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APPLIED SCIENCES DEPARTMENT (R&D) PATENTS; A COMPILATION

NAVAL WEAPONS SUPPORT CENTER
APPLIED SCIENCES DEPARTMENT
CRANE, IN 47522

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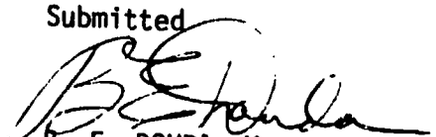

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This is a compilation of 57 patents issued on a wide range of pyrotechnics subjects.

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PREFACE

Thanks are due to Mary Ann Sollman and Debra P. Courtney who assembled these patents and prepared them for printing. Some of the patents were reproduced from best available copies which explains the marginal reproduction quality.

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United States Patent [19]

Douda et al.

[11] **4,032,374**

[45] **June 28, 1977**

[54] **CINNAMIC ACID CONTAINING PYROTECHNIC SMOKE COMPOSITION**

[75] Inventors: **Bernard E. Douda**, Bloomfield; **John E. Tanner, Jr.**, Bloomington, both of Ind.

[73] Assignee: **The United States of America as represented by the Secretary of the Navy**, Washington, D.C.

[22] Filed: **Sept. 22, 1976**

[21] Appl. No.: **725,606**

[52] U.S. Cl. **149/19.8**; 102/90; 149/19.1; 149/78; 149/83; 149/84; 149/85; 149/117; 252/305

[51] Int. Cl.[2] **C06B 45/10**

[58] Field of Search 149/19.1, 19.8, 79, 149/83, 84, 85, 117; 102/90; 252/305

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Primary Examiner—Edward A. Miller
Attorney, Agent, or Firm—R. S. Sciascia; Paul S. Collignon

[57] **ABSTRACT**

A non-toxic smoke composition for use in simulating fires in damage control exercises and for use in training. Transcinnamic acid is used as the smoke producing agent and is volatilized by energy from a potassium chlorate/sugar mixture which provides a low burning temperature.

5 Claims, No Drawings

CINNAMIC ACID CONTAINING PYROTECHNIC SMOKE COMPOSITION

BACKGROUND OF THE INVENTION

The present invention relates to a smoke composition, and more particularly to a non-toxic smoke composition which can be used to simulate fires for training purposes.

Various devices and compositions are presently used to simulate a fire for training purposes. For examples, one such device currently in use by the Navy for training of personnel in fire fighting procedures and the use of gas masks resembles a hand grenade. A grenade igniting fuze is fitted in a cylindrical metal body and a quantity of oil is provided in an upper chamber and a fuel mixture is provided in the base. A venturi tube extends from directly above the fuel mixture through the oil chamber to the top of the pot. There are small openings, each sealed with low-melting-point solder, in the venturi tube; one into the oil chamber, the other into the space above the oil surface. There are three tape-covered holes in the top of the pot. When the fuze ignition mixture ignites the starter mixture at the lower end of the venturi tube, the fuel mixture starts burning. Heat melts the solder in the venturi tube openings and the oil flows into the venturi tube where it is vaporized. This vapor passes upward and emits through the vent holes in the top of the smoke pot. Upon emission, it condenses to form a dense white cloud.

One disadvantage of the grenade-type smoke pot is that personnel are required to be in respiratory protective devices prior to commencing a fire drill and thus the value of the smoke for realistic training is greatly reduced. Additionally, such devices cannot be used aboard submarines operating submerged due to the toxic affect of the smoke.

SUMMARY OF THE INVENTION

The present invention relates to a non-toxic smoke composition wherein trans-cinnamic acid is used as the smoke-producing agent. The trans-cinnamic acid is volatilized by burning a potassium chlorate/sugar mixture. In the preferred embodiment, a small amount of sodium bicarbonate is added as a cooling agent, diatomite silica is added as a filler and nitrocellulose is added as a binder.

It is therefore a general object of the present invention to provide a smoke composition for use in simulating fires for training purposes.

Other objects, advantages and novel features of the invention will become apparent from the following detailed description of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

A non-toxic smoke composition is provided which utilizes trans-cinnamic acid as the smoke producing agent. Pyrotechnic volatilization of trans-cinnamic acid is accomplished by burning a potassium chlorate/sugar mixture.

Trans-cinnamic acid, also known as trans-B-phenylacrylic acid, is a white crystalline solid which has a melting point of 135° C. and a normal boiling point of 300° C.

The decomposition temperatures of various mixtures of sugar, trans-cinnamic acid and potassium chlorate were determined by differential thermal analysis and

are shown in the following TABLE I, wherein approximately equal portions of each ingredient were used.

TABLE I

(Temperature of Exothermic Decomposition by Differential Thermal Analysis)

COMPOSITION	TEMPERATURE
Sucrose/$KClO_3$	140° C.
Lactose/$KClO_3$	190° C.
Trans-Cinnamic Acid/$KClO_3$	260° C.
$KClO_3$	370° C
Trans-Cinnamic Acid/Sucrose/$KClO_3$	170° C
Trans-Cinnamic Acid/Lactose/$KClO_3$	210° C

As can be seen from TABLE I, sucrose decomposes at a lower temperature than lactose and thus would be preferably for the volatilization of trans-cinnamic acid. Also, the fact that the decomposition of trans-cinnamic acid by potassium chlorate occurs at a higher temperature than the decomposition of the sugar, shows that it is possible to vaporize the trans-cinnamic acid without decomposition, by means of the combustion of sugar.

The following examples will illustrate the preferred embodiments of the invention wherein parts and percentages are by weight unless otherwise specified.

EXAMPLE I

Trans-Cinnamic Acid	47.5
Sucrose	12.0
Potassium chlorate	29.0
Sodium bicarbonate	6.5
Diatomite Silica	5.0

The trans-cinnamic acid, sucrose, potassium chlorate and sodium bicarbonate were mixed dry and then enough cellulose nitrate was added as a 40 percent solution in acetone to make the mixture stiff, but not visibly wet or pasty. It is estimated that the amount of dry cellulose nitrate so added equaled 2 to 5 percent of the total weight of composition. As the cellulose nitrate is used for a binder, its exact weight is not critical to the formula.

The mixture was air dried for about an hour until the smell of acetone was nearly gone and the mixture was then crushed to a powder and the diatomite silica was added. The mixture was then lightly tamped by hand into a fish paper tube having an internal diameter of 33 mm. A layer of first fire composition was placed on one end of the candle to facilitate ignition. The first fire composition used is described in MIL-STD-720, and consists of 50 percent of barium nitrate, 20 percent of silicon, 10 percent of tetranitrocarbazole, 15 percent of zirconium hydride and 5 percent of a binder solution.

The candle was ignited by the first fire and, after ignition, the flame was extinguished and the candle continued to smoke without again bursting into flame. The candle burned to completion at a somewhat irregular rate leaving a case filled with a fluffy black powder. The total weight of the candle was 32g and the weight of the ash was 8g. The smoke produced was of moderately good volume.

EXAMPLE II

Trans-Cinnamic Acid	48.0
Sucrose	12.5
Potassium chlorate	28.5
Sodium bicarbonate	6.5

EXAMPLE II-continued

Diatomite silica	4.5

The ingredients were mixed and a candle was made as described in EXAMPLE I. A layer of first fire composition was added and the candle burned as in EXAMPLE I. The total weight of the candle was 42g. and the weight of the ash was 9g. The candle burned for 1.5 minutes and the smoke produced was of moderately good volume.

EXAMPLE III

Trans-Cinnamic Acid	58.0
Sucrose	10.0
Potassium chlorate	23.0
Sodium bicarbonate	5.5
Diatomite silica	3.5

The ingredients were mixed and a candle was made as described in EXAMPLE I. A layer of first fire composition was added and the candle burned as in EXAMPLE I. The candle burned for 3 minutes and the smoke produced was of moderately good volume.

EXAMPLE IV

Trans-Cinnamic Acid	45.5
Sucrose	12.0
Potassium chlorate	27.5
Sodium bicarbonate	10.5
Diatomite silica	4.5

The ingredients were mixed and a candle was made and burned as described in EXAMPLE I. The candle burned for 3.5 minutes and the smoke produced was of moderately good volume.

EXAMPLE V

Trans-Cinnamic Acid	75.5
Sucrose	5.5
Potassium chlorate	13.0
Sodium bicarbonate	4.0

EXAMPLE V continued

Diatomite silica	2.0

The ingredients were mixed as described in EXAMPLE I and a candle was made with a hollow core of 6.4 mm. The hollow core was filled with a first fire composition and ignited. The candle smoked intensely for 15 seconds and then died down and went out. A thin layer of melted, rehardened material covered the lower half of the candle.

It will now be readily apparent that the present invention provides a pyrotechnic smoke composition which can be used to simulate fires for training personnel in fire fighting techniques.

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 the invention may be practiced otherwise than as specifically described.

We claim:

1. A non-toxic smoke composition comprised, by weight, of
between 45.5 parts and 75.5 parts of cinnamic acid,
between 5.5 parts and 12.5 parts of sugar,
between 13 parts and 29 parts of potassium chlorate,
between 4 parts and 10.5 parts of sodium bicarbonate,
between 2 parts and 5 parts of diatomite silica, and
between 2 parts and 5 parts of a binder.

2. A non-toxic smoke composition as set forth in claim 1 wherein said sugar is sucrose.

3. A non-toxic smoke compostion as set forth in claim 1 wherein said sugar is lactose.

4. A non-toxic smoke composition as set forth in claim 1 wherein said binder is nitrocellulose.

5. A non-toxic smoke composition comprised, by weight, of
about 48 parts of cinnamic acid,
about 12 parts of sucrose,
about 29 parts of potassium chlorate,
about 7 parts of sodium bicarbonate,
about 4 parts of diatomite silica, and
between 2 and 5 parts of nitrocellulose.

* * * * *

United States Patent [19]

Wildridge

[11] **4,007,690**

[45] **Feb. 15, 1977**

[54] **PRACTICE BOMB SIGNAL FOR DAY OR NIGHT OPERATION**

[75] Inventor: **John E. Wildridge**, Washington, Ind.

[73] Assignee: **The United States of America as represented by the Secretary of the Navy**, Washington, D.C.

[22] Filed: **Nov. 21, 1975**

[21] Appl. No.: **634,212**

[52] **U.S. Cl.** **102/87**; 102/6; 102/32; 102/60; 102/66; 102/90

[51] **Int. Cl.**[2] **F42B 11/16**

[58] **Field of Search** 102/6, 7.6, 65, 66, 102/87, 90, 32, 37.6, 39, 31; 149/37, 84

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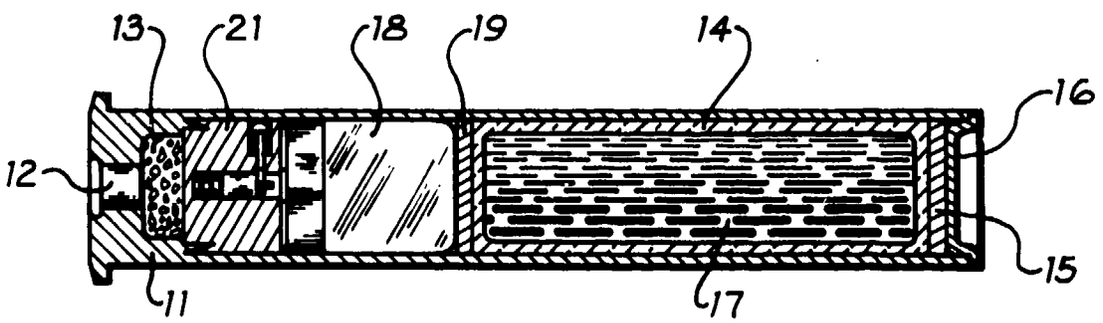
Primary Examiner—Harold Tudor
Attorney, Agent, or Firm—R. S. Sciascia; Paul S. Collignon

[57] **ABSTRACT**

A signal cartridge for displaying the location of a practice bomb during day or night operation. Upon detonation of the signal cartridge, a power charge expels both a chemical payload and a flashcube from the cartridge case. The flashcube is activated outside the cartridge case. The chemical payload, which is air/water reactive, forms a cloud which is visible during daylight. At night, the light produced by the flashcube is scattered and reflected by particles in the cloud to provide a display.

4 Claims, 5 Drawing Figures



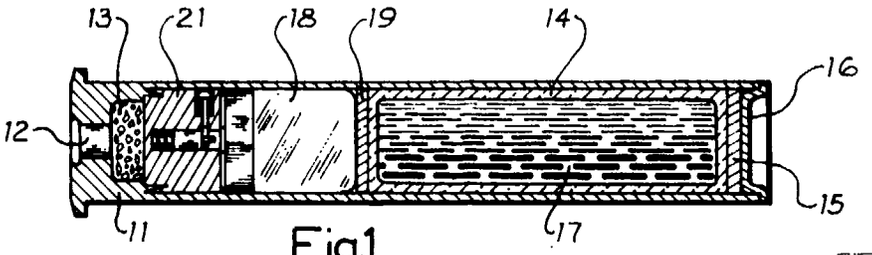


Fig.1

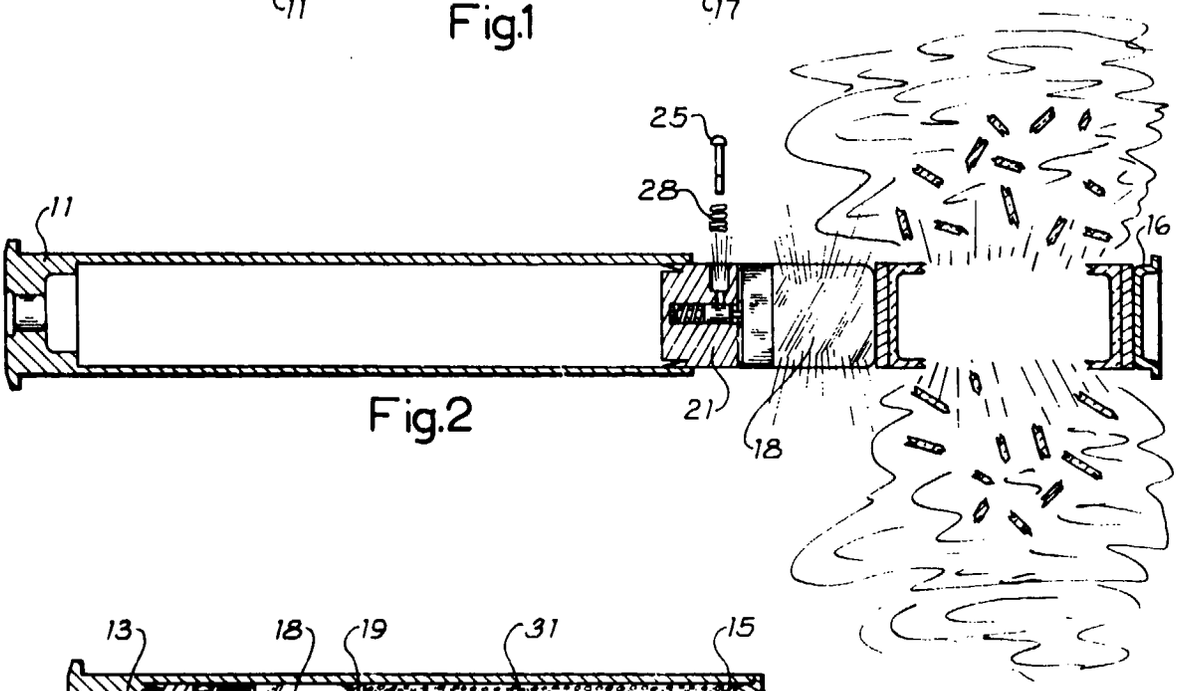


Fig.2

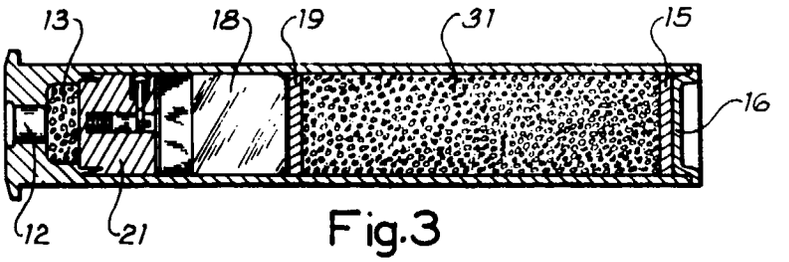


Fig.3

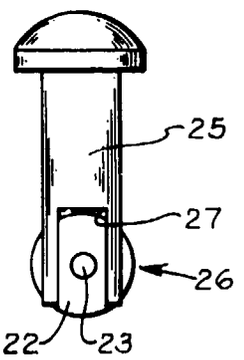


Fig.5

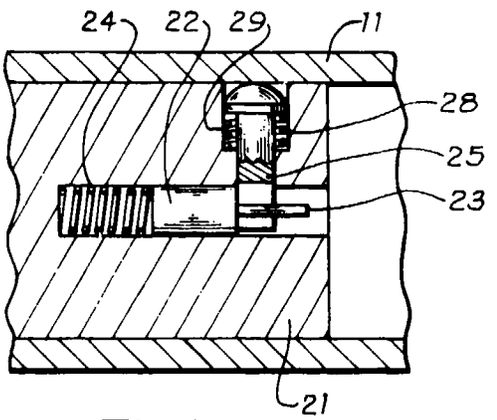


Fig.4

PRACTICE BOMB SIGNAL FOR DAY OR NIGHT OPERATION

BACKGROUND OF THE INVENTION

The invention relates to practice bomb cartridges and more particularly to a practice bomb cartridge which will not start fires when detonated in grass or woods during the dry months.

Various types of signal cartridges are used in practice bombs which are launched from aircraft to indicate the point of bomb impact. The cartridge is fitted into the signal cavity of the practice bomb and, when the bomb is dropped, impact forces a firing pin against the signal primer, and ignites an expelling charge. The expelling charge, which is usually smokeless powder, ignites and expels a phosphorus composition, such as red phosphorus, to produce a flash of light and a puff of white smoke. While signal cartridges containing phosphorus provide, upon detonation, an excellent signal, these cartridges have the disadvantage in that the burning of the phosphorus composition start fires and therefore the cost of fire protection services and damage claims are significantly high.

In order to reduce the danger of fires, one military cartridge case is filled with an inert material, such as zinc oxide powder. Upon detonation, the expelling charge expels a cloud of zinc oxide powder. This cloud, however, is not visible at night and the use of an inert material such as zinc oxide is limited to daytime operation.

In U.S. Pat. No. 3,810,426, entitled "Gun Launched Training Projectile", which issued May 14, 1974, to Alan C. Baker, there is disclosed a marking projectile which has a flashcube mounted in the body. Upon impact of the projectile, a hammer drives actuating fingers into the base of the flashcube to fire the flashlamps and provide an impact signal.

SUMMARY OF THE INVENTION

The present invention relates to a signal cartridge for displaying the location of a practice bomb during day or night operation and, more particularly, relates to a signal cartridge which, when fired, is not likely to start grass or forest fires.

An expelling charge is provided in a cartridge case near a primer, and a flashcube and chemical payload are positioned within the cartridge case and are expelled upon ignition of the expelling charge. A firing device is provided adjacent the flashcube, however, a bore rider device is provided which prevents flashing of the flashcube until the flashcube extends outside the cartridge. During daylight, the ejection of the chemical payload forms a cloud which is visible. During night operations, the flashcube provides light which is scattered and reflected by the particles in the cloud to provide a display.

It is therefore a general object of the present invention to provide a signal cartridge which can be used during either day or night operations to provide a signal for locating a practice bomb.

Another object of the present invention is to provide a signal cartridge which is safe to use in grassy and wooded areas and which will not start fires.

Other objects, advantages and novel features of the present invention will become apparent from the following detailed description of the invention when considered in conjunction with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a longitudinal sectional view of a preferred embodiment of the present invention;

FIG. 2 is a sectional view showing the invention being fired;

FIG. 3 is a sectional view, similar to FIG. 1, of another embodiment,

FIG. 4 is a partial sectional view showing a bore rider pin arrangement; and

FIG. 5 is a side view of a bore rider pin.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawing, there is shown in FIG. 1, a cartridge case 11 having a primer 12 in one end and arranged to be detonated when struck by the tang of a firing pin. An expelling charge 13, such as a quantity of either black or smokeless powder, is positioned near primer 12 and firing of primer 12 will cause ignition of expelling charge 13. An ampoule 14 of frangible material is placed within cartridge case 11 near the forward end which is closed with a spacer 15 and an end cap 16. The frangible ampoule 14 is filled with a chemical payload 17 such as an air/water reactive material which, when dispersed will provide a cloud visible in daylight. By way of example, titanium tetrachloride ($TiCl_4$) has successfully been dispersed to provide a visible cloud and also a mixture comprised of fifty percent titanium tetrachloride and fifty percent vanadium oxytrichloride has been used.

A flashcube 18 is positioned within cartridge case 11 and is separated from frangible ampoule 14 by a spacer 19. Flashcube 18 is commercially available and is of the type that can flash without batteries. The flashcube is provided with a percussive primer in its base which fires the lamp when struck by a tensioned spring. Each lamp has its own spring which is held under tension by a tiny retaining pin. When the spring is lifted over the retaining pin, the freed spring immediately snaps sharply against the flashcube's metal tube to fire the primer. The primer sparks fly upward and ignite zirconium foil within the lamp to provide a bright flash.

As best shown in FIG. 4 of the drawings, an initiator 21 is closely fitted in cartridge case 11 an is provided with a firing pin 22 having a tang 23 which is designed to release the spring in the base of flashcube 18. A spring 24 is provided to supply the necessary force to move firing pin 22 against flashcube 18, however, a bore rider pin 25 prevents firing pin 22 from being actuated until flashcube 18 is outside cartridge case 11. Bore rider pin 25 is provided with a flat portion 26 which has a slot 27 therein which is greater in width than the diameter of tang 23 but less in width than the diameter of pin 22. A spring 28 is provided in bore 29 of initiator 21 and, when bore rider pin 25 clears cartridge case 11, spring 28 causes bore rider pin 25 to be ejected thereby releasing firing pin 22.

OPERATION

By way of example, the signal cartridge of the present invention might be used in a practice bomb of the type shown in U.S. Pat. No. 3,635,162, which issued Jan. 18, 1972, to Carl W. Lohkamp and James E. Short, Jr. In this practice bomb, the signal cartridge is loosely fitted in the bore of the practice bomb and, upon impact of the bomb with the ground, or some target, the momen-

tum of the signal cartridge causes the primer to strike a firing pin

Detonation of primer **12** causes ignition of expelling charge **13** which blows off end cap **16** and discharges the items inside cartridge case **11**. As shown in FIG. **2** of the drawing, the pressure build-up inside cartridge case **11** causes ampoule **14** to break thereby dispersing the chemical payload **17**. The chemical payload, such as a quantity of titanium tetrachloride, reacts with the air, and the moisture in the air, to provide a cloud thereby providing a signal which is visual and indicates the point of impact of the practice bomb.

As initiator **21** moves along the cartridge case **11** bore rider pin **25** prevents firing pin **22** from actuating flashcube **18** and bore rider pin **25** is prevented from moving by the inside of cartridge. When bore rider pin **25** passes the end of cartridge case **11**, spring **28** ejects bore rider pin **25** and spring **24** moves firing pin **22** so that tang **23** will trigger flashcube **18**. It can be seen that flashcube **18** is, at the time of flashing, outside of cartridge case, and the light is scattered and reflected by the particles of the cloud to provide a display for night exercises.

Referring now to FIG. **3** of the drawings, there is shown another embodiment wherein the frangible ampoule is eliminated and a quantity of display material **31** is placed directly in cartridge case **11**. By way of example, the display material might be a fluorescent dye, glitter material, ground glass or other inert material. In feasibility tests conducted at the Naval Weapons Support Center, Crane, Indiana, high-temperature fluorescent dyes produced brillant clouds of yellow, green, red, and orange which were distinguishable from a one mile observation point. High temperature fluorescent dyes are commercially available and can be obtained from the Hercules, Inc., Wilmington, Del. 19899 (Radiant Fluorescent Pigments) or from the Day-glo Color Corp., Cleveland, Ohio, 44103 (Day-glo Pigments).

It can thus be seen that the present invention provides a cartridge signal which, when detonated, can provide a day or night display. As detonation of the cartridge signal does not produce heat or flame, the initiation of fires in grass or wooded areas has been eliminated.

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.

I claim:

1. A signal cartridge for use in a practice bomb for indicating a point of impact comprising,

a cartridge case,

a primer in said cartridge case arranged to be detonated by a first firing pin,

an expelling charge adjacent said primer,

a quantity of marking material within said cartridge case for forming a signal cloud upon discharge from said cartridge case by said expelling charge,

a percussively-ignitable flashcube within said cartridge case, and

means for flashing said flashcube after said flashcube is expelled from said cartridge case, said means including a second firing pin engageable with said flashcube and a bore rider pin for preventing actuation of said second firing pin until said bore rider pin passes the end of said cartridge case.

2. A signal cartridge for use in a practice bomb for indicating a point of impact as set forth in claim **1** wherein said quantity of marking material is an air/water reactive material and is contained in a sealed frangible container within said cartridge case.

3. A signal cartridge for use in a practice bomb for indicating a point of impact as set forth in claim **2** wherein said air/water reactive material is titanium tetrachloride.

4. A signal cartridge for use in a practice bomb for indicating a point of impact as set forth in claim **2** wherein said air/water reactive material is a mixture of equal parts of titanium tetrachloride and vanadium oxytrichloride.

* * * * *

United States Patent [19]

Doades et al.

[11] **3,982,930**

[45] **Sept. 28, 1976**

[54] **METHOD FOR DISPOSAL OF TRACER BULLETS**

[75] **Inventors:** William E. Doades, Otwell; James E. Short, Jr., Switz City; Karen S. Whorrall, Shoals, all of Ind.

[73] **Assignee:** The United States of America as represented by the Secretary of the Navy, Washington, D.C.

[22] **Filed:** Sept. 25, 1975

[21] **Appl. No.:** 616,698

[52] **U.S. Cl.** ..... 75/101 R; 75/121; 423/155; 423/395

[51] **Int. Cl.²** C22B 26/22

[58] **Field of Search** ..... 75/101 R, 121; 423/155, 423/395

[56] **References Cited**

UNITED STATES PATENTS

3,930,844 1/1976 Parrish et al. ..... 75/101 R

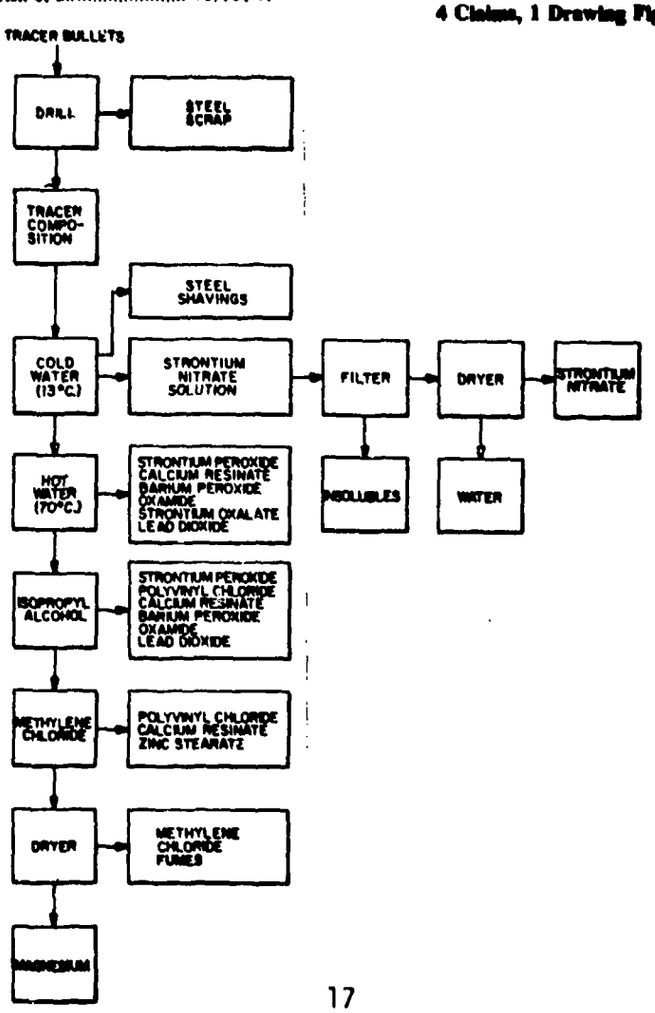
Primary Examiner—G. Ozaki

Attorney, Agent, or Firm—R. S. Sciascia; Paul S. Collignon

[57] **ABSTRACT**

A method for disposing of tracer bullets having in a steel bullet a pyrotechnic material containing strontium nitrate, magnesium, strontium peroxide, polyvinyl chloride, calcium resinate, barium peroxide, oxamide, zinc stearate, polyethylene, strontium oxalate and lead dioxide, with strontium nitrate and magnesium accounting for about sixty percent of the total material. The pyrotechnic material is removed from the steel bullet by drilling and the steel is used as scrap. Strontium nitrate is first removed from the material by dissolving in cold water, and the water solution of strontium nitrate is evaporated to reclaim the strontium nitrate. The remaining materials are given successive washes in hot water, isopropyl alcohol and methylene chloride to remove all the other materials except magnesium. The magnesium is dried and reclaimed.

4 Claims, 1 Drawing Figure



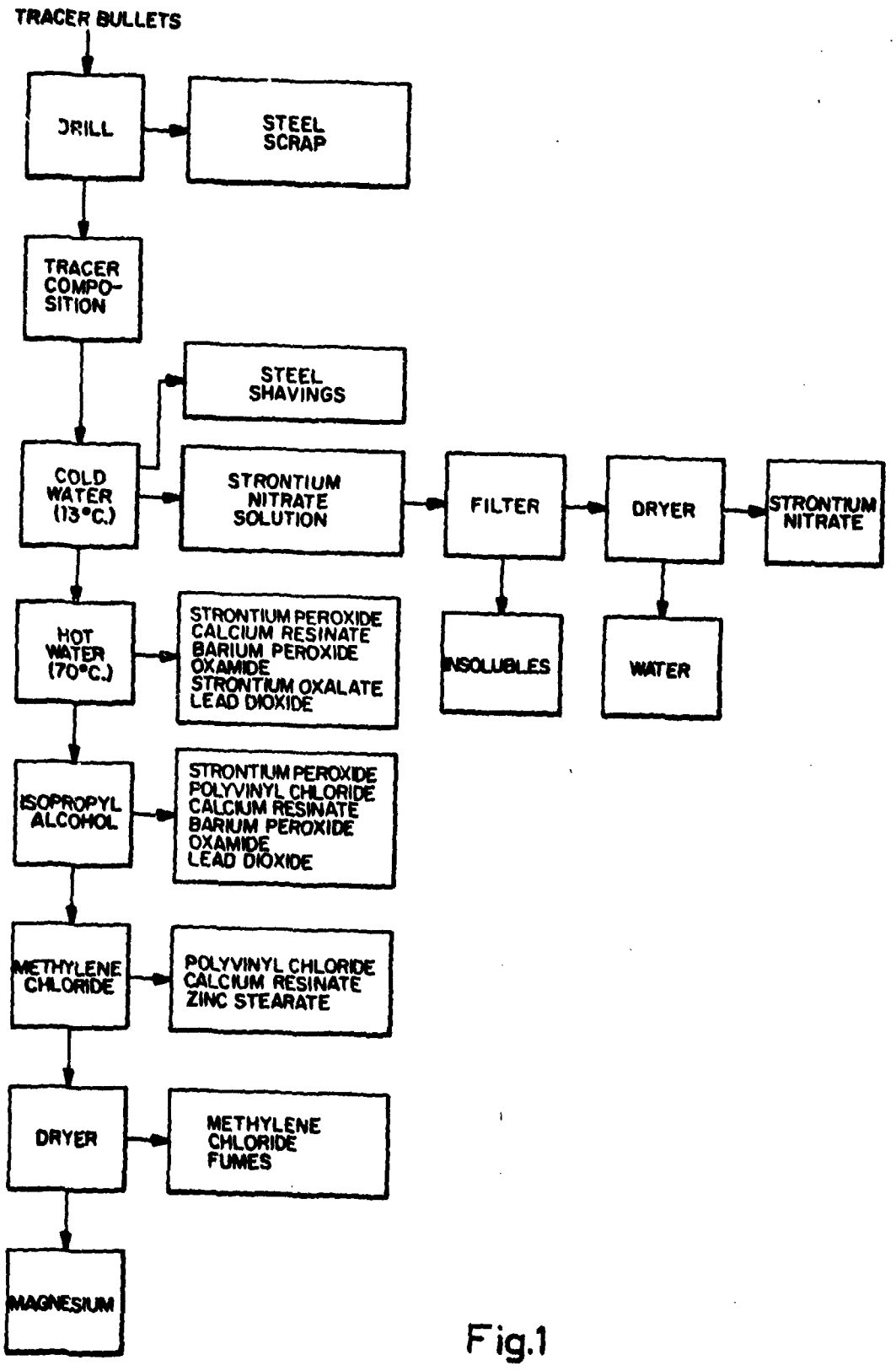

TRACER BULLETS
DRILL
STEEL SCRAP
TRACER COMPO-SITION
STEEL SHAVINGS
COLD WATER (13°C.)
STRONTIUM NITRATE SOLUTION
FILTER
DRYER
STRONTIUM NITRATE
HOT WATER (70°C.)
STRONTIUM PEROXIDE
CALCIUM RESINATE
BARIUM PEROXIDE
OXAMIDE
STRONTIUM OXALATE
LEAD DIOXIDE
INSOLUBLES
WATER
ISOPROPYL ALCOHOL
STRONTIUM PEROXIDE
POLYVINYL CHLORIDE
CALCIUM RESINATE
BARIUM PEROXIDE
OXAMIDE
LEAD DIOXIDE
METHYLENE CHLORIDE
POLYVINYL CHLORIDE
CALCIUM RESINATE
ZINC STEARATE
DRYER
METHYLENE CHLORIDE FUMES
MAGNESIUM

Fig.1

METHOD FOR DISPOSAL OF TRACER BULLETS

CROSS-REFERENCE TO RELATED APPLICATION

Patent application of Clyde F. Parrish et al, entitled, "Method For Disposal Of Pyrotechnic Waste", Ser. No. 547,535, filed Feb. 6, 1975, now U.S. Pat. No. 3,930,844.

BACKGROUND OF THE INVENTION

The present invention relates to a method for disposing of tracer bullets.

Tracer bullets are normally comprised of a steel, conical-shaped jacket having a cavity which contains a pyrotechnic composition. Most tracer compositions are made from varying percentages of the same basic materials and these are, in order of quantity, strontium nitrate, magnesium, strontium peroxide, polyvinyl chloride, calcium resinate, barium peroxide, oxamide, zinc stearate, polyethylene, strontium oxalate, and lead dioxide. The strontium nitrate and magnesium account for about 60 percent of the total. The heretofore known method of disposing of tracer bullets consisted in burning the bullets in metal containers at a burning ground. This method, however, puts degraded pyrotechnic material into the air and is ecologically unsound and not desirable.

SUMMARY OF THE INVENTION

The present invention relates to a method for disposing of tracer bullets having a pyrotechnic composition which is about forty percent strontium nitrate and about twenty-four percent magnesium. The remaining materials are strontium peroxide, polyvinyl chloride, calcium resinate, barium peroxide, oxamide, zinc stearate, polyethylene, strontium oxalate and lead dioxide. The particular materials and percentages used depend on the caliber of the ammunition and also on the particular depot which is manufacturing the ammunition. The pyrotechnic material is removed from the steel bullet by drilling and the steel bullet is sufficiently clean so that it can go directly to the scrap pile without any additional processing. The pyrotechnic material is collected and strontium nitrate is first removed from the pyrotechnic composition by immersing the composition in water sufficiently cold so that it will only dissolve strontium nitrate. The water solution is then filtered and evaporated to reclaim the strontium nitrate. The remaining ingredients are given successive washes in hot water, in isopropyl alcohol and methylene chloride. The solution is decanted after each wash and the remaining material is magnesium, which is then dried and reclaimed for subsequent use as a pyrotechnic material.

It is therefore a general object of the present invention to provide an improved method for disposing of tracer bullets without creating air pollution.

Other objects, advantages and novel features of the present invention will become apparent from the following detailed description of the invention when considered in conjunction with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a flow-diagram showing the steps of the present invention.

DESCRIPTION OF THE PREFERRED METHOD

The first step required in the present method is that of removing the pyrotechnic material from the steel bullet. The pyrotechnic material is drilled from the bullet and in a preferred method the drill bit is mounted in a stationary position. A tracer bullet is inserted into a drill chuck and rotated and then lowered while turning onto the drill bit. The composition falls down and is collected in a tray.

Most tracer bullets contain varying percentages of the same basic materials with strontium nitrate and magnesium accounting for about 60 percent of the total composition. In the present method, strontium nitrate and magnesium are reclaimed for use in other pyrotechnic compositions and thus the amount of pyrotechnic waste which is to be disposed is less than half. Additionally, the residual is primarily inert materials and is less hazardous than the original compositions.

Although specific materials and percentages vary for different types and sizes of tracer bullets, the present method is designed so that all tracer compositions can be mixed together and be processed by a single method. This procedure is not only more economical, but prevents errors that could occur if a multiple number of processes were employed. The following examples show various compositions for tracer ammunition currently being manufactured by the military departments:

M62 Ammunition (7.62mm)	
Strontium Nitrate	41.9%
Magnesium	23.1%
Strontium Dioxide	19.8%
Polyvinyl Chloride	12.9%
Calcium Resinate	2.3%

M196 Ammunition (5.56mm)	
Strontium Nitrate	37.4%
Magnesium	26.0%
Strontium Dioxide	21.1%
Polyvinyl Chloride	11.5%
Calcium Resinate	1.8%
Barium Peroxide	1.1%
Lead Dioxide	1.1%

M25 Ammunition (.30 Cal.)	
Strontium Nitrate	41.9%
Magnesium	22.6%
Strontium Dioxide	20.3%
Polyvinyl Chloride	12.9%
Calcium Resinate	2.3%

M48 Ammunition (.50 Cal.)	
Strontium Nitrate	32.4%
Magnesium	23.9%
Strontium Dioxide	8.6%
Polyvinyl Chloride	6.9%
Calcium Resinate	2.8%
Barium Peroxide	23.5%
Strontium Oxalate	1.6%
Zinc Stearate	0.3%

M17 Ammunition (.50 Cal.)	
Strontium Nitrate	41.8%
Magnesium	25.7%
Strontium Dioxide	5.9%
Polyvinyl Chloride	10.6%
Calcium Resinate	1.9%
Barium Peroxide	12.9%
Strontium Oxalate	1.1%
Zinc Stearate	0.1%

M242 Ammunition (20mm)	
Strontium Nitrate	34.5%
Magnesium	19.8%
Strontium Dioxide	22.1%
Polyvinyl Chloride	12.6%
Calcium Resinate	4.3%
Oxamide	6.7%

M220 Ammunition (20mm)

Strontium Nitrate	35.5%
Magnesium	20.5%
Strontium Dioxide	29.7%
Polyvinyl Chloride	11.0%
Calcium Resinate	3.3%

The present invention is illustrated by the following example:

EXAMPLE

Five hundred 7.62mm tracer bullets were drilled and the pyrotechnic material collected. A No. 1 twist drill (0.228 inch) was mounted in a stationary position and each tracer bullet was inserted into a chuck and lowered turning onto the twist drill. The composition fell down and was collected in a tray. The composition is washed with cold water (13° C.) and the mixture was agitated with a magnetic stirrer to dissolve the strontium nitrate. Any shavings from the steel bullets are attracted to the magnetic stirrer and are easily removed. The mixture was allowed to settle and the liquid decanted and filtered. The solution was dried and 71.3 grams of strontium nitrate were recovered from the 500 rounds of tracer bullets.

