March 18, 1958 N. CZAJKOWSKI 2,826,992

SAFETY DEVICE FOR LOW SPIN PROJECTILES

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FIG. 1.

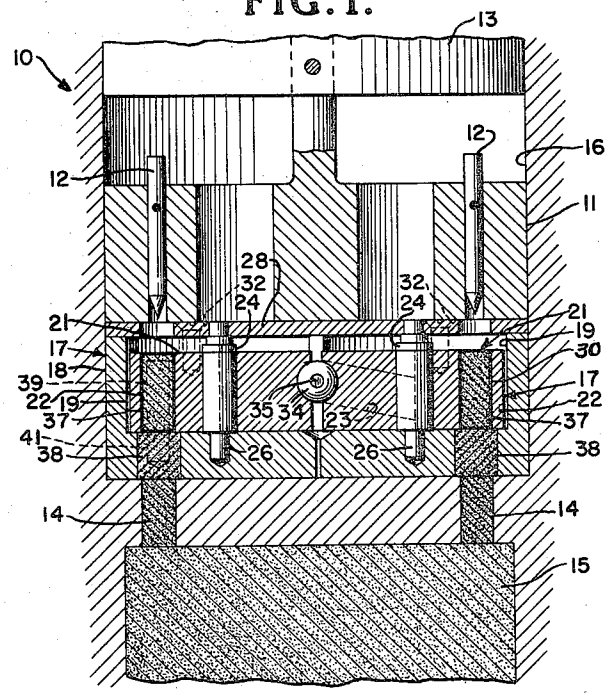


FIG. 4.

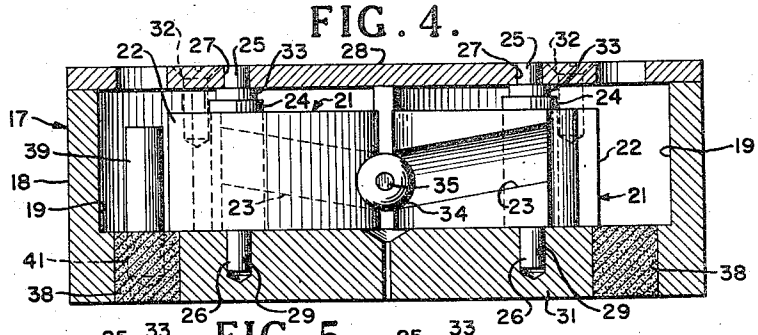
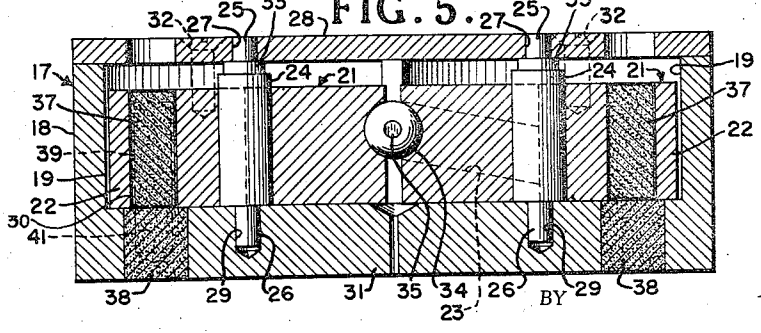


FIG. 5.



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FIG. 2.

