

[54] **CENTRIFUGALLY ARMED FUZE**  
[75] Inventor: William J. Donahue, Takoma Park, Md.  
[73] Assignee: The United States of America as represented by the Secretary of the Navy  
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[51] Int. Cl. ....F42c 15/22  
[58] Field of Search.....102/71, 79, 80

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Primary Examiner—Samuel W. Engle  
Attorney—R. S. Sciascia and J. A. Cooke

[57] **ABSTRACT**

A centrifugally armed fuze having a spring-biased, spin-actuated slider containing a stab detonator. Once armed at a first predetermined rotational velocity, a compound lever system, having two centrifugally responsive sears, restrains a spring-biased firing pin until the spin rate decays to a second (lower) predetermined rotational velocity.

**5 Claims, 4 Drawing Figures**

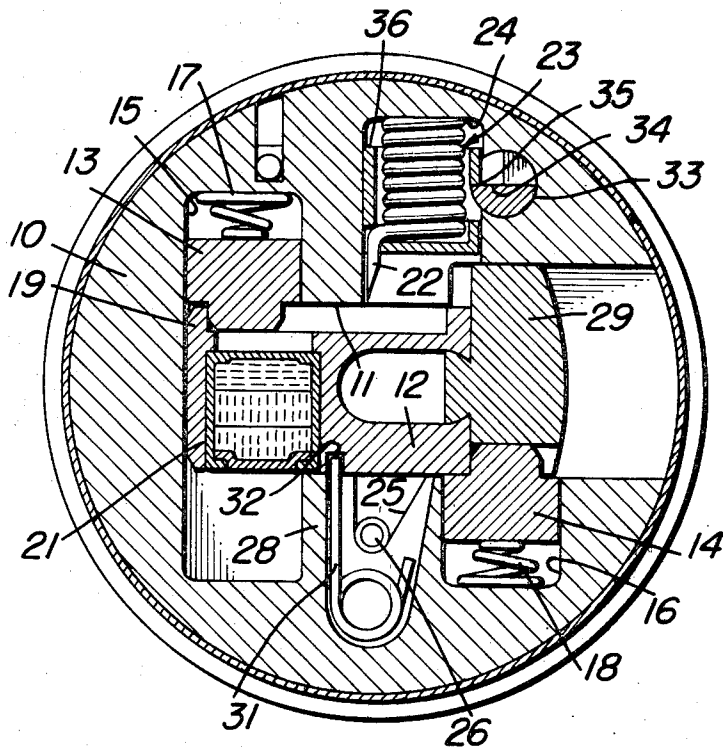


Fig. 1

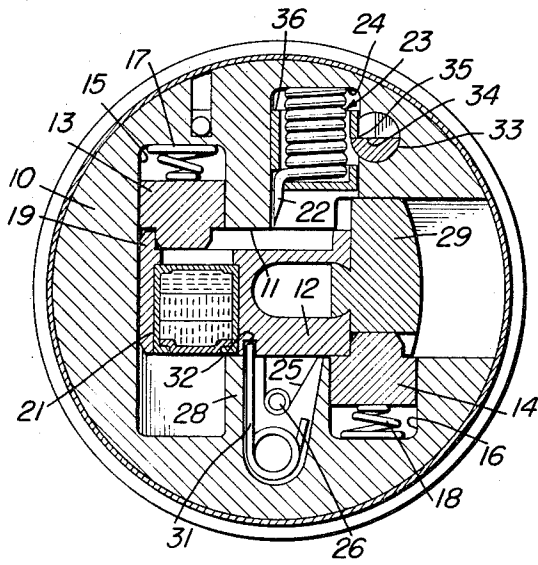


Fig. 2

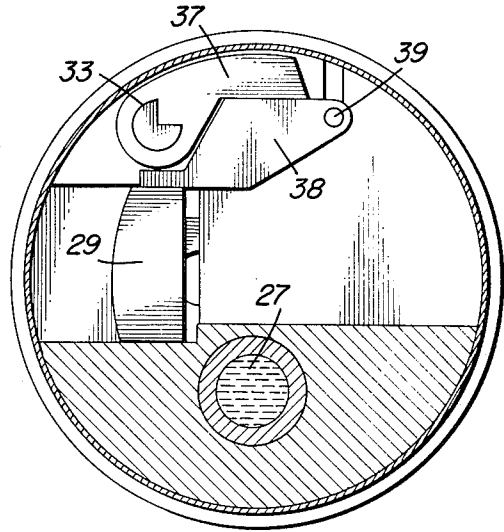


Fig. 3

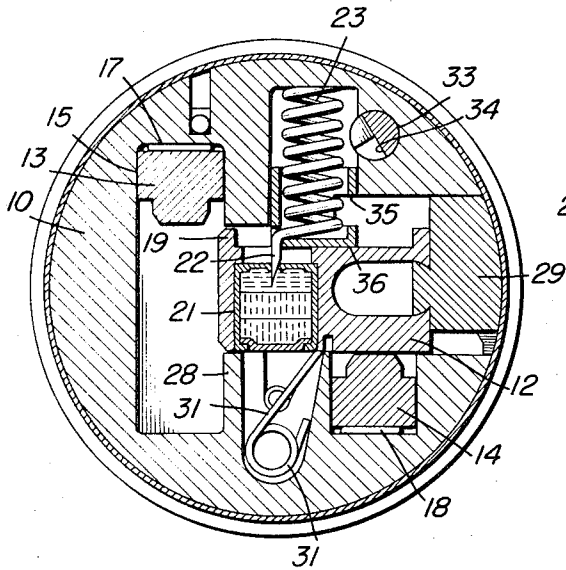
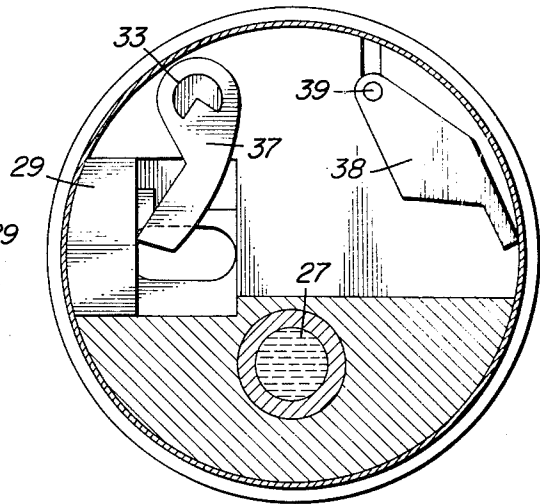


Fig. 4



INVENTOR

William J. Donahue

BY

*Roger J. Erickson*

ATTORNEYS

**CENTRIFUGALLY ARMED FUZE**

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

The present invention relates generally to improvements in ordnance fuzes and more particularly to a new and improved centrifugally armed ordnance fuze capable of detonating upon impact with the target regardless of the orientation of the fuze at the time of impact.

Those concerned with the development of centrifugally armed fuzes have long recognized the need for a fuze which will fire at target impact regardless of the orientation of the fuze with respect to the target, and the present invention fulfills this need. Previously known centrifugally armed fuzes utilize a striker pin located in the nose of the ordnance item or a movable inertial weight for firing the ordnance item upon impact with the target but, for the fuze to function properly in either case, it is critical that the angle of attack of the fuze be within specific narrow limits and proper functioning of the fuze can not be assured unless the fuze is so