FAIL-SAFE HAND GRENADE

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ABSTRACT

This invention relates to a completely sealed improved hand grenade fuze having an out-of-line detonator held in a safe position by two independent safing elements. The present invention includes a formed latching member for preventing the inadvertent removal of the grenade initiating handle, puncturable sealing foil to prevent malfunctions due to accumulations of mud and ice, a compliant element intermediate the handle and the sealing foil, a spring biased detent cap for penetrating the sealing foil upon release of the safety handle and for mechanically releasing a rotor housing. The rotor housing, after mechanical release by the biased detent cup, is first rotated by a short delay cord which activates a gas generating charge forcing the rotor to turn from a "safe" out-of-line position to an "armed" in-line position. The detonator in the in-line position is initiated by a long delay cord which is ignited simultaneously with a short delay cord. The detent cap releases a biased firing pin causing it to strike a primer which initiates the dual delay cords. The initiated detonator in the in-line position activates an explosive train causing detonation of the grenade.

4 Claims, 11 Drawing Figures
FAIL-SAFE HAND GRENADE

GOVERNMENTAL INTEREST

The invention described herein may be manufactured, used and licensed by or for the Government for governmental purposes without the payment to me of any royalty thereon.

BACKGROUND OF THE INVENTION

Various means have been used in the prior art to incorporate both safety and lethality in the design of a hand grenade. In the past because of the uncertainty of fuze delay personnel throwing the munition were often endangered when the grenade was picked up by the enemy and thrown back. In addition, in order to protect personnel from accidental initiation of the device, prior art grenades used a simple pull type cotter pin to hold down a handle, which if released would fly off the grenade and permit a mechanical mechanism to initiate a spring loaded firing pin. The difficulty with this prior art handle-cotter pin safety means was that the cotter pin ring could be accidentally snagged and pulled from the handle thereby causing premature detonation while the grenade was being transported by friendly troops.

A further problem with prior art hand grenades has been in the use of an in-line delay train between the primer and the lead detonator. In the event that a delay train was inadvertently left out of these in-line delay devices, a premature detonation would occur causing injury to user. In order to avoid these premature malfunctions costly 100 percent X-ray inspection of the assembled device had to be used in the past. The prior art devices using such in-line delay trains also suffered failures because of uncontrollable variations in the delay column resulting in too short and too long delay times. Other causes of failure have been due to primer cavity blockage, failure of the primer striker to function due to spring corrosion and porosity in the die casting of the delay train housing. Another problem with the prior art design utilizing in-line explosive train has been accidental primer initiation due to rough handling or inadvertent exposure of the grenade to fire which would lead inevitably to a malfunction.

The present invention overcomes the aforementioned problems regarding safety and inadvertent malfunction by utilizing an improved cotter pin lock handle design, a duel circuitous path for the delay train, and a fail safe pyrotechnique-mechanical means to avoid premature.

SUMMARY OF THE INVENTION

The present invention relates to an improved hand grenade fuze which has a completely sealed out-of-line detonator held in a "safe" position by two separate safing elements. The present invention utilizes a fuze delay train comprising two independent delay columns which must function in a given sequence in order to achieve detonation. In the event that there is a premature delay the hand grenade will fail safe. The present device prevents inadvertent cotter pin removal by the incorporation of a novel two stage arming lever which requires a positive squeeze by the user in order to allow the pin to be removed. As a result of the aforementioned improvements in the present invention the button contour has been greatly reduced resulting in improved handling and implacement characteristics.

One of the objects of the present invention is to insure the safety of the personnel carrying the hand grenade by requiring a positive squeeze on the handle of the release lever by the user prior to the pulling of the release cotter pin.

Another object of the present invention is to provide an improved hand grenade which will fail safe in the event of accidental omission of a delay column.

Another object of the present invention is to provide an improved hand grenade which is inexpensive to manufacture because of reduced inspection costs.

Another object of the present invention is to protect the user of the hand grenade from premature malfunctions by requiring two independent delay columns to sequentially function in order to achieve detonation.

Another object of the present invention is to reduce the chance of accidental detonation by utilizing an out-of-line detonator held in a safe position by two separate safing elements.

Another object of the present invention is to insure the operability of the hand grenade after exposure to mud and ice by utilizing a sealed primer and firing mechanisms.

For a better understanding of the present invention, together with other and further object thereof, reference is made to the following description taken in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a partial cross-sectional view of the grenade in the "safe" unarmed position.

FIG. 2 is a partial cross-sectional view of the grenade handle, bouchon, cotter pin and pull ring taken along line 2—2 as illustrated in FIG. 1 showing the locking position of the cotter pin in relation to the handle and the bouchon when the grenade is in the safe position.