The insoluble residue was next washed with hot water and, after the solids were allowed to settle, the liquid was decanted. The optimum temperature for the hot water was about 70° C. Temperature greater than 70° C. gave some fizzing as the magnesium oxidized and released hydrogen. Temperatures lower than 70° C. resulted in magnesium that was visually less pure. Strontium peroxide, calcium resinate, barium peroxide, oxamide, strontium oxalate and lead dioxide are dissolved by hot water and those that are dissolved are decanted off with the hot water.

The remnining ingredients are then washed with isopropyl alcohol followed by wash with methylene chloride. As shown in the drawing, the wash with isopropyl alcohol removes strontium peroxide, polyvinyl chloride, calcium resinate, barium peroxide, oxamide, and lead dioxide. The wash with methylene chloride removes polyvinyl chloride, calcium resinate and zinc stearate. Both the methylene chloride and the isopropyl alcohol are saved for reuse or reclamation.

The remaining ingredient, magnesium, was dried and 59.3 grams of magnesium were recovered from the 500 rounds of tracer bullets. The magnesium and strontium nitrate that was recovered was loaded into new tracer rounds and performed satisfactorily when fired.

The present method of removing the tracer composition from the steel bullet by drilling and then treating the composition with water, isopropyl alcohol and methylene chloride has two significant advantages over burning. Magnesium and strontium nitrate are recovered for reuse in pyrotechnic compositions and also the tracer composition is not transformed into an atmospheric pollutant.

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.

We claim:

1. A method for disposing of tracer bullets having a steel casing filled with pyrotechnic material containing strontium nitrate, magnesium, strontium peroxide, polyvinyl chloride, calcium resinate and other pyrotechnic materials, with the combined percentages of strontium nitrate and magnesium comprising at least sixty percent of the total percentage of said pyrotechnic material, comprising the steps of

first rotating said steel casing filled with pyrotechnic material against a stationarily mounted twist drill whereby said pyrotechnic material is drilled from said steel casing and falls onto a collecting tray,

then immersing the collected pyrotechnic material in water sufficiently cold to dissolve only strontium nitrate,

then decanting the water solution of strontium nitrate and evaporating the water to reclaim strontium nitrate,

then removing all materials of said tracer ammunition pyrotechnic material other than magnesium by successive washes of hot water and solvents, and

then drying the remaining magnesium for reuse as a pyrotechnic material.

2. A method for disposing of tracer bullets as set forth in claim 1 wherein said pyrotechnic material is immersed in water having a temperature of about 13° C. to dissolve only strontium nitrate.

3. A method for disposing of tracer bullets as set forth in claim 2 wherein said pyrotechnic material and cold water are agitated by a magnetic stirrer whereby any steel shavings resulting from drilling are attracted to said magnetic stirrer.

4. A method for disposing of tracer bullets as set forth in claim 1 wherein said successive washes are a water wash with water having a temperature of about 70° C., followed next by a wash with isopropyl alcohol and then by a wash with methylene chloride.

* * * * *

United States Patent [19]

Herold et al.

[11] **3,964,396**

[45] **June 22, 1976**

[54] **SPIN ACTUATED RELEASE MECHANISM**

[75] Inventors: **Stanley J. Herold**, Switz City; **Donald E. Lagrange**, Washington; **John E. Laswell**, Bloomfield, all of Ind.

[73] Assignee: **The United States of America as represented by the Secretary of the Navy**, Washington, D.C

[22] Filed: **Mar. 19, 1975**

[21] Appl. No.: **559,959**

[52] **U.S. Cl.** **102/79**; 102/35.6; 102/83; 244/150

[51] **Int. Cl.²** **F42B 4/12**; F42C 15/22

[58] **Field of Search** ..... 102/79, 83, 84, 4, 35, 102/35.6, 37.1, 37.6, 70 R; 244/150, 3.27, 3.28; 89/1.5 D

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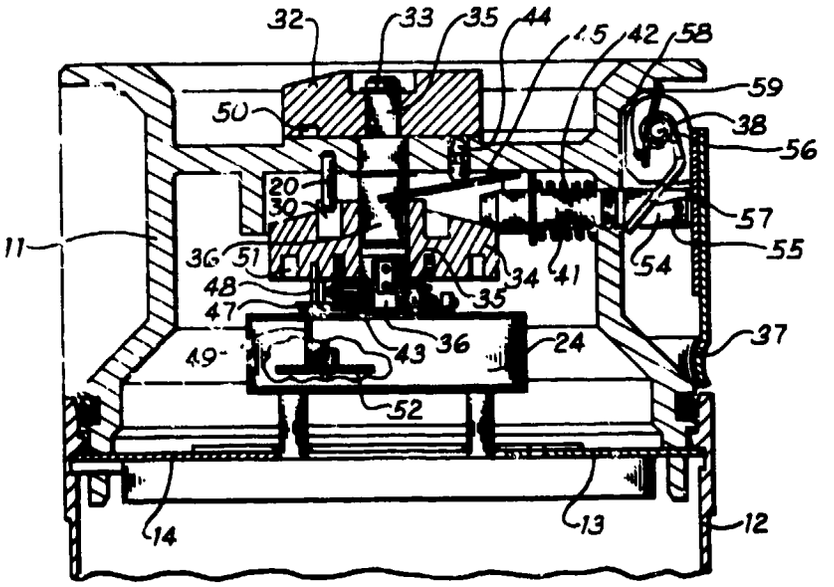
Primary Examiner—David H. Brown

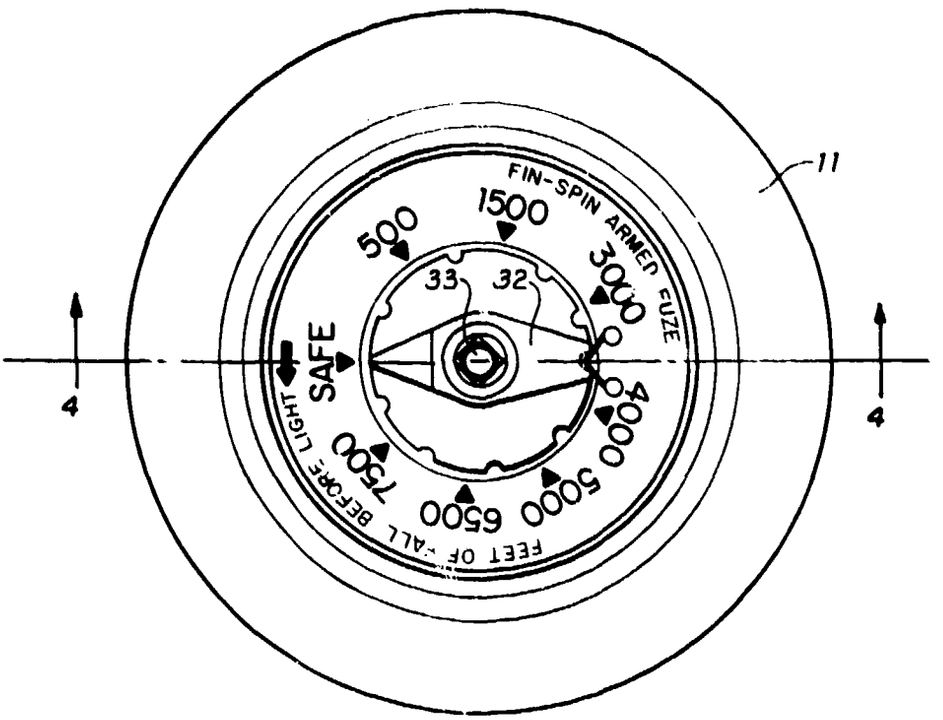
Attorney, Agent, or Firm—R. S. Sciascia; Paul S. Collignon

[57] **ABSTRACT**

A release mechanism for use with an air-dropped store having a timed firing mechanism which can be set for different time intervals. Action is initiated by a plurality of dynamic pressure sensing fins which, upon actuation, first unlock an inertia locking arm and then the fins impart a rotation to the store which rotation, in turn, causes the locking arm to pivot and initiate a timer. The timer, in turn, initiates separation of the release mechanism from the store.

4 Claims, 8 Drawing Figures




11
FIN-SPIN ARMED FUZE
500
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4000
5000
6500
7500
SAFE
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FEET OF FALL BEFORE LIGHT

Fig.1

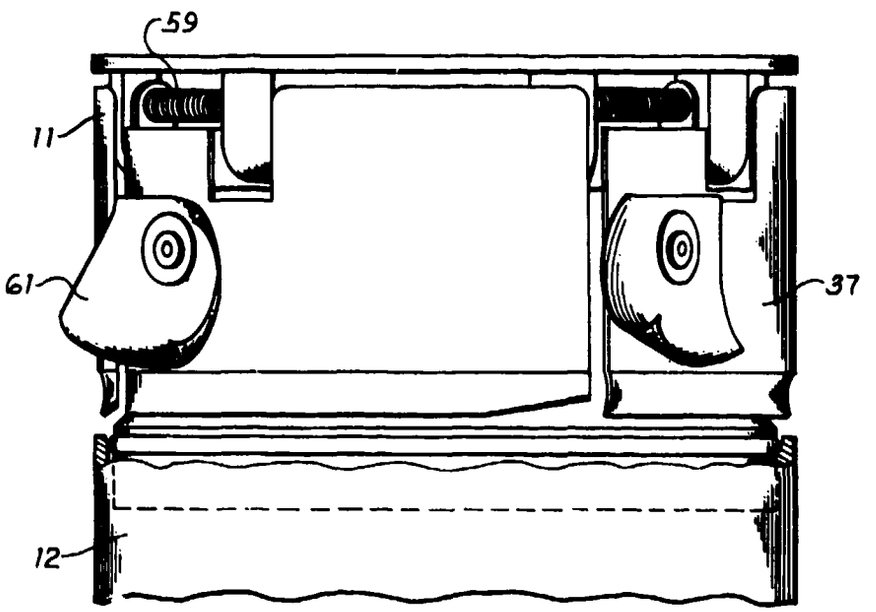
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Fig.2

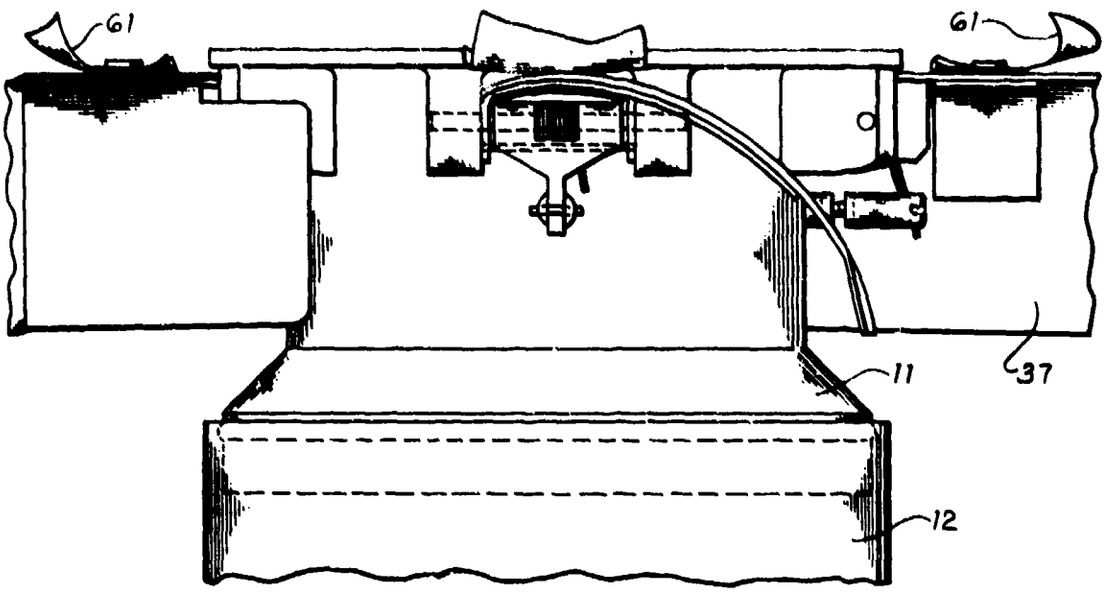
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Fig.3

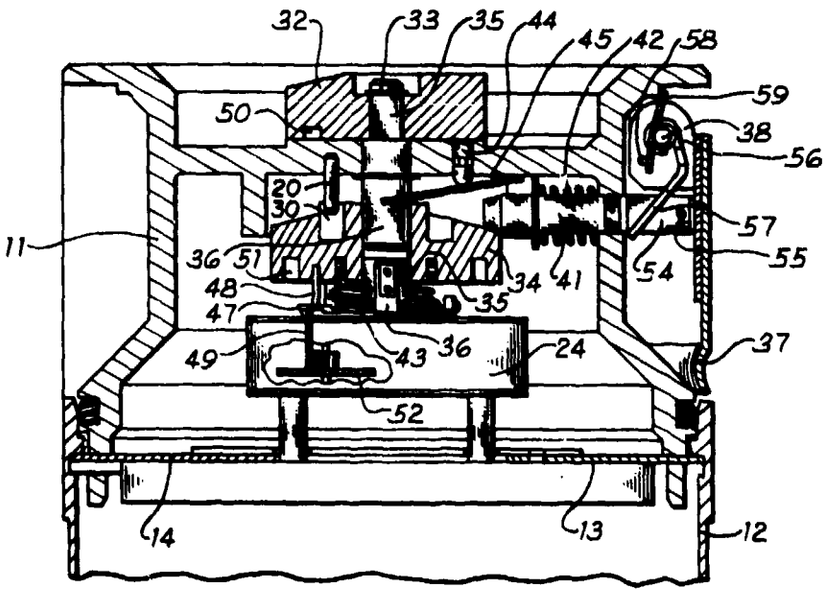
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Fig.4

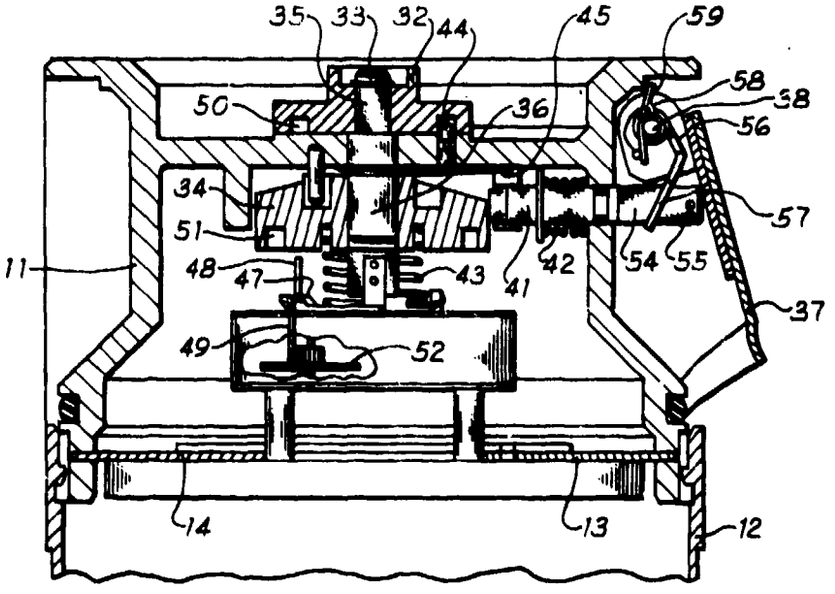

Fig.5

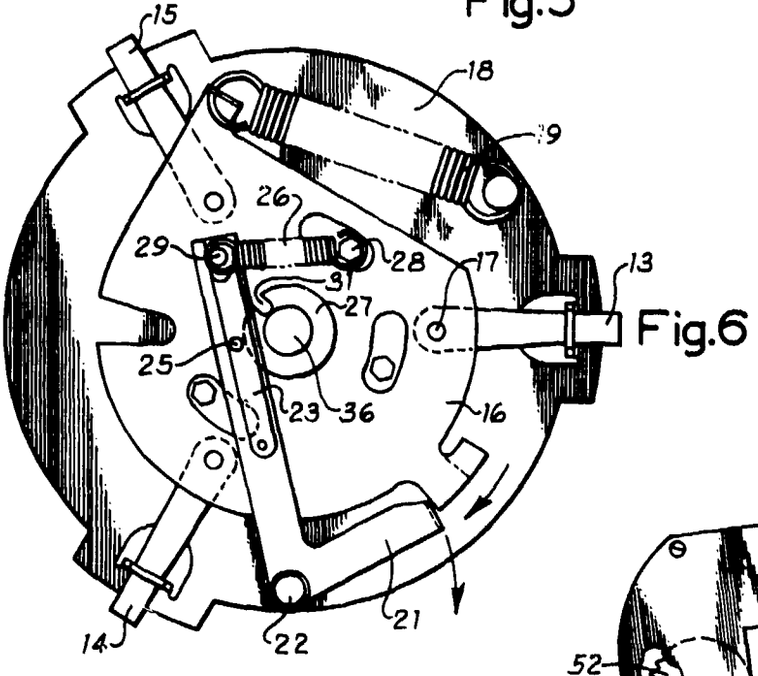

Fig.6

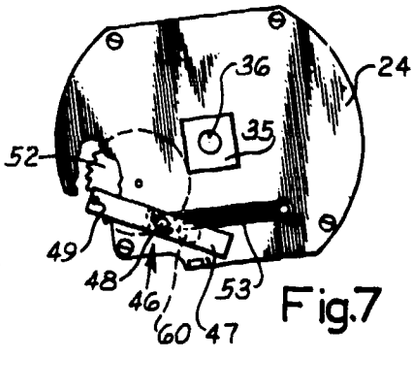

Fig.7

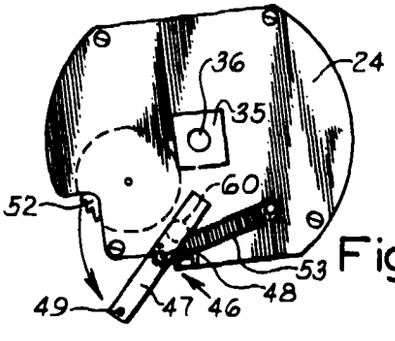

Fig.8

SPIN ACTUATED RELEASE MECHANISM

BACKGROUND OF THE INVENTION

The present invention relates to a release mechanism for a pyrotechnic item, such as an aircraft parachute flare, and more particularly to a release mechanism which is actuated by fins which first open and then impart a spin to the release mechanism to unlock an inertia arm preventing operation of a timer.

An aircraft parachute flare is normally provided with three sections or components, namely a parachute, a section containing a pyrotechnic composition and a triggering mechanism. The triggering mechanism, in addition to igniting the pyrotechnic composition, frequently provides for a delay period so that the aircraft parachute flare can free fall a predetermined distance prior to parachute opening. This free fall feature permits the aircraft parachute flare to be launched or dropped from relatively high altitudes, but prevents ignition of the pyrotechnic composition until the parachute flare is at an altitude such that light from the flare will illuminate the ground below.

As an aircraft parachute flare is an expendable item, possibly the most important features on these flares are the safety features which attempt to prevent accidental or premature ignition of the pyrotechnic composition. As the illuminating materials which are used in present day flares provide extreme heat upon burning, any accidental ignition of these flares could result in a catastrophic disaster, particularly if the flares are in storage aboard a ship. In order to provide some measure of safety, most present day flares are provided with a safety pin which is kept in position until the flare is mounted in a launching rack on an aircraft. In the event the aircraft returns with flares, the safety pins are reinserted.

In one type of fuze widely used by the military departments, a lanyard is provided and has one end attached to the fuze and the other end attached to the aircraft. Upon dropping the store to which the fuze is attached, the lanyard actuates a triggering mechanism which fires the store. While a lanyard is normally successful in triggering a fuze, it has a disadvantage of sometimes causing an undesired triggering, such as the dropping of a store during landing or taxing of an aircraft. In a carrier landing, for example, an accidental dropping of a flare which is triggered by a lanyard, could cause a serious shipboard fire.

In order to eliminate the need for a lanyard, a fuze was developed for the Navy which is initiated by the environment. This device is shown and described in U.S. Pat. No. 3,780,659, entitled, "Environmental Fuze For Pyrotechnic Device", which issued Dec. 25, 1973, to Stanley Kulesza and Max Sapsowitz. In this device, fuze action is started by a plurality of pressure sensing fins which, upon actuation, initiates a timing mechanism and seals a bellows assembly. The bellows assembly monitors the increase of atmospheric pressure as the fuze falls and, if a predetermined pressure change occurs within a given time period, the firing pin is released to detonate a primer. In the event that the desired pressure change does not occur during a given time interval, the timing mechanism will jam and the fuze will remain in a safe condition.

SUMMARY OF THE INVENTION

The present invention relates to a spin actuated release mechanism which is adaptable to be attached to an aircraft parachute flare for deploying a parachute and igniting an illuminating composition. Action is initiated by a plurality of fins which first unlocks an inertia arm to permit rotation or pivoting of this arm, which is engaged with a timing mechanism to prevent movement. The fins are designed to impart rotation or spin to the release mechanism and, when sufficient speed is reached, the inertia arm is pivoted and is disengaged from the timing mechanism. The timing mechanism, in turn, causes the release mechanism to be separated from the store and this separation causes a parachute to deploy and the pyrotechnic composition to be ignited.

It is therefore a general object of the present invention to provide a release mechanism that will eliminate any type of accidental ignition by requiring a predetermined speed of rotation before any action can start.

Other objects, advantages and novel features of the invention will become apparent from the following detailed description when considered in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a top view of a preferred embodiment of the present invention;

FIG. 2 is a side view of a preferred embodiment showing spin fins in a closed position;

FIG. 3 is a side view similar to FIG. 2 of the drawing only showing spin fins opening;

FIG. 4 is a sectional view taken on line 4—4 of FIG. 1 showing the release mechanism of the present invention in a safe condition;

FIG. 5 is a sectional view similar to FIG. 4 of the drawings only showing the release mechanism in an unlocked condition;

FIG. 6 is a bottom view of the release mechanism of the present invention showing a locking arrangement;

FIG. 7 is a bottom view, partly broken away, showing an inertia locking device in a locked condition; and

FIG. 8 is a bottom view similar to FIG. 7 only showing an inertia locking device in an unlocked condition.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, there is shown a housing 11 which is releasably attached to a container 12 by means of three retractable arms 13, 14, and 15. By way of example, container 12 might contain a quantity of flare composition and a parachute and a spring (not shown) might be provided between housing 11 and container 12 for separating the housing 11 from container 12 when arms 13, 14, and 15 are retracted.

As best shown in FIG. 6 of the drawings, arms 13, 14, and 15 are pivotally attached to actuator plate 16 by means of pins 17. Plate 16, in turn, is rotatably mounted on plate 18 and spring 19 is connected to plates 16 and 18 to provide the driving force to rotate plate 16 and, in turn, actuate arms 13, 14, and 15. In FIG. 6, plate 16 is shown in a cocked position and arms 13, 14, and 15 are extended. Rotation of plate 16 is prevented by stop arm 21 which is pivotally attached to plate 18 by pin 22. A follower arm 23, which is attached to a timing mechanism 24, has a pin 25 which is biased by spring 26 against disk 27 which is rotated by

timing mechanism **24**. Spring **26** has one end attached to a post **28** on plate **18** and the other end of spring **26** is attached to pin **29** on the outer end of follower arm **23**. Pin **29**, additionally, engages with a slot in stop arm **21**. Disk **27** has a notch **31** in its periphery and when pin **25** moves into notch **31**, pin **29** pivots stop arm **21** about pin **22** and stop arm **21** is disengaged from actuator plate **16**. Upon disengagement of stop arm **21** from plate **16**, spring **19** causes plate **16** to be rotated and arms **13**, **14**, and **15** are retracted. By way of example, timing mechanism might be purchased as an assembled item and one source is M. H. Rhodes, Inc., Hartford, Connecticut.

Referring now to FIGS. **1** and **4** of the drawings, a knob **32** is rotatably attached to housing **11** by a shaft **33** which is connected to timing mechanism **24** through actuator **34**. Shaft **33** has two square sections **35** and **36** that fit, respectively, in square holes in knob **32** and actuator **34**. A square adapter **35** is pinned to shaft **36** of timing mechanism **24** and rotation of knob **32** causes rotation of actuator **34** and shaft **36** of timing mechanism **24**. As disk **27** is attached to shaft **36** of timing mechanism **24**, rotation of knob **32** causes rotation of disk **27**. As shown in FIG. **1** of the drawings, a scale showing "Feet of Fall" is provided on the top of housing **11** so that knob **32** can be set to provide a desired delay before parachute opening is initiated.

Four arcuate fins **37** are pivotally attached to housing **11** by pins **38** and, as best shown in FIG. **3** of the drawings, each fin is pivoted at its end so that when fully opened the fins will impart a spin to housing **11** and container **12**. Four fin pins **41** are slidably mounted in housing **11** and are retained in position by springs **42**. As best shown in FIG. **4** of the drawings, a spring **43** is provided to bias actuator **34** upwardly, however, fin pins **41** prevent any movement until fin pins **41** are actuated by opening of fins **37**. When knob **32** is set on "SAFE", as shown in FIG. **1** of the drawings, knob **32** depresses a safing pin **44**, which, in turn biases a safing fork **45** against the top of actuator **34** thereby preventing upward movement of actuator **34**. It can be seen then that two independent safing devices restrain actuator **34** when knob **32** is on "SAFE", that is, safing pin **44** and safing fork **45** prevent upward movement of actuator **34** and also fin pins **41** prevent upward movement of actuator **34**.

An inertia locking device **46** is provided on top of timing mechanism **24** and consists of a lever **47** which is pivotally mounted on the top of timing mechanism **24**. An upwardly extending pin **48** and a downwardly extending pin **49** are provided on lever **47**. Pin **48** is engageable in a circular groove **51** in the bottom of actuator **34** and, when so engaged, lever **47** cannot be pivoted. Pin **49** is engageable with a toothed ratchet wheel **52** and, when so engaged, timing mechanism **24** will not operate. A spring **53** has one end attached to the top of timing mechanism **24** and the other end attached to pin **48**. Referring to FIGS. **4** and **7** of the drawings, when actuator **34** is in a locked position by fin pins **41** and safing pin **44** and safing fork **45**, pin **48** is in groove **51** which prevents pivoting of inertia locking device **46**. Pin **49** is engaged with ratchet wheel **52** and timing mechanism **24** cannot function.

Fin pins **41** are each provided with a slot **54** in the outer end, and pins **55** are positioned transversely across each slot **54**. A pin retractor **56** is rotatably positioned about each pin **38** and has an arm **57** that moves freely in slot **54** and is engageable with pin **55**. A pin **58** is provided on each fin **37** and is engageable with a pin retractor **56**. This arrangement permits fins **37** to partially open before there is any movement of fin pins **41**, otherwise springs **42** would provide a resistive force and keep fins **37** closed. Once fins **37** are partially opened, wind will apply a greater force to them thereby opening fins **37** fully and withdrawing fin pins **41**. Also this arrangement permits a coupling between fins **37** having a circular or pivotal movement and fin pins **41** having a linear movement. When a fin **37** is opened, pin **58** will move in a circular pattern and engage pin retractor **56**. Pin retractor **56** will also move in a circular pattern and arm **57** will engage pin **55**. Continued movement of arm **57** against pin **55** will cause fin pin **41** to retract. A spring **59** is provided for each fin **37** and provides a small force to keep a fin in a closed position until the release mechanism is launched into an airstream.

OPERATION

Assuming that the release mechanism is set on "SAFE" as shown in FIGS. **1** and **4** of the drawings, pin **49** is engaged with ratchet wheel **52** and timing mechanism **24** will not operate. Pin **48** is positioned in groove **51** of actuator **34** and prevents pivoting of inertia locking device **46** until actuator **34** is raised. Movement of actuator **34** is prevented by safing fork **45** which is biased by safing pin **44**. In addition, fin pins **41** prevent movement of actuator **34**.

Prior to launch from an aircraft knob **32** is set to the desired "feet of fall", as shown in FIG. **1** of the drawings. Turning of knob **32** winds-up timing mechanism **24** and also causes rotation of disk **27**. Upon turning of knob **32**, safing pin **44** moves upwardly into groove **50** of knob **32** and frees safing fork **45**, however actuator **34** is still restrained by fin pins **41**. A stop pin **20** is provided in housing **11** and extends into a groove **30** in actuator **34**. Groove **30** is not completely annular and pin **20** and groove **30** limit the travel of actuator **34** thereby preventing over-winding of timing mechanism **24**.

Upon launch, wind catches and opens fins **37** and retracts fin pins **41**. In order to facilitate the initial opening of fins **37**, a small piece of flexible plastic material **61** is attached to the outer surface of each fin **37**. Upon retraction of fin pins **41**, spring **43** moves actuator **34** upwardly and pin **48** clears groove **51**. Spring **53**, however, maintains pin **49** in engagement with ratchet wheel **52** and timing mechanism **24** remains locked. When fins **37** are fully deployed they will impart a spin to the release mechanism and, when a sufficient rotational velocity is reached, the inertia locking device **46** will pivot about pin **60** and pin **49** will disengage from ratchet wheel **52**. Timing mechanism **24** will start to run and will rotate disk **27**. When pin **25** on follower arm **23** moves into notch **31** on disk **27**, stop arm **21** will pivot about pin **22** and become disengaged from actuator plate **16**. Spring **19** will then rotate actuator plate **16** and retract arms **13**, **14**, and **15**, and housing **11** separates from container **12** and, upon separation, a parachute is deployed.

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.

We claim.

1. A release mechanism for use with an aircraft parachute flare comprising,

a housing,

a plurality of arms for removably attaching said housing to an aircraft parachute flare,

means for actuating said arms for uncoupling said housing from said aircraft parachute flare,

an ertia arm pivotally mounted in said housing for locking said means for actuating said arms,

a pin attached to said inertia arm,

an actuator slidably mounted to said housing and engageable with said pin attached to said inertia arm,

spring means for disengaging said actuator from said pin attached to said inertia arm,

a plurality of shafts slidably positioned in said housing engageable with said actuator for holding said actuator in a locking position with said pin attached to said inertia arm, and

means for disengaging said plurality of shafts from said actuator and pivoting said inertia arm whereby said means for actuating said arms is unlocked.

2. A release mechanism for use with an aircraft parachute flare as set forth in claim 1 wherein said means

for disengaging said plurality of shafts from said actuator and pivoting said inertia arm comprises a plurality of arcuate fins pivotally attached to said housing and connected one each with each said shaft, each said arcuate fin being movable from a retracted position with said shafts engaging said actuator to a deployed position with said shafts disengaging said actuator and whereby said arcuate fins impart rotation to said housing when deployed during a free-fall condition.

3. A release mechanism for use with an aircraft parachute flare as set forth in claim 1 wherein said means for actuating said arms includes spring means for retracting said arms, a trigger mechanism for actuating said spring means and a timer for delaying actuation of said trigger mechanism.

4. A release mechanism for use with an aircraft parachute flare as set forth in claim 3 having a shaft rotatably mounted in said housing having one end connected with said timer and having a dial on the other end thereof and stop means positioned between said dial and said actuator for preventing movement of said actuator when said dial is in one rotatable position.

* * * * *

United States Patent [19]

Beatty et al.

[11] **3,960,087**

[45] **June 1, 1976**

[54] **SMOKE AND ILLUMINATION SIGNAL**

[75] Inventors: **Bobby D. Beatty**, Bloomfield; **Russell D. Daniel**, Bloomington; **Billy J. Humerickhouse**, Odon; **Gary G. Norris**, Burns City, all of Ind.

[73] Assignee: **The United States of America as represented by the Secretary of the Navy**, Washington, D.C.

[22] Filed: **Oct. 4, 1974**

[21] Appl. No.: **512,262**

[52] **U.S. Cl.** **102/90;** 102/6; 102/37.7; 102/66; 149/18; 149/19.91; 149/84; 149/85; 149/116

[51] **Int. Cl.**[2] **F42B 13/44**

[58] **Field of Search** ..... 102/6, 7, 14, 16, 32, 102/37.7, 37.8, 81, 70 R, 87, 90, 6, 66; 149/84, 85, 116, 18, 117, 19.91

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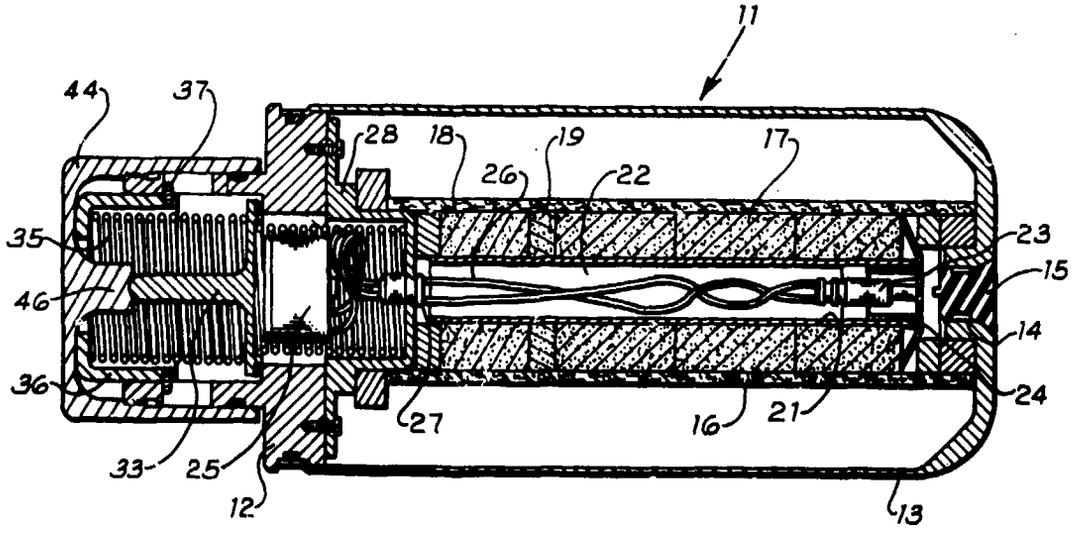
Primary Examiner—Harold Tudor
Attorney, Agent, or Firm—R. S. Sciascia; Paul S. Collignon

[57] **ABSTRACT**

A pyrotechnic signal providing smoke and flame and which is launchable from underwater. Launching of the signal from underwater arms the signal, however, the signal is not initiated until the ambient sea pressure reaches a predetermined pressure valve. When this predetermined pressure valve is reached, sea water enters a cavity and energizes a battery which detonates an electric squib. The squib, in turn, ignites a smoke composition in the signal housing.

8 Claims, 4 Drawing Figures



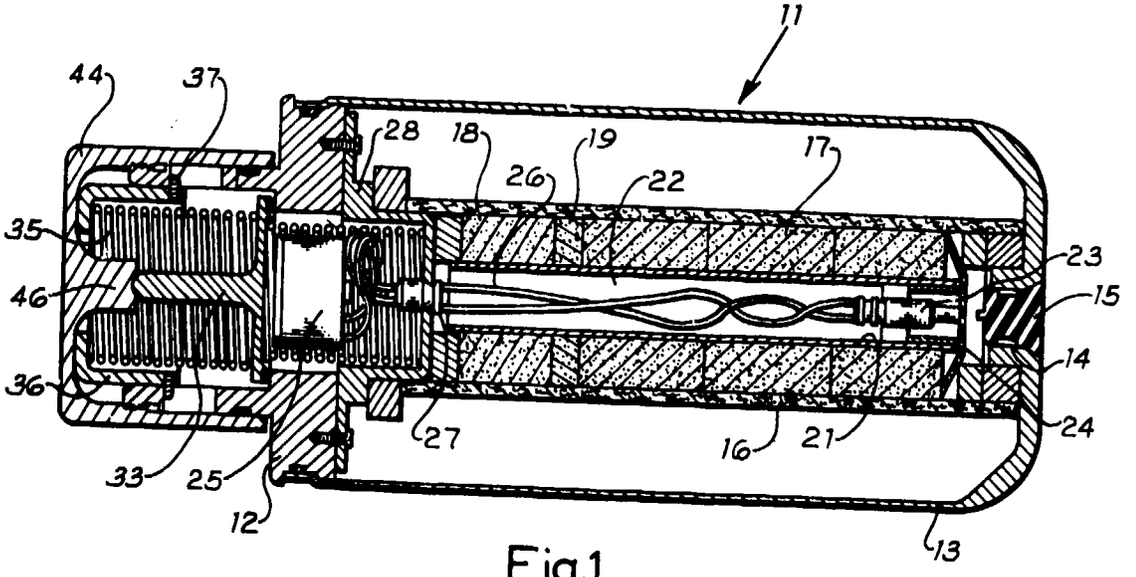

11
44
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Fig.1

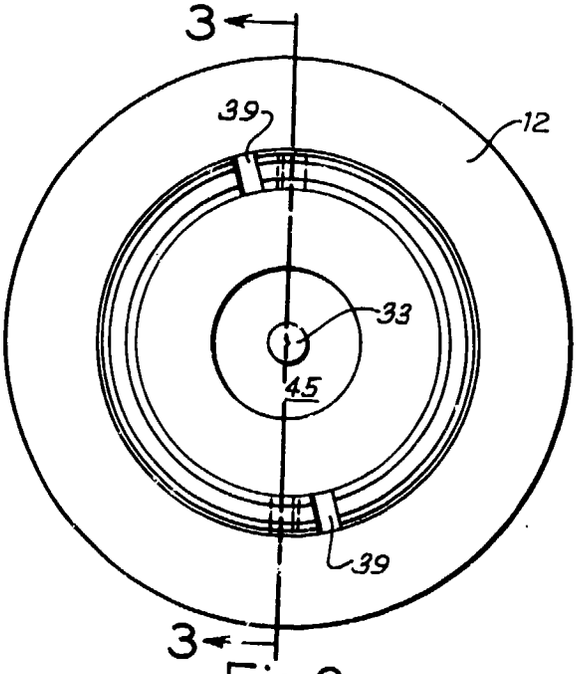
3
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Fig.2

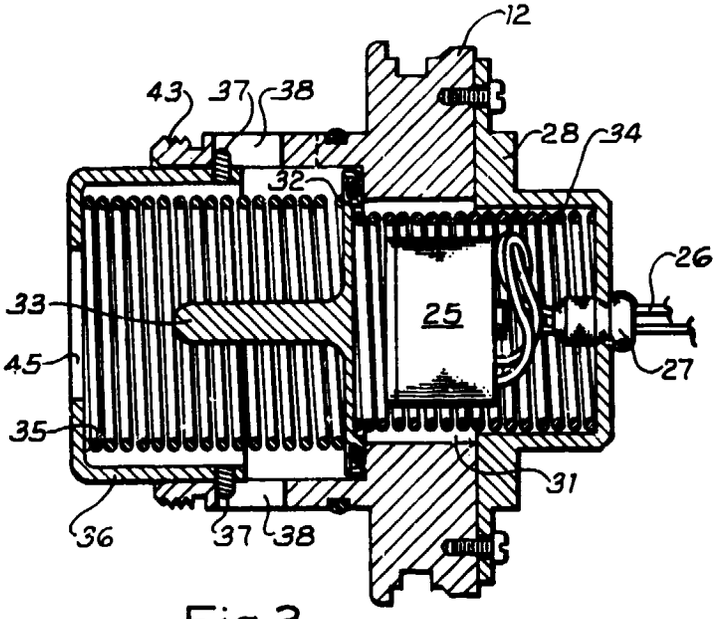

Fig.3

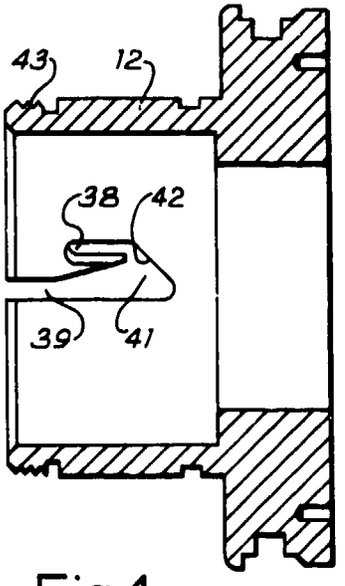

Fig.4

SMOKE AND ILLUMINATION SIGNAL.

