July 11, 1950 M. S. KHARASCH ET AL 2,514,499

DELAY ACTION FUSE

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Fig. 1.

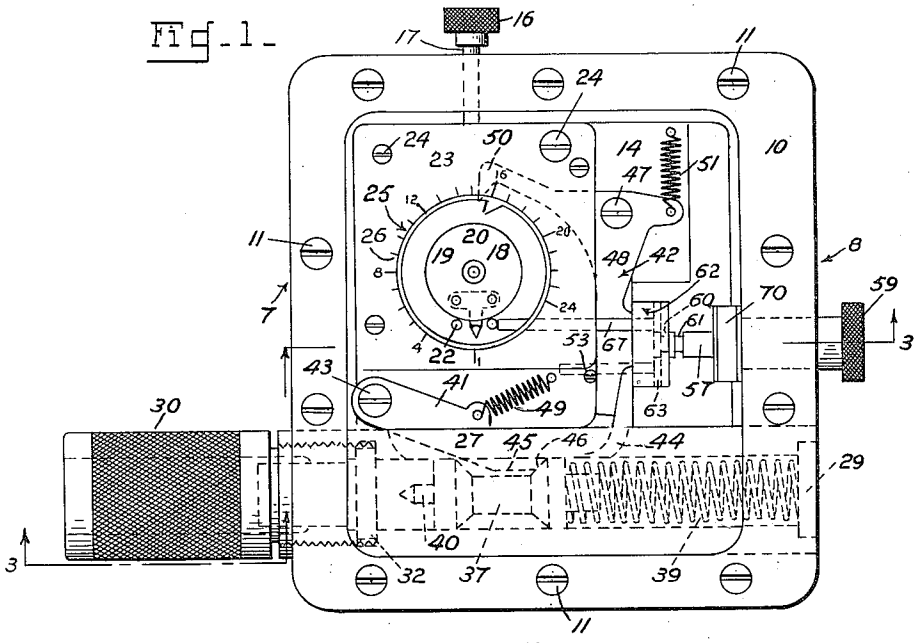


Fig. 2.

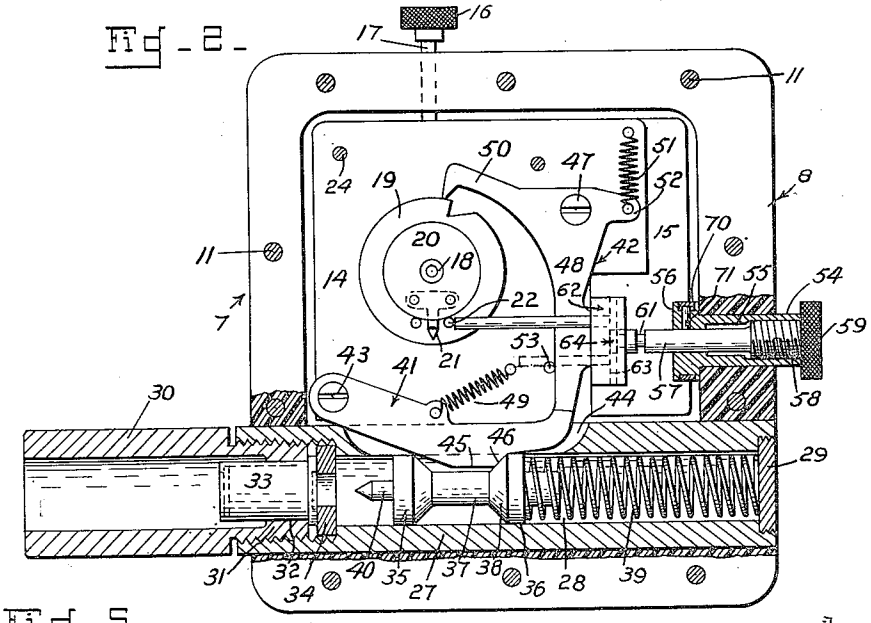
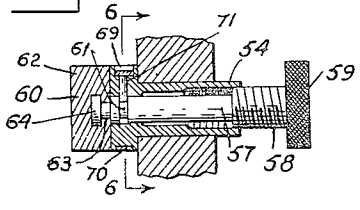


Fig. 5.



