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CENTRIFUGAL UNSHORTING DEVICE

Filed Jan. 27, 1943

FIG. 1

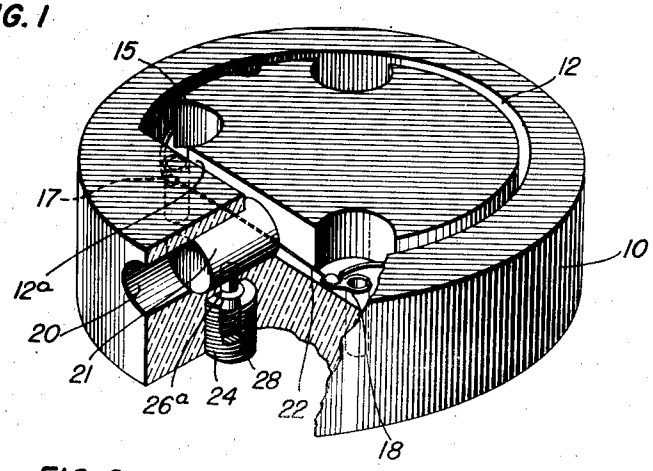


FIG. 2

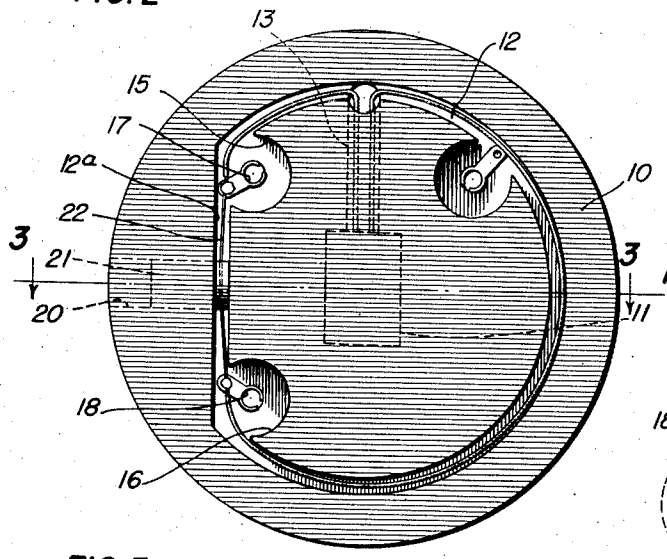


FIG. 4

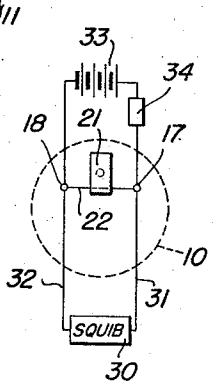
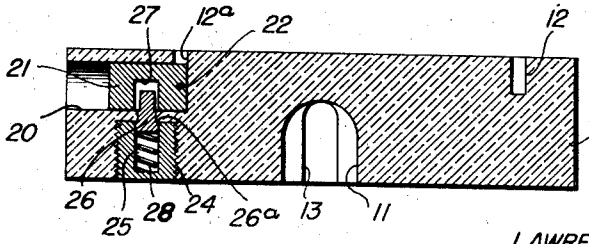


FIG. 3



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CENTRIFUGAL UNSHORTING DEVICE

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3 Claims. (Cl. 102—70.2)

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This invention relates to switches and more particularly to a so-called "unshorting" switch of novel construction which is adapted normally to shortcircuit an electrical element and is operable to remove the shortcircuit automatically in response to the dual action of a force of setback and centrifugal force. The new switch is of simple construction adapted for manufacture at low cost and is positive in operation. The invention may be employed to particular advantage in explosive projectiles of the type which rotates at high speed when fired from a gun, and, therefore the invention will be described in a form suitable for this use, although it will be understood that the invention may be used for other purposes as well.