BACKGROUND OF THE INVENTION

The present invention relates to a signaling device and more particularly to a signaling device which is launchable from underwater and which rises to the surface and produces smoke and flame. One particular use of the present invention is that of launching the signal from underwater to simulate that a mine has been detonated.

Various types of signaling devices have been launched underwater to indicate the position of a vessel, such as a submarine, a swimmer, or of a mine. Generally, these signaling devices have some type of delay mechanism so that ignition of the pyrotechnic material is delayed until the signal floats to the surface. One type of ignition system being successfully used by the Navy employs a sea water battery which, when activated, provides a voltage which will ignite or explode squibs to ignite a pyrotechnic composition. The sea water battery is not energized until the signal nears the surface and thus ignition is delayed. One such signaling device is shown in U.S. Pat. 3,196,789 entitled, "Submarine Signal Fuze", which issued July 27, 1965, to Stanley M. Fasig and Glenn C. Johnson. In this signaling device, the fuze is armed when a lever strikes the end of a launching tube and is pivoted thereby unlocking a valve assembly. This valve assembly is held closed by water pressure until the signal nears the surface whereupon a spring opens the valve and ejects a battery into the sea.

SUMMARY OF THE INVENTION

The present invention relates to a pyrotechnic signal which can be launched underwater, as from a float. Ejection of the signal from the float causes an arming cup to be rotated and then ejected. When the signal nears the surface, a cavity is opened and flooded thereby energizing a sea water battery which provides current for detonating a squib. The squib, in turn, ignites a smoke composition and the burning of this pyrotechnic material increases pressure within the signal to eject a plug thereby permitting smoke to flow through an opening in the signal shell.

It is therefore a general object of the present invention to provide a smoke and illumination signal which can be launched underwater and which will be ignited when the signal nears the surface.

Other objects and advantages of the present invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a longitudinal sectional view of a preferred embodiment of the present invention;

FIG. 2 is an end view of a base assembly;

FIG. 3 is a sectional view taken on line 3-3 of FIG. 2; and

FIG. 4 is a sectional view of a base.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, there is shown a smoke and illumination signal 11 having a base 12 to which a shell 13 is attached. Shell 13 is provided with

an orifice 14 which is closed by a plug 15. A combustion tube 16, which is made of fish paper or other combustible material, is attached to base 12 and contains a smoke composition 17 and a flare composition 18. A starter composition 19 is provided between the two pyrotechnic compositions so that, at the end of the burning time for smoke composition 17, starter composition 19 is ignited and, in turn, ignites flare composition 18. In one embodiment of the invention used by the Navy, a green colored smoke flare composition is used and, in another embodiment, a yellow colored smoke and flare composition is used.

The green colored smoke composition consists, by weight, of between 45 and 51 parts of a green dye mix, between 22 and 28 parts of potassium chlorate, between 17 and 23 parts of refined sugar, between two and four parts of baking soda and between 3 and 5 parts of diatomaceous earth. The green dye mix is comprised, by weight, of 75 percent of solvent green 3 dye, 10 percent of benzanthrone dye and 15 percent of vat yellow 4 dye.

The green flare composition consists, by weight, of between 13.28 and 17.28 parts of magnesium powder, between 18.92 and 24.92 parts of potassium perchlorate, between 43.55 and 49.55 parts of barium nitrate, between 10.00 and 16.00 parts of polyvinyl chloride and between 2.25 and 4.25 parts of a binder solution. A binder solution suitable for use might consist of 98.5 percent of Laminac 4110 procured from American Cyanamide Company and 1.5 percent of a catalyst solution which is a 60% solution of methyl ethyl ketone peroxide in dimethylphthalate, procured as Lupersol DDM from the Lucidol Div. of Wallace and Tierman, Inc.

The yellow colored smoke composition consists, by weight, of between 50 and 54 percent of yellow dye mix, between 19 and 25 percent of potassium chlorate, between 10 and 16 percent of refined sugar, between 2 and 8 percent of baking soda and between 5 and 11 percent of diatomaceous earth. The yellow dye mix is comprised, by weight, of 42 percent of vat yellow 4 dye and 58 percent of benzanthrone dye.

The yellow flare composition consists, by weight, of between 17 and 21 percent of magnesium powder, between 12 and 22 percent of potassium perchlorate, between 24 and 34 percent of barium nitrate, between 23 and 31 percent of sodium oxalate, between 3 and 5 percent of asphaltum, and between 3-3/4 and 4-1/4 percent of a binder solution. A binder solution suitable for use might consist of 98.5 percent of Laminac 4110 procured from American Cyanamide Company and 1.5 percent of a catalyst solution which is a 60% solution of methyl ethyl ketone peroxide in dimethylphthalate, procured as Lupersol DDM from the Lucidol Div. of Wallace and Tierman, Inc.

Starter composition 19 is comprised, by weight, of between 79.80 and 80.20 percent of tetra-red lead oxide, between 15.90 and 16.10 percent of silicon and between 3.96 and 4.04 percent of a binder solution, which is 79 percent vinylidene fluoride and 21 percent hexafluoropropylene.

A small diameter tube 21 of fish paper or other combustible material is provided within the pyrotechnic materials and provides a passageway 22. An electric squib 23 is positioned within passageway 22 adjacent the end of smoke composition 17 and an ignition heat pad 24 of paper is provided at the end of smoke composition 17. Upon detonation of squib 23, pad 24 is ig-

nited and, in turn, ignites smoke composition **17**. A sea water battery **25** is provided in base **12** and is electrically connected to squib **23** by leads **26** which pass through passageway **22**. As shown in FIG. **1** of the drawings, leads **26** pass through a grommet **27** which is provided in a base cover **28**, so that, when sea water energizes battery **25**, water cannot enter to extinguish the burning pyrotechnic materials.

Referring now to FIG. **3** of the drawings, it can be seen that battery **25** is positioned in a cavity **31** in base **12** and that cavity **31** has one end closed by base cover **28**. The other opening of cavity **31** is closed by disc **32** which has an elongated probe **33** extending outwardly. A first compression spring **34** is provided in cavity **31** between base cover **28** and the inner side of disc **32** and spring **34** provides a biasing force to move disc **32** outwardly. A second compression spring **35** is positioned between the outer side of disc **32** and an arming cup **36** to provide a biasing force that keeps disc **32** in a position for closing cavity **31**. Arming cup **36** is provided with a pair of guiding pins **37** that engage slots in base **12**. As best shown in FIG. **4** of the drawings, the slots in base **12** consist of a short slot **38** and a longer slot **39** that extends to the end of base **12**. The metal between slots **38** and **39** is removed so that the slots are connected by a passageway **41** and the inner-most edge of passageway **41** is provided with a tapered surface **42**. When pins **37** are positioned in slots **38**, arming cup **36** is secured to base **12**. When arming cup **36** moves inwardly, guiding pins **37** will engage surface **42** and pins **37** will be shifted from short slot **38** to longer slot **39**, and the biasing force applied by compression spring **35** will disengage arming cup **36** from base **12**.

The outer end of base **12** is provided with threads **43** and a protective cap **44** is threadedly attachable thereto. Arming cup **36** is provided with a hole **45** and a boss **46** on the inside of protective cap **44** passes through hole **45** and engages probe **33** on disc **32**. Protective cap **44** thus locks disc **32** so that cavity **31** remains securely sealed during storage. Protective cap **44** is removed prior to signal **11** being used.

OPERATION

Prior to operation, protective cap **44** is removed from signal **11** which is then attached to some type of launching device. For example, in one use by the Navy, signal **11** is attached to a float which is anchored under water at a depth up to 160 feet. Signal **11** is separated from the anchored float by an explosive device, and the force of the explosion causes arming cup **36** to move toward disc **32** thereby compressing spring **35**. Guiding pins **37** on arming cup **36** move in short slot **38** and, upon contacting tapered surface **42**, arming cup **36** is rotated and pins **37** are aligned in long slot **39**. Compression spring **35** then moves arming cup **36** outwardly and arming cup **36** and spring **35** separate from base **12**. After spring **35** separates from base **12**, water pressure holds disc **32** against base **12** and keeps cavity **31** closed. As signal **12** rises to the surface, the water pressure against disc **32** decreases and when the force applied by spring **34** exceeds ambient water pressure, spring **34** ejects disc **32** and sea water enters cavity **31**. Sea water energizes battery **25** and current from battery **25** detonates electric squib **23**, which ignites heat pad **24**. Heat pad **24**, in turn, ignites smoke composition **17**. The combustion of smoke composition **17** increases the pressure within shell **13** and this pressure ejects plug **15** from shell **13** thereby permitting smoke to flow through orifice **14**. When smoke composition **17** is nearly consumed, starter composition **19** is ignited from the burning smoke composition and starter composition ignites flare composition **18**.

It can thus be seen that the present invention provides an improved smoke and flare signaling device which can be launched from underwater. 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 describe.

We claim:

1. A smoke and illumination signal adapted to be launched in a body of sea water beneath the surface thereof comprising,

a base having a cavity therein,

a sea water battery positioned within said cavity,

a disc closing an opened end of said cavity,

a shell attached to one end of said base containing a smoke composition and a flare composition separated by a quantity of a starter composition, said smoke composition being comprised, by weight, of between 50 and 54 percent of yellow dye mix, between 19 and 25 percent of potassium chlorate, between 10 and 16 percent of refined sugar, between 2 and 8 percent of baking soda and between 5 and 11 percent of diatomaceous earth and said flare composition being comprised by weight of between 17 and 21 percent of magnesium powder, between 12 and 22 percent of potassium perchlorate, between 24 and 34 percent of barium nitrate, between 23 and 31 percent of sodium oxalate, between 3 and 5 percent of asphaltum and between 3¾ and 4¼ percent of binder material,

an electric squib adjacent said smoke composition and electrically connected to said sea water battery,

an arming cup slidably and removably attached to said base,

a first compression spring in said arming cup biasing said disc in a closing relationship with respect to said cavity, and

a second compression spring within said cavity biasing said disc in an opening relationship with respect to said cavity whereby, upon launching of said signal, said first compression spring ejects said arming cup and said second compression spring ejects said disc.

2. A smoke and illumination signal as set forth in claim **1** wherein said base is provided with a threaded portion and a protective cap is threadedly connected with said threaded portion and engages said disc to lock said disc prior to said signal being placed in use.

3. A smoke and illumination signal as set forth in claim **1** wherein said base is provided with at least one closed end slot and at least one opened end slot, said slots being connected by a passageway having a tapered surface and wherein said arming cup is provided with at least one guiding pin engageable in said slots.

4. A smoke and illumination signal as set forth in claim **1** wherein said shell is provided with an orifice in one end and having a plug closing said orifice whereby said plug is ejected upon buring of said pyrotechnic composition.

5. A smoke and illumination signal adapted to be launched in a body of sea water beneath the surface thereof comprising,

a base having a cavity therein,

a sea water battery positioned within said cavity,

a disc closing an opened end of said cavity,

a shell attached to one end of said base containing a smoke composition and a flare composition separated by a quantity of a starter composition, said smoke composition being comprised, by weight, of between 45 and 51 percent of green dye mix, between 22 and 28 percent of potassium chlorate, between 17 and 23 percent of refined sugar, between 2 and 4 percent of baking soda and between 3 and 5 percent of diatomaceous earth, and said flare composition being comprised, by weight, of between 13.28 and 17.28 percent of magnesium powder, between 18.92 and 24.92 percent of potassium perchlorate, between 43.55 and 49.55 percent of barium nitrate, between 10.00 and 16.00 percent of polyvinyl chloride and between 2.25 and 4.25 percent of binder material,

an electric squib adjacent said smoke composition and electrically connected to said sea water battery,

an arming cup slidably and removably attached to said base,

a first compression spring in said arming cup biasing said disc in a closing relationship with respect to said cavity, and

a second compression spring within said cavity biasing said disc in an opening relationship with respect to said cavity whereby, upon launching of said signal, said first compression spring ejects said arming cup and said second compression spring ejects said disc.

6. A smoke and illumination signal as set forth in claim **5** wherein said base is provided with a threaded portion and a protective cap is threadedly connected with said threaded portion and engages said disc to lock said disc prior to said signal being placed in use.

7. A smoke and illumination signal as set forth in claim **5** wherein said base is provided with at least one closed end slot and at least one opened end slot, said slots being connected by a passageway having a tapered surface and wherein said arming cup is provided with at least one guiding pin engageable in said slots.

8. A smoke and illumination signal as set forth in claim **5** wherein said shell is provided with an orifice in one end and having a plug closing said orifice whereby said plug is ejected upon burning of said pyrotechnic composition.

* * * * *

United States Patent [19]

Baker et al.

[11] **3,942,445**

[45] **Mar. 9, 1976**

[54] **HIGH ALTITUDE FRICTION IGNITER**

[75] Inventors: **Charles Baker**, Avoca; **Benjamin F. Harkness**, Odon; **Alfred W. Norris**, Bloomington, all of Ind.

[73] Assignee: **The United States of America as represented by the Secretary of the Navy**, Washington, D.C.

[22] Filed: **Sept. 18, 1974**

[21] Appl. No.: **507,038**

[52] U.S. Cl. ..... **102/70 R**; 102/70 F; 149/22; 149/29; 149/44; 149/82

[51] Int. Cl.[2] **F42C 7/00**

[58] Field of Search ..... 102/70 R, 70 F, 37.8, 35, 102/86.5; 149/22, 29, 82, 44

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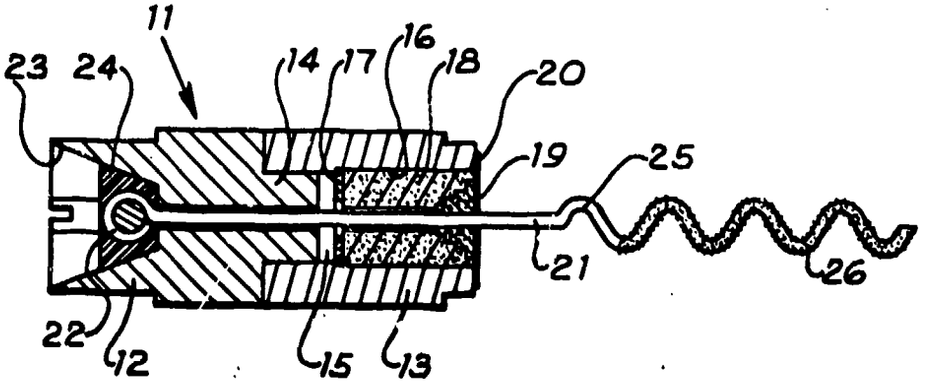
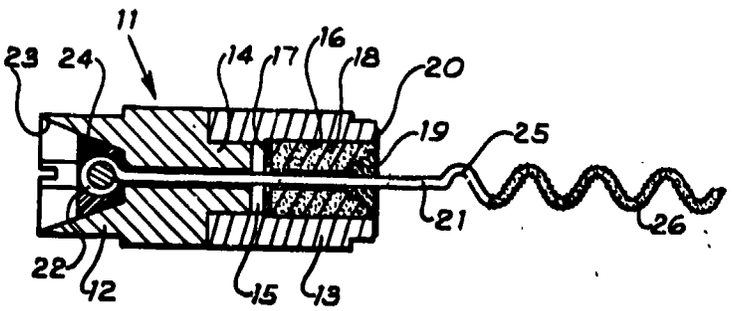
Primary Examiner—Samuel W. Engle
Assistant Examiner—Harold Tudor
Attorney, Agent, or Firm—R. S. Sciascia; Paul S. Collignon

[57] **ABSTRACT**

A friction igniter assembly for high altitude operation having a pull wire coated with a scratch sensitive composition which is moved through a chlorate composition. The scratch sensitive composition containing red phosphorus reacts with the chlorate to provide a flash which transfers ignition to an adjacent boron-lead dioxide composition. The boron-lead dioxide composition is the main igniting charge and provides an intense output of heat in a very short time for igniting a pyrotechnic composition.

2 Claims, 1 Drawing Figure

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HIGH ALTITUDE FRICTION IGNITER

BACKGROUND OF THE INVENTION

The present invention relates to an igniter assembly and more particularly to an igniter assembly that is highly reliable up to altitudes of 100,000 feet.

Present igniter assemblies used by the military work satisfactory at altitudes up to about 12,000 feet, however, above 12,000 feet their performance degrade and at about 40,000 feet, presently available igniters will not sustain ignition. Various military operations require the use of igniters at altitudes considerably greater than 40,000 feet and, heretofore, none has been available that would provide reliable performance.

SUMMARY OF THE INVENTION

The present invention relates to a high altitude friction igniter having a housing comprised of two sections that are movable relative to one another. One section contains first and second igniter compositions and a wire having a red phosphorus scratch mixed on one end portion passes through the two igniter compositions and is attached to the second section. The first igniter composition is a chlorate composition and the second igniter composition is a boron-lead dioxide composition. Movement of one section relative to the other section causes a phosphorus-chlorate reaction which provides a flash to transfer ignition to the boron-lead dioxide composition. The boron-lead dioxide is the main igniting charge and provides an intense output of heat in a very short time.

BRIEF DESCRIPTION OF THE DRAWING

The FIGURE of the drawing is a longitudinal sectional view of a preferred embodiment of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawing, there is shown an igniter housing **11** consisting of two sections **12** and **13**. Section **12** is provided with a reduced diameter portion **14** that slip-fits into a central bore **15** of section **13** so that sections **12** and **13** can move relative to one another. By way of example, housing **11** might have section **12** attached to a piston mounted within a case of a decoy flare, and movement of the piston causes movement of both sections **12** and **13**. When the piston reaches the end of the case, it is stopped, along with section **12**, however section **13** is separated from section **12**.

Section **13** is provided with a second central bore **16**, only slightly larger in diameter than bore **15**, and a thin washer **17** is positioned in bore **16**, adjacent bore **15**. An igniter composition **18** is pressed into bore **16** and igniter composition **18** is provided with a plurality of stepped counterbores that are filled with a second igniter composition **19**. A closing disk **20** is cemented to section **13** to retain the igniter compositions in bore **16**. Igniter composition **18** is comprised, by weight, of 89 parts of potassium chlorate, 10 parts of charcoal and 1 part of dextrin. In igniter compositions mixed and tested at the Naval Ammunition Depot, Crane, Indiana, it has been determined that the following tolerances can be used: for potassium chlorate, plus or minus 1.8 parts; for charcoal, plus or minus 0.5 part; and for dextrin, plus or minus 0.1 part.

Igniter composition **19** is comprised, by weight, of 46.6 percent of lead dioxide, 20 percent of boron and 33.4 percent of a binder, such as a cellulose nitrate-camphor binder dissolved in acetone. The cellulose nitrate is plasticied with camphor and is more fully described in Military Specification MIL-B-10854. By way of example, the binder solution might be 8 parts, by weight, of cellulose nitrate-camphor which has been dissolved in 92 parts of acetone. In igniter compositions **19** mixed and tested at the Naval Ammunition Depot, Crane, Ind., it has been determined that the following tolerances can be used: for lead dioxide, plus 0, minus 3 parts; for boron, plus 3, minus 0 parts, and for the binder, plus 6, minus 0 parts.

As shown in the drawing, a friction wire **21** is passed through igniter compositions **18** and **19**, and a loop **22** is formed on one end and soldered in a conical cavity **23** in section **12**. A portion of cavity **23** is then filled with an epoxy filler **24** which is then cured thereby securely fastening wire **21** with section **12**. The end of wire **21** that extends outside housing **11** is provided with a plurality of undulations **25** which are coated with a scratch mix **26**. The scratch mix is comprised, by weight, of 50 parts of red phosphorus, 35 parts of a moisture-proof varnish and 15 parts of an elastomeric adhesive more fully described in Federal Specification MM-A-1617. The elastomeric adhesive is mixed with equal parts of paint thinner, such as volatile mineral spirits, and the varnish is also thinned with paint thinner by mixing, by weight, 65 parts of varnish and 35 parts of paint thinner.

In operation, relative movement between sections **12** and **13** of housing **11** causes friction wire **21** to move through igniter composition **18** and the red phosphorus on scratch mix **26** reacts with the potassium chlorate to provide a flash. This flash ignites the boron-lead dioxide composition, which is the main igniting charge and provides an intense output of heat in a very short time. By way of example, section **13** might be retained in a bore in a pyrotechnic candle and ignition of the boron-lead dioxide composition will ignite the pyrotechnic candle.

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.

We claim:

1. A high altitude friction igniter comprising,

a housing having first and second sections adaptable for movement relative to one another,

a first igniter composition contained within said first section comprised, by weight, of between 87.2 and 90.8 percent of potassium chlorate, between 9.5 and 10.5 percent of charcoal and between 0.9 and 1.1 percent of dextrin,

a second igniter composition contained within said first section adjacent said first igniter composition, said second igniter composition comprised, by weight, of between 43.6 and 46.6 percent of lead dioxide, between 20 and 23 percent of boron and between 33.4 and 39.4 percent of binder, and

a friction wire passing through said first and second igniter compositions and having both ends thereof extending beyond said compositions, one end of said friction wire being attached to said second section, and a length of wire extending beyond said housing having a coating of scratch mix comprised,

by weight between 48 and 52 percent of red phosphorus, between 33 and 37 percent of a varnish composition and between 13 and 17 percent of an adhesive composition, whereby relative movement between said first and second sections causes engagement of said scratch mix with said first igniter composition to produce a flash of flame which ignites said second igniter composition.

2. A high altitude friction igniter as set forth in claim 1 wherein said length of wire extending beyond said housing has a plurality of undulations coated with said scratch mix.

* * * * *

United States Patent [19]

Parrish et al.

[11] **3,930,844**

[45] **Jan. 6, 1976**

[54] **METHOD FOR DISPOSAL OF PYROTECHNIC WASTE**

[75] Inventors: **Clyde F. Parrish**, Terre Haute; **James E. Short, Jr.**, Switz City; **Karen S. Whorrall**, West Baden, all of Ind.

[73] Assignee: **The United States of America as represented by the Secretary of the Navy**, Washington, D.C.

[22] Filed: **Feb. 6, 1975**

[21] Appl. No.: **547,535**

[52] **U.S. Cl.** ..... **75/101 R**; 75/121; 423/155; 423/395

[51] **Int. Cl.²** **C22B 26/22**

[58] **Field of Search** ..... 75/101 R, 121; 423/155, 423/395

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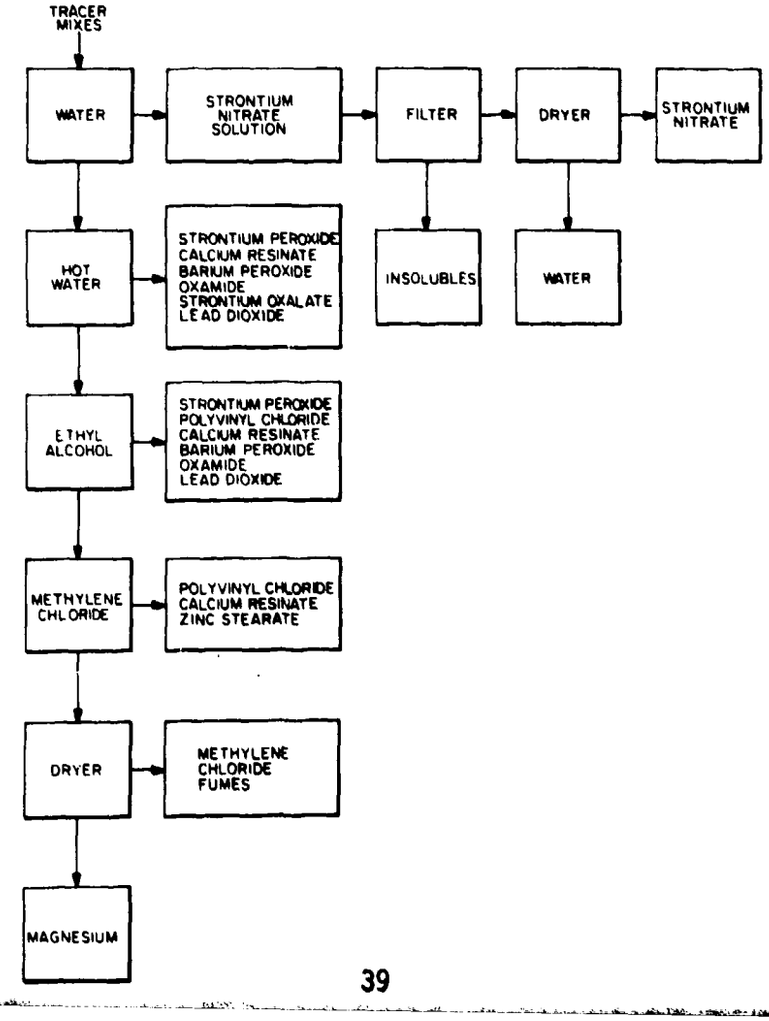
Primary Examiner—G. Ozaki
Attorney, Agent, or Firm—R. S. Sciascia; Paul S. Collignon

[57] **ABSTRACT**

A method for disposing of tracer ammunition pyrotechnic material containing strontium nitrate, magnesium, strontium peroxide, polyvinyl chloride, calcium resinate, barium peroxide, oxamide, zinc stearate, polyethylene, strontium oxalate and lead dioxide, with strontium nitrate and magnesium accounting for about 60 percent of the total material. Strontium nitrate is first removed from the material by dissolving in cold water, and the water solution of strontium nitrate is filtered and evaporated to reclaim the strontium nitrate. The remaining material are given successive washes in hot water, ethyl alcohol and methylene chloride to remove all the other materials except magnesium. The magnesium is dried and reclaimed.

4 Claims, 2 Drawing Figures



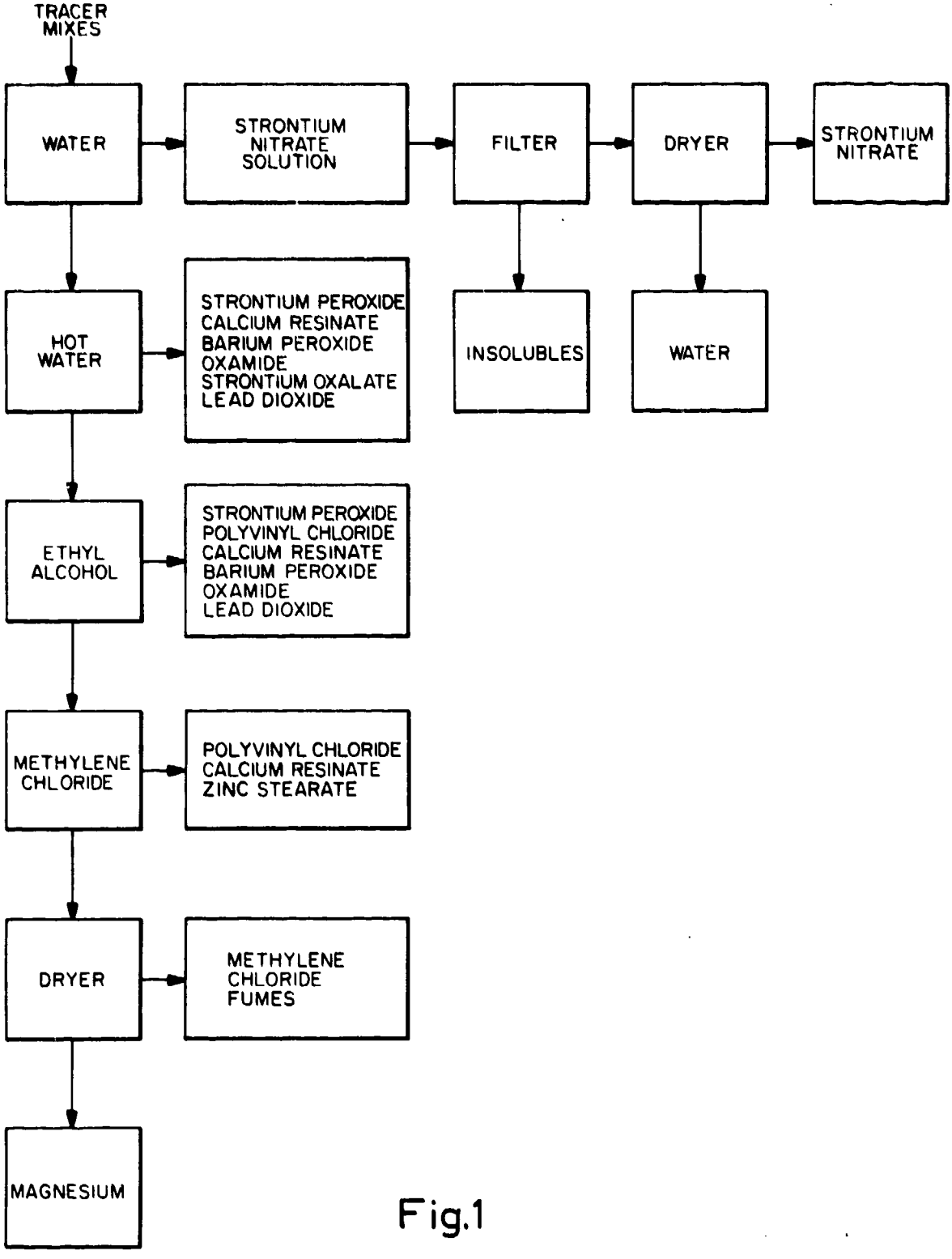

TRACER MIXES
WATER
STRONTIUM NITRATE SOLUTION
FILTER
DRYER
STRONTIUM NITRATE
HOT WATER
STRONTIUM PEROXIDE
CALCIUM RESINATE
BARIUM PEROXIDE
OXAMIDE
STRONTIUM OXALATE
LEAD DIOXIDE
INSOLUBLES
WATER
ETHYL ALCOHOL
STRONTIUM PEROXIDE
POLYVINYL CHLORIDE
CALCIUM RESINATE
BARIUM PEROXIDE
OXAMIDE
LEAD DIOXIDE
METHYLENE CHLORIDE
POLYVINYL CHLORIDE
CALCIUM RESINATE
ZINC STEARATE
DRYER
METHYLENE CHLORIDE FUMES
MAGNESIUM

Fig.1

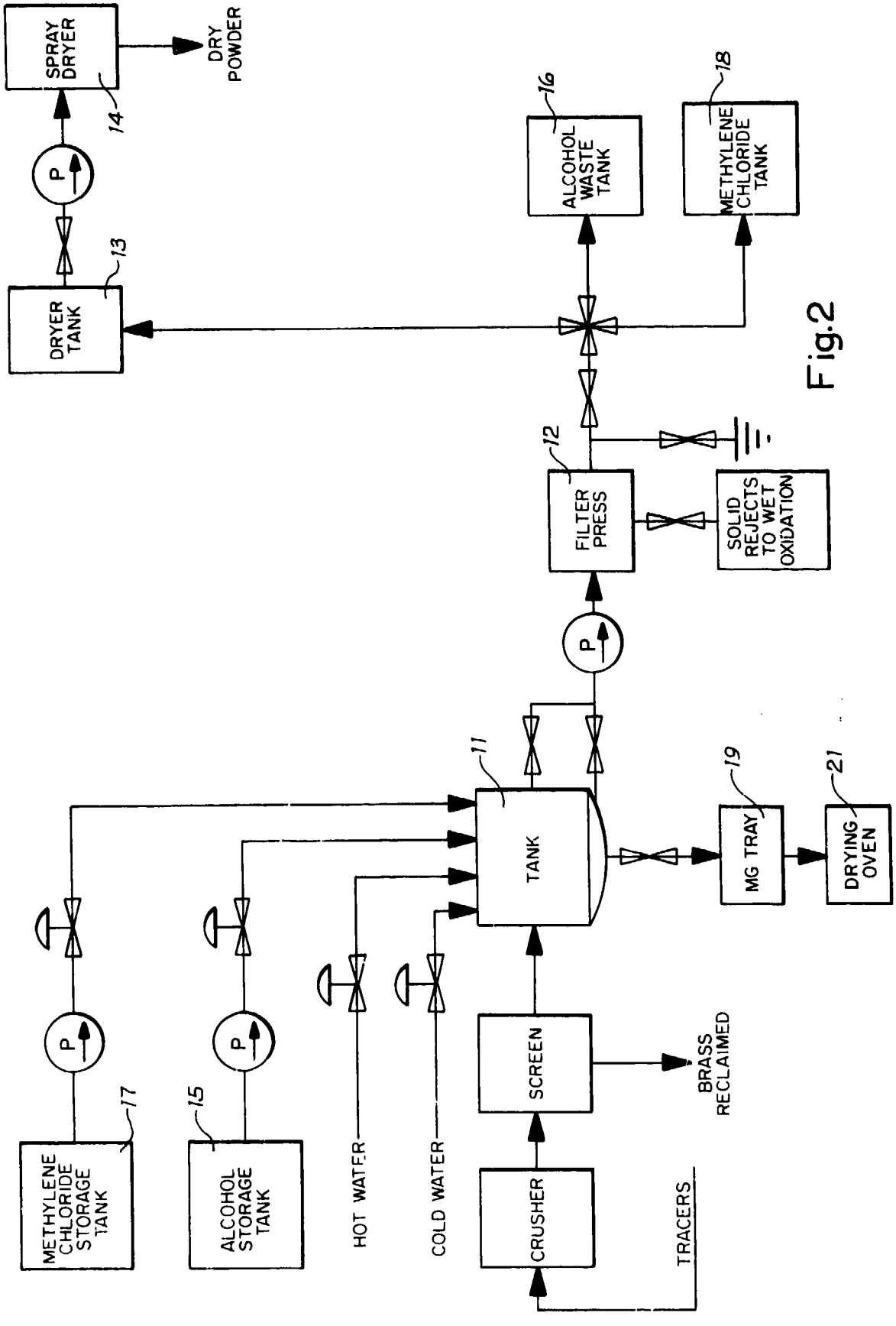

SPRAY DRYER
DRY POWDER
14
P
13
DRYER TANK
16
ALCOHOL WASTE TANK
18
METHYLENE CHLORIDE TANK
12
FILTER PRESS
SOLID REJECTS TO WET OXIDATION
P
11
TANK
19
MG TRAY
21
DRYING OVEN
P
17
METHYLENE CHLORIDE STORAGE TANK
P
15
ALCOHOL STORAGE TANK
HOT WATER
COLD WATER
SCREEN
BRASS RECLAIMED
CRUSHER
TRACERS

Fig.2

METHOD FOR DISPOSAL OF PYROTECHNIC WASTE

BACKGROUND OF THE INVENTION

The present invention relates to a method of disposing of pyrotechnic waste and more particularly to a method for disposing of tracer ammunition.

Most tracer compositions are made from varying percentages of the same basic materials and these are, in order of quantity, strontium nitrate, magnesium, strontium peroxide, polyvinyl chloride, calcium resinate, barium peroxide, oxamide, zinc stearate, polyethylene, strontium oxalate, and lead dioxide. The strontium nitrate and magnesium account for about 60 percent of the total. Present waste treatment methods used for disposing of tracer ammunition involve burning or chemical degradation of the pyrotechnic material and produces air and water pollution.

The method used for disposing of tracer material depends on the stage of the manufacturing process when the material is scrapped. Rejected finished tracer cartridges are burned in metal containers at a burning ground. If a batch of tracer material must be discarded, it is placed in oil and burned. Dry wastes spilled during the assembly process are collected by a vacuum system, under water, and the vacuum collectors are periodically dumped and the contents are treated with caustic, water and steam in a system of sumps. The waste from the sumps are taken by truck to basins on a high hill and the degraded material is leached to the soil. As the methods presently used put degraded pyrotechnic material into the air and water, these methods are ecologically unsounded and no longer desirable.

SUMMARY OF THE INVENTION

The present invention relates to a method for disposing of tracer ammunition having a pyrotechnic composition which is about 40 percent strontium nitrate and about 24 percent magnesium. The remaining materials are strontium peroxide, polyvinyl chloride, calcium resinate, barium peroxide, oxamide, zinc stearate, polyethylene, strontium oxalate and lead dioxide. The particular materials and percentages used depend on the caliber of the ammunition and also on the particular depot which is manufacturing the ammunition. Strontium nitrate is first removed from the pyrotechnic composition by immersing the composition in water sufficiently cold so that it will only dissolve strontium nitrate. The water solution is then filtered and evaporated to reclaim the strontium nitrate. The remaining ingredients are given successive washes in hot water, in ethyl alcohol and methylene chloride. The solution is decanted after each wash and the remaining material is magnesium, which is then dried and reclaimed for subsequent use as a pyrotechnic material.

It is therefore a general object of the present invention to provide an improved method for disposing of a pyrotechnic composition without creating pollution.

Other objects, advantages and novel features of the present invention will become apparent from the following detailed description of the invention when considered in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a flow-diagram showing the steps of the present invention; and

FIG. 2 is a diagram for a high production plant using the method of the present invention.

DESCRIPTION OF THE PREFERRED METHOD

Most tracer compositions are made from varying percentages of the same basic materials with strontium nitrate and magnesium accounting for about 60 percent of the total composition. In the present method, strontium nitrate and magnesium are reclaimed for use in other pyrotechnic compositions and thus the amount of pyrotechnic waste which is to be disposed is less than half. Additionally, the residual is primarily inert materials and is less hazardous than the original compositions.

Although specific materials and percentages vary for different types and sizes of tracer ammunition, the present method is designed so that all tracer compositions can be mixed together and be processed by a single method. This procedure is not only more economical, but prevents errors that could occur if a multiple number of processes were employed. The following examples show various compositions for tracer ammunition currently being manufactured by the military departments:

M62 Ammunition (7.62mm)

Strontium Nitrate	41.9%
Magnesium	23.1%
Strontium Dioxide	19.8%
Polyvinyl Chloride	12.9%
Calcium Resinate	2.3%

M196 Ammunition (5.56mm)

Strontium Nitrate	37.4%
Magnesium	26.0%
Strontium Dioxide	21.1%
Polyvinyl Chloride	11.5%
Calcium Resinate	1.8%
Barium Peroxide	1.1%
Lead Dioxide	1.1%

M25 Ammunition (.30 Cal.)

Strontium Nitrate	41.9%
Magnesium	22.6%
Strontium Dioxide	20.3%
Polyvinyl Chloride	12.9%
Calcium Resinate	2.3%

M48 Ammunition (.50 Cal.)

