June 19, 1956 G. H. LEONARD 2,750,890

TIME DELAY FUZE FOR A MINE

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FIG. 1.

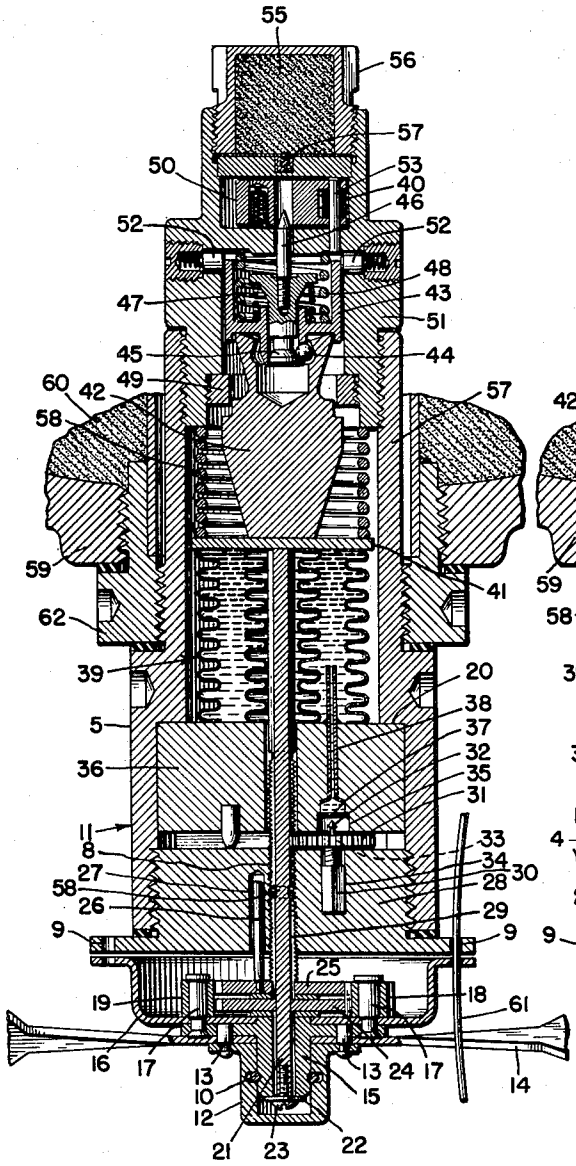
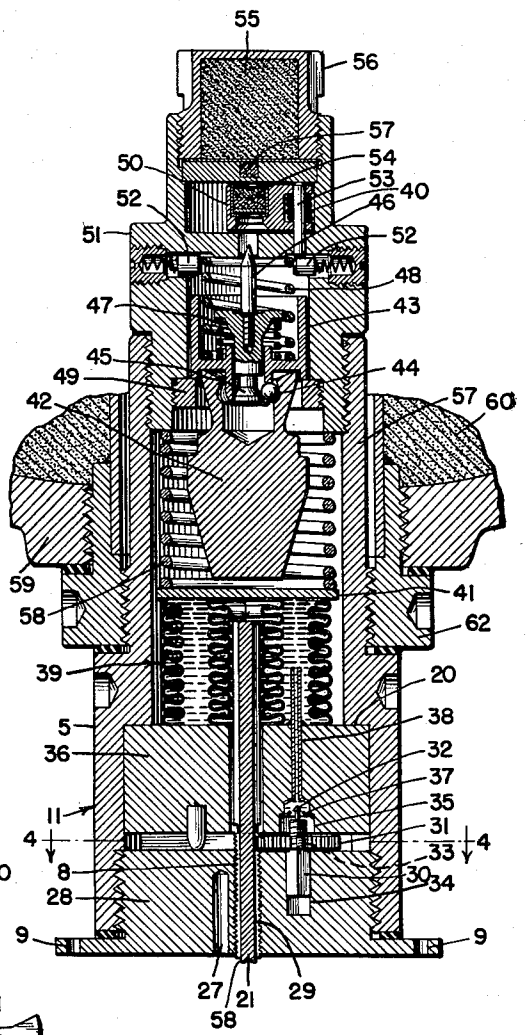



FIG. 2.




