Aug. 25, 1959 E. BURRELL 2,900,908

CENTRIFUGAL SAFETY DEVICE FOR A PROJECTILE FUZE

Filed Oct. 7, 1949

Fig. 1

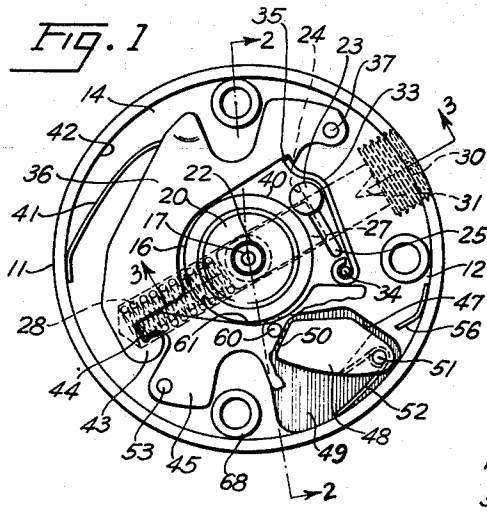


Fig. 2

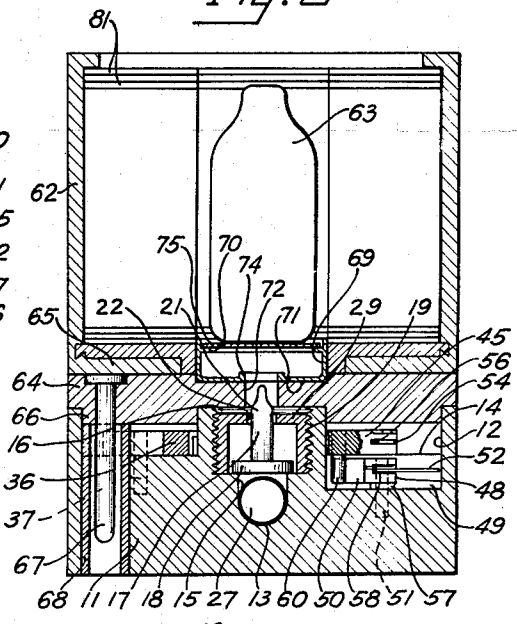


Fig. 3

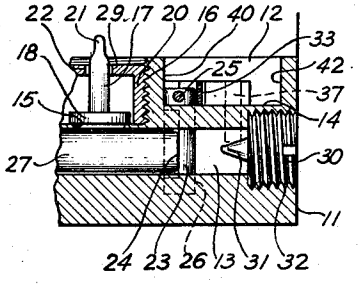


Fig. 4

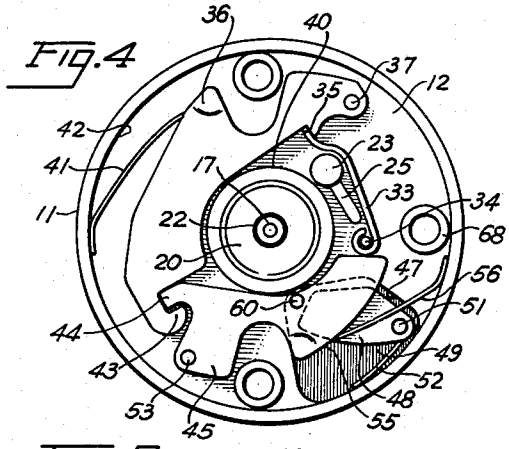


Fig. 5

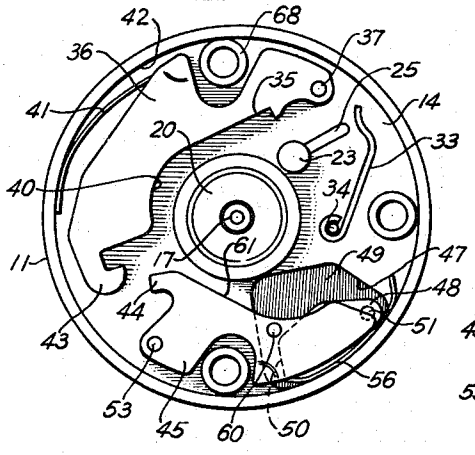
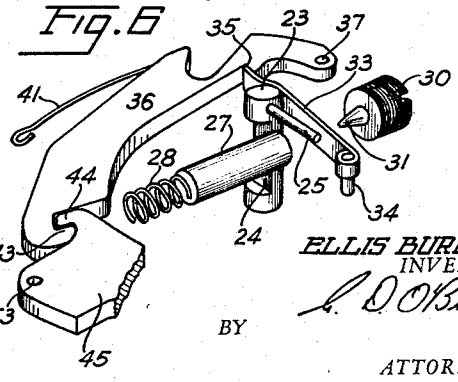


Fig. 6



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United States Patent Office

2,900,908

Patented Aug. 25, 1959

2,900,908

CENTRIFUGAL SAFETY DEVICE FOR A PROJECTILE FUZE

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Application October 7, 1949, Serial No. 120,051

5 Claims. (Cl. 102—70)

This invention relates to a fuze for projectiles, and more particularly to a centrifugally operated safety device which will provide a positive lock against accidental detonations in handling mechanically detented fuzes.

In electric fuzes dependent upon deferred action type batteries to supply electrical energy, the electrolyte for the cells is usually contained in a rupturable ampule mounted above a rupturing pin upon a compression spring or other means strong enough to hold the ampule away from the pin during normal handling or accidental dropping of the fuze, but weak enough to allow the force of inertia or setback, when a projectile is fired from a gun for example, to cause the ampule to collide with the rupturing pin. However, when electric fuzes are used in rockets or mortar shells, the initial force of setback is not always sufficient to shatter the ampule. To ensure the release of the electrolyte to the battery plates a percussion type detonator fired when the rocket or projectile attains a predetermined angular velocity is utilized to rupture the ampule if it should fail to break upon setback. Before the projectile is fired mechanical detents hold a spring actuated percussion detonator away from a firing pin in active bolting position. The detents are held in place against the restraining action of springs until the projectile attains sufficient angular velocity to cause the detents to fly outward under the influence of centrifugal force and release the detonator against the firing pin.

