Jan. 19, 1960 J. RABINOW 2,921,524

FUZE SAFETY DEVICE

Filed Aug. 29, 1944 2 Sheets-Sheet 1

FIG. 1.

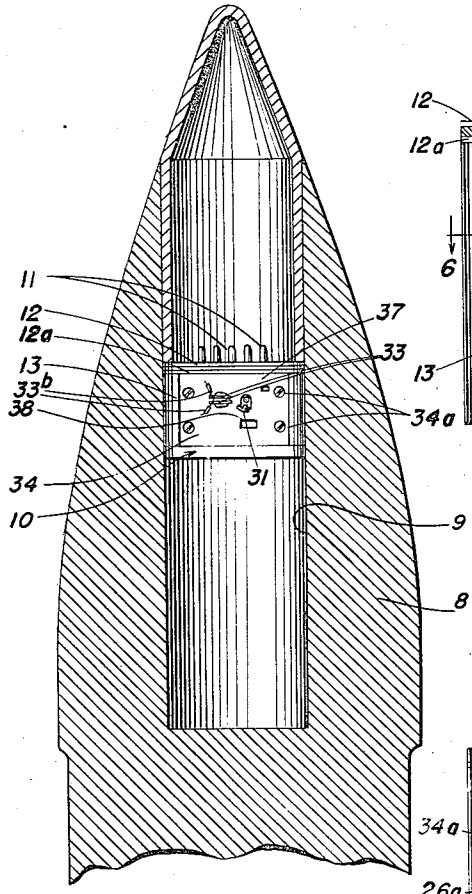


FIG. 2.

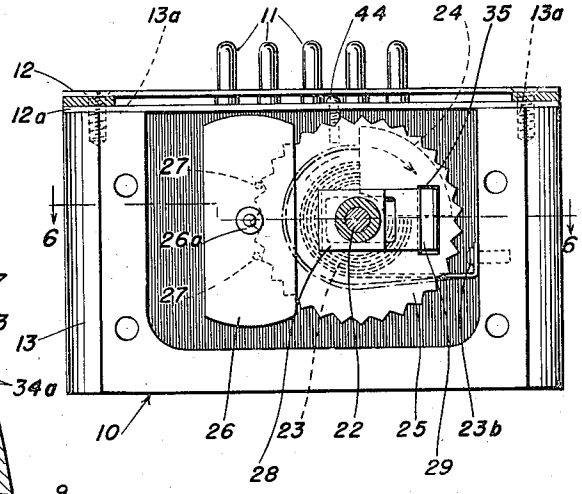
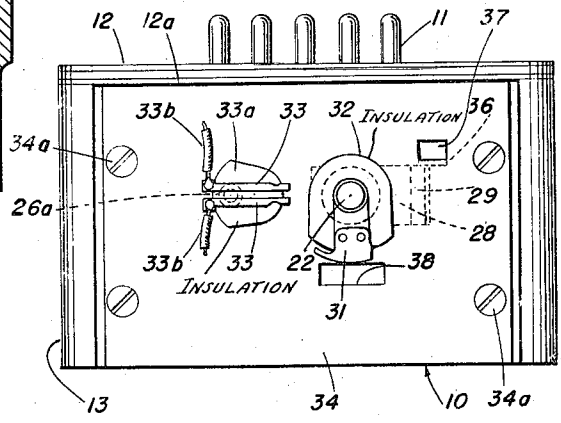


FIG. 3.



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FIG. 4.

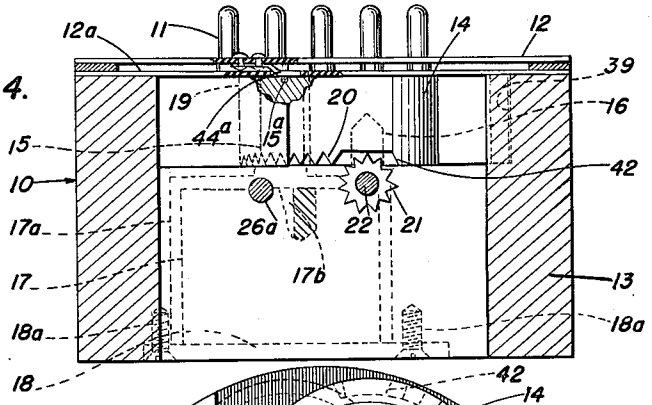


FIG. 5.

