and arming mechanism which will not operate until a bias acceleration has been achieved.

These and other objects of the invention will become apparent when taken with reference to the following drawings in which:

FIG. 1 is a sectional side elevation view of the fuzing and arming mechanism showing one type of safety latch;

FIG. 2 is a side elevational view of the fuzing and arming mechanism similar to FIG. 1 but showing the aligning aperture in the case and a different type of safety latch and showing portions of the case and housing broken away.

FIG. 3 is a sectional view of the portion of FIG. 2 which is broken away only the housing and case walls are shown in full to show the relationship of the alignment of the rollers, case and housing;

FIG. 4 is a plan sectional view of the mechanism of FIGS. 1 and 3 showing the relationship of the rollers to the case and housing.

Portions of the mechanism which constitute this invention function according to the principles described in U.S. Pat. Nos. 3,452,175 and 3,471,668. The instant device is different from the devices described in those patents since there are two separate band systems acting on the rollers and each band system is connected to a separate encasing member, the members being movable relative to each other.

Referring now to FIG. 1, there is shown the preferred form of this invention, generally designated as **100**. It consists of a

flat base member **101** having a generally rectangular housing affixed thereto. The housing consists of walls **102**, **103**, **104** and **105** (FIGS. 2 and 3) and a cap portion **106**.

Affixed to wall **103** is a projection **107** having a latch **112** of resilient material which is carried by an extension **110** of projection **107**. The projection **110**, latch **112** and projection **107** form a U-shaped area **109**. Hook portion **111** on extension **110** prevents latch member from being bent outwardly and only allows it to be bent inwardly in relation to area **109**.

A second projection **108**, identical to projection **107**, has an extension **114** which supports a resilient latch **116** which is prevented from being bent upwardly by hook portion **115**. Latch **116**, extension **114** and projection **108** form a U-shaped area **113**. Projection **108** and extension **114** are secured to wall **105**. Areas **109** and **113** are adapted to receive latch pins such as **119**.

Wall **103** of the housing has a vertical slot **117** therein and wall **102** has a similar slot **118** therein (FIG. 3).

Surrounding the housing is a case generally designated as **120**. It has a top portion **121** and side walls **122**, **123**, **124** and **125**.

The case is generally rectangular when viewed from the top (FIG. 3) and has slightly larger dimensions than housing **100** to enable it to fit over the housing and vertically slide relative thereto. A spring **130**, as shown in FIG. 1, may connect the case with the housing.

Walls **122** and **123** of the case **120** having vertically extending relieved areas **126** and **128** which are beveled as at **127** and **129**, respectively. Areas **126** and **128** are aligned with slots **117** and **118**, respectively, in housing **100**.

Mounted inside of housing **100** are a pair of rollers **140** and **150**. Roller **140** has two external cylindrical portions **141** and **143**, of equal diameter, and a central cylindrical portion **142** of a diameter larger than that of portions **141** and **143**.

A central cylindrical bore **146** (FIG. 3) in roller **140** terminates at each end thereof in necked surfaces such as **145** and openings **144**. The internal bore may carry either a detonator or an explosive material.

Roller **150** is identical with roller **140** and has portions **151**, **152** and **153** which correspond with portions **141**, **142** and **143** on roller **140**. Extending from the roller **150**, which may carry detonator or explosive in a bore similar to bore **146** is a latch pin **119** which is adapted, as roller **150** moves downwardly in FIG. 1, to bias resilient latch member **112** open and enter area **109**. Similarly, a latch pin **119'** on roller **140** can enter area **113**. The resilient latch members **112** and **116** interact with hook portions **111** and **115** to prevent movement of the rollers other than that occurring from the travel of latch pins **119** and **119'** within areas **109** and **113**.

Securing rollers **140** and **150** in place are three bands although two may be used. A first band **160** is secured at one end thereof to the inner surface of wall **102** by any suitable means such as screw **161**. Band **160** extends upwardly along wall **102** and around cylindrical portion **141** of roller **140** as at **162** down as at **163** and around cylindrical surface **151** of roller **150** as at **164** and up along the inner surface of wall **123**, around the central cylindrical portion **142** of roller **140** as at **172** which projects outwardly through the elongated vertical slot **118** in wall **102** of housing **100** down as at **173**, around the central cylindrical portion **152** of roller **150** as at **174** which projects outwardly through the elongated vertical slot **117** in wall **103** of housing **100** and up along the recessed area **126** of the inner surface of wall **122** to a point of attachment to the case such as screw **175**.