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Fig. 3.

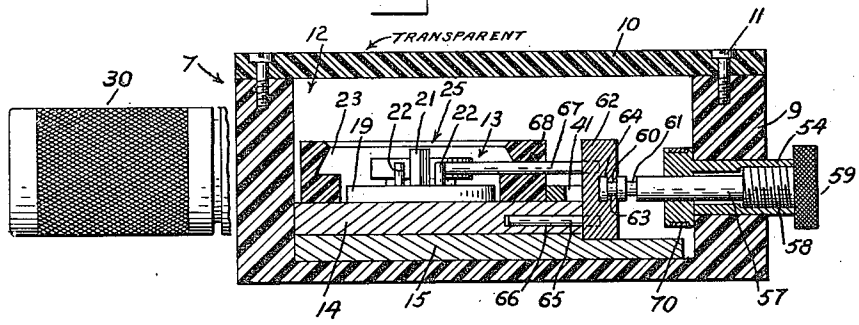


Fig. 4.

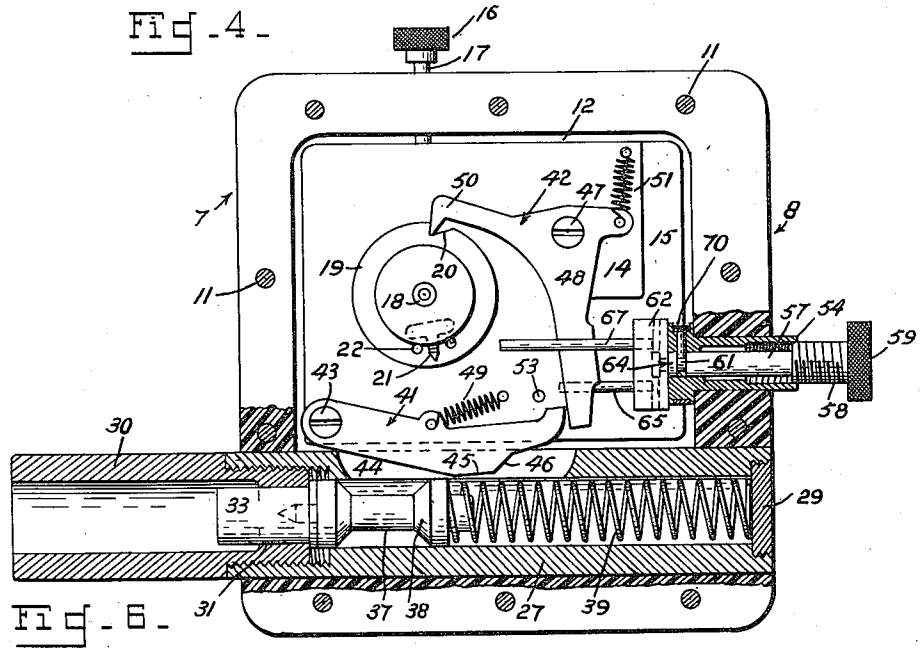
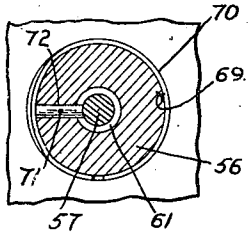


Fig. 6.



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DELAY ACTION FUSE

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6 Claims. (Cl. 102—82)

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This invention relates to an improved delay action fuse and more particularly to a delay action fuse of mechanical construction capable of operating efficiently for setting off a charge of explosive at a predetermined future time.

It is a primary object of this invention to provide a mechanical fuse for delay action operation which will overcome certain disadvantages inherent in chemically controlled delay action fuses, to wit: the variance in the functioning of the chemical means due to changes in temperature.

More particularly, it is an aim of the present invention to provide a fuse which is entirely mechanical in operation and construction, employing a watch or clock mechanism by means of which the operation of the fuse can be accurately regulated; and which is so constructed that the possibility of the failure of the fuse to function is practically eliminated.

Another object of the invention is to provide a fuse of the above described character which is of a very compact construction and which can be made waterproof so that the fuse can function in a submerged position for detonating a submerged charge of explosive, and which is also capable of being set and armed after having been connected to the explosive and while in a submerged position.

