Sept. 8, 1959 R. M. BLEAKNEY ET AL 2,903,534

SWITCH

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FIG. 2.

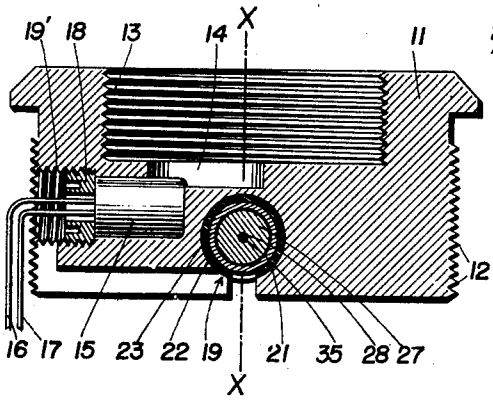


FIG. 1.

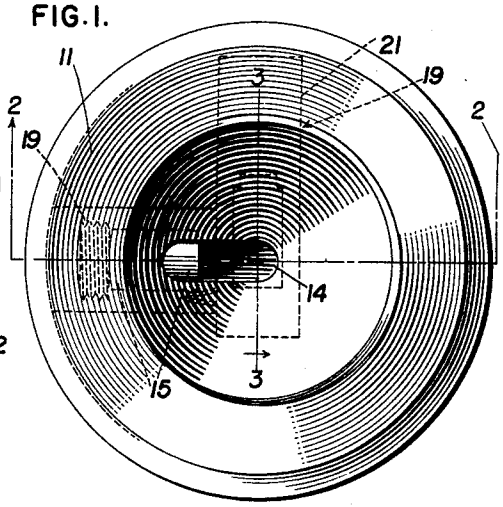


FIG. 3.

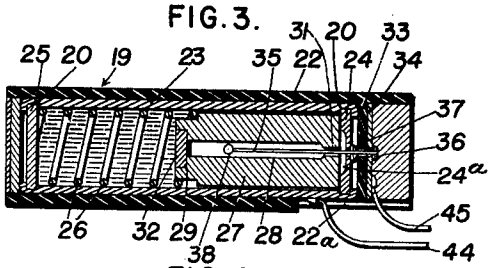


FIG. 6.

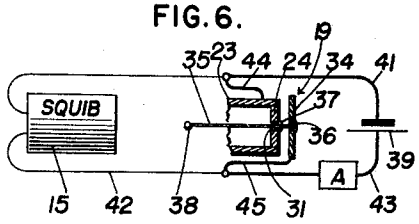


FIG. 4.

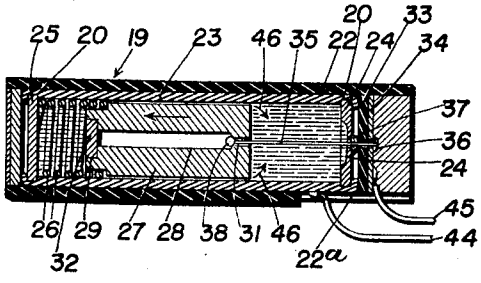


FIG. 7.

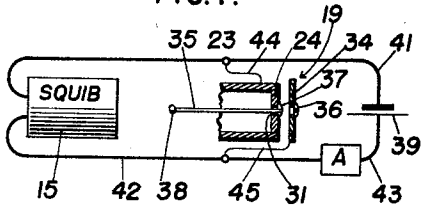
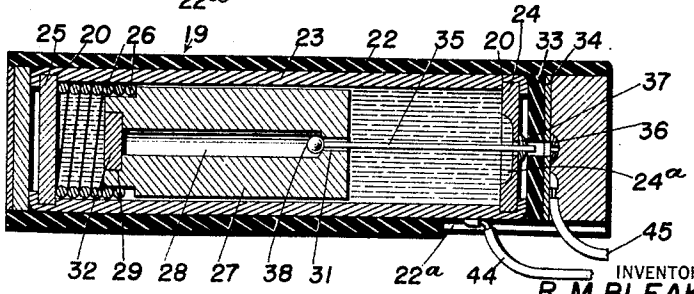


FIG. 5.



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FIG. 8.

