April 11, 1961 R. BIANCHI 2,978,982

MAGNETICALLY DELAYED ARMING DEVICE FOR A FUZE

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FIG. 1.

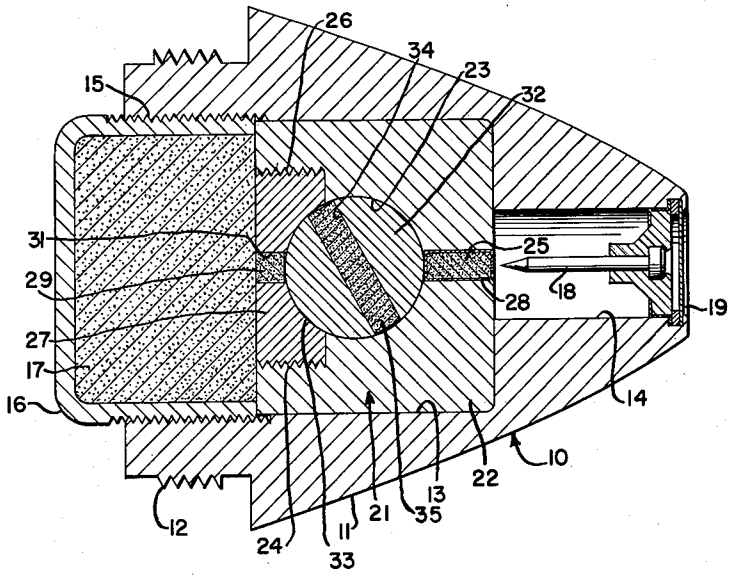


FIG. 2.

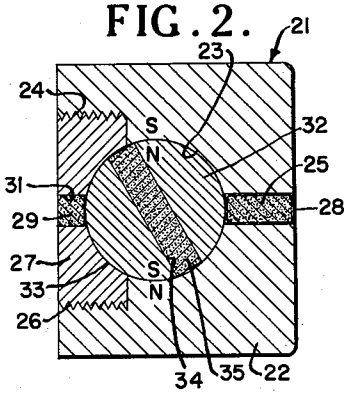
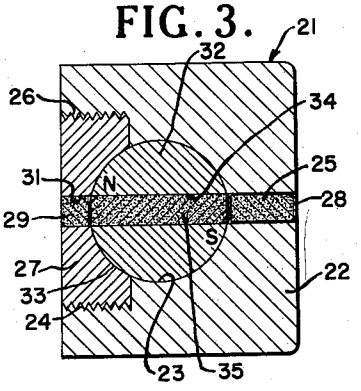


FIG. 3.



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FIG. 4.

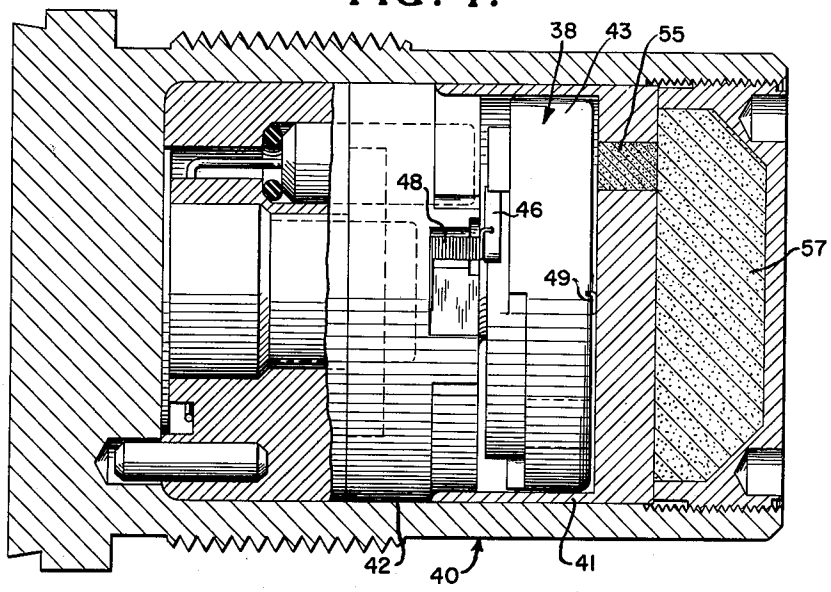


FIG. 5.

