April 21, 1959 J. H. BILLINGS 2,882,826

SET-BACK DEVICE FOR FUZE

Filed Aug. 5, 1955

Fig. 1.

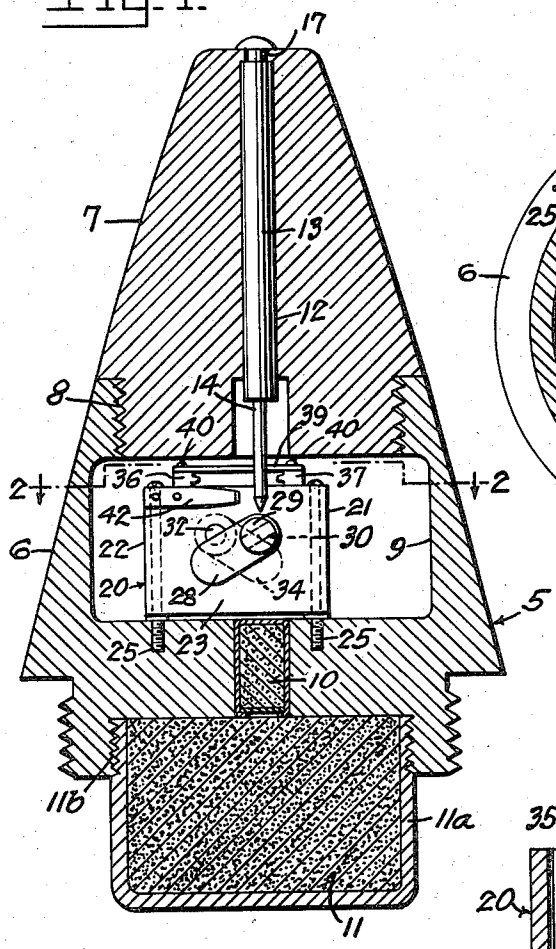


Fig. 2.

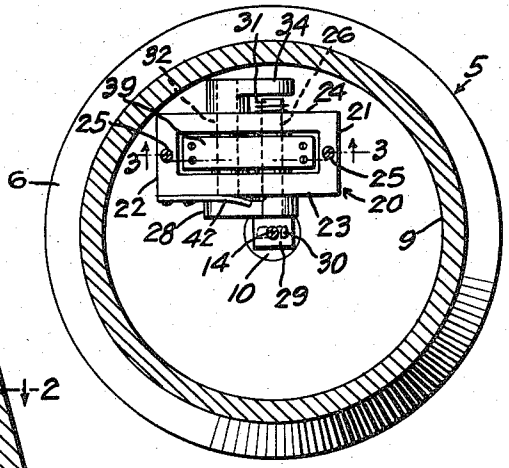


Fig. 3.

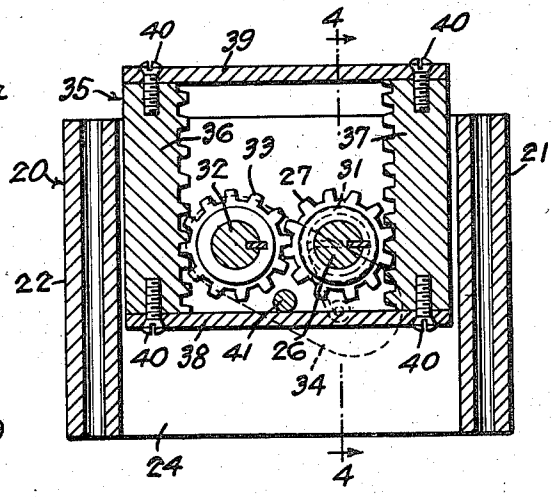
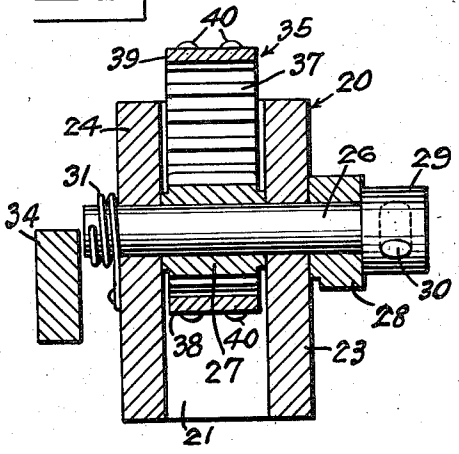


Fig. 4.



