Feb. 4, 1969 D. CARLSON 3,425,354

CENTRIFUGALLY ARMED FUZE

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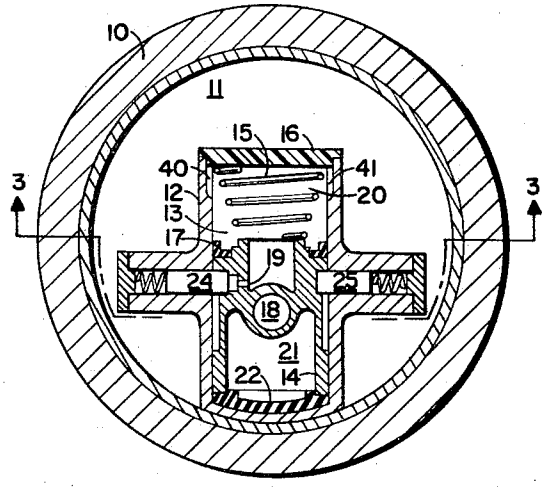

FIG. 1

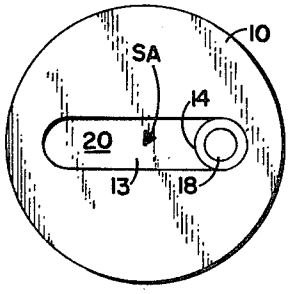

FIG. 2

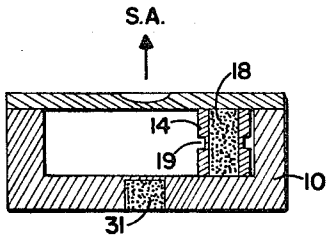

FIG. 4

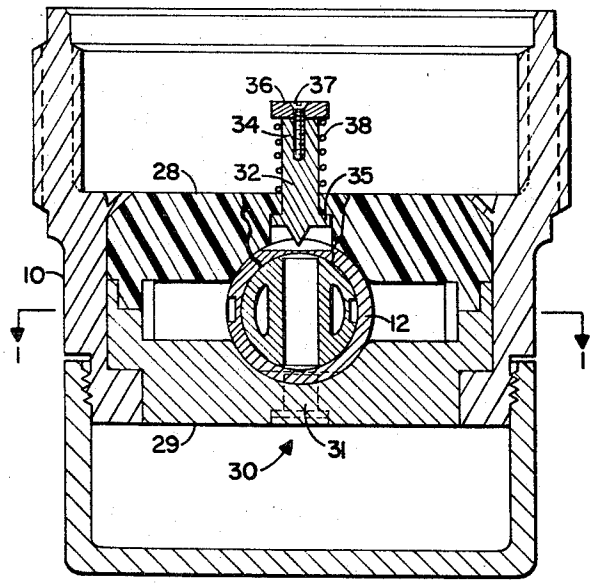

FIG. 3

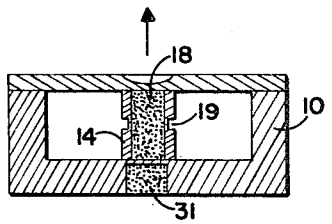

FIG. 5

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CENTRIFUGALLY ARMED FUZE

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ABSTRACT OF THE DISCLOSURE

An arming and time delay mechanism for a spin operated fuze. The fuze employs a buoyant slider member mounted in a housing filled with a fluid having adequate density to float the slider member and having long-term stability and relatively uniform viscosity over a broad temperature range. In the unarmed condition the slider member is held away from the axis of rotation by centrifugal or by setback or environment actuated locking arrangement.

Background of the invention

Field of the invention.—Percussive or electric fuzes wherein the fuze is armed by movement of a member which responds centrifugally to rotation of the shell (CL 102–79).

Description of the prior art.—Centrifugal arming is quite well-known in the prior art. Most centrifugal arming arrangements, however, comprised of mechanical locks and weights. Fluid is utilized in some cases for the purpose of delaying the operation of the fuze. Examples of the prior art are Patents 2,641,186 to Apotheloz and 3,118,379 to Jasse. The applicant is not, however, aware of any prior art wherein fluid is used as a positive force in the arming sequence of a centrifugally armed fuze.

Summary of the invention

The present invention provides for an arming and time delay mechanism for spin operated fuzes. Its unique feature is that it employs a buoyant slider member mounted in a fluid-filled housing. In the unarmed condition the slider member is held away from the axis of rotation by a spring and by centrifugal locks or other suitable safing mechanisms. The space around the slider member is filled with a fluid having long-term stability and a relatively uniform viscosity over a broad temperature range. The fluid has adequate density to float the slider assembly.