FIG. 3 is a partial cross-sectional view of the grenade handle, bouchon, cotter pin and pull ring taken along line 3—3 as illustrated in FIG. 1 showing the unatched position of the cotter pin in relation to the depressed handle just prior to the final withdrawal of the pin and the throwing of the grenade.

FIG. 4 is a partial side view of the handle and the bouchon taken along line 4—4 as illustrated in FIG. 1 showing how the front portion of the handle is retained by the bouchon while the grenade is in the "safe" position.

FIG. 5 is a partial cross-sectional view taken along line 5—5 as illustrated in FIG. 1 showing how the deton cap is radially and slidably positioned in the fuze body groove.

FIG. 6 is a cross-sectional view taken along line 6—6 as illustrated in FIG. 1 showing how the firing pin housing detents the primer assembly washer.

FIG. 7 is a cross-sectional view taken along line 7—7 as illustrated in FIG. 1 showing how the deton cap rotor stop passes through the delay cord positioning spacer.

FIG. 8 is a partial cross-sectional view taken along line 8—8 as illustrated in FIG. 1 showing how the detonator is positioned in the rotor housing relative to the gas generating charge and the lead detonator when the fuze is in the safe position.
FIG. 9 is a partial cross-sectional view taken along line 9—9 showing the lead in the lead housing, detent ball, gas generating charge and the rotor housing stop.

FIG. 10 is a partial cross-sectional view of the grenade showing the fuze in the "armed" condition.

FIG. 11 is a partial cross-sectional view taken along line 11—11 as illustrated in FIG. 10 showing the detonator positioned by the rotor housing directly in-line with the lead.

Throughout the following description like reference numerals are used to denote like parts of the drawing.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to FIGS. 1, 2, 3 and 4 a hand grenade assembly 10 is maintained in the "safe" condition by handle 12 which is removably fixed to fuze body 14 by body pivot 16 on the bifurcated handle end 18, and in the handle middle section 20 by a formed cotter pin 22 which passes through a pair of axially aligned handle pin slots 24 and a fuze body pin bore 26. The fuze pin bore 26 is aligned with reference to the handle pin slots 24. An intermediate cotter pin projection 28 slidable fits in the slotted "U" shaped handle latch 30 so that the cotter pin 22 cannot be inadvertently withdrawn by cotter pin ring 32 without the user intentionally squeezing the handle lever end 13 toward the grenade body proper.

Referring to FIGS. 1 and 5 fuze body 14 is screwed into grenade casing 34. Fuze body 14 has a central keyed detent cap bore 36 for slidable holding therein detent cap 38. The hollow cylindrical detent cap 38 has a forward closed end 40 and a rear open end 42. The detent cap forward end 40 is biasedly held in the "safe" position by the compressed detent spring 44 which forces the closed end 40 in the direction of an aluminum foil sealing disc 46, glued or otherwise affixed to stop nut 50, and a compressed rubber compliant disc 48. The latter is held intermediate the handle middle section 20 and the aluminum foil sealing disc 46 with the annular groove 49 operatively positioned over annular clearance space 51. An annular axially positioned stop nut 50 is threadably affixed to the fuze body 14 to permit the detent cap forward end 40 to slidable pass through annular clearance space 51 and to provide the structural support for the thin sealing disc 46. A pair of detent balls 52 are operatively positioned within firing pin housing 54. In the safe position, as shown by FIG. 1, the balls 52 prevent the firing pin 56 from being driven into axially aligned primer 58. The firing pin 56 is biasedly held within the housing 54 by the firing pin helical spring 60. The detent spring 44 is biased position intermediate the inner surface of the detent cap forward closed end 40 and shoulder 62 of the housing 54. An assembly washer 64 fits within the detent cap 38 and has an axial counter bore 66 and two delay cord locating bores 68, 70 communicating with the counter bore 66. An assembly bore 72 radially positioned in the peripheral side of the washer 64 is axially aligned with one of the two detent cap balls 74 and 76 which are diametrically positioned in side wall 75. An assembly pin (not shown) is inserted in bores 72 and 74 during the fabrication of the device and removed after the handle 12 and the cotter pin 22 are attached to the fuze body 14.

Referring to FIGS. 1 and 6, a cross-sectional view taken along line 6—6 of FIG. 1 shows the fuze body 14 circumambient the detent cap 38 which has located therein the assembly washer 64 and axially aligned therewith primar 58. An assembly washer groove 78 is peripherally positioned in the assembly washer 64 to mate with the firing pin housing locking tongue 80 so that delay cord assembly 82 remains stationary with respect to rotor housing 84. The delay cord assembly consists of a delay cord mandrel 86 about which is wrapped a short delay cord 88 and about which is wrapped in turn a long delay cord 90.

