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CENTRIFUGALLY OPERATED SAFETY AND ARMING DEVICE

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FIG. 1

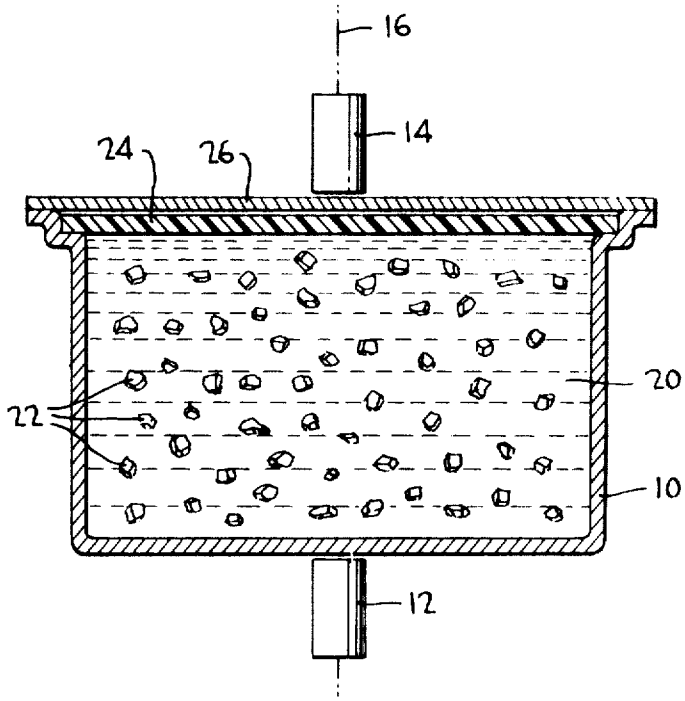
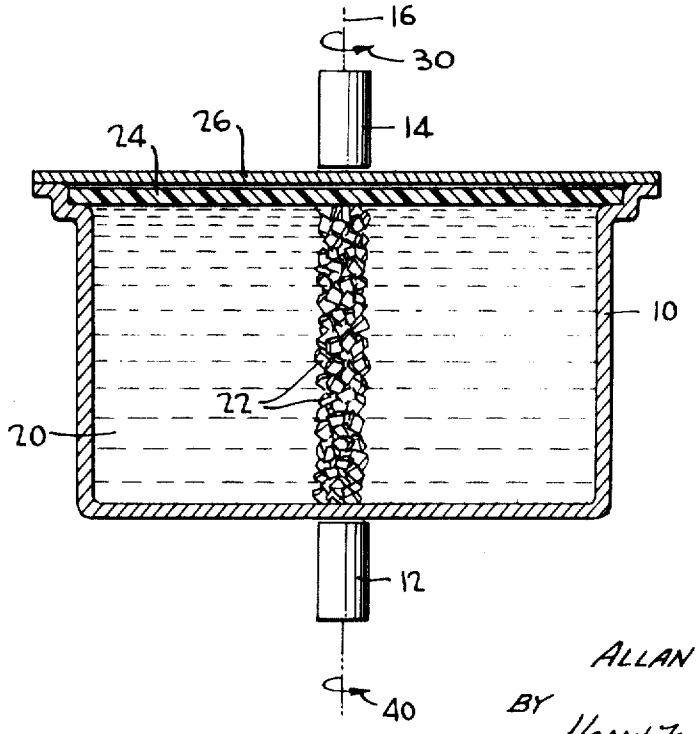


FIG. 2



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CENTRIFUGALLY OPERATED SAFETY AND ARMING DEVICE

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ABSTRACT OF THE DISCLOSURE

A safety and arming device for use in spin-operated munition fuzes. A container placed along the spin axis of the explosive train is filled with a fluid in which are randomly spaced explosive granules of a density less than that of the fluid. The mixture, in addition to providing a detonation wave barrier, maintains the explosive train out of line prior to launch. After launching, the centrifugal force due to spin acts to align the less dense explosive granules along the axis of rotation of the device, thus completing the explosive train and arming the fuze.