A further object of the invention is to provide a fuse capable of being quickly, accurately and safely set and armed and which is so constructed that it is incapable of functioning for a predetermined time interval after the fuse has been armed.

Another object of the invention is to provide a fuse having safety means for arming the fuse, after it has been attached to the charge to be detonated and set for the delayed action, which having once been armed is locked against movement to a position to disarm the fuse.

Other objects and advantages of the invention will hereinafter become more fully apparent from the following description of the drawings, which illustrate a preferred embodiment thereof, and wherein:

Figure 1 is a top plan view showing the fuse disarmed;

Figure 2 is a top plan view, partly in section, of the fuse and with certain of the parts removed;

Figure 3 is a transverse sectional view taken along the line 3—3 of Fig. 1;

Figure 4 is a view similar to Fig. 2 and showing the fuse parts in released positions;

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Figure 5 is a sectional view of a portion of the fuse; and

Figure 6 is an enlarged cross sectional view of a part of the fuse taken substantially along a plane as indicated by the line 6—6 of Figure 5.

Referring more particularly to the drawings, wherein like reference characters designate like or corresponding parts throughout the several views, 7 designates generally the improved mechanical fuse in its entirety and which includes a housing 8 formed of a body portion 9 and a transparent cover 10, which is secured to the body portion 9, by screw fastenings 11. The body portion 9 is preferably formed integral and may be of any material such as a suitable plastic, and is provided with an interior chamber 12 which is closed by the transparent cover 10. A watch mechanism, designated generally 13, is contained within the housing 8 and the driving mechanism thereof, not shown, is disposed within a recess, not shown, in the soft iron plates 14 and 15, which serve to shield the driving mechanism from external magnetic fields. The driving mechanism has not been illustrated and will not be described since it may be of a conventional construction controlled by a knob 16 connected to a shaft 17, by means of which the driving mechanism is wound and set in a conventional manner. An arbor or shaft 18 is driven by the watch driving mechanism and is suitably geared thereto so as to make one revolution approximately every 30 or 32 hours. A disk 19 is keyed to the arbor 18 and is provided with a notch 20 in its periphery. An indicating pointer 21 is secured to the upper surface of the disk 19 and is disposed between corresponding studs 22 which project upwardly from said disk. The watch mechanism 13 is provided with a cover plate 23 detachably mounted by screw fastenings 24 and having a central opening 25 above the disk 19. Around the opening 25 the upper surface of the plate 23 is suitably inscribed with time interval calibrations 26. The distance between adjacent markings of the calibrations equal the distance of the movement of the pointer 21 and disk 19 during a period of one hour. The disk 19 is driven in a counterclockwise direction and as clearly illustrated in Fig. 2, the leading portion of the notch 20 is defined by a substantially radially disposed edge, for a purpose which will hereinafter become apparent.

A barrel or tubular housing 27 is contained in and extends across one end of the housing 8 and is provided with a bore 28 which extends therethrough and which is closed at one end by a

threaded plug 29. The opposite end of the bore 28 is enlarged and internally threaded to receive and mount a percussion cap holder 30 which is provided with a restricted threaded end for detachably engaging in said threaded end of the bore 28. The holder 30 is provided with a bore which extends therethrough and its restricted portion 31 contains a restricted bore portion 32 in which is mounted a percussion cap 33, the head of which is disposed at the inner end of the portion 31. A metal washer 34 is mounted between the head of the percussion cap 33 and the inner end of the threaded portion of the bore 28 until such time as the fuse 7 is prepared for use, when said washer 34 is removed. A firing pin or striker 35 is slidably mounted in the bore 28 and is provided with an elongated body portion 36 having a restricted intermediate portion 37 including an annular rearwardly inclined or frusto-conical portion 38. An expansion coil spring 39 is disposed between the plug 29 and the adjacent end of the firing pin 35 for resiliently urging the firing pin toward the percussion cap 33, and said firing pin, at its leading end, is provided with pointed projection 40 arranged to strike and detonate the percussion cap 33 when the firing pin is projected by spring 39.