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FIG. 3.

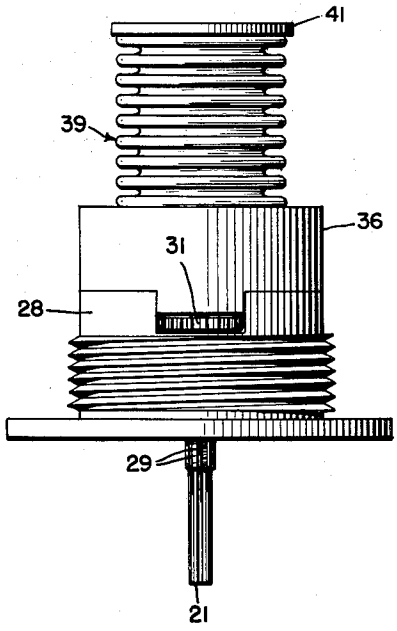



FIG. 4.

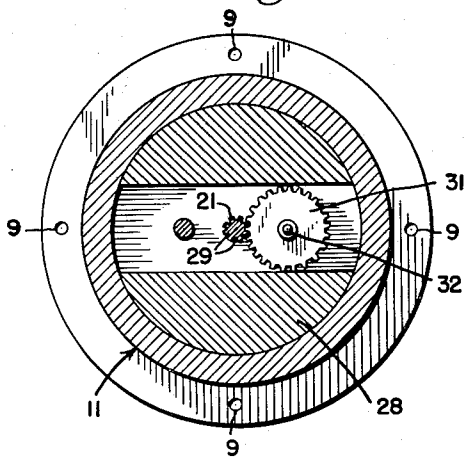



FIG. 6.

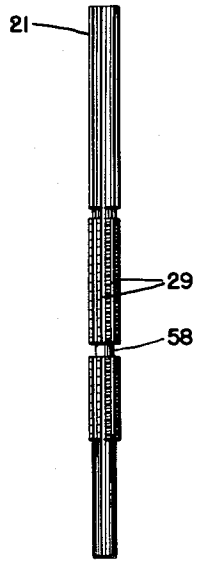
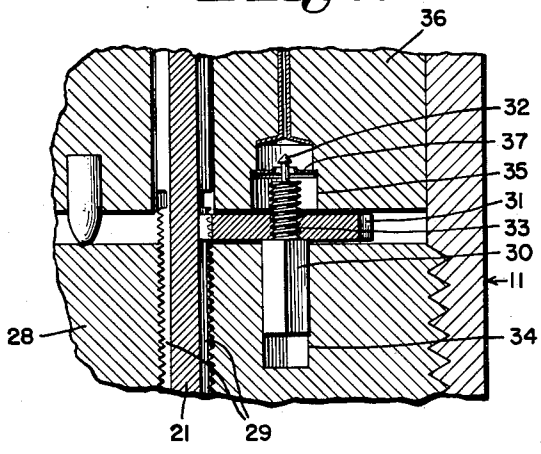



FIG. 5.




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2,750,890

# TIME DELAY FUZE FOR A MINE

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6 Claims. (Cl. 102—82)

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

The present invention relates generally to time-delay devices for fuzes employed to detonate the explosive charges contained in mines, bombs, and similar ordnance devices. More specifically, the invention resides in a new and improved time-delay device for use with a floating mine adapted to be launched from an aircraft in flight and to be fired by an inertia force applied thereto after the launching operation has been completed.

In time-delay devices heretofore employed with fuzes of the aforedescribed chracter, means responsive to the motion of the mine through the air after launching from an aircraft in flight usually are employed to permit the inertia firing mechanism for the fuze to move from a safe or unarmed position into a position effective to fire the mine when an inertia element of the firing mechanism responds to a lateral blow applied to the mine. In such devices there is usually provided a screw shaft for maintaining the firing mechanism in the safe position thereof until the shaft has been screwed out a predetermined amount, the shaft being operated by an air-driven impeller through an appropriate reduction gear, whereby a predetemined period of time is caused to elapse before the mechanism is moved to its armed position. The time delay provided by such means has usually been found to be satisfactory in service to prevent arming of the mine until a period of time has elapsed sufficient to permit the mine to fall a safe distance away from the launching craft. Such time-delay means, however, have not been found to be entirely satisfactory in service when used with an aircraft launched marine mine for the reason that the inertia firing mechanism may operate in response to the impact as the mine strikes the surface of the water.

