Jan. 27, 1959 R. WELLER 2,870,714

DELAYED ARMING DEVICE FOR A FUZE

Filed June 3, 1949

Fig. 1.

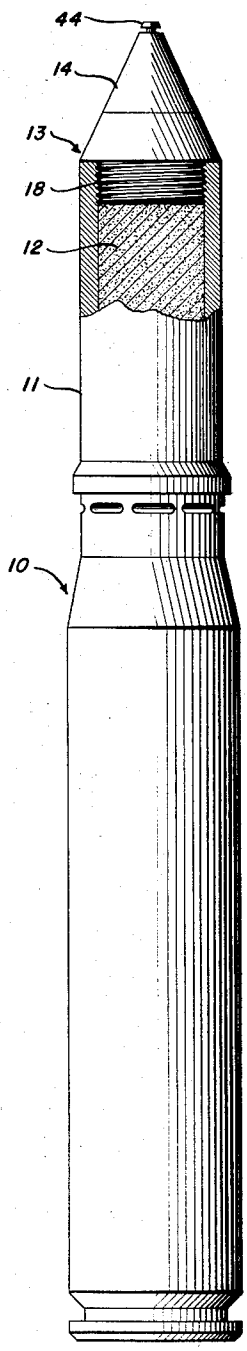


Fig. 2.

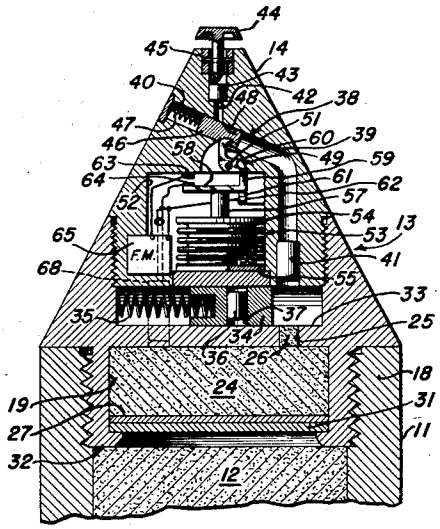


Fig. 3.

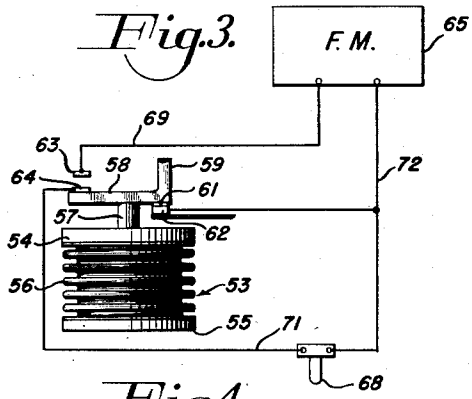
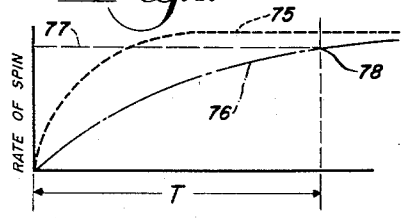


Fig. 4.



Inventor

ROYAL WELLER

By M. A. Hayes

Attorney

United States Patent Office 2,870,714 Patented Jan. 27, 1959

2,870,714

DELAYED ARMING DEVICE FOR A FUZE

Royal Weller, Silver Spring, Md., assignor to the United States of America as represented by the Secretary of the Navy

Application June 3, 1949, Serial No. 97,064

5 Claims. (Cl. 102—79)

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

This invention relates to a fuze for a projectile, or the like adapted to be fired from a gun and exploded upon reaching a target, in which new and improved means are employed for preventing the premature firing of the explosive or bursting charge until the shell has traveled a safe distance beyond the muzzle of the gun. More specifically, the invention relates to new and improved means for maintaining the fuze in a safe condition until a quantity of fluid within the projectile has attained a predetermined speed of rotation after the projectile has been fired from a gun and the force of acceleration of the projectile has diminished to a value corresponding to the force of acceleration acting on the projectile at a safe distance from the gun after the projectile has been fired therefrom.

This invention provides new and improved means for preventing the premature explosion of the shell or projectile in or within the vicinity of a gun as the gun is fired.

One of the objects of the present invention is the provision of new and improved means for preventing the premature firing of an explosive charge within a projectile during the transportation, handling, loading and firing of the projectile from a gun.

Another of the objects is to provide new and improved means for maintaining the fuze in a safe condition as the projectile is fired from a gun until the acceleration of the projectile and the speed of rotation of a fluid sealed within a casing having the axis thereof in coincidence with the axis of the projectile has reached a predetermined value.