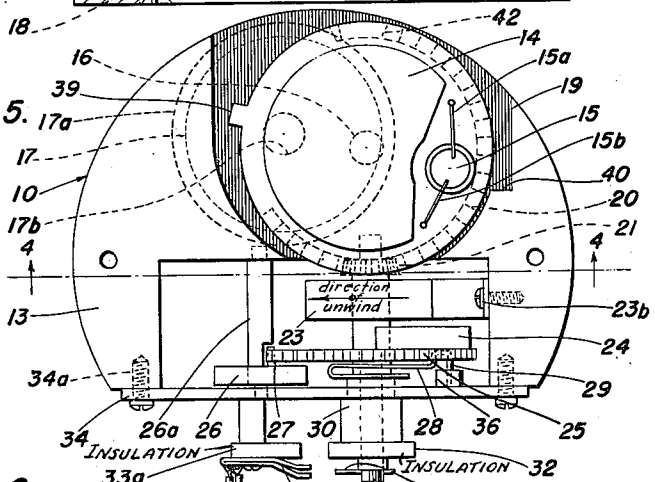


FIG. 6.

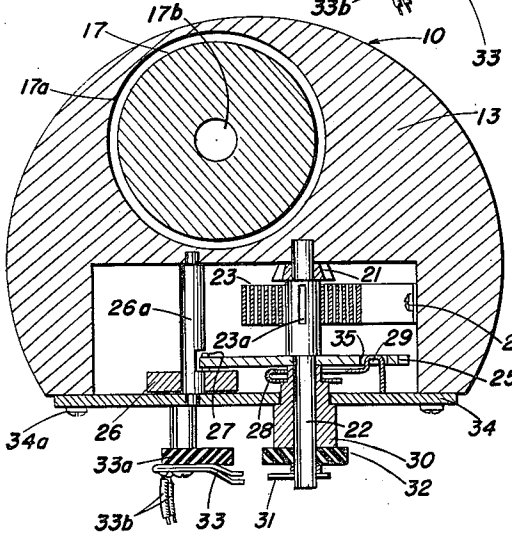
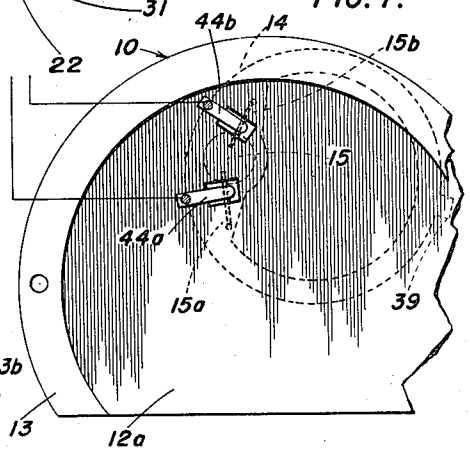


FIG. 7.



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FUZE SAFETY DEVICE

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Application August 29, 1944, Serial No. 551,762

9 Claims. (Cl. 102—70.2)

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

This invention relates to safety devices for projectile fuzes of the electrically operated type and has particular reference to a combination safety switch and powder train interrupter of novel construction which is started in operation by inertia incident to acceleration of the projectile when it is fired. The new safety device is simple and compact in construction and positive in operation.

One object of the present invention resides in the provision of a combination inertia switch and powder train interrupter for fuzes, which includes an arming switch operable only by a setback force resulting from sustained acceleration of the projectile, and a latch normally locking the interrupter in an unarmed position and operable only by the sustained setback force to release the interrupter for movement to its armed position and to lock the switch in its armed position.

Another object of the invention is to provide a combination inertia switch and powder train interrupter having an operating shaft rotatable in one direction by an inertia element to close an arming switch and in the opposite direction by a driving spring to move the interrupter to its armed position, and a latch normally locking the shaft against rotation by the spring and operable by the inertia element only upon sustained acceleration to release the latch from the shaft and allow rotation of the shaft by the spring.

