Oct. 25, 1949. S. H. DIKE 2,485,817

DETONATOR SAFETY DEVICE

Filed April 16, 1943

FIG. 1

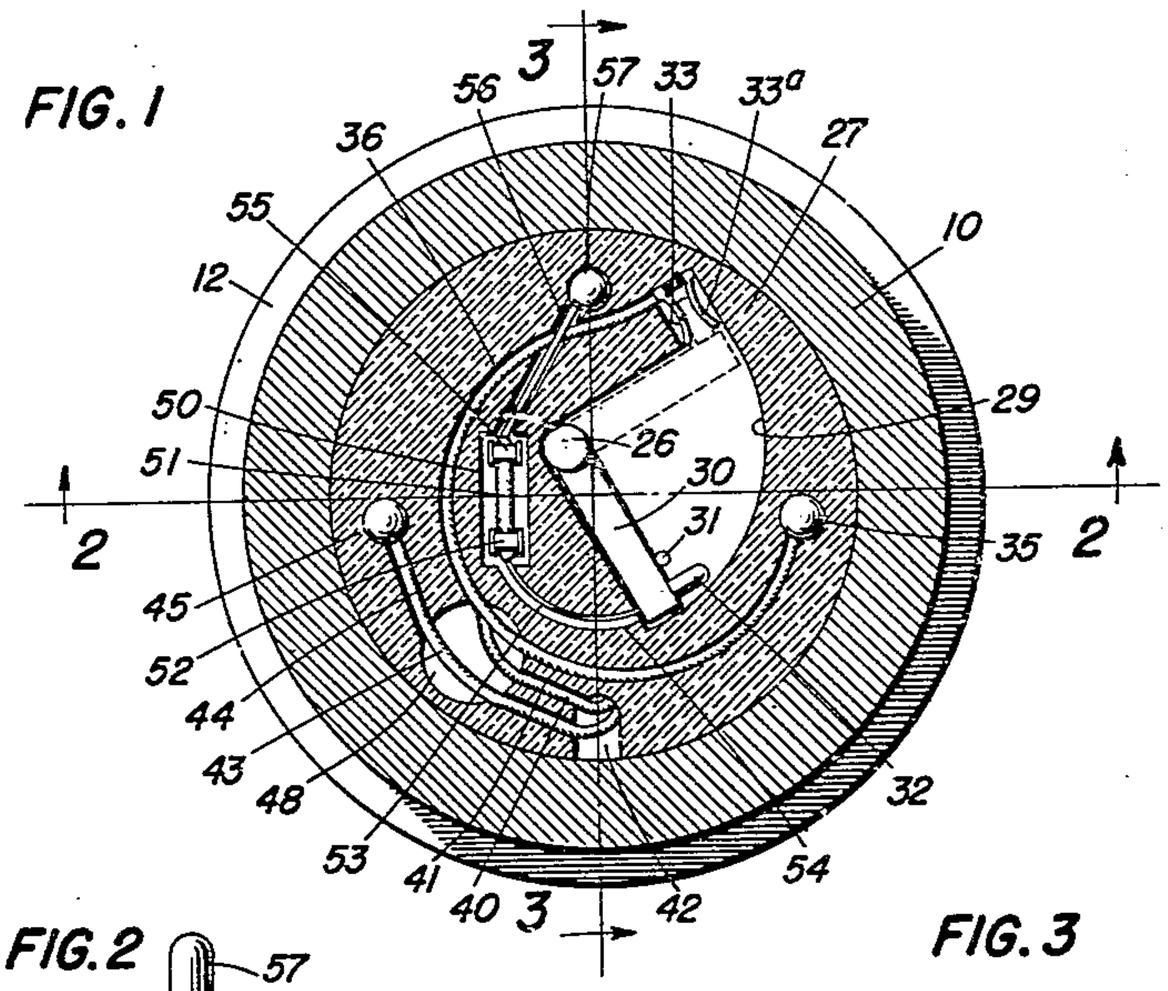