positioned at impact. In most ordnance applications it would be desirable to incorporate a fuze which will function properly at impact with the target regardless of its orientation at the time of impact, and this characteristic in fact becomes essential in a fuze for use in a free falling bomb or bomblet. The general purpose of the present invention is to provide a centrifugally armed fuze having all of the advantages of the previously known fuzes and yet which is capable of firing upon impact with the target independently of its orientation at the time of impact.

It is therefore an object of the present invention to provide a new and improved fuze for use with a free falling bomb to fire upon impact with the target regardless of its orientation at the time of impact.

Another object of the invention is to provide a centrifugally armed fuze capable of firing upon impact independently of its position at the time of impact.

A further object of the invention is to provide a centrifugally armed fuze for use with small ordnance items and capable of being manufactured in subminiature sizes to thereby increase the amount of explosive charge in the payload of the ordnance item.

Still another object of this invention is to provide a centrifugally armed fuze which is simple in construction and rugged in character and which is efficient and reliable in operation.

Other objects, advantages and novel features of the invention will become readily apparent upon consideration of the following detailed description when read in conjunction with the accompanying drawings in which like reference numerals designate like parts throughout the various figures thereof and wherein:

FIG. 1 is a side elevation of the device of the present invention in accordance with the preferred embodiment thereof, the mechanism being shown in an unarmed or safe condition;

FIG. 2 is a side elevation of the opposite side of the device, the mechanism being shown in an unarmed or safe condition;

FIG. 3 is a view similar to FIG. 1 with the mechanism shown in its armed condition; and

FIG. 4 is a view similar to FIG. 2 with the mechanism shown in its armed condition.