Still another object is to provide a combination inertia switch and powder train interrupter having an operating shaft rotatable in one direction by an inertia element to close an arming switch and in the opposite direction by a driving spring to move the interrupter to its armed position, and an adjustable self-destruction switch including the driving spring as one contact.

A further object is to provide a device of the character described in which the interrupter is adjustable to vary the driving connection between the interrupter and the operating shaft, whereby the arming time may be varied.

An additional object of the invention is to provide a safety device for fuzes, which comprises a booster removably mounted in a housing and having a firing passage, a powder train interrupter removably and rotatably mounted on the booster and having a firing passage initially offset from the booster passage, and driving means in the housing for rotating the interrupter on the booster to align the passages for firing of the booster, the interrupter being adjustable relative to the driving means and the booster to vary the arming time.

Still another object is to provide a device of the character described having a second arming switch operated by movement of the powder train interrupter to its armed position.

These and other objects of the invention may be better understood by reference to the accompanying drawings, in which:

Fig. 1 is a longitudinal sectional view of the nose portion of a projectile embodying one form of the new safety device;

Fig. 2 is a front elevational view of the safety device

shown in Fig. 1, with parts of the device removed and certain parts shown in section;

Fig. 3 is a front elevational view of the safety device;

Fig. 4 is a sectional view on the line 4—4 in Fig. 5, with the interrupter in its armed position;

Fig. 5 is a top plan view of the device shown in Figs. 2 and 3, with the covers removed;

Fig. 6 is a sectional view on the line 6—6 in Fig. 2, and

Fig. 7 is a view similar to Fig. 5 but with only the upper plate removed, part of the device being broken away.

The new safety device, as illustrated, is in a form particularly adapted for use in a projectile 8 having an axial bore 9 in its nose portion for receiving the components of an electrically operable fuze (not shown), such as that disclosed in a copending application of W. S. Hinman, Jr., et al., Serial No. 560,832, filed October 28, 1944. In such fuzes, it is desirable to provide safety means for preventing premature firing of the fuze in handling or before the projectile has travelled a safe distance from the gun or other launching device.

The safety device, shown generally at 10, is fitted closely in the axial bore 9 and has a plurality of connector plugs 11 extending from its front end for electrically connecting the device to the fuze parts. The plugs 11 are clamped between insulating plates 12 and 12*a* secured to the front end of a hollow cylindrical casing or housing 13, as by means of screws 13*a*. A rotary powder train interrupter 14 is mounted in the casing 13 near the front end thereof and has a longitudinal passage for receiving an electrically operable detonator or squib 15. The interrupter 14 is rotatable in a horizontal plane, as seen in Fig. 4 on a pin 16 secured to a booster cup 17 which is disposed in a longitudinal passage 17*a* extending from the rear end of the casing. The booster 17 may be inserted in passage 17*a* from the rear end of the casing and is held in position by a rear cover-plate 18 secured to the casing by screws 18*a* or other suitable means. The interrupter 14 is inserted in the casing through a front opening 19 and is removable from the pin 16 on which the interrupter may rotate. In assembling the device, the interrupter 14, with the detonator 15 in it, may be installed by sliding the interrupter through the front opening 19 (Fig. 5) and then inserting the booster 17 in place so that the pin 16 acts as a bearing for the interrupter, as described. The interrupter 14 is held on the pin 16 by the front cover plates 12 and 12*a*.

On its rear face, the interrupter or rotor 14 is provided with teeth 20 forming a generally circular rack extending part way around the rotor. The rack 20 meshes with a pinion 21 mounted on an operating shaft 22 extending transversely of the casing and suitably journalled therein. A coil spring 23 extends around the shaft intermediate its ends, one end of the spring being secured to the shaft, as by a key 23*a*, and the other end of the spring being secured to the casing, as by a screw 23*b*. Thus, the spring 23 serves as a driving member acting to rotate the shaft 22 counter-clockwise, as seen in Fig. 2.