FIG. 2

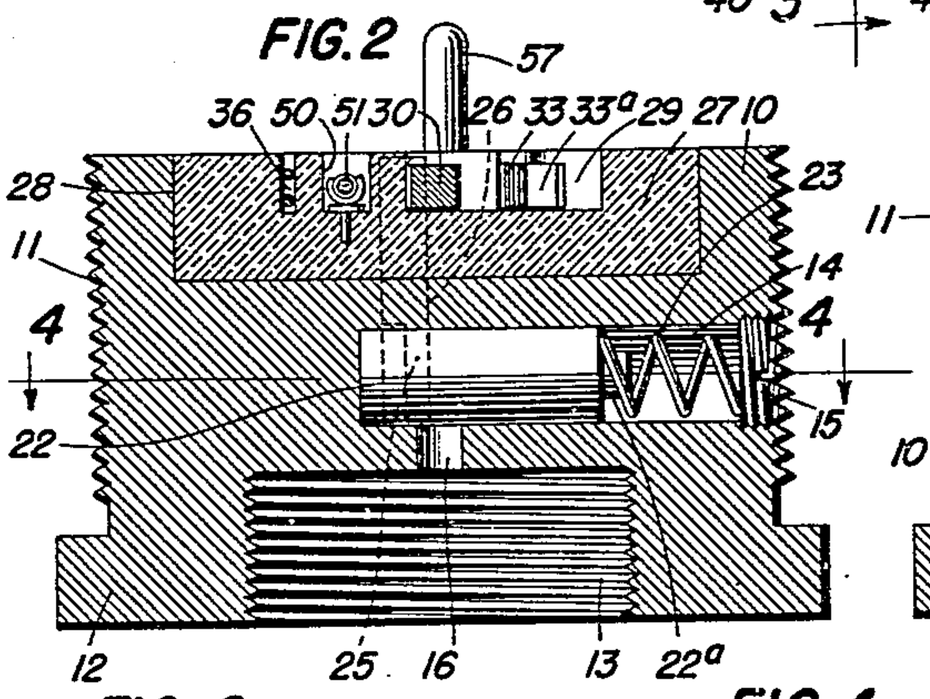


FIG. 3

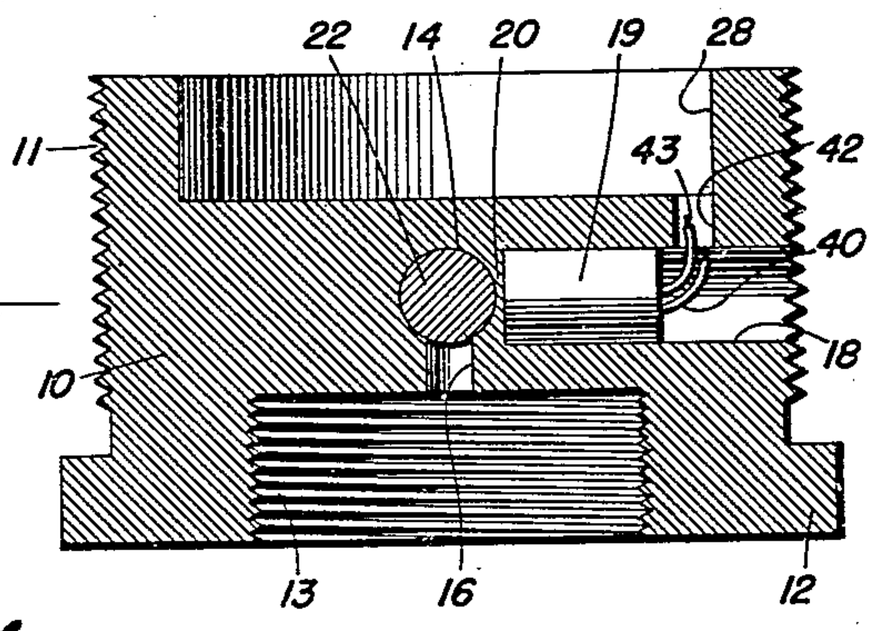


FIG. 6