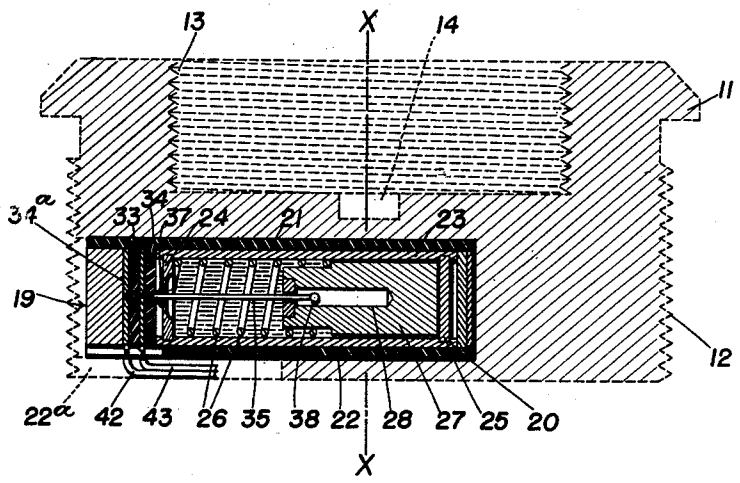


FIG. 9.

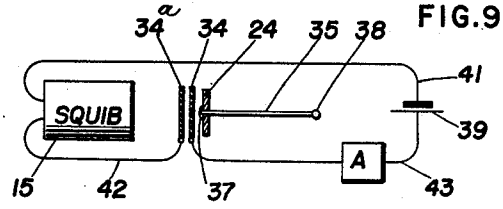
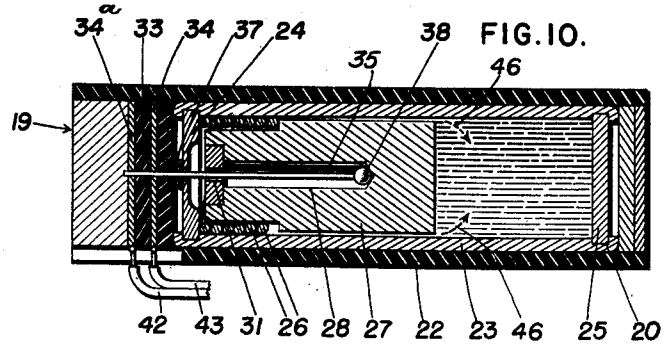


FIG. 10.



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2,903,534

SWITCH

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Original application July 9, 1942, Serial No. 450,344, now Patent No. 2,712,791, dated July 12, 1955. Divided and this application August 14, 1953, Serial No. 374,452

7 Claims. (Cl. 200—61.08)

This invention relates generally to electrical short-circuiting means, and more particularly to an electrical switching mechanism of the type operated by the centrifugal force produced by rotation of a projectile when fired from a gun. This patent application is a division of co-pending U.S. patent application, Serial No. 450,344, filed July 9, 1942, by the same inventors, now Patent No. 2,712,791.

Certain types of projectiles are provided with electrical detonating devices by virtue of which the explosive charge is set off by electricity supplied by a battery provided within the shell body.

One of the difficulties sometimes encountered in the operation of this type of detonating device is that the charge will be exploded too soon after the shell has started on its way, causing damage to the gun.

It is, therefore, an object of this invention to prevent premature detonating of the explosive charge in a projectile.

It is also an object of this invention to prevent premature operation of an electrical detonating mechanism contained within a projectile.

It is a further object of this invention that in the event an electrical impulse is transmitted to the squib by a fuze mechanism, this impulse will not operate the squib until some time after the projectile has been fired from its gun.