Still another object is to provide a fuze for a projectile having new and improved mechanical means for delaying the arming of a fuze as the projectile travels along a trajectory and to render the electrical firing mechanism effective when a quantity of fluid has caused movement of the arming mechanism in response to centrifugal force developed by rotation of the fluid.

A further object is to provide a new and improved fuze for an explosive projectile having means arranged therein for preventing arming and firing thereof until the projectile is shot clear of the gun, which is economical to manufacture, reliable in operation, and which possesses the qualities of durability and safety during handling and transportation.

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 view partially in section of a projectile employing the fuze of the present invention according to a preferred embodiment thereof;

Fig. 2 is an enlarged sectional view of the fuze of Fig. 1 in an unarmed condition;

Fig. 3 is a diagrammatic view of the firing circuit therefor; and

Fig. 4 is a graph illustrating in diagrammatic form

the delay in the arming of the fuze caused by the retarded rate of acceleration of spin of the fluid within the expansible casing.

Referring now to the drawings for a more complete understanding of the invention and more particularly to Fig. 1 thereof, there is shown thereon a shell or projectile indicated by the numeral **10** comprising the shell casing **11** having the usual explosive or bursting charge **12** disposed therein, as is well known to those skilled in the art.

The fuze generally indicated by the reference character **13**, comprising a nose **14** is secured to the shell casing **11** in any suitable manner, preferably by an externally screw threaded nipple **18** having threaded engagement with shell casing **11**. The nipple **18** is provided with an enlarged well **19**, having a booster charge **24** arranged therein and composed of any explosive suitable for the purpose such, for example, as the type known in the trade as "Tetryl."

A reduced bore **25** is arranged within the nose **14** in communication with the well **19** and a lead-in explosive charge indicated by the reference character **26** is disposed therein, in engagement with the booster charge **24** to provide means for firing the booster charge when the fuze is functioned upon impact thereof with a target. The booster charge is sealed within the recess by a disc **27** composed of any material suitable for the purpose such, for example, as blotting paper or the like and a steel disc **31**, the aforesaid discs being clamped in position by a flange **32** formed on the magazine and crimped or rolled into clamping engagement with disc **31**.

The nose **14** has formed therein a recess or guide-way **33** having an arming plunger **34** releasably and slideably arranged therein. The arming plunger is urged to an armed position Fig. 2 by a spring **35** when the plunger has been released whereupon the sensitive detonator **36** disposed within a bore **37** in the arming member is brought into registration with the lead-in charge **26**. It will be understood, however, that the arming plunger is locked in a safe or unarmed condition, Fig. 1, by the usual centrifugally actuated detents (not shown), the detents being adapted to be moved to a release position in response to centrifugal force whereupon the plunger is moved to an armed position by the spring **35**.

As shown on Fig. 2 the nose **14** is provided with a bore or passageway **38** comprising a vertical portion **39** and an inclined portion **40**. The vertical portion is in communication with recess **33** and has disposed therein a sensitive detonator **41** in proximate spaced relation with respect to the plunger **34** and adapted to fire the detonator **36** when the plunger is in an armed position and upon impact of the shell with a target, The inclined portion is in communication with a centrally disposed bore **42** and has disposed therein a flash primer **43** adapted to be fired by a firing pin **44** releasably supported within the bore **42** by a shear pin **45** as the pin is severed upon impact of the shell with a target.

Disposed within the inclined portion **40** of the bore **38** is a centrifugally actuated detent **46**, the detent being normally urged into a safe position by a spring **47**, Fig. 2, thereby to prevent communication between the bore **42** and the inclined bore **40** until the detent has been actuated to an armed position in response to centrifugal force. When this occurs the detent will be moved from the safe position sufficiently to permit communication between the aforesaid bores and thus permit the flash from primer **43** when fired by the firing pin to contact and fire the detonator **41**.

The detent **46** is provided with a groove **48** having disposed therein one end of a pawl or latch **49**, the other end thereof being rotatably supported on a pivot **51**. The latch **49** maintains the detent **46** locked in a safe position

until actuated to a release position by the expansible bellows indicated generally by the numeral **53** as the bellows is extended to an armed position during the flight of the projectile. The bellows **53** is arranged within a recess **52** formed in the nose **14** with the axis thereof in coincidence with the spin axis of the projectile, the bellows comprising a pair of spaced end walls **54** and **55** having respectively secured thereto the ends of the expansible portion **56** thereof. The bellows has sealed therein a copious amount of liquid suitable for the purpose such, for example, as oil, mercury or the like.