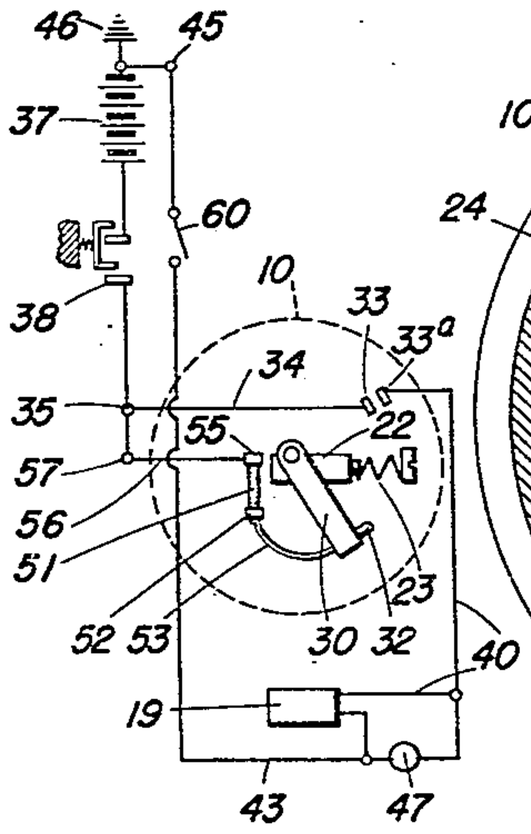


FIG. 4

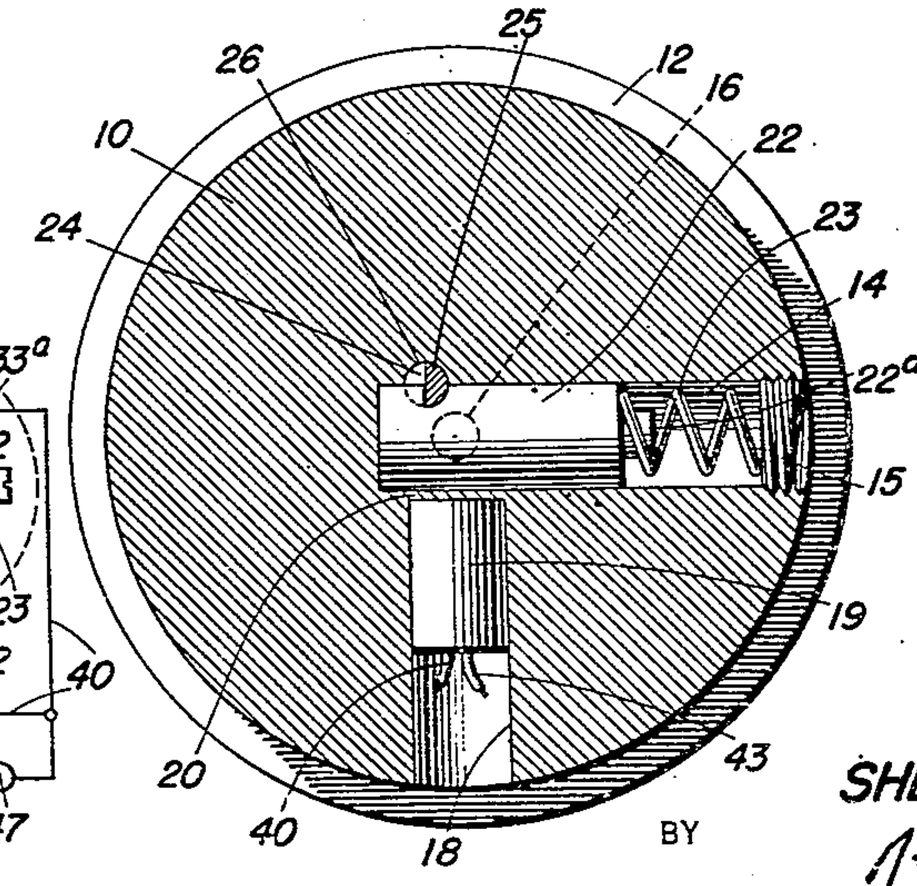
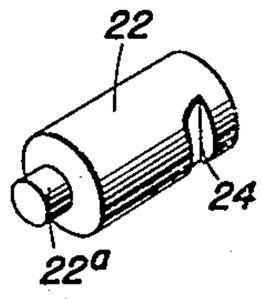