Strontium Nitrate	32.4%
Magnesium	23.9%
Strontium Dioxide	8.6%
Polyvinyl Chloride	6.9%
Calcium Resinate	2.8%
Barium Peroxide	23.5%
Strontium Oxalate	1.6%
Zinc Stearate	0.3%

M17 Ammunition (.50 Cal.)

Strontium Nitrate	41.8%
Magnesium	25.7%
Strontium Dioxide	5.9%
Polyvinyl Chloride	10.6%
Calcium Resinate	1.9%
Barium Peroxide	12.9%
Strontium Oxalate	1.1%
Zinc Stearate	0.1%

M242 Ammunition (20mm)

Strontium Nitrate	34.5%
Magnesium	19.8%
Strontium Dioxide	22.1%
Polyvinyl Chloride	12.6%
Calcium Resinate	4.3%
Oxamide	6.7%

M220 Ammunition (20mm)

Strontium Nitrate	35.5%
Magnesium	20.5%
Strontium Dioxide	29.7%

continued

M62 Ammunition (7.62mm)

Polyvinyl Chloride	11.0%
Calcium Resinate	1.3%

The present invention is illustrated by the following examples:

EXAMPLE I

Twenty-five grams of M62 Ammunition was processed in order to reclaim strontium nitrate and magnesium. After the pyrotechnic tracer material was separated from the cartridge, it was first washed with cold water (13° C) and the water solution of strontium nitrate was decanted. The solution was filtered to remove some floating material and then the water was removed by heating to reclaim strontium nitrate. The reclaimed strontium nitrate was analyzed and its purity was 97.8 percent.

The remaining pyrotechnic material was washed with hot water and the solution was decanted. Next the remaining material was washed with ethyl alcohol and the solution was decanted, and finally, the remaining material was washed with methylene chloride and the solution was decanted. The remaining ingredient, which was predominately magnesium, was dried and had a purity of 86.5 percent.

EXAMPLE II

Twenty-five grams of M196 Ammunition was processed as described in EXAMPLE I, with successive washes of cold water, hot water, ethyl alcohol and methylene chloride. The reclaimed strontium nitrate had a purity of 96.1 percent and the reclaimed magnesium had a purity of 79 percent.

EXAMPLE III

Twenty-five grams of M25 Ammunition was processed as described in EXAMPLE I, with successive washes of cold water, hot water, ethyl alcohol and methylene chloride. The reclaimed strontium nitrate had a purity of 97.8 prcent and the reclaimed magnesium had a purity of 89.6 percent.

EXAMPLE IV

Twenty-five grams of M48 Ammunition was processed as described in EXAMPLE I, with successive washes of cold water, hot water, ethyl alcohol and methylene chloride. The reclaimed strontium nitrate had a purity of 92.5 percent and the reclaimed magnesium had a purity of 71.5 percent.

EXAMPLE V

Twenty-five grams of M17 Ammunition was processed as described in EXAMPLE I, with successive washes of cold water, hot water, ethyl alcohol and methylene chloride. The reclaimed strontium nitrate had a purity of 95.6 percent and the reclaimed magnesium had a purity of 86.5 percent.

EXAMPLE VI

Twenty-five grams of M242 Ammunition was processed as described in EXAMPLE I, with successive washes of cold water, hot water, ethyl alcohol and methylene chloride. The reclaimed strontium nitrate had a purity of 96.1 percent and the reclaimed magnesium had a purity of 73.2 percent.

EXAMPLE VII

Twenty-five grams of M220 Ammunition was processed as described in EXAMPLE I, with successive washes of cold water, hot water, ethyl alcohol and methylene chloride. The reclaimed strontium nitrate had a purity of 96.1 percent and the reclaimed magnesium had a purity of 84.6 percent.

EXAMPLE VIII

Seventy-five grams each of tracer mixes from M62, M196, M25, M48, M17, M242 and M220 Ammunition was placed in a 2000 ml beaker and 1500 ml of cold water was added and the mixture stirred. The liquid solution was condensed on a hot plate and precipitated. The precipitate was oven dried and a yield of 73 percent of strontium nitrate was obtained. Next 1000 ml of hot water was added to the beaker and the solution was stirred and allowed to settle. The liquid was decanted. Then 1000 ml of ethyl alcohol were added to the beaker and the solution was stirred and allowed to settle. The liquid was decanted. Then 1000 ml of methylene chloride were added to the beaker, and the solution was stirred and allowed to settle. The reclaimed magnesium was dried in an oven and a yield of 69 percent of magnesium was obtained.

The reclaimed strontium nitrate and magnesium were combined with virgin strontium dioxide, polyvinyl chloride and calcium resinate to make a tracer material having a formula as listed-above for M62 Ammunition. The mix was pressed into pellets and topped with a starter mix. Identical pellets using all virgin material was also pressed as a control. Nine pellets using reclaimed strontium nitrate and magnesium were burned and compared with nine pellets made from virgin material. The following medians were obtained:

TABLE

	RECLAIMED MATL.	VIRGIN MATL.
Dominant Wave Length	599.1	600.6
% Purity	95.7	93.8
Candle Power	2001.0	2751.7
Burn Time	7.82 secs	8.57 secs
Foot Candle Seconds	1.57	2.35

When boiling water was added to the tracer mix, after having first decanted the cold water solution, some fizzing was experienced. When a lower temperatured water of between 70° and 85°C. was used, this fizzing was eliminated and the magnesium cleaned-up equally well.

Referring now to FIG. 2 of the drawings, there is shown a diagrammatic view for a production plant utilizing the process of the present invention. Waste tracers are crushed and screened to remove the pyrotechnic material which is introduced into an agitated tank 11. Pyrotechnic material left-over from batch mixes and that material collected by collectors can be added directly to the tank. First, cold water is added to the agitated tank 11. Agitation will wet down the solids and speed dissolution of the strontium nitrate. This solution is removed through an outlet above the bottom of tank 11, leaving behind the undissolved, sinking solids. The solution is pumped through filter press 12

where floating and suspended light-weight impurities, such as calcium resinate and decomposed oxides are removed. The clarified strontium nitrate solution is collected in tank **13** and then spray dried in spray dryer **14** to give a dry powder that can be used to produce more tracers.

Next, hot water is introduced into tank **11** and the hot water washes remove more of the material other than magnesium from the remaining solids. The hot water is decanted, filtered and the liquid discarded. Then, ethyl alcohol is pumped from tank **15** into tank **11** to dissolve additional materials. The alcohol is then decanted, filtered and collected in tank **16** for recycling or reprocessing. In addition to dissolving additional materials, ethyl alcohol prevents clumping of the material that occurs when a water wash is followed by a wash with methylene chloride.

Methylene chloride is then pumped from tank **17** into tank **11** to dissolve the last of the impurities from the magnesium. The methylene chloride is decanted, filtered and stored in tank **18** for recycling or reprocessing. The bottom valve of tank **11** is then opened and magnesium flows onto trays **19** to be dried in a vented oven **21**. The sludge collected by filter press **12** is washed to a storage drum to await shipment to a wet oxidation facility.

By using the present method, tracer mixes from various types of ammunition can be handled together thus significantly reducing labor costs. Also, the likelihood of failures is decreased when operators do not have to make decisions as to which process to use or where to place scrap.

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.

We claim:

1. A method for disposing of tracer ammunition pyrotechnic material containing strontium nitrate, magnesium, strontium peroxide, polyvinyl chloride, calcium resinate and other pyrotechnic materials, with the combined percentages of strontium nitrate and magnesium comprising at least 60 percent of the total percentage of said tracer ammunition pyrotechnic material, comprising the steps of

first immersing said tracer ammunition pyrotechnic material in water sufficiently cold to dissolve only strontium nitrate,

then decanting the water solution of strontium nitrate and evaporating the water to reclaim strontium nitrate,

then removing all materials of said tracer ammunition pyrotechnic material other than magnesium by successive washes of hot water and solvents, and

then drying the remaining magnesium for reuse as a pyrotechnic material.

2. A method of disposing of tracer ammunition pyrotechnic material as set forth in claim **1** wherein said tracer ammunition pyrotechnic material is first immersed in water having a temperature of about 13° C.

3. A method of disposing of tracer ammunition pyrotechnic material as set forth in claim **1** wherein said water solution of strontium nitrate is filtered before evaporating the water to reclaim strontium nitrate.

4. A method of disposing of tracer ammunition pyrotechnic material as set forth in claim **1** wherein said successive washes are a water wash with water having a temperature within the range of 70°–85° C., followed next by a wash with ethyl alcohol and then by a wash with methylene chloride.

* * * * *

United States Patent [19]

Dare

[11] **3,910,190**

[45] **Oct. 7, 1975**

[54] **HAND-HELD SIGNALING DEVICE HAVING MANUAL FIRING MEANS**

[75] Inventor: **Sherman E. Dare**, Wheatland, Ind.

[73] Assignee: **The United States of America as represented by the Secretary of the Navy**, Washington, D.C.

[22] Filed: **Apr. 22, 1974**

[21] Appl. No.: **463,077**

[52] **U.S. Cl.** ..... **102/37.4**; 42/1 Z; 102/37.8

[51] **Int. Cl.**[2] **F42B 4/26**

[58] **Field of Search** ..... 102/37.4, 31, 37.8, 90; 42/1 Z, 1 R

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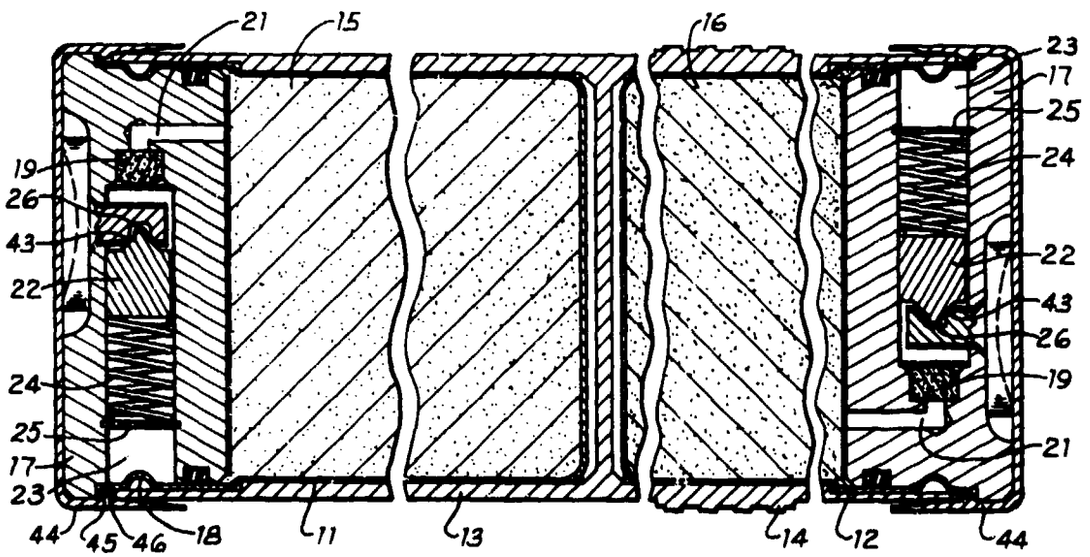
Primary Examiner—Harvey E. Behrend
Assistant Examiner—C. T. Jordan
Attorney, Agent, or Firm—R. S. Sciascia; Paul S. Collignon

[57] **ABSTRACT**

A hand-held pyrotechnic device having a housing containing a quantity of pyrotechnic material, a primer for igniting the pyrotechnic material, a spring loaded firing pin for detonating said primer and a slidable barrier for restraining the firing pin until the barrier is first slidably moved and then pivotally moved from the path of the firing pin.

4 Claims, 6 Drawing Figures



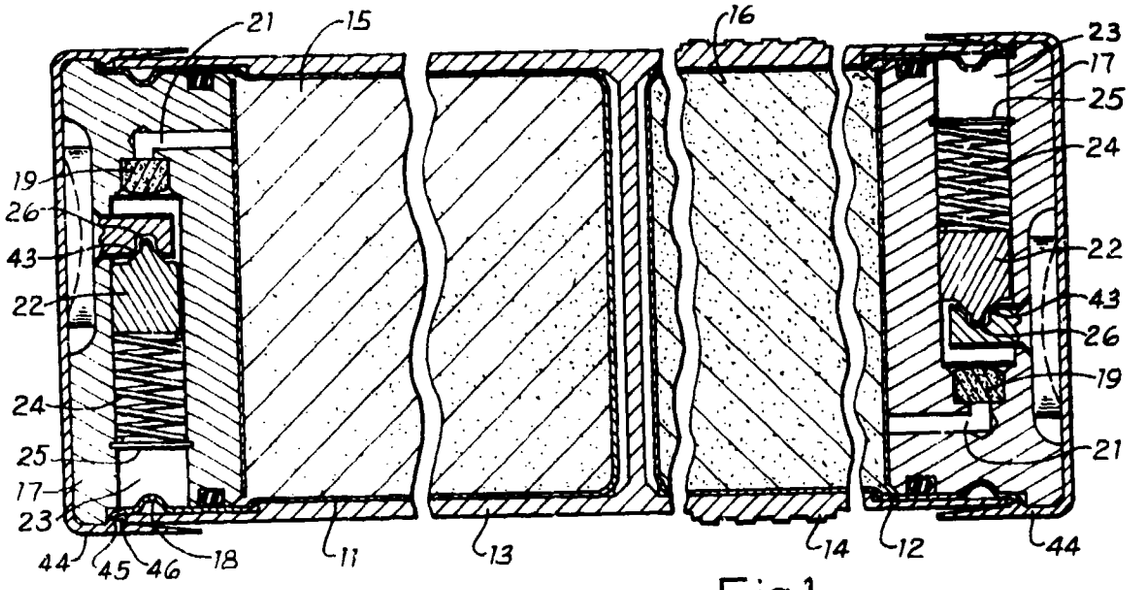


Fig.1

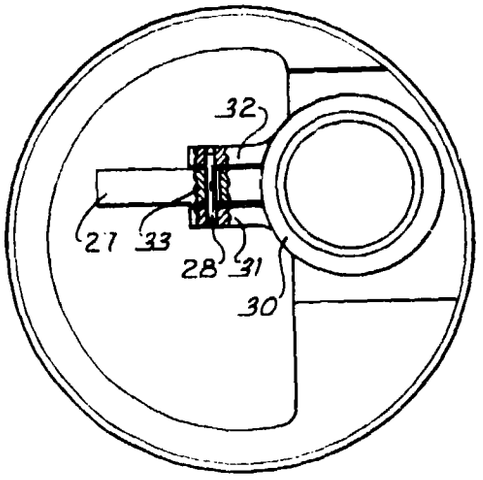


Fig.2

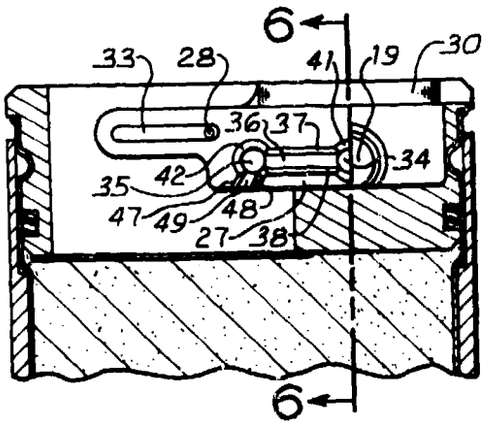


Fig.3

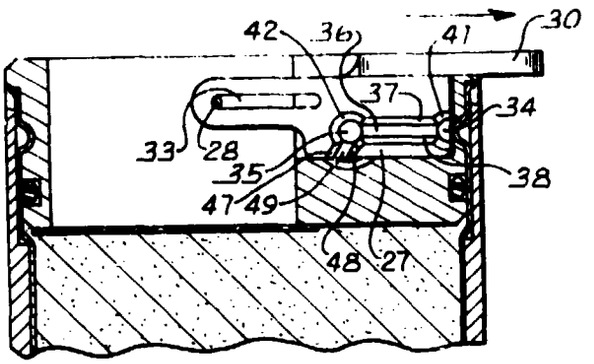


Fig.4

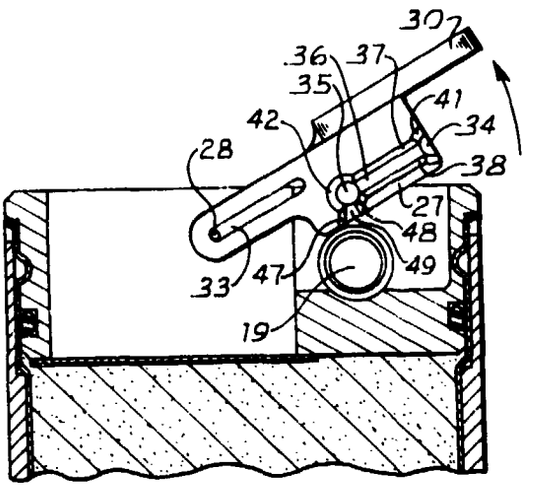


Fig.5

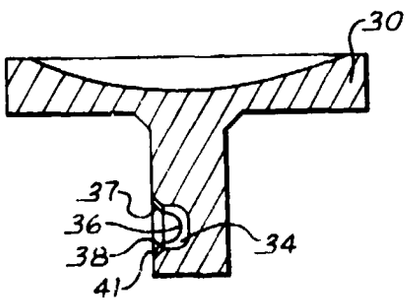


Fig.6

HAND-HELD SIGNALING DEVICE HAVING MANUAL FIRING MEANS

BACKGROUND OF THE INVENTION

The present invention relates to a hand-held signaling device and more particularly to hand-held signaling device which can be readily actuated by using only one hand

Various types of hand-held pyrotechnic devices are used by the military departments primarily for signaling purposes In one type of Navy flare, which is sometimes referred to as a Railroad Warning flare, ignition is made by a friction igniter. One end of the flare is closed by a cover which has an exterior coating of the same abrasive material found on the side of a safety-match box. Beneath the cover is a small cotton wad that protects the friction igniter which is impregnated in a cloth substance covering the pyrotechnic composition. This friction igniter is the same material as is used in the head of a safety match. The signal is ignited by scraping the inverted cover across the friction igniter.

In another type of friction ignition device, a pull wire is provided to ignite a primer. A sharp, quick pull on a ring moves a friction wire through igniter material and causes ignition thereof, and this igniter material, in turn, ignites either a smoke mixture, for day use, or a pyrotechnic candle, for night use.

While the above-described hand-held ignition devices are still being used by the military departments, reliability is not as good as desired and also ignition of these devices normally require the use of both hands. Accordingly, in the event a person might be in the water and holding onto a raft, or in the event a person might be injured, ignition devices which require the use of both hands are undesirable.

A third, and more sophisticated triggering device, utilizes a spring actuated striker assembly. One such device is shown in U.S. Pat. No. 3,167,050, which issued Jan 26, 19[illegible] to Glenn C. Johnson. In this patented device, a striker assembly is maintained in a cocked position by a cover that is slidably attached to the container. The cover can be removed by pushing sideways, and as the cover becomes disengaged, the striker assembly is actuated to ignite a primer which, in turn, ignites the signal producing composition. This device is constructed so that it can be operated by using only one hand

SUMMARY OF THE INVENTION

The present invention provides a container having a smoke producing [illegible] position [illegible] ne end and a flare composition [illegible] the other [illegible]. Separate, but identical, ignition devices are provided for each composition. A primer is positioned near the pyrotechnic composition for ignition and a spring loaded firing pin is provided for detonating the primer A barrier plate or stop is positioned for restraining the firing [illegible] ntil it is desired to ignite the pyrotechnic comp[illegible], whereupon the barrier is first slidably moved in a direction transverse to the longitudinal axis of the firing pin and then pivotally moved to release the firing pin. This dual motion, which can readily be performed by using one-hand, prevents accidental ignition of the device.

It is therefore a general object of the present invention to provide an improved firing device for a hand-held pyrotechnic signal

Other objects and advantages of the present invention will be readily appreciated as the same becomes better understood be reference to the following detailed description when considered in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a longitudinal sectional view of a preferred embodiment of the present invention;

FIG. 2 is an end view, with cap removed, and partially in section of the preferred embodiment of FIG. 1;

FIG. 3 is a partial side view showing a firing pin barrier;

FIG. 4 is a partial side view showing a barrier in a pivotal position;

FIG. 5 is a partial side view showing a barrier in a clearance position; and

FIG. 6 is a sectional view of a finger lever.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawing, there is shown a pyrotechnic device for providing both smoke and light. The smoke producing section has an outer container 11 and the light producing section has an outer container 12. The two containers 11 and 12 are enclosed in a cylindrical case 13 and an identification band 14 is placed around container 13 so that the flare section can be identified in the dark. A smoke mixture 15 is provided in container 11 and a flare composition 16 is provided in container 12. By way of example, smoke mixture 15 and flare composition 16 might be formulated as described in U.S. Pat. No. 3,167,050, which issued Jan. 26, 1965, to G. C. Johnson.

Separate ignition devices are provided for the smoke composition and the flare composition, and only the ignition device for smoke composition 15 will be described. As ignition housing 17 is provided in the end of container 11 and is held in position by means of crimp 18. A primer 19 is positioned in housing 17 and a passage 21 is provided in housing 17 so that, upon detonation of primer 19, the heat and flame from primer 19 will ignite smoke mixture 15. A firing pin 22, having a tang 26, is slidably positioned in bore 23 in housing 17 and bore 23 is aligned with the bore that retains primer 19. A spring 24 is provided in bore 23 and is retained by retaining ring 25. Spring 24 engages the end on firing pin 22 opposite to tang 26, and spring 24 provides the driving force so that firing pin 22 can detonate primer 19. A barrier plate 27 is attached to housing 17 by a pin 28 which is attached to arms 31 and 32 on housing 17. Barrier plate 27 is positioned between arms 31 and 32 and pin 28 passes through slot 33 in barrier plate 27 so that barrier plate 27 can travel the length of slot 33. A finger lever 30 is provided on top of barrier plate 27 to facilitate movement of barrier plate 27. Detent holes 34 and 35 are provided in the side of barrier plate 27 and are connected by a relief groove 36 having tapered portions 37 and 38 at the top edge thereof. Tapered portions 41 and 42 surround detent holes 34 and 35, respectively, and the tapered surface 43 of firing pin 22 contacts these tapered surfaces. A safety cover 44 is provided on both ends of container 13 in order to prevent accidental ignition of the pyrotechnic compositions. By way of example, cover 44 might be made of a plastic material and have nodules

45 that engage with a groove 46 formed between container 13 and housing 17.

OPERATION

Assuming it is desired to ignite the smoke mixture 15 in container 11, safety cover 44 is removed thereby permitting access to finger lever 30. As barrier plate 27 starts its outward movement, tapered surface 43 which has been engaging tapered portion 41, moves to engage tapered surfaces 37 and 38, thereby slightly compressing spring 24 as firing pin 22 moves slightly outwardly. Barrier plate 27 moves outwardly until pin 28 is at the end of slot 33, as shown in FIG. 4 of the drawings, and tapered surface 43 on firing pin 22 is engaged with tapered portion 42 surrounding hole 35. At this point, barrier plate 27 can be pivoted about pin 28 and, during pivoting, tapered portion 43 engages tapered surfaces 47 and 48 that are contiguous to groove 49. When barrier plate 27 pivots about thirty degrees about pin 28, as shown in FIG. 5 of the drawings, barrier plate 27 clears firing pin 22 and spring 24 drives firing pin 22 into primer 19, thereby causing detonation of primer 19. Heat and flame from primer 19 passes through passage 21 and causes ignition of smoke mixture 15.

It can thus be seen that the present invention provides a hand-held signaling device that can be readily ignited by using only one hand. 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.

I claim:

1. A signaling device comprising,

an outer container,

at least one inner container within said outer container having pyrotechnic composition therein,

an ignition housing in one end of said outer container,

a primer in said ignition housing,

a firing pin slidably mounted in said ignition housing and having a tang on one end adaptable for engaging said primer, and

a barrier plate slidably and pivotally attached to said ignition housing and engageable with the tang end of said firing pin whereby said barrier plate must be first slidably moved and then pivotally moved to release said firing pin for detonating said primer.

2. A signaling device as set forth in claim 1 wherein said barrier plate has a slot therein and having a pin attached to said ignition housing and passing through said slot.

3. A signaling device as set forth in claim 1 wherein said barrier plate has first and second detent holes therein and a groove connecting said detent holes, said firing pin being engageable with said detent holes and said groove.

4. A signaling device as set forth in claim 1 having one inner container of smoke composition and one container of flare composition.

* * * * *

United States Patent [19]

Beatty et al.

[11] **3,908,550**

[45] **Sept. 30, 1975**

[54] **ONE HAND OPERABLE DISTRESS SIGNAL**

[75] Inventors: **Bobby D. Beatty**, Bloomington; **Stanley J. Herold**, Switz City; **Donald E. LaGrange**, Washington; **David E. Sanders**, Bloomington, all of Ind.

[73] Assignee: **The United States of America as represented by the Secretary of the Navy**, Washington, D.C.

[22] Filed: **Apr. 10, 1974**

[21] Appl. No.: **459,768**

[52] **U.S. Cl.** **102/37.4**; 102/37.8

[51] **Int. Cl.**[2] **F42B 4/20**

[58] **Field of Search** 102/37.4, 31, 37.6, 37.8, 102/90; 116/DIG. 40

[56] **References Cited**

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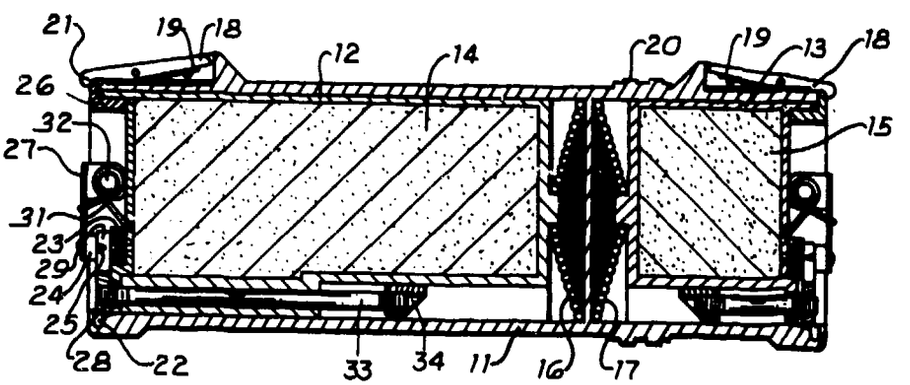
2,595,939	5/1952	Griffith	102/37.4
3,167,050	1/1965	Johnson	102/90
3,224,232	12/1965	Dzvonik	102/37.4

Primary Examiner—Harvey E. Behrend
Assistant Examiner—C. T. Jordan
Attorney, Agent, or Firm—R. S. Sciascia; Paul S. Collignon

[57] **ABSTRACT**

A hand-held pyrotechnic device having a housing containing a quantity of pyrotechnic material, a primer for igniting the pyrotechnic material, a pivotally mounted firing pin for detonating the primer, a spring for actuating the firing pin and a manually actuated push-rod for pivoting the firing pin and increasing spring pressure and then releasing the firing pin after a predetermined amount of pivoting of the firing pin.

4 Claims, 4 Drawing Figures



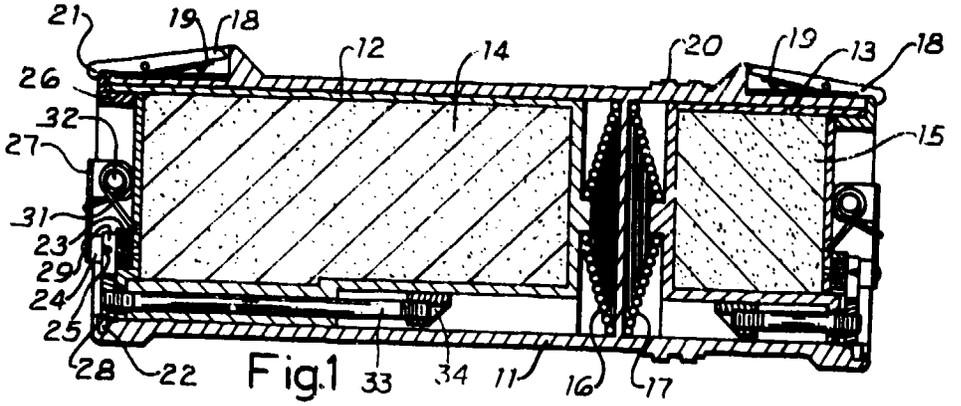


Fig.1

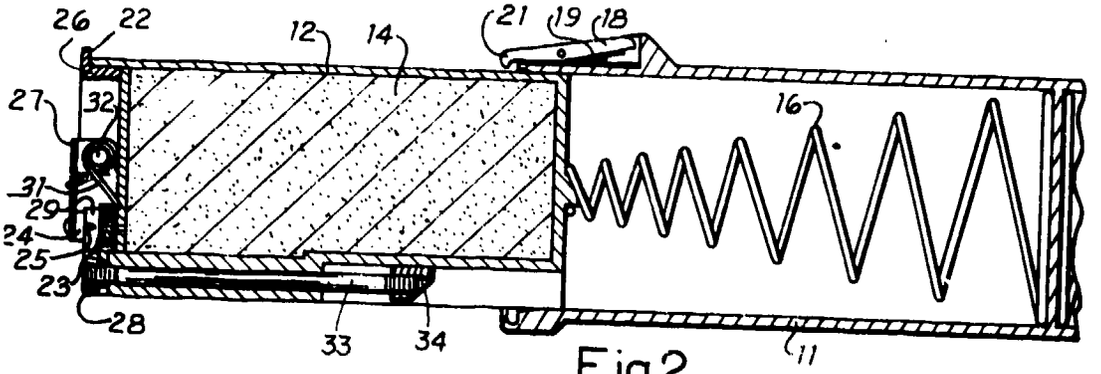


Fig.2

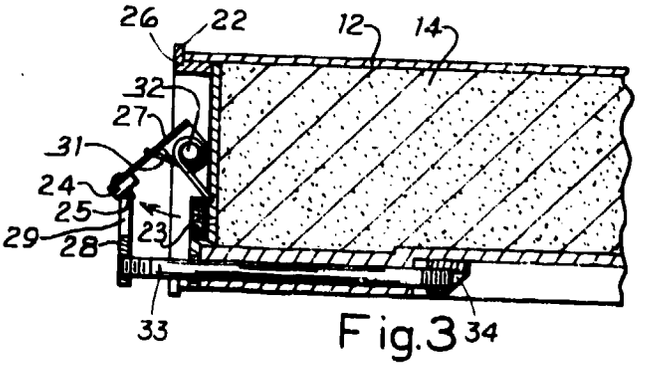


Fig.3

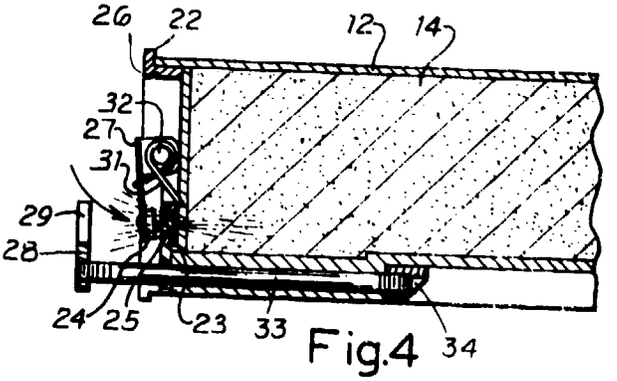


Fig.4

ONE HAND OPERABLE DISTRESS SIGNAL

BACKGROUND OF THE INVENTION

The present invention relates to a hand-held signaling device and more particularly to a device for producing either smoke or light and which can be readily actuated by using only one hand.

Various types of hand-held pyrotechnic devices are used by the military departments primarily for signaling purposes. In one type of Navy flare, which is sometimes referred to as a Railroad Warning flare, ignition is made by a friction igniter. One end of the flare is closed by a cover which has an exterior coating of the same abrasive material found on the side of a safety-match box. Beneath the cover is a small cotton wad that protects the friction igniter which is impregnated in a cloth substance covering the pyrotechnic composition. This friction igniter is the same material as is used in the head of a safety match. The signal is ignited by scraping the inverted cover across the friction igniter.

In another type of friction ignition device, a pull wire is provided to ignite a primer. A sharp, quick pull on a ring moves a friction wire through igniter material and causes ignition thereof, and this igniter material, in turn, ignites either a smoke mixture, for day use, or a pyrotechnic candle, for night use.

While the above-described hand-held ignition devices are still being used by the military departments, reliability is not as good as desired and also ignition of these devices normally require the use of both hands. Accordingly, in the event a person might be in the water and holding onto a raft, or in the event a person might be injured, ignition devices which require the use of both hands are undesirable.

A third, and more sophisticated triggering device, utilizes a spring actuated striker assembly. One such device is shown in U.S. Pat. No. 3,167,050, which issued Jan. 26, 1965, to Glenn C. Johnson. In this patented device, a striker assembly is maintained in a cocked position by a cover that is slidably attached to the container. The cover can be removed by pushing sideways, and as the cover becomes disengaged, the striker assembly is actuated to ignite a primer which, in turn, ignites the signal producing composition. This device is constructed so that it can be operated by using only one hand.

SUMMARY OF THE INVENTION

The present invention provides a container having a smoke-producing composition in one end and a flare composition in the other end. Each pyrotechnic composition is contained in a separate inner container which in turn are housed in a telescoping fashion in each end of an outer container. A spring is provided for extending each inner container and a locking lever is provided for retaining the inner container inside the outer container. Once the inner container is extended, a manual firing lever is accessible for actuating a firing pin which detonates a primer and, in turn, ignites a pyrotechnic material

It is therefore a general obejct of the present invention to provide an improved firing device for a hand-held pyrotechnic signal.

Other objects and advantages of the present invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a longitudinal sectional view of a preferred embodiment of the invention;

FIG. 2 is a longitudinal sectional view of a preferred embodiment showing a smoke container in an extended position;

FIG. 3 is a partial sectional view showing a firing pin being actuated; and

FIG. 4 is a partial sectional view showing a firing pin detonating a primer.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawing there is shown a cylindrical housing **11** that has slidably mounted therein containers **12** and **13**. A smoke mixture **14** is provided in container **12** and a flare composition **15** is provided in container **13**. By way of example, smoke mixture **14** and flare composition **15** might be formulated as described in U.S. Pat. No. 3,167,050, which issued Jan. 26, 1965, to G. C. Johnson. A pair of springs **16** and **17** are provided for extending containers **12** and **13**, respectively, and arming levers **18**, which are pivotally connected to housing **11**, are provided for retaining the containers within housing **11**. Springs **19** are provided for keeping levers **18** in a latched position, with hook **21** on lever **18** being engaged with a forward lip **22** on the covers **26** of the containers. A boss **20** is provided around container **11** at the flare end in order to orient the housing in darkness.

As the firing mechanism is the same for both the smoke composition and the flare composition, only the mechanism for firing the smoke composition will be discussed. A primer **23** is provided for igniting smoke composition **14**, and a firing pin **24**, having a tang **25** thereon, is rotatably attached to cover **26** which closes container **12** by means of arm **27**. A barrier **28**, having a slot **29** therein, is positioned between firing pin **24** and primer **23**, with tang **25** being positioned in slot **29**. A spring **31** is positioned around shaft **32** about which arm **27** is rotatable, and spring **31** biases firing pin **24** against barrier **28**. Barrier **28** is threadedly attached to shaft **33** which is slidably mounted in container **12**, and a firing button **34** is attached to one end of shaft **33** to facilitate actuation of shaft **33**.

OPERATION

In operation, an operator, such as a downed pilot, first determines which pyrotechnic composition is to be ignited. During daylight hours, smoke composition **14** would normally be ignited and, during darkness, the flare composition would be ignited. In darkness, boss **20** helps identify the end of container **11** housing the flare composition.

Assuming it is desired to ignite smoke composition **14**, lever **18** is pivotally actuated so that hook **21** disengages lip **22** on the covers **26** of container **12** and spring **16** extends container **12**, as shown in FIG. 2 of the drawing. With container **12** being extended, firing button **34** is now accessible. When ignition of smoke composition **14** is desired, firing button **34** is pushed outwardly and shaft **33** is slidably moved in container **12**. Barrier **28**, which is threadedly attached to the end of shaft **33**, moves outwardly and causes arm **27** holding

firing pin **24** to pivot about shaft **32**. Slot **29** in barrier **28** prevents tang **25** on firing pin **24** from binding the barrier **28**, as barrier **28** moves linearly and firing pin **24** moves in an arcuate path. As arm **27** rotates, spring **31** becomes tightened and, upon disengagement of barrier **28** with firing pin **24**, firing pin **24** is driven by spring **31** in a reverse direction to detonate primer **23** which, in turn, ignites smoke composition **14**.

It can thus be seen that the present invention provides a signaling device which can readily be actuated by using one hand. 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.

We claim:

1. A hand-held signaling device comprising,

an outer container opened at both ends,

first and second inner containers within said outer container, said first container having a smoke composition therein and being extendable through one end of said outer container, and said second container having a flare composition therein and being extendable through the other end of said outer container,

first and second springs for extending portions of said first and second inner containers, respectively, outwardly from said outer container,

latching means pivotally attached to said outer container for releasably retaining said inner containers within said outer container,

first and second primers for igniting each said composition,

first and second firing pins pivotally connected to said first and second inner containers, respectively, for detonating said primers, and

first and second manually-actuated means for triggering said first and second firing pins, respectively.

2. A hand-held signaling device as set forth in claim **1** wherein said first and second manually-actuated means are attached to said first and second inner containers and surrounded by said outer container when said inner containers are retained in said outer container thereby preventing actuation of said firing pins.

3. A hand-held signaling device as set forth in claim **1** wherein each said manually-actuated means includes a shaft slidably mounted to an inner container and having a barrier attached to one end of said shaft, said barrier being positioned between a firing pin and a primer when said inner container is positioned within said outer container and said barrier being adaptable for rotating said firing pin.

4. A hand-held signaling device as set forth in claim **3** wherein each said firing pin is biased by a spring wherein after a predetermined amount of rotation of a firing pin in one direction by linear movement of said barrier, said firing pin is disenguged from said barrier and rotated by said spring in an opposite direction to detonate a primer.

* * * * *

United States Patent [19]

Musselman et al.

[11] **3,897,237**

[45] **July 29, 1975**

[54] **PROCESS FOR DISPOSING OF PYROTECHNIC FLARES**

[75] Inventors: **Kenneth A. Musselman**, Logootee, **James E. Short, Jr.**, Switz City, both of Ind.

[73] Assignee: **The United States of America as represented by the Secretary of the Navy**, Washington, D.C.