For the protection of personnel the mechanical detents are contoured to interlock and prevent motion thereof in an outward direction if the fuze is dropped or receives a sudden jar or shock, but to allow free movement of the detents under spin conditions against the restraining action of springs. However, the tolerances allowable in the manufacture of the detents are critical if interlocking only is relied upon to prevent outward movement thereof every time a fuze is jolted, and in the past detents have been jarred open when a fuze has been dropped on a non-resilient surface, allowing the detonator to be released against the firing pin. This danger is particularly acute in fuzes designed for use in low-spin projectiles which never attain high rotational speeds. In mortar shells, which seldom spin at rotational velocities above sixty-five revolutions per second, the springs which restrain the mechanical detents from outward rotation under the influence of centrifugal force must be considerably weaker than similar springs provided in fuzes for projectiles which rotate at several hundred revolutions per second in flight. Consequently it is much easier for the detents to be jolted open in the fuzes of low spin projectiles, and in the past it has not been perfectly safe to handle such mechanically detented fuzes.

It is an object of this invention to provide a positive lock to prevent outward movement of centrifugal action mechanical detents no matter how hard a fuze is jolted or jarred in handling.

It is a further object of the invention to provide novel safety means which will ensure a positive safeguard

against accidental detonations in mechanically detented electric fuzes.

In accordance with the present invention the danger of accidental firing of a detonator has been eliminated by the addition of a safety detent to the combination of a main detent and auxiliary detent heretofore provided. The centrifugal force required to rotate the safety detent in an outward direction against the restraining action of its spring is less than the force required to move either the auxiliary detent or the main detent. If the jolt to the fuze during handling is insufficient to move the auxiliary detent, the safety detent can rotate to its operated position and return without movement of the auxiliary detent. Under spin conditions the safety detent can rotate to its operated position before the auxiliary detent moves. However, if an intense jolt or jar is given to a fuze during handling, any movement of the auxiliary detent will cause an interference between this lever and the safety detent, thereby absolutely locking both detents.

