April 1, 1969 A. STAV 3,435,767

SAFETY DEVICE FOR A PROJECTILE

Filed April 14, 1967 Sheet 1 of 2

FIG. 1

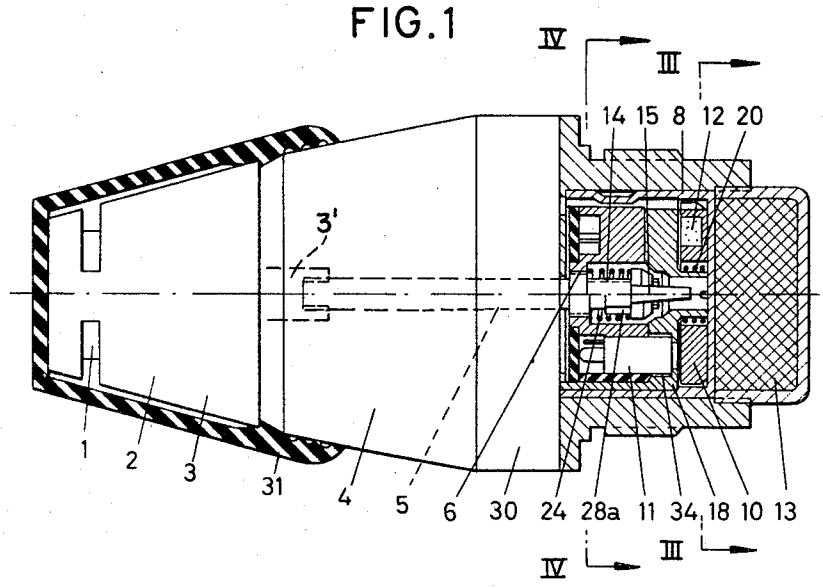

FIG. 3

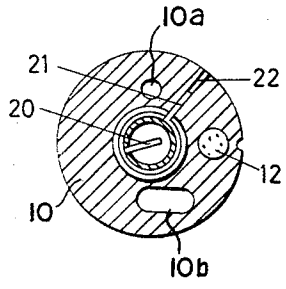

FIG. 4

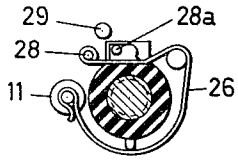

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FIG. 2a

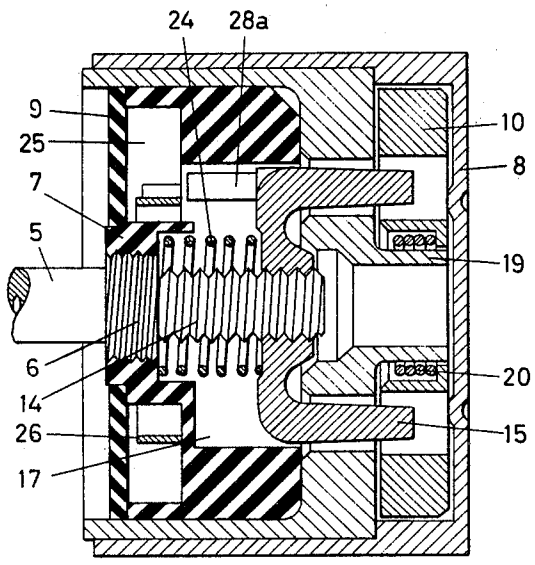
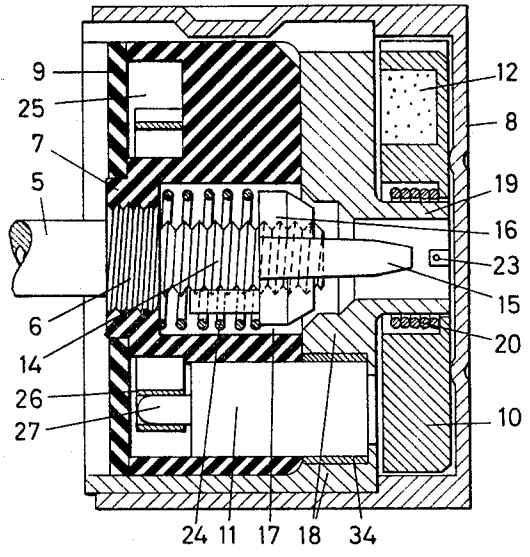


FIG. 2b



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SAFETY DEVICE FOR A PROJECTILE

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Int. Cl. F42b 5/08, 9/08
U.S. Cl. 102—70.2
5 Claims

ABSTRACT OF THE DISCLOSURE

A safety device for a shell in which an explosive primer charge is supported on a rotary disc spring-biased toward a position in which the primer charge is aligned with a detonator charge and a main charge for igniting the latter when the former is electrically ignited. An air-operated turbine turns a shaft for threadedly withdrawing prongs which normally block the disc in an inoperative position. The external ignition circuit to the detonator is closed by the movement of the disc into the operative position.

