July 6, 1954 J. MEISTER 2,682,835

DELAY ARMING DEVICE

Filed Nov. 28, 1951

Fig. 1.

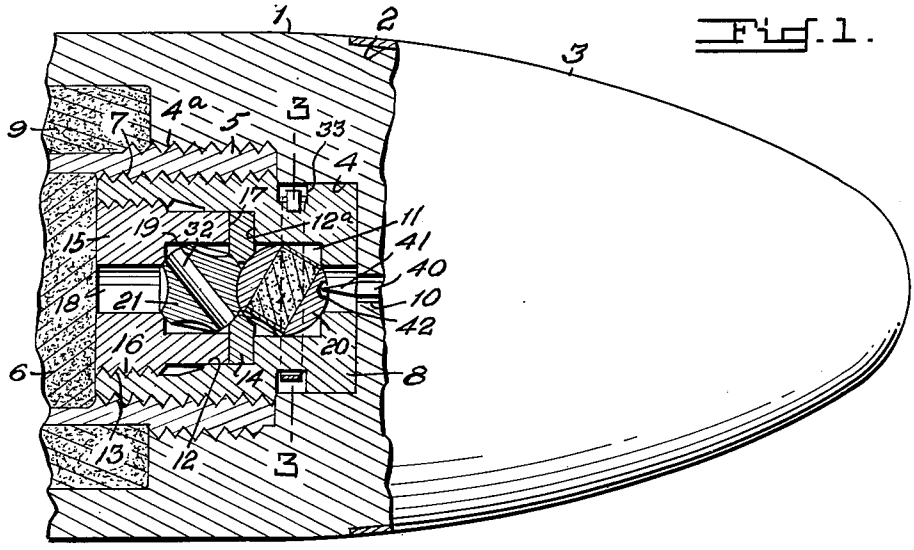


Fig. 2.

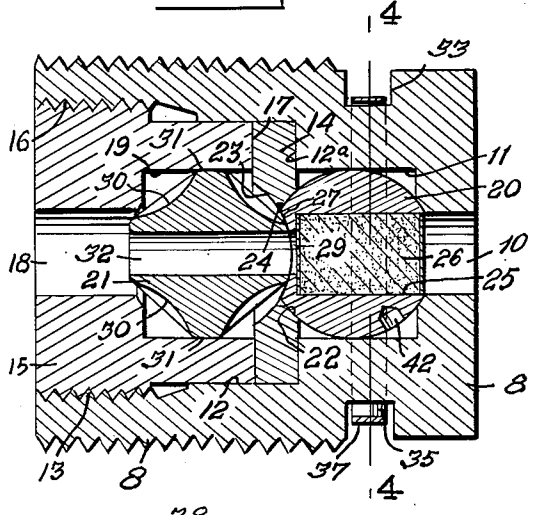


Fig. 3.

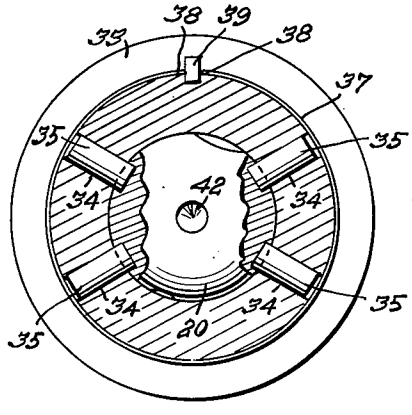


Fig. 5.

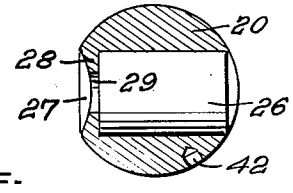
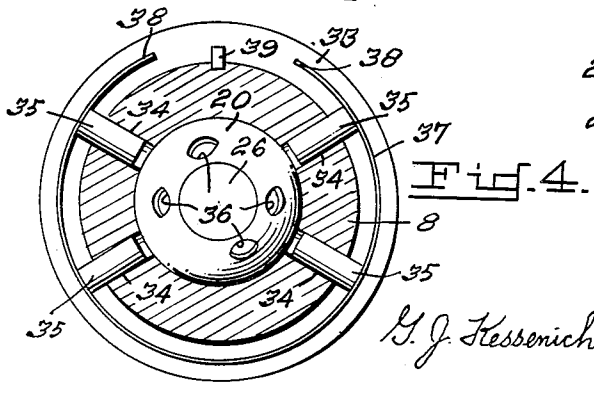


Fig. 4.