Other objects and advantages of the invention will be apparent from the following description taken in connection with the accompanying drawings which form a part hereof.

In the drawings:

Fig. 1 is a plan view of a safety device constructed in accordance with and embodying a preferred form of the invention in which a part of the auxiliary detent has been cut away;

Fig. 2 is a vertical sectional view through a partial fuze assembly comprising a deferred action type battery of annular plates and the safety device of Fig. 1 with the section through the safety device taken along line 2—2 of Fig. 1;

Fig. 3 is a vertical sectional view taken radially along line 3—3 of Fig. 1;

Fig. 4 is a plan view similar to Fig. 1 showing the detents in the normal unoperated positions;

Fig. 5 is a plan view similar to Fig. 4 showing the detents in the operated positions; and

Fig. 6 is a perspective view with the casing in which the elements are mounted removed illustrating means for holding a spring actuated percussion detonator away from a firing pin until sufficient angular velocity is attained to cause the detents to move outward against the restraining action of their springs.

In Figs. 1, 2 and 3 similar reference numerals refer to similar details. The illustrative embodiment of the invention shown includes a cylindrical casing 11 machined with an annular groove 12 in the top surface thereof. A hole 13 drilled diametrically through the lower portion of the casing 11 normal to the axis thereof and below the floor 14 of the groove 12 extends almost through the casing 11. A second hole 15 bored axially in the top surface of the casing 11 to intersect the hole 13 perpendicularly is counterbored at the upper end thereof to form a cylindrical cavity 16. A breaker pin 17, T-shaped in cross section, is located in the cavity 16 with the circular flange 18 thereof seated against the bottom of the cavity 16 and covering the hole 15. A screw thread 19 is tapped in the circumference of the cylindrical cavity 16 to receive a threaded cup-shaped insert 20 which is screwed in inverted position into the cavity 16 with the stem 21 of the breaker pin 17 extending through a clearance hole 22 drilled axially in the transverse section 29 of the insert 20. The diameter of the flange 18 is slightly less than the inner diameter of the cavity provided in the cup-shaped insert 20, allowing the breaker pin 17 to move upward under the influence of expanding gases from the firing of a detonator until the flange 18 strikes against the transverse section 29.

The exterior periphery of a cylindrical releasing shaft 23 is milled to provide a flat surface 24 (best shown in

Figs. 3 and 6) in the plane of the axis thereof, and a pin 25 is affixed near the top of the releasing shaft 23 normal to the axis thereof and parallel to the flat surface 24. A hole 26 of slightly larger diameter than the releasing shaft 23 drilled vertically downward in the floor 14 partly intersects the hole 13 perpendicularly. When the releasing shaft 23 is positioned in the hole 26 with the pin 25 perpendicular to the axis of the hole 13, the flat surface 24 partly obstructs the hole 13. In an assembled fuze the flat surface 24 holds a spring actuated percussion detonator 27 in active bolting state in the hole 13 away from a firing pin. In the assembling operation for the fuze a helical spring 28 is first inserted in the hole 13, a cylindrical detonator 27 is then forced into the hole 13 against the compression of the spring 28, and the releasing shaft 23 is then inserted in the hole 26 and rotated until the pin 25 is perpendicular to the axis of the hole 13. The detonator 27 is thus held in active bolting state abutting against the flat surface 24 and subject to the stresses in the compressed spring 28.