The fuze of this invention is intended for use in a free falling drop bomb or bomblet having aerodynamic fins to induce rotation of the bomblet about an axis. Referring now to FIGS. 1 and 3, the fuze is provided with a cylindrical support block or housing 10 having a radial channel 11 formed therein, said channel extending from one peripheral wall of the support block substantially through the length of the block. A slider 12 is received within the channel for movement therein from a first position to a second position in response to a predetermined centrifugal force, i.e., from an unarmed to an armed position in response to a predetermined centrifugal force. A pair of slider locking detents 13 and 14 are received within a pair of recesses 15 and 16, respectively, formed in the support block and are resiliently biased outwardly of said recesses into abutting contact with the slider by means of helical compression springs 17 and 18. Locking detent 13 is resiliently urged into abutting contact with an upstanding shoulder 19 integrally formed on the slider body while locking detent 14 is resiliently biased into abutting contact with the forward edge of the slider body, to thereby obstruct movement of the slider and releasably lock the slider in its unarmed position.

The slider is provided with a conventional stab detonator 21 of the type normally employed in fuzes and being so constructed as to detonate upon being punctured or pierced by a sharp object, said detonator having three explosive components each of which magnifies or amplifies the magnitude of the initial detonation. A firing pin 22 is resiliently urged into the channel 11 by means of a stored energy compression spring 23 but the firing pin is normally held in a cocked position by a restraining means hereinafter explained. The firing pin and compression spring 23 are received within a firing pin recess 24 formed in said support block and being in communication with the channel 11. The firing pin 22 may be formed by the sharpened end of the helical compression spring 23 or may be a separate element operatively connected to the firing pin housing 36. The firing pin is so mounted in the support block that when the slider is moved from its unarmed position to its armed position, the stab detonator 21 will be positioned directly below the firing pin for actuation thereby. Positioned beneath the firing pin and on the opposite side of said channel 11 is a recess 25 into which extends one end of a mild detonating fuze 26. The mild detonating fuze is so positioned as to receive the detonation generated by the stab detonator 21 upon piercing of said stab detonator by the firing pin 22, the mild detonating fuze being connected to a bell end booster lead-in 27 which is detonated by the mild detonating fuze and amplifies the detonation to a magnitude sufficient to detonate the main explosive charge in the weapon. As seen in FIG. 1, when the fuze is in its unarmed position, the stab detonator 21 is on one side of a barrier wall 28 while the mild detonating fuze 26 is on the opposite side of the barrier wall to prevent a sympathetic detonation of the mild detonating fuze and main charge by the stab detonator in the event that the stab detonator 21 is in some manner actuated before the fuze has gone through its arming cycle.

To enable the slider 12 to move from its unarmed to its armed position in response to centrifugal force developed during the spin of the fuze, it is of course necessary that the center of gravity of the slider be dis-

placed radially from the axis of the fuze and for this reason a slider weight 29 is secured to the slider in the position shown in the drawings. For the same reason, the locking detents 13 and 14 must be positioned in a radially offset position from the axis of the fuze so that the centrifugal force acting upon the mass of the detents will cause the detents to compress the springs and be retracted into the recesses 15 and 16 when subjected to a predetermined centrifugal force. The masses of the slider locking detents 13 and 14 and the spring rates of the compression springs 17 and 18 are so selected that the slider locking detents will be withdrawn into the recesses 15 and 16 at a rotational velocity slightly lower than the rotational velocity required to move the slider from the unarmed to the armed position. As the rotational velocity of the spinning fuze increases to the magnitude necessary to retract the slider locking detents, centrifugal force also acts upon the slider 12 and this force must be counteracted to prevent the slider from pushing the slider locking detents against the walls of their recesses and binding the detents to prevent retraction thereof into their recesses. To perform this function, a torsion spring 31 is positioned within a seat formed in the support block and has one arm thereof extending outwardly therefrom, the end of said arm extending into a shallow recess 32 formed in a side wall of the slider. The spring characteristics of the torsion spring are so selected that the spring will restrain the slider from movement in response to the centrifugal force acting thereupon until the rotational velocity of the fuze has reached a value greater than the rotational velocity required to retract the slider locking detents 13 and 14 into their recesses. After the slider locking detents have been retracted, the increasing rotational velocity of the fuze develops a centrifugal force on the slider sufficient to overcome the power of the spring 31 and the slider is caused to move outwardly in the channel 11, which movement deflects the arm of the spring 31 and withdraws it from the shallow recess 32, the end of the spring arm then engages the outer surface of the slider 12 and functions as a ratchet to lock the slider in its armed position.

