April 29, 1947. R. G. FERRIS 2,419,828

SET-BACK SWITCH

Filed March 17, 1943

FIG. 1.

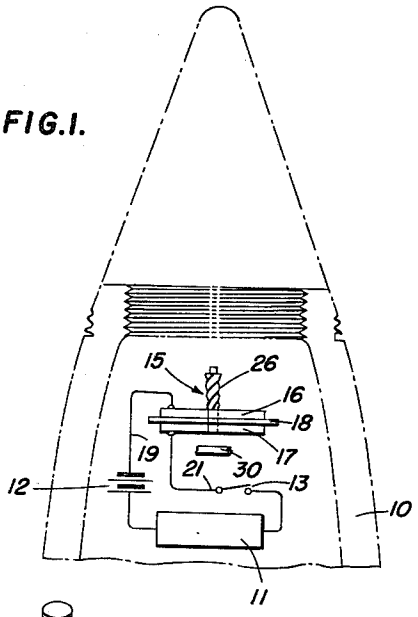



FIG. 2.

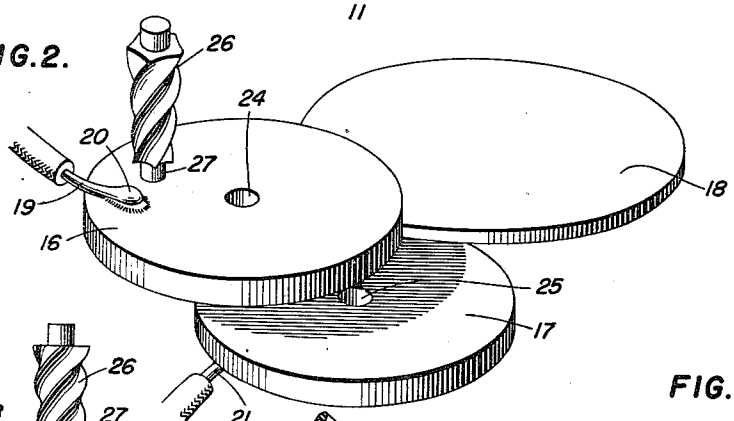



FIG. 3.

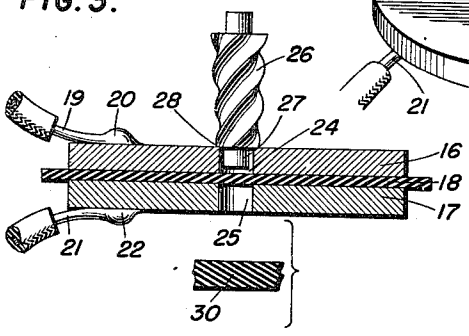
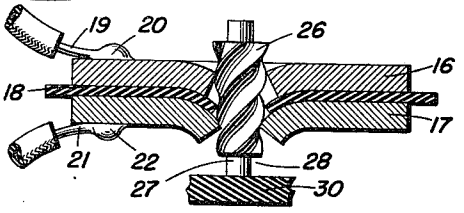



FIG. 4.




INVENTOR
ROBERT G. FERRIS

BY

ATTORNEY

Patented Apr. 29, 1947

2,419,828

# UNITED STATES PATENT OFFICE

2,419,828

## SETBACK SWITCH

Robert G. Ferris, Harvard, Ill., assignor to the United States of America as represented by the Secretary of Navy

Application March 17, 1943, Serial No. 479,517

8 Claims. (Cl. 200—52)

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This invention related to switches for use in projectiles and has particular reference to a novel setback-operated switch for this use which is positive in action and is held securely in its operative position after it has been actuated by a force of setback.

One object of the invention is to provide a switch having a stud of electrically conducting material which is shifted by a force of setback to penetrate two superimposed conducting pieces separated by a thin flat insulating piece, the stud having a periphery of irregular configuration whereby it makes good electrical contact with the flat conducting pieces and is held in contact with both pieces during the flight of the projectile.