An inertia weight 24 is secured to a toothed wheel 25 which is mounted on shaft 22 and forms part of an escapement mechanism including an escapement weight 26 rotatable on a transverse shaft 26*a*. The weight 26 has a pair of pins 27 adapted to be engaged alternately by the teeth of wheel 25, in the usual manner, to limit the speed of rotation of the wheel 25 under the influence of spring 23 in one direction and under a setback force on weight 24 in the other direction.

The wheel 25 rotates with shaft 22 and cooperates with a latch comprising a strap spring 28 having a hump 29, the latch being secured to a sleeve or hub 30 mounted on shaft 22 for rotation relative to the shaft. A switch blade 31 is connected to an insulating plate 32 secured to the rear end of hub 30, and the hub is adapted to be rotated by

weight 24 through shaft 22 so as to move the blade 31 to a position for bridging a pair of switch contacts 33. The contacts 33 are secured to an insulating mounting 33*a* on a plate 34 at one side of the casing. The contacts may be connected through wires 33*b* and plugs 11 into a battery circuit of the fuze (not shown), such as an A battery circuit, so as to close the circuit when the blade 31 bridges the contacts. A similar switch blade and contacts (not shown) may be used to close a B battery circuit in the fuze.

The spring 28 normally tends to move the hump 29 away from the wheel 25 but is prevented from doing so by the plate 34 which normally engages the free end of spring 28. The plate 34 is secured to the casing in any suitable manner, as by means of screws 34*a*, and serves to cover the escapement mechanism and the driving spring 23 in the casing and also to support the shafts 22 and 26*a* and the collar 30 as well as the switch mounting 33*a*. Normally, the plate 34 holds the strap spring 28 in a position such that the hump 29 projects into an opening 35 in the wheel 25, so that rotation of the wheel by shaft 22 will also rotate the hub 30 and the switch blade 31. The free end portion of latch spring 28 is normally pressed by wheel 25 and driving spring 23 against a stop lug 36, which may be formed by stamping out an opening 37 in plate 34.

In operation, when the projectile 8 is fired, the resulting acceleration causes inertia weight 24 to move downwardly, as seen in Fig. 2, thereby rotating wheel 25 and shaft 22 in a clockwise direction (Fig. 2) against the action of spring 23, until the free end of latch spring 28 overlies a slot 38 (Fig. 3) formed in plate 34. Thereupon, the spring tension in the latch 28 moves the free end of the latch into the slot 38 and moves the hump 29 out of the opening 35 in wheel 25. In this position of the parts, the switch blade 31 bridges switch contacts 33 so as to close the battery circuit (not shown), and the hub 30 is locked in the switch closing position by engagement of latch spring 28 in slot 38. Also, the wheel 25 is released from the hub 30 by the latch. Accordingly, shaft 22 is rotated in the opposite direction by driving spring 23 after the acceleration has been sufficiently reduced to enable the driving spring to overcome the setback force on inertia weight 24.

Rotation of shaft 22 by driving spring 23 rotates the interrupter rotor 14 clockwise (Fig. 5) through pinion 21, until a lug 39 on the rotor strikes a shoulder 40 in the casing recess 19. When the lug 39 engages shoulder 40, the rotor 14 has moved detonator 15 to a position directly in line with a tetryl passage 17*b* (Fig. 4) in the booster 17, so that the booster charge is adapted to be fired by the detonator through the firing passage 17*b*. The detonator 15 has contact arms 15*a* and 15*b*, and in the normal unarmed position of rotor 14 the arms 15*a* and 15*b* are disengaged to maintain an open circuit at the detonator, and the detonator is offset from firing passage 17*b* through an angle of approximately 180°. However, when the interrupter is rotated to its armed position to align the detonator with the booster passage 17*b*, as described, the detonator contact arms 15*a* and 15*b* are moved into engagement with contacts 44*a* and 44*b*, respectively (Fig. 7), for connecting the detonator through plugs 11 into a fuze firing circuit (not shown). The device is now armed.