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SET-BACK DEVICE FOR FUZE

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Application August 5, 1955, Serial No. 526,796

5 Claims. (Cl. 102—78)

This invention relates to a fuze for rocket projectiles and more particularly to a type of fuze which employs the forces of forward acceleration to move the mechanism from unarmed to armed position.

An object of the invention is to provide a fuze having great stability in unarmed position and which moves quickly to armed position under acceleration forces developed in a high velocity rocket.

Another object of the invention is to provide a mechanism which possesses stability and resistance to transverse movement when subjected to jars, jolts and accidental dropping, but which moves powerfully to armed position under the influence of the forces of forward acceleration of the projectile.

Another object of the invention is to provide a mechanism wherein a translatable mass is free for straight line movement under forward acceleration of the projectile without the use of friction producing guides.

Other objects and advantages will be apparent from the following detailed description and the accompanying drawings, in which:

Fig. 1 is a longitudinal sectional view of a fuze showing one form of the invention.

Fig. 2 is a transverse sectional view of the fuze taken on the line 2—2 of Figure 1,

Fig. 3 is an enlarged sectional view of the rotating and translated masses taken on the line 3—3 of Figure 2, and

Fig. 4 is a similar sectional view taken on the line 4—4 of Figure 3.

The fuze mechanism herein disclosed moves to armed position by translation of a mass in response to linear accelerations along the path of flight of a rocket projectile, and rotating masses connected to the translated mass and movable in response to linear accelerations in such manner that the two masses tend to oppose one another under the initial set back forces. Later under sustained acceleration the translated mass overcomes the rotating masses even when the rotating masses are directed transversely of the fuze. As the rotating masses move from transverse to forward position in the fuze, the rotational forces in the rotating arms combine with inertia transmitted to the translated mass to quickly move the fuze components to armed position. Sidewise accelerations, either to the right or left, produce reactive forces in the rotating masses which are in opposition and of equal magnitude, thereby annuling any transversely directed forces.

Therefor it will be apparent from the following disclosure that the fuze will move to armed position only under the influence of sustained linear accelerations and with very slight time delay action.

Referring now to the accompanying drawings, the numeral 5 identifies a fuze body comprising a main section 6 and a forward section 7 secured thereto by screw threads 8. A cavity 9 is formed in the main section 6 and rearwardly thereof is an axially aligned opening for receiving a primer 10 leading to a booster charge 11

within a container 11*a* secured to the main section 6 as by threads 11*b*. The forward section 7 of the fuze body is formed with an axial bore 12 to slidably receive the diametrically enlarged portion 13 of a firing pin 14. The forward end of the firing pin 14 is secured as at 17 in the nose of the forward section 7 of the fuze body.

A hollow frame member 20, of any suitable configuration, houses the moving parts of fuze, to be hereinafter fully described, and is formed of an integral unit comprising end walls 21 and 22 and side walls 23 and 24. The frame 20 is secured to the rear wall of cavity 9 by any suitable means such as the screws 25. Journaled in the side walls 23 and 24 of the frame member 20 is a first shaft 26 whose axis of rotation intersects the longitudinal axis of the firing pin 14 at an angle of 90°. The shaft 26 has keyed thereto a first pinion 27 which is located between the side walls 23 and 24. Outwardy of the side wall 23 is an arm 28 which is secured to the shaft 26 and in normal safe position assumes an angle to the longitudinal axis of the fuze as clearly shown in Figure 1. A head 29, Fig. 4, integral with the shaft 26 is formed with a bore 30 whose longitudinal axis is parallel with the longitudinal axis of the lever 28 and is normally out of axial alignment with the firing pin 14. Outwardly of the side wall 24 and secured at one end thereto, is a helical spring 31 secured at its other end to the shaft 26 and tensioned to hold the bore 30 in the head 29 of shaft 26 in unarmed position. Journaled in the side walls in spaced parallel relation to the shaft 26 is a second shaft 32 having a second pinion 33 keyed thereto in mesh with the first pinion 27, see Fig. 3. Outwardly of the side wall 24 the shaft 32 carries an arm 34 normally positioned at a similar but reversed angle to arm 28, Figs. 1 and 3. The arms 28 and 34 serve as the rotating masses, and the centroid of each arm is radially offset from the axis of its shaft. As indicated upon Fig. 1, in the normal or assembled position, the radial direction of offset of each centroid is rearwardly and inwardly toward the shaft of the other arm.