A threaded screw 30 formed with a conical firing point 31 in the end thereof is screwed into a thread 32 tapped in the end of the hole 13. The detonator 27 can be fired by allowing the stresses transmitted from the compressed spring 28 to rotate the releasing pin 23 from its normal position (shown in Fig. 4) to its operated position (shown in Fig. 5), thereby releasing the percussion detonator 27 against the firing point 31. The expanding gases from the burning powder transmitted through the hole 15 will force the breaker pin 17 upward until the flange 18 strikes against the transverse section 29 of the insert 20 to shatter the glass ampule 63 (shown in Fig. 2). The releasing shaft 23 is held in its normal position with the flat surface 24 perpendicular to the axis of the hole 13 by a trigger 33 which is pivoted at one end on a pin 34 mounted in the floor 14 and secured at the opposite end in a lip 35 formed in the main detent 36. The main detent 36 is pivoted at one end on a pin 37, and in its normal unoperated position it is held against the inner wall 40 of the annular groove 12 by a wire spring 41. The weight of the spring 41 is closely held to allow accurate setting of the angular velocity at which the main detent 36 will move to its operated position against the outer wall 42 of the annular groove 12. When the main detent 36 is rotated to its operated position, the edge of the lip 35 is moved past the end of the trigger 33, allowing the trigger 33 and the releasing pin 23 to rotate from their normal positions (shown in Figs. 4 and 6) under the stresses transmitted from the compressed spring 28 to their operated positions (shown in Fig. 5), thereby releasing the detonator 27 against the firing point 31.

At the end opposite the pin 37 the main detent 36 is formed with a hook-shaped portion 43 which engages an inverted-hook shaped end 44 of the auxiliary detent 45 to provide an interlock which should prevent outward motion of either the main detent 36 or the auxiliary detent 45 if the fuze is jarred or dropped. However, if the contours of the engaging hook-shaped elements are not held to critical tolerances, it is sometimes possible to jar the main detent 36 and the auxiliary detent 45 open to their operated positions, allowing the releasing shaft 23 to release the detonator 27 against the firing point 31. This danger of injury to gun crew personnel is present particularly in fuzes for rockets or mortars having low rotational velocities which must be designed to have comparatively weak springs to restrain the mechanical detents against outward motion.

This invention is not directly concerned with the contours of the interlocking surfaces of the auxiliary detent 45 and the main detent 36, nor with the means of releasing the detonator 27 when the main detent 36 moves to its operated position under spin conditions, all of which are well known. The present invention is embodied in a novel safety arrangement whereby an additional safety detent 48 prevents outward motion of the auxiliary detent 45 to its operated position no matter how hard the fuze is jolted in handling.

In the preferred embodiment of the invention a cavity 49 approximately trapezoidal in outline is broached in the floor 14 between the inner wall 40 and the outer wall 42. A flat oblong safety detent 48 formed with a flat edge 50 at one end thereof is pivoted at the opposite end on a pin 51 mounted in the floor of the cavity 49 near the outer wall 42. The safety detent 48 is formed with a slot 58 in the edge at the pivoted end thereof, and a wire spring 52 coiled around the pin 51 in the slot 58 normally maintains the safety detent 48 against the side wall 47 of the cavity 49. A thin washer 57 assembled over the pin 51 beneath the safety detent 48 prevents temporary locking of the safety detent 48 in intimate contact against the floor of the cavity 49, or "freezing," under the high inertial forces encountered upon setback.

The auxiliary detent 45 is pivoted near the hook-shaped end 44 thereof on a pin 53 mounted in the floor 14 near the outer wall 42. A slot 54 is provided in the edge 55 of the auxiliary detent 45, and a wire spring 56 is clamped in the slot by pinching the flat surfaces at the edge 55. The spring 56 normally maintains the auxiliary detent 45 against the inner wall 40. A pin 60 extending vertically downward into the cavity 49 is mounted on the lower flat surface of the auxiliary detent 45 near the inner edge 61. In the normal position of the auxiliary detent 45 the pin 60 is adjacent the flat edge 50 of the safety detent 48.

