Nov. 17, 1959 J. RABINOW 2,912,933

SAFETY DEVICE

Filed Jan. 24, 1944 2 Sheets-Sheet 1

FIG. 2.

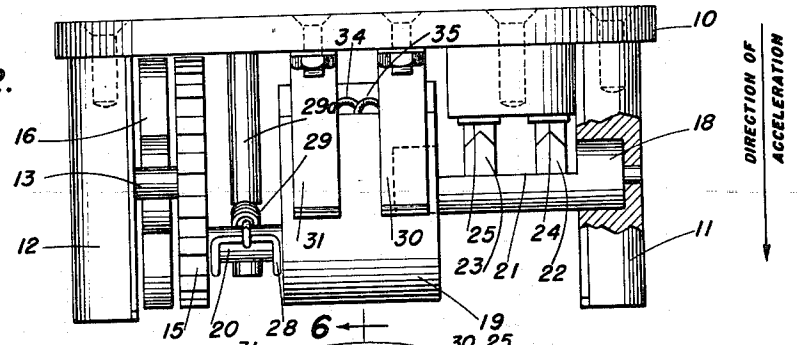


FIG. 1.

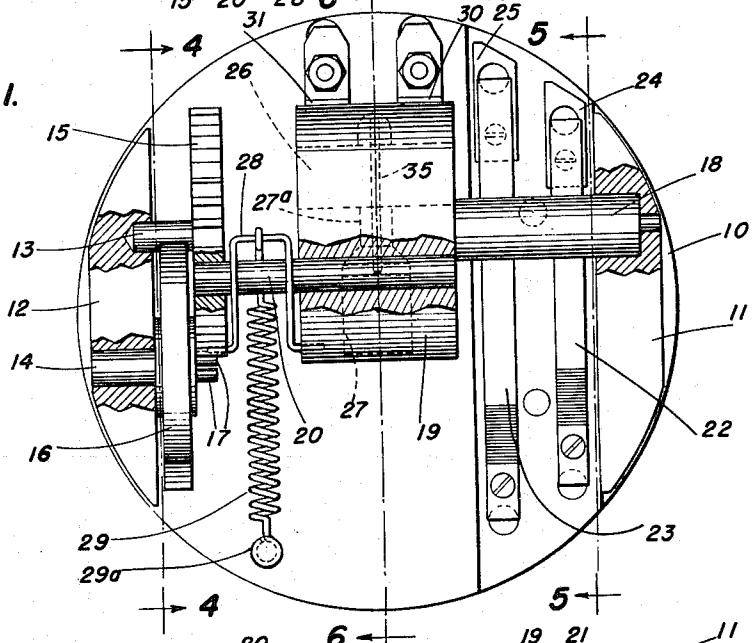
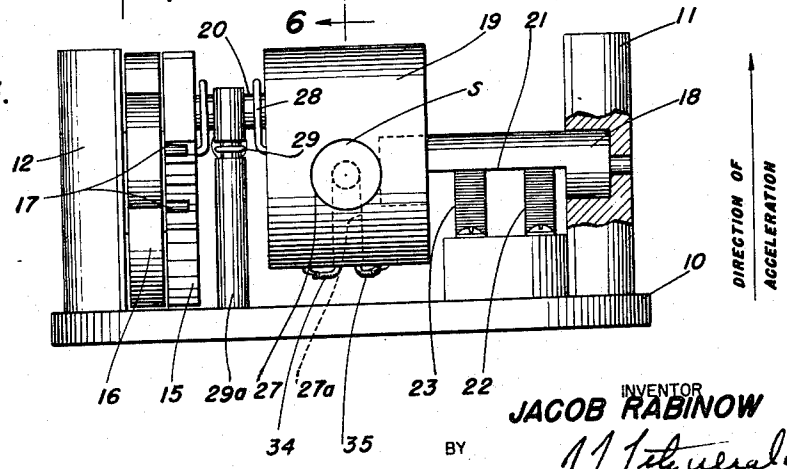


FIG. 3.



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Nov. 17, 1959 J. RABINOW 2,912,933

SAFETY DEVICE

Filed Jan. 24, 1944 2 Sheets-Sheet 2

FIG. 4.