A plunger assembly 35 serving as the translated mass comprises parallel rack bars 36 and 37 joined by end plates 38 and 39, and positioned within the frame 20 with the teeth of rack bar 36 meshing with the teeth of pinion 33 and the teeth of rack bar 37 meshing with the teeth of pinion 27. The end plates are secured to the rack bars by any preferred means such as screws 40. As there are no friction guiding means for the plunger assembly, stability thereof is achieved by the intermeshing connection of the rack bars and the pinions, to effect speedy and uniform travel without tilting the plunger assembly.

A torsion coil spring 31 surrounds the projecting end of shaft 26 and has its respective ends connected with the shaft and wall plate 24 so that the spring tends to hold the gears 27 and 33 and the plunger 35 in the normal or forward position as shown upon Fig. 3. Further forward motion of the plunger is arrested by a stop pin 41, Fig. 3, secured at its ends in the side walls 23 and 24 and positioned to be abutted by the end plate 38.

In the normal or safe position shown particularly in Figs. 1 and 3, the mass center of each of the pivoted arms 28 and 34 is offset from the axis of its shaft in a direction transversely of the longitudinal axis of the fuze. Due to the interconnections between plunger assembly 35 and the arms, by way of pinions 27 and 33 and racks 36 and 37, the torques exerted upon the shafts by the arms as the result of any longitudinal component of acceleration, opposes the torque similarly exerted by assembly 35. Furthermore, any component of acceleration normal to the longitudinal axis of the fuze applies torques to the

respective shafts which are canceled out by reason of the intermeshing pinions.

The mass of the plunger assembly **35** with relation to the combined masses of arms **28** and **34**, the angular position of the latter in the normal or safe position, and the torque of spring **31**, are so selected and proportioned that in this position the torque exerted by the plunger **35** is only slightly in excess of that exerted by the arms, for any unidirectional longitudinal component of acceleration. Consequently, the effect or net torque upon shafts **26** and **32** is initially of a low value and decreases as the arms pivot upwardly as viewed upon Figure 1 and approach parallelism with the axis of the fuze. When parallelism is attained, bore **30** is aligned with the firing pin **14** so that the latter may be forced into primer **10**, on impact to initiate the fuze. At this point resilient pawl **42** snaps into position behind arm **28** to hold the arms in the firing or armed position.

The operation of the fuze is as follows:

When the rocket projectile is fired and accelerated upwardly, as viewed in Fig. 1, the setback force on plunger **35** tends to urge it downwardly.

Setback forces also tend to rotate arm **28** and gear **27** counterclockwise, and arm **34** and gear **33** clockwise, as the parts are viewed in Fig. 1, in opposition to the forces set up in plunger **35**. By proper proportioning of the masses and initial angular positioning of the arms **28** and **34**, the two forces thus applied to the plunger **35** tend to be substantially initially balanced. The model illustrated is ordinarily constructed so that the downward force exerted due to the mass of the plunger itself is slightly greater than the force exerted thereon by the arms, even when the arms are rotated directly transversely of the fuze. However, since the mass center or centroid of each of the arms **28** and **34** is offset from its pivot axis, as described, acceleration causes the plunger mass to overcome the setback forces in the arms and the bias of spring **31** to rotate arm **28** in a clockwise direction and arm **34** in a counterclockwise direction. Under sustained acceleration the arms **28** and **34** rotate to a position transversely of the fuze under the influence of inertia imparted by the plunger **35** and thereafter rotate quickly past the spring detent **42**. As the arms rotate from a transverse to a forward position the force exerted upon the plunger by the pivoted arm decreases, becoming zero when the arms point forwardly from their respective shafts. Any movement of the arms beyond forwardly pointing position causes the forces imparted to the arms to combine with the forces imparted to the plunger to speed the component parts of the fuze to armed positions with bore **30** in axial alignment with the firing pin **14**.