In accordance with the arrangement of the present invention, a fluid-filled bellows having a sealed capillary tube as an outlet therefor is employed in addition to the aforementioned impeller driven means for the purpose of maintaining the firing mechanism in the safe position thereof, and means under the control of the impeller driven means is employed to puncture the seal of the capillary tube as the impeller driven means nears completion of its operation, thereby to discharge the fluid from the bellows at a predetermined rate and permit the collapse thereof whereby the firing mechanism is permitted to move into its armed position a predetermined interval of time after the seal has been punctured.

Thus the screw shaft serves to lock positively the firing mechanism in its safe position prior to the launching of the mine and the fluid-filled bellows serves to maintain the mechanism in the safe position until the screw shaft has been substantially screwed out its predetermined amount and for an additional interval of time thereafter controlled by the rate of discharge of the fluid from the bellows and the extent of collapse thereof necessary to permit movement of the firing mechanism into its armed position. Thus the present invention affords a sufficient time delay to permit the mine to become fully launched within a body of water before the mine becomes armed.

An important object of the present invention, therefore,



is to provide a time-delay device for a fuze employed in an aircraft launched marine mine in which the time-delay device is adapted to prevent arming of the mine for a period of time sufficient to permit the completion of the launching operation thereof within a body of water.

Another object is to provide a new and improved fuze of the aforedescribed character in which means are employed for positively locking the firing mechanism of the fuze in a safe position prior to the launching of the mine from an aircraft in flight and in which means under the control of the positive locking means are provided for maintaining the mechanism in the safe position for an additional period of time after the locking means has completed its operation.

Another object is to provide a fluid-filled collapsible member for maintaiinng the firing mechanism in the safe position thereof until the launching operation of the mine has been completed, in which means are provided for causing the discharge of the fluid from the member to be initiated before the mine strikes the surface of the water.

Another object is to provide a new and improved fuze in which the firing mechanism is maintained in its safe position for a period of time controlled by the rate of discharge of fluid from a collapsible member.

A further object is to provide new and improved means for restricting the flow of the fluid from the collapsible member whereby the rate of discharge of the fluid therefrom may be controlled and the member is caused to measure a predetermined period of time during the collapse thereof.

Other objects, features, and advantages will be apparent from the following specification, taken in connection with the accompanying drawings, in which:

Fig. 1 is a vertical sectional view of a fuze according to a preferred embodiment of the present invention, the firing mechanism of the fuze being shown in the safe position thereof;

Fig. 2 is a view similar to that of Fig. 1 and showing the mechanism approaching the fully armed position thereof;

Fig. 3 is a side elevational view of the time-delay device of the present invention;

Fig. 4 is a sectional view taken along the line 4—4 of Fig. 2;

Fig. 5 is an enlarged fragmentary sectional view showing the seal puncturing mechanism of Fig. 2; and

Fig. 6 is a detail view of the screw shaft used with the present invention.

Referring now to the drawings in which like numerals indicate like parts throughout the several views, there is shown thereon an inertia controlled time delay fuze indicated generally by the numeral 11.

The fuze 11 is shown mounted in the nose of a mine case 59, it being understood that the device also may be adapted for use with bombs or similar ordnance devices. An adapter 62 is screwed into the mine case 59 and receives the casing 5 of the fuze 11. Threadedly engaged in the outer end of the casing 5 is a flanged closure 28 having openings 9 formed in the flange thereof. Closure 28 is provided with a threaded central bore 8 adapted to receive a threaded shaft 21. Rotatably held on the unthreaded projecting end of shaft 21 by screw 23 and washer 22 is a flanged bearing member 15. A flanged hub 12 is mounted on the member 15 and is secured by a snap ring 10 set in complementary grooves in the members 12 and 15.