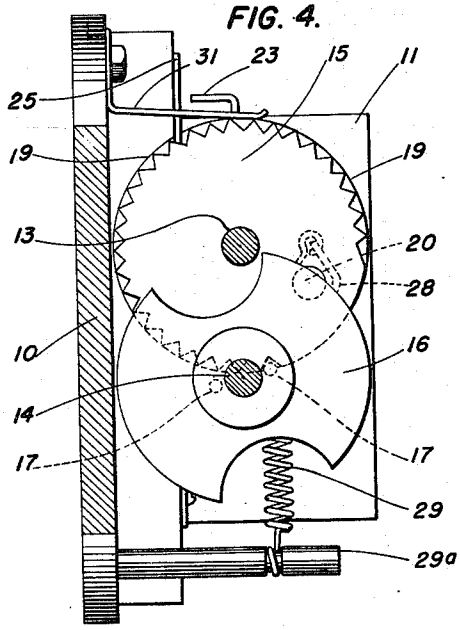


FIG. 5.

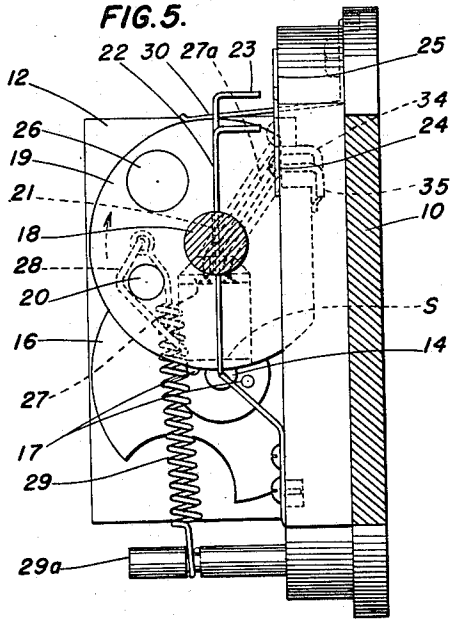


FIG. 7.

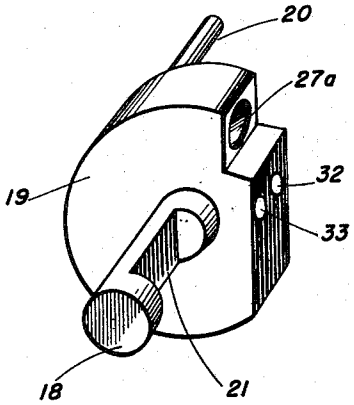
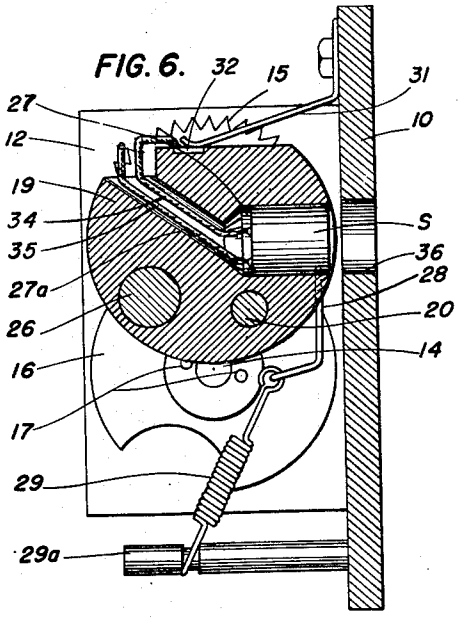


FIG. 6.



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SAFETY DEVICE

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Application January 24, 1944, Serial No. 519,456

6 Claims. (Cl. 102—70.2)

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

This invention relates to circuit making and breaking devices and more particularly to a novel inertia-arming switch for use in an electrical device, such as a fuze, in a projectile.

An object of this invention is to provide an inertia-operated powder train interrupter and switch for projectile fuzes, which, when acted upon by a sustained force of set-back, actuates one or more switches and also establishes a connection between a squib and a booster charge.