The force of the spring 52 restraining the safety detent 48 from outward rotation is less than the restraining force of the spring 56 tending to keep the auxiliary detent 45 in its normal position. Thus, if only a slight jolt or jar is given to a fuze, the safety detent 48 can rotate against the restraint of the spring 52 to its operated position (as shown in Fig. 5) and return without movement of the auxiliary detent 45. When a projectile containing the safety means embodying the invention is fired, the inertial forces of setback "freeze" the main detent 36 and the auxiliary detent 45 against the floor 14 and prevent outward movement of either. The thin washer 57 holds the lower face of the safety detent 48 away from the floor of the cavity 49 and prevents "freezing" of the safety detent 48 upon setback. The safety detent 48 is thus free to rotate outward to its operated position under initial spin conditions before the auxiliary detent 45 moves at all. However, if a drop of or jar to a fuze during handling is of great enough magnitude to rotate the auxiliary detent 45, the initial motion of the auxiliary detent 45 will cause an interference between the pin 60 and the flat edge 50 of the safety detent 48, thereby absolutely locking both levers. A positive lock in thus formed by contact between the pin 60 in the auxiliary detent and the flat edge 50 of the safety detent 42 to prevent outward rotation of either detent no matter how hard the fuze is jolted.

Fig. 2 illustrates the location of safety means embodying the invention with relation to a deferred action type of battery made up of a stack of annular battery plates 81 around which a jacket of plastic 62 has been molded. A rupturable ampule 63 containing electrolyte is assembled within the cylindrical compartment formed by the apertures in the plates 81. A molded disk 64 of insulating material is positioned against the lower end 65 of the plastic jacket 62 with a downwardly extending annular ridge 66 formed on the bottom surface thereof disposed between the upper edges of the inner wall 40 and the outer wall 42 and with metal plugs 67 molded in the disk 64 extending vertically downward into sleeves 68 of insulating material which extend through the cylindrical casing 11 parallel to the axis thereof. The metal plugs 67 allow electrical connections to be conveniently made from the battery to fuze elements below the casing 11 by the insertion of jacks (not shown) formed to receive the plugs 67 into the lower end of the sleeves 68.

A cup-shaped member 69 provided with an inwardly extending circular shoulder 70 along the inner circumference near the open end thereof is positioned within the cylindrical compartment formed by the apertures in the plates 81 with the bottom closed end thereof fitting into a circular recess 71 molded in the upper face of the disk 64. An aperture 72 large enough to receive the stem 21 of the breaker pin 17 is provided axially through the disk 64 and the cup-shaped member 69. An annular breaker ridge 74 of larger diameter than the aperture 72 is provided on the upper surface of the closed end of the cup-shaped member 69. A thin circular flexible disk 75 of slightly larger diameter than the cup-shaped member 69 at the shoulder 70 is seated on the circular shoulder 70. In an assembled fuze the rupturable ampule 63 rests upon the flexible disk 75 which is rigid enough to keep the ampule 63 away from the breaker ridge 74 during normal handling or dropping of the fuze. However, the high inertial forces of setback acting on the ampule 63 are sufficient to bend the flexible disk 75 until it comes off the shoulder 70, allowing the ampule 63 to collide against the breaker ridge 74.

If the impact upon setback is insufficient to rupture the ampule 63 against the breaker ridge 74, the expanding gases from the firing of the detonator 27 will cause the breaker pin 17 to shatter the ampule 63. The mechanical detents will fly outward when the desired rotational velocity has been reached, releasing the detonator 27 to fire against the firing point 31. The expanding gases from the burning powder transmitted through the hole 15 will force the breaker pin 17 upward with the stem 21 extending through the aperture 72 to rupture the ampule 63.