One object of the invention resides in the provision of a novel unshorting switch for use in explosive projectiles, which remains unoperative except when subjected to both setback and centrifugal forces. A switch made in accordance with the invention comprises a shortcircuiting element, preferably in the form of a wire extending between a pair of terminals, and means operable by centrifugal force to rupture the shortcircuiting element. The rupturing means is normally secured against movement by a stop operable by a force of setback to release the rupturing means.

Another object of the invention is to provide an unshorting switch for use in electrical fuzes for projectiles, which is simple, compact, positive in action and capable of withstanding the usual drop and tumble tests for fuzes.

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

Fig. 1 is a perspective view of one form of the new switch, with parts broken away;

Fig. 2 is a plan view of the switch shown in Fig. 1;

Fig. 3 is a sectional view on the line 3—3 in Fig. 2, and

Fig. 4 is a schematic view of the switch, showing the wiring for connecting it in a fuze detonating circuit.

Referring to the drawing, the switch there shown comprises a cylindrical body 10 made of a suitable insulating material, such as Lucite, and having in its rear face a recess 11 for receiving a detonating squib, to be referred to in greater detail presently. In its front face, the body is provided with a generally circular groove or rout 12 lying inwardly from the edge of the body and substantially concentric to the axis thereof, the

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groove being circular except for a straight portion 12*a*. A passage 13 parallel to the straight groove portion 12*a* connects the recess 11 to the curved part of the groove. At the ends of the straight groove portion 12*a* are recesses 15 and 16 containing terminals 17 and 18 respectively secured to the switch body. A radial passage 20 extends inwardly from the edge of the body to the groove 12*a* between the recesses 15 and 16 and receives a centrifugally operated element in the form of a plunger 21 which fits closely in the passage. A shortcircuiting wire 22 in the groove 12*a* is connected at its ends to the terminals 17 and 18 and extends through an opening in the inner end of the plunger, which normally projects into the groove.

A plug 24 threaded into the rear face of the switch body has a bore 25 terminating short of the rear end of the plug and communicating at its front end with the radial passage 20 through an aligned opening in the switch body. The bore 25 contains a detent 26 projecting through the aligned opening into a recess 27 in the plunger, the detent having a shoulder 26*a* engaging a corresponding shoulder on the switch body to limit movement of the detent into the plunger. A coiled spring 28 seated on the closed end of the plug engages the detent 26 and urges it forwardly to maintain the detent in the plunger recess.

In the use of the new switch, a detonating squib 30 (Fig. 4) is placed in the recess 11 and connected by wires 31 and 32 to the terminals 17 and 18, respectively, the wires extending from the squib through passage 13 into the groove 12. It will be understood that the wire 31 extends from passage 13 counterclockwise (Fig. 2) along the groove 12 to terminal 17, while the wire 32 extends clockwise in the groove from passage 13 to the terminal 18. The terminals 17 and 18, in turn, are connected across a current source 33 in the projectile (not shown) through a circuit control device 34, such as a timing mechanism or a device responsive to proximity of a target to the projectile. The switch body 10, being cylindrical, is adapted to fit in the casing of the projectile with the groove 12 facing the nose of the projectile.

In operation, the wire 22 normally shortcircuits the detonating squib 30, the relative resistances of the squib and the shortcircuiting wire being such that the current flowing from the battery through the squib while it is shunted is insufficient to operate the squib and cause detonation. Because of the detent 26, the plunger 21 is secured positively against movement in the switch body,

whereby accidental breaking of the shortcircuiting wire 22 is prevented. However, when the projectile is fired in a gun, the resulting force of setback causes the detent 26 to move rearwardly out of the plunger recess 27 against the action of spring 28. Accordingly, the plunger is released and the centrifugal force incident to rotation of the projectile by the rifling in the gun causes the plunger to move outwardly in the passage 20 and break the shortcircuiting wire 22. The retonating squib 30 is then "unshorted" so that the fuze is armed and made ready for firing by the control device 34.

