EXPLOSIVE INITIATOR-BOOSTER CONTAINING DIETHYLACETYLENE AND A PERCHLORATE SALT

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INVENTOR.

DAVID C. SAYLES

BY

ORLANDO Z. MARTIN

ATTORNEYS
EXPLOSIVE INITIATOR-BOOSTER CONTAINING DIETHYLACETYLENE AND A PERCHLORATE SALT

David C. Sayles, Huntsville, Ala., assignor to the United States of America as represented by the Secretary of the Army

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

This invention relates to an explosive initiator-booster device serving as a fuze point detonating apparatus when mounted in the forward end of warheads, projectiles and the like, and a new and improved explosive material for the explosive charge within projectiles of a variety of kinds.

Booster devices which are currently used to detonate high explosive charges in projectiles or warheads may contain lead azide of the composition Pb(N2)2 as the initiator for a booster charge which may contain RDX, 1,3,5-trinitro-1,3,5-triazacyclohexane, which has been described in selected wax compositions. This explosive train provides the energy to detonate the high explosive filler in the projectile or warhead. Problems to be overcome in booster devices are the unintentional initiating of fuze explosions by environmental conditions such as the heat encountered in automatic weapons and in aerodynamic heating, heat generated by inductive couplings with electrical apparatus and the like, and abnormal pre-launch shocks and rough jolts from transportation and handling.

The objects of the present invention are to provide a new and improved point initiating non-delay fuse for detonating the high explosive in a warhead or a projectile filler; a device that materially reduces the unintentional initiating of fuze explosions; the use of mercury or an amalgam of comparable function to react with a mixture of silver perchlorate and 3-hexyne as replacement for the earlier loading increments of a primer mixture; lead azide and an RDX wax explosive; etc.

The booster device that is illustrated in the single figure of the accompanying drawing comprises a hollow cylindrical inner core 1 made of steel or the like. The core 1 bears external threads 2 that thread axially into internal threads 3 of a booster holder assembly outer sleeve 4. A flange 5 of the inner core 1 abuts axially the left hand end of the outer sleeve 4. The outer sleeve 4 may be made of steel and is provided with external threads 20 for threading the device into the front end of the warhead or projectile with which it is to be used.

The inner core 1 is apertured centrally to contain a thin inert metal or plastic fuse booster can 6 that is secured in its compartment by beads 7 of cold solder or the like. The fuse booster can 6 contains a suitable fuse booster, such illustratively as a mixture of silver perchlorate AgClO4 and 3-hexyne or diethylacetylene C2H5C=CC2H5 in the weight proportion of 16.1 grams of silver perchlorate to 7.2 grams of 3-hexyne. The front end 8 of the fuse booster can 6 is frangible and illustratively may be made of glass, a thin, prescored plastic, such as a phenol-formaldehyde resin or the like.

The front end socket 9 of the inner core 1 is shaped as a concave part of a sphere or a cylinder, as preferred, to house a freely rotatable member 10. The rotatable member 10 contains a detonator containing cup 11. The cup 11 contains a detonator that is explosively reactive when mixed with the fuze booster contents of the can 6. An illustrative detonator is mercury, a suitable amalgam that releases mercury on impact or the like. An amalgam is a solution of a metal in mercury.

The rotatable member 10 illustratively may be made of a refractory material, as indicated by the dashed section lines. The rotatable member 10 contains a cylindrical detonator cup 11 that is of a material that is inert to mercury, such as glass, or the like. The member 10 is shown in full lines in its unarmed position and in dotted outline in its armed position. In its unarmed position the rotatable member 10 has a firing pin plunger retention hole 31 in its peripheral surface that receives and retains the tip of the frusto-conical plunger end 17 of the firing pin 18. The firing pin 18 slides axially of the assembly in a cylindrical hole in the forward end of the outer sleeve.

The cup 11 has a bottom 12 that is of a mercury inert frangible material, such as a thin disc of glass, a scored disc of phenol-formaldehyde resins or the like, that is sealed in plastic with cement against the inwardly flared bottom flange 13 of the cup 11 in leakproof relation therewith to avoid the loss of the contents of the cup 11.

The cup 11 contains a cushion 14 of resilient rubber or plastic that compensates for the expansion and contraction of the contents of the cup from the temperature change to which the device is subjected. Above the rubber cushion 14 is a top disc 15 of frangible material that is inert toward mercury. The peripheral edge of the cup top disc 15 is cemented against leakage to the upper flange 16 of the cup 11.

The upper flange 16 of the cup 11 in its armed position is dimensioned to progressively closely fit and preferably as nearly as possible to seal its engagement with the frusto-conical plunger end 17 of the firing pin 18 when the firing pin plunger end is rammed into the orifice defined by the cup 11 upper flange 16 on impact of the device against its target.

The rotatable member 10 has a pair of shoulders 24 and 25 that are engaged by a retaining leaf spring 26 to positively secure the rotatable member 10 against rotation in its unarmed position. The spring 26 is positioned at the ends abutting against the outer sleeve shoulder 27 and the firing pin shoulder 28. The rotatable member 10 is held in its unarmed position by the engagement of its shoulders 24 and 25 bearing against the edge of the spring 26. The rotatable member shoulders 24 and 25 are shown to be spaced away from the internal flange 16 that is turned in along the edge of the upper end of the cup 11 to secure the cup 11 in place within the rotatable member 10 during the assembly of the device. A ring 32 arrests the motion of the right hand end of the spring 26 during the assembly of the device.