Further objects and many of the attendant advantages of this invention will become evident in the following detailed description taken in connection with the accompanying drawings in which:

Fig. 1 is a plan view of a supporting element which fits within a projectile body embodying the invention;

Fig. 2 is a view in axial section, taken along line 2—2 of Fig. 1;

Fig. 3 is a sectional view of the time delay circuit-breaker which forms the principal element of the invention, taken along line 3—3 of Fig. 1;

Fig. 4 is a view similar to Fig. 3, except that centrifugal force has begun to operate on the mechanism;

Fig. 5 is an enlarged sectional view of the time-delay mechanism showing its operation completed by centrifugal force and the electrical circuit open;

Fig. 6 is a schematic wiring diagram of the electrical detonating circuit;

Fig. 7 is similar to Fig. 6 except that the time-delay mechanism is shown in the open-circuit position;

Fig. 8 is a sectional view of a modified form of the time delay circuit-breaker showing its position within its supporting element;

Fig. 9 is a schematic wiring diagram of the modified form of the electrical detonating circuit; and

Fig. 10 is an enlarged sectional view of the modified form of the time delay mechanism showing its operation completed by centrifugal force and the electrical circuit closed.

Referring now to the drawings, on which like numerals of reference are employed to designate like parts throughout the several views, and more particularly to Figs. 1 and 2 thereof, there is shown therein a supporting element **11**, which is substantially cylindrical in shape. The supporting element is provided with threads **12** which enable it to be screwed into a suitable place provided with matching threads within the casing of a projectile (not shown). The disposition of this member is such that the axis of rotation X—X of the supporting element will coincide with that of the projectile. Internal threads **13** are provided, into which the usual booster charge may be inserted. A communicating chamber **14** permits the booster charge to be fired by the squib **15**. The squib receives an electrical firing impulse, in a manner later to be described, at the appropriate time by means of the wires **16** and **17**. As will be noted from Figs. 1 and 2, the squib **15** is held in place by a closure plug **18** provided with a thread which may be screwed into the tapped hole **19'** provided in the supporting element **11**.

An electrical time-delay switch mechanism **19** is placed within a cylindrical opening **21** provided in the supporting element **11**. This switch mechanism is shown in detail in Figs. 3, 4, and 5. A cylindrically shaped outer insulating member **22** is supported within the opening **21**. Within the insulating member **22** a metal tube **23** is fitted. The outer insulating member may be cut away as at **22*a*** to give accessibility for wiring. Annular shoulders **20** are provided on the interior surface of each end of the tube **23**, and the discs **24** and **25** are fitted into the ends of the tube against these shoulders and held in place by spinning over the rims of the tube. The disc **24** should be composed of an electrically conductive material and has a small centrally located hole provided therein, while its central inner surface may be recessed as at **24*a***. The disc **25** may be made of any suitable material as its purpose is to seal the end of the tube and to act as a support for one end of the spring **26**.

The other end of the spring **26** presses against the bottom of an annular channel cut in one end of a plunger or piston **27** which slides with a loose fit within the tube **23**. The pressure of the spring tends to maintain the plunger in the position in which it is shown in Fig. 3. The plunger **27** is provided with an axial bore **28** which extends from an annular recess **29** at the outer end to a smaller bore **31** at the inner end. The recess **29** is closed by means of a plug **32**.

Fitted within the insulating member **22** and abutting the inner end of the metal tube **23** is a disc **33** of suitable insulating material and another disc **34** of electrically conductive material. These discs are also provided with centrally positioned openings or apertures in axial alignment with the hole provided in disc **24**. An electrical connection is made between the discs **24** and **34** by means of the centrally disposed wire **35** which also extends through the small bore **31** of the plunger **27** into the axial bore **28**. This wire is initially attached to the disc **34** by means of a drop of solder **36**, and to the disc **24** by another drop of solder **37**. An enlargement **38** is provided on the end of the wire **35** which lies within the axial bore **28**. This enlargement may be made by knotting the end of the wire and applying a drop of solder, or may comprise any other suitable arrangement. The enlargement, however, should be of a size such that it will move freely within the axial bore **28** but will not pull through the smaller bore **31**.

The electrical circuit is shown diagrammatically in Figs. 6 and 7. A battery **39**, or other source of electric current is provided within the body of the projectile. A wire **41** leads from this battery **39** to the squib **15**, while a return wire **42** from the squib leads to a circuit-closing means A, thence to the other side of the battery through the wire **43**. The circuit-closing means

A may comprise any device which operates by means of electrical radiations, sound waves, light rays, radiant heat, or by any other suitable means to result in the sending of an electrical impulse through the squib **15** when the projectile is in proximity to a target, or which may actuate the squib in response to a prearranged signal and, per se, forms no part of this invention. An electrical short-circuit across the squib **15** is initially obtained by means of the leads **44** and **45**, which run from the wires **41** and **42**, respectively, to the metal tube **23** and the conductive disc **34**, respectively. Thus the initial electrical circuit, in the event the device A should permit a flow of electricity from the battery **39** would be from one side of the battery through lead **43** to the device A, to lead **42**, thence through lead **45** to disc **34**, wire **35** to disc **24**, metal tube **23**, lead **44**, thence to the other side of the battery **39** through lead **41**. The squib **15**, being thus short-circuited, would receive no current and the projectile is rendered safe, regardless of the action of the device A.