After the slider has been moved to its armed position, the firing pin is still restrained from contact with the stab detonator by means of a shaft 33 rotatably mounted within the support block and having an arcuate sector removed therefrom to define a flat shoulder 34 which engages a slot or recess 35 formed in a firing spring housing 36. The firing pin compression spring 23 is maintained in its compressed condition by means of the engagement of shoulder 34 with the slot 35 in the firing spring housing and release of the firing pin may only be accomplished by rotation of the shaft 33 in a counterclockwise direction as viewed in FIGS. 1 and 3. Rotational movement of the shaft 33 is controlled by a mechanism positioned on the back side of the cylindrical fuze housing and more clearly illustrated in FIGS. 2 and 4. The stored energy spring 23 acts upon the shaft 33 by means of the spring housing 36 to urge the shaft 33 for rotation in a counterclockwise direction as viewed in FIGS. 1 and 3, which motion would be a clockwise motion as viewed in FIGS. 2 and 4. Fixedly mounted upon the shaft 33 for rotation therewith is a first sear 37 for cooperation with a second sear 38

which is pivotally mounted on a shaft 39, the axis of the shaft 39 being parallel to the axis of shaft 33. Clockwise movement of the sear 37 under the force of the firing pin compression spring 23 is obstructed by sear 38 which is prevented from movement by means of an abutting contact with the slider weight 29 when the slider is in its unarmed position. When the fuze has been subjected to a rotational velocity sufficient to cause the slider to move to its armed position, the slider weight 29 is moved out of contact with the sear 38 thus freeing the sears 37 and 38 for movement by the force exerted by the firing pin compression spring 23. The sears 37 and 38 are pivotally mounted at their ends and have their centers of gravity displaced from their pivotal axis to thereby form a compound lever system acting upon the shaft 33 in such a manner that the centrifugal forces exerted upon the sears 37 and 38 produce a moment of force upon the shaft 33 in a direction opposite to the moment of force produced by the firing pin compression spring 23. The spring characteristics of the compression spring 23 and the masses and dimensions of the sears 37 and 38 are so designed that the centrifugal forces developed by the sears 37 and 38 will be greater than the force of the spring 23 upon the shaft until the rotational velocity of the fuze has diminished to a predetermined value below the rotational velocity at which arming occurs. At this predetermined rotational velocity which is lower than the arming velocity, the force of the firing pin compression spring overcomes the centrifugal forces developed by the sears 37 and 38 and thereby rotates the sears to the positions shown in FIG. 4, and permits rotation of the shaft 33. Rotation of shaft 33 releases the firing spring housing 36 from its abutting contact with shoulder 34 and thus permits the spring 23 to thrust the firing pin 22 into the stab detonator 21, as shown in FIG. 3.

From the foregoing it may be seen that the fuze of this invention operates as follows: When the free falling bomb or bomblet is dropped, the rotational velocity of the bomblet and the fuze contained therein increases from zero to a magnitude in excess of the rotational velocity required for arming. Prior to the attainment of the arming rotational velocity, the slider locking detents retract and release the slider for movement from its unarmed position to its armed position upon attainment of a predetermined rotational velocity. When the slider moves to its armed position, the stab detonator is brought into alignment with the firing pin and the mild detonating fuze lead-in charge and is prepared for detonation in response to a predetermined decay in the spin rate of the fuze. The firing pin is, however, held in its cocked position by means of the shoulder 34 on the shaft 33 engaging the firing pin compression spring housing. The firing pin will be maintained in its cocked position by means of the centrifugal forces acting upon the sears 37 and 38 until the rotational velocity of the fuze diminishes to a predetermined magnitude below the arming rotational velocity, at which time the firing pin compression spring will overpower the centrifugal forces upon the sears and thus drive the firing pin into the stab detonator.