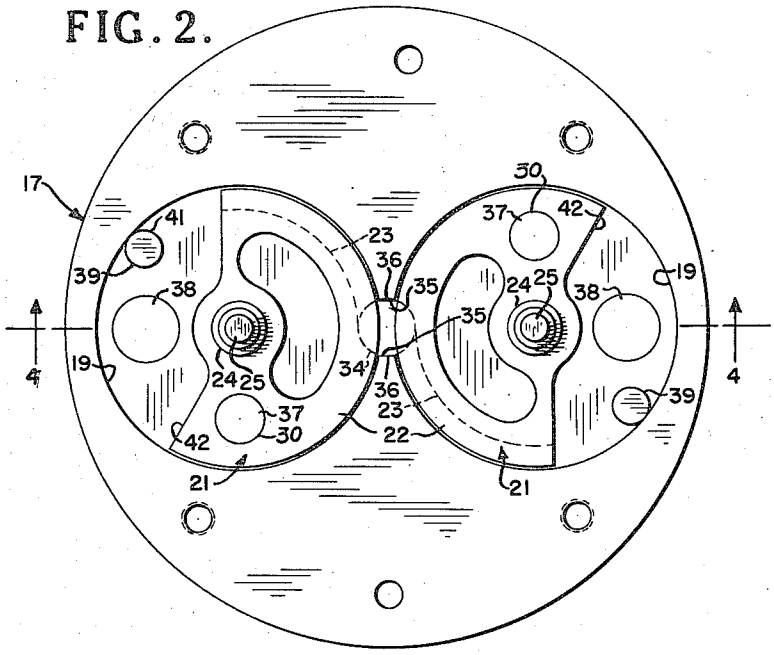
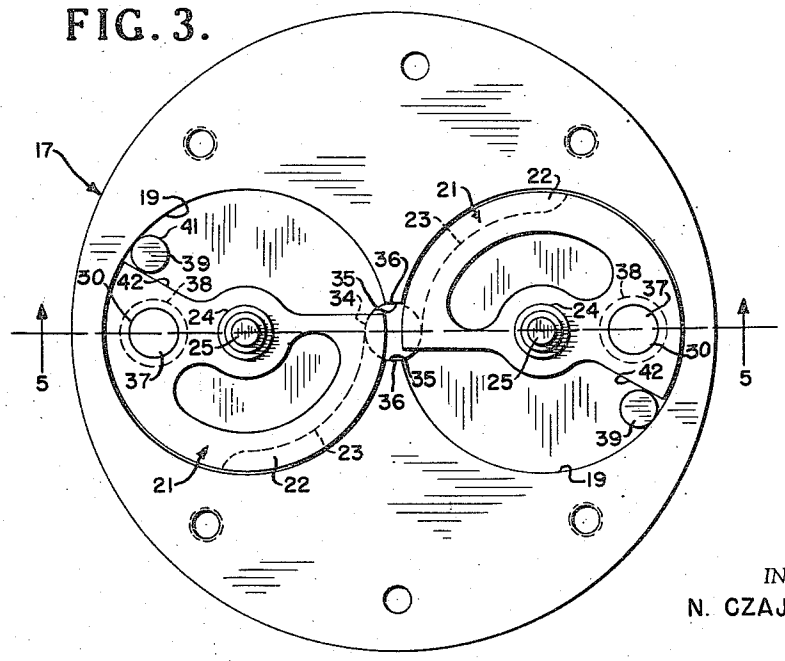


FIG. 3.



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SAFETY DEVICE FOR LOW SPIN PROJECTILES

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5 Claims. (Cl. 102—79)

(Granted under Title 35, U. S. Code (1952), sec. 266)

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 to a fuze adapted for use in a low spin projectile and more particularly to a new and improved safety device for maintaining the fuze in a safe condition during handling and transportation and for arming the fuze in response to centrifugal force.

Heretofore, fuzes of this type employed spring loaded weights and detents pivotally mounted on the fuze casing and disposed 180° apart with respect to each other, the detents being normally forced into locking engagement with the arming rotor by a relatively heavy spring, thus maintaining the fuze in a safe position during handling and transportation.

However, to adapt such devices for use in low spin projectiles it is necessary to reduce the size and tensile strength of the springs and increase the size and weight of the locking detents. Such an arrangement, however, has not proven entirely satisfactory for the reason that upon reducing the strength of the springs and increasing the mass of the detents such devices were extremely sensitive to sudden shock and thus premature arming of the fuze would often times occur during handling and transportation.