[22] Filed: **Aug. 2, 1974**

[21] Appl. No.: **494,131**

[52] **U.S. Cl.** **71/1**; 71/58

[51] **Int. Cl.²** **C05C 5/02**

[58] **Field of Search** 23/266; 149/61; 102/24; 71/1, 25, 58

[56] **References Cited**

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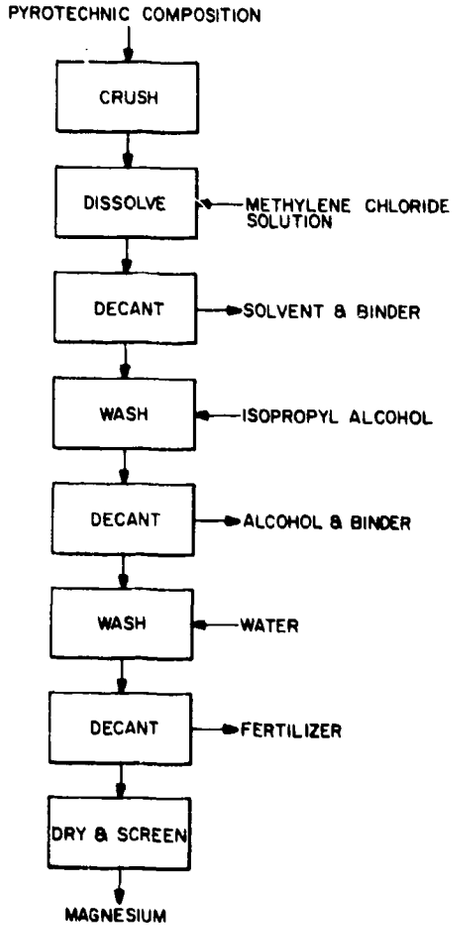
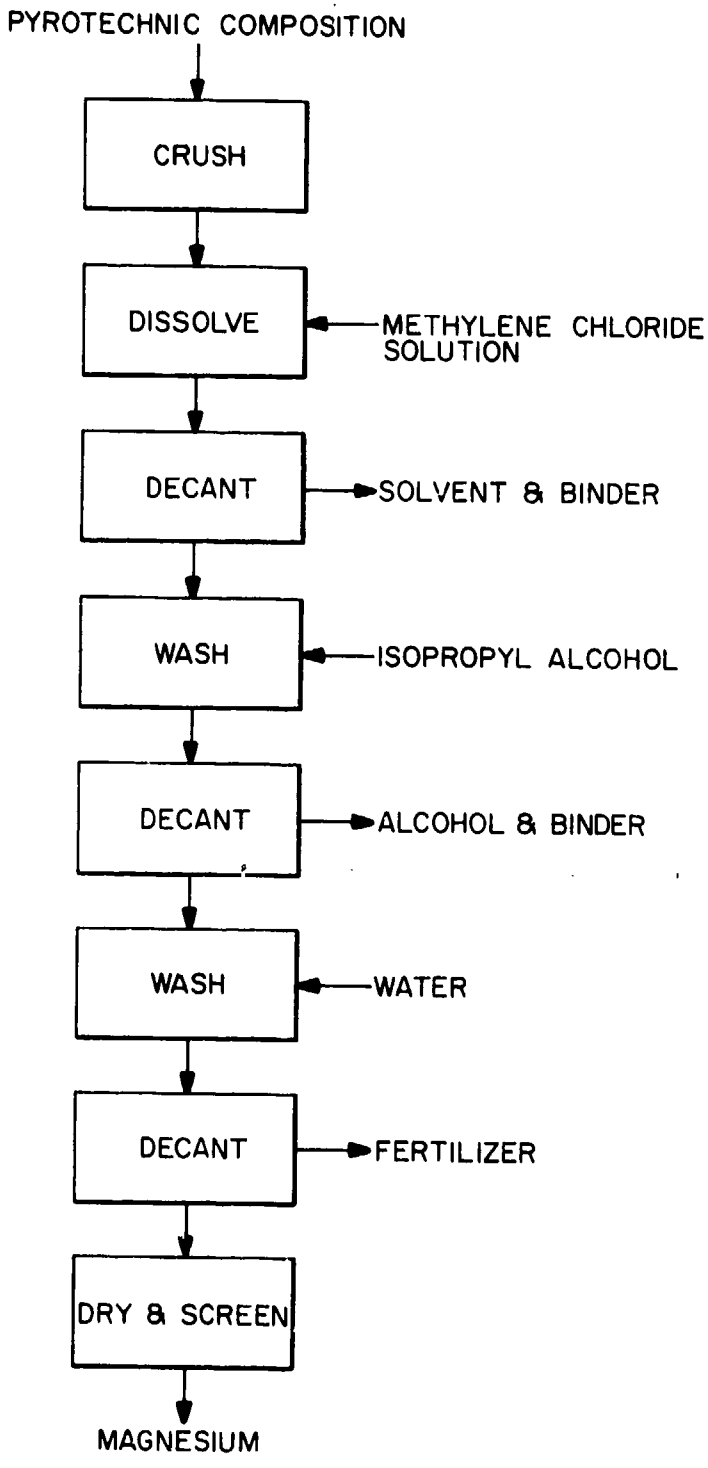
Primary Examiner—Frank A. Spear, Jr.
Assistant Examiner—Ferris H. Lander
Attorney, Agent, or Firm—R. S. Sciascia; Paul S. Collignon

[57] **ABSTRACT**

A process for the disposal of pyrotechnic flares comprised essentially of magnesium, sodium nitrate and a binder. The flare is crushed and then soaked in a solvent which softens and dissolves the binder material. The dissolved binder and solvent is decanted and the remaining magnesium and sodium nitrate are washed in water which dissolves the sodium nitrate. The aqueous solution of sodium nitrate is removed and is useful as a fertilizer. The remaining magnesium is dried and screened and is reusable as an ingredient in a pyrotechnic device.

5 Claims, 1 Drawing Figure




PYROTECHNIC COMPOSITION
CRUSH
DISSOLVE
METHYLENE CHLORIDE SOLUTION
DECANT
SOLVENT & BINDER
WASH
ISOPROPYL ALCOHOL
DECANT
ALCOHOL & BINDER
WASH
WATER
DECANT
FERTILIZER
DRY & SCREEN
MAGNESIUM

PROCESS FOR DISPOSING OF PYROTECHNIC FLARES

BACKGROUND OF THE INVENTION

The invention relates to a method for disposing of pyrotechnic flares and more particularly to a non-polluting method of disposing of flares comprised of magnesium, sodium nitrate and a binder and also for a method of disposing of waste materials which come from the manufacture of such flares.

It is necessary to dispose of waste pyrotechnic flare compositions as its storage is both costly and hazardous. Waste flare composition may either be bulk composition, left over from a production run or might be from defective illuminating flare candles. At one Naval Ammunition Depot, for example, over 900 pounds of pyrotechnic bulk production wastes were accumulated each day during a peak production period.

Heretofore the main disposal method for such pyrotechnic waste was to burn the waste in an open buring-pit in a sparsely populated area. In some cases, disposable of unserviceable items was accomplished by dumping at sea. Both methods, however, are undesirable because of pollution to either the air or water.

SUMMARY OF THE INVENTION

The present invention relates to a process for disposing of pyrotechnic compositions comprised of magnesium, sodium nitrate and a binder which is either an unsaturated polyester or an epoxy. The material is first crushed and then placed in a solvent, such as a methylene chloride based stripper material, and allowed to soak until the binder becomes soft and dissolves. The solvent and dissolved binder are then decanted off and the remaining ingredients are washed in water which dissolves the sodium nitrate. The aqueous solution of sodium nitrate is removed and is useful as a fertilizer. The remaining magnesium is then dried and screened and is reusable as an ingredient in a pyrotechnic device.

It is therefore a general object of the present invention to provide a method for disposing of a flare composition which is safe and non-polluting of the environment.

Other objects, advantages and novel features of the present invention will become apparent from the following detailed description of the invention when considered in conjunction with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

The FIGURE of the drawing is a block diagram showing the steps of a preferred method of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In the disposal method of the present invention, the three ingredients of the flare are first separated and then disposed of in an ecologically permissible and useful manner. By way of example, a flare composition might be comprised, by weight, of about 58 percent of magnesium, about 38 percent of sodium nitrate and about 4 percent of a binder. The binder is either an epoxy or an unsaturated polyester.

Prior to separation of the three basic ingredients of the composition, the pyrotechnic composition is first crushed by suitable means, such as by a hydraulically operated crushing blade. When waste production material is being processed, it can be directly placed into a crushing device, however, when a flare is to be processed, the aircraft parachute flare and related hardware are first removed and then the paper tube surrounding the candle composition is removed. After crushing, the candle pieces or the waste composition pieces are fed into a mixing tank and allowed to soak in a solvent solution for about 30 minutes. Preferably the pieces and solvent solution are stirred at about 500–600 rpm, using an air operated mixing motor. One solvent used successfully is a methylene chloride based stripper which is comprised, by weight, of about 25 percent methylene chloride, about 25 percent isopropyl alcohol and about 50 percent water. The reaction of this solvent with the binder causes the hardened binder to soften and separate from the magnesium and sodium nitrate. The solvent and dissolved binder are decanted-off and that portion of the binder that is not removed by the solvent is washed away by isopropyl alcohol.

The remaining ingredients are next given a water wash which dissolves sodium nitrate. The ingredients are washed for about 15 minutes and the solution is agitated at about 500-600 rpm. The aqueous solution of sodium nitrate is filtered and the aqueous solution is useful as a fertilizer. Water does not vigorously attack the magnesium. In actuality, magnesium decomposes water slowly because its hydroxide, which results from the reaction:

$$(1)\ Mg + 2HOH \rightarrow Mg(OH)_2 + H_2$$

is insoluble and once the hydroxide has been formed on the surface, the hydroxide hinders any further attack on the magnesium. After the aqueous solution of sodium nitrate is removed, the remaining ingredient, magnesium is dried by placing in open pans and heated at about 140° F., in a vented oven. The dried magnesium is screened through a No. 20 (841 micron) sieve and the magnesium passing through the sieve is useful as a fuel in pyrotechnic devices. In tests conducted at the Naval Ammunition Depot, Crane, Indiana, laboratory analysis of the screened magnesium indicated that the screened product was between 91 and 96 percent magnesium, and the product was successfully used in the manufacture of flares.

It can thus be seen that the present invention provides a disposal method for a pyrotechnic composition which does not pollute the environment. Further, that a portion of the ingredients of a pyrotechnic composition are recycled to provide useful end products.

Obviously may 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.

We claim:

1. A process for isolating and disposing of the chemical ingredients in illuminating flares comprised of magnesium, sodium nitrate, and a binder, said process comprising,

first crushing said chemical ingredients,

then dissolving said binder in a solvent,

then decanting to remove said solvent and the dissolved binder,

then washing the remaining chemical ingredients in water to dissolve sodium nitrate,

then decanting the aqueous solution of sodium nitrate for use as a fertilizer, and

then drying and screening the remaining ingredients for use as a fuel in pyrotechnic devices.

2. A process for isolating and disposing of the chemical ingredients in illuminating flares as set forth in claim 1 wherein said solvent is an aqueous solution of methylene chloride comprised, by weight, of about 25 percent of methylene chloride, about 25 percent of isopropyl alcohol and about 50 percent of water.

3. A process for isolating and disposing of the chemical ingredients in illuminating flares as set forth in claim 1 wherein the step of first decanting to remove said solvent and the dissolved binder is followed by washing the remaining ingredients in isopropyl alcohol to remove any binder not dissolved by said solvent.

4. A process for isolating and disposing of the chemical ingredients in illuminating flares as set forth in claim 1 wherein said solvent is agitated for about 30 minutes.

5. A process for isolating and disposing of the chemical ingredients in illuminating flares as set forth in claim 4 wherein said water is agitated for about 15 minutes.

* * * * *

United States Patent [19]

Laswell et al.

[11] **3,829,146**

[45] **Aug. 13, 1974**

[54] **DELAYED PARACHUTE DISCONNECT**

[75] Inventors: **John E. Laswell**, Bloomington; **John E. Wildridge**, Washington, both of Ind.

[73] Assignee: **The United States of America as represented by the Secretary of the Navy**, Washington, D.C.

[22] Filed: **July 30, 1973**

[21] Appl. No.: **383,841**

[52] **U.S. Cl.** ..... **294/83 A**, 244/149

[51] **Int. Cl.** **B64d 17/38**

[58] **Field of Search** ..... 294/83; 244/149, 150, 151; 24/201 D, 201 TR, 201 P, 241 SL, 241 PS

[56] **References Cited**

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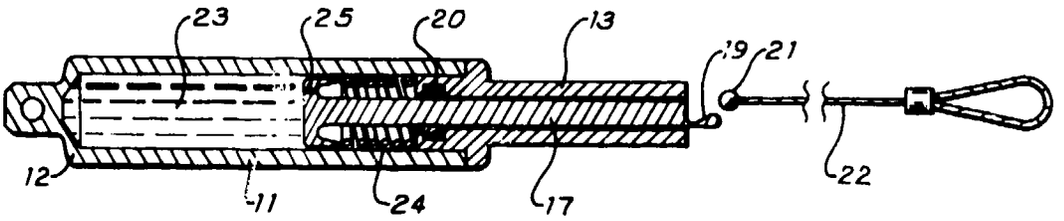
Primary Examiner—Richard A. Schacher
Assistant Examiner—James L. Rowlands
Attorney, Agent, or Firm—R. S. Sciascia; Paul S. Collignon

[57] **ABSTRACT**

A delayed parachute disconnect having a piston slidably mounted in a cylinder having fluid therein. One end of the piston is releasably connected to a pulling element which automatically releases upon clearance from the cylinder. The piston is provided with an orifice and the speed of the piston is controlled by the fluid escaping through the orifice.

1 Claim, 3 Drawing Figures



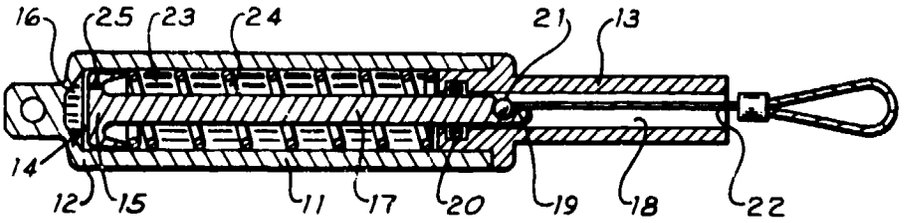


Fig.1

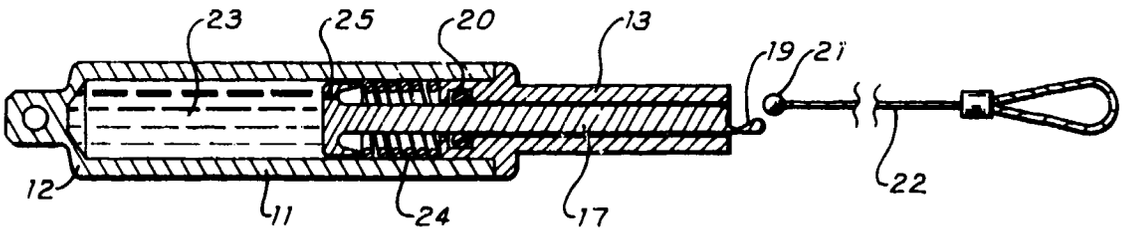


Fig.2

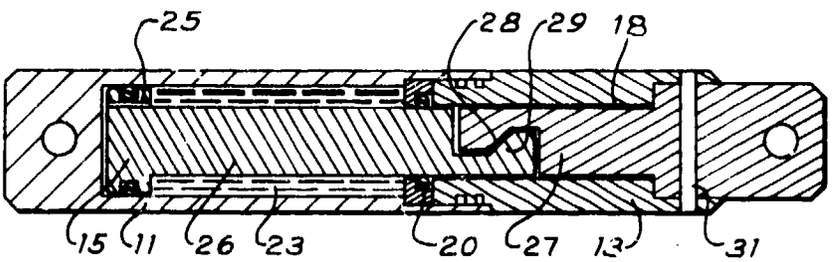


Fig.3

DELAYED PARACHUTE DISCONNECT

BACKGROUND OF THE INVENTION

The present invention relates to a delayed parachute disconnect and particularly to a delayed parachute disconnect for reducing the deployment velocity of a main parachute system.

In the past, reefing line cutters have been incorporated into decelerator systems to reduce the deployment velocity of the main parachute system. The reduced deployment velocity is achieved by allowing the drogue parachute to decelerate the payload and main parachute. The parachute reefing line cutter usually has a 3–5 second delay between drogue parachute deployment and main parachute deployment. Since the opening shock loading is significantly decreased during the main parachute deployment when a reefing line cutter is employed, the main parachute and suspension system may be fabricated of lower strength materials. The lower strength materials cost less and usually occupy less volume. The cost and volume factors are highly critical in today's aircraft parachute flare competition

The present cost of commercial reefing line cutters is prohibitively high with respect to the overall function that they perform and the total cost of the parachute flare. The parachute reefing line cutter consists of a firing pin, primer, pyrotechnic delay, explosive charge, knife, anvil, and housing. The reefing line cutter operation is initiated by pulling the firing pin, which functions the delay, which subsequently forces the knife to cut the reefing lanyard at the anvil. One such reefing line cutter is shown and described in U.S. Pat. No. 2,897,799, entitled, "Explosive Cutter For Parachute Lines," which issued Aug. 4, 1959, to Joe A. Stupian.

SUMMARY OF THE INVENTION

The present invention relates to a delayed parachute disconnect which releases after a piston travels a predetermined distance. The speed at which the piston travels is determined by an orifice which permits fluid to escape therethrough. The fluid opposes piston travel and movement is controlled by the size of the orifice. After a predetermined distance of travel, the piston becomes disengaged from a lanyard and it is this disengagement which initiates the main parachute opening. In one embodiment, a spring is provided to retain the piston in a forward inactive position and in another embodiment a shear pin prevents unwanted movement of the piston until a predetermined force is applied to the end of the piston.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a longitudinal sectional view showing a preferred embodiment of the present invention,

FIG. 2 is a sectional view similar to FIG. 1 only showing a lanyard in a released condition; and

FIG. 3 is a longitudinal sectional view of another embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawing, there is shown in FIG 1, a disconnect assembly having a cylindrical housing 11 which is closed at end 12 and has a head 13 attached

to the other end. Head 13 might be attached, as by press-fitting, soldering, welding, or the like, or might be threadedly attached to housing 11. Piston 14 is provided and has an enlarged diameter end 15 that is slidably fitted in the bore 16 of housing 11, and piston 14 has a stem 17 which is slidably mounted in bore 18 of head 13. The end of stem 17 has a partial ball-socket 19 which receives a ball 21 on the end of a lanyard 22. The dimensions of the partial ball-socket 19 and ball 21 are such that when they are engaged and when the end of stem 17 is within bore 18, the ball is locked or retained in ball-socket 19.

A quantity of liquid 23, such as a 50 percent ethylene glycol-water solution, is provided within bore 16 of housing 11 and a coil spring 24 is provided to bias piston 14 toward end 12 of housing 11. It should be understood that other fluids, such as air and silicone fluid may also be used. In one design requirement of providing a 3–5 second delay period between initiation and separation, the 50 percent ethylene glycol-water solution provided the desired delay time, with silicone fluid providing longer delay times and air providing very short delay times. An orifice 25 is provided in the enlarged diameter end 15 of piston 14 and permits fluid 23 to pass therethrough when piston 14 is moved in a direction to compress spring 24. A ring seal 20 is provided to seal stem 17 so that fluid 23 is retained within bore 16.

Referring now to FIG. 3 of the drawing, there is shown another embodiment of the present invention wherein stem 26 and shaft 27 are provided with complementary tapered portions 29 and 28, respectively, which locks stem 26 and shaft 27 together as long as they are within the bore 18 of head 13. A shear pin 31 retains shafts 26 until sufficient force is applied to shear pin 31 and allows movement. Thus the need for spring 24, which is used in the embodiment of FIG. 1 is eliminated.

OPERATION

Referring specifically to FIGS. 1 and 2 of the drawing, spring 24 biases piston 14 so that the enlarged diameter end 15 is adjacent end 12. Ball 21 on the end of lanyard 22 is engaged in partial ball-socket 19 and thus connects lanyard 22 with stem 17. Upon launch from an aircraft, in connection with a parachute assembly, tension is applied to lanyard 22 by a drogue parachute thereby moving piston 14 in a direction to compress spring 24. Movement of piston 14 is, however, controlled by fluid 23 which must pass through orifice 25. Thus it can be seen that the velocity of piston 14 is controlled by the size of orifice 25. As best shown in FIG. 2 of the drawing, when the end of stem 17 moves beyond the end of head 13, ball 21 is released from ball-socket 19 and this release is used to initiate the main parachute opening

In the embodiment shown in FIG 3 of the drawing, movement of shafts 26 and 27 is prevented by shear pin 31. When the force on the end of shaft 27 becomes sufficiently large, pin 31 shears and movement of shaft 27 causes shaft 26 to move. Movement of shaft 26 is, however, controlled by fluid 23 which must pass through orifice 25. Stem 26 and shaft 27 remain connected until the tapered portions 28 and 29 clear head 13, whereupon stem 26 and shaft 27 separate, and it is this separation that initiates the main parachute opening

It can thus be seen that the present invention provides a mechanical parachute disconnect that can provide a delay time of 3–5 seconds between drogue parachute deployment and main parachute deployment.

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.

We claim:

1. A delayed parachute disconnect comprising,

a housing having a cavity therein, said housing being closed at one end and partially closed at the opposite end by a head having a bore therein,

a quantity of fluid within said cavity,

a piston slidably mounted in said housing, said piston being comprised of a stem having a partial ball-socket on one end thereof and an enlarged diameter portion on the opposite end thereof, said enlarged diameter portion being movable in said cavity and said end having a partial ball-socket being movable in said bore,

an orifice in said enlarged diameter portion of said piston,

a spring biasing said enlarged diameter portion of said piston toward said closed end of said housing, and

a lanyard extending in said bore of said head and having a ball on one end engageable with said partial ball-socket on said stem, said ball being retained in said partial ball-socket by the surface of said bore and the opposite end of said lanyard being connectable to a parachute whereby a force applied to said lanyard moves said piston at a velocity controlled by fluid passing through said orifice thereby providing a delay between the time said force is first applied and the time said ball clears said bore thereby disconnecting said lanyard from said stem.

* * * * *

United States Patent [19]

Lipscomb, Jr. et al.

[11] **3,821,120**

[45] **June 28, 1974**

[54] **PROCESS FOR PROMOTING AN OXIDE FOR USE IN A PYROTECHNIC COMPOSITION**

[75] Inventors: **Charles A. Lipscomb, Jr.**, Crane, Ind.; **Treva M. Smith**, Hernando, Fla.

[73] Assignee: **The United States of America as represented by the Secretary of the Navy**, Washington, D.C.

[22] Filed: **Aug. 21, 1972**

[21] Appl. No.: **282,508**

[52] **U.S. Cl.** **252/186,** 149/20, 149/37

[51] **Int. Cl.** **C06b 15/00,** C01g 9/02, C01g 49/06

[58] **Field of Search** 252/186; 149/20, 37, 19.1; 423/622, 633

[56] **References Cited**

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2,775,514	12/1956	Wainer	149/37
3,203,843	8/1965	Jackson	149/19
3,411,964	11/1968	Douda	149/20
3,625,855	12/1971	Douda	149/37

Primary Examiner—Carl D. Quarforth
Assistant Examiner—Irwin Gluck
Attorney, Agent, or Firm—R. S. Sciascia; Paul S. Collignon

[57] **ABSTRACT**

A process for increasing the heat of combustion of a metallic oxide to be used in a pyrotechnic composition comprising dissolving in water a metallic sulfate and a doping material which is a lithinum or zirconium compound and then calcining to form a doped metallic oxide.

5 Claims, 2 Drawing Figures

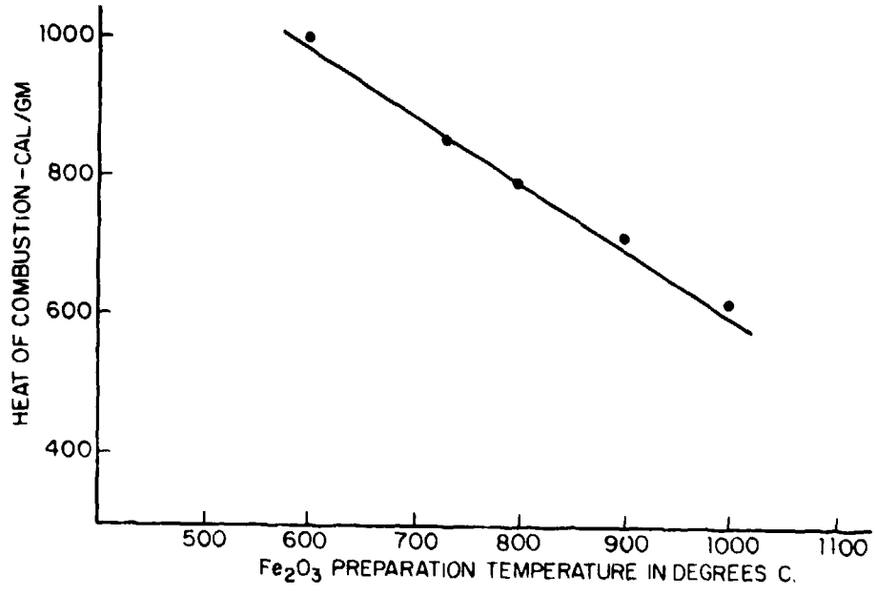
1000
800
600
400
HEAT OF COMBUSTION - CAL/GM
500
600
700
800
900
1000
1100
Fe_2O_3 PREPARATION TEMPERATURE IN DEGREES C.

Fig.1

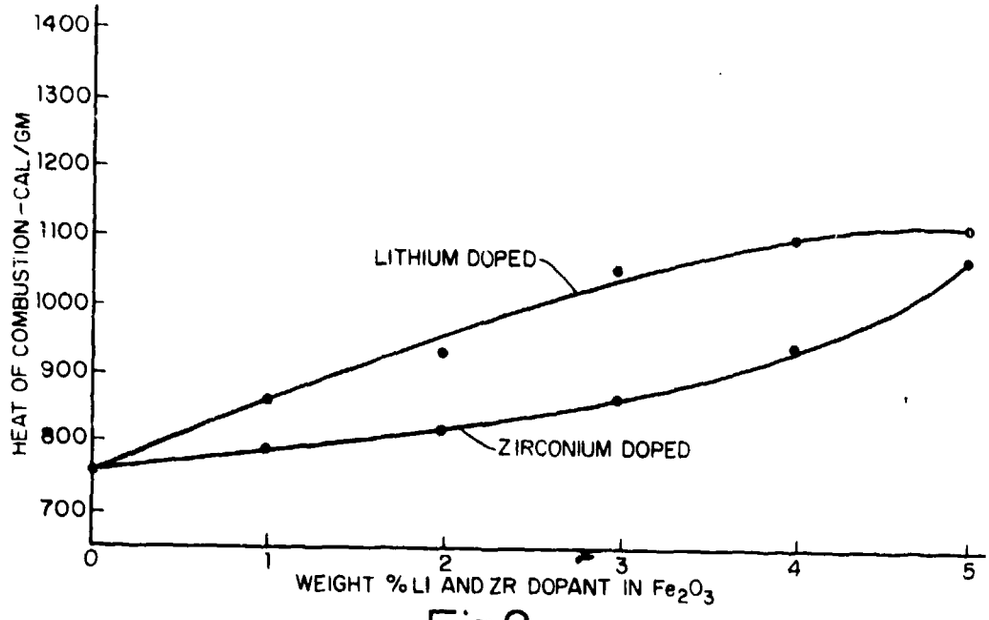
1400
1300
1200
1100
1000
900
800
700
HEAT OF COMBUSTION - CAL/GM
LITHIUM DOPED
ZIRCONIUM DOPED
0
1
2
3
4
5
WEIGHT % LI AND ZR DOPANT IN Fe_2O_3

Fig.2

PROCESS FOR PROMOTING AN OXIDE FOR USE IN A PYROTECHNIC COMPOSITION

CROSS-REFERENCE TO RELATED APPLICATION

U.S. Pat. application of Charles A. Lipscomb, Jr. and Treva M. Smith entitled, "Pyrotechnic Composition Providing Increased Heat of Combustion," Ser. No. 281,582, filed Aug. 17, 1972.

BACKGROUND OF THE INVENTION

The present invention relates to a method of increasing the heat of combustion of an oxide which is to be used in a pyrotechnic composition.

Pyrotechnic devices are widely used by military personnel and contain combustible chemicals which, when ignited, generate a flame, flash, infrared radiation, smoke or sound display, or combinations of these effects, for a broad variety of purposes. Many devices, particularly the smoke and illuminating devices, are comprised of a fuel, an oxidizer and a binder.

Many of the recent improvements in pyrotechnic devices, such as flares, have been centered on providing an improved binder system. For example, in U.S. Pat. No. 3,411,964, which issued Nov. 19, 1968, to Bernard E. Douda, there is disclosed an illuminating flare composition comprised of a fuel, an oxidizing agent and a binder comprised of an epoxy resin and a polyglycol resin. Little, if any, work has been done on improving an oxidizer for use in a pyrotechnic composition.

SUMMARY OF THE INVENTION

The present invention relates to a process for increasing the heat of combustion of a metallic oxide to be used in a pyrotechnic composition. In particular, the present invention provides a method to increase the heat of combustion of zinc oxide and ferric oxide which is to be used in pyrotechnic munitions such as red phosphorus smokes and hygroscopic chloride (HC) smokes.

A metallic sulfate, such as ferric sulfate or zinc sulfate is dissolved in boiling distilled water to which about 1 to 5 percent, by weight, of a doping material has been added. The doping material is a compound of either lithium or zirconium. The solution is boiled until it becomes pasty in consistency and then the pasty solution is calcined at a temperature of between 600° and 1,000° C. to form a doped metallic oxide.

It is therefore a general object of the present invention to provide a process for increasing the heat of combustion of a metallic oxide to be used in pyrotechnic compositions.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a graph showing the effect of preparation temperature on heat of combustion of ferric oxide; and

FIG. 2 is a graph showing the effect of the percentage of dopant on heat of combustion of ferric oxide.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In preparing a metallic oxide according to the present invention, preweighed amounts of metallic sulfate and the selected dopant are dissolved in distilled water. The metallic sulfates which have been successfully used are ferric sulfate, ferrous sulfate and zinc sulfate and the

doping materials which have been used successfully are lithium hydroxide, lithium nitrate, zirconium sulfate and zirconium nitrate. The solution is heated to boiling, and heat is maintained until a persistent froth forms and the solution becomes very viscous. The solution is then transferred to crucibles and heated in a furnace at a temperature of between 600° and 1,000° C. for between 24 and 100 hours until calcining is complete. The remaining water is quickly driven off at this temperature, and the doped metallic sulfate decomposes to doped metallic oxide. It is necessary to periodically disturb the contents of the crucible to permit adequate venting of sulfur dioxide and steam decomposition products. The crucible and contents are then removed from the furnace and allowed to stand until cooled to ambient conditions. The metallic oxide is made up largely of loosely agglomerated fine particles having a size of about 0.5 to 1.0 microns and these agglomerates can be broken up with a mortar and pestel, by screening, or by other appropriate methods.

The following examples are provided in order to illustrate the present invention.

EXAMPLE I

99 grams of zinc sulfate and 1 gram of zirconium sulfate were dissolved in 100 ml of boiling distilled water. The solution was stirred and heated until the solution was reduced to 40 ml and was pasty in consistency. The pasty solution was calcined in a crucible at 700° C. for about 100 hours. The contents of the crucible were stirred several times during the calcining process to permit venting of sulfur dioxide and other gaseous products. The final material produced was white in color and had an absolute density of 5.94 gm/cm^3, as compared with 5.58 gm/cm^3 for unpromoted zinc oxide.

EXAMPLE II

99 grams of ferric sulfate and 1 gram of zirconium sulfate were dissolved in 300 ml of distilled water and the solution was boiled until a persistent froth forms and the solution became very viscous at a volume of between 70 and 100 ml. This viscous solution was then stored under refrigeration at a temperature of 45° F. for 18 hours. The solution was then transferred to crucibles and placed in a furnace at a temperature of 600° C. for 24 hours. The remaining water was quickly driven off and the doped ferric sulfate decomposed to doped ferric oxide. The contents of the crucible were periodically disturbed to permit adequate venting of sulfur dioxide and steam decomposition products. The crucible and contents were then removed from the furnace and cooled at ambient room temperature. The Fe_2O_3 was fine particles of between 0.5 and 1.0 micron in size and was loosely agglomerated. The agglomerates were broken up by screening.

Referring to FIG. 1 of the drawing, it can be seen that the temperature used in preparing the doped ferric oxide has a noticeable effect on the heat of combustion when mixed with titanium and reacted. The reaction that occurs is:

$$3Ti + Fe_2O_3 \rightarrow 3TiO + 2Fe \quad (1)$$

It can be seen that ferric oxide prepared at a temperature of 600° C. has a heat of combustion of about 1,000 cal/gm, while ferric oxide prepared at a temperature of 1,000° C. has a heat of combustion of only about 620 cal/gm.

Referring now to FIG. 2 of the drawing, there is shown the effect of dopant concentration on the heat of reaction that occurs in the chemical equation (1) shown above. When no dopant is used, the heat of combustion is about 760 cal/gm (Preparation temperature of about 800° C.). As the percent of doping material is increased, the heat of reaction increases. With a 1 percent lithium doping material, the heat of reaction is about 850 cal/gm and, for 5 percent, the heat of combustion increases to about 1,100 cal/gm. For corresponding 1 and 5 percent of zirconium doping material, the heats of combustion are about 780 cal/gm and 1,050 cal/gm, respectively.

It is recognized that various changes may be made to the process of this invention, and that ingredients other than those specifically described herein may be employed in its practice without departing from the spirit and scope of the invention.

We claim:

1. A process for promoting a metallic oxide for use in a pyrotechnic composition comprising,

dissolving in distilled water between about 95 and 99 parts by weight of a metallic sulfate selected from the group consisting of ferric sulfate, ferrous sulfate, and zinc sulfate and between about 1 and 5 parts by weight of a doping material selected from the group consisting of lithium hydroxide, lithium nitrate, zirconium sulfate and zirconium nitrate,

then heating the solution containing the metallic sulfate and doping material until the solution becomes pasty in consistency, and

then calcining at a temperature of between about 600 and 1,000 degrees C. to produce a doped metallic oxide.

2. A process for promoting a metallic oxide for use in a pyrotechnic composition as set forth in claim 1 wherein said metallic sulfate is ferric sulfate and said doping material is zirconium sulfate.

3. A process for promoting a metallic oxide for use in a pyrotechnic composition as set forth in claim 1 wherein said metallic sulfate is zinc sulfate and said doping material is zirconium sulfate.

4. A process for promoting a metallic oxide for use in a pyrotechnic composition as set forth in claim 1 wherein said metallic sulfate is ferric sulfate and said doping material is lithium hydroxide.

5. A process for promoting a metallic oxide for use in a pyrotechnic composition as set forth in claim 1 wherein said metallic sulfate is ferric sulfate and said doping material is lithium nitrate.

* * * * *

United States Patent [19]

Gilliam

[11] **3,813,534**

[45] **May 28, 1974**

[54] **CHEMICAL LIGHTING DEVICE HAVING INTERLOCKING AMPOULES**

[75] Inventor: **Clarence W. Gilliam**, Bloomington, Ind.

[73] Assignee: **The United States of America as represented by the Secretary of the Navy**, Washington, D.C.

[22] Filed: **Sept. 14, 1973**

[21] Appl. No.: **397,554**

[52] **U.S. Cl.** ..... **240/2.25**, 206/47 R, 222/94

[51] **Int. Cl.** **F21v 9/16**

[58] **Field of Search** ..... 240/2.25; 222/94; 206/47 A

[56] **References Cited**

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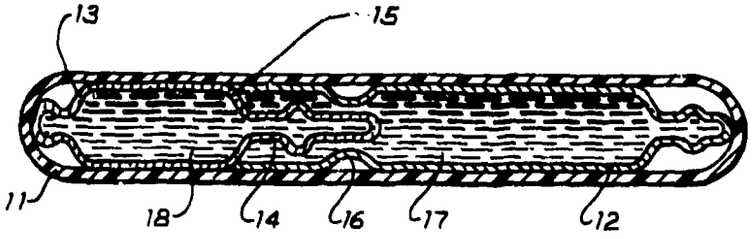
3,591,089	7/1971	Cronan	239/304
3,720,522	3/1973	Nakagami	206/47 A
3,764,796	10/1973	Gilliam et al.	240/2.25

Primary Examiner—Richard M. Sheer
Attorney, Agent, or Firm—R. S. Sciascia; Paul S. Collingnon

[57] **ABSTRACT**

A chemical lighting device having an outer cylindrical sleeve of light transmitting material and a pair of interlocking frangible ampoules positioned within said outer cylindrical sleeve. A first ampoule containing an activator material has a reduced diameter portion that extends into a second ampoule containing a chemiluminescent material. The first ampoule is fuzed to the second ampoule and closes one end of the second ampoule. The second ampoule is provided with an indentation that surrounds the reduced diameter portion of the first ampoule so that the two ampoules can be broken simultaneously, and, upon mixing of the chemiluminescent material and the activator material, light is emitted through the outer sleeve.

1 Claim, 2 Drawing Figures



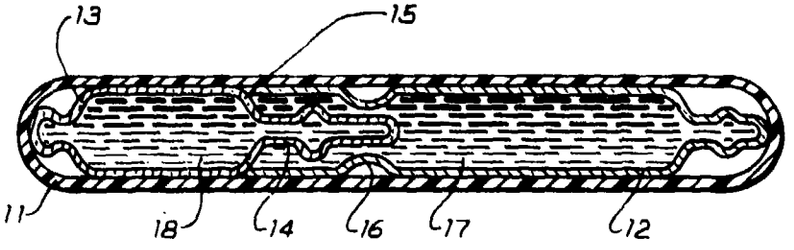


Fig. 1

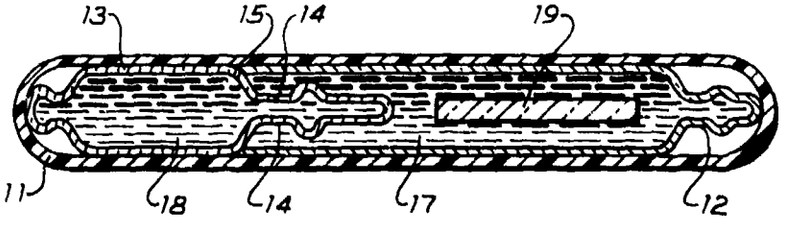


Fig. 2

CHEMICAL LIGHTING DEVICE HAVING INTERLOCKING AMPOULES

CROSS-REFERENCE TO RELATED APPLICATION

Patent application of Clarence W. Gilliam and Thomas N. Hall entitled, "Chemical Lighting Device," Ser. No. 295,335, filed Oct. 5, 1972.

BACKGROUND OF THE INVENTION

The present invention relates to a chemical lighting device and more particularly to a chemical lighting device which can be held in a hand and readily activated.

Various chemiluminescent peraminoethylene compounds have been used for lighting and marking purposes. One such use is described in U.S. Pat. No. 3,239,406, entitled, "Chemiluminescent Structures And Their Preparation," which issued Mar. 8, 1966, to Donald D. Coffman and Hilmer E. Winberg. This patent teaches the coating of flexible material, such as plastic strips, with tetrakis (dimethylamino) ethylene to provide a nocturnal marking tape. As tetrakis (dimethylamino) ethylene becomes luminescent upon exposure to air, the preparation of the tape is made under nitrogen and the saturated material is protected from air by covering with polyethylene film

Another group of chemiluminescent compounds are made by adding a fluorescer to an oxalate-ester compound and then activating the mixture with an oxidizing material. U.S. Pat. No. 3,612,857, entitled, "Location Marker For Producing Luminous Display," which issued Oct. 12, 1971, to Dave Beatty and James Reinhart, describes a location marker which is a cloth streamer saturated with a mixture of bis(2,4,5 Trichloro-6-carbobutoxyphenyl) oxalate, anthracene cyanacryl terpolymer, and bis(2-ethylhexyl) phthalate in benzene. The activator fluid used to activate the chemiluminescent mixture is hydrogen peroxide in dimethyl phthalate.