Arranged between the flanges of the members 12 and 15 is the hub of an impeller 14. Pins 13 mounted on the flange of hub 12 pass through openings formed in the hub of the impeller 14 and the flange of the member 15 thereby locking the assembly together as a rotatable unit. Secured to the flange of the bearing member 15 by pins 17 is a cover 16 having a flange provided with open-

ings aligned with openings 9 of the closure 28 to receive the usual arming wire 61.

One of the pins 17 acts as a pivot for a planetary pinion 18, the other pin 17 serving as a support for a diametrically arranged counterweight 19. Mounted on the shaft 21 and held for rotation therewith by the gear spline 29 is a gear 24. Mounted on shaft 21 is a gear 25 having fixed thereto a pin 26 slidable in bore 27 formed in closure 28, thereby to hold said gear against rotation as it moves outwardly with the impeller assembly. Gears 24 and 25 have a differential of one tooth, gear 24 having one tooth more than gear 25.

The gears 24 and 25 are in meshing engagement with the planetary pinion 18. Thus, each revolution of the pinion about the axis defined by the shaft 21 causes the gear 24 to rotate the distance of one tooth of gear 25. It will be seen that gears 24 and 25 and pinion 18 constitute a planetary reduction gearing, whereby shaft 21 makes comparatively few revolutions corresponding to many revolutions of the impeller. Gear 24 rotates shaft 21 in a direction to feed the shaft out of the closure 28 for a purpose to be hereafter more fully described.

Confined between closure 28 and a shoulder 20 formed within the casing 5 is a bellows base 36. Secured to base 36 in fluid-tight relation therewith is a pair of concentrically arranged metallic bellows generally designated 39. The inner bellows defines a passageway for the shaft 21, while the space provided between the inner and outer bellows is filled with a fluid having a viscosity substantially unaffected by temperature changes. Secured to the other end of the bellows 39 in fluid-tight relation therewith is a plate 41.

Mounted in a bore in the bellows base 36 and extending into the fluid filled bellows 39 is a capillary tube 38. This bore is enlarged at one end thereof to define a chamber 35. Fastened, as by soldering, to a shoulder in the chamber, so as to form a seal against leakage of the bellows fluid, is a soft metal disc or seal 37.

The squared end 30 of the screw shaft 33 constituting a portion of the puncturing element 32 is mounted in a complementary bore 34 in the closure 28. A gear 31 is threadedly carried by the screw shaft 33 in such a manner that rotation of gear 31 feeds the puncturing element in a direction to penetrate the sealing disc 37, the puncturing element 32 having a sharpened end for this purpose.

As shown in the drawings, gear 31 meshes with the gear spline 29 of shaft 21 whereby the aforementioned rotation of gear 31 is accomplished as shaft 21 revolves. It is, of course, understood that if desired, a train of gears may be interposed between shaft 21 and gear 31 to afford the degree of time delay desired before the element 32 punctures the disc 37.

Threadedly secured to the inner end of the casing 5 is a casing 51 having an inertia controlled firing mechanism therein. Between the casing 51 and the bellows plate 41 a biasing spring 58 is interposed which maintains pressure against the bellows plate 41, thereby forcing the fluid from the bellows when the sealing disc 37 is punctured. When this occurs the flow of fluid is restricted by the capillary tube 38, thereby to produce a predetermined time delay in moving bellows plate 41 to its retracted position for a purpose to be hereinafter more fully described.

The inertia controlled firing mechanism comprises a substantially cup-shaped member 43 slidably arranged within a central bore in the casing 51. Mounted in the cup-shaped member 43 is a firing pin support 45. A spring 47 normally urges the firing pin support 45 against a plurality of locking balls 44 normally resting in openings in the wall of a tubular extension of the cup-shaped member 43. The balls 44 are restrained from passing laterally outwardly of the aforementioned openings by means of an inertia member 42 which, in turn, is restrained against movement by the bellows plate 41. The firing pin passes



through a reduction of the central bore of casing 51 and extends into an opening therefor in the detonator cap retainer 50. The firing pin 46 thus is positioned to hold the detonator cap retainer in such a position that the detonator cap 54 is held out of registry with the firing pin.

The cap retainer 50 is pivotally mounted on a pin 53 and is normally urged by a spring 40 to a position wherein the detonator cap 54 is in registry with the firing pin 46 and an explosive element 57 disposed adjacent the detonator charge 55 contained in a housing 56 in screw threaded engagement with the casing 51.