The device of the present invention provides new and improved safety means for a fuze which overcomes all the disadvantages heretofore encountered in prior art devices by providing an arrangement which is devoid of springs and detents, and which will not arm in response to translational forces due to sudden shocks but will be readily actuated to an armed position in response to a low order of centrifugal force. The invention provides dual arming means for a fuze, particularly adapted for use in a projectile wherein dual firing means are employed for firing the fuze and exploding the projectile upon impact of the projectile with a target. Furthermore, the safety device is provided with a pair of unbalanced arming rotors or elements, each element may be provided with a suitable explosive device such, for example, as a detonator or the like normally out of alignment with a pair of explosive trains arranged in the fuze, the elements being moved from an initial position to an armed position in response to centrifugal force whereupon the detonators therein are moved into alignment with their respective explosive trains and firing means and thus establishing a pair of continuous explosive trains from the firing means to the booster charge. Movement of the aforesaid rotors or elements to an armed position is restrained by a ball or spherical detent disposed in a pair of helical grooves formed in the rotors respectively for the reason that such forces tend to move the rotors in a direction whereby the helical grooves tend to shear the ball. Thus due to such shearing forces on the ball rotation of the rotors to an armed position is prevented.

An object of the present invention is to provide a new and improved safety device for use in a low spin projectile.

Another object of the invention is to provide a new and improved centrifugally actuated safety device for use in a low spin ordnance missile.

Still another object of the invention is to provide a new and improved safety device for a fuze wherein means are provided for preventing arming of the fuze in response to translational forces due to sudden shocks.

A further object of the invention is the provision of a new and improved safety device for a fuze in which translational forces tend to maintain the device in a safe position and in which the arming means is released for rotation to an armed position in response to centrifugal force.

A still further object of the invention is the provision of a new and improved safety and arming device for a low spin projectile wherein translational forces tend to lock the arming rotors thereof in a safe position and centrifugal forces release the arming rotors for rotation to an armed position.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

Fig. 1 is a fragmentary sectional view of a conventional fuze illustrating the manner in which the device of the invention may be arranged therein, the device being shown armed;

Fig. 2 is a top plan view of the device of Fig. 1 in an unarmed condition, the cover therefor being removed;

Fig. 3 is a view similar to Fig. 2 with the device in an armed condition;

Fig. 4 is a sectional view taken on the line 4—4 of Fig. 2, the arming rotors thereof being shown in elevation; and

Fig. 5 is a sectional view taken on the line 5—5 of Fig. 3.

Referring now to the drawings for a more complete understanding of the present invention and more particularly to Fig. 1 thereof, the numeral 10 indicates a fragmentary portion of a conventional fuze of the dual control type. The fuze comprises a casing 11 having a pair of firing pins 12 releasable and slidably supported in the casing 11 and actuated to a firing position by a firing plunger 13 as the plunger is moved into firing engagement therewith in response to impact of the projectile with a target. The fuze is provided with a pair of lead-in charges 14 in communication with the usual booster charge 15 whereupon the booster charge is fired by the lead-in charges.

The fuze casing 11 is provided with a centrally disposed bore 16 having disposed therein the safety and arming device of the present invention which is generally indicated by the reference character 17. The safety and arming device comprises a casing 18 having a pair of oppositely disposed recesses 19 formed therein. Arranged within each recess 19 is an unbalanced rotor element generally indicated by the reference character 21 and comprising a substantially semicircular body 22, each body having a helical groove 23 formed therein and extending substantially half-way around the peripheral surface thereof and in an opposite direction with respect to each other (Figs. 2 and 3). As shown more clearly on Fig. 4 the rotors 21 are secured to a pair of pivotally mounted shafts 24 respectively. Each shaft is provided with trunnions 25—26, trunnion 25 being disposed in openings 27 formed in the cover plate 28 and trunnion 26 being disposed in recesses 29 formed in the end wall 31 of the casing 17. By this arrangement the shafts 24 are pivotally mounted between the aforesaid cover plate

28 and end wall 31 and rotatably support the rotors 21 within the recesses 19. The cover plate is secured to the casing 11 by screws or the like 32 and disposed in abutting engagement with a shoulder 33 formed on each of the shafts 24 of Figs. 4 and 5 and thus by this arrangement the rotors 21 are maintained within the recesses 19.