In the above-identified patent application, a chemical lighting device is shown and described which can be held in the hand and activated. An outer cylindrical sleeve of light transmitting material contains first and second ampoules which are kept separated in the cylindrical sleeve. One ampoule contains a chemiluminescent material and the second ampoule contains an activator fluid. Each ampoule is provided with a reduced neck portion which facilitates breaking the ampoule. When both ampoules are broken, the chemiluminescent material and activator fluid are mixed and light is obtained and transmitted through the cylindrical sleeve.

SUMMARY OF THE INVENTION

The present invention relates to a hand-held chemical lighting device having interlocking ampoules within an outer sleeve of light transmitting material. One ampoule has a reduced diameter portion which extends into a second ampoule and the two ampoules are fused together so that the first ampoule closes the second ampoule. One ampoule contains a chemiluminescent material and the second ampoule contains an activator fluid, and when the ampoules are broken and the materials are mixed, light is obtained and transmitted through the outer sleeve. A weight, such as a cylindrical rod, is provided in one ampoule so that if a device is launched from a launcher, the weight will break the other ampoule to allow the materials to mix.

It is therefore a general object of the present invention to provide an improved chemical lighting device which can be activated manually by hand or which can be automatically activated during launch.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a longitudinal sectional view of a preferred embodiment of the present invention; and

FIG. 2 is a longitudinal sectional view, similar to FIG. 1, having a weight therein for breaking a frangible ampoule.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawing, there is shown a tubular outer sleeve **11** made of a material which will transmit light, such as clear radiation-crossed-linked polyolefinic plastic tube. Two ampoules **12** and **13** of frangible material, such as glass, are positioned within outer sleeve **11**. Ampoule **13** has a reduced diameter portion **14** that extends into ampoule **12** and the shoulder **15** of ampoule **13** is fuzed by heating to ampoule **12** so that ampoule **12** is sealed. Ampoule **12** is provided with a reduced diameter portion **16**, which might also be scored to facilitate breakage, and this reduced diameter portion **16** is positioned opposite to the reduced diameter portion **14** of ampoule **13** so that breakage of ampoule **12** at reduced diameter portion **16** will also cause breakage of portion **14** of ampoule **13**.

Ampoule **12** contains a chemiluminescent material **17** which, by way of example, might be a mixture of an oxalate ester, such as bis(2,4,5-trichloro-6-carbopentoxyphenyl) oxalate, and a fluorescer, such as 9,10,-bis(phenylethynl) anthracene. Ampoule **13** contains an activator **18**, such as hydrogen peroxide.

When it is desired to activate the chemical lighting system described herein, sleeve **11** is bent in the region of reduced diameter portion **16** and ampoules **12** and **13** will break at about the same time. Mixing of the chemiluminescent material and the activator produces light that passes through sleeve **11**.

Referring now to FIG. 2 of the drawing, there is shown an embodiment of the invention which is designed to activate the lighting system upon firing from a launcher. A weight **19** which, by way of example, might be a cylindrical glass rod, is provided within ampoule **12** and, upon launching, the inertia of weight **19** causes ampoule **13** to strike weight **19** which breaks ampoule **13** and permits the chemiluminescent material **17** and activator **18** to mix.

It can thus be seen that the present invention provides an improved chemical lighting device having interlocking ampoules which can be broken simultaneously to permit mixing of the chemical therein. Also, one ampoule can be broken during launch to permit mixing of chemicals.

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.

I claim:

1. A chemiluminescent light device comprising,

an outer sleeve of light transmitting material,

first and second frangible ampoules positioned in said outer sleeve and fused together with said first frangible ampoule providing a closure for one end of said second ampoule and said first ampoule having a reduced diameter portion extending into said second ampoule, said second ampoule having a reduced diameter portion surrounding said reduced diameter portion of said first ampoule, said reduced diameter portion of said second ampoule being scored to break upon flexure of said outer

sleeve whereby said reduced diameter portion of said first frangible ampoule will also break,

a chemiluminescent fluid in one of said frangible ampoules, and

activator fluid in said other frangible ampoule, said chemiluminescent fluid and said activator fluid being mixed upon breakage of said first and second frangible ampoules.

* * * * *

United States Patent [19]

Clifton et al.

[11] **3,788,227**

[45] **Jan. 29, 1974**

[54] **JET IGNITION DEVICE FOR A PYROTECHNIC FUZE**

[75] Inventors: **John R. Clifton; Gary S. Edwards,** both of Bedford, Ind.

[73] Assignee: **The United States of America as represented by the Secretary of the Navy,** Washington, D.C.

[22] Filed: **Jan. 5, 1973**

[21] Appl. No.: **321,435**

[52] **U.S. Cl.** ..... **102/70 R,** 102/49.7

[51] **Int. Cl.** **F42c 19/08**

[58] **Field of Search** 102/49.7, 70, 70.2, 86.5; 60/256

[56] **References Cited**

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3,210,931	10/1965	Elzufon et al.	60/256
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3,392,673	7/1968	King	102/70

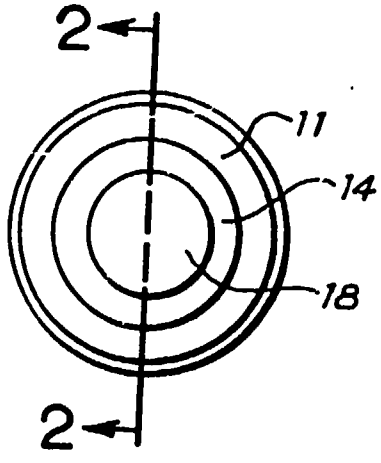
Primary Examiner—Verlin R. Pendegrass

Attorney, Agent, or Firm—R. S. Sciascia; Paul S. Collignon

[57] **ABSTRACT**

An ignition device having an open-ended case with a primer closing one end and a nozzle closing the opposite end. An orifice is provided in the nozzle and the orifice is closed by a frangible disk attached to the outer end of said nozzle. An ignition pellet is contained in said case adjacent said nozzle and detonation of said primer ruptures said frangible disk and ignites said ignition pellet.

1 Claim, 2 Drawing Figures



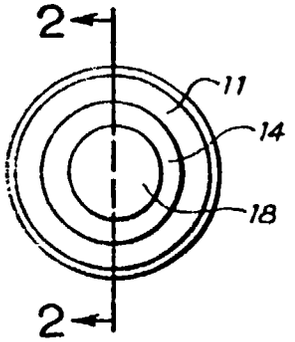


Fig.1

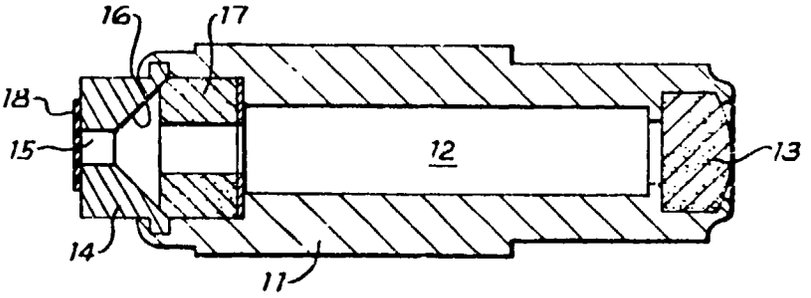


Fig.2

JET IGNITION DEVICE FOR A PYROTECHNIC FUZE

CROSS-REFERENCE TO RELATED APPLICATION

U. S. application of Carroll Abel, John R. Clifton, and James R. Lueking, entitled, VARIABLE DELAY FUZE FOR AIRCRAFT PARACHUTE FLARE, Ser. No. 769,999, filed Oct. 23, 1968, and now U.S. Pat. No. 3,712,232.

BACKGROUND OF THE INVENTION

The present invention relates to a jet ignition system and more particularly to an ignition system for a pyrotechnic item, such as an aircraft parachute flare.

In the above-referenced patent application, there is shown a device for igniting a delay fuze in an aircraft parachute flare. A primer is positioned in one end of a holder and an ejection plunger is positioned in the opposite end. The ejection plunger contains a quantity of black powder and has a pointed forward end and has a passageway so that heat and flame from a burning of the black powder can pass into the forward end and exit through a plurality of holes in the pointed end. Detonation of the primer drives the ejection plunger into a delay fuze and simultaneously ignites a fixed delay which subsequently ignites the black powder.

The device shown and described in the above-referenced patent application has several disadvantages. The pointed ejection plunger was required to hit the center of the delay fuze in order to insure reliable ignition and thus accurate positioning of the ignition device was necessary. Also the pyrotechnic delay elements and the black powder was very susceptible to moisture intrusion which caused excessive delay times and duds.

SUMMARY OF THE INVENTION

A cylindrical case is provided and has a center bore therethrough. A primer closes the aft end of the case and a nozzle closes the forward end of the case. The nozzle is provided with an orifice whose length is partly tapered and an ignition pellet is positioned in the center bore adjacent the nozzle. The orifice is closed with a frangible disk that is attached, as by adhesive, to the front face of the nozzle.

It is therefore a general object of the present invention to provide an improved ignition device for igniting a pyrotechnic fuze.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is an end view of a preferred embodiment of the present invention; and

FIG. 2 is a sectional view taken on line 2—2 of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawing, there is shown a case 11 having a central bore 12 therethrough, and a primer 13 closes the aft end of case 11. A nozzle 14 is attached to the forward end of case 11 by crimping. As best shown in FIG. 2 of the drawing, nozzle 14 is provided with an orifice 15 that has a flared portion 16 and an ignition pellet 17 is contained in bore 12 adjacent nozzle 14. A frangible disk 18 is attached, as by cementing, to the front face of nozzle 14 thereby closing bore 12 to prevent any moisture from entering and affecting ignition pellet 17. By way of example, case 11 might be aluminum, nozzle 14 might be brass and disk 18 might be plastic, such as polyester film. Ignition pellet 17 might be comprised of powdered magnesium and teflon.

OPERATION

In operation, a firing pin detonates primer 13 and the pressure and flame from primer 13 ruptures frangible disk 18. The flame from primer 13 also ignites ignition pellet 17, and the hot gases and flame generated by the burning of ignition pellet 17 are directed outwardly through orifice 15 of nozzle 14 and are used to ignite a pyrotechnic delay element.

We claim:

1. An ignition device for a pyrotechnic fuze comprising,

a case having a central bore therethrough,

a primer closing one end of said central bore,

a nozzle crimped to the other end and closing said central bore, said nozzle having a circular orifice in the forward end thereof and an outwardly extending flared portion in the aft end thereof,

an ignition pellet positioned in said central bore adjacent said flared portion of said nozzle, and

a frangible disk attached to the outer end of said nozzle and closing said circular orifice of said nozzle.

* * * * *

United States Patent [19]

Johnson et al.

[11] **3,769,107**

[45] **Oct. 30, 1973**

[54] **PYROTECHNIC COMPOSITION FOR GENERATING LEAD BASED SMOKE**

[75] Inventors: **Duane M. Johnson**, Bicknell; **Donald R. Hazelton**, Winslow, both of Ind.

[73] Assignee: **The United States of America as represented by the Secretary of the Navy**, Washington, D.C.

[22] Filed: **Oct. 28, 1968**

[21] Appl. No.: **773,694**

[52] **U.S. Cl.**.....**149/19.6**, 149/20, 149/22, 149/117

[51] **Int. Cl.**..... **C06d 5/06**

[58] **Field of Search**..... 149/19, 22, 44, 83–85

[56] **References Cited**

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Primary Examiner—Benjamin R. Padgett
Attorney—E. J. Brower and R. Miller

[57] **ABSTRACT**

A pyrotechnic composition comprising lead iodate, alkali iodate, boron, and epoxy resin which upon combustion generates a lead based smoke which can be used for artificial weather modification.

2 Claims, No Drawings

PYROTECHNIC COMPOSITION FOR GENERATING LEAD BASED SMOKE

GOVERNMENT INTEREST

BACKGROUND OF THE INVENTION

Various types of pyrotechnic compositions capable of providing clouds of smoke upon combustion are well known as are pyrotechnic compositions containing silver iodate which upon combustion produce silver iodide nuclei which if properly introduced into the appropriate cloud may increase rainfall, make hail formation more difficult, or disperse supercooled fog. The technique of seeding undercooled clouds is known. Two widely used artificial ice nuclei are dry ice (solid carbon dioxide) used successfully for cloud modification by Schaefer in 1946, and silver iodide whose excellent activity was discovered by Vonnegut in 1947. The use of silver iodide as a seeding material is based on its property of acting as freezing nuclei at relatively high temperatures, namely between −4° C. and −5° C. and of turning undercooled clouds into ice particles. Heretofore only very few substances have become known which have nucleus properties similar to silver iodide, such as lead iodide. The generation of silver iodide remains comparatively expensive. However, the generation of lead based nuclei by pyrotechnic means has never been too successful and therefore has not produced results comparable to silver iodide smokes. The present invention provides a pyrotechnic composition which not only produces lead-based freezing nuclei which show excellent ice forming activity, but the material is fairly inexpensive.

SUMMARY OF THE INVENTION

The invention relates to improved pyrotechnic compositions. More particularly, to a pyrotechnic which upon combustion yields a lead-based active nuclei which has application in artificially influencing the weather.

The general purpose of this invention is to provide a pyrotechnic composition which is comparable to or better than other pyrotechnic compositions which upon combustion yield by-products which show improved freezing nuclei activity. Another object is to provide a pyrotechnic which is economical to prepare and safe to handle.

DESCRIPTION OF THE INVENTION

The present invention is for a composition comprising at least two oxidizers, one an alkali iodate and the other lead iodate, a nonmetallic fuel, and a binder which contains no halogens other than iodine.

The alkali iodate used includes potassium, cesium, sodium and rubidium iodate. The preferred fuel is boron which is safe and does not tend to form more energetic bonds with iodine than with oxygen. Other metals which may be used are aluminum or magnesium; also, others which do not tend to form more energetic bonds with iodine than with oxygen. The preferred binder is epoxy resin. It is necessary to aid in the consolidation of the composition if pelletizing is desired. It is important to this composition that the binder used contain no halogens other than iodine. Other halogens may reduce the efficiency of this composition. The preferred formulation is accomplished by maintaining an alkali metal to lead mole ratio between 1:1 and 20:1. Sufficient fuel is added to react with the oxygen present in the composition but is not necessarily required as the composition will function with less. It is not necessary that a stoichiometric quantity of fuel be used, but it is recommended that no more than twice this amount be used. The quantity of binder is that needed to mix the materials needed to compact into a solid grain.

Upon combustion the present improved pyrotechnic compositions yield lead iodide-alkali metal iodide complexes. It is postulated that by forming the alkali iodide the lead iodide formed is chemically and physically protected by chemically bonding the metallic iodides as double base salts or by physically forming a protective layer around the lead iodide in the flame and/or upon cooling to the solid state, i.e., smoke particles. This protection is believed to prevent the oxidation of the lead iodide formed in the flame and/or when contact with atmospheric oxygen occurs.

The following examples better illustrate this invention but should not be considered as limiting.

EXAMPLE I

Ingredients	Percent by weight
Lead iodate	48.6
Potassium iodate	37.6
Boron	7.8
Epoxy resin binder	6.0

The inverse burn rate =4.3 sec/inch

The nucleation efficiency (nuclei per gram of composition) is as follows:

−6° C., 5.6×10^{11}

-7° C., 6.2×10^{11}

−0.7° C., 8×10^{9}

EXAMPLE II

Ingredients	Percent by weight
Lead iodate	26.2
Potassium iodate	59.6
Boron	8.2
Epoxy resin binder	6.0

The inverse burn rate =4.3 sec/inch

The nucleation efficiency (nuclei per gram of composition) is as follows

−6.5° C., 2.2×10^{11}

−7.5° C., 3.2×10^{11}

−10.5° C., 1.2×10^{12}

EXAMPLE III

Ingredients	Percent by weight
Lead iodate	87.2
Boron	6.8
Epoxy resin binder	6.0

The inverse burn rate = 5.2 sec/inch

The nucleation efficiency (nuclei per gram of composition) is as follows:

−9° C., 3.4×10^{11}

EXAMPLE IV

Ingredients	Percent by weight
Lead iodate	26.2
Potassium iodate	59.6
Boron	4.7
Gilsonite	3.5
Epoxy binder	6.0

The inverse burn rate =12 sec/inch

EXAMPLE V

Ingredients	Percent by weight
Lead iodate	41.0
Potassium iodate	31.5
Magnesium	21.5
Epoxy resin binder	6.0

EXAMPLE VI

Ingredients	Percent by weight
Lead iodate	40.0
Potassium iodate	46.2
Boron	7.8
Epoxy binder	6.0

EXAMPLE VII

Ingredients	Percent by weight
Lead iodate	62.6
Potassium iodate	24.1
Boron	7.3
Epoxy binder	6.0

The nucleation activity of Examples VI and VII were about the same as those for Example I above.

All of the Examples (I - VII) were prepared by dissolving the epoxy resin and curing agent which is used with the epoxy in acetone. The other ingredients are added while agitating until a homogeneous mixture was obtained. The acetone was then removed by vacuum and the composition pressed into cylinders of predetermined size and cured. When burned, these compositions produce smokes ranging from white to pink in color. The compositions show good nuclei activity at temperatures ranging from $-1°$ to $-10°$ C.

The preferred epoxy resin system is DER 321, which may be obtained from Dow Chemical Company. It is a liquid having an epoxide equivalent of 187 - 193; average molecular weight 350 - 400 and viscosity at 25° C. of 11,000 - 16,000 centipoises. It is a reaction product of Bisphenol A and epichlorohydrin to which is added about 10 weight percent butyl glycidyl ether as a reactive diluent. It is cured with about 11 parts by weight to 100 parts of the resin/diluent combination of a conventional curing agent, such as diethylene triamine. Epoxy resins were found to be the best binders because they give a longer, more stable shelf life to the composition.

Use of this lead based composition in pyrotechnic generators for cloud seeding experiments has shown that the ice forming efficiency is equal to or better than that of silver and much less expensive. These pyrotechnic devices are either fired from the ground or from airplanes as they fly into the preselected clouds. Because the crystal of lead complex formed, like the silver iodide used in the prior art, is similar to that of ice, it acts as a seed for the growth of ice crystals in a supercooled cloud.

The boron and other nonmetals such as silicon offer greater safety in manufacturing as well as much better storage properties and resistance to moisture degradation.

What is claimed is:

1. A pyrotechnic composition comprising the following:

Ingredients	Percent by weight
Lead iodate	25 - 65
Potassium iodate	25 - 60
Boron	4 - 8
Epoxy resin	6 - 8

2. The composition of claim 1 to which gilsonite is added in a percent by weight ranging from 3 - 4, as needed for desired burning rate.

* * * * *

United States Patent [19]

Gilliam et al.

[11] **3,764,796**

[45] **Oct. 9, 1973**

[54] **CHEMICAL LIGHTING DEVICE**

[75] Inventors: **Clarence W. Gilliam**, Bloomington, Ind.; **Thomas N. Hall**, Adelphi, Md.

[73] Assignee: **The United States of America as represented by the Secretary of the Navy**, Washington, D.C.

[22] Filed: **Oct. 5, 1972**

[21] Appl. No.: **295,335**

[52] U.S. Cl. **240/2.25**, 222/94, 222/541

[51] *Int. Cl.* **F21v 9/16**

[58] *Field of Search* 240/2.25; 222/94, 222/541

[56] **References Cited**

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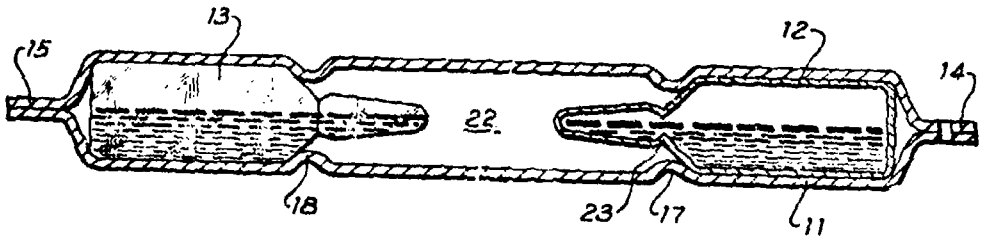
Primary Examiner—Fred L. Braun

Attorney—R. S. Sciascia et al.

[57] **ABSTRACT**

A chemical lighting device having an outer cylindrical sleeve of light transmitting material and first and second frangible ampoules positioned within said outer cylindrical sleeve. Indentions are provided in the outer cylindrical sleeve for keeping the ampoules separated in the cylindrical sleeve. One ampoule contains a chemiluminescent material and the other ampoule contains an activator material. The ampoules can be broken by bending the outer cylindrical sleeve and light is obtained when the chemiluminescent material and activator are mixed.

3 Claims, 2 Drawing Figures



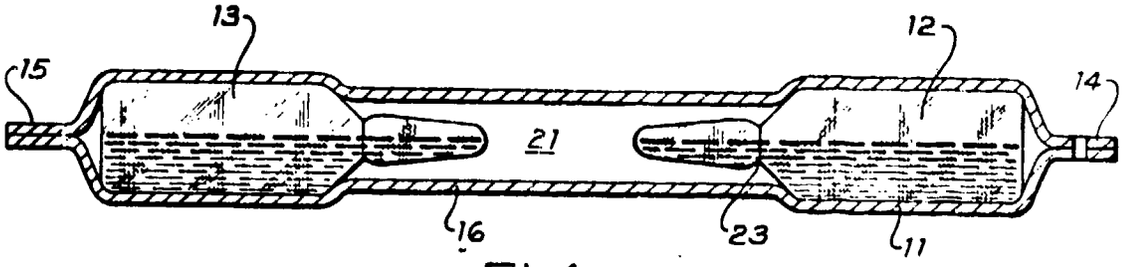


Fig.1

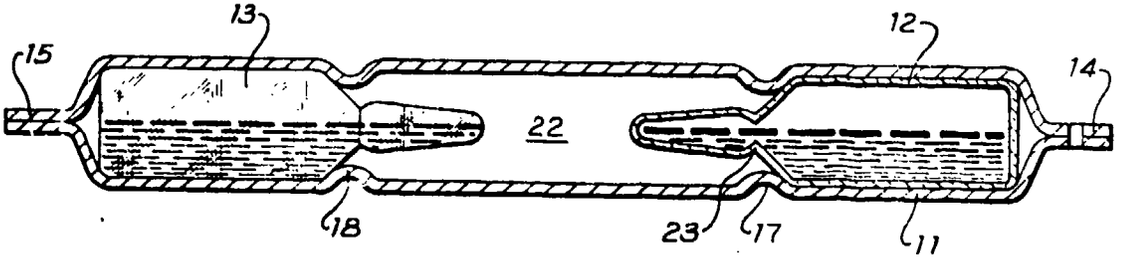


Fig. 2

CHEMICAL LIGHTING DEVICE

BACKGROUND OF THE INVENTION

The present invention relates to a chemical lighting device and more particularly to a chemical lighting device which can be held in a hand and readily activated.

Various chemiluminescent peraminoethylene compounds have been used for lighting and marking purposes. One such use is described in U. S. Pat. 3,239,406, entitled, "Chemiluminescent Structures And Their Preparation," which issued Mar. 8, 1966, to Donald D. Coffman and Hilmer E. Winberg. This patent teaches the coating of flexible material, such as plastic strips, with tetrakis (dimethylamino) ethylene to provide a nocturnal marking tape. As tetrakis (dimethylamino) ethylene becomes luminescent upon exposure to air, the preparation of the tape is made under nitrogen and the saturated material is protected from air by covering with polyethylene film.

Another group of chemiluminescent compounds are made by adding a fluorescer to an oxalate-ester compound and then activating the mixture with an oxidizing material. U. S. Pat. 3,612,857, entitled, "Location Marker For Producing Luminous Display," which issued Oct. 12, 1971, to Dave Beatty and James Reinhart, describes a location marker which is a cloth streamer saturated with a mixture of bis(2,4,5 Trichloro-6-carbobutoxyphenyl) oxalate, anthracene cyanacryl terpolymer, and bis(2-ethylhexyl) phthalate in benzene. The activator fluid used to activate the chemiluminescent mixture is hydrogen peroxide in dimethyl phthalate.

SUMMARY OF THE INVENTION

The present invention relates to a chemical lighting device which can be held in the hand and which can be readily activated. An outer cylindrical sleeve of light transmitting material contains first and second ampoules which are kept separated in the cylindrical sleeve. One ampoule contains a chemiluminescent material and the second ampoule contains a activator fluid. Each ampoule is provided with a reduced neck portion which facilitates breaking the ampoule. When both ampoules are broken, the chemiluminescent material and activator fluid are mixed and light is obtained and transmitted through the cylindrical sleeve. As chemiluminescent material deterioates when even very small amounts of moisture are present, the sealing of the chemiluminescent material in a glass ampoule prevents such deterioration and permits long shelf life.

It is therefore a general object of the present invention to provide a chemical lighting device which can be readily activated.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a longitudinal sectional view of a preferred embodiment of the present invention; and

FIG. 2 is a longitudinal sectional view of another embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawing, there is shown a tubular outer sleeve 11 having glass ampoules 12 and 13 positioned therein. Sleeve 11 is made of material which will transmit light such as clear radiation-crossed-linked polyolefinic plastic tube. The ends of sleeve 12 have been flattened by applying heat and pressure to form flat ends 14 and 15 that serve to retain ampoules 12 and 13 within sleeve 11. Referring now to FIG. 1 of the drawing, it can be seen that sleeve 11 is provided with a reduced diameter portion 16 which prevents ampoules 12 and 13 from moving together and be susceptible to breaking. Ampoule 12 is retained between flat end 14 and reduced diameter portion 16 and ampoule 13 is retained between flat end 15 and reduced diameter portion 16. By way of example, sleeve 11 might be of a heat shrinkable material and reduced diameter portion 16 can be formed by applying heat to sleeve 11. In FIG. 2 of the drawing, two reduced diameter portions 17 and 18 are provided to retain ampoules 12 and 13 in position. The space 21 inside reduced diameter portion 16 and the space 22 between reduced diameter portions 17 and 18 serves as a mixing area when ampoules 12 and 13 are broken and the fluids therein are released. Ampoules 12 and 13 are provided with necks 23 that facilitate breaking the ampoules.

Ampoule 12 contains a chemiluminescent material which, by way of example, might be a mixture of an oxalate ester, such as bis(2,4,5-trichloro-6-carbopentoxyphenyl) oxalate, and a fluorescer, such as 9,10,-bis(phenylethynl) anthracene. Ampoule 13 contains an activator, such as hydrogen peroxide.

When it is desired to activate the chemical lighting system described herein, sleeve 11 is bent first in the region of the neck 23 of ampoule 12 to break ampoule 12 and then in the region of the neck of ampoule 13 to break ampoule 13. Mixing of the chemiluminescent material and the activator produces light that passes through sleeve 11.

We claim:

1. A chemiluminescent light device comprising,

an outer cylindrical sleeve of light transmitting material having flat end portions and first and second reduced diameter portions between said flat end portions,

first and second frangible ampoules positioned in said outer cylindrical sleeve, one of said ampoules being positioned between one flat end portion and said first reduced diameter portion and the other of said ampoules being positioned between the other flat end portion and said second reduced diameter portion,

a chemiluminescent fluid in said one frangible ampoule, and

activator fluid in said other frangible ampoule.

2. A chemiluminescent light device as set forth in claim 1 wherein said frangible ampoules are glass.

3. A chemiluminescent light device as set forth in claim 1 wherein said frangible ampoules have a neck portion to facilitate breakage.

* * * * *

United States Pate[illegible] [19]

Lohkamp

[11] **3,750,574**

[45] **Aug. 7, 1973**

[54] **ILLUMINATING ROUND HAVING DUAL RANGE CAPABILITY**

[75] Inventor: **Carl W. Lohkamp**, Bloomfield, Ind.

[73] Assignee: **The United States of America as represented by the Secretary of the Navy**, Washington, D.C.

[22] Filed: **Feb. 28, 1972**

[21] Appl. No.: **230,539**

[52] U.S. Cl. **102/34.1**, 102/32, 102/35.6, 102/38, 102/49.7, 244/3.1

[51] Int. Cl. **F42b 13/38**

[58] Field of Search 102/32, 34, 34.6, 102/35.6, 37.6, 38, 49.3, 49.7; 244/3.1

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3,105,438	10/1963	Aberg	102/34.4

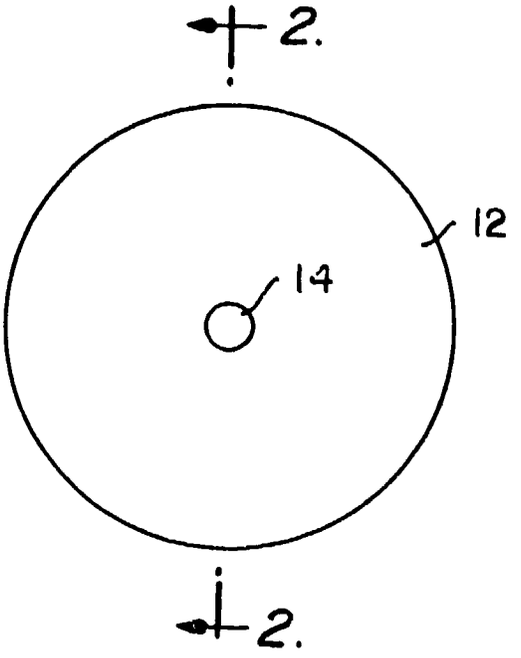
Primary Examiner—Robert F. Stahl

Attorney—R. S. Sciascia, H. H. Losche and Paul S. Collignon

[57] **ABSTRACT**

An illuminating round having propulsion means and a flare composition, and means for deploying a parachute upon ignition of the flare composition. The forward end of the round is configured for low drag and means are provided for attaching an auxiliary part which provides for high drag during propulsion of the round.

1 Claim, 4 Drawing Figures



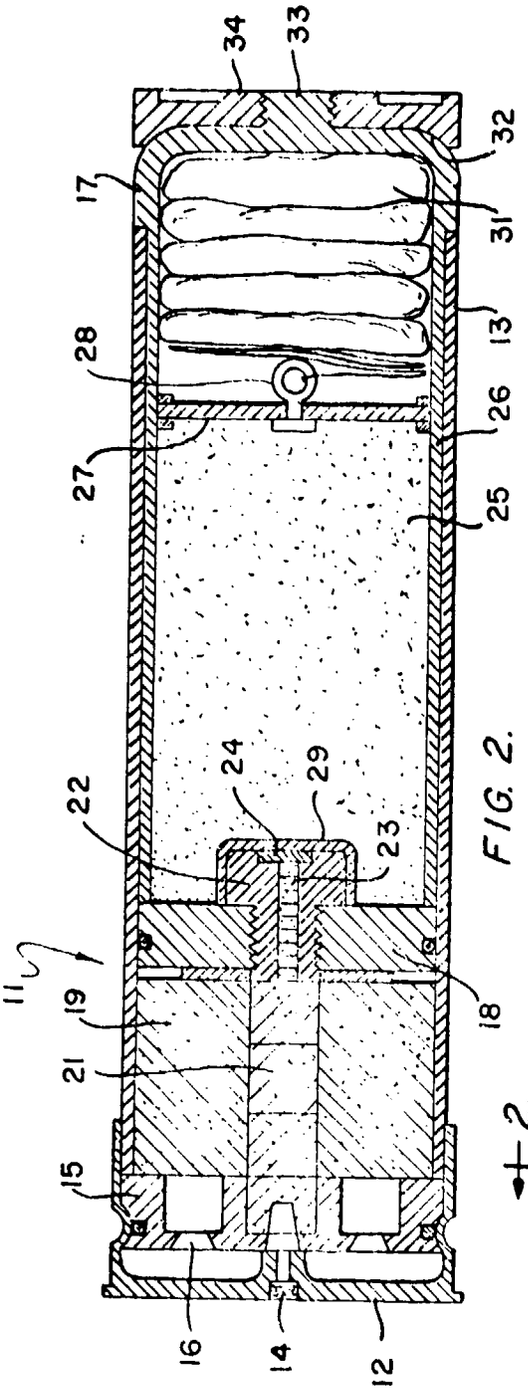


FIG. 2.

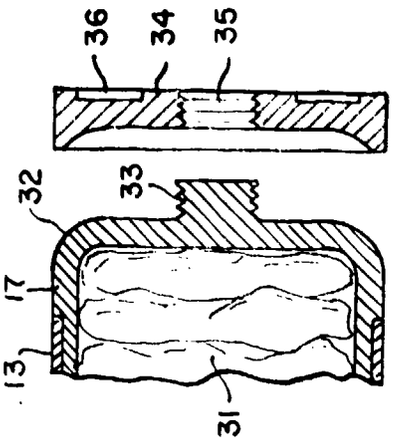


FIG. 3.

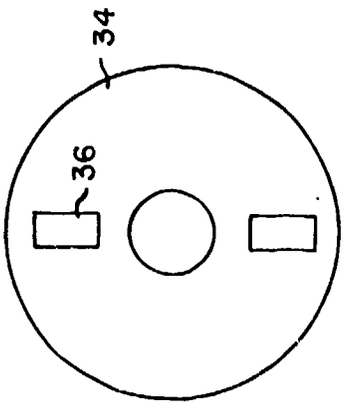


FIG. 4.

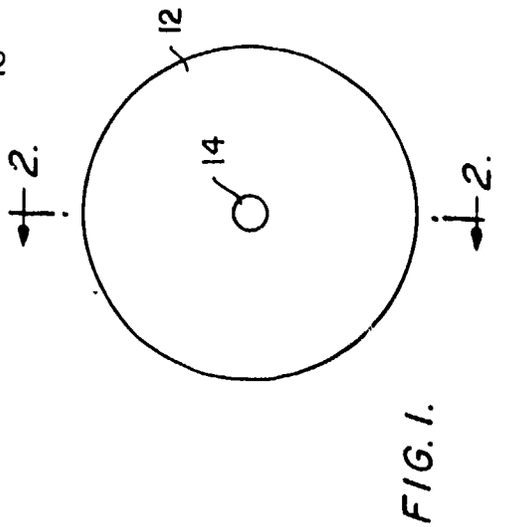


FIG. 1.

ILLUMINATING ROUND HAVING DUAL RANGE CAPABILITY

STATEMENT OF GOVERNMENT INTEREST

BACKGROUND OF THE INVENTION

The present invention relates to an illuminating round which can be fired from a hand-held weapon, such as a grenade launcher, and more particularly to an illuminating round having dual range capability provided by a low drag and a high drag configuration.

Various devices are provided on projectiles and missiles to control either their range or rate of descent. While parachutes are most frequently used to retard descent of falling objects, rotor and speed brakes are also used as retarding devices. An example of a speed brake is shown in U. S. Pat. No. 3,047,259, entitled "Speed Brake Retarding Mechanism For An Air-Dropped Store," which issued July 31, 1962, to George J. Tatnall and Albert F. Scarcelli. In this patented device, a ballistic-shaped cylindrical store is used and the speed brake is comprised of a plurality of blades which are individually pivoted about pins disposed near the outer circumference of the store. Spring means are provided for opening the blades, and a flexible screen is attached to the blades for increasing drag.

An example of a rotor device is shown in U. S. Pat. No. 3,057,589, entitled, "Aerial Device Having Rotor For Retarding Descent," which issued Oct. 9, 1962, to Derek J. Nutkins and Clifford B. Packard. In this rotor device, a plurality of blades are connected to the rear portion of a cylindrical body. The blades are pivotal so they can assume either a collapsed or an operative position, and, when in the operative position, the blades extend outwardly from the body at pitch angles suitable to cause autorotation for retarding descent of the body.

In addition to retarding apparatus for free-falling objects, various devices have been provided on ground-launched missiles for adjusting range. In U. S. Pat. No. 3,343,767, entitled "Device For Adjusting The Range Of A Missile," which issued Sept. 26, 1967, an aerodynamic brake is attached to a missile to control range. Hinged panels are mounted around the rocket, and these panels can be positioned at various angles to provide different degrees of resistance as the missile is propelled in flight.

SUMMARY OF THE INVENTION

The present invention relates to an illuminating round which can be launched from a hand-held weapon, such as a grenade launcher. A firing pin in the launcher detonates a primer which, in turn, ignites a propellant to propel the round. The burning of the propellant ignites a delay element which, in turn, ignites an illuminating composition. The ignition of the illuminating composition causes a parachute to deploy and the burning composition is parachuted to the ground. The round has two possible aerodynamic drag configurations, that is, high drag and low drag. The forward nose of the round is streamlined to provide for low drag and a disk is attachable to the forward end to provide a high drag configuration.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an end view of the aft end of a round;

FIG. 2 is a sectional view taken on line 2–2 of FIG. 1;

FIG. 3 is a partial sectional view of the forward end of a round showing a high drag disk and low drag nose configuration; and

FIG. 4 is an end view of a round showing a high drag disk.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, an illuminating round 11 is shown having a primer case 12 and a motor case 13. Primer case 12 has a primer 14 positioned therein and primer case 12 and motor case 13 are removably attached together, as by crimping. Motor case 13 is closed at its aft end by a nozzle plate 15 having a plurality of nozzles 16 therein, and the forward end of motor case 13 is closed by a low drag nose tube 17. A closure plate 18 is provided in motor case 13 and a propelling charge 19, such as black powder, is provided between closure plate 18 and nozzle plate 15. Igniter pellets 21 are provided in the center of propelling charge 19 and detonation of primer 14 ignites pellets 21 which, in turn, ignites propelling charge 19.

A pyrotechnic holder 22 is threadedly attached to closure plate 18 and contains pyrotechnic delay elements 23 and a flash charge 24. A quantity of illuminating composition 25 is provided in inner container 26 which has an outside diameter slightly less than the inside diameter of motor case 13, so that inner container 26 can be ejected. The forward end of container 26 is closed by plate 27 which has a swivel ring 28 attached thereto. A quantity of ignition mix 29 is provided on illuminating composition 25 adjacent flash charge 24 to facilitate ignition of composition 25.

Illuminating flare composition 25 is comprised of a fuel, such as magnesium, an oxidizing agent such as sodium nitrate and a binder system comprised of a liquid epoxy resin of the bisphenol A Epichlorohydrin type containing cresyl glycidyl ether and a liquid epoxy resin of the Polyglycol-Epichlorohydrin type. By way of example, composition 25 might be comprised of between 56 and 60 percent, by weight, of magnesium, between 35 and 40 percent, by weight, of sodium nitrate, between 2 and 7.5 percent, by weight, of liquid epoxy resin of the bisphenol A Epichlorohydrin type containing cresyl glycidyl ether, between 0.9 and 3.5 percent, by weight, of liquid epoxy resin of the Polyglycol-Epichlorohydrin type, and between 0.4 and 1.5 percent, by weight, of an aliphatic polyamine hardener. The liquid epoxies and hardener can be obtained from The Dow Chemical Company, Midland, Mich. The liquid epoxy resin of the bisphenol A Epichlorohydrin type containing cresyl glycidyl ether is marketed by The Dow Chemical Company under the trademark D.E.R. 321 and is a liquid epoxy resin having an epoxide equivalent weight value of between 182–192 and a viscosity of between 500–700 cps at 25°C. The liquid epoxy resin of the Polyglycol-Epichlorohydrin type is marketed by The Dow Chemical Company under the trademark D. E. R. 732 and is a liquid epoxy resin having an epoxide equivalent weight value of between 305 and 335 and a viscosity of between 55 – 100 cps at 25°C. The hardener is an aliphatic polyamine and is

marketed by The Dow Chemical Company under the name Experimental Hardener QX-3482.1. The hardener has an amine hydrogen equivalent of about 29 and is similar in characteristics to diethylene triamine and triethylene tetramine.