FIG. 5



INVENTOR
SHELDON H. DIKE
BY
J. J. Fitzgerald
ATTORNEY

Patented Oct. 25, 1949 2,485,817

UNITED STATES PATENT OFFICE

2,485,817

DETONATOR SAFETY DEVICE

Sheldon H. Dike, Ventnor, N. J., assignor to the United States of America as represented by the Secretary of the Navy

Application April 16, 1943, Serial No. 483,303

4 Claims. (Cl. 102—70.2)

1

This invention relates to safety devices for use with the detonator in an explosive projectile of the type which rotates during its flight. More particularly, the invention has reference to a novel safety device for this purpose including a control member movable between safe and armed positions by centrifugal force and which is normally secured in its safe position by means operable electrically with a time delay to release the member. The new safety device is simple and compact in construction and provides a high safety factor.

One object of the invention resides in the provision of a novel safety device including a control member which is normally held in a safe position by fusible means operable electrically to release the member after the projectile is fired from a gun. The control member may be arranged to control a suitable safety element, such as a gate in the explosion discharge passage of the detonator or a switch in a detonating circuit, or both. A safety device made in accordance with the invention comprises a housing containing a control member in the form of a pivoted arm movable between safe and armed positions by centrifugal force, and means including a conductor connected to the arm and latching the arm in its safe position, the latching means being operable electrically to release the arm. A current source is connected at one side to the latching means and is grounded at the other side to the housing, whereby the current source is in circuit with the arm and the latching means. The circuit is normally open and is designed to be closed by a switch responsive to firing the projectile from the gun, so that the latching means is operated to release the arm. Preferably, the control arm when released operates a switch in the detonating circuit to explode the detonator and also retracts a latch for permitting a safety gate to move from the explosion discharge passage of the detonator.

Another object of the invention is to provide a novel safety detonator for rotary projectiles which is positive and reliable in operation and provides a time delay in arming the detonator.

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

Fig. 1 is a front view of one form of the new safety device, the housing and the insulating block being in section, to show the channels therein clearly;

Figs. 2 and 3 are longitudinal sectional views on the lines 2—2 and 3—3, respectively, in Fig. 1, the insulating block being omitted in Fig. 3;

2

Fig. 4 is a transverse sectional view on the line 4—4 in Fig. 2;

Fig. 5 is a perspective view of the safety gate shown in Figs. 2, 3 and 4, and

Fig. 6 is a schematic view of the device showing the electrical connections.

The new safety device is illustrated in a form suitable for use in a radio-controlled proximity fuze of the type disclosed in a copending application of M. A. Tuve et al., Serial No. 471,388, filed January 6, 1943, although it will be understood that the device may take other forms. Referring to the drawing, the device there shown comprises a cylindrical housing 10 having an externally threaded course 11 on its front end portion so that the housing may be screwed into the usual can (not shown) for containing the parts of the proximity fuze in the projectile casing. At its rear end, the housing has an external flange 12 designed to engage the end of the can when the housing is screwed tightly therein. A threaded chamber 13 is formed in the rear end of the housing to receive the usual booster (not shown) for detonating the main charge in the main charge in the projectile casing. Intermediate its ends, the housing has a transverse bore, forming a cylinder 14 closed at its outer end by a threaded plug 15, the cylinder communicating with the booster chamber 13 through an explosion discharge passage 16 disposed axially of said chamber. A second cylinder 18 extends transversely of the housing at right angles to the cylinder 14 and contains an electrically operable squib 19. The inner end of the squib cylinder 18 terminates adjacent one side of the cylinder 14 and is separated therefrom by a thin, frangible wall 20.