The upper metal plate 14 projects beyond the cover 23 to provide a supporting base member for a sear lever 41 and a trigger 42. Sear 41 is pivotally mounted at one end thereof at 43 on the plate 14. The intermediate portion of the sear 41 extends through a longitudinally disposed slot 44 in the barrel 27 and one longitudinal edge thereof is provided with an enlargement 45 which extends into the recess 37 of the firing pin 35. The enlargement 45 is provided with a beveled edge 46 which bears against the frusto-conical portion 37 to retain the firing pin 35 in a retracted position against the action of spring 39, as best seen in Fig. 2. The trigger 42 is pivotally connected, intermediate of its ends at 47, to the plate 14 and is provided with an arm 48 which extends toward the sear 41 and which normally has its free end bearing against the free end of the sear 41, as clearly illustrated in Fig. 2, for retaining the sear in engagement with the firing pin 35. A contractile coil spring 49 is anchored at one end to base 14 and is connected at its opposite end to the sear 41 for yieldably urging the sear portion 45 out of engagement with the firing pin. The other arm 50 of the trigger 42 is disposed at an angle to the arm 48 and is shaped to define a pawl which terminates in a pointed bill which normally bears against the periphery of the disk 19 and which is shaped to fit into the notch 20. A contractile coil spring 51 is anchored at one end thereof to the base 14 and is connected at its opposite end to a laterally projecting arm 52 of the trigger 42 for urging the pawl 50 inwardly relative to the disk 19 and for urging the detent arm 48 outwardly and out of engagement with the free end of the sear 41. The engagement of the bill of the pawl 50 with the periphery of the disk 19 normally retains the arm 48 in engagement with the sear 41 to retain these parts in a cocked position, as best illustrated in Fig. 2. A stop 53 projects upwardly from the base 14 and is disposed to be engaged by the arm 48 to prevent an inward movement of said arm beyond its position of Fig. 2.

A bushing 54 extends through one side wall of the housing 8 and is provided with a bore 55 which extends therethrough. The bushing 54

is provided with an enlargement or head 56 at its inner end and which is disposed within the housing 8. A shaft 57 extends through the bore 55 of the bushing 54 and slidably and turnably engages the restricted inner end of the bore 55 and is provided with an enlarged outer end portion 58 which is threaded to engage the enlarged internally threaded outer end of the bore 55. The shaft 57, at its outer end, is provided with a knurled knob 59. Shaft 57, adjacent its inner end, is provided with spaced annular grooves 60 and 61. As best seen in Figs. 3 and 5, a block 62 is provided with a dovetailed slot 63 which extends lengthwise therethrough and which opens outwardly of one side thereof and which is sized to receive the outermost groove 60 and the head 64 on the inner end of the shaft 57, for swiveling the shaft 57 to the block 62. The block 62 is disposed over the exposed portion of the metal base block 15 which protrudes from one edge of the upper metal block 14 as best shown at Figure 3. A pin 65 projects from the block 62 parallel with shaft 57 and into a bore 66 in the block 14, and slidably fits said bore to limit motion of block 62 to translation in the direction of the axis of shaft 57. A stop pin 67 is secured to and projects from the block 62 parallel with shaft 57 and pin 65, and as best seen in Fig. 3, extends through and slidably engages a bore 68 in the cover 23 and, when in a projected position, as seen in Figs. 1, 2, and 3, has its free end disposed in the path of movement of the studs 22. The head 56 is provided with an outwardly opening peripheral groove 69, as best seen in Fig. 6, containing a split spring ring 70 which engages the outer end of a locking pin 71, which is slidably mounted in a radial bore 72 of the head 56. The pin 71 normally bears against the shaft 57 and is held thereby in a retracted position against the action of the spring ring 70, as seen in Fig. 2. However, when the shaft 57 is fully retracted, as seen in Figs. 4, 5, and 6, the pin 71 is projected inwardly by the spring 70 into the groove 61, which is then disposed to receive the pin, for locking the shaft 57 to prevent inward axial movement thereof.