Reference may now be had more particularly to Fig. 4, which depicts the detents and detonator releasing means in their normal unoperated positions, and to Fig. 5, which illustrates the same members in their operated positions after a projectile has attained sufficient angular velocity to cause the detents to fly outward under the influence of centrifugal force. If a fuze containing the preferred embodiment of the invention is dropped or jolted, the pin 60 mounted in the auxiliary detent 45 will contact the flat edge 50 of the safety detent 48 and will prevent motion of either detent. If a projectile containing the fuze is fired from a gun, the inertial forces of setback will "freeze" the main detent 36 and the auxiliary detent 45 against the floor 14, but as the thin washer 57 provides a clearance between the lower face of the safety detent 48 and the floor of the cavity 49, the safety detent 48 does not "freeze" against the floor of the cavity 49, and centrifugal force will cause the safety detent 48 to rotate outward to its operated position against the restraining force of the weaker spring 52 before the projectile attains sufficient angular velocity to move the auxiliary detent 45 against the restraining force of the stiffer spring 56. When the projectile attains sufficient angular velocity, the auxiliary detent 45 rotates outward, releasing the inverted-hook-shaped end 44 from the hook-shaped portion 43 of the main detent 36. The main detent 36 is then free to rotate to its operated position against the outer wall 42 when the influence of centrifugal force is sufficient to overcome the restraining force of the spring 41. Outward movement of the main detent 36 releases the trigger 33 from the lip 35 and allows the compressive stresses in the spring 28 to rotate the releasing shaft 23 and the trigger 33 to their operated positions (shown in Fig. 5) to release the percussion detonator 27 against the firing point 31. The expanding gases from the detonation transmitted through the hole 15 force the breaker pin 17 upward to shatter the ampule 63.

In Fig. 6 the normal unoperated positions of the detonator releasing means are shown diagrammatically in perspective with the casing 11 in which the elements are mounted removed.

It is believed to be evident from the foregoing description and the drawings that the invention consists of a novel safety device that removes a dangerous hazard to personnel handling mechanically detented electric fuzes. The prime advantage of the invention lies in the fact that a positive lock is formed between the safety detent and the auxiliary detent which will prevent firing of the detonator no matter how hard the fuze is jolted or how far it is dropped in handling, yet under spin conditions will allow free outward movement of the safety detent 48 to clear the path for movement of the auxiliary detent 45. It should be obvious to those skilled in the art that the embodiment of the invention described is easily adaptable to fuzes wherein the safety mechanisms consist of members which interrupt a flash passage and are movable to an inoperative or armed position under the influence of centrifugal force during flight of the projectile.

While the embodiment of the present invention as herein described constitutes a preferred form, it is to be understood that other forms might be adopted all coming within the scope of the claims which follow. It is evident that the combination of the safety detent with a single detent adapted to prevent firing of a detonator in its normal unoperated position would also provide a positive safeguard against accidental detonations.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. In projectile fuze safety means to prevent firing of a detonator during handling, the combination with a spring restrained main detent pivotably mounted to rotate outward under the influence of centrifugal force from a normal first position wherein said main detent holds a spring actuated percussion detonator away from a firing pin to a second position in which said detonator is released, and a spring restrained auxiliary detent pivotably mounted to rotate outward under the influence of centrifugal force from a normal first position wherein said auxiliary detent interlocks with said main detent to prevent outward motion of both detents to a second position in which said main detent is free to rotate outward, of a safety detent restrained against outward rotation by a spring weaker than the spring restraining said auxiliary detent and having a normal first position in which said safety detent interferes with said auxiliary detent to prevent outward motion of said auxiliary detent and a second position wherein said auxiliary detent is free to move outward, said safety detent being pivotably mounted to rotate outward to the second position under the influence of centrifugal force before said auxiliary detent moves outward to its second position, and means for positively locking all of said detents against outward movement to their second positions when the fuze is subjected to an abnormal force tending to move said auxiliary detent toward its second position prior to movement of said safety detent to its second position by positively locking said auxiliary and said safety detents against outward rotation to their second positions, said means including a stop member on said auxiliary detent and an abutting surface on said safety detent.