It is apparent that the fuze of this invention is simple in construction but reliable in operation since it eliminates the need for any point detonating striker

pins or inertial weights arranged for movement upon impact with the target. The decay in the rotational velocity required to fire the fuze of the present invention occurs when the weapon hits the target. The particular structural elements employed in this invention and their arrangement in a new and novel manner produce a fuze which is extremely reliable and yet is designed in such a manner as to lend itself readily to manufacturing in subminiature sizes to thereby decrease the volume occupied by fuze in small weapons and thus maximize the destructive capabilities of the weapon by increasing its explosive payload. To avoid sympathetic detonation of the lead-in charge by the stab detonator, safety requirements necessitate a predetermined minimum separation distance between the lead-in charge and the stab detonator, and the use of a mild detonating fuze as the lead-in charge maintains the safety separation distance but minimizes the volume occupied by the lead-in charge and thus further miniaturizes the fuze. By varying the masses of the slider, slider weight, sears and sear dimensions, locking detents, as well as the spring rates of the various resilient bias springs, the amount of spin rate decay required for firing of the fuze may be varied so that the fuze may either be designed to fire instantaneously upon impact or alternatively, by designing the fuze to have a greater spin rate decay, a delayed action may be induced which would cause the bomblet to bounce and fire above ground for increased fragmentation effects against ground personnel.

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.

Having thus described the invention, what is claimed is:

1. A fuze for arming a weapon in response to a predetermined rotational velocity and for firing the weapon in response to a predetermined decrease in rotational velocity below the arming velocity comprising,

a support block rotatable about an axis and having a radial channel formed therein,

a slider received within said channel for movement therein from an unarmed position to an armed position,

said slider having its center of gravity displaced radially from the axis of said block,

slider locking means for restraining said slider in said unarmed position and for releasing said slider for movement to said armed position in response to a first predetermined rotational velocity,

a firing pin resiliently biased toward its firing position by a stored energy spring,

a stab detonator mounted with said slider for movement therewith and being non-aligned with the firing pin when said slider is in said unarmed position and being aligned with the firing pin when the slider is in said armed position,

firing pin restraining means for preventing movement of the firing pin until said slider has moved to said second position and said fuze is rotating at a second predetermined rotational velocity which is less than said first predetermined rotational velocity, said firing pin restraining means including

a shaft mounted for rotation within said block and having a flat surface formed thereon to engage a firing pin housing,

a first sear fixedly secured to said shaft for rotation therewith and having its center of gravity displaced from the axis of said shaft, and

means engaging said first sear for preventing movement of said first sear when the slider is in said unarmed position and for releasing said first sear for movement by said stored energy spring when the slider is in said armed position, said means for preventing movement of said first sear comprising

a second sear pivotally mounted at one end thereof upon said support block about an axis parallel to the axis of said shaft,

said second sear being positioned between and contacting each of said first sear and a slider weight,

whereby movement of said sears is prevented by said slider weight until said slider has been moved to its armed position,

whereby the fuze arms in response to a predetermined rotational velocity and fires upon a predetermined decrease in rotational velocity below the arming velocity upon impact with the target irrespective of the orientation of the fuze at the time of impact.

2. A fuze for firing a weapon in response to a decrease in its rotational velocity from a first predetermined value to a second predetermined value comprising,

a firing pin resiliently biased toward a firing position, a rotatable shaft having a flat surface formed thereon (to engage said firing pin) for restraining said firing pin when said shaft is in its initial position,

a first sear fixedly secured to said shaft for rotation therewith, said first sear having its center of gravity displaced from the axis of said shaft,

a second sear pivotally mounted at one end thereof about an axis parallel to the axis of said shaft, said second sear being positioned between and contacting each of said first sear and a slider,

whereby movement of said sears, and thereby said shaft, is prevented by said slider until said fuze is armed at a rotational velocity of said first predetermined value and, thereafter, by centrifugal forces acting upon said sears until the rotational velocity decreases from said first predetermined value to said second predetermined value.

3. The fuze of claim 2 wherein said first sear and said second sear cooperate to form a compound lever system acting upon said shaft in such a manner that the centrifugal forces exerted upon said sears produce a moment of force upon said shaft in a direction opposite to the moment of force produced by said resiliently biased firing pin.

4. A fuze for firing a weapon in response to a decrease in its rotational velocity from a first predetermined value to a second predetermined value comprising,

a firing pin resiliently biased toward its firing position,

a first pivotally mounted sear having its center of gravity displaced from its pivotal axis,

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a second pivotally mounted sear having its center of gravity displaced from its pivotal axis, said second sear being so positioned with respect to said first sear as to bear against said first sear and thereby form (a) an interdependent compound lever system therewith, whereby the centrifugal forces exerted upon said sears may produce a moment of force upon a shaft in a direction opposite to a moment of force which

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may be produced by said resiliently biased firing pin.

5. The fuze of claim 4 wherein said first sear is fixedly secured to a rotatable shaft whereby the centrifugal forces exerted upon said sears produce a moment of force upon said shaft in a direction opposite to a moment of force which may be produced by said resiliently biased firing pin.

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