Switches have been devised heretofore in which a weight is dropped down a well to drive a circuit-closing pin through two insulated copper gauge disks for closing a circuit and exploding a detonator in the well, as disclosed in Barab Patent No. 1,458,925. These prior switches are intended to energize the circuit and explode the detonator immediately upon closing of the switch, and, therefore, it is not necessary to provide means for holding the pin in its circuit-closing position. However, in a safety switch for projectiles, it is necessary to maintain the switch positively in its closed position after it has been actuated by the force of setback incident to firing the projectile, so that the detonating circuit is armed during flight of the projectile. Accordingly, the prior switches of the type described are not suited for use as safety switches in projectiles.

Another object of the invention, therefore, resides in the provision of a novel safety switch for projectiles in which the penetrating stud or pin is retained positively in its circuit-closing position against the forces of reverse setback, vibration, etc. encountered in projectiles during their flight.

A further object of the invention is to provide a novel setback-operated switch of simple and inexpensive construction adapted to be manufactured in large quantities and which is positive and reliable in operation.

These and further objects of my invention will be better understood by reference to the accompanying drawing, in which

Fig. 1 is a schematic view of a projectile embodying one form of the new switch;

Fig. 2 is a perspective, exploded view of the switch shown in Fig. 1;

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Fig. 3 is a vertical sectional view of the switch in its open-circuit position, and

Fig. 4 is a similar view showing the switch in its closed-circuit position.

Referring to Fig. 1, the numeral 10 designates the casing of an explosive projectile containing a detonator 11 operable electrically by a current source, such as a battery 12. A normally open switch 13 in series with the battery and the detonator is adapted to be closed by suitable means (not shown), such as a radio apparatus responsive to proximity of a target to the projectile, as disclosed in a copending application of M. A. Tuve et al., Serial No. 471,388, filed Jan. 6, 1943. It will be understood that when the switch 13 is closed, the detonating circuit is energized by the battery to fire the detonator 11 and explode the main charge in the projectile.

The setback switch 15 of the invention, as shown, is included in the detonating circuit in the projectile to prevent premature explosion of the detonator due to accidental closing of the operating switch 13. The switch 15 comprises a pair of conducting discs 16 and 17 separated by a frangible insulating disc 18, the discs being secured in the projectile by any suitable means (not shown). A wire 19 is connected to the conducting disc 16, as by means of solder 20, and leads to the negative side of the battery. The other conducting disc 17 is connected to a wire 21 by a soldered joint 22, and the wire 21 is connected through the switch 13 and the detonator to the positive side of the battery.

In the central portions of the conducting discs 16 and 17 are aligned openings 24 and 25, respectively, separated by the insulating disc 18. A piercing stud 26, which may be hardened and brass plated, is disposed in front of the disc 16 in line with the openings 24 and 25, the stud being loosely mounted in the projectile in any suitable manner whereby it is movable longitudinally under a force of setback. The stud 26 has a peripheral surface of irregular contour which may take various forms, for a purpose to be described presently. As shown, the peripheral surface of the stud is provided with spiral flutes or grooves 26 and tapers gradually to the rear toward the discs. At its rear end, the stud is formed with a reduced portion or guide 27 which fits loosely in the disc opening 24 to maintain the stud in alignment with the openings. The main body of the stud is somewhat larger in diameter than the opening 24 and has a shoulder 28 which normally rests on the front disc 16 around the opening.

The operation of the switch is as follows: Normally, the conducting discs 16 and 17 are maintained in non-conducting relation by the insulating disc 18, so that the detonating circuit cannot be energized accidentally by premature closing of the operating switch 13. Also, the stud 26 is held in front of the discs by the shoulder 28. When the projectile is fired from a gun, the resulting force of setback causes the stud 26 to move rearwardly against the discs, with the result that the enlarged portion of the stud enters and enlarges the opening 24 in the front disc, penetrates the insulating disc 18, and then enters and enlarges the opening 25 in the other conducting disc, as shown in Fig. 4. The rearward movement of the piercing stud is preferably limited, as by means of a stop 30, to prevent the stud from passing completely through the discs. When the stud has moved through the rear disc 17, it is in contact with the two conducting discs and thus forms a conducting path between them. The detonating circuit is then armed and ready to explode the detonator 11 upon closing of the operating switch 13 when the projectile approaches a target.