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DELAY ARMING DEVICE

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10 Claims. (Cl. 102—79)

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

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The invention described in the specification and claims may be manufactured and used by or for the Government for governmental purposes without the payment to me of any royalty thereon.

This invention relates to a delay arming device for a fuse or booster.

Delay arming devices in fuses and boosters for rotating or spin-stabilized projectiles of the type such as is common in artillery ammunition are desirable from the standpoint of maintaining the fuse in safe and unarmed position until the projectile has left the bore of the weapon, in order to protect operating personnel from premature explosions. Fuses using the expedient of a ball arming rotor to supply the necessary delay in arming are well known in the art. However, prior art devices, though effective to maintain the fuse safe while the projectile is traversing the gun bore, have fallen short in providing sufficient time to enable the projectile to clear forward battery positions, or to maintain the projectile fuse in safe condition until the projectile has arrived in the vicinity of the aimed-for target.

So also in spin-stabilized rockets it is often desirable that considerable time elapses before the rocket becomes fully armed to explode on impact, in order to insure that the projectile has traveled to a location where the blast propagation can no longer affect friendly personnel.

It is therefore a primary object of this invention to provide a centrifugal force responsive delay arming device which will permit a longer time to elapse while a projectile is in flight before the fuse becomes fully armed.

It is also an object of this invention to provide a centrifugal force responsive delay arming device incorporating more than one ball arming rotor to insure a longer delay in fuse arming.

It is also a further object of this invention to provide a centrifugal force responsive delay arming device including more than one rotor wherein a preceding rotor acts as a locking means to retain a successive contiguous rotor in unarmed position until the first rotor has itself moved into armed position.

It is also a further additional object of this invention to provide means to lock the first rotor in unarmed position and responsive to centrifugal forces set up by the rotating projectile to unlock the rotor so that it may precess into armed position.

With these and other objects in view which will become apparent as the following specification develops, reference is made to the accompanying drawing wherein:

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Figure 1 is a longitudinal section of the forward portion of a projectile incorporating the device of the present invention with the delay arming mechanism in unarmed position.

Figure 2 is a section showing the delay arming mechanism of Figure 1 in fully armed position.

Figure 3 is a transverse section taken on line 3—3 of Figure 1 showing the centrifugal force responsive means for locking the forward rotor in unarmed position.

Figure 4 is a section taken on line 4—4 of Figure 2.

Figure 5 is a view in detail of the forward rotor for receiving the detonating capsule.

Referring more particularly to Figure 1, the device comprises a main body portion 1 of the shell peripherally recessed as at 2 to receive the nose 3 of the projectile to complete the forward ogive. The main body portion comprises an axially stepped bore 4 a portion of which is internally threaded as at 4a to screw-threadedly receive the outer forward wall 5 of a container for accommodating a booster charge 6 in the well known manner. The forward wall of booster container 5 is internally threaded as at 7 to screw-threadedly receive the main housing 8 of the delay arming device, the forward portion of which extends forwardly into a reduced portion of stepped axial bore 4. The usual explosive or incendiary charge 9 is received in the rearward enlarged portion of axial bore 4 as plainly seen in Figure 1.

Referring now to Figures 1 and 2, there is formed in main housing 8 a forward axial bore 10 communicating rearwardly with a larger axial counterbore 11 which in turn communicates with an even larger axial counterbore 12 internally threaded as at 13. An annular disc shaped member 14 is received in the forward portion of counterbore 12 to abut the shoulder 12a formed by counterbores 11 and 12 and making a comparatively tight fit with the walls of counterbore 12. A plug or annulus 15 having an external screw thread 16 to screw into threads 13 is received in counterbore 12 with a forward flat surface 17 abutting the rear face of disc 14. An axial flash passage 18 is formed in the rearward portion of plug 15 to communicate rearwardly with the booster container 5 and forwardly with an axial counterbore 19 in plug 15 of diameter approximately equal to the diameter of counterbore 11.

Received respectively in counterbores 11 and 19 are substantially spheroidal arming ball rotors 20 and 21 with contiguous surfaces resting respectively in opposed spherical seats 22 and 23 formed in the front and rear faces of disc 14. The op-

posed concave surfaces of disc 14 forming spherical seats 22 and 23 are truncated centrally to form an aperture 24 to permit the arming ball rotors to face upon and touch each other at this point. Arming ball rotor 20 has a central cylindrical portion cut out to provide a diametral or axial bore 25 to receive a detonating capsule 26 containing an explosive of considerably less specific gravity than the metal rotor. The peripheral surface of the arming ball rotor 20 is dished out as at 27 in axial alinement with the rear terminus of bore 25 to form a concavity for a purpose to be later described. The concavity 27 and bore 25 are separated by an abutment or shoulder 28 made integral with rotor 20 and having an axial bore 29 of smaller diameter than bore 25. Shoulder 28 serves as a stop for the bottom of detonating capsule 26.