A safety gate 22 is slidable in the cylinder 14 and is urged against the inner end thereof by a compression spring 23 seated on the plug 15, the inner end of the spring being coiled around a projection 22*a* on the gate for locating the spring in the cylinder 14. Near its inner end, the gate has a transverse notch 24 which normally receives a segment 25 on the rear end of a rotatable shaft 26 extending longitudinally through the housing. In the normal position of the shaft, as shown in Figs. 2 and 4, part of the segment 25 is disposed in the notch 24 so as to lock the gate in its innermost position where it blocks the explosion discharge passage 16. Accordingly, if the squib 19 should accidentally explode, the explosion is prevented from firing the booster through passage 16. When the shaft 26 is rotated

substantially 90°, the segment 25 is moved completely out of notch 24 and releases the gate.

The shaft 26 terminates in an insulating block 27 secured in a recess 28 in the front of the housing. In its front face, the block 27 is provided with a recess 29 in the form of a sector of a circle, the apex of the recess being offset from the axis of the housing, which corresponds to the axis of rotation of the projectile. The front end of shaft 26 is located in the apex of the recess and has a control arm 30 secured thereto, the arm being normally held at one end of the recess by a pin 31 which is slidable longitudinally in the insulating block under a force of setback to release the arm. On the free end of the arm 30 is an insulated switch contact 32, and when the arm is released it is movable on the shaft 26 by centrifugal force to the opposite end of the recess where the contact 32 engages a pair of fixed contacts 33 and 33*a* in the block 27.

The contact 33 is connected through a wire 34 to a terminal plug 35 in the insulating block which is formed with a suitable groove 36 for receiving the wiring. The plug 35 is designed to fit in a suitable socket (not shown) in the adjacent part of the fuze, the socket being connected to the positive side of a battery 37, preferably through a normally open switch 38 which is closed by a force of setback when the projectile is fired. The other contact 33*a* is connected to one side of the squib 19 by a wire 40 which extends along the groove 36, an intersecting groove 41 and an opening 42 in the block 27 and the housing. The other side of the squib is connected to a wire 43 which leads through the opening 42 and a groove 44 in the insulating block to a terminal plug 45 designed to fit in a suitable socket (not shown) connected to the negative side of the battery which is grounded to the housing 10, as shown at 46. Preferably, the squib 19 is normally short-circuited by a setback switch 47 connected between the wires 40 and 43 and disposed in a recess 48 which intersects the wiring grooves in the insulating block. The switch 47 may be of any conventional type which is normally closed and opens when subjected to a force of setback incident to firing the projectile.

A recess 50 is formed in the front face of the insulating block and contains a heating element 51 here shown as a carbon cylinder. On one end of the cylinder is a fusible head 52 made of eutectic solder, or the like, in which the looped end of a flexible conductor 53 is embedded. The conductor 53 extends from the head 52 along a groove 54 in the insulating block and is connected to the free end of the control arm 30. The opposite end of the heating element 51 has a head 55 connected through a conductor 56 to a terminal plug 57 in the insulating block, the plug 57 being designed to fit in a socket (not shown) connected through setback switch 38 to the positive side of the battery.

Normally, the control arm 30 is held in a "safe" position by the setback-operated detent 31 and conductor 53, and in this position of the arm the gate 22 is locked in its safe position by shaft 25. Also, the detonating circuit is held open because the switch contact 32 is maintained out of engagement with the contacts 33, 33*a*. It will be understood that if the detent 31 should be operated accidentally, the control arm 30 is still locked in its safe position by the conductor 53, and if the latter should be broken accidentally, the control arm still remains in its safe position for

the reason that it can move to its armed position only by the action of centrifugal force. The short-circuiting switch 47 and the setback switch 38 provide additional safety means for preventing premature detonation of the squib 19. The squib is preferably under control of a normally open switch 60 operable by a radio apparatus (not shown) in response to proximity of the projectile to a target, as disclosed in the above-identified application of M. A. Tuve et al.