The rack 20 on the interrupter rotor 14 terminates in a recess 42 in which the pinion 21 lies when the interrupter lug 39 engages shoulder 40. Accordingly, when the rotor is moved to its armed position, the pinion 21 is free to continue its rotation in recess 42 under the action of spring 23 and independently of the rotor, the rate of rotation being controlled by the escapement. As the driving spring 23 unwinds, it expands and finally engages an insulated contact screw 44 (Fig. 2) which, with the spring 23, forms a self-destruction switch. That is, the contact 44 and spring 23 upon engagement are adapted to connect the detonator 15 directly to a battery (not shown) for firing the detonator in the event that the normal operation of the fuze does not fire the detonator. It will be understood that the closing of the self-destruction switch may be timed by adjusting the switch contact 44. Also, the character of the escapement mechanism and the driving spring 23 will partly determine the time required to operate the self-destruction switch. If desired, the contact 44 may be connected to one side of the battery through a plug 11, and the spring 23 and the other side of the battery may be grounded to the projectile casing, so that the detonator is energized upon engagement of spring 23 with contact 44.

The safety device of my invention is simple and rugged in construction and is positive and reliable in operation. The interrupter and the arming switches are positively locked in their unarmed positions prior to firing of the projectile, and the parts are released from their unarmed positions only by a sustained force of setback incident to sustained acceleration of the projectile. The latch 28 serves to lock the operating shaft 22 and the switch hub 30 together and prevent rotation of the parts by driving spring 23, and also to release the switch hub from the driving shaft and lock the switch 31—33 in its armed position when the device is subjected to a sustained acceleration. The interrupter rotor 14 is held securely in its armed position after rotation by the operating shaft 22, by engagement of pinion 21 in the rack recess 42. Another advantage of the new device is that the time interval for final arming may be adjusted by placing the interrupter rotor 14 in mesh with pinion 21 at any desired angular position.

The invention herein described 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.

I claim:

1. A safety device for fuzes, which comprises an operating shaft, a spring connected to the shaft for rotating said shaft in one direction, an inertia element for rotating said shaft in the opposite direction against the spring upon acceleration of said device, means for securing said shaft against rotation by the spring, said securing means being operable to release said shaft only upon rotation of said shaft by said element in response to sustained acceleration, an arming switch operable by said shaft upon rotation in response to said sustained acceleration, a booster charge, a rotor, a powder train within said rotor for communication with said booster, said rotor being biased normally in an unarmed position whereby to break the communication of said train with said booster, a driving connection between the shaft and the rotor for rotating said rotor to an armed position through action of the spring, and means for controlling the speed of rotation of said shaft.

2. A safety device for fuzes, which comprises an operating shaft, a spring connected to the shaft for rotating it in one direction, stop means for securing the shaft against rotation by the spring, an inertia element for rotating the shaft in the opposite direction against the spring upon acceleration of the device, means for rendering the stop means ineffective only upon rotation of the shaft by said element in response to sustained acceleration, an arming switch operable by the shaft upon rotation in response to said sustained acceleration, a rotor having a powder train therein, said rotor being biased normally in an unarmed position, a driving connection between the shaft and the rotor for rotating the rotor to an armed position through action of the spring, and means for controlling the speed of rotation of the shaft by the spring.

3. A safety device for fuzes, which comprises an operating shaft, a spring connected to the shaft for rotating it in one direction, an inertia element for rotating the shaft in the opposite direction against the spring upon acceleration of the device, means for securing the shaft

against rotation by the spring and operable to release the shaft only upon rotation of the shaft by said element in response to sustained acceleration, an arming switch operable by the shaft upon rotation in response to said sustained acceleration, a rotor having a powder train therein, said rotor being biased normally in an unarmed position, a driving connection between the shaft and the rotor for rotating the rotor to an armed position through action of the spring, means for controlling the speed of rotation of the shaft, and a second arming switch operable upon rotation of the rotor to its armed position.

4. A safety device for fuzes, which comprises an operating shaft, a spring connected to the shaft for rotating it in one direction, an inertia element for rotating the shaft in the opposite direction against the spring upon acceleration of the device, means for securing the shaft against rotation by the spring and operable to release the shaft only upon rotation of the shaft by said element in response to sustained acceleration, an arming switch operable by the shaft upon rotation in response to said sustained acceleration, a rotor having a powder train therein, said rotor being biased normally in an unarmed position, a driving connection between the shaft and the rotor for rotating the rotor to an armed position through action of the spring, means for disengaging said driving connection after rotation of the rotor to its armed position to permit continued rotation of the shaft by the spring independently of the rotor, means for controlling the speed of rotation of the shaft, and a second switch operable by said continued rotation of the shaft.