The peripheral surface of rearwardly located arming ball 21, received in counterbore 19, is dished out to form a plurality of concavities 30, so that a cross-section as seen in Figures 1 and 2 presents a substantially crescent-shaped configuration but with the portions 31 represented by the truncated points of the crescent formed as convex-spherical bearing surfaces to contact, when rotating, the walls of bore 19, seat 23, and concavity 27 in ball rotor 20, as later to be described. Ball rotor 21 is provided with a cylindrical axial or diametral bore 32 to form a flash passage extending between the periphery of two of the convex-bearing surfaces 31, and with a diameter approximately the same as bore 29, to aline therewith when the fuse is armed.

The detent means to prevent the forward arming ball rotor from rotating until released by centrifugal force comprises a peripheral recess or groove 33, formed in main housing 8, communicating with a plurality of radial bores 34 in each of which is received a detent pin 35 with the innermost end of each pin resting in drilled cavities 36 formed in rotor 20 when the fuse is unarmed (see Figure 3). The pins 35 are biased into ball locking position by a C-type spring 37 which is circumferentially received in groove 33. The spring forms almost a complete circle and has free ends 38 abutting a stop 39 extending into groove 33 to prevent the spring from turning. Alternatively it is to be understood that instead of C-type spring 33, each pin may be individually biased into ball locking position by separate compression springs.

The firing pin may or may not be used to provide additional locking means for the forward rotor. In the illustrated embodiment and as clearly seen in Figure 1, the firing pin is also used to lock the forward rotor in unarmed position, however since this expedient forms no part of the present invention it will only briefly be described. The firing pin 40 is received in axial bore 10 and has a rearwardly directed point 41 received in a drilled shallow hole 42 in the peripheral surface of the rotor, when the fuse is unarmed. Centrifugal force responsive means (not shown) maintain the pin in this position, however when the projectile is in flight the pin will be released to creep forwardly and out of hole 42 so that the rotor 20 can precess into armed position.

Operation

Figure 1 illustrates the delay arming device in unarmed position. Under static conditions spring 33 biases detent pins 35 into drilled cavities 36 to hold ball rotor 20 in unarmed position.

As explained above, firing pin 40 is pressed rearwardly into hole 42 to accomplish the same purpose. In this position the axis of cylindrical detonator 26 lies crosswise of the longitudinal axis of the fuse. So also in this position, the spherical surface of rotor 20 slidably engages one of the dished out cavities 30 in rotor 21, a portion of this surface also slidably engaging the forward spherical seat 22 in disc 14. It can readily be seen that so long as this engagement obtains ball rotor 21 cannot precess in response to centrifugal action until the rotor 20 has moved into armed position. In the unarmed position flash passage 32 in rotor 21 also lies crosswise of the longitudinal axis of the fuse, but is turned through an angle of approximately 120° from the axis of rotor 20.

When the projectile is fired it commences to spin because of the gun rifling or other means employed for that purpose, however, while the projectile is traversing the gun bore, setback forces hold the detent pins 35 and firing pin point 41 in their respective holes to maintain the fuse unarmed. As soon as the projectile leaves the muzzle of the gun and setback forces cease, detent pins 35 move out against the bias of spring 37 under the action of centrifugal forces and firing pin too is released so that it may creep forward under the influence of linear acceleration to release the ball rotor 20. Centrifugal forces cause rotor 20 to precess until its axis coincides with the longitudinal axis of the projectile. When this occurs concavity 27 completes, with spherical seat 23 in disc 14, a spherical cavity which is engaged by a bearing surface 30 of rotor 21 thereby releasing rotor 21 so that it can now precess under the influence of centrifugal force until its axis coincides with the longitudinal axis of the fuse to attain a fully armed position for the entire arming device. Upon impact, therefore, pin 40 is driven rearwardly to strike detonator capsule 26 and the explosion proceeds through bore 29 into flash passage 32 of rotor 21, then into flash passage 18 to ignite the explosive in the booster and finally the charge in the shell.

It is to be noted at this time that ball rotors 20 and 21 are arranged to precess in opposed directions so that the frictional forces due to rotation and precession will assist one another.

It is readily apparent that a plurality of interlocking rotors in excess of the two shown may also be used, and also that the arrangement of detonating capsule and flash passage may be reversed in the rotors. Additionally other means than the illustrated firing pin may be used to initiate ignition upon impact or otherwise.