As shown in Fig. 2 the end wall **54** has formed thereon a boss **57**. Secured to the boss **57** is a member **58** having formed thereon a lug **59** in engagement with the end portion **60** of the pawl **49**. By means of this arrangement, the detent **46** is maintained immovable until the pawl is moved out of engagement therewith by the bellows as the spin of the projectile gradually accelerates the liquid contained within the bellows which develops sufficient centrifugal force to cause the bellows to be lengthened or extended in response to such force. It will be understood, however, that the transfer of angular momentum from the shell to the liquid will cause the liquid to develop sufficient centrifugal force to move the bellows gradually and longitudinally, the purpose of which motion will be more clearly apparent as the description proceeds.

When the fuze is in an armed position, the detonator **36** is in line with the lead-in charge **26** and also in line with the primer **41**, the detent **46** having been moved outwardly sufficiently to permit an uninterrupted passageway between primers **43** and **41**. Upon impact of the shell with a target the firing pin **44** is driven into firing engagement with the primer **41** with sufficient force to cause firing thereof, the flash therefrom being directed by way of passageway **38** into firing engagement with primer **41** and thus initiating firing of detonator **36**, lead-in charge **26** and booster charge **24** in successive order.

The electrical arming of the fuze is delayed by the specific construction and arrangement of the bellows **53** and the physical properties of the liquid sealed therein for the reason that as the projectile is fired from a gun and rotates about its axis the liquid within the bellows gradually accelerates rotatively, which acceleration develops sufficient centrifugal force to cause the liquid to be forced outwardly thereby creating sufficient pressure to extend the bellows.

As shown on Figs. 2 and 3 means are employed to arm the fuze by movement of the member **58** and to fire the fuze electrically, if desired, the means comprising a pair of normally closed contacts **61** and **62** and a pair of normally open contacts **63—64**, the contacts **61** and **64** being secured to the moveable member **58**. When the fuze is in an armed condition, a firing circuit is established from the firing mechanism **65** of any well-known type suitable for the purpose to the electroresponsive detonator **68** by way of conductor **69**, contacts **63** and **64**, and conductor **71** to one side of the detonator, the other side of the detonator being connected to the firing mechanism by conductor **72**. The fuze is maintained in a safe condition during handling and transportation by the detent **46** and latch **49** and also by the circuit arrangement whereby the electroresponsive detonator **68** is normally short circuited by contacts **61—62**, Fig. 3.

By the foregoing arrangement it will be understood that a firing circuit will not be established from the firing mechanism to the electroresponsive detonator until the bellows has been expanded or lengthened in the aforesaid manner, thereby moving the member **58** sufficiently to engage contacts **63—64** and to disengage contacts **61—62**. It will be understood, however, that movement of the detent **46** will not occur until the bellows **53** has extended a sufficient distance to disengage the latch member **49** therefrom and thus complete arming of the fuze will not occur until the shell

has cleared the muzzle of the gun and traveled a predetermined distance therebeyond sufficient to cause the fluid within the bellows to spin at a rate at which the member **58** is moved thereby to an armed position.

The lag in the spin of the fluid with respect to the spin of the projectile and the delay in arming caused thereby will best be understood by reference to Fig. 4 on which it is shown by the curve **75** the rate of spin of the projectile as the projectile is fired from the gun and travels along a trajectory. The rate of spin of the fluid within the bellows **53** is shown by the curve **76**. The acceleration of the fluid from a state of rest to the rate of spin corresponding to the spin of the projectile requires a much longer period of time to achieve than the time required for the shell to reach a state of maximum rate of spin. The dash line **77** is employed to indicate the rate of spin of the fluid required to generate centrifugal force sufficient to extend the expansible bellows to the armed position thereof. The intersection of the dash line **77** with the curve **76** at point **78** occurs at a time T sufficient for the projectile to be well clear of the gun before the bellows is extended sufficiently for contacts **61—62** to be disengaged and contacts **63—64** to be brought into engagement and thereby close the firing circuit from the firing mechanism to the detonator **68**.

From the foregoing it will be apparent that the firing mechanism and the circuit arrangement therefor is particularly adapted to function the fuze electrically when the projectile strikes the target a glancing blow, and the firing pin **44** is adapted to function the fuze mechanically when the projectile strikes the target a head-on-blow. Furthermore, by the aforesaid arrangement means are provided for delaying the arming of the fuze thereby to prevent explosion of the shell within the muzzle of the gun, such means being adapted to function the fuze and explode the shell regardless of the angle at which the shell strikes the target.