The spiral fluting or other irregular configuration of the periphery of the stud 26 is an advantageous feature of my invention. One function of the spiral fluting is to insure a good electrical contact between the stud and the conducting discs 16 and 17. Another important function of the spiral fluting is to hold the stud positively in its closed-circuit position after it has moved through the discs under the action of a force of setback. During the flight of the projectile, the parts in it are acted upon by centrifugal force, due to rotation of the projectile, and also by reverse setback or creep, with the result that the stud 26 might be loosened and moved from its circuit-closing position unless it is held positively and securely in this position. If the stud were accidentally moved from its closed-circuit position during the flight of the projectile, it would be impossible for the fuze to explode the main charge. Such accidental movement of the piercing stud from its circuit-closing position is prevented in the new switch by providing the stud with an irregular configuration on its periphery. More particularly due to the spiral grooves in its periphery, the stud acts as a screw when forced into the discs. The discs 16 and 17 may be made of a soft metal, such as copper, to cause the spiral grooves to give the stud a twist as it penetrates the discs, whereby the stud is held securely in its final position. The taper of the stud provides a wedging action in the discs and results in a firmer electrical contact when the stud is driven through the discs.

Attention is called to the fact that the spring action of disc 16 absorbs the force produced by the stud on a drop test, due to the short time this force is exerted. However, force applied over a longer period of time, as in a projectile under acceleration from a gun, will result in the movement of the stud through the discs for puncturing the insulation and closing the circuit. The discs 16 and 17 are to be supported only at their peripheries.

I claim:

1. A setback operated switch comprising two electrically conducting discs, a frangible insulating disc between said conducting discs, and piercing means having a periphery of irregular configuration and movable by setback to pierce said discs and form an electrically conducting connection between the conducting discs.



2. A setback operated switch comprising two electrically conducting discs, a frangible insulating disc between said conducting discs, and piercing means having spiral grooves formed in its periphery and movable by setback to pierce said discs and form an electrically conducting connection between the conducting discs.

3. A setback operated switch comprising two electrically conducting discs, a frangible insulating disc between said conducting discs, and a tapered piercing stud having a periphery of irregular configuration, the stud being movable by setback to pierce said discs and form an electrically conducting connection between the conducting discs.

4. A setback operated switch comprising two electrically conducting discs, a frangible insulating disc between said conducting discs, a piercing stud having a periphery of irregular contour and tapered toward its penetrating end, said piercing stud being movable by setback to pierce said discs and form an electrically conducting connection between the conducting discs, and a stop for limiting movement of the stud to define the closed circuit position of the stud.

5. A setback operated switch comprising two electrically conducting discs, a frangible insulating disc between said conducting discs, a piercing stud having a periphery of irregular contour and tapered toward its penetrating end, said piercing stud being movable by setback to pierce said discs and form an electrically conducting connection between the conducting discs, and means for aligning the stud relative to the discs.

6. A setback operated switch comprising a pair of electrically conducting discs having aligned openings, a frangible insulating disc between the conducting discs, and a piercing stud aligned with the openings and having a periphery of irregular contour, the stud being movable by a force of setback to enter and enlarge said openings and penetrate the insulating disc to form an electrically conducting connection between the conducting discs.

7. A switch including a pair of electrically conducting elements having axially aligned openings and an intermediate, frangible, insulating element obstructing said openings, and a piercing stud larger in diameter than and aligned with said openings, movable under set-back to pierce the elements and electrically connect the conducting elements.

8. A switch including a pair of electrically conducting elements having axially aligned openings and an intermediate, frangible, insulating element obstructing said openings, and a piercing stud larger in diameter than and aligned with said openings, movable under set-back to pierce the elements and electrically connect said elements, and said stud having a reduced end initially aligned in one of the openings.

ROBERT G. FERRIS.


## REFERENCES CITED

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