When the projectile is fired from a gun, the switch 38 closes under the resulting force of setback, and the switch 47 is opened by the force of setback to remove the shortcircuit from squib 19. In addition, the force of setback renders the detent 31 inoperative so that it can no longer prevent movement of control arm 30. Upon closing of switch 38, the heating element 51 is energized by a circuit traceable from the positive side of battery 37 through switch 38, terminal plug 57, the heating element, conductor 53, arm 30, shaft 26, and the housing 10 to the negative side of the battery through the ground connection 46. The carbon cylinder 51 then commences to heat the fusible head 52 which, after a predetermined time interval, becomes sufficiently soft to release the looped end of conductor 53. As a result, the arm 30 is released and swings to the opposite end of recess 29 under the action of centrifugal force incident to rotation of the projectile in its flight. The swinging movement of the arm 30 rotates shaft 26 through substantially 90° so as to release the gate 22 which then moves outwardly under centrifugal force against the spring 23 to clear the explosion discharge passage 16. When the arm 30 approaches its armed position, shown in dotted lines in Fig. 1, it also engages contact 32 with the switch contacts 33, 33*a* and thereby prepares the detonating circuit traceable from the negative side of battery 37 through plug 45, normally open switch 60, wire 43, squib 19, wire 40, switch 32—33—33*a*, wire 34, plug 35 and switch 38 to the positive side of the battery. Accordingly, when the switch 60 is closed in response to proximity of the projectile to a target, the squib 19 is exploded and fractures the thin wall 20, the explosion being communicated through discharge passage 16 to the booster in recess 13.

It will be evident that the new safety device may be made in a compact form and is of a relatively simple construction which affords a high factor of safety. The heating element 51 provides a time-delay of a predetermined amount in the arming of the squib 19, and by locking the control arm 30 the heating element serves the dual function of retaining the safety gate 22 in its safe position and maintaining the detonating circuit open at the switch contacts 33, 33*a*.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. A safety device comprising a safety member movable between operative and inoperative positions, means including a thermo-responsive element for holding said member in its operative position, means for heating the thermo-responsive element to release the safety member, said device having an explosion discharge passage therein, a detonating element disposed in said explosion-discharge passage, a gate normally blocking said passage and movable to a position for clearing

said passage, and means under control of the safety member for locking the gate in the passage and operable to release the gate on movement of said member to its inoperative position.

2. A safety device comprising a safety member movable between operative and inoperative positions, means including a thermo-responsive element for holding said member in its operative position, means for heating the thermo-responsive element to release the safety member, an electrical detonating element disposed in an explosion discharge passage, a gate normally blocking the passage and movable to a position for clearing the passage, means under control of the safety member for locking the gate in the passage and operable to release the gate on movement of said member to its inoperative position, and a circuit for energizing the detonating element including a switch operable by the safety member.

3. A detonator for rotary projectiles, which comprises a housing, an electrical squib in the housing operable through an explosion discharge passage, a gate normally blocking the passage and movable by centrifugal force to a position for unblocking the passage, a shaft in the housing for locking the gate in its blocking position and rotatable to release the gate, an arm on the shaft operable by centrifugal force to rotate the shaft, means including a conductor connected to the arm for securing the arm against movement to hold the shaft in its locking position, said means being operable electrically to release the arm, a current source connected at one side to said means and grounded at the other side to the housing, whereby the current source is in circuit

with the shaft, the arm and said means, a switch responsive to firing of the projectile for closing said circuit to cause said means to release the arm, and a detonating circuit for the squib including a safety switch operable by said arm.

4. A detonator for rotary projectiles, which comprises a housing, having an explosion discharge passage therein, an electrical squib in the housing operable through said passage, a gate normally blocking the passage and movable by centrifugal force to a position for unblocking the passage, a shaft in the housing for locking the gate in its blocking position and movable to release the gate, an arm on the shaft operable by centrifugal force to so move the shaft, means for securing the arm against movement, to hold the shaft in its locking position, said means being operable electrically to release the arm, a source of electricity connected in circuit with the shaft, the arm and said last-named means, a switch responsive to firing of the projectile for closing said circuit to cause said means to release the arm, and a detonating circuit for the squib including a safety switch operable by said arm.

SHELDON H. DIKE.

REFERENCES CITED

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

FOREIGN PATENTS

Number	Country	Date
241,941	Great Britain	Nov. 26, 1925
265,797	Italy	July 6, 1929
376,987	Italy	Dec. 4, 1939