5. A safety device for fuzes, which comprises an operating shaft, a spring connected to the shaft for rotating it in one direction, an inertia element for rotating the shaft in the opposite direction against the spring upon acceleration of the device, stop means for securing the shaft against rotation by the spring and operable to release the shaft only upon rotation of the shaft by said element in response to sustained acceleration, an arming switch operable by the shaft upon rotation in response to said sustained acceleration, a rotor having a powder train therein, said rotor being biased normally in an unarmed position, a pinion on the shaft, a rack on the rotor engaging the pinion and terminating in a recess, the spring being operable through the shaft and pinion to rotate the rotor to an armed position in which the pinion is disposed in the recess to permit continued rotation of the shaft independently of the rotor, means for controlling the speed of rotation of the shaft, and a second switch operable by said continued rotation of the shaft.

6. A safety device for fuzes, which comprises an operating shaft, a coil spring connected to the shaft for rotating it in one direction, said spring forming a switch contact, an inertia element for rotating the shaft in the opposite direction against the spring upon acceleration of the device, stop means for securing the shaft against rotation by the spring and operable to release the shaft only upon rotation of the shaft by said element in response to sustained acceleration, an arming switch operable by the shaft upon rotation in response to said sustained acceleration, a rotor having a powder train therein, said rotor being biased normally in an unarmed position, a driving connection between the shaft and the rotor for rotating the rotor to an armed position through action of the spring, means for disengaging said driving connection after rotation of the rotor to its armed position to permit continued rotation of the shaft by the spring independently of the interrupter, means for controlling the speed of rotation of the shaft, and an adjustable switch contact engageable by the spring upon expansion thereof incident to said continued rotation of the shaft.

7. A safety device for fuzes, which comprises an operating shaft, a spring connected to the shaft for rotating it in one direction, an inertia element for rotating the shaft in the opposite direction against the spring upon acceleration of the device, a collar on the shaft and rotatable relative to the shaft, a latch for locking the collar and the shaft together, a stop for securing the collar against rotation by the spring, means responsive to rotation of the shaft and collar by said element upon sustained acceleration for rendering the latch inoperative, thereby to release the shaft from the collar, an arming switch operable by rotation of the collar upon said sustained acceleration, a rotor having a powder train therein, said rotor being biased normally in an unarmed position, a driving connection between the shaft and the rotor for rotating the rotor to an armed position through action of the spring, and means for controlling the speed of rotation of the shaft by the spring.

8. A safety device for fuzes, which comprises an operating shaft, a spring connected to the shaft for rotating it in one direction, an inertia element for rotating the shaft in the opposite direction against the spring upon acceleration of the device, an escapement mechanism for governing the speed of rotation of the shaft and including a toothed wheel on the shaft, a collar on the shaft rotatable relative thereto, a spring latch on the collar for locking the wheel and collar together and biased toward an inoperative position, a stationary plate normally engaging the latch for holding it in locking relation to the wheel, said plate having means operable to release the latch upon rotation of the shaft by said element in response to sustained acceleration, whereby the collar is released from the wheel, a stop for securing the collar against rotation by the spring, an arming switch operable by the collar upon rotation thereof by the shaft in response to said sustained acceleration, a rotor having a powder train normally in an unarmed position, and a driving connection between the shaft and the rotor for rotating the rotor to an armed position through action of the spring.

9. In a safety device for projectile fuzes, an arming switch, a powder train, an interrupter therefor, a driving spring for moving the interrupter to an armed position and normally urging the switch to an unarmed position, an inertia element for moving the switch to an armed position against the spring action upon sustained acceleration of the device, and a latch for securing the interrupter against movement by the spring, means for actuating said latch upon movement of the inertia member and latch to a predetermined position to release said interrupter, said means cooperating with said latch after the release of the interrupter to lock the switch in its armed position.

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