It is obvious that a third band may be used which would be identical with band **160** and would be in contact with the housing and cylindrical surfaces **143** and **153** of the rollers **140** and **150**.

Wall **124** has an aperture **180** therein by which the explosive and detonator (one of which is carried externally of the case and the other of which is carried by either of the rollers) can align when the mechanism is subjected to a predetermined acceleration in the vertical direction. Obviously, there is a

second aperture (not shown) provided in wall **105** of housing **100**.

The operation of the mechanism comprising the rollers, bands, housing and case is initiated by a positive or negative acceleration in the vertical direction. Any component of acceleration in the vertical direction can actuate the mechanism. Either a linear or centripetal acceleration or a combination of the both will be detected by the mechanism and if the magnitude and duration of the accelerating environment is sufficient, the mechanism will operate and can be used to arm a fuze.

With a vertical component of acceleration the mechanism can be designed such that the case will move downwardly with respect to the housing and the rollers will move upwardly relative to the housing so that the bore of roller **140**, the aperture (not shown) in wall **105** and the aperture **180** in wall **124** will align. When such an alignment occurs, the rollers, housing and case can be held in that position by the proper positioning of the latches within housing **100**.

As an alternative, the mechanism can operate in a reverse manner such that when the housing **100** is subject to an acceleration in the upward vertical direction, the case **120** will accelerate relative to the housing in the upward vertical direction and the rollers will accelerate, relative to housing **100**, in the downward vertical direction. This, of course, is achieved by the direction in which the bands are secured within the case and housing, the tension of the bands and the force exerted by the spring **130**.

When the holes in the case **120** and housing **100** are aligned with the bore of a roller, the detonation train is complete.

The displacement of the rollers relative to the housing does not have to be equal in magnitude to the displacement of the case with respect to the housing. Neither the rollers nor the case need have displacements relative to the housing that are large relative to the motion of the frame.

The band construction can be varied to build in a bias acceleration to the mechanism. This means that no relative motion between the housing, case and rollers will occur when the mechanism is subjected to an acceleration smaller than the bias acceleration. The bias acceleration can be built in by either cutting out portions of the band or by preforming the band or by doing both.

Referring now to FIG. **2**, the mechanism of FIG. **1** is shown in elevation and incorporating a different type of latching means from that shown and described in FIG. **1**.

The wall **124** of case **120** is shown broken away as at **124'** to show wall **105** of housing **100** in FIG. **2**. Wall **105** is shown broken away as at **105''** to show roller **140**. FIG. **4** shows the relationship of these areas of walls **105** and **124** in relation to roller **140**.

As seen in FIG. **2**, a rectangular slot **182** is shown in wall **105**. Mounted on the inner surface of wall **105** is a resilient latch **183** having, as seen in FIG. **4**, a hooking portion **184** which is adapted to ride on the end surface of cylindrical portion **141** of roller **140**.

The particular mechanism shown in FIGS. **2** and **4** is adapted to allow the rollers **140** and **150** to move upwardly upon acceleration in the upward vertical direction. However, the hooking portion **184** of latch **183** is adapted to enter the opening **144** of bore **146** in roller **140** and prevent further downward travel of roller **140** should a band break or the end of a band break loose from either the case **120** or housing **100**.

As seen in FIG. **4**, wall **105** of housing **100** has an aperture **181** which is adapted to align with opening **144** in roller **140** and aperture **180** in wall **124** of case **120**.

To secure the case **120** to housing **100** in case of band breakage, a rectangular opening **185** is provided in housing wall **205** to allow biasing of a resilient latch **186**. The end of latch **186** is attached by any suitable means to the outer surface of wall **105** and the hooking portion **189** of which is adapted to first slide on beveled area **187** on the inside of case wall **124** to bias the latch as the case slides down over the housing and then enter a rectangular locking aperture **188** in casing wall **124**.

To insure against overtravel of rollers **140** and **150** in the upward direction, a rectangular aperture **194** is located on the upper housing wall **105** and allows for biasing of resilient latch **195** having a hooking portion **196**. Portion **196** is adapted to bias inward to engage in the bore of roller **150** to prevent overtravel of the rollers in the upward position. In this sense, latch **195** acts in a manner similar to latch **183**.