Referring now to FIGS. 1 and 7 the cross-sectional view along line 7—7 shows the rotor-mandrel delay cord spacer 92 positioned within the fuze body 14 intermediate to the delay cord assembly 82 and the rotor housing 84. The spacer 92 has two operatively positioned spacer delay bores 94 and 96 for holding therein the short and long delay cords 88 and 90 respectively. The short delay cord 88 has a first end 87 which is operatively positioned in the assembly washer delay cord bore 70 and its other end 89 positioned in spacer delay bore 94. The long delay cord 90 has a first end 91 which is likewise positioned in the assembly washer delay bore 68 and its other end 93 positioned in the spacer bore 96. A peripherally positioned detent tongue groove 98 permits the detent cap tongue 100 to slidably extend therethrough to rotor housing 84 preventing the latter from rotating when the grenade is in a safe position. The delay spacer 92 has an axidal pivot bore 102 for slidably holding therein pivot 104.

Referring to FIGS. 1 and 8 partially cylindrical piece-shaped rotor housing 84 has a front end rotor housing surface 83 and rear end rotor housing surface 85 rotatably positioned in fuze body 14. The rotor housing 84 is held, while the grenade is in the "safe" position, adjacent to the "L" shaped lead housing rotor stop 106 by the detent cap tongue 100. A gas generating charge 108 is operatively held in alignment with the short delay cord end 89. The rotor housing 84 holds detonator 110 in an out-of-line position with respect to lead 112 when the grenade is in the "safe" position. The rotor housing 84 is prevented from rotating while in the "safe" position by the tongue 100 which abuts against rotor leading edge 124 and by rotor detent ball 114 biased by a compressed rotor detent spring 116 located in lead housing rotor detent spring bore 117 which keeps the ball 114 locked into rotor housing detent ball cavity 118. A second detent ball cavity 118 is located in the rotor housing 84 to lock the rotor in an in-line position after the grenade is armed. A residual rotor housing gas cavity 120 adjacent to the rotor leading edge is provided in the rotor housing 84 to permit the gases entrapped between the stop back wall 122 and the rotor leading edge 124 to be compressed into cavity 120 thereby allowing the rotor to rotate, when the grenade is armed, so that the detonator 110 will be aligned directly over the lead 112 and under the long delay cord end 93.

Referring to FIGS. 1 and 9 the lead housing 126 is positioned within the fuze body 14 underneath the rotor housing 84 for holding, the gas generating charge 108, the detent ball 114 and detent spring 116, and the lead 112 intermediate the booster charge 128 and the long delay cord end 93 the stop 106 is integral with lead housing 126.
FIG. 10 shows the grenade in the "armed" condition just after cotter pin 22 has been pulled out of the handle pin slot 24 and the handle 12 has rotated away from and clear of the detent cap 38. The detent spring 44 has forcibly pushed the detent cap forward closed end 40 through the foil 46. The movement of cap 38 has placed detent cap ball bores 74 and 76 adjacent to detent balls 52 permitting them to move transversely away from the firing pin 56 thereby allowing firing pin spring 60 to forcibly cause firing pin 56 to impact against primer 58. The upward movement of detent cap 38 unlocks the rotor housing 84 by withdrawing of detent cap tongue 100.

FIG. 11 shows a cross-sectional view taken along line 11-11 illustrated in FIG. 10. Referring now to FIGS. 10 and 11 the gas-generating charge 108 after being initiated by the short delay cord 88 causes the rotor housing 84 to move so that the detonator 110 is in-line with lead 112.

In operation the hand grenade is held in a normal manner. When it is desired to throw the grenade for implementation handle 12 is squeezed, this action unlocks the cotter pin projection 28 from the handle latch 30 so that cotter pin 22 can be removed by pulling on pull ring 32. As soon as the grenade leaves the hand and the handle 12 is released, detent spring 44 pushes detent cap 38 through the aluminum foil sealing disc 46 and up against the stop nut 50. Detent spring 44 is sufficiently strong to overcome any obstructions around the bouchon such as hard mud and ice. As the detent cap 38 reaches its uppermost position of travel it withdraws the integrally connected detent cap tongue 100 from the rotor housing 84, thus removing the first safety holding the detonator 110 out-of-line. Also, in this armed position the detent cap ball bores 74 and 76 align themselves with the detent balls 52. Firing pin 56, propelled by the biased firing pin spring 60, cams out the detent balls 52 and forcibly strikes the primer 58. In the armed position the detent balls 52 lock the detent cap 38 thereby preventing accidental relocking of the rotor housing 84. The initiated primer 58 ignites the short and long delay cords 88 and 90 respectively. Both of the aforementioned delay cords have identical rate of burning. However, because delay cord 88 is shorter in length than delay cord 90 it reaches the rotor housing front end surface 83 in 3 sec. thereby igniting the gas generating charge 108. This charge upon burning creates gas pressure on one side of rotor housing 84, cams out rotor detent ball 114 from rotor detent ball cavity 118 located in the rear end rotor housing surface 85 and rotates rotor housing 84 about pivot 104 so that detonator 110 is in-line with lead 112 as shown by FIG. 11. Detent ball 114 relocks the rotor housing 84 by engaging the detent ball cavity 118.