The operation of the preferred form of the invention here disclosed, therefore, is to break this short-circuit when the projectile is fired from a gun, and only then. In addition, the operation of the device contemplates a short time-lag before it is broken which will enable the projectile to pass beyond the range of nearby objects before the squib **15** is rendered capable of being exploded by the electrical charge controlled by the device A.

The breaking of the short-circuit is controlled by the operation of the plunger **27**. When the projectile is at rest, the spring **26** maintains the plunger in the position shown in Fig. 3, as before stated. However, as soon as the projectile is fired, the rifling of the gun causes it to rotate about the axis X—X. Inasmuch as the center of mass of the plunger **27** is to one side of the axis of rotation, it will be forced by centrifugal force against the pressure of spring **26**, toward the outer end of the tube **23** until it reaches the position shown in Fig. 4. In addition to the pressure of the spring, another retarding influence is produced by light oil or other suitable fluid with which the interior of the tube is filled. The plunger is fitted rather loosely within the tube so as to provide enough clearance to allow the passage of the oil as shown by the arrows **46**.

A special advantage results from the presence of the oil. A momentarily heavy shock in handling a projectile might result in compressions of the spring **26** so as to permit the plunger **27** to open the circuit, whereas the pressure of the oil in the cylinder acts as a buffer to limit movement of the plunger except when acted upon by a continuing force such as that produced by centrifugal force when a projectile is rotating at high speed.

The length of the wire **35** is such that when the plunger has reached the position shown in Fig. 4, the enlargement **38** will abut the shoulder formed by the junction between the bores **31** and **28**. Further outward movement of the plunger will, therefore, result in the severance of the frangible connection between the wire **35** and the drops of solder **36** and **37** on the discs **34** and **24**, respectively. When the plunger has reached the end of its travel, as shown in Fig. 5, the wire has been pulled entirely away from the disc **34** and the short-circuit is broken as shown by the electrical diagram in Fig. 7. It will be understood that the length of the wire **35** may be adjusted so that the movement of the plunger **27** will pull the wire entirely away from both discs but this is not essential to the breaking of the short-circuit. The short-circuit being broken, the squib **15** may be exploded, although it is obvious that it will not be actuated merely by the breaking of the short-circuit. The electrical firing impulse must be supplied to the squib from the battery by virtue of some operation of the device A, which will be dependent upon the position of the shell with respect to a target, or upon the operation of some prearranged signal means to which it may respond.

In the modified form of the invention as shown in Figs. 8 through 10, the mechanical operation is substantially the same as that previously described in the preferred form of the invention, the main distinction between the two forms being in the electrical detonating circuit. In the modified form, the circuit extends directly from the battery **39** or other source of electrical current through wire **41** to the squib **15**. The other side of the circuit extends from the battery **39** to the fuze A and hence to conductive disc **34** through wire **43**. As readily seen in Fig. 9, the circuit is normally broken between conductive disc **34** and a corresponding conductive disc **34*a***. Wire **42** completes the circuit from disc **34*a*** to the squib **15**.

In Fig. 8, the time-delay switch mechanism is shown in its normal position, wherein the spring **26** retains the plunger **27** in its right-hand position. The connecting wire **35** with its enlargement **38** extends from the axial bore **28** in the plunger **27** through an aperture in the supporting disc **24**, and is held in its position by solder **37**. When the parts are in this position, the electrical circuit is broken between conductive discs **34** and **34*a***, and, hence, current cannot be supplied to the squib, thus rendering the projectile "safe."