A spring 48 urges the cup-shaped member in a direction toward the bellows plate 41, and detents 52 carried by casing 51 are spring-urged against the cup-shaped member 43 for a purpose to be more fully described hereinafter.

When the mine is launched from an aircraft in flight, arming wire 61 is withdrawn from the registered openings in the flanges of the closure 28 and the cover 16, thereby releasing the impeller 14 and associated mechanism for rotation. The motion of the mine through the surrounding air drives the impeller 14 thereby rotating housing 16 and pinion 18 about the gears 24 and 25. Such rotation causes gear 24 to advance one tooth for each revolution of the impeller and drives the screw shaft 21 slowly outwardly through the threaded bore 8 of the closure 28. Thus the inner end of the shaft is moved away from the bellows plate 41, said plate at such time being entirely supported against the action of springs 58 and 48 by the fluid filled bellows 39. As the screw shaft 21 moves outwardly the puncturing element 32 is moved toward the sealing disk 37, through the action of gear 31 which is driven by the gear spline 29 of the shaft 21.

After the puncturing element 32 has penetrated the disc 37, the squared end thereof bears against the gear 31. This causes jamming of the mechanism and causes a weakened portion 58 of shaft 21 to break, thereby jettisoning the propeller drive mechanism.

Upon penetration of the disc 37, the fluid in the bellows 39 passes through the capillary tube 38 at a predetermined rate of flow governed by the size bore through the tube. The fluid escapes to a chamber between the closure 28 and the bellows base 36 and thence outwardly of the fuze through the gear splines 29 of the shaft 21.

As the fluid escapes from the bellows 39 upon collapse thereof under the action of the springs 48 and 58, the bellows plate 41 moves in a direction toward the bellows base 36. Spring 48 forces the inertia member 42 and associated firing mechanism including the cup-shaped member 43 and the firing pin 46, to follow the bellows plate until the cup-shaped member reaches the shoulder defined by the ring member 49.

As cup-shaped member 43 moves beyond detents 52, said detents are spring urged against spring 48 thereby blocking the return of member 43 to its initial position, and thus preventing accidental firing of the mine. This action also draws firing pin 46 out of the aperture therefor in cap retainer 50, allowing spring 40 to swing the cap retainer to a position wherein the detonator cap 54 is brought into registry with the firing pin, as shown in Fig. 2. At the same time, bellows plate 41 moves away from the inertia member 42 thereby causing the inertia member to be supported by the balls 44 and free to be pivotally displaced with respect to cup-shaped member 43 in response to a lateral shock received from a ship passing in proximity to the mine. When the inertia member 42 is displaced laterally, the balls move outwardly in the holes in member 43, thereby freeing the firing pin. Upon release of the firing pin it is moved forcibly into engagement with detonator cap 54 under power of spring 47, thereby detonating the cap which, in turn, causes ignition of the detonator charge 55 to fire the main charge 60 of the mine.

It will of course be understood that while the invention has been shown in particularity with relation to a floating mine of the type adapted to be launched from an aircraft in flight, it could also be adapted for use with related ordnance devices without departing from the spirit and scope of the invention as defined by the appended claims.

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

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

1. In a time-delay fuze for a marine mine adapted to be launched from an aircraft in flight, inertia actuated firing means movable from a safe position to an armed position for firing said mine in response to a lateral shock received thereby, means in engagement with said firing means for yieldably urging the firing means into said armed position, normally fluid-filled expanded collapsible means in engagement with said firing means and having puncturable sealing means for maintaining the firing means in a safe position against the force of the urging means until the normally expanded means has collapsed, penetrating means slideably disposed within said fuze for puncturing said sealing means as the penetrating means is moved a predetermined amount, discharge means disposed within said expanded means for causing said normally expanded means to collapse at a predetermined rate controlled by the flow of fluid therefrom, and means including an impeller device for moving said penetrating means said predetermined amount when a predetermined interval has elapsed after the mine is launched from the aircraft thereby to permit gradual movement of the firing means into said armed position.