A further object of this invention is to provide an inertia-operated device in which a rotor having a passage extending therethrough is rotated by a sustained force of setback, whereby it moves the passage into position to establish a connection between an electrically fired squib and a booster charge, and also operates one or more electrical switches. A toggle is provided which tends to retain the rotatable element either in its normal or unarmed position, or in its armed position. Retarding means, such as an escapement, is provided to retard rotation of the rotating element and thus assure that the device will be actuated only by a sustained force of setback. The retarding means also delays the arming of the device until the projectile has traveled a safe distance, and allows time for the heating of electronic tubes if such are employed in the fuze. The new device resets to a safe position if the acceleration is not maintained for a proper duration, and remains unresponsive to a sudden shock or to the cumulative effect of repeated shocks. In this way, premature explosions resulting from the shock of firing or from rough handling are avoided.

These and further objects will be apparent from the following description and the accompanying drawings, in which

Fig. 1 is a top view of one embodiment of the invention for use in an electrical fuze, showing the parts in their unarmed or safe positions, with sections broken away to show details of the structure;

Fig. 2 is a front elevation of the device shown in Fig. 1;

Fig. 3 is a rear elevation of the device shown in Fig. 1;

Figs. 4 and 5 are vertical sectional views taken on lines 4—4 and 5—5 of Fig. 1, respectively;

Fig. 6 is a vertical sectional view taken on line 6—6 of Fig. 1 but with the rotor in its armed position, and

Fig. 7 is a perspective view of the rotor of the device.

Referring to the drawings, the numeral 10 represents the chassis or base plate of the device which has an opening 36 therein for a purpose which will be explained presently, and to which are attached supporting members 11 and 12 by means of bolts or other suitable means. Stub shafts 13 and 14 carried by supporting member 12 carry notched or toothed wheel 15 and rocker wheel 16, respectively, the latter having pins 17 which cooperate with the notches in wheel 15 to constitute an escapement. Supporting member 11 supports one end of a semicylinder 18 of insulating material, the other end of the semicylinder being keyed to, and serving as a support for rotor 19. Additional support for the rotor is provided by shaft 20

which connects wheel 15 and the rotor, and serves as a driving connection between the two. The central portion of semicylinder 18 has a flat side 21 which engages resilient metal strips 22 and 23 mounted on the chassis 10. When the semicylinder is rotated, its round portion bears against the resilient metal strips 22 and 23 and exerts a cam action against them, forcing the metal strips into engagement with contacts 24 and 25, respectively, which are also carried by the chassis 10.

The rotor 19 carries a weight 26 mounted near its periphery so as to cause rotation of the rotor when a force of setback is applied. The rotor 19 also contains an opening 27 which diminishes in diameter near the center of the rotor where it communicates with a passage 27*a* extending at an angle from the line of opening 27. Passage 27*a* and opening 27 form a passage which extends entirely through the rotor transversely thereof. An electrically operable squib S (shown only in Figs. 3, 5 and 6) is adapted to be inserted in opening 27 and is connected to contacts 32 and 33 which lie on the periphery of the rotor near the outer end of passage 27*a*. The passage 27*a* serves as a conduit for the electrical connections 34 and 35 between the squib and the contacts 32 and 33.

A crank-shaped connecting member 28 is secured to the notched wheel 15 and rotor 19 and extends upwardly in front of the shaft 20 between the wheel and the rotor. This member 28 serves to increase the angle of toggle action at the end of the arming cycle so that 270 degrees of total rotation of rotor 19 may be obtained. A spring 29 attached at one end to post 29*a* on the chassis passes upwardly behind shaft 20 and is attached at its other end to the central portion of connecting member 28.

Resilient metal strips 30 and 31 attached to the chassis 10 bear against the periphery of rotor 19 and make electrical contact with the contact points 32 and 33 when the rotor is in its armed position (Fig. 6). This closes what is called the squib circuit.