When the projectile has been fired from a rifled gun, a centrifugal force will act upon the plunger **27**. The oil contained within the cylinder **23**, aided by the action of the spring **26** will tend to overcome a portion of the centrifugal force, thus permitting the plunger **27** to move slowly to its position as shown in Fig. 10. As the plunger **27** nears the end of its displacement, the abutment **38** formed on wire **35** will rest against the end of the axial bore **28** formed in the plunger **27**. Further displacement of the plunger **27** will move the wire **35** (breaking the solder **37**) to the left, and through apertures formed in conductive discs **34** and **34*a***, thereby making contact between the conductive discs. Thus, the circuit is closed from the supply source **39** to the squib **15**, except for the fuze A, and when the fuze A is actuated as previously described, the squib **15** will be detonated, which, in turn, fires the projectile.

While the invention has been described with reference to certain preferred examples thereof which give satisfactory results, it will be understood by those skilled in the art to which the invention pertains, after understanding the invention, that various changes and modifications may be made without departing from the spirit and scope of the invention, and it is intended, therefore, to cover in the appended claims all such changes and modifications.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. A switching mechanism capable of being operated by centrifugal force, comprising in combination, a plurality of electrical contacts, a conducting element frangibly connected to said contacts, a relatively heavy mass operatively connected to said conducting element capable of being displaced by centrifugal force for severing the connection between said conducting element and at least one of said contacts.

2. A switching mechanism capable of being operated by centrifugal force, comprising in combination a plurality of electrical contacts, a conducting element frangibly connected to said contacts, a relatively heavy mass operatively connected to said conducting element capable of being displaced by centrifugal force so as to sever the connection between said conducting element and at least one of said contacts, and means to inhibit rapid movement of said relatively heavy mass.

3. A switching mechanism capable of being operated by centrifugal force, comprising in combination a plurality of electrical contacts, a conducting element frangibly connected to said contacts, a cylinder, a relatively heavy mass operatively connected to said conducting ele-

ment and disposed within said cylinder so as to be capable of being displaced by centrifugal force, thereby severing the connection between said conducting element and at least one of said contacts, said cylinder containing fluid for inhibiting rapid movement of said relatively heavy mass.

4. A switching mechanism capable of being operated by centrifugal force, comprising in combination a plurality of electrical contacts, a conducting element frangibly connected to said contacts, a cylinder, a plunger operatively connected to said conducting element loosely disposed within said cylinder so as to be capable of being displaced by centrifugal force thereby severing the connection between said conducting element and at least one of said contacts, said cylinder containing fluid for inhibiting rapid movement of said plunger.

5. A switching mechanism capable of being operated by centrifugal force comprising, in combination, a plurality of electrical contacts, a conducting element frangibly connected to said contacts, a cylinder, a plunger operatively connected to said conducting element and disposed within said cylinder so as to be capable of being displaced by centrifugal force for severing the connection between said conducting element and at least one of said contacts, said connection between said plunger and said conducting element permitting relative movement between said plunger and said conducting element so that said plunger does not actuate said conducting element at the beginning of the displacement of said plunger.

6. A switching mechanism capable of being operated by centrifugal force comprising in combination, a plurality of electrical contacts, a conducting element frangibly connected to said contacts, a cylinder, a plunger disposed within said cylinder and capable of being displaced by centrifugal force, means connecting said plunger with said conducting element so that displacement of said plunger will sever the connection between said conducting element and at least one of said contacts, said connecting means including a bore in said plunger through which said conducting element loosely extends for permitting relative movement between said plunger and said conducting element, and means on said conducting element for causing movement of said conducting element when said plunger nears the end of its displacement.

7. A switching mechanism capable of being operated by centrifugal force comprising, in combination, a plurality of electrical contacts, a conducting element frangibly connected to said contacts, a cylinder, a plunger disposed withn said cylinder and capable of being displaced by centrifugal force, means connecting said plunger with said connecting element so that displacement of said plunger will sever the connection between said conducting element and at least one of said contacts, said connecting means including a bore in said plunger through which said conducting element loosely extends for permitting relative movement between said plunger and said conducting element and means on said conducting element for causing movement of said conducting element when said plunger nears the end of its displacement, and means in said cylinder including fluid for preventing rapid displacement of said plunger.

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