As shown more clearly on Fig. 4 a ball 34 is arranged between the rotors 21 and disposed within the helical grooves 23 thereof, the ball being provided with oppositely disposed flat surfaces 35 arranged in engagement with corresponding flat surfaces 36 formed on the casing 17, whereupon longitudinal movement of the ball is permitted in response to rotation of the rotor while rotative movement thereof is prevented.

Each rotor 21 has formed therein a bore 30 extending therethrough and having a detonator 37 arranged therein, the detonators being normally out of alignment with the firing pins 12 and the primer or lead-in 38 arranged in the bottom wall 31 of the casing 17. When the rotors have been moved to an armed position in response to centrifugal force, Fig. 1, the detonator 37 is moved into alignment with the lead-in charges 14 and 38 thus a continuous explosive train is provided from the detonators to the booster charge 15. Thus upon impact the firing pins are forcibly driven into firing engagement with the detonators thereby firing the primers 38 which in turn fires the lead-in 14 which initiate the booster charge.

A stop pin 39 is arranged within each circular recess 19 and secured to the casing 17 in any suitable manner such, for example, as having a press fit with a pair of bores 41 respectively, the bores being formed in the end wall 31. As more clearly shown on Fig. 3, the pins 39 limit the movement of rotors 21 as the rotors are rotated in response to centrifugal force and the shoulders 42 thereon engage the stop pins. When this occurs the rotor is in an armed position as shown in Fig. 1.

By the aforesaid safety device arrangement it will be understood that the forces due to sudden shock to which the device may be subjected during handling and transportation are translational forces and thus since the rotors are constructed and arranged to be actuated to an armed position only in a central force field, obviously translational forces will not cause the device to arm. For example, translational forces tend to rotate the rotors in the same direction whereby the helical grooves tend to shear the ball and thus due to such shearing forces on the ball, the rotors are locked and maintained in an initial safe position. However, in response to a central force field such, for example, as produced by the spin of a projectile the unbalanced rotors are rotated in opposite directions whereby no shearing forces are applied to the ball and thus the ball will ride freely upwardly in the helical grooves thereby to release and permit the rotors to be readily rotated to an armed position.

The operation of the fuze safety device in a spin-projectile will be made more apparent by the following description. Initially the rotor safety elements 21 are arranged in casing 18 as shown in Fig. 2. In this initial position the detonators 37 disposed in the rotor elements are out of alignment with firing pins 12 and primers 38, and the fuze is thereby in an unarmed condition. Upon launching of the spin-projectile, the rotor elements are subjected to a centrifugal force which causes the rotors to rotate about the shaft 24. Due to the unbalanced design of these rotors, resulting from their peripheral configuration and cut-out portions, the center of gravity of each rotor is located in a region between the bore 30 and the shaft 24. As is shown in Fig. 2, the center of gravity of each rotor is located on opposite sides of the shaft, and therefore a centrifugal force acting on each rotor will develop a rotational torque in opposite directions. Due to the design of the helical groove 23 of each rotor, rotation in opposite directions by the

rotors will enable detent ball 34 to ride fully in the grooves, and the rotors will continue their rotation until contact with stop pins 39 occurs, as shown in Fig. 3. Upon contact with the stop pins, the detonators 37 are aligned with the primers and firing pins and the fuze is in an armed condition, as shown in Fig. 1. Upon contact of the projectile with a target, the firing plunger 13 of the fuze is driven rearward into contact with the firing pins forcing them into contact with the detonators and actuating them. Actuation of the detonator fires the lead in charge, or primer, 14 whereupon the booster charge 15 is initiated.