Background of the invention

This invention relates to safety devices which prevent premature explosion of a projectile, such as an artillery shell, bomb, or rocket, and which cause the projectile to be armed after a predetermined trajectory.

More specifically, the invention relates to projectiles whose explosive charges are ignited electrical by proximity fuses, altitude responsive circuits and similar devices which produce an igniting pulse under desired conditions not themselves relevant to this invention.

The object of the invention is the provision of a projectile in which the electrical ignition circuit is interrupted, and the explosive train, normally consisting at least of a detonator charge, a primer charge, and a main charge, is not established until the projectile has travelled at least over a portion of its trajectory from a launching site toward a target.

Summary of the invention

The projectile of the invention is equipped with a support carrying one of the afore-mentioned three explosive charges, and movable toward and away from a position of alignment of the one charge with the other two charges in which the primer charge is interposed between the detonator and main charges to form the explosive train of the projectile.

Blocking means normally block the support in a position remote from the position of alignment, and the external circuit which can connect a source of an electric igniting pulse with the detonator charge is interrupted. When the projectile has moved through the ambient air over a certain distance, actuating means causes the support to move from the remote position to the position of alignment, and inactivates the circuit opening means which interrupts the external circuit.

Other features, additional objects and many of the advantages of this invention will become readily apparent from the following detailed description of a preferred embodiment when considered in connection with the attached drawing.

Brief description of the drawing

In the drawing:

FIG. 1 shows the nose portion of a shell equipped with the priming mechanism of the invention in a side elevational and partly sectional view;

FIG. 2*a* shows the mechanism of the shell of FIG. 1 in an axially sectional plan view on a larger scale;

FIG. 2*b* shows the mechanism of FIG. 2*a* in an axially sectional side elevational view;

FIG. 3 is a fragmentary view of the apparatus of FIG. 1 in section on the line III—III; and

FIG. 4 shows a portion of the apparatus of FIG. 1 in section on the line IV—IV.

Description of the preferred embodiment

Referring now to the drawing in detail, and initially to FIG. 1, there is seen the nose portion of a shell, the front end of which is protected by a rubber cap **31** until the shell is ready to be fired. When the cap is removed, a radial turbine **1** is exposed. The turbine is operated in the flying projectile by the ambient air and drives an electric generator and the input shaft of a speed reducing gear transmission, the generator and transmission being housed in respective axial sections **2**, **3** of the conical nose portion and not being visible in the drawing. Another axial nose section **4** encloses electronic gear energized by the afore-mentioned generator to provide a suitably timed detonating pulse in a manner known in itself.

The priming mechanism of the shell with which this invention is more specifically concerned is installed in the cylindrical portion **30** of the shell in a housing **8** provided with a metallic insert **18** and an insulating insert **7**. The drive shaft **5** of the priming mechanism is splined to the output shaft **3'** of the afore-mentioned transmission, not otherwise shown, so that it rotates coaxially with the transmission shaft as long as the splines couple the two shafts to each other, but is axially movable relative to the transmission shaft, and disengageable by such axial movement.

As is better seen in FIGS. 2*a* and 2*b*, the shaft **5** carries fine threads **6** which are received in mating internal threads of the insulating insert **7** in the inoperative position of the mechanism shown in the drawing. Coarse threads **14** on the shaft **5** in a cavity **17** of the insert **7** threadedly engage a nut **16** which carries two prongs **15**. A helical compression spring **24** axially interposed between the nut **16** and a radial face of the insulating insert **7** biases the nut **16** toward the right, as viewed in FIGS. 2*a* and 2*b*, and thereby tends to pull the shaft **5** out of engagement with the output shaft **3'** of the speed reducing transmission.

The insert **18** is generally cup-shaped and encloses the insert **7**. A tubular outward projection **19** on the bottom of the cup provides a bearing for a disc **10** also seen in FIG. 3. A torsion spring **20** is coiled about the projection **19**. One end of the spring is held in a radial bore **23** of the projection **19**. The other end **21** engages a radial groove **22** in the disc **10**. When the disc **10** is in the illustrated position, the spring **20** is tensioned, and the prongs **15** which enter axial bores **10***a*, **10***b* in the disc **10** prevent rotation of the disc.

An axial recess in the disc **10** is filled with an explosive primer charge **12** which is offset 180° from axial alignment with a detonator **11**. The detonator is secured in axially aligned bores of the inserts **7**, **18** by a sleeve **34**. A contact pin **27** of the detonator projects into an annular groove **25** in the radial front face of the insert **7** which is normally closed by a cover **9**.