A parachute 31 is packed inside nose tube 17 and the shroud lines of parachute 31 are connected to swivel ring 28. As best shown in FIGS. 2 and 3 of the drawing, the forward edge of nose tube 17, which is cylindrical in shape, is provided with a radiused corner 32 which provides low drag as motor case 13 is propelled through the air. A threaded stud 33 is provided on the forward end of nose tube 17 and is used to attach blunt nose disk 34 thereto. As shown in FIGS. 3 and 4 of the drawing, disk 34 has a leading edge with sharp corners and is provided with a tapped hole 35 that is engageable with stud 33. A pair of notches 36 is provided on the forward end of disk 34 to accommodate a spanner wrench for tightening disk 34 to nose tube 17.

OPERATION

In operation, prior to loading illuminating round 11 into a grenade launcher, a choice must be made on using either a low drag or high drag nose configuration. By way of example, when disk 34 is threadedly attached to low drag nose tube 17, parachute 31 deploys at a range of about 600 yards and, without disk 34 in place, parachute 31 deploys at a range of about 300 yards.

The firing pin of a grenade launcher strikes, and detonates, primer 14 which ignites igniter pellets 21 which, in turn ignites propelling charge 19. The gases emitted from the burning of propelling charge 19 exit through nozzles 16 and propel motor case 13 through the air. Primer case 12 remains in the launcher barrel and is ejected before another round is fired. The burning propelling charge 19 ignites delay elements 23, and elements 23 burn for 5 or 6 seconds and then ignite illuminating composition 25. The gases created by the burning of composition 25 causes inner container 26 to separate, which also causes nose tube 17 to be ejected, whereupon parachute 31 is deployed. Parachute 31 retards the descent of inner container 26 and the burning of composition 25 illuminates the ground below.

I claim:

1. An illuminating round comprising,

a motor case,

a nozzle plate closing an aft end of said motor case,

an inner case in said motor case positioned forward of said propelling charge, said inner case extending beyond the forward end of said motor case and having a radiused leading edge providing reduced wind resistance during flight,

a quantity of illuminating composition and a parachute within said inner case, said parachute being deployed upon ignition of said illuminating composition,

a propelling charge in said motor case positioned between said nozzle plate and said quantity of illuminating composition,

a primer for igniting said propelling charge,

a pyrotechnic delay element for igniting said illuminating composition after said propelling charge is ignited, and

a cylindrical disk having a leading edge with a sharp corner removably attached to the forward end of said inner case for providing high drag during flight of said illuminating round.

* * * * *

Code 53169

United States Patent [19]

Harkness et al.

[11] **3,747,528**

[45] **July 24, 1973**

[54] **AIRCRAFT PARACHUTE FLARE HAVING TAPERED CORE CANDLE**

[75] Inventors: **Benjamin F. Harkness; Billy J. Humerickhouse**, both of Odon; **Norbert E. Matheis**, Jasper; **Alfred W. Norris**, both of Bloomington, all of Ind.

[73] Assignee: **The United States of America as represented by the Secretary of the Navy**, Washington, D.C.

[22] Filed: **Feb. 25, 1972**

[21] Appl. No.: **229,609**

[52] **U.S. Cl.** **102/35**, 102/35.6, 244/142

[51] **Int. Cl.** **F42b 13/38**

[58] **Field of Search** 102/35–35.6, 37.1, 34.1; 244/142

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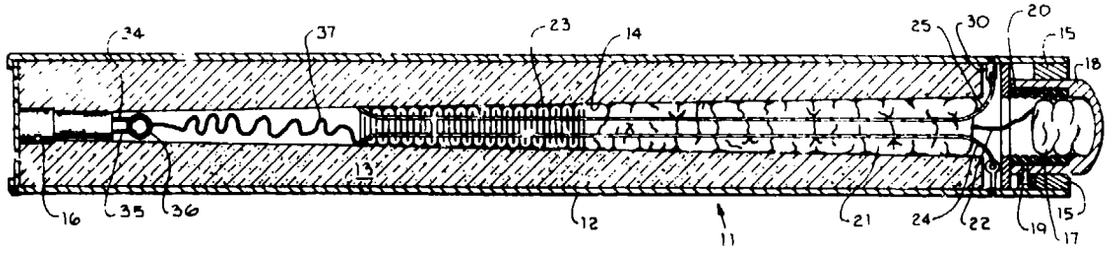
Primary Examiner—Robert F. Stahl

Attorney—R. S. Sciascia, Paul S. Collignon et al.

[57] **ABSTRACT**

An aircraft parachute flare having an outer case of consumable material filled with a candle of pyrotechnic material. The pyrotechnic candle is provided with a tapered core that provides a chamber for storing a parachute. An environmental fuze is provided for initiating parachute deployment and deployment of the parachute initiates an igniter which, in turn ignites the pyrotechnic candle.

4 Claims, 4 Drawing Figures



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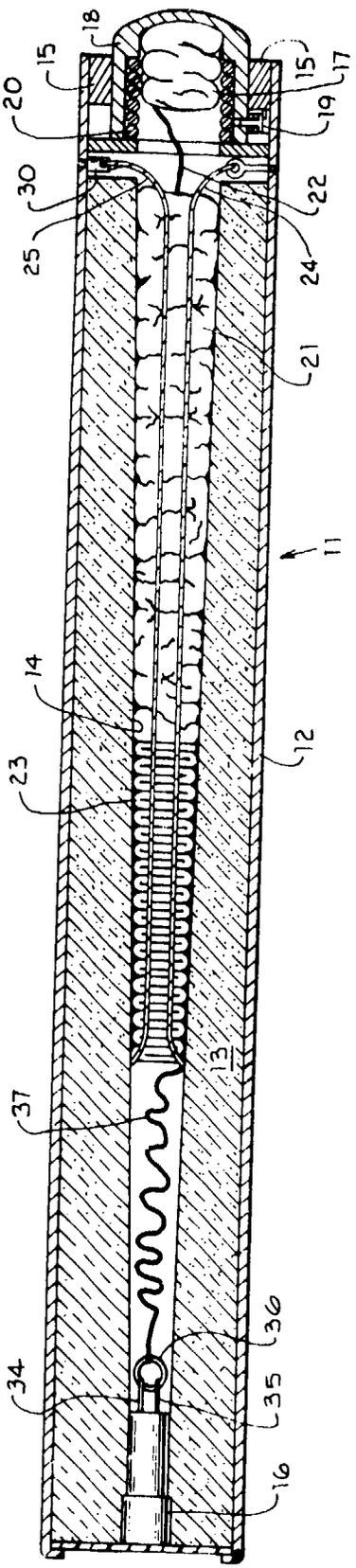

Fig. 1

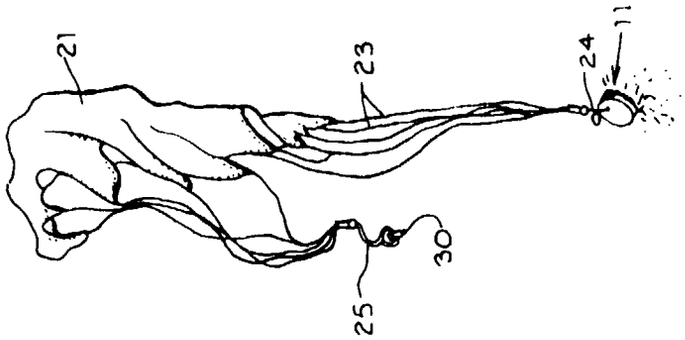

Fig. 4

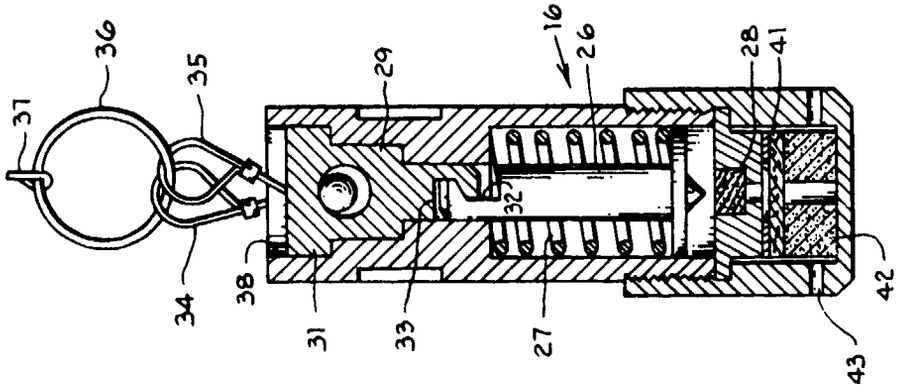

Fig. 3

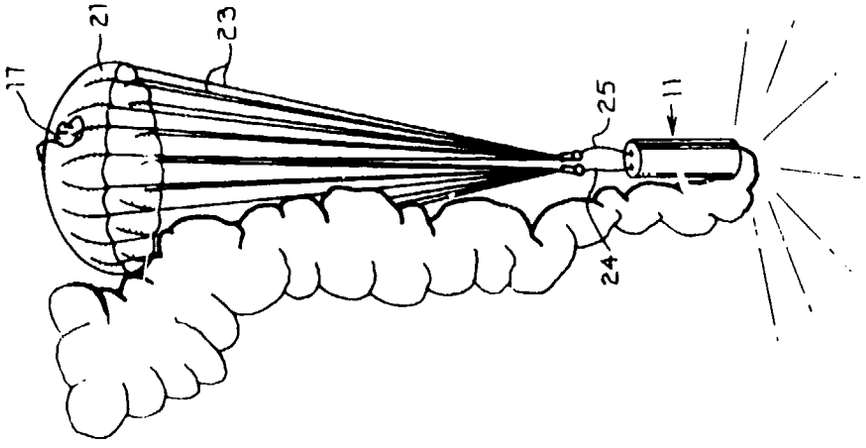

Fig. 2

AIRCRAFT PARACHUTE FLARE HAVING TAPERED CORE CANDLE

CROSS-REFERENCE TO RELATED APPLICATION

Patent application of Carroll Abel et al., entitled, "Variable Delay Fuze For Aircraft Parachute Flare", Ser. No. 769,999, filed Oct. 23, 1968.

BACKGROUND OF THE INVENTION

The present invention relates to an aircraft parachute flare and more particularly to a flare having means for storing a parachute inside a pyrotechnic candle.

Aircraft parachute flares are used for various military purposes and one type which is most frequently used consists of an outer container having a fuze or triggering means, a pyrotechnic candle and a parachute. The candle and parachute are positioned within the outer container and after launching or dropping, the candle and parachute are ejected from the container. In current flare launchings, fuze actuation is initiated by the flare's weight pulling on a lanyard attached to an aircraft or drogue. A safety pin is normally provided to prevent accidental ignition of the flare in current use and, once removed, a pull of about 12 pounds on the lanyard will start on irreversible fuze functioning. Explosive ejection of the candle from the outer container constitutes a possible missile hazard. In one flare in current use, the candle is ejected from its container at a velocity of about 150 feet per second and the outer container travels more than 100 yards. In order to prevent premature actuation of flares that are mounted on external racks on aircraft, elaborate lanyard taping procedures must be followed and, if the flare is not launched, extreme care must be taken to avoid contact with the lanyard while replacing the safety pin.

When flares in current use are deployed in a normal manner, the outer case free falls to the ground and presents a potential hazard to friendly forces. Additionally the material falling to the ground could be of some use when recovered by enemy forces.

SUMMARY OF THE INVENTION

The present invention relates to an aircraft parachute flare having a pyrotechnic candle cast within a consumable container. The pyrotechnic candle is provided with a conically shaped bore which is used to store a parachute. Deployment of the parachute is initiated by an environmental fuze, and deployment of the parachute initiates an igniter which, in turn, ignites the pyrotechnic candle.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a sectional view showing a preferred embodiment of the present invention;

FIG. **2** is a diagrammatic view showing a preferred embodiment of the present invention with a parachute being deployed;

FIG. **3** is a sectional view showing a firing pin assembly; and

FIG **4** is a diagrammatic view showing the parachute of FIG. **2** in a collapsed condition.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, in FIG. **1** there is shown an aircraft parachute flare **11** having a cylindrical case **12** of consumable material which contains a pyrotechnic candle **13**. By way of example, case **12** might have a thin wall and be made of aluminum, and candle **13** might be comprised of a mixture of between 56 and 60 percent, by weight, of magnesium, between 35 and 40 percent, by weight of sodium nitrate and between 3.5 and 12 percent, by weight, of a binder system comprised of between 51 and 71 percent, by weight, of liquid epoxy resin of the bisphenol A Epichlorohydrin type containing cresyl glycidyl ether, between 16 and 36 percent, by weight, of liquid epoxy resin of the Polyglycol-Epichlorohydrin type and between 10 and 15 percent, by weight, of a hardener, such as an aliphatic polyamine. A tapered hole **14** is provided in candle **13** with the smallest cross-sectional area of hole **14** being at the end of the candle which is first ignited and burned. If the length of candle **13** burns at a uniform rate, a greater volume of pyrotechnic material will be consumed when the candle is first ignited and thus provide greater illumination when the candle is farthest from the ground.

An environmental arming mechanism **15** is attached to one end of case **12** and an igniter assembly **16** is shown positioned at the opposite end. Environmental arming mechanism **15** might be one of many well-known devices which are used to sense various conditions such as acceleration, time of fall, tumbling, barometric pressure, and the like. The basic function of an environmental arming mechanism is two-fold, namely to initiate ignition of the pyrotechnic candle at a desired altitude, but more important, to prevent ignition in the event that the flare device is accidental dropped, bumped or damaged. By way of example, one type of environmental fuze is shown and described in U.S. Pat. No. 3,421,442, entitled, "Environmental Fuze Device For Air-Dropped Flares And The Like", which issued Jan. 14, 1969, to Donald R. St. Clair.

A drogue chute **17** is provided within a drogue cap **18** which is retained in position by locking pin **19**. A compression spring **20** is provided to eject drogue cap **18** when locking pin **19** is withdrawn from cap **18** by action of arming mechanism **15** and, upon ejection of drogue cap **18**, drogue chute **17** is deployed. A main parachute **21** is attached to drogue chute **17** by means of cable **22**, and shroud lines **23** of parachute **21** are connected to case **12** by suspension cables **24** and **25**. Cable **25** is attached to case **12** by means of an explosive bolt **30** which severs upon application of heat to collapse parachute **21**.

Referring now to FIG. **3** of the drawing, there is illustrated one manner by which candle **13** might be ignited. Igniter **16** contains a firing pin **26** which is actuated by spring **27**. Spring **27** provides a small biasing force on firing pin **26**, however, firing pin **26** does not engage primer **28** as firing pin **26** is restrained by release pin **29** and the forward movement of release pin **29** is limited by a shoulder portion **31**. A notch **32** is provided in the rearward end of firing pin **26** and the rearward most side of notch **32** is a tapered surface. Likewise, a mating notch **33** is provided in the forward end of release pin **29**, and the forward most side of notch **33** is provided with a complementary tapered surface which engages the tapered surface of notch **32**. As shown in FIG. **1** of the drawing, a pair of short cables **34** and **35** are attached to release pin **29** and ring **36** which, in turn is connected by cable **37** to suspension cable **24**. Upon deployment of parachute **21**, a force is applied to short cables **34** and **35** and release

pin 29 moves rearwardly and pulls firing pin 26 rearwardly thereby compressing spring 27. As long as shoulder portion 31 of release pin 29 is still in bore 38, release pin 29 moves in a straight line and firing pin 26 stays engaged with release pin 29. When shoulder portion 31 clears bore 38, the continued pull by short cables 34 and 35 causes release pin 29 to become disengaged from firing pin 26 due to the tapered surfaces in notches 32 and 33. Upon disengagement of firing pin 26 from release pin 29, spring 27 drives firing pin 26 forward to detonate primer 28. Z-2 paper 41 and ignition pellet 42 are, in turn, ignited and heat and flame from ignition pellet 42 passes through holes 43 to ignite candle 13.

OPERATION

Upon dropping the aircraft parachute flare 11 from an aircraft, arming mechanism 15 senses the predetermined environmental condition, such as altitude, and reacts to permit locking pin 19 to be withdrawn from drogue cap 18. Spring 20 then ejects drogue cap 18 and drogue chute 17 is deployed. Deployment of drogue chute 17, in turn, causes main parachute 21 to deploy, whereupon igniter assembly 16 ignites candle 13.

The burning of candle 13 consumes case 12, which might be of aliminum or other consumable material, and the burning of case 12 also provides additional illumination. The narrow portion of tapered hole 14 is adjacent the end of candle 13 that is ignited and thus a greater volume of pyrotechnic material is burned when the flare is farthest from the target.

When candle 13 and case 12 are substantially consumed, heat from the burning composition causes explosive bolt 30 to rupture, and as one-half of shroud lines 23 of parachute 21 are attached to bolt 30 through suspension cable 25, parachute 21 collapses and flutters to the ground. The collapse of parachute 21 prevents its drifting and becoming a hazard to aircraft that might be in the area.

We claim:

1. An aircraft parachute flare comprising:
   - a case of consumable material,
   - a candle of pyrotechnic material positioned inside said case and having a concentrically positioned tapered hole extending end to end thereof,
   - a parachute stored in said tapered hole having a drogue chute attached and having a plurality of shroud lines attached to one end of said case,
   - an igniter assembly positioned in said hole of said candle at the end of said case opposite to the end at which said shroud lines are attached,
   - environmental fuze means for deploying said drogue chute positioned in said case at the end to which said shroud lines are attached, and
   - means connected to said parachute for actuating said igniter assembly whereby said candle of pyrotechnic material is ignited upon deployment of said parachute.

2. An aircraft parachute flare as set forth in claim 1 wherein said igniter assembly is positioned in said tapered hole at the end wherein the hole is lesser in diameter than the opposite end whereby a greater volume of pyrotechnic material is burned when the aircraft parachute flare is farthest from the ground.

3. An aircraft parachute flare as set forth in claim 1 wherein said case is aluminum.

4. An aircraft parachute flare as set forth in claim 1 wherein one-half of said shroud lines of said parachute are connected to an explosive bolt attached to said case whereby heat from burning pyrotechnic material detonates said bolt to release said one-half of said shroud lines from said case and cause collapse of said parachute.

* * * * *

United States Patent [19]

Little et al.

[11] **3,736,876**

[45] **June 5, 1973**

[54] CATALYST GENERATOR

[75] Inventors: **Steven M. Little**, China Lake; **John H. Lyons**; **Ronald C. Noles**, both of Ridgecrest; **Pierre St. Amand**, China Lake, all of Calif.; **Donald R. Hazelton**, Winslow, Ind.; **Duane M. Johnson**, Carthage, Ind.; **James J. Riester**, Bloomington, Ind.

[73] Assignee: **The United States of America as represented by the Secretary of the Navy**, Washington, D.C.

[22] Filed: **June 26, 1970**

[21] Appl. No.: **48,786**

[52] **U.S. Cl.** **102/32**, 102/39, 102/66, 102/90, 239/2, 252/305

[51] **Int. Cl.** **C06d 1/00**

[58] **Field of Search** 102/31, 32, 39, 83, 102/90; 239/2; 252/305

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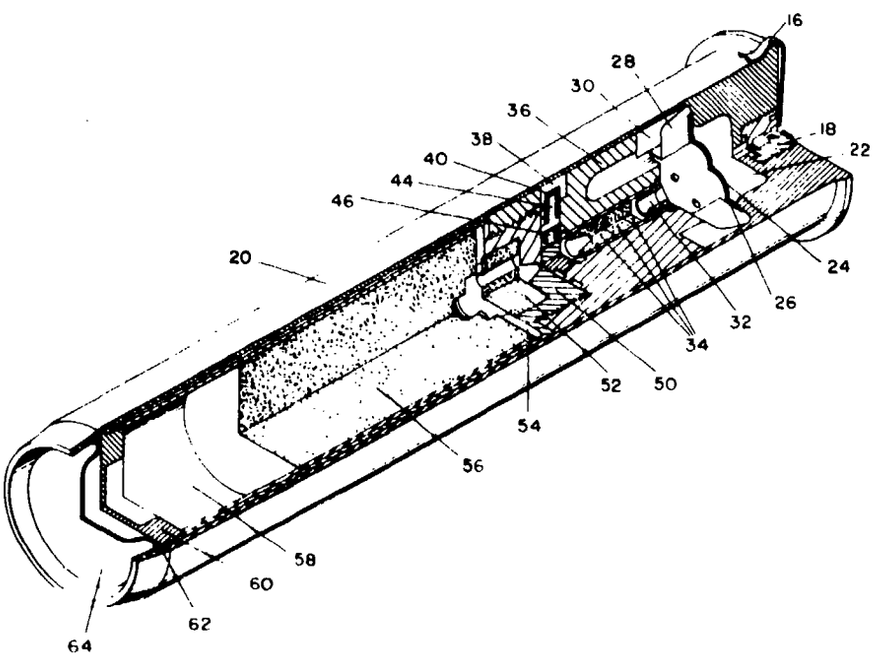
Primary Examiner—Robert F. Stahl
Attorney—R. S. Sciascia and Roy Miller

[57] **ABSTRACT**

A catalyst generator cartridge for weather modification having a spring loaded slider for moving a detonator into alignment with the ignition chain only when the pyrotechnic has been ejected from the cartridge case. If the pyrotechnic remains in the cartridge case after an ejection charge has been fired, the cartridge case prevents the slider from aligning the detonator with the ignition chain, thereby preventing the detonator from eroding through an ignition blocking device and igniting the pyrotechnic. But, if the pyrotechnic is ejected from the cartridge case, the spring is permitted to move the slider, thereby aligning the detonator with the ignition chain and allowing the pyrotechnic to be ignited. Delay compositions are included to allow the pyrotechnic to reach a predetermined distance before it is ignited.

3 Claims, 2 Drawing Figures



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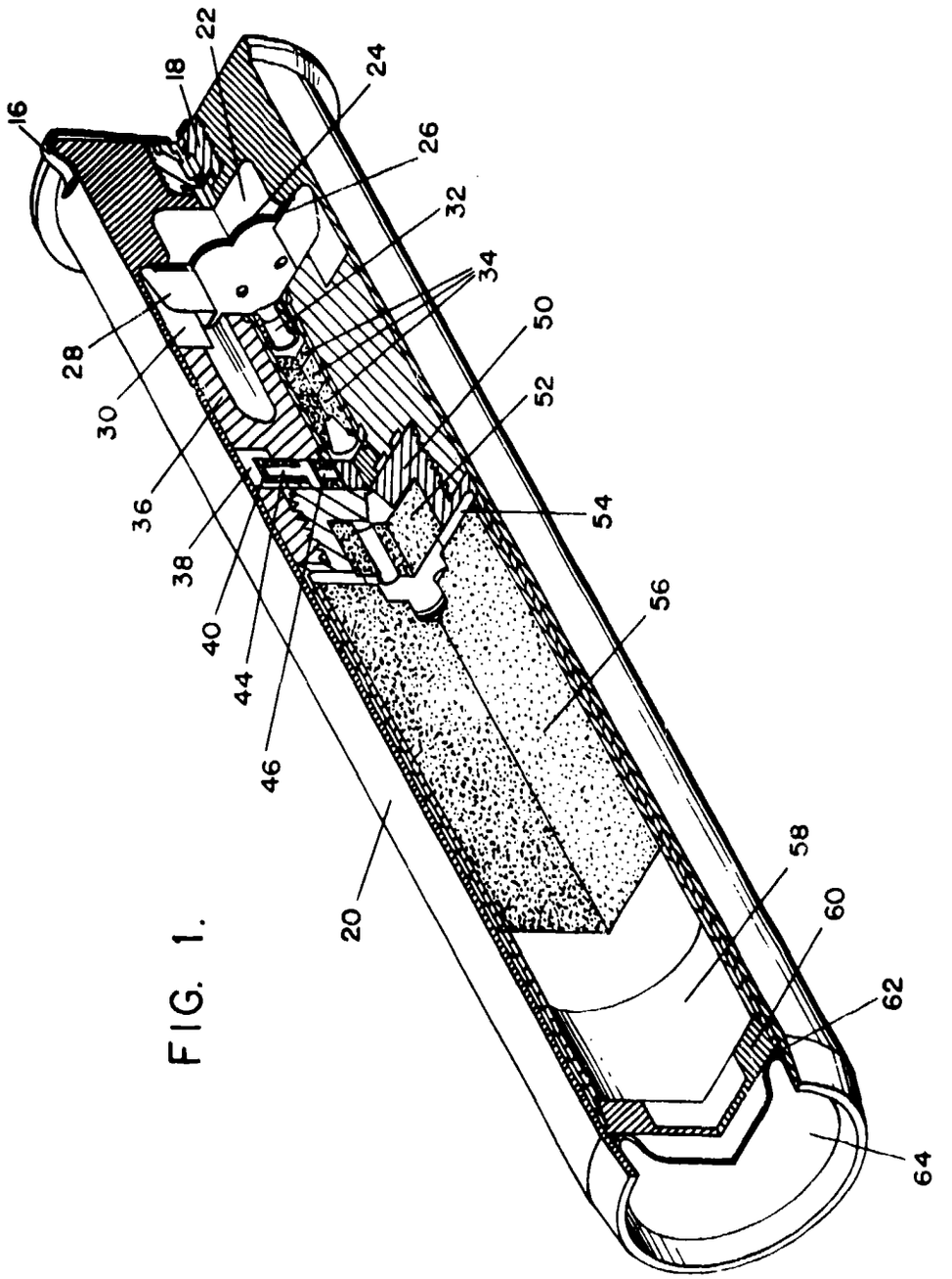

FIG. 1.

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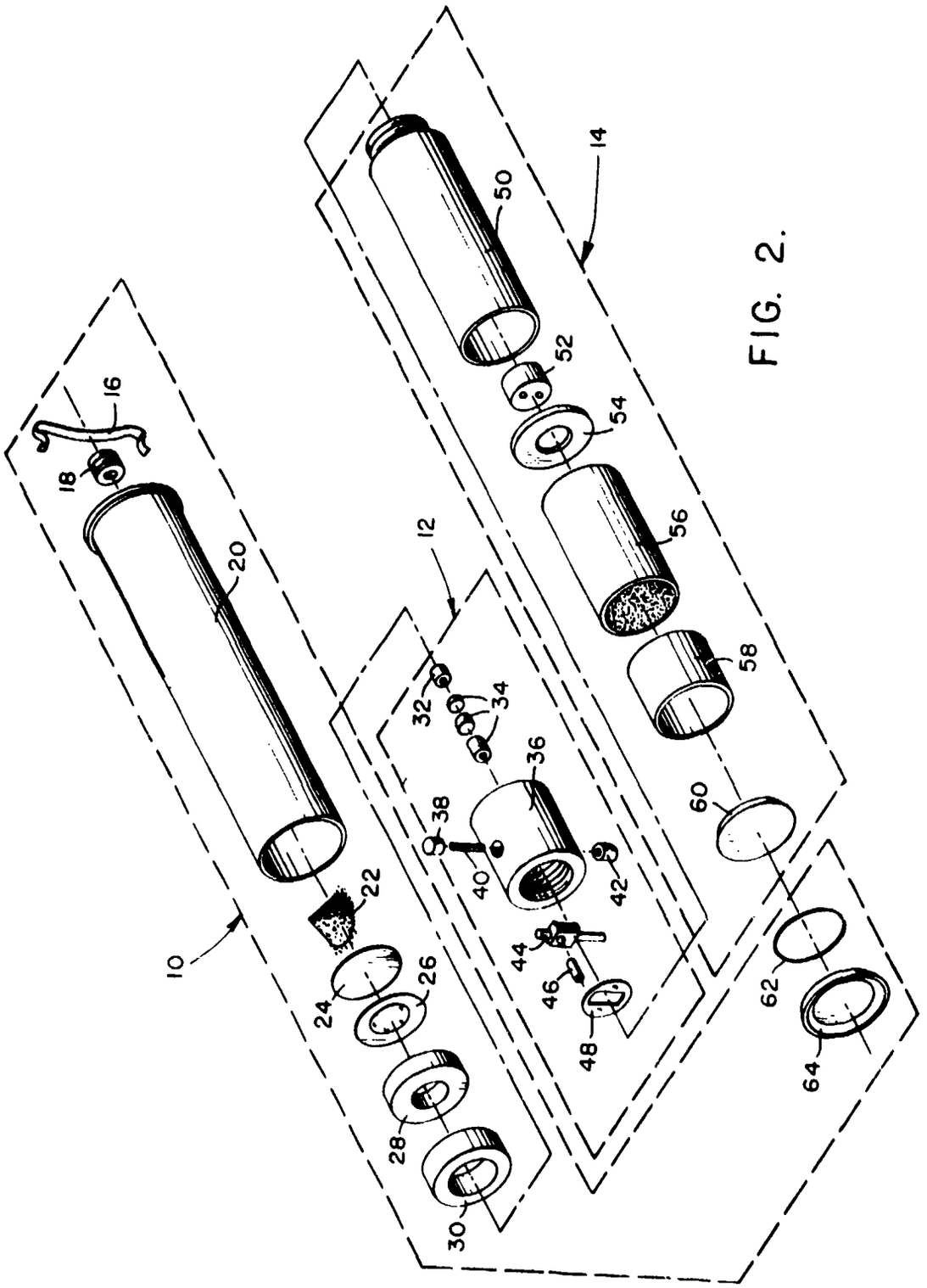
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FIG. 2.

CATALYST GENERATOR

GOVERNMENT INTEREST:

BACKGROUND OF THE INVENTION:

The invention relates to the field of weather modification in which clouds are seeded by grain assemblies such as silver iodate and, in particular, the cartridges to be shot at the clouds from an aircraft.

The prior devices ignite the pyrotechnic upon firing the cartridge ejection charge. If the pyrotechnic sticks in the cartridge case a fire might result when the grain assembly is ignited, causing possible injury and damage to nearby personnel and property.

BRIEF DESCRIPTION OF THE DRAWINGS:

FIG. 1 is a perspective view of the invention; and

FIG. 2 is an exploded perspective view of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT:

Referring to FIGS. 1 and 2, the catalyst generator cartridge comprises an ejector **10**, an ignition safety **12**, and a pyrotechnic **14**.

Ejector **10** has a primer shunting clip which is removed prior to firing, an electric primer **18**, a cartridge case **20**, two grams of black powder **22**, a paper disk **24**, a primer shield **26**, a primer spacer **28**, and an obturator **30**. When fired, the electric primer **18** ignites the black powder **22** which burns through the paper disk **24** and the primer shield **26**, and flashes through the hole in the spacer **28**, obturator **30** and a retaining ring **32**.

The ignition safety **12** has retaining ring **32**, a delay composition **34**, a fuze housing **36**, a spring retaining cup **38**, a spring **40**, a bushing **42**, a slider **44**, a detonator **46**, and a slider spacer **48**. By the time a spark from the ejector flashes through the hole in the obturator **30** and the retaining ring **32**, and ignites the delay composition **34**, the ignition safety **12** and the pyrotechnic **14** should have been ejected from the cartridge case **20**. The retaining ring **32** encourages delay composition **34** to ignite detonator **46** by preventing heat from escaping back through obturator **30**.

If the ignition safety **12** and the pyrotechnic **14** are ejected, a plunger on slider **44** is pushed through bushing **42** by spring **40** allowing slider **44** to align detonator **46** with delay composition **34**. Thereby, delay composition **34** ignites detonator **46** which in turn erodes through a web on the rear of charge case **50** and ignites the pyrotechnic **14**. If, however, they are not, the plunger on slider **44** cannot be pushed through bushing **42** by spring **40** because of the proximity of the inner surface of cartridge case **20**. Therefore, slider **44** is prevented from aligning detonator **46** with delay composition **34**. Hence, as a result, detonator **46**, although ignited, will be aligned with a thicker portion of the surface on the rear of charge case **50** through which it cannot erode to ignite pyrotechnic **14**.

Pyrotechnic **14** has a charge case **50**, an ignition composition **52**, an ignition spacer **54**, a grain assembly **56**, a charge spacer **58**, a charge case cover **60**, an "O" ring **62**, and a cartridge cap **64**. When detonator **46** has been moved into position by slider **44** and is ignited it will erode through an aluminum webbing on the rear end of charge case **50** and ignite the ignition composition **52**. Ignition composition **52** in turn ignites the grain assembly **56** which then becomes an ice forming catalyst removing moisture from the clouds and causing precipitation.

Most of the structural elements of the cartridge may be made of any suitable material, such as, for example, a lightweight metal or plastic.

A brief resume of the operation of the invention is as follows: Upon firing, and electric primer **18** ignites the powder **22** ejecting the ignition safety **12** and the pyrotechnic **14** from the cartridge case **20**. As the ignition safety **12** and the pyrotechnic **14** begins to move the cartridge case cap **64** is forced from its seat in the end of cartridge case **20**, thereby allowing the charge case **50** to move freely out of the cartridge **20**. When the slider **44** moves past the lip of cartridge case **20** spring **40** forces the slider **44** to align the detonator **46** with delay composition **34**, which has been ignited by a spark from the powder **22**, and the thin web portion on the rear of charge case **50**. Thereby, the detonator **46**, when ignited, is in position to erode through the thin web portion and ignite composition **52** which in turn ignites the grain assembly **56**. If, however, the slider does not pass the lips of the charge case **20**, the path between the delay composition **34** and the ignition composition **52** remains blocked by the web portion of charge case **50** even though detonator **46** will be ignited, thereby preventing the ignition composition **52** from being ignited. The charge case **20** is designed to be strong enough to withstand the force of the expanding gases without rupturing.

The invention has the advantage that unless the ignition safety **12** is ejected from the cartridge case **20** the pyrotechnic **14** will not be ignited, and therefore, will not be dangerous.

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 catalyst generator cartridge for cloud seeding comprising:

a pyrotechnic;

an ejector having a propellant for propelling said pyrotechnic into a cloud mass to be seeded and comprising a cartridge case from which said pyrotechnic is to be ejected when said propellant is ignited; and

ignition safety means positioned between said ejector and said pyrotechnic for preventing the ignition of said pyrotechnic until after said pyrotechnic has been ejected from said cartridge case;

wherein said pyrotechnic comprises;

a grain assembly which, when ignited, produces nuclei, wherein said nuclei are ice-forming catalysts,

an ignition composition, ignitable by said ignition safety, for igniting said grain assembly,

an annular ignition spacer positioned between said ignition safety and said grain assembly,

a charge spacer positioned adjacent said grain assembly, and

a cylindrical charge case closed at one end and having a removable charge case cover at the other end, and slideable within said cartridge case, for containing said ignition composition, said ignition spacer, said grain assembly, and said charge spacer;

wherein the central portion of said closed end has a reduced thickness from that of the peripheral portion of said closed end.

2. The cartridge of claim 1 wherein said ignition safety means comprises:

a delay composition;

a retaining ring;

a spring moveable slider containing a detonator ignitable by said delay composition, wherein said detonator is positioned out of alignment with said central portion of said closed end so that said detonator will not ignite said ignition composition when said cartridge case contains said ignition safety means;

a spring for moving said detonator into alignment with said central portion of said closed end after said ignition safety means is ejected from the cartridge case such that said detonator, when ignited, will erode through said central portion of said closed end and ignite said ignition composition; and

a fuze housing slidable within said cartridge case for containing said retaining ring, said delay composition, said slider, said detonator and said spring.

3. The cartridge of claim 2 wherein said ejector further comprises:

an electric primer for igniting said propellant;

a paper disc positioned adjacent said propellant;

a primer shield positioned adjacent said paper disc;

an annular primer spacer positioned adjacent said primer shield;

an annular obturator positioned between said primer spacer and said ignition safety means;

such that said propellant when ignited by said electric primer, will burn through said paper disc, erode through said primer shield, flash through the hole in said primer spacer, said obturator, and said retaining ring, and ignite said delay composition;

wherein said cartridge case contains said electric primer, said propellant, said paper disc, said primer shield, said primer spacer, said obturator, said ignition safety means and said pyrotechnic.

* * * * *

United States Patent Office

3,733,223
Patented May 15, 1973

3,733,223

NEAR INFRARED ILLUMINATING COMPOSITION

Carl W. Lohkamp, Bloomfield, Ind., assignor to the United States of America as represented by the Secretary of the Navy

No Drawing. Filed May 22, 1972, Ser. No. 255,333
Int. Cl. C06d 1/10
U.S. Cl. 149—19 4 Claims

ABSTRACT OF THE DISCLOSURE

An illuminating composition which, upon burning, produces infrared radiation in the 0.74–1.2 micron region of the spectrum. The produced radiation can be utilized to produce irradiance upon a target to improve the range and resolution of a night viewing device. The composition is comprised of silicon, hexamethylenetetramine, an epoxy binder, and an alkali metal nitrate selected from the group consisting of potassium nitrate, cesium nitrate and rubidium nitrate.

BACKGROUND OF THE INVENTION

The present invention relates to the production of infrared radiation by chemical means, and more particularly to the production of radiation in the 0.74–1.2 micron region of the spectrum with little visible light emission. This radiation may be utilized to produce irradiance upon a target being viewed with an image intensifier night viewing device and the irradiance greatly improves the range and resolution of these night viewing devices.

In the past, filtered search lights have been used to irradiate targets, however, there are various disadvantages to the use of search lights in a combat area. Search light systems are heavy and cumbersome and also require a source of power. Also the usefulness of search lights is affected by scattering as the radiation has to travel to the target, be reflected, and return.

SUMMARY OF THE INVENTION

The present invention relates to an illuminating composition which, when burned, will produce infrared radiation in the 0.74–1.2 micron region of the spectrum with little visible light emission. The composition is comprised of silicon, hexamethylenetetramine, an epoxy binder and an alkali metal nitrate selected from the group consisting of potassium nitrate, rubidium nitrate and cesium nitrate. The composition is pressed into a tube to make a pyrotechnic candle.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The near infrared illuminating composition of the present invention is comprised, by weight, of between 5 and 45 percent of silicon, between 5 and 30 percent of hexamethylenetetramine, between 2 and 20 percent of an epoxy binder and between 20 and 80 percent of an alkali metal nitrate. The composition is pressed into tubes at a pressure between 4,000 and 10,000 pounds per square inch and the candles formed can be placed in any conventional illuminating projectile or air-dropped illuminating round. The candle, during combustion, produces the desired radiation by emission from its reaction. The majority of the emission is due to atomic excitation-transition emission (line emission) and from molecular band emission. For maximum emission of a wavelength of 0.76 micron, potassium nitrate is used as the oxidizing material and for maximum emission in the 0.77–0.80 micron region, rubidium nitrate is used. When cesium nitrate is used in the composition, burning of the candle produces maximum emission in the 0.85–1.2 micron region.