RIGHTS OF GOVERNMENT

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.

BACKGROUND OF THE INVENTION

This invention relates generally to safety and arming devices commonly used in munition fuzing, and more particularly to a centrifugally operated safety and arming device that greatly enhances the safety aspect of the fuze while providing a preselected time delay between the time of firing of the projectile and the time at which it becomes fully armed and capable of detonation.

In fuzing systems it is common for safety purposes to employ some means for physically separating the more sensitive components from the rest of the explosive train until such time as it is desirable to arm the fuze. The means may be in the form of an effective barrier to absorb or retard the shock wave created by a premature triggering of the detonator, or merely means to keep part of the explosive train out of line until arming is desired. Most of the systems devised to accomplish these functions have been mechanical in nature, utilizing for example, rotors or sliding bars which house the sensitive components and which rotate or translate in a manner to complete the explosive train. Centrifugal arming is particularly well known in the art due to the inherent nature of certain projectiles to spin about their longitudinal axis when launched. Again, most of the centrifugal arming arrangements have been comprised of mechanical weights and sliding members that move into the proper position under the influence of the rotation of the shell. Examples of such prior art are U.S. Patents 3,397,640 to Ziemba et al. and 3,425,354 to Carlson. Such systems employ as a safety device mechanical locking means or various spring-loaded mechanisms to withold the sensitive component from its critical position until after the shell has been fired. Such mechanisms are inherently subject to premature release upon an accidental dropping of the shell or unavoidable rough handling prior to launching.

Accordingly, a primary object of the present invention is to provide, for ordance fuzes in rotating projectiles, an improved, simple, economical and foolproof safety and arming device that is completely impervious to spurious shocks and vibrations prior to launching and that positively will arm in response to sustained rotation of the projectile.

SUMMARY OF THE INVENTION

Briefly, in accordance with the invention, a nonmechanical safety and arming device for use in munition fuzes is disclosed that provides a degree of safety, reliability and simplicity heretofore unattained. The device utilizes an inhomogeneous liquid-and-particle mixture encased in an air-tight cylindrical cup that is aligned along the longitudinal axis of the explosive train of the projectile and placed so as to separate the more sensitive components from the rest of the explosive train.

The inhomogeneous mixture comprises particles or granules of a suitable explosive element and a nonvolatile liquid of a density greater than the explosive. The mixture within the cup acts as a barrier which would effectively block propagation of a detonation wave along the train prior to firing. It would be impossible for the explosive granules to align themselves with the rest of the explosive train under any ordinary conditions. However, after the projectile is launched and undergoes the associated rapid rotation about its longitudinal axis, the less dense explosive granules float inward to the axis of spin under the resultant centrifugal force and align themselves along this axis, thus completing the explosive train and arming the fuze. The time delay between launching and arming is controlled by the density of the fluid in the cup and can be selected so as to provide positive bore safety as well.

BRIEF DESCRIPTION OF THE DRAWINGS

The specific nature of the invention as well as other objects, aspects, uses, and advantages thereof will clearly appear from the following description and from the accompanying drawings, in which:

FIG. 1 is a sectional view of a safety and arming device embodying the present invention in its unarmed or normal condition; and

FIG. 2 is a sectional view of the device of FIG. 1 in its armed condition which occurs after launching.

DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. 1 shows a sectional view of the safety and arming device cut along a plane parallel to the axis of rotation, represented by dotted lines **16**, of a fuzed projectile (not shown) in which the device would be housed. The device in FIG. 1 is depicted in its unarmed state and is shown positioned in the explosive train between a detonator **12** and a lead charge **14**, both of which, being well known in the art, are represented schematically.

A cylindrical cup **10** and its cover **26** form an air tight container for a barrier **24** that has grid holes therein (not shown) and an inhomogeneous mixture comprising a nonvolatile liquid **20** and a number of explosive granules **22**. The liquid and granules should be selected with care. Granules **22** should be composed of a relatively stable explosive element such as tetryl. Liquid **20** must have a density greater than that of the explosive, must not react or dissolve with the explosive, must not freeze or boil easily, and should be inexpensive and easy to handle. A suitable liquid for use with tetryl granules, for example, consists of a 51% by weight solution of zinc chloride in water.