In approximately 4 seconds the long delay cord 90 ignites the in-line explosive train consisting of detonator 110 and booster 128 which in turn actuates the grenade main explosive charge (not shown).

While there has been described and illustrated specific embodiments of the invention, it will be obvious that various changes, modifications and additions can be made herein without departing from the field of the invention which should be limited only by the scope of the appended claims.

Having thus fully described the invention, what is claimed as new and desired to be secured by Letters Patent of the United States is:

1. An improved hand grenade fuze of the type wherein said fuze has means for releasably holding an initiating handle attached to a fuze body, biased firing pin means operatively disposed proximate to said handle, a cotter pin for holding said handle, a primer adjacent to said firing pin and initiated thereby, short and long delay cords having first ends proximately disposed adjacent to said primer, a delay housing for holding said delay cords, a detonator adjacent the other end of said long delay cord, a gas generating charge adjacent to the other end of said short delay cord, a lead adjacent to said detonator, a booster charge adjacent to said detonator for actuating a main explosive charge in the grenade when said handle has been released and said grenade has been imploded, wherein the improvement comprises:

- puncturable sealing means for protecting said biased firing pin means and said primer from malfunction due to accumulations of mud and ice;
- compliant means intermediate said handle and said sealing means for maintaining said sealing means intact when said grenade is in a safe position and for allowing said handle to be inwardly depressed toward said grenade so that said cotter pin can be disengaged from said fuze;
- a spring biased hollow cylindrical detent cap having a forward closed end operatively positioned intermediate said sealing means and said firing pin means, a rear open end having an integral tongue projecting therefrom, a side wall slidably positioned intermediate said fuze body and said delay cord, and a pair of ball bores intermediate said closed and open end diametrically disposed in said wall;
- an assembly washer axially disposed within said detent cap intermediate said firing pin means and said delay housing, said washer having an axial counter bore therein for holding said primer, a pair of delay cord bores intermediate said counter bore and said delay housing for holding therein the first end of a long delay cord and the first end of a short delay cord, a radially positioned assembly bore concentrically aligned with one of said detent cap ball bores;
- a delay cord spacer axially aligned and slidably held within said detent cap rear open end having a pair of spacer delay bores therein for holding the other ends of said long delay and short delay cords, said spacer having a peripherally positioned detent tongue groove therein for allowing said detent cap tongue to pass therethrough;
- a partially cylindrical rotor housing slidably held within said fuze body having a front end and a rear end surface, said front end positioned adjacent said delay cord spacer, a detonator held in said housing in an out-of-line position when said grenade is in a "safe" position and in an in-line position when said grenade is armed, a residual gas cavity operatively disposed therein, and a pair of detent ball cavities in said rotor's rear end housing surface, said detent cap tongue preventing said rotor housing from moving into an armed position when said handle is attached to said fuze body.
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a lead housing, fixedly held within said fuze body adjacent said rotor rear end, having a gas generating charge operatively positioned therein adjacent said short delay cord other end and intermediate a housing rotor stop peripherally positioned therein, a lead operatively positioned within said housing so that it is out-of-line with said detonator when said rotor housing is in the "safe" position and axially aligned and in-line with said detonator when said rotor housing has been moved by said gas generating charge in the "armed" condition, a lead housing rotor detent spring bore intermediate said lead and said gas generating charge; detent means operatively positioned in said spring bore for engaging said rotor detent ball cavities; and a booster charge fixedly held within said fuze body immediately adjacent said lead so that upon initiation of said detonator by said long delay cord said lead and booster charge will form an explosive train which initiates the explosion of said grenade.

2. An improved hand grenade fuze as recited in claim 1 wherein the safety means comprises:

3. An improved hand grenade fuze as recited in claim 2 wherein the puncturable sealing means comprises: a stop nut threadedly affixed to said fuze body; and an aluminium foil fixedly held to said stop nut and operatively positioned intermediate said complaint means and said detent cap closed end.

4. An improved hand grenade fuze as recited in claim 3 wherein the complaint means is a rubber disc having an annular groove in one side, said annular groove operatively positioned so that it covers an annular clearance space intermediate said stop nut and said detent cap closed end.  

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