The two ends of a leaf spring **26** are looped under tension in the groove **25** over the contact pin **27** of the detonator **11** and over a holding pin **28**, as is best seen in FIG. 4. The pin **28** is axially slidable in the inserts **7**, **18** and biased by a spring (not shown) into abutting engagement with an imperforate face portion of the disc **10** in the illustrated position of the apparatus. A stud **28***a* on one of the prongs **15** is axially aligned with a portion of the groove **25** near the pin **28** and near a contact pin **29** in the groove **25**, which is connected with one output terminal of the detonating circuit in the nose portion **4**, the

other terminal being connected to the cover of the detonator **11** through the metallic elements of the shell in a conventional manner, not shown.

The main explosive charge of the shell, or a booster charge **13** are contiguously adjacent the frangible rear wall of the housing **8**.

The afore-described apparatus operates as follows:

When the shell is fired from a gun, the air striking the blades of the turbine **1** turns the shaft **5**, the rotary speed of the turbine being reduced at a ratio of 300:1 by the transmission in the nose section **3**. The rotating shaft **5** axially moves toward the right, as viewed in FIGS. 1, 2*a* and 2*b*, on the fine threads **6** while the nut **16** moves much more rapidly to the left on the coarser threads **14**. The prongs **15** are thereby withdrawn from the bores **10***a*, **10***b*, the stud **28***a* is moved into the groove **25**, and the disc **10** is released to rotate under the urging of the spring **20**.

When the prongs **15** are again simultaneously aligned with the bores **10***a*, **10***b*, respectively, after rotation of the disc through 180°, the holding pin **28** is axially aligned with a portion of the circumferentially elongated bore **10***b*, and drops into the bore, thereby releasing the spring **26**, which strikes the stud **28***a*, and stopping the disc **10**.

Immediately thereafter, the threads **6** lose contact with the insert **7**, and the shaft **5** is shifted toward the right and out of engagement with the transmission shaft by the spring **24**. The prongs **15** drop into the bores **10***a*, **10***b*, while the disc **10** is stopped in a position 180° from that shown in the drawing. The intermediate charge **12** is axially aligned with the detonator **11**.

Simultaneously, the stud **28***a* is withdrawn from the groove **25**, and the spring **26** relaxes or expands further until its free end strikes the contact pin **29**, thereby closing the external circuit between the non-illustrated electronic gear in the nose section **4** and the detonator **11**.

The explosive train of the shell is now armed or primed. When an igniting pulse is generated in the electronic gear, the detonator **11** is set off, thereby causing explosion of the aligned primer charge **12** which in turn ignites the main or booster charge **13** through an opening blasted in the insert **18**.

What is claimed is:

1. In a projectile having a shell, an electrically ignited detonating charge, a main explosive charge, a primer charge adapted to form an explosive train with said detonating charge and with said main explosive charge when aligned therewith, a source of an igniting pulse, an external detonating circuit adapted to connect said source to said detonating charge, and a safety device for preventing premature explosion of said main charge, said charges being arranged in said shell, the improvement in the safety device comprising:

(a) a support carrying one of said three charges, said support movable toward and away from a position of alignment of said one charge with the other two charges in which said primer charge is interposed between said detonator charge and said main charge to form said explosive train therewith;

(b) blocking means for blocking said support in a position remote from said position of alignment;

(c) circuit opening means for interrupting said external circuit; and

(d) actuating means responsive to movement of said projectile through ambient air over a predetermined distance for releasing said blocking means and moving said support from said remote position to said position of alignment, and for inactivating said circuit opening means to close said external circuit, said actuating means including an air operated motor, motion transmitting means operatively interposed between said motor and said support for moving the support in response to movement of said motor, said motion transmitting means including a shaft having an axis and adapted to be mounted in said projectile for threaded movement about said axis, coupling means for connecting said shaft to said motor and for rotating said shaft about said axis, said coupling means being responsive to the axial component of said threaded movement for disengaging said shaft from said motor, said actuating means further including resilient means urging said support to move from said remote position to said position of alignment, and said blocking means being connected to said shaft for releasing said support from said remote position in response to rotation of said shaft, said support being mounted in said projectile for rotation about an axis, said one charge being spaced on said support from the axis of rotation, the support moving angularly between said positions thereof and being formed with two circumferentially spaced openings, and said blocking means including prong means mounted on said shaft for threaded movement responsive to rotation of the shaft inwardly and outwardly of one of said openings in said remote position of said support, and for movement inwardly and outwardly of the other opening in said support in the position of alignment of the support.

2. In a projectile as set forth in claim **1**, said one charge being said primer charge.

3. In a projectile as set forth in claim **2**, said actuating means further including circuit closing means responsive to said movement of said support into said position of alignment for closing said circuit.

4. In a projectile as set forth in claim **1**, engageable threads on said shaft and on said shell for threadedly mounting said shaft in the projectile, said threads being disengaged by rotation of said shaft, and yieldably resilient means urging said shaft to move axially in a direction to engage said prong means with an opening in said support

5. In a projectile as set forth in claim **4**, said actuating means including circuit closing means responsive to said angular movement of said support for closing said external circuit.

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