The foregoing description applies to the use of my invention in connection with a self-propelled missile such as a rocket. However, the invention is equally useful in connection with the arming of a mortar or other projectile of the non-spinning type. In such a use, the general arrangement described might be reversed so that assembly **35** will be moved from its safe position in response to deceleration of the projectile after it has been fired which movement, of course, will be opposed to a decreasing degree by arms **28** and **34** as they approach the trailing or rearwardly disposed armed position. Since the fuze is substantially unaffected by short-period accelerations such as that involved in traversing a gun or mortar barrel, my improved fuze may by proper proportioning of the masses of the parts be rendered bore safe; and it will arm only after the projectile is well along upon its trajectory.

While I have disclosed a form of the invention presently preferred by me, various changes and modifications will occur to those skilled in the art after a study of the present disclosure. Hence the disclosure is to be taken in an illustrative rather than a limiting sense; and

it is my desire and intention to reserve all modifications falling within the scope of the subjoined claims.

Having now fully disclosed the invention, what I claim and desire to secure by Letters Patent is:

1. In a fuze for a rocket projectile, a fuze body having a central longitudinal axis, a plunger, means mounting said plunger in said body for guided translation only parallel with said axis, said plunger comprising first and second laterally spaced confronting parallel racks, first and second shafts mounted in spaced parallel relation on laterally spaced axes perpendicular to and between said racks, a first pinion fixed on said first shaft and in mesh with said first rack, a second pinion fixed on said second shaft and in mesh with said first pinion and second rack, first and second arms each fixed on a respective one of said first and second shafts with its mass center offset from the axis of its shaft, the arrangement being such that a component acceleration parallel with said longitudinal axis causes said arms to apply a force to said plunger opposite to the force applied thereto directly by the acceleration, and means responsive to rotation of said shaft to predetermined position to arm said fuze.

2. In a fuze for a rocket projectile having a body portion, a frame member secured in the body portion, a pair of shafts journaled in said frame member in spaced parallel relationship, a gear wheel secured to each shaft in intermeshing relationship with each other, an arm secured to each said shaft and constituting a rotatable mass, a plunger having rack teeth therein in intermeshing relationship with said gear wheels constituting a translatable mass, and spring means holding said plunger in forward position during unarmed position of the fuze.

3. In a fuze for a rocket projectile having a body portion, a firing pin in axial alignment with the body portion, a frame member secured in the body portion, first and second shafts journaled in said frame member in spaced parallel relationship, first and second gear wheels secured to respective shafts, first and second arms secured to respective shafts and disposed inwardly at equal and opposite angles, a plunger having a pair of rack bars whose teeth are in mesh with respective gear wheels, a head formed on one end of said first shaft and having an opening therein out of alignment with said firing pin in unarmed position and movable to alignment therewith in armed position, and a spring member for restraining said first shaft and plunger in normal unarmed position.

4. In a fuze for a rocket projectile of the type which is adapted to arm under forces of forward acceleration, a fuze body having a central longitudinal axis, a translatable mass comprising a plunger assembly consisting of a pair of spaced parallel gear racks, a pair of spaced parallel shafts journaled in said body transversely of said axis, and a rotatable mass comprising an arm fixed in radial offset relation on one end of each shaft in opposed relation, a gear mounted on each said shaft, said gears and said racks being in intermeshed relation, said translatable and said rotatable masses normally acting upon initial setback force to counterbalance each other and remain momentarily stable, but upon sustained forward acceleration to overcome said force and move rapidly to arm said fuze.

5. In a fuze for a rocket projectile, a fuze body having a central cavity therein, a frame including side and end walls rigidly affixed in said cavity, a plunger assembly comprising a pair of first and second laterally spaced confronting gear racks freely slidable in said frame, first and second shafts journaled in spaced parallel relation, the axis of said shafts being perpendicular to and disposed between said racks, a first pinion fixed on said first shaft and meshing with said first rack, a second pinion fixed on said second shaft and meshing with said first pinion and said second rack, first and second arms each fixed in angular relation on a respective one of said

first and said second shafts each with its mass center offset from the axis of its respective shaft, a detonator carrying head mounted on the arm carrying end of said first shaft and adapted for rotation therewith, said detonator to be in alignment with a firing pin longitudinally mounted in the forward portion of said fuze when said fuze is in armed condition, and a torsion coil spring connecting a side wall of said frame and said first shaft normally urging said plunger in a forward position, said plunger and said arms being of such design and arrangement as to oppose forward acceleration force upon initial set back and provide a momentary delay, but, upon sustained forward acceleration said plunger will act to overcome said setback force and rotate said arms to align said detonator with said firing pin.

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