The operation of the device will now be explained. With the parts of the device in their unarmed positions as shown in Fig. 1 through 5, switches 22—24 and 23—25 and the switch which comprises resilient elements 30 and 31 and contacts 32 and 33 are open. Passage 27—27*a* in the rotor 19 is in the position shown in Fig. 5, and in this position the squib and the booster charge (not shown) are separated by the rotor so that if the squib is prematurely fired, the flash cannot reach the booster charge through opening 36 to ignite the booster. Due to the fact that one of the pins 17 lies in an end notch of the notched escapement wheel 15, the latter and rotor 19 are at the limit of their clockwise movement, as viewed in Fig. 4. The toggle consisting of spring 29 and connecting member 28 tends to maintain the rotor and notched wheel in this initial position, in which the device is unarmed.

When the device is acted upon by a force of setback caused by acceleration in the direction of the arrows in Figs. 2 and 3 of a projectile containing the device, the inertia of weight 26 causes it to shift to the right, as viewed in Fig. 5, thus rotating the rotor 19 in the direction of the dotted arrow in Fig. 5. As soon as the weight 26 has moved the toggle through its dead center position, the toggle will continue the rotation of the rotor until it reaches the position where the center of gravity of the rotor is nearest to the base, in which position the rotor is retained as long as the mechanism is under acceleration of sufficient magnitude to overcome the force of spring 29. After the cessation of acceleration, the spring 29 will continue to rotate the rotor 19 until stopped by the limiting action of the unnotched portion of the escapement wheel 15. In this position the squib passage 27 is directly in line with the opening 36 and will detonate the booster when the squib is fired.

The rotation of the rotor 19 is retarded by the escapement mechanism consisting of notched wheel 15 and wheel 16 which carries pins 17 cooperating with the notches on the periphery of wheel 15. The retarding of the rotation of rotor 19 by the escapement prevents the device from being armed prematurely by the shock of firing or from rough handling. Also, the retarding action of the escapement delays the arming of the device until a predetermined period of time has elapsed during which the projectile travels a certain safe distance away from the projector from which it was fired, and during which period any electronic tubes which may be in circuit with the device are allowed to heat. If the rotor is turned a short distance by an unsustained acceleration caused, for example, by dropping the device, the spring 29 will return the rotor and the notched wheel 15 to their original positions after termination of the shock, so that the device remains unarmed and repeated shocks have no cumulative effect.

Rotation of the rotor to the position shown in Fig. 6 rotates semicylinder 18. Rotation of the semicylinder causes its round portion to bear against resilient metal strips 22 and 23, thus forcing them into contact with the contact members 24 and 25 and closing the circuits including those contacts, for example, A and B battery circuits. If it is desired to close the contacts 22—24 and 23—25 earlier in the arming cycle, springs 22 and 23 may be weighted with sufficient mass so that the application of setback causes the springs to bend and thus close these contacts. The action of the semicylinder will then be merely that of a lock to keep these contacts closed after the acceleration has ceased. When the rotor reaches the final or armed position shown in Fig. 6, the contactors consisting of resilient metal strips 30 and 31 engage contact points 32 and 33 mounted on rotor 19 so that upon operation of the fuze, the squib S will be fired electrically through contactors 30 and 31, contacts 32 and 33, and conductors 34 and 35. When rotor 19 is in the position shown in Fig. 6, the passage 34 provides a direct connection between the squib S and a booster charge (not shown) so that when the squib is fired, it will flash into the booster charge through opening 36 and ignite the booster. The initial and final positions of the rotor are determined by varying the number and position of the notches on the periphery of notched wheel 15, thus limiting the rotation of notched wheel 15, and consequently the rotation of the rotor 19. Other means such as detents, may be used to determine these positions of the rotating elements, if desired.

Instead of mounting the squib in the passage 27 as described above, the squib may be mounted adjacent the rotor in such a position that the rotor provides a safety gate between the squib and the booster when the rotor is in its unarmed position, and provides a connecting passage between the squib and the booster through passage 27—27*a* when the rotor is in its armed position shown in Fig. 6. In such an embodiment of the invention, the contacts 32 and 33 would be connected together electrically so that rotation of the rotor to its armed position shown in Fig. 6 would provide a connection between resilient strips 30 and 31 to arm the squib.