The fuze is spin actuated. The centrifugal locks are are released under spin environment, releasing the slider member. Under the spin conditions, the fluid is displaced outwardly, away from the axis of rotation, and the buoyant slider is forced by the fluid inwardly toward the axis of rotation. The slider member carries an explosive detonator, which upon actuation is carried by the slider member into a position in line with a firing pin and a pyrotechnic chain.

It is therefore an object of the present invention to provide an improved centrifugally armed fuze. A further object of the present invention is to provide a centrifugally armed fuze wherein a fluid is used to provide a positive force in the arming sequence. These and further objects will become apparent to those skilled in the art upon examination of the following specification, claims, and the drawing.

A brief description of the drawing

FIGURE 1 is a cross-sectional view of a typical embodiment of the fuze according to the present invention, looking along the spin axis from the top of the fuze;

FIGURE 2 is a simplified schematic representation of the embodiment of FIGURE 1;

FIGURE 3 is a sectional side view taken along line 3—3 of FIGURE 1;

FIGURE 4 is a simplified schematic representation of the sectional side view of FIGURE 3; and

FIGURE 5 is a similar sectional side view, but with the fuze in the armed position.

Detailed description

Referring now to FIGURE 1, a cross-sectional view of the fuze is shown cut along a plane perpendicular to the axis of rotation. The fuze has an outside fuze housing **10**. Within fuze housing **10** is mounted a delay housing **12**. Delay housing **12** defines a cylindrical cavity **13** whose axis intersects the axis of rotation and lies in a plane substantially perpendicular to the axis of rotation. Cavity **13** extends from one side of housing **10** across the center of housing **10**, a certain distance beyond the axis of rotation. Within cavity **13** is mounted a buoyant slider piston **14**. Slider piston **14** is biased towards the end of cavity **13** which is nearest the outside wall of housing **10**. The biasing is accomplished by a light spring **15** located between slider piston **14** and a closure member **16** which defines the inner end of delay housing **12**.

Slider piston **14** carries a detonator **18** at a position which is away from the axis of rotation while the slider piston is in its normal position adjacent to the outside wall of housing **10**. The entire internal cavity of delay housing **12** is filled with a fluid **20**. Fluid **20** is chosen for a long-term stability and a relatively uniform viscosity over a broad temperature range. The relative density of fluid **20** to slider piston **14** is such that slider piston **14** will float. To give slider piston **14** sufficient buoyancy, the slider piston can be provided with a hollow cavity **21**, such as shown in FIGURE 1. Cavity **21** is shown being sealed by a cover **22**.

At the inner most end of slider piston **14**, a seal **17** is placed around the periphery of slider member **14**, adjacent to the internal walls of delay housing **20**. The purpose of seal **17** is to prevent uncontrolled flow of fluid **20** from one side to the other side of slider piston **14**. A metering orifice **19** is, however, provided to allow the flow of fluid **20** from one side to the other side of slider piston **14** at a controlled rate.

A pair of centrifugal locks **24** and **25** are mounted within delay housing **12** and are adapted to engage with slider piston **14** to prevent the motion of piston **14** prior to a predetermined threshold of angular rotation about the fuze axis of rotation.

A more clear understanding of the apparatus of FIGURE 1 will be achieved by referring to FIGURE 3. FIGURE 3 shows a cross-section of a side view cut along lines 3—3 of FIGURE 1. Delay housing **12** is shown held between a forward housing member **28** and a rear housing member **29**. Formed in the rear housing member **29**, concentric with the axis of rotation, is an opening **30** within which is located a lead cup or booster charge **31**. An opening **32** is formed in forward housing member **28**, opening **32** being centrally located and coaxial with opening **30** on rear housing member **29**. Mounted within opening **32** is a firing pin **34**. Firing pin **34** has a first flange **35** formed adjacent the pointed end thereof, to prevent the firing pin **18** from being forced out of opening **17**. A second flange **36** is connected to the opposite end of firing pin **34** by a screw **37**. Mounted between flange **36** and forward housing member **28** is a coiled spring **38** which tends to hold firing pin **34** in the position shown in FIGURE 3.

The simplified schematics of views **2**, **4**, and **5** will be helpful in understanding the operation of the invention.