The fuse parts are in the positions as seen in Figures 1 and 2 prior to setting the fuse 7 for use. In order to set the fuse 7, as previously mentioned, the washer 34 is first removed and the holder 30 is screwed tight into the threaded end of the bore 28 after which the outer end of the holder can be connected in any suitable manner to the charge, not shown, to be detonated by the operation of the fuse. The knurled knob 16 is then pulled outwardly for setting the mechanism of the watch 13, and from its position of Fig. 1, disk 19 is turned by the setting operation in a clockwise direction to set the pointer 21 at the indicia representing the desired number of hours after which the fuse 7 is intended to function after being set. The knurled knob 16 is then pushed inwardly, to its position of Fig. 1, and turned in a conventional manner for winding the driving mechanism of the watch. The block 62 is disposed in its forward position during this operation, in engagement with the intermediate portion of the arm 48 to prevent said arm from moving out of engagement with and releasing the sear 41. Likewise the pin 67 is disposed in the path of movement of the studs 22 so that until retracted, the disk 19 cannot rotate sufficiently in a counterclockwise direction to position the notch 20 to receive the bill of the pawl 50, thus providing a dual positive safety for retaining the

fuse 7 in a disarmed condition. The fuse 7 is armed and ready to operate by turning the knurled knob 59 in a counterclockwise direction for retracting shaft 57, block 62 and the stop pin 67 to fully arm the fuse. The knurled knob 59 is turned sufficiently to fully retract shaft 57 so that the locking pin 71 will engage the groove 61 to hold shaft 57 against inward axial movement, to prevent the fuse 57, once armed, from being disarmed. The driving mechanism of the watch 13 turns the disk 19 in a counterclockwise direction until it moves beyond its position of Fig. 1 and to its position of Fig. 4, at which time the notch 20 will be disposed so that the bill of the pawl 50 will drop into said notch, and, as previously mentioned, the leading edge of the notch 20 is substantially radially disposed so that the bill of the pawl 50 will ride over the outer end of the notch and be projected immediately into the notch by the spring 51. This will cause the trigger 42 to be rocked from its position of Figs. 1 and 2 to its position of Fig. 4, to thus move the arm 48 out of engagement with the free end of the sear 41 to permit the spring 49 to pull the sear 41 away from the barrel 27 to release the firing pin 35. Firing pin 35 will be projected by the spring 39 so that the pointed projection 40 will forcibly strike and detonate the primer 33 to thereby detonate the charge connected to the holder 30. If desired, the spring 49 can be omitted and the coacting cam surfaces 38 and 46 will function, due to the pressure exerted by the spring 39, to retract the sear 41 and release the firing pin 35.

As seen in Fig. 1, when the stop pin 67 is disposed in its fully projected, operative position, it will engage one of the studs 22 at a point at which the disk 19 still has a travel of a distance that requires approximately one hour before the notch 20 is disposed to receive the pawl 50. Consequently, the watch mechanism 13 cannot be set, when the safety means is in an operative position, so that the fuse will function as soon as the safety means is moved to an inoperative, arming position. By providing the locking pin 71, the fuse 7, once armed, is rendered incapable of being disarmed, so that the fuse must be detached from the charge or destroyed in order to prevent it from functioning. The fuse housing 8 can be made waterproof so that the fuse can be submerged and set and armed while thus positioned. The entire operation of setting and arming the fuse is accomplished by operation of the knurled knobs 16 and 59 from the exterior of the fuse housing and the setting of the watch mechanism 13 can be observed through the transparent cover 10. The soft metal container, formed by the blocks 14 and 15, in addition to preventing the watch mechanism from being effected by magnetic fields, also renders the operation of the mechanism substantially silent. The threaded connection of the shaft 57 with the bushing 54 prevents accidental withdrawal of the safety.

Various modifications and changes are contemplated and may obviously be resorted to, without departing from the spirit and scope of the invention as hereinafter defined by the appended claims, as only a preferred embodiment thereof has been disclosed.

We claim:

1. In a delay action fuse, a housing, a spring-urged firing pin slidably mounted in said housing, a sear in said housing pivotable on a first axis from a first position engaging and holding said pin retracted, to a second position releasing said pin, a time-controlled disk rotatable in said housing, a trigger pivoted in said housing and having an arm adapted, in a first position of said trigger, to engage and hold said sear in its said first position, and in a second position of said trigger, to release said sear, said trigger and disk having means cooperating to permit movement of said trigger to its second position when said disk is in one position of rotation only, and to maintain said trigger in its first position at all other times, a unitary safety member movably mounted in said housing, said member engaging and holding said trigger in its first position, and simultaneously engaging said disk to positively prevent its movement into said one position, said safety member being movable to a second position to simultaneously free said trigger and disk, and spring means urging said sear and trigger into their second positions.