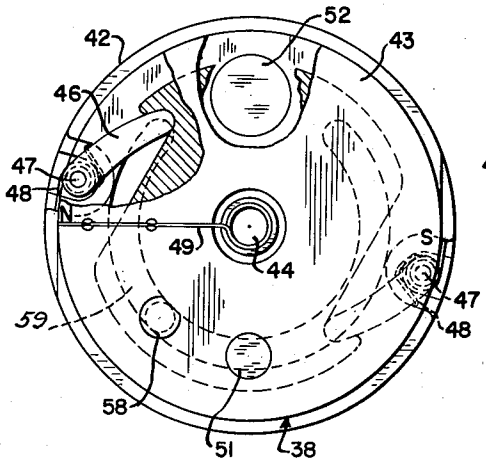
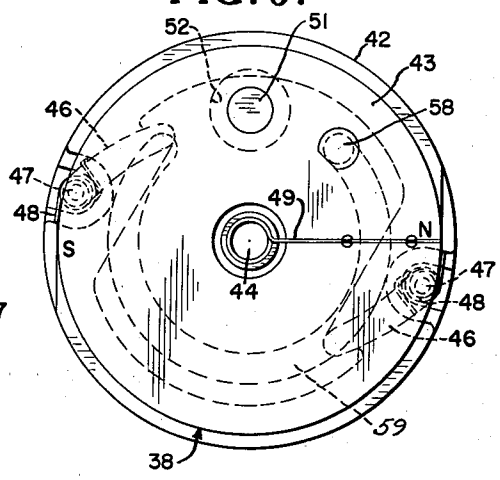


FIG. 6.



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MAGNETICALLY DELAYED ARMING DEVICE FOR A FUZE

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7 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 and more particularly to a delayed arming device for a fuze adapted for use in various types of ordnance missiles such, for example, as both small and large caliber projectiles.

Prior art delay arming devices such, for example, as the type employing rotors actuated to an armed position in response to frictional and inertia forces and the type actuated by escapement devices have not proven entirely satisfactory for the reason that the devices depending upon the aforesaid forces have not given reproduceable results and sufficient time delay periods to meet the desired requirements and the escapement devices often times being erratic in operation due to the faulty functioning of the delicate and intricate mechanisms thereof.

In view of the foregoing, the present invention contemplates the provision of a new and improved rotor device for a fuze adapted to overcome the objectional characteristics heretofore encountered in prior art devices of this type by providing simple and efficient damping means which delays the movement of the arming rotor from an initial position to an armed position to meet the desired requirements and which is void of delicate and intricate mechanisms.

Moreover, the arming device comprises a magnetized ball rotatably supported within a spherical cavity formed in a conductive housing, the ball rotor carrying a detonator and, if desired, suitable centrifugally actuated locking detents may be employed, to maintain the rotor in an initial safe position. In response to the spin of the projectile, however, the rotor is adapted to be moved from an unarmed position to an armed position. In accordance with the present invention, however, as the ball moves toward an armed position in response to centrifugal force eddy-currents are induced in the conductive casing in response to such movement. These eddy-currents create a force proportional to the relative velocity of the rotor and casing which opposes the force tending to move the rotor thus retarding the movement of the rotor to an armed position. When the rotor has been moved to an armed position, the detonator is in alignment with the percussion primer and the lead-in charge and provides a continuous firing train from the primer to the usual booster charge mounted in the fuze casing, the explosive charges being fired in successive order as the firing pin is forcibly driven into engagement with the aforesaid primer.

An object of the present invention is to provide a new and improved delayed arming device for a fuze.

Another object of the invention is the provision of a magnetic damping means for delaying the arming of a projectile fuze.

Still another object of the invention is the provision of a new and improved magnetic damping device wherein an arming rotor is subjected to a damping action as the rotor is rotated in a conductive casing thereby to prevent premature arming of a fuzed projectile.

A still further object of the invention of a new and improved magnetic damping device for a fuze which is economical to manufacture, reliable in operation and which possess all the qualities of durability in service.

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 longitudinal section of a fuze illustrating a preferred embodiment of the present invention arranged therein with the arming rotor thereof in an unarmed position;

Fig. 2 is a view in diagrammatical form of the delay device of Fig. 1 with the ball arming rotor thereof in an unarmed position;

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

Fig. 4 is a longitudinal sectional view of a fuze illustrating an alternate arrangement of the present invention;

Fig. 5 is a view in diagrammatical form of arrangement of the device of Fig. 4 with the cylindrical rotor thereof in an unarmed position; and

Fig. 6 is a view similar to Fig. 4 with the rotor in an armed position.

Referring now to the drawings and more particularly to Fig. 1 thereof, the numeral **10** generally indicates a fuze comprising a casing **11** threaded as at **12** for attachment to an explosive shell. The casing **11** is provided with a centrally disposed bore **13** terminating in a restricted bore **14**. Bore **13** is threaded as at **15** for threaded engagement with a container **16** having a booster charge **17** arranged therein and bore **14** having an impact responsive firing pin **18** releasably supported therein by a support **19**.