Operation

In the unarmed condition, buoyant slider piston **14**, carrying detonator **18**, is held away from the axis of rotation by centrifugal locks **24** and **25**. If redundancy is desired for additional safety, setback locks can also be added although they are not shown in the embodiments of FIGURES 1 and 2. The space surrounding slider piston **14** is filled with a fluid such as Dow Corning Silicone 200, which has a long-term stability, has a relatively uniform viscosity over a broad temperature range, and is of adequate density to float slider piston **14**. The displacement away from the axis of rotation of lock weights of centrifugal locks **24** and **25** under the spin environment releases slider piston **14**. Under spin conditions the fluid is displaced outwardly through orifice **19** at a rate depending on rotational velocity and orifice size. The resulting buoyant force acting on the slider member moves it toward the in-line position against a light return spring **15**.

Delay time will depend on the viscosity of the fluid and hence on temperature. The use of a very short orifice causes the flow rate to follow the Bernoulli equation, and minimizes the flow restriction due to the viscous shear-forces, thus yielding a delay that is inversely proportional to the spin rate and relatively insensitive to temperature. The delay time can be controlled by varying the spring biasing and varying viscosity of the fluid.

Although centrifugal locks are shown in FIGURE 1 for holding the slider prior to the operation of the fuze, these may not be necessary because of the force-time integrating features of the dash-pot system. A setback lock pin may be more appropriate.

A unique feature of the present invention, as compared to prior art fluid delays, is that in case of loss of fluid from the system, the fuze will remain in a fail-safe condition. This is an advantage of great importance, as will be obvious to those who are familiar with the safety hazards in the area of fuzing art.

The following functioning sequence places the fuze from a unarmed to an armed position. Centrifugal locks **24** and **25** are released by centrifugal forces above a safety threshold. Fluid **20** is displaced radially through metering orifice **19** by a centrifugal force at a rate dependent upon projectile spin and orifice size. The slider floats toward armed position, snapping in line when seal **17** passes over arming grooves **40** and **41**, thus permitting a sudden increase in fluid flow rate.

Obvious advantages of the present invention are that it is extremely simple in operation and is therefore highly reliable. It has the unique safety feature that it is impossible to prematurely arm and has high resistance to rough handling environments.

From the above description it will be apparent that I have invented a munition fuzing concept having new and more effective means for utilizing the centrifugal force developed by a rotation munition for arming purposes and providing safety in handling.

I claim:

1. An arming and time delay mechanism for spin operated fuzes comprising:

a fuze housing defining a hermetically sealed chamber filled with a relatively high density fluid;

a buoyant slider positioned in said fluid within said chamber, said slider having a freedom of motion along a line substantially perpendicular to the spin axis of the fuze;

an explosive detonator mounted on said slider; and

locking means mounted in said housing for holding said slider away from the axis of rotation when said fuze is in an unarmed condition, and to release said slider for motion toward the axis of rotation in response to fluid pressure exerted on said slider, in line with a firing pin and pyrotechnic chain, after the fuze is subjected to an angular rotation.

2. An arming and time delay mechanism for a spin operated munition fuze comprising:

a fuze housing having an axis of rotation;

a firing pin and an explosive lead cup mounted in said housing centered on said axis of rotation;

a delay housing mounted within said fuze housing, said delay housing defining a hollow hermetically sealed chamber of generally cylindrical shape with its axis substantially perpendicular to said axis of rotation;

a slideable piston member mounted within said delay housing, said piston member subdividing the sealed chamber of said delay housing into a first chamber toward said axis of rotation and a second chamber away from said axis of rotation, said piston member further having a fluid passage to allow fluid transfer between said two chambers;

a fluid filling said sealed chamber of said delay housing, said fluid having sufficient density to float said piston member;

a detonator mounted on said piston member; and

safing means mounted in said delay housing for holding said piston member away from the axis of rotation when said fuze is in an unarmed state, and to allow said piston member to move toward the axis of rotation when said fuze is caused to spin about its axis of rotation in response to fluid flow from said first chamber to said second chamber to arm the fuze by bringing said detonator in line with said firing pin and said explosive lead cup.

3. Apparatus according to claim **2** wherein said safing means includes a spring for biasing said piston member away from the axis of rotation.

4. Apparatus according to claim **3**, wherein said safing means further includes centrifugal locking means for maintaining said slideable piston locked in a safe position until said fuze is caused to spin about its axis of rotation in excess of a predetermined angular rate.

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