Whereas the invention in accordance with a preferred embodiment thereof has been described with particular reference to arming a projectile electrically by actuating electrical contacts as the bellows expands longitudinally, it is not so limited as, if desired, the bellows may be employed to cause motion in a mechanical arming system sufficient to move the components thereof into armed position as the bellows expands in response to the centrifugal force of the liquid sealed therein when the speed of rotation of the liquid reaches a predetermined value during the flight of the missile without departing from the spirit or scope of the invention. Furthermore, the elastic properties of the bellows may be supplemented by restraining springs or the like for additionally retarding movement of the bellows to the extended position thereof and, if desired, the bellows may be encased within a sleeve of sufficient size to allow free longitudinal movement thereof but sufficiently close fitting to prevent bursting of the bellows in response to the pressure of the liquid therein as the liquid is spun during the flight of the projectile.

Whereas the invention has been described in detail with respect to a projectile, it will be understood, that it may be advantageously employed, if desired, with a spin rocket or other missile which rotates during travel thereof toward a target. While the device has been shown and described with electrical safety firing and arming means, it will be understood, that if desired, any electrical means may be employed with the bellows arrangement for maintaining the fuze in a safe condition until the missile has been fired from a gun and to delay the arming of the fuze until the missile has traveled a predetermined distance therefrom, in which means are provided for firing the explosive within the missile upon impact of the missile with the target.

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 specifically described.

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.

What is claimed as new and desired to be secured by Letters Patent is:

1. In an impact fuze for a spin missile, a casing, an explosive charge arranged within said casing, an extensible bellows arranged within said fuze in coincidence with the axis of spin of the missile, respective end walls sealing said bellows, a quantity of liquid sealed within the bellows whereby said bellows is extended in response to the pressure of the liquid caused by centrifugal force of the liquid as the spin of the liquid approaches the spin of the missile, means actuated by an end wall of the bellows for arming the fuze when the bellows has been extended a predetermined amount, and means responsive to impact of the missile with a target for firing said explosive charge.

2. In an impact fuze for a spin missile, a casing, an explosive charge arranged within said casing, an extensible bellows arranged within the fuze in coincidence with the axis of spin of the missile, respective walls sealing said bellows, a quantity of liquid sealed within the bellows whereby said bellows is extended in response to the pressure of the liquid caused by centrifugal force as the spin of the liquid approaches the spin of the missile, means including a latch member in engagement with an end wall of the bellows and operated thereby as the bellows is extended for arming the fuze, and means responsive to impact of the missile with a target for firing said explosive charge.

3. In an impact fuze for a spin missile, a casing, an explosive charge arranged within said casing, an extensible bellows arranged within said fuze with the axis thereof in coincidence with the axis of the missile, respective end walls sealing said bellows, a quantity of liquid sealed within the bellows whereby said bellows is extended axially in response to the pressure of the liquid caused by centrifugal force as the spin of the liquid approaches the spin of the missile for moving the bellows longitudinally within the fuze, means including a detent slideably arranged within the fuze for initially maintaining the fuze in an unarmed condition and constructed and arranged to arm the fuze when moved a predetermined amount, means for releasing said detent in response to the movement of an end wall of said bellows, and means responsive to the impact of the missile with a target for firing said explosive charge.

4. In fuze for a spin missile, a casing, an explosive charge arranged within said casing, an extensible bellows arranged within said fuze with the axis thereof in coincidence with the axis of the missile, end walls sealing the ends of the bellows, a quantity of liquid sealed within the bellows whereby said bellows is extended in response to the pressure of the liquid caused by centrifugal force as the spin of the liquid approaches the spin of the missile, a normally open firing circuit arranged within the fuze, means responsive to movement of an end wall of said bellows for closing the firing circuit, a firing device arranged within said circuit for generating an electrical firing impulse, and an electroresponsive detonator included within the firing circuit and adapted to be fired in response to said electrical impulse.

5. In a fuze for a spin missile, a casing, an explosive charge arranged within said casing, an extensible bellows arranged within said fuze with the axis thereof in coincidence with the axis of the missile, respective end walls sealing the ends of the bellows, a quantity of liquid sealed within the bellows whereby said bellows is extended in response to the pressure of the liquid caused by centrifugal force of the liquid as the spin of the liquid approaches the spin of the missile, a normally open firing circuit arranged within the fuze, means responsive to movement of an end wall of said bellows for closing the firing circuit, a firing device arranged within said circuit for generating an electrical firing impulse, an electroresponsive detonator included within the firing circuit and adapted to be fired in response to said electrical impulse, and means on said bellows for normally short circuiting the detonator until the bellows has been moved longitudinally.

References Cited in the file of this patent

UNITED STATES PATENTS

1,689,470	Adelman	Oct. 30, 1928
2,110,552	Hayden	Mar. 8, 1938
2,331,633	Spooner	Oct. 12, 1943
2,404,553	Wales	July 23, 1946
2,455,958	Taylor	Dec. 14, 1948