2. Fuze safety means to prevent release of a spring actuated percussion detonator against a firing pin during handling, comprising a flat horizontal main detent pivotably mounted to rotate outward from a normal first position wherein said main detent engages said detonator to a second position wherein said detonator is released, spring means for restraining the outward rotation of said main detent from the first position, a horizontal flat auxiliary detent pivotably mounted at one end to rotate outward under the influence of centrifugal force from a normal first position wherein said auxiliary detent interlocks with said main detent to prevent outward rotation of both detents to a second position in which the main detent is free to rotate outward, said auxiliary detent having a vertical pin affixed thereto away from the pivoted

end, spring means for restraining the outward rotation of said auxiliary detent from the first position weaker than said spring means of said main detent, a horizontal flat safety detent formed with a flat edge at one end thereof and pivoted at the end opposite said flat edge, and spring means, weaker than said spring means for said auxiliary detent, for restraining the outward rotation of said safety detent under the influence of centrifugal force from a first position, where said flat edge interferes with outward rotation of said pin to prevent outward rotation of said auxiliary detent to its second position, to a second position wherein said auxiliary detent is free to rotate outward to its second position, said auxiliary detent being adapted to cause said pin to bind against said flat edge to lock both said auxiliary and said safety detents against outward rotation to their second positions when the fuze is subjected to an abnormal force tending to move said auxiliary detent toward its second position prior to movement of said safety detent to its second position.

3. In a safety device for a projectile fuze in which a plurality of pivoted detents interlock in their safety positions and are adapted to swing outwardly from their safety positions consecutively to inoperative positions and the last detent when in its safety position prevents release of a spring-actuated detonator against a firing pin, the combination with said detents of a plurality of spring means, one for each detent, of successively smaller restoring force from the last to the first of said detents for urging said detents into their safety positions to restrain them against outward movement under the influence of centrifugal force, and safety means including a pivotal detent normally engaging a depending member on one of said plurality of detents for locking all of said detents against movement to their inoperative positions when the fuze is subjected to any force other than said centrifugal force.

4. In a projectile fuze having a firing pin and a detonator spring-biased toward said firing pin, safety means comprising a plurality of pivotably mounted detents, means for interlocking said detents in their safety positions and for allowing outward rotation of said detents to their inoperative positions only in consecutive order, the last of said detents when in its safety position locking said detonator against movement toward said firing pin, and a plurality of spring means, one for each detent, of successively smaller restoring force from the last to

the first of said detents, for urging said detents into their safety positions to restrain them against outward movement under the influence of centrifugal force, the first of said detents having a portion thereof engaging a depending member on the second of said detents for normally maintaining said detents in said interlocked relation and preventing movement to their inoperative positions when the fuze is subjected to any force tending to move any one of the detents toward its inoperative position prior to the movement of the preceding detent cooperating therewith.

5. In a projectile fuze having a detonating mechanism comprising a firing pin, a percussion detonator spring-biased toward said firing pin, a plurality of pivotal detents arranged in a normally interlocked relation to prevent movement of said detonator toward the firing pin and adapted to be moved successively by a predetermined centrifugal force to release positions, one of said detents having a depending member, safety means including a pivotal detent arranged in a plane parallel to the plane of said plurality of detents and spaced vertically therefrom and having a portion thereof adapted in a normal position to engage said depending member for maintaining said plurality of detents in said interlocked relation and adapted to be rotated by said centrifugal force to a release position in which said portion is disengaged from said depending member to permit said plurality of detents to move to said release positions in which said last detent frees said detonator, and spring means for maintaining the pivotal detent of said safety means in said normal position and permitting movement thereof to said release position by said predetermined centrifugal force and for maintaining said plurality of detents in said interlocked relation upon application to the fuze of any other force tending to move said detents.

References Cited in the file of this patent

UNITED STATES PATENTS

896,135	Meigs	Aug. 18, 1908
932,173	Rausenberger	Aug. 24, 1909
2,073,250	Morpeth	Mar. 9, 1937
2,396,987	Christian	Mar. 19, 1946
2,421,271	Kiang	May 27, 1947

FOREIGN PATENTS

216,189	Switzerland	Nov. 17, 1941