The firing pin 18 flange 33 abuts the right hand end of the outer sleeve 4 and, together with the spring 26 exerts a dual safety provision for the device.

The fuze cover 34 is of thin metal such as aluminum, steel or the like and terminates to the left in an inturned flange 35 that overlies the outwardly extending outer sleeve flange 36 that is intermediate between the ends of the device.

The theory of operation of the point detonating fuze that is shown in the accompanying drawing mounted in the front end of a warhead or a projectile starts with inertial forces acting on the members of the fuze assembly. The leaf spring 26 acts as a strut and together with the firing pin flange 33 prevents the firing pin plunger 17 from damaging the rotatory member 10 during acceleration within the gun bore.

During the launching operation with the fuze in the gun bore the rotatory member 10 remains as shown in the drawing with the axis of the cup 11 out of incidence with the central axis of the fuze during acceleration. The riding
in the gun bore from which the projectile is launched imparts rotary motion to the fuze. Increasing centrifugal force causes the spring 26 to move out to its dotted line position and free the rotary member 10 and the firing pin 18.

The emission of the fuze from the gun bore removes the initial acceleration and the firing pin moves axially forwardly of the assembly and permits the unbalanced rotatable member 10 to assume its balanced position with the central axis of the detonator cup 11 coincident with the central axis of the fuze assembly. The fuze is then armed and awaits impact.

On impact the velocity of the firing pin 18 is arrested, driving its conical plunger end 17 through the orifice in the front end of the cup 11 and, acting as a piston, the firing pin plunger end 17 crushes the detonator cup frangible top disc 15 and advances the rubber plunger 14 axially of the cup 11.

The resulting pressure applied to the mercury or amalgam in the cup 11 ruptures both the rear frangible disc 12 in the detonator cup 11 and the top frangible disc 8 in the booster can 6. The contents of the booster can 6 detonates on contact with the mercury from the cup 11 and the force of the resultant explosion is directed through the bottom of the can 6 directly into the high explosive filler in the warhead or in the projectile.

The melting point of an element or a compound is the temperature at which its liquid and solid phases exist together at one atmosphere of pressure. Mercury melts at $-39^\circ$ C. or $-38^\circ$ F. Gallium melts at $30^\circ$ C. Indium melts at $156^\circ$ C. Tin melts at $232^\circ$ C. Bismuth melts at $271^\circ$ C. Cadmium melts at $321^\circ$ C. Lead melts at $327^\circ$ C. All of these melting points are depressed or lowered when mercury is alloyed with the element as an amalgam of the element. The same is true for other elements such as zinc, tellurium, antimony, aluminium, gold, copper etc.

The silver perchlorate disclosed herein may if preferred be replaced for an equivalent function by perchlorates of aluminium, copper and gold. The triple bond between carbon atoms in 3-hexyne or $\text{C}_2\text{H}_5\text{C}≡\text{CCH}_3$ imparts a high performance initiating system to the silver perchlorate 3-hexyne complex in the booster can 6 since the triple bond energy per mole is 123 kilocalories, as compared with single bond at 58.6 kilocalories. Bombs containing comparable charges in glass or plastic frangible containers that mix the reagents on impact fall within this disclosure. Amalgams are solid or liquid depending on the proportion of mercury present. Prestressed aluminium dissolves promptly in mercury. Homologues of acetylene $\text{HC}≡\text{CH}$ here of interest include 2-pentyne or ethylmethylyacetylene $\text{H}_2\text{C}≡\text{CCH}_3\text{CH}_3$.

Amalgams that function interchangeably with mercury illustratively are those of gallium, indium, tin, bismuth, cadmium, lead, zinc, tellurium, antimony, aluminium, gold, and copper.

The chemical complex of inorganic perchlorates with disubstituted alkynes and low melting point metals impart an improved performance to the device that is disclosed herein. In this initiator the mercury replaces three loading increments in earlier devices, namely the primer mixture, lead azide and the RDX wax explosive. The explosive components that are disclosed herein provide uniformly reproducible results.

It is to be understood that the device and the charge that are described herein are submitted for the purposes of describing this invention and that similarly functioning modifications may be made therein without departing from the spirit and scope of the invention.

I claim:

1. The booster can contents as a charge proportionally by weight consisting of 7.2 grams of diethylacetylene; mixed with the equivalent of 16.1 grams of silver perchlorate of a perchlorate of a metal selected from the group consisting of silver, aluminum, gold and copper and the mixed material cooperating to produce the unitary result of causing the detonation of an explosive charge.

2. The fuze booster material consisting of silver perchlorate; mixed with diethylacetylene in the weight proportion of 16.1 grams of silver perchlorate to 7.2 grams of diethylacetylene and the mixed material cooperating to produce the unitary result of causing the detonation of an explosive charge.

References Cited in the file of this patent

UNITED STATES PATENTS

2,824,518 Piskorski et al. February 25, 1958
2,850,980 Stevenson et al. September 9, 1958

FOREIGN PATENTS

18,659 Great Britain November 1912

OTHER REFERENCES