Cup **10** and cover **26** are constructed of a nonreacting but sturdy material such as vacuum formed sheet polyethylene. Barrier **24** is designed to be used in the loading procedure to prevent loss of granules from the mixture. Liquid **20** may be injected through the grid holes (not shown) of barrier **24** into cup **10** into which

granules **22** had already been placed. The air in cup **10** is displaced and then cover **26** is heat-sealed in place. Naturally the grid holes in barrier **24** must be smaller than the smallest granules present. The device as shown in FIG. 1 in its unarmed state serves as an effective barrier which will block propagation of a detonation wave along the train. Additionally, it is virtually impossible for explosive granules **22** to align themselves with detonator **12** and lead charge **14** under prelaunch conditions.

After the projectile is launched, it undergoes a rapid rotation about axis **16**. This rotation or spinning gives rise to a centrifugal force that acts on the mixture to drive the less dense granules **22** inward towards the axis of rotation **16** that is concentric with the explosive train. FIG. 2 illustrates the device when fully armed after launching, where the spinning necessary for arming is schematically represented by the arrows **30** and **40**. It is seen in FIG. 2 that explosive granules **22** have, under the influence of the centrifugal force, alinged themselves with the rest of the explosive train as represented by detonator **12** and lead charge **14**. Fluid **20**, being more dense than granules **22**, has been displaced from the denter of cup **10** to fill the voids left by the granules. Gaps or discontinuities in the column of granules cannot exist since the number of granules was initially chosen according to the various dimensions involved to provide a continuous explosive train when aligned and the enclosure itself was made air-tight by the loading procedure. The time delay between launching and arming is controlled by the density of fluid **20** and can be selected to meet the required specifications of the particular fuze and projectile in which it is used.

It is seen that I have provided a simple, nonmechanical and economical safety and arming device that will arm the associated fuze only after undergoing sustained rapid rotation about its longitudinal axis, an environmental requirement peculiar to the launching of the projectile.

I wish it to be understood that I do not desire to be limited to the exact details of construction shown and described, for obvious modifications will occur to a person skilled in the art.

I claim as my invention:

1. In a projectile having a central axis of rotation, the combination with said projectile of an explosive train safety and arming device comprising

(a) detonator means;

(b) main explosive means; and

(c) means for housing an inhomogeneous mixture placed between said detonator means and said main explosive means and ailgned concentrically with said central axis of rotation of said projectile, said inhomogeneous mixture comprising

(1) fluid damping means for damping a detonation wave in the absence of rapid rotations about said central axis; and

(2) explosive granules of a density less than that of said fluid damping means, each of said explosive granules floating freely in said fluid whereby said explosive granules become axially aligned with said detonator means and said main explosive means in response to rapid rotations about said central axis of said projectile.

2. The invention according to claim **1** wherein said means for housing an inhomogeneous mixture comprises a cylindrical cup, a barrier placed therein for use in loading said cup, and a cover, said barrier containing grid holes through which said fluid damping means is injected into said cylindrical cup after said explosive granules have been placed therein, whereby said granules are saved from loss and all air is displaced from said cup.

3. The invention according to claim **2** wherein said cover for said cylindrical cup is heat-sealed to provide an air tight enclosure.

4. The invention according to claim **1** wherein said explosive granules are tetryl.

5. The invention according to claim **4** wherein said fluid damping means is a solution of zinc chloride.

6. An apparatus comprising a safety and arming device having an explosive train for use in a spin-operated projectile, comprising a housing containing a fluid and explosive granules of a density less than that of said fluid, each of said explosive granules floating freely in said fluid, said granules aligning with the spin axis of said projectile in response to rapid rotations thereabout so as to provide a completed path for said explosive train.

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SAMUEL W. ENGLE, Primary Examiner

U.S. Cl. X.R.

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