The device of the present invention is arranged within the bore **13** and is generally indicated by the reference character **21**. The aforesaid device comprises a magnetized casing **22** composed of any siutable electroconductive paramagnetic material such, for example, as iron or the like and having a spherical cavity or recess **23** formed therein. The cavity **23** communicates with a well **24** formed in the casing **22** at one end thereof and with a bore **25** formed in the other end thereof. The well **24** is threaded as at **26** for threaded engagement with a plug or retaining element **27**. The bore **25** has arranged therein a percussion primer **28** in alignment with the firing pin **18** and a lead-in charge **29** disposed within a bore **31** formed in the plug **27**, the charge **29** being in engagement with the booster charge **17**.

A magnetized spherical rotor **32** is rotatably supported within the spherical recess **23** of the casing **22** and a complementary spherical recess **33** formed in the plug **27**, the ball being adapted to be rotated from an initial safe position, Fig. 1, to an armed position, Fig. 3, as the rotor is moved in response to centrifugal force during the spin of the projectile along its trajectory. The ball rotor **32** is provided with a centrally disposed bore **34** extending therethrough in which is arranged a detonator **35** normally out of alignment with the foresaid primer when the rotor is in the initial safe position, Figs. 1 and 2. It will be noted that the ball **32**, Fig. 2, is arranged within the rotor casing **22** with the magnetic south pole on the rotor disposed opposite the magnetic north pole on the casing and the magnetic north pole on the rotor disposed opposite the magnetic south pole on the casing. Thus by this arrangement, the rotor is initially maintained in a safe position by the magnetic force of attraction between adjacent magnetic poles and the usual centrifugally actuated detents, employed to maintain the

rotor in an initial safe position and to release the rotor for rotation to an armed position, may be omitted.

It will be understood, however, that as the missile spins along its trajectory the rotor **32** is rotated within the aforesaid spherical recesses in response to centrifugal force. Such movement of the rotor within the conductive casing assembly induces eddy-currents and these eddy-currents create an electromagnetic force, proportional to the relative velocity of the members, opposing the centrifugal force tending to move the rotor from an initial safe position to an armed position thus retarding the rate of movement of the rotor. While the aforesaid device has been described in connection with a magnetized rotor disposed within a magnetized casing as illustrated, it will be understood that the same results may be obtained by employing a non-magnetized rotor disposed within a magnetized casing or by having the rotor magnetized and casing non-magnetized.

Referring now to an alternate arrangement of the device illustrated in Figs. 4 to 6 and more particularly to Fig. 4 thereof, the numeral **38** generally indicates the rotor device. The device is arranged in the fuze housing **40** and comprises a casing **41** composed of suitable conductive material such, for example, as iron or the like and having arranged therein a rotor support or base **42** for rotatably supporting a magnetized wafer or disc type arming rotor **43** as by a shaft **44** carried thereby. In this arrangement it will be noted that the rotor **43** is maintained in an initial safe position by a pair of oppositely disposed centrifugally actuated detents **46** disposed within a pair of notches, respectively, formed in the rotor. The detents are pivotally mounted on the base **42** as at **47**, each detent being maintained in engagement with the notches by a spring **48**.

As the projectile is fired from a gun and during the angular acceleration thereof the inertial force of the rotor moves the rotor angularly sufficiently to disengage the detents from the notches and to wind a torsional spring **49** secured to the rotor and base. When the angular acceleration of the projectile has disappeared and before the detens are returned to an initial position by the springs, the spin of the projectile is sufficient to maintain the detents in a release position with the detents out of engagement with the notches. With the detents out of engagement with the notches the arming rotor is free to be rotated to an armed position by the aforesaid torsional spring **49**. It will be understood, however, that the rotor is first moved in one direction to a release position by the inertial force thereof in response to the initial angular acceleration of the projectile and thereafter moved in a reverse direction to an armed position, Fig. 6, by the spring **49**.

When the rotor **43** is in the initial safe position, Fig. 5, it will be noted that the detonator **51** carried thereby is normally out of alignment with the electroresponsive detonator **52** mounted in the base **42**. Upon release of the rotor, however, the rotor is moved to an armed position, Fig. 6, in the aforesaid manner with the detonator **51** in alignment with the detonator or primer **52** and the rotor locked in the armed position by the aforsesaid detent and notch arrangement.

Furthermore, when the rotor moves to an armed position the detonator **51** in the rotor moves into alignment with a lead-in charge **55** arranged in the casing **41** in engagement with a booster charge **57** and thus a continuous explosive train is provided from the detonator **51** to the booster charge **57**.