Other modifications and alterations will be apparent to one skilled in the art, and it is obvious that the same may be made without departing from the spirit and scope of the invention as defined in the following claims.

I claim:

1. In a point detonating fuse for a rotating projectile, a body, a rearwardly directed firing pin located forwardly in said body, a first spheroidal rotor having a diametral detonator located rearwardly of said firing pin in said body, a second spheroidal rotor having a diametral flash passage located in said body rearwardly of and axially alined with said first rotor and said firing pin, the axes of said flash passage and said detonator lying crosswise of the longitudinal axis of said body when the fuse is unarmed, means to lock said first rotor in unarmed position, and means including a spherical concavity formed in

the peripheral surface of said second rotor engaging the spherical surface of said first rotor to lock said second rotor in unarmed position.

2. The combination in claim 1 wherein said means to lock said first rotor in unarmed position comprises a plurality of detent pins received in radial passages in said body and extending into holes in said first rotor, and resilient means to bias said pins inwardly.

3. The combination in claim 2 whereby said detent pins are outwardly movable under influence of centrifugal force to release said first rotor for precession into armed position.

4. The combination in claim 1 wherein said detonator and said flash passage are out of axial alinement with each other and with said firing pin when said fuse is unarmed.

5. In a fuse for a spin-stabilized projectile a first centrifugal spheroidal rotor comprising a diametral detonator, a second substantially spheroidal centrifugal rotor axially alined with said first rotor and having a diametral flash passage, a plurality of resiliently inwardly pressed radial detent pins received in holes in said first rotor to lock said first rotor in unarmed position, said detent pins moving outwardly in response to centrifugal force to release said rotor for precession into armed position, said second rotor having a spherical concavity in its periphery to engage the spherical surface of said first rotor when said first and second rotors are in unarmed position to lock said second rotor in unarmed position, said first rotor having a spherical concavity in its periphery to engage a spherical surface of said second rotor when said first rotor has precessed to armed position, whereby centrifugal force permits said second rotor to precess into armed position.

6. In a point detonating fuse for a rotating projectile, an elongated body symmetrical about a longitudinal axis, a rearwardly directed firing pin located in a forward bore in said body, a first arming ball rotor located in said body rearwardly of said firing pin and having a diametral bore with its axis lying crosswise of the longitudinal axis of said body when said fuse is unarmed, a detonator received in said diametral bore, detent means in said body locking said first arming ball rotor in unarmed position, resilient means to bias said detent means into ball locking position, a second arming ball rotor located in said body rearwardly of said first ball rotor and having a diametral flash passage with axis lying cross said longitudinal axis when said rotor is in unarmed position, said second ball rotor having a spherical cavity in its periphery to engage the spherical surface of said first rotor in unarmed position to lock said second rotor in unarmed position.

7. The combination of claim 6 wherein said detent means to lock said first rotor in unarmed

position comprises a plurality of detent pins received in radial bores formed in said body and biased to extend into holes formed in the periphery of said first rotor.

8. The combination in claim 7 wherein said detent pins are outwardly movable in response to centrifugal force to release said first rotor for precession into armed position, said first rotor having a cavity to engage a spherical portion of said second rotor when said first rotor is in armed position, whereby said second rotor is released so that centrifugal force precesses said second rotor into armed position.

9. In a centrifugally-armed fuse, a body having a flash passage therein, first and second balls mounted for rotation only in contiguous relation in said passage, each ball having a diametral bore determining an axis of maximum moment of inertia, said first ball having one end of its bore enlarged in the form of a spherical concavity symmetrical therewith and within which said second ball may turn only when the bore of said first ball is aligned with said passage, said second ball having a spherical concavity circumferentially offset from its said axis and in which fits a contiguous portion of said first ball to thereby maintain said second ball with its bore out of alignment with said flash passage and said fuse unarmed.

10. In a centrifugally-armed fuse, a body having a flash passage therein, first and second balls mounted for rotation only in contiguous relation in said passage, each ball having a diametral bore determining an axis of maximum moment of inertia, said first ball having one end of its bore enlarged in the form of a spherical concavity symmetrical therewith and within which said second ball may turn only when the bore of said first ball is aligned with said passage, said second ball having a spherical concavity circumferentially offset from its said axis and in which fits a contiguous portion of said first ball to thereby maintain said second ball with its bore out of alignment with said flash passage and said fuse unarmed, and centrifugally released means securing said first ball with its bore out of alignment with said passage.

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