As explained above, the provision of the toggle and the escapement in the device assures that the device will be actuated only by a sustained force of setback, thus avoiding premature explosions resulting from the shock of firing or from rough handling. The delay interposed by the escapement assures that the device will be bore-safe and allows time for the heating of electronic tubes, if such are employed in the fuze circuit. Once the toggle passes dead center, it assures that the rotor will reach the desired armed position, due to the fact that the spring in the toggle will cause the rotor to continue its rotation even though the force of acceleration which initially actuated the device has ceased.

In constructing the device, the chassis 10 and the rotor 19 may be of nonconducting material if desired, or if such material is not used, suitable insulation will, of course, be required between electrically conducting elements and the chassis 10 and rotor 19.

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. In an inertia-operated device for projectile fuzes, a rotor having a weight mounted therein near the periphery of said rotor, the rotor having an explosion discharge passage adapted to contain an electrically detonatable squib and being movable by a setback force on the weight from an unarmed position in which the passage is inoperative toward an armed position in which the passage is operative to discharge, a cam rotatable with said rotor, a switch for closing a circuit being operable by said cam, a switch arm engageable with the rotor for closing a squib circuit to conduct current to detonate the squib when the rotor is in its armed position, a toggle connected to and tending to maintain said rotor in respectively its unarmed and armed positions, means for retarding said rotor while rotating to the latter position, and means on the rotor coacting with a part of the retarding means for determining the respective armed and unarmed positions of said rotor and the circuit-open and circuit-closed positions of said cam.

2. In a setback switch, a potentially movable squib, a contactor fixed at the arming position of the switch and comprising the terminal of an electrical circuit for detonating the squib, and an inertia-operable safety device supporting the squib at an initially unarmed position and causing its eventual movement toward the armed position, said device having a conductor leading from the squib and terminating in a contact distanced from the contactor in said unarmed position.

3. A projectile fuze switch comprising an inertia-operable element carrying an electrically fired squib, a spring toggle device connected eccentrically to said element, applying a pull on the element to turn it toward unarmed and armed positions when exercised at opposite sides of the turning axis, a toothed escapement wheel coupled to the element, a rocker pin device acting on the teeth to slow the element when turned by components of setback and toggle spring action during acceleration of the switch, an untoothed portion on said wheel coacting with the rocker pin device to limit turning of the element toward its respective positions, and contact-making means rendered operative by said element for closing an electrical circuit through the squib in the arming position of said element.

4. A projectile fuze switch comprising an inertia-operable element carrying an electrically fired squib, a toothed escapement wheel axially coupled to said element and spaced therefrom, a spring toggle device located in the space being coupled eccentrically to the element and wheel to apply a pull to turn them toward unarmed and armed positions when exercised at opposite sides of the axis, a rocker pin device acting on the teeth of the wheel to slow the element when turned by components of setback and toggle spring action during acceleration of the switch, an untoothed portion on said wheel coacting with the rocker pin device to limit turning of the element toward its respective positions, and contact-making means rendered operative by said element for closing an electrical circuit through the squib in the arming position of said element.

5. A projectile fuze switch comprising an inertia-operable element carrying an electrically fixed squib, a toothed escapement wheel, an off-centered shaft connecting said element and wheel in spaced relationship and serving as a driving connection therebetween, a toggle device located in the space, consisting of a crank shaped member secured to the element and wheel and having a portion in proximity to the shaft, and an anchored spring connected to said portion, said toggle device applying a pull on the element

and wheel to turn them toward unarmed and armed positions when exercised through the crank member at opposite sides of the axis, a rocker pin device acting on the teeth of the wheel to slow the element when turned by components of setback and toggle spring action during acceleration of the switch, an untoothed portion on said wheel coacting with the rocker pin device to limit turning of the element toward its respective positions, and contact-making means rendered operative by said element for closing an electrical circuit through the squib in the arming position of said element.

6. A projectile fuze switch comprising an inertia-operable element carrying an electrically fired squib, a spring toggle device connected eccentrically to said element, applying a pull on the element to turn it toward unarmed and armed positions when exercised at opposite sides of the turning axis, a time-delay mechanism coupled to the

element to slow the element when turned by components of setback and toggle spring action during acceleration of the switch, means on said element to limit turning of the element toward its respective positions, and contact-making means rendered operative by said element for closing an electrical circuit through the squib in the arming position of said element.

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