The movement of the rotor to a release position and to an armed position is controlled by a stop pin **58** carried by the rotor and disposed in a substantially semicircular slot **59** formed in the base **42**, Figs. 5 and 6.

It will be understood, however, that during the rotation of the magnetized rotor **43** within the conductive casing **41** by the action of spring **49**, eddy-currents are induced in the casing and these eddy-currents create a force retarding the rotor thereby delaying the arming of the fuzed projectile.

Furthermore, the aforesaid device is particularly adapted to use in connection with electric control fuzes such, for example, as the type which fire in response to an electrical impulse generated or a voltage discharged from a storage device as the projectile strikes the target or the type which fires in response to an electrical impulse induced therein when the projectile is in proximate relation with respect to the target.

In view of the foregoing, it will be apparent that a new and improved delayed arming device has been devised for use with an ordnance missile wherein magnetic damping means are provided for retarding the movement of the arming rotor thereof from an initial position to an armed position and which is economical to manufacture, reliable in operation and which possesses all the qualities of durability in service.

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 of the United States is:

1. A delayed arming device for a spin projectile comprising a casing composed of magnetic material having north and south magnetic poles in a plane normal to the axis of spin of the projectile, a magnetic rotor disposed within said casing and having north and south poles aligned with and in opposition with the magnetic poles on said casing for maintaining the rotor in an initial safe position in response to the magnetic flux therethrough, said rotor being adapted to be moved from said initial safe position to an armed position in response to centrifugal force, the movement of the magnetic rotor within said magnetic casing inducing eddy-currents to retard movement of the rotor from said initial position to said armed position.

2. A delayed arming device for a spin projectile comprising a casing composed of conductive material, a magnetic rotor movable within said casing, means for locking said rotor in an initial safe position and for releasing the rotor for rotation to an armed position as the rotor is moved a predetermined amount to a release position in response to the initial angular acceleration of the projectile as the projectile is fired from a gun, resilient means operatively connected to said rotor for rotating the rotor from said release position to an armed position when the spin of the projectile has decreased to a predetermined value, the movement of said rotor from said release position to said armed position being retarded by the eddy-currents induced in response to the rotation of said magnetic rotor within said conductive casing.

3. A delayed arming device for a spin projectile comprising a casing composed of conductive material, a magnetic rotor normally locked within said casing in an initial safe position and moved to a release position in response to the initial acceleration of the projectile as the projectile is fired from a gun, means responsive to centrifugal force for locking said rotor in said initial position and for releasing the rotor for rotation from said initial position to an armed position as the locking means is moved to a release position by said force, resilient means operatively connected to the rotor for rotating the rotor from said release position to an armed position, said movement of the magnetic rotor within the conductive casing inducing eddy-currents to retard rotation of the rotor from said release position to said armed position, and means on said locking means for urging the locking means into locking engagement with the rotor as the spin of the projectile reaches a predetermined value and the rotor is in said armed position.

4. A delayed arming device for a spin projectile comprising a casing composed of magnetic material and magnetically poled in a plane normal to the axis of spin

of the projectile, and a movable magnetically poled element disposed within said casing and yieldably held in a safe position by magnetic attraction between the poles thereof and the poles of said casing, said element being dynamically constructed to be moved from an initial safe position to an armed position in response to centrifugal force during the flight of the projectile, the movement of said element being retarded by eddy-currents induced therein during such movement.

5. A delayed arming device for a spin projectile comprising a casing composed of magnetic material and having a seat therein, a bipolar magnetized element disposed within said seat in engagement with said casing and of dynamic structure to effect movement thereof in response to centrifugal force, said element being yieldably retained in an initial safe position by magnetic attraction between the poles of said element and the casing and adapted to be moved therefrom to an armed position by centrifugal force during the flight of the projectile, the rate of movement of the element being retarded by eddy-currents therein caused by said movement.

6. A claim according to claim 5 and including means

for maintaining the element within said seat in engagement with the casing.

7. A delayed arming device for a spin projectile comprising a casing composed of magnetic material and having a spherical cavity therein, a spherical bipolar magnetized rotor disposed within said cavity in engagement with said casing and dynamically constructed for movement by centrifugal force from an initial safe position to an armed position during the flight of the projectile, said rotor being yieldably maintained in said initial position by magnetic attraction between the poles thereof and the casing, means for maintaining the rotor within said cavity in engagement with the casing, an explosive charge in said casing, and a detonator carried by said rotor for movement into alignment with said explosive charge when the rotor is in said armed position, said movement being retarded by eddy-currents induced in said casing.

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