A rectangular opening **190** is located on the upper housing wall **105** and allows for biasing of a resilient latch **191** having a hooking portion **192**. Portion **192** is adapted to swing outward to engage in aperture **193** in case wall **124** as the case **120** moves upwardly on housing **100**.

The various latches can be used solely as safety latches, i.e., to prevent any overtravel of the rollers or case in relation to the housing to prevent damage due to band breakage or failure or they can be used to secure the various components in a position whereby the arming apertures, such as **180** and **181** are aligned with the bore of the roller carrying the detonator or explosive.

Both latches **186** and **195** swing inwardly to locking position and latches **186** and **191** swing outwardly to lock.

The bands of the mechanism may be formed to obtain constant force level positive and negative spring constants, second order and higher force curves and detenting actions, in any desired combinations. The bands are constructed of thin metals and may be fashioned so that their thickness and width vary along their length. They also may be cut out in areas to vary the spring modulus.

What is claimed is:

1. A safety and arming mechanism, said mechanism comprising a housing means, said housing means having a base and at least two vertically extending opposing walls, said walls having vertically extending slot means therein, a case means having a top and at least two depending opposing sides, said sides being separated by a distance greater than the space between said walls and said case means telescopingly received over said housing means, a plurality of rotatable members intermediate said walls and movable vertically therein, said rotatable members having a first cylindrical portion of a given diameter and at east one second cylindrical portion of lesser diameter than said first surface, the cross section of said first portions having a combined cross section greater than the spacing between said sides and said second portions having a combined cross section greater than the spacing between said walls, said first cylindrical portions extending through said vertically extending slot means, a first flexible band looped in a substantially S-shaped configuration around said first portions and having each of its ends attached to said sides, respectively, a second flexible band looped in a substantially S-shaped configuration around said second portions and having each of its ends attached to said walls, respectively, said bands being under tension and allowing rolling movement of said members and relative movement between said housing and case upon attainment of a predetermined acceleration and fuze and explosive means associated with said housing, case and rotatable members and adapted to be activated when said housing, case and members attain a predetermined relative position caused by a predetermined acceleration.

2. A mechanism as in claim **1** wherein said rotatable members have a third cylindrical portion, said third portion being of equal diameter with said second portion, and a third flexible band looped around said third portions in a substantially S-shaped configuration and having each of its ends attached to said walls respectively.

3. A mechanism as in claim **2** wherein said second and third portions of each said rotatable member are coaxial with said first portion thereof and are on each side of said first portion.

4. A mechanism as in claim **1** including safety means to prevent movement of said members and arming of said fuze means upon breakage of any of said flexible bands.

5. A mechanism as in claim **4** wherein said safety means includes an opening in one of said housing walls, a resilient latch means protruding through said opening, one of said rotatable members having a receiving means adapted to coact with said

resilient latch means to prevent accidental displacement of said rotatable member within said housing.

6. A mechanism as in claim 4 wherein said safety means includes a first opening in one of said housing walls, a resilient latch means protruding through said opening, a second opening in one of said depending sides vertically aligned with said first opening and adapted to receive said latch means upon accidental displacement of said case relative to said housing.

7. A mechanism as in claim 4 wherein said safety means includes a pin on at least one of said rotatable members, and extending coaxially therefrom, a pin receiving means on said housing, a resilient latch means associated with said pin receiving means and adapted to bias in only one direction so as to allow said pin to enter said receiving means but prevent it from exiting.

8. A mechanism as in claim 1 including a spring means connected to said housing and said case, said spring means along with the tensioned flexible bands determinative of the amount of acceleration necessary to initiate relative movement between said case and housing.

9. A mechanism as in claim 1 wherein said fuze and explosive means includes a charge of explosive and a detonator means, one of said explosive and detonator means being located on said case and the other being associated with one of said rotatable members.

10. A mechanism as in claim 9 wherein one of said rotatable members has a bore therein, said explosive being located within said bore, a first aperture in said housing wall vertically aligned with said bore, a second aperture in the depending side of said case adjacent said housing wall having said first aperture and vertically aligned with said first bore, said detonator means adapted to act through said first and second apertures when they become horizontally aligned with each other and said bore to detonate said explosive upon said mechanism being acted upon by an acceleration.

11. A mechanism as in claim 9 wherein said detonator means is located within said bore and said explosive means is associated externally with said case means.

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