2. In a time-delay fuze adapted for use with an aircraft launched marine mine, firing means movable from a safe position to an armed position and adapted to respond to lateral shock when in said armed position, impeller means adapted to be operated in response to the movement of the mine through the air, a reduction gearing, a screw shaft adapted to be driven by said impeller through said gearing and adapted to hold the firing means in said safe position prior to the launching of the mine, means including a normally expanded bellows adapted to be collapsed gradually at a predetermined rate for maintaining the firing means in the safe position until the mine has entered the water, means controlled by said screw shaft for initiating collapse of the bellows thereby to permit movement of the firing means into said armed position after a predetermined interval of time has elapsed sufficient to complete the launching of the mine, and means for moving said firing means.

3. In a time-delay fuze for use with an aircraft launched marine mine, firing means adapted to be yieldably urged from a safe position into an armed position and thereafter to be operated in response to a lateral shock received by the mine, means for moving the firing means into said armed position, a screw shaft for maintaining the firing means in said safe position while the shaft is in an initial position, impeller means for actuating the shaft rotatively and axially from said initial position as the mine is launched from the aircraft, means including a normally expanded fluid filled bellows for additionally maintaining the firing means in said safe position for a predetermined interval of time after the shaft has been moved from said initial position, and means under the control of the shaft and adapted to initiate discharge of the fluid from the bellows when said predetermined interval has elapsed whereby the firing means is moved gradually to the armed position thereof in accordance with the rate of discharge of the fluid.

4. In a time-delay fuze adapted for use with an aircraft launched marine mine, firing means disposed within



the fuze and adapted to be moved from a safe position to an armed position and having an inertia element adapted to be released for response to lateral shocks received by the mine after the firing means has moved into the armed position thereof, means for moving said firing means, a screw shaft for maintaining said firing means in the safe position for an initial period of time, impeller means for driving said shaft out of its maintaining position during the free flight of the mine, fluid-filled collapsible means for maintaining said firing means in the safe position after the shaft has been driven out of its maintaining position, means under control of the shaft for puncturing said fluid filled means near the end of the outward movement of the shaft, and means for controlling the rate of flow of fluid from the fluid-filled means whereby collapse thereof is retarded at a rate sufficient to complete the launching operation prior to movement of the firing means into the armed position and release of said inertia member.

5. In a time delay fuze for use with an aircraft launched marine mine, firing means adapted to be yieldably urged from a safe position to an armed position and thereafter to be operated in response to a lateral shock received by the mine, a screw shaft for maintaining the firing means in said safe position while the shaft is in an initial position and for releasing the firing means when moved axially to a predetermined moved position, impeller means for actuating the shaft rotatively and axially from said initial position to said moved position as the mine is launched from the aircraft, a first collapsible bellows surrounding said shaft, a second larger collapsible bellows surrounding said first bellows in spaced relation therewith, said first and second bellows comprising the inner and outer walls respectively of a sealed collapsible chamber, said chamber being normally fluid-filled, said inner and outer bellows additionally maintaining the firing means in said safe position for a predetermined interval of time after the shaft has been moved from the initial position and corresponding to a predetermined number of revolutions of the shaft, and means for releasing said fluid from the bellows under control of said shaft when said predetermined interval has elapsed, said firing means being moved gradually to the armed position thereof in accordance with the rate of discharge of the fluid.

6. In a time delay fuze for a marine mine adapted to be launched from an aircraft in flight, firing means disposed within said fuze for firing the mine, said firing means being movable from a safe position to an armed position, means for yieldably urging said firing means into said armed position, liquid-filled collapsible bellows for maintaining said firing means in the safe position, a hermetic seal for said bellows, an impeller mounted on said fuze, a splined and threaded gear shaft in said fuze and driven by said impeller whereby the shaft is moved rotatively and outwardly of said fuze, a gear having a threaded axial bore and meshing with said splined gear of said shaft, a puncturing element threadedly engaging the axial bore of said pinion, said puncturing element being mounted adjacent the seal of the collapsible bellows whereby the puncturing element is moved into the seal after a predetermined number of rotations of the shaft thereby to release the liquid contained in the bellows and to permit the firing means to move to the armed position, and means for restricting the flow of said liquid from the bellows.

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