2. A delay action fuse comprising a housing, a clockwork in said housing, including a rotatable disk having a notch in its periphery, a trigger pivoted on an axis in said housing and having first and second angularly related arms extending radially of said axis, said first arm having a nose adapted to drop in said notch in one position of said disk, a sear pivoted in said housing, the pivot axes of said disk, trigger and sear being parallel, a firing pin slidable in said housing, a spring urging said pin from retracted to firing position, said sear being adapted in a first position to hold said pin in retracted position and to release said pin when moved to a second position, the second arm of said trigger engaging and holding said sear in its first position when said nose engages the periphery of said disk, a spring urging the nose of said trigger against the periphery of said disk, an abutment on said disk, and safety means movably mounted in said housing and adapted in one position to simultaneously engage and hold said trigger against movement releasing said sear and to engage the abutment on said disk to prevent said notch from moving under said nose, means operable externally of said housing to withdraw said safety means from engagement with said trigger and disk, and means within said housing automatically operable to lock said safety means in withdrawn position.

3. In a delay action fuse, a housing, a spring-urged firing pin slidably mounted in said housing, a sear in said housing pivotable on a first axis from a first position engaging and holding said pin retracted, to a second position releasing said pin, a time-controlled disk rotatable in said housing, a trigger pivoted in said housing and having an arm adapted, in a first position of said trigger, to engage and hold said sear in its said first position, and in a second position of said trigger, to release said sear, said trigger and disk having means co-operating to permit movement of said trigger to its second position when said disk is in one position of rotation only, and to maintain said trigger in its first position at all other times, safety means movably mounted in said housing, said means engaging and holding said trigger in its first position, and simultaneously preventing movement of said disk to its said one position, said safety means being movable to a second position to simultaneously free said trigger and disk, spring means urging said sear and trigger into their second positions, said safety means including a block slidably mounted in said housing and adapted in safety position to engage and hold said trigger in first

position, an abutment extending from said block having its end interposed in the path of an abutment on said disk, and means manually operable from the exterior of said housing for sliding said block out of its said safety position, to simultaneously free said trigger and disk.

4. A fuse as recited in claim 3, said manually operable means comprising a shaft slidably and rotatably mounted in an aperture in the wall of said housing and having a circumferential groove and a portion within said housing, a swivel connection between said block and shaft, and spring lock means within said housing adapted to engage in said groove and lock said shaft when said shaft has been operated to move said block out of its safety position.

5. A fuse as recited in claim 3, said manually operable means comprising a shaft threaded through a wall of said housing and having a circumferential groove in a portion within said housing, a swivel connection between said block and the adjacent end of said shaft, and a spring-pressed plunger within said housing and adapted to engage in said groove and thereby lock said shaft against axial movement when said block has been withdrawn from said safety position.

6. A delay action fuse comprising a housing, a clockwork in said housing, including a rotatable disk having a notch in its periphery, a trigger pivoted on an axis in said housing and having first and second angularly related arms extending radially of said axis, said first arm having a nose adapted to drop in said notch in one position of said disk, a sear pivoted in said housing, the pivot axes of said disk, trigger and sear being parallel, a firing pin slidable in said housing, a spring urging said pin from retracted to firing position, said sear being adapted in a first position to hold said pin in retracted position and to release said pin when moved to a second position, the second arm of said trigger engaging and holding said sear in its first position when said nose engages the periphery of said disk, a spring urging the nose of said trigger against the periphery of said disk, an abutment on said disk, and safety means movably mounted in said housing and adapted in one position to simultaneously engage and hold said trigger against movement releasing said sear and to engage the abutment on said disk to prevent said notch from moving under said nose, means operable externally of said housing to withdraw said safety means from engagement with said trigger and disk, means within said housing automatically operable to lock said safety means in withdrawn position, said means operable externally of said casing comprising a shaft threaded through one wall of said housing and having a circumferential channel within said housing, a swivel connection between said safety means and said shaft, and means in said housing cooperating with said channel to lock said shaft to thereby maintain said fuse in armed condition.

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