While the aforesaid safety device of the present invention has been shown in connection with a fuze employing dual firing means for firing the fuze and exploding the projectile it will be understood that, if desired, the device may be employed with a fuze employing single firing means and if such is the case only one of the rotors 21 would be provided with a detonator or explosive device. Furthermore, while the rotors have been described as being provided with detonators it will be understood that, if desired, the rotors may be provided with any other suitable explosive devices such, for example, as a primer, initiator, lead-in charge or the like whereupon an explosive train may be completed to arm the fuze when the rotors have been rotated to an armed position.

In view of the foregoing, it will be apparent that the present invention provides a new and improved safety and arming means for a low spin ordnance missile wherein means responsive to translational forces due to sudden shocks tend to lock the arming rotors in a safe position and to release the rotors for rotation to an armed position in response to centrifugal force.

Obviously many modifications and variations of the present invention are possible in the 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.

What is claimed as new and desired to be secured by Letters Patent in the United States is:

1. A safety device for a low spin fuzed projectile comprising a casing, a pair of unbalanced rotors having helical grooves formed thereon supported within said casing for movement to an armed position by centrifugal force, and a spherical detent disposed between said pair of rotors in said grooves for restraining the movement of the rotors to said armed position in response to translational forces and for releasing the rotors for movement to said armed position by centrifugal force thereby to arm said fuzed projectile.

2. A safety device for a low spin ordnance missile comprising a casing, a pair of recesses in said casing, a pair of centrifugally actuated rotors disposed within said recesses respectively, means secured to said rotors and pivotally mounted on said casing for rotatably supporting the rotors within said recesses, a pair of helical grooves arranged within said rotors respectively, and a ball disposed between said rotors and arranged within said grooves for locking and maintaining the rotors in a safe position when the missile is subjected to translational forces and for releasing the rotors for rotation to an armed position in response to centrifugal force.

3. A safety device for a low spin projectile comprising a casing, a pair of recesses in said casing, a pair of centrifugally actuated rotors disposed within said recesses respectively, means secured to said casing for maintaining the rotors within said recesses, a shaft secured to each of the rotors and pivotally mounted on the casing for rotatably supporting the rotors within said recesses, a pair of helical grooves arranged within the rotors respectively, a ball disposed between and arranged within said grooves for locking and maintaining the rotors in a safe position when the device is subjected to translational

force, said ball being adapted to release the rotors for rotation to an armed position in response to centrifugal force, and means on the casing for preventing further movement of the rotors as the rotors move to said armed position.

4. In a safety and arming device for a fuze adapted for use in a low spin projectile, the combination, a casing supported by said projectile, an explosive charge arranged within the casing, a pair of firing devices slidably supported within the casing, a pair of rotors having helical grooves formed thereon arranged within the casing for movement from a safe position to an armed position by centrifugal force, means including a spherical detent disposed between and within said grooves of said rotors for maintaining the rotors in said safe position when the device is subjected to translational forces and for releasing the rotors for rotation to said armed position in response to said centrifugal force, a pair of explosive devices arranged in said rotors respectively and moved into alignment with the firing devices as the rotors move to said armed position, and means responsive to impact of the projectile with a target for forcibly driving the firing devices into firing engagement with said explosive device thereby to fire the explosive device and explode the explosive charge.

5. In a safety and arming device for a fuze adapted for use in a low spin projectile, the combination, a housing supported by said projectile, an explosive charge arranged within the housing, a pair of firing devices slidably supported within said housing, a casing arranged within said

housing, a pair of centrifugal actuated rotors disposed within said casing for movement from a safe position to an armed position by centrifugal force, means secured to said rotors and pivotally mounted on the casing for rotatably supporting the rotor therein, a pair of helical grooves arranged within the rotors respectively, a spherical detent disposed between said rotors and arranged within said grooves for locking the rotors in said safe position when the device is subjected to translational forces and for releasing the rotors for rotation to said armed position in response to said centrifugal force, a pair of detonators arranged in the rotors respectively and moved into alignment with said firing devices as the rotors move to said armed position, and means responsive to impact of the projectile with a target for forcibly driving the firing devices into firing engagement with said detonator thereby to fire the detonator and explode the explosive charge.

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