The switch of our invention may be made in a compact form and provides an effective safety means for preventing premature detonation of a projectile fuze. Since the plunger 21 can move only in a direction normal to the axes of the switch body 10 and the projectile, it cannot be actuated by the force of setback. Also, since the detent 26 can move only in a direction parallel to the axes of the switch body and the projectile, it can not be actuated by centrifugal force. Accordingly, removal of the shortcircuit of the detonating squib requires the operation of the two interconnected elements 21, 26 by the action of two independent forces. It will be apparent that with the new construction, the squib 30 can not be accidentally armed by dropping or tumbling the projectile, because the plunger 21 for breaking the shortcircuiting wire 22 is held positively in an unarmed position by the detent 26, which releases the plunger only in response to a relatively large, unidirectional force of setback incident to firing the projectile.

The dimensions of the operating parts of the switch may be varied to suit particular conditions. However, it has been found that satisfactory results may be obtained with a plunger weighing .00229 pound and a short-circuiting wire having a diameter of .005 inch, the plunger producing a shear pull on the wire of 6.4 pounds with a minimum required rotation of the projectile of 200 revolutions per second at an angular acceleration of 2000 "g," where "g" is 32 feet per second per second. The weight of the detent 26 and the tension in the spring 28 should be carefully predetermined to balance the weight of plunger 21 and insure that the plunger is released by the detent only when the device is subjected to a force of setback of the desired magnitude.

While we have shown the locking detent 26 and its spring 28 mounted in a plug 24 in the body 10, the plug may be eliminated by mounting the detent and spring directly in a bore in the body. The bore may be formed to extend from the front face of body 10 and terminate short of the rear face, so that the bore intersects passage 20 and the spring has a seat on the closed rear end of the bore. Thus, in assembling the device, the detent may be held retracted in the bore against spring 28 by a wire inserted through the front end of the bore, until the plunger 21 is moved inwardly to a position overlying part of the detent, whereupon the wire may be removed and the plunger shifted to its innermost position so that the detent snaps into recess 27. This construction is well adapted for large scale production and may be preferred to that illustrated in Figs. 1 to 3, inclusive.

We claim:

1. An unshorting switch for use in a rotating projectile, which comprises an insulating body having a squib-receiving recess, a pair of terminals on the body, said body having a passage for conducting wiring from the squib to said terminals, a shortcircuiting wire extending between the terminals, means in the body connected to the shortcircuiting wire for rupturing the wire in response to centrifugal force, and means in the body for locking the rupturing means in an inoperative position and movable by a force of setback to release the rupturing means.

2. An unshorting switch for use in a rotating projectile, which comprises an insulating body having a squib-receiving recess in one end of the body and a groove in the other end of the body extending in a closed path, a pair of terminals in the groove, the groove forming a passage for wiring between said recess and the terminals, a shortcircuiting wire in the groove connected to the terminals, a plunger in the body having a part disposed in the groove and connected to the wire, the plunger being movable radially of the axis of the body by centrifugal force to break the wire, and means in the body for locking the plunger in an inoperative position and movable by force of setback to release the plunger.

3. An unshorting switch for use in a rotating projectile, which comprises a generally cylindrical insulating body having a squib-receiving recess in one end and a groove in the opposite end, the groove extending in a closed path having a straight portion, terminals mounted in the groove at the ends of the straight portion thereof, the body having a passage connecting said recess with the groove, and the passage and groove forming a means for conducting wiring from the recess to said terminals, a shortcircuiting wire disposed in the straight portion of the groove and connected between the terminals, a plunger in the body projecting into the groove and connected to the shortcircuiting wire, the plunger being movable radially in the body to break the wire in response to centrifugal force, a detent in the body projecting into the plunger for locking the plunger in an inoperative position, and a spring normally urging the detent into the plunger, the detent being movable in the body against the spring by a force of setback to release the plunger.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
571,909	Scribner	Nov. 24, 1896
1,806,877	Hale	May 26, 1931

FOREIGN PATENTS

Number	Country	Date
6,757	Great Britain	Mar. 19, 1912
91,592	Sweden	Feb. 24, 1938
376,987	Italy	Dec. 4, 1939
668,368	Germany	Dec. 1, 1938