The following examples will serve to further illustrate the present invention but are not meant to limit it thereto.

EXAMPLE I

	Percent (by weight)
Silicon	10
Potassium nitrate	70
Hexamethylenetetramine ($C_6H_{12}N_4$)	16
Epoxy resin (D.E.R. 321)	2.8
Epoxy hardener (D.E.H. 14)	1.2

The epoxy material is mixed with the silicon and then the other ingredients are added and thoroughly mixed. The composition was pressed at 4000 p.s.i. to form a candle approximately 1¼ inches in diameter and 1¼ inches in length. The candle was then cured at room temperature for 48 hours. The candle burned for about 1½ minutes and produce infrared radiation having a maximum emission at 0.76 microns.

The epoxy resin and hardener were obtained from The Dow Chemical Company, Midland, Mich. The resin and hardener are marketed by The Dow Chemical Companyl under the trademarks D.E.R. 321 and D.E.H. 14. The epoxy resin is a liquid epoxy resin of the Bispherol A epichlorohydrin type containing cresyl glycidyl ether.

EXAMPLE II

	Percent (by weight)
Silicon	10
Rubidium nitrate	60.8
Hexamethylenetetramine ($C_6H_{12}N_4$)	23.2
Epoxy resin (D.E.R. 321)	4 2
Epoxy hardener (D.E.H. 14)	1.8

The ingredients were mixed and pressed as in Example I to produce a candle 1¼ inches in diameter and 1¼ inches in length. The candle burned for about 1½ minutes and produced infrared radiation having maximum emission in the 0.77–0.80 micron region.

EXAMPLE III

	Percent (by weight)
Silicon	16.3
Cesium nitrate	78.7
Epoxy resin (D.E.R. 321)	3.3
Epoxy hardener (D.E.H. 14)	1.7

The ingredients were mixed and pressed as in Example I to produce a candle 1¼ inches in diameter and 1¼ inches in length. The candle burned for about 30 seconds and produced infrared radiation having maximum emission in the 0.85–1.2 micron region.

Burning of the candles produced in the above examples generated near infrared emission with little visible emission. The hexamethylenetetramine serves as a burning rate controller and slows up the burning time for the candle. The candle produced in Example III did not contain any hexamethylenetetramine and burned three times faster than the candles produced in Examples I and II.

I claim:

1. An illuminating flare composition for generating near infrared radiation having wave length in the .76 to 1.2 micron region of the spectrum with little visible emission comprised of

between 5 and 45 percent, by weight, of silicon,

between 20 and 80 percent, by weight, of an alkali metal nitrate selected from the group consisting of potassium nitrate, cesium nitrate and rubidium nitrate,

between 5 and 30 percent, by weight, of hexamethylenetetramine, and

between 2 and 20 percent, by weight, of epoxy binder.

2. An illuminating flare composition as set forth in claim 1 wherein said alkali metal nitrate is potassium nitrate and said composition upon burning generates maximum emission at 0.76 micron.

3. An illuminating flare composition as set forth in claim 1 wherein said alkali metal nitrate is rubidium nitrate and said composition upon burning generates maximum emission in the .77 to .80 micron region of the spectrum.

4. An illuminating flare composition as set forth in claim 1 wherein said alkali metal nitrate is cesium nitrate and said composition upon burning generates maximum emission in the .85 to 1.2 micron region of the spectrum.

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CARL D. QUARFORTH, Primary Examiner

E. A. MILLER, Assistant Examiner

U.S. Cl. X.R.

149—43, 44, 61

United States Patent [19]

Beatty et al.

[11] **3,724,385**

[45] **Apr. 3, 1973**

[54] **FUZE HAVING A PNEUMATIC AND INERTIA ARMING SYSTEM**

[75] Inventors: **Bobby D. Beatty, Bloomfield; Gary D. Butts, Loogootee; Stanley J. Herold, Switz City; Donald E. LaGrange, Washington, all of Ind.**

[73] Assignee: **The United States of America as represented by the Secretary of the Navy**

[22] Filed: **Sept. 20, 1971**

[21] Appl. No.: **181,791**

[52] U.S. Cl. **102/81, 102/78**

[51] Int. Cl. **F42c 5/00**

[58] Field of Search **102/81, 76, 75, 70**

[56] **References Cited**

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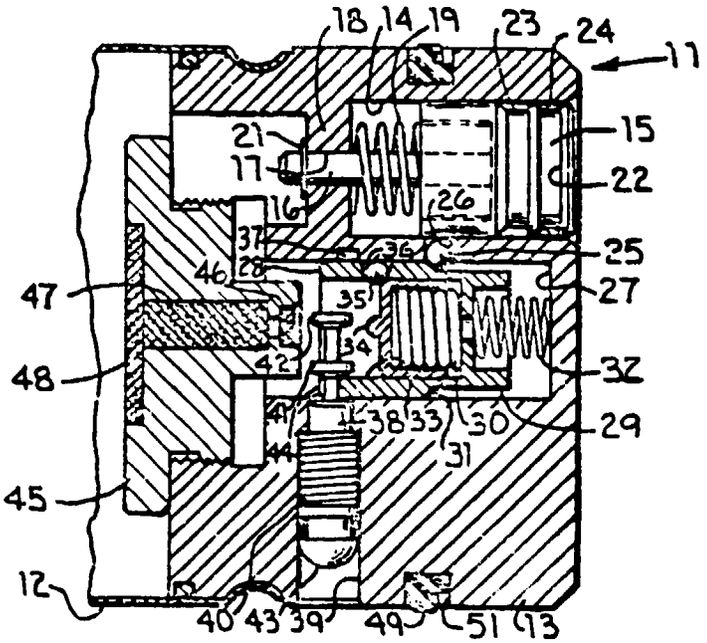
Primary Examiner—Samuel W. Engle

Attorney—R. S. Sciascia et al.

[57] **ABSTRACT**

A fuze for a pyrotechnic device having a firing pin for detonating a primer. An inertia sleeve is provided for preventing forward movement of the firing pin until a pneumatic latch is operated by the pressure supplied by a launching force. A borerider pin is also provided for preventing detonation of the primer while the fuze is inside a launcher barrel.

2 Claims, 6 Drawing Figures



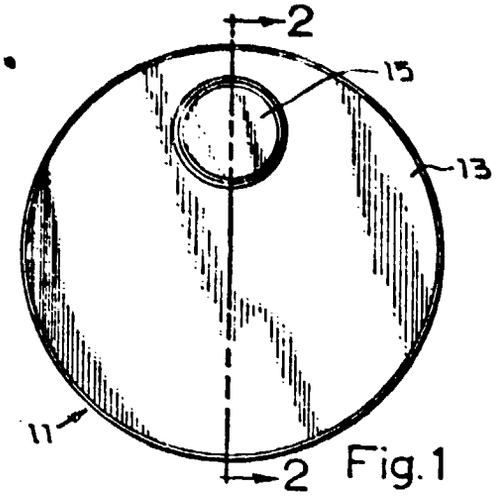


Fig. 1

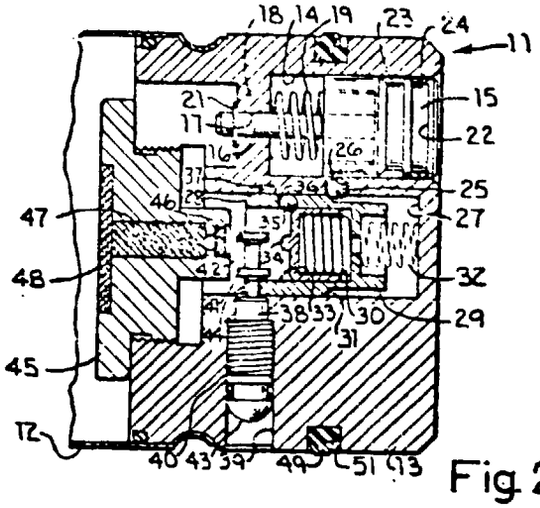


Fig. 2

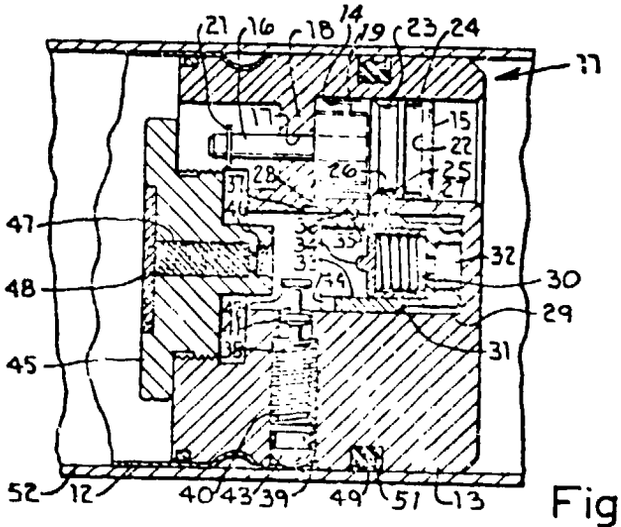


Fig. 3

SHEET 2 OF 2

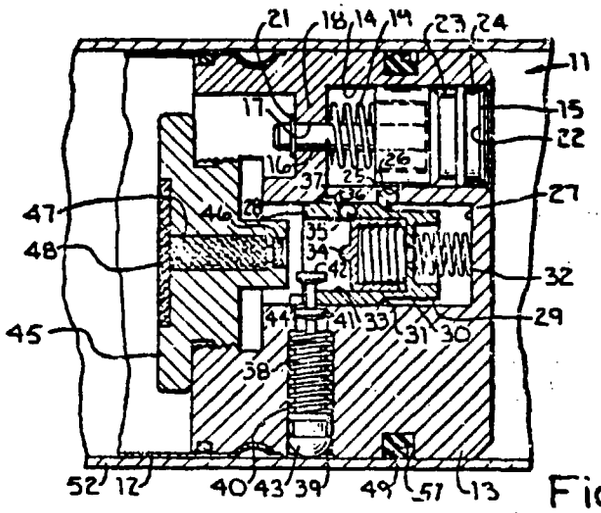


Fig. 4

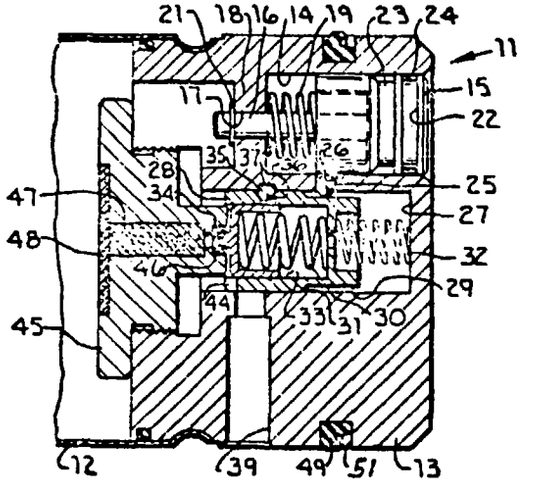


Fig. 5

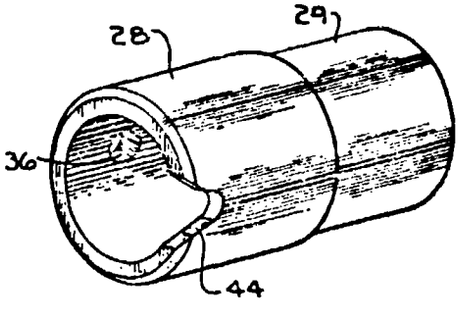


Fig. 6

FUZE HAVING A PNEUMATIC AND INERTIA ARMING SYSTEM

STATEMENT OF GOVERNMENT INTEREST

BACKGROUND OF THE INVENTION

The present invention relates to a fuze for a pyrotechnic device, such as a flare, and more particularly relates to a fuze having safety features to prevent accidental arming of the fuze.

Various safety devices are employed to prevent accidental arming and premature ignition of ordnance devices, as ignition of flares, or explosion of bombs or missiles, while aboard a ship or plane, creates a highly dangerous condition. Frequently, an arming pin, or wire, is provided to prevent actuation of a firing pin until the arming pin is removed. For example, in U.S. Pat. No. 3,316,841, which issued May 2, 1967, to Charles E. McFann and Arnold S. Munach, there is shown a bomb fuze having an arming pin passing through a housing and shaft thereby locking all movable elements of the fuze until the arming pin is removed.

Another device for arming a fuze uses a setback slide mechanism which responds to setback forces developed during acceleration to arm the fuze. Such a device is shown in U.S. Pat. No. 3,339,488, which issued Sept. 5, 1967, to Julius Borchers. In this patented device, movement of a setback slide pivots a lever and initiates a timing mechanism to release a detonator carrier which moves into an armed position.

SUMMARY OF THE INVENTION

The present invention relates to a fuze that is to be attached to an ordnance item, such as a pyrotechnic flare, and which is to be launched through a launching barrel. A setback slide is provided which carries a spring-loaded firing pin and forward movement of the setback slide and firing pin is prevented by a borerider pin. Aft movement of the setback slide is prevented by a locking mechanism which is unlocked by the pressure applied for launching the ordnance item. In the event that the setback slide is unlocked and moves rearward, if the ordnance item does not clear the barrel, the borerider pin is provided with means for preventing actuation of the firing pin.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a top view showing a preferred embodiment of the present invention;

FIG. 2 is a partial sectional view taken on line 2—2 of FIG. 1;

FIG. 3 is a partial sectional view similar to FIG. 2 of the drawing showing the fuze in a launching condition;

FIG. 4 is a partial sectional view similar to FIG. 3 of the drawing showing the fuze in a malfunctioning condition;

FIG. 5 is a partial sectional view showing a location marker leaving a launching tube; and

FIG. 6 is a perspective view of a setback slide.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring first to FIGS. 1 and 2 of the drawings, there is shown a fuze section 11 having a cylindrical container 12 crimped to the forward end thereof. Fuze section 11 is comprised of a housing 13 having a bore 14 in the aft end in which a pneumatic button 15 is slidably mounted. A shaft 16 is attached to the inner end of pneumatic button 15 and shaft 16 passes through a bore 17 in wall 18 of housing 13. A compression spring 19 is provided around shaft 16 between wall 18 and button 14, and a retaining ring 21 is provided on the end of shaft 16 to retain button 15 within housing 13. Button 15 is provided with two annular grooves 22 and 23. A sealing ring 24 is positioned in groove 22 and groove 23 is arranged to receive a ball 25 that is positioned in a hole 26 that communicates between bore 14 and a second bore 27 in housing 13.

A cylindrical setback slide 28 is positioned in bore 27 and setback slide 28 is provided with a reduced diameter portion 29 that joins the enlarged diameter portion of slide 28 by a tapered surface 31. A spring 32 is provided between one end of setback slide 28 and the end of bore 27 to bias setback slide 28 in a forward direction. A bore 33 is provided in setback slide 28 and a firing pin 34 is slidably positioned in bore 33 of setback slide 28. A ball 35 is provided for locking firing pin 34 in a cocked position and a spring 30 is provided for driving firing pin 34 when firing pin 34 is released. Ball 35 is positioned in a tapered hole 36 in setback slide 28 and the diameter of ball 35 is sufficiently large to extend into bore 27 of setback slide 28 and prevent forward movement of firing pin 34. A hole 37 is provided in housing 13 to receive ball 35 when setback slide 28 moves forward to permit release of firing pin 34.

A borerider pin 38 is provided in hole 39 of housing 13 and borerider pin 38 has a pair of enlarged diameter portions 41 and 42 and a hemispherical portion 43. A spring 40 is positioned in hole 39 for biasing borerider pin 38 outwardly from hole 39. As best shown in FIGS. 2 and 6 of the drawings, setback slide 28 has a slot 44 which is sufficiently large to accept pin 38 but prevents the passage of enlarged diameter portions 41 and 42. A fuze cap 45 is threadedly attached to housing 13 and contains a primer 46, delay pellet 47 and ignition pellet 48. As one method of launching the fuze and attached ordnance item is by compressed air, a sealing ring 49 of resilient material is provided around the outer periphery of housing 13 in an annular groove 51 to prevent excessive leakage of air between the outer perimeter of fuze section 11 and the inner surface of a launching tube 52.

OPERATION

Upon launching fuze section 11 and the associated ordnance item, the propelling force, such as that created by an explosion, or such as compressed air, moves pneumatic button 15 against the force of spring 19 and groove 23 becomes aligned with hole 26 in housing 13. Ball 25 is now free to move partially into groove 23 so that setback slide 28 will no longer be in a locked condition. As fuze section 11 is accelerated through launching tube 52, the inertia of setback slide

28 causes spring 32 to be compressed and setback slide 28 moves rearwardly to release borerider pin 38, as shown in FIG. 3 of the drawings. Firing pin 34, however, remains locked with setback slide 28. Spring 40 moves borerider pin 38 so that hemispherical portion 43 contacts launching tube 52.

Referring now to FIG. 4 of the drawings, a malfunction condition is shown wherein fuze section 11 has not cleared launching tube 52, but is no longer in motion. Spring 32 will drive setback slide 28 to its original position against borerider pin 38 and firing pin 34 remains in a locked condition by ball 35. In the event that fuze section 11 is removed manually from launching tube 52, the enlarged diameter 42 of borerider pin 38 prevents spring 40 from driving borerider pin 38 out of hole 39.

Referring now to FIG. 5 of the drawings, fuze section 11 has cleared launching tube 52 and spring 40 has driven borerider pin 38 out of hole 39. After the setback force created by the acceleration of the device has diminished, spring 32 drives setback slide 28 forward, as borerider pin 38 is not now present to prevent movement. When tapered hole 36 in setback slide 28 becomes aligned with hole 37 in housing 13, ball 35 moves partially into hole 37 and firing pin 34 becomes unlocked. Firing pin spring 30 then drives firing pin 34 into primer 46 and the detonation of primer 46 ignites delay pellet 47 which, in turn, ignites ignition pellet 48.

It can thus be seen that two sequential events must take place before primer 46 is detonated by firing pin 34. First, pneumatic button 15 must be depressed to release ball 25 and, while button 15 is in this position, setback slide 28 must move in an opposite direction to the movement of button 15, in order to release borerider pin 38. For example, an accidental dropping of the fuze will not release firing pin 34, as two forces acting in opposite directions are required for this actuation.

We claim:

1. A fuze for a pyrotechnic device comprising,
- a housing having first and second longitudinally extending parallel bores,
- a setback slide slidably positioned in said first longitudinally extending bore, said setback slide having a reduced diameter portion,
- a pneumatic button slidably positioned in said second longitudinally extending bore, said pneumatic button having an annular groove in its periphery,
- a firing pin slidably mounted within said setback slide,
- spring means for actuating said firing pin,
- releasable means for locking said firing pin in said setback slide,
- a borerider pin releasably connected to said setback slide and having means for preventing actuation of said firing pin,
- a primer ignitable by said firing pin, and
- a locking ball in said housing engageable with said reduced diameter portion of said setback slide for locking said setback slide in said housing, said locking ball being receivable in said annular groove of said pneumatic button for unlocking said setback slide whereby said firing pin is actuated upon forward movement of said pneumatic button, then rearward movement of said setback slide, followed by forward movement of said setback slide.

2. A fuze for a pyrotechnic device as set forth in claim 1 wherein said releasable means for locking said firing pin in said setback slide comprises a second locking ball engageable with the forward end of said firing pin, and a hole in said housing for receiving a portion of said second locking ball thereby unlocking said firing pin.

* * * * *

United States Patent [19]

Calkins et al.

[11] **3,724,375**

[45] **Apr. 3, 1973**

[54] ILLUMINATING FLARE HAVING HIGH DRAG CONFIGURATION

[75] Inventors: **Burton H. Calkins**, Bloomington, Ind.; **Dale L. Carstens**, Sault Sainte Marie, Mich.; **James J. Riester**, Bloomington, Ind.

[73] Assignee: **The United States of America as represented by the Secretary of the Navy**

[22] Filed: **Apr. 6, 1970**

[21] Appl. No.: **31,040**

[52] U.S. Cl. **102/31**, 102/35, 102/37.6

[51] Int. Cl. **C06d 1/04**

[58] Field of Search.....102/37.5, 31, 37.6, 1, 79, 102/99, 100, 101, 102, 103, 37.8

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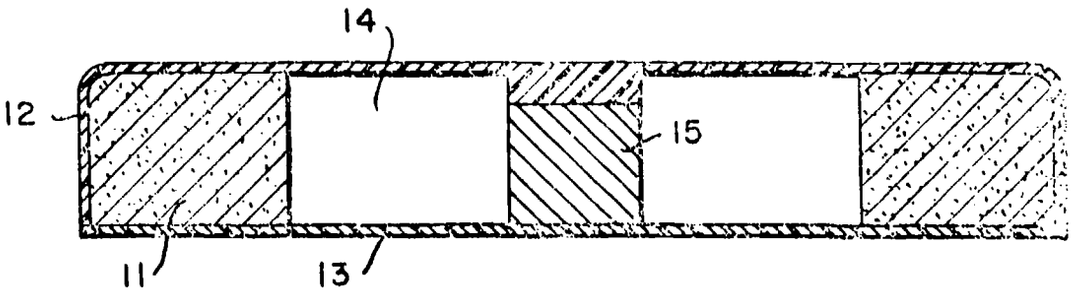
Primary Examiner—Robert F. Stahl

Attorney—R. S. Sciascia, H. H. Losche and Paul S. Collignon

[57] **ABSTRACT**

A flat, circular flare having a thin-walled plastic case containing a disk of pyrotechnic material provided with a star-center and having a fuze means for igniting said pyrotechnic material. The flat, circular flare is launched from an aircraft by spinning and the flare floats or sails to the ground while burning.

2 Claims, 2 Drawing Figures



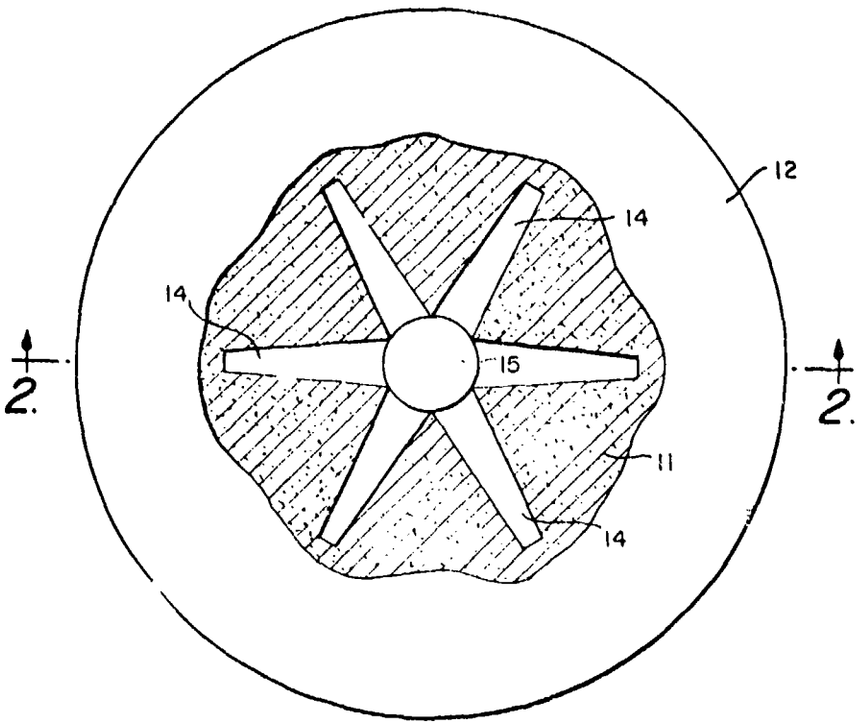


FIG. 1.

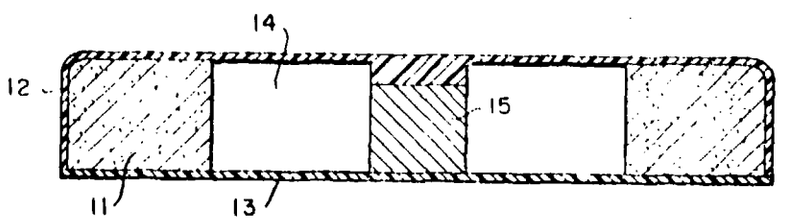


FIG. 2.

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BY DALE L. CARSTENS
H. B. Tracy
Paul S. Collignon

ILLUMINATING FLARE HAVING HIGH DRAG CONFIGURATION

STATEMENT OF GOVERNMENT INTEREST

BACKGROUND OF THE INVENTION

The present invention relates to an illuminating flare and more particularly to an illuminating flare that is to be launched from an aircraft for the purpose of illuminating the area below the aircraft.

Various types of illuminating flares are presently available for dropping from an aircraft and consist basically of a cannister or container of pyrotechnic composition which is suspended by a parachute. Such a device is shown in U.S. Pat. No. 1,755,388 which issued Apr. 22, 1930, to George Clark and Ernest Jones. While various improvements to aircraft parachute flares have been made over the years, particularly with improved ignition devices and better illuminating compositions, practically all flares still utilize a parachute to slow the descent of the flare in its fall to the ground.

The use of a parachute on an illuminating flare, however, has several disadvantages, one of which is the high cost of manufacturing and rigging the parachute. Also, after the illuminating composition is consumed, the empty container attached to the parachute does not have much weight and the unit may float and drift for considerable time and provide a hazard to air traffic. This problem of drifting aircraft parachute flares is of particular concern in a military zone where hundreds of flares may be dropped in a very short time.

SUMMARY OF THE INVENTION

The present invention relates to an illuminating flare that is designed for launching from an aircraft without using a parachute. A cast or pressed disk of illuminating composition is housed in a thin-walled plastic container and a fuze is provided in the center of the disk to ignite the composition. The flare is launched by spinning about an axis perpendicular to a flat disk surface and gyroscopic forces are generated which retard the motion of the disk toward a low drag attitude.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a top plan view, partially broken away, showing a preferred embodiment of the present invention; and

FIG. 2 is a sectional view taken on line 2—2 of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawing, there is shown a circular disk 11 of illuminating composition that is enclosed by housing 12 and cover 13. By way of example, the illuminating composition might be comprised of about 58 percent of granulated magnesium, about 37.5 percent of sodium nitrate and about 4.5 percent of a resinous binder. Housing 12 is preferably made of a thermosetting plastic material and cover 13 is preferably made of a thermoplastic material. A star-shaped center cavity 14 is provided to facilitate burning of the illuminating composition.

An arming fuze 15 is provided at the center of the star cavity to ignite the illuminating composition. By way of example, arming fuze 15 might be of the spin to arm type which are well-known in the fuze art. Generally, these spin to arm fuzes require a first spin rate to arm the fuze and then, upon decay of the spin rate, the fuze will function to actuate a firing pin which strikes a primer.

Circular disk 11 is designed to meet the aerodynamic requirements of a high drag flat plate and the ratio of the disk diameter to its thickness must be at least 6 to 1. As flat plates exhibit high drag only when the broad side of the plate is perpendicular to the air flow, without some stabilizing force a flat plate will not free fall in a high drag mode. By spinning the disk about an axis perpendicular to the flat plate, gyroscopic forces are generated that retard the motion of the plate toward a low drag attitude.

By calculations and experiments conducted at Naval Ammunition Depot, Crane, Indiana, it has been determined that illuminating flare with star-shaped cavities that burn from the center out in the fashion of a rocket grain, burn with normal efficiency of 40,000 CP-sec/gram. Also it has been determined that as a five million candlepower flare falls from an altitude of 3,500 feet to an altitude of 1,000 feet, there is a circular area on the ground one mile in diameter that is illuminated to a minimum of 0.2 lumens per square foot. Twelve pounds of illuminating composition comprised of about 58 percent of granulated magnesium, about 37.5 percent of sodium nitrate and about 4.5 percent of a resinous binder, burning at 40,000 CP-sec./gram will produce five million candlepower for a period of 43.6 seconds. It was determined that 12 pounds of illuminating composition could be pressed into a circular disk of 12 inches in diameter and 2 inches thick. During burning, the disk will loose mass at the rate of 0.207 pounds per second and, while burning, will fall about 2700 feet.

We claim:

1. An illuminating flare having high drag configuration comprising:
   - a circular disk of illuminating composition having a diameter to thickness ratio of at least 6 to 1,
   - a plastic container enclosing said circular disk of illuminating composition, and
   - means positioned in the center of said circular disk for igniting said circular disk of illuminating composition whereby upon ignition said illuminating composition burns from the center outwardly toward the edge.

2. An illuminating flare as set forth in claim 1 wherein a star-shaped cavity is provided in the center of said circular disk of illuminating composition to facilitate burning.

* * * * *

United States Patent [19]

Dare et al.

[11] **3,713,394**

[45] **Jan. 30, 1973**

[54] SMOKE SIGNAL DEVICE

[75] Inventors: Sherman E. Dare, Wheatland; Davey S. Haas, Bloomington; Stanley J. Herald, Switz City; Steven R. Norris, Wheatland; Terry V. Patterson, Bloomington; Robert E. Sloan, Linton, all of Ind.

[73] Assignee: The United States of America as represented by the Secretary of the Navy

[22] Filed: March 1, 1971

[21] Appl. No.: 119,765

[52] U.S. Cl. ..... 102/90, 42/1 F, 102/65.2

[51] Int. Cl. F42b 11/24

[58] Field of Search ..... 102/65.2, 90, 87, 66; 42/1 F

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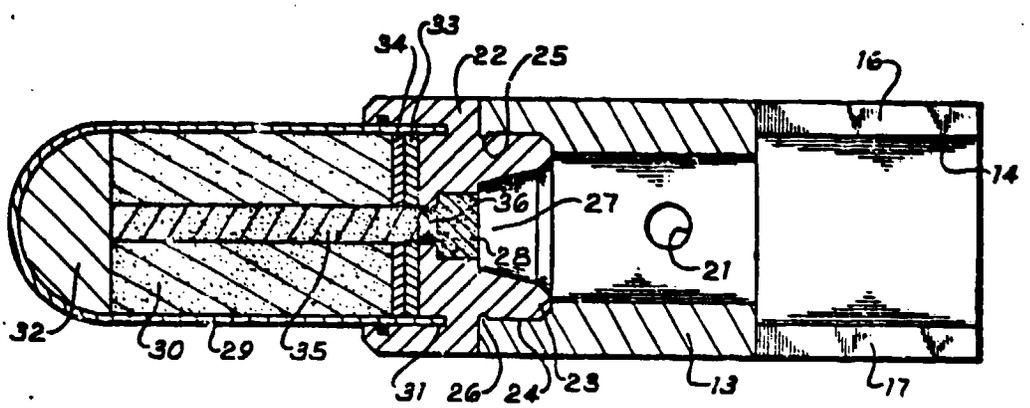
[57] ABSTRACT

A smoke signal device adaptable for attaching to a pistol and being launched by firing the pistol. An adapter is provided which slip-fits onto a pistol barrel and a base having a percussion primer therein is removably attached to the adapter. A case having a quantity of smoke-producing composition therein is attached to the forward end of the base and an ignition train is provided to ignite the smoke-producing composition upon detonation of the percussion primer. The case is separated from the base upon ignition and a trailing smoke signal is emitted from the case during flight.

4 Claims, 2 Drawing Figures



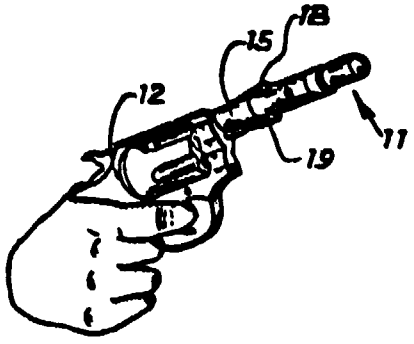


Fig.1

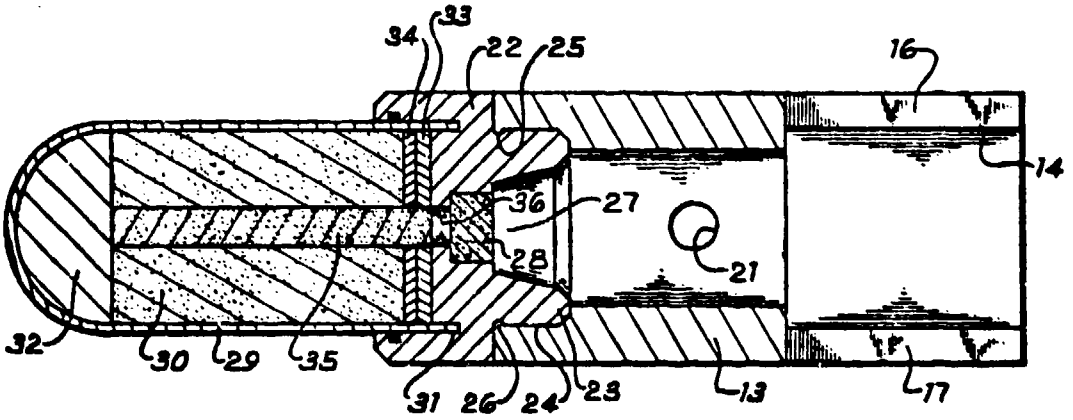


Fig.2

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SMOKE SIGNAL DEVICE

STATEMENT OF GOVERNMENT INTEREST

BACKGROUND OF THE INVENTION

The present invention relates to a signalling device and more particularly to a signaling device which can be launched by firing a pistol.

Various devices have been employed in the past to launch a pyrotechnic flare by a hand-held device. One relatively small device for launching flares is shown in U. S. Pat. No. 3,044,360, which issued July 17, 1962, to Russell O. Stefan and Anton G. Lang. A guide tube having a bore therein is provided with a cylindrical firing pin that is spring biased by an expansive coil spring. The lower end of the tube is closed by a threaded plug and the opposite, or upper end, is threaded. A flare cartridge is provided with an externally threaded nipple which is threadedly engageable in the upper end of the tube.

In U. S. Pat. No. 3,102,477, which issued Sept. 3, 1963, to Russell O. Stefan and Anton G. Lang, there is shown a device similar to that shown in U. S. Pat. No. 3,044,360, except there is shown an improved flare cartridge. In this patented device, the fuse charge is ignited in a manner to delay its burning and thus assure that a substantial portion of the mass of the fuse will remain unconsumed during a considerable portion of the upward flight of the projectile, thereby contributing to the momentum aiding in the ascent of the projectile and deferring the ignition of the signal charge until the projectile has reached an altitude where it will be an effective signal. The device of U. S. Pat. No. 3,102,477, like that of U. S. Pat. No. 3,044,360, threadedly connects the projectile to the launcher.

While the devices of the above-mentioned patents perform adequately, they have a disadvantage in that the operator needs both hands to assemble the projectile to the launcher and also to disassemble the projectile after firing. Also, the time required to threadedly attach and disconnect the projectile to the launcher is relatively long and flares or signals cannot be rapidly launched.

In U. S. Pat. No. 3,315,397, which issued Apr. 25, 1967, to Clarence W. Gilliam et al, a launching device is shown having a circumferential groove on one end that engages with a quick disconnect device that is provided on the outer end of the projector tube. The quick disconnect consists of a plurality of balls that are separately retained in tapered holes that are of such dimensions that a portion of the balls extend into the inner diameter of the tube. A spring-biased sleeve is provided on the outer diameter of the tube and the inner bore of this sleeve is provided with a tapered portion that is engageable with the balls. Lateral movement of the sleeve causes the balls to move inwardly or outwardly, depending upon the direction of travel of the sleeve. The balls are engageable with the circumferential groove to lock the projectile case to the projector tube.

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SUMMARY OF THE INVENTION

The present invention relates to a signaling device which can be attached to barrel of a pistol and is launched by firing the pistol. An adapter is provided for fitting the signaling device onto a barrel and a base having a percussion cap therein is connected to the adapter. A case having a quantity of smoke-producing composition is attached to the forward end of the base and an ignition train is provided to ignite the composition upon detonation of the percussion cap by a projectile fired from the pistol. During flight, the case is separated from the base and a trail of colored smoke is emitted from the aft end of the case.

It is therefore a general object of the present invention to provide a signaling device which can be fired from a pistol and thus eliminate the need for a special launching device.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a diagrammatic view showing a signaling device attached to a hand-held pistol; and

FIG. 2 is an enlarged sectional view showing a preferred embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring first to FIG. 1 of the drawing, there is shown a preferred embodiment of the invention wherein a smoke signaling device 11 is shown attached to a pistol 12. Referring now to FIG. 2 of the drawing, the smoke signaling device 11 has an adapter 13 that has a bore 14 on one end to slip-fit onto the outside of a pistol barrel 15. A pair of slits 16 and 17 are provided to permit clearance for the front sight 18 and locking lug 19 on pistol 12. A pair of holes 21 are provided in adapter 13 forward of bore 14 to permit escapage of gas generated by firing pistol 12.

A base 22 is provided with a reduced diameter portion 23 which fits into a second bore 24 of adapter 13. A groove 25 is provided in reduced diameter portion 23 and a bead 26 is provided on the forward end of adapter 13 and snaps into groove 25 to hold base 22 to adapter 13. A central bore 27 is provided in base 22 and a percussion primer 28 is positioned in bore 27. Percussion primers are commercially available and, by way of example, might be obtained from the Federal Cartridge Corp., Anoka, Minn. (Part No. 210) or from Olin Mathieson Chemical Corp., Winchester-Western Div., East Alton, Ill., (Part No. 120M).

A case 29 is attached to the forward end of base 22 and a quantity of smoke-producing composition 30 is provided within case 29. As shown in FIG. 2 of the drawing, a groove 31 is provided in the forward end of base 22 and accommodates the aft end of case 29. Ballast 32, such as a quantity of lead, is provided in the forward end of case 29 to provide stability during flight. An ignition agent 33 and transfer agent 34 are provided in the aft end of case 28 near percussion primer 28. An ignition fuze 35 is provided to ignite the smoke-producing composition upon ignition of transfer agent 34. An orifice 36 is provided in base 22 to permit passage of heat and flame produced by the detonation of primer 28. By way of example, the smoke-producing composition 30 might be comprised, by weight, of about 15.1

percent of Disperse Red 9 dye, about 15.1 percent of Fluorescent Red dye, about 22.6 percent of potassium chlorate, about 2.0 percent of potassium bicarbonate, about 11.0 percent of sugar and about 34.2 percent of binder solution comprised, by weight, of about 8 percent of cellulose nitrate camphor and about 92 percent of acetone. Also by way of example, ignition agent 33 might be comprised, by weight, of about 80 percent of red lead, about 16 percent of powdered silicon and about 4 percent of a copolymer binder comprised of about 79 mole percent of vinylidene fluoride and about 21 mole percent of hexafluoropropylene. Transfer agent 34 might be comprised, by weight, of about 60.7 percent of potassium nitrate, about 8.8 percent of powdered amorphous boron, about 27 percent of atomized aluminum and about 3.5 percent of the same copolymer binder used in the ignition agent.

OPERATION

In operation, the smoke signaling device 11 is first positioned on pistol 12, with slits 16 and 17 being aligned to provide clearance for front sight 18 and locking lug 19 on pistol 12. Pistol 12 is then aimed and fired, and the bullet which is fired strikes percussion primer 28. The momentum of the striking bullet will cause the entire assembly of smoke signaling device to be projected from the pistol, however, detonation of percussion primer 28 will cause adapter 13 to be separated from base 22 and adapter 13, which is light weight, will travel only a short distance from the pistol.

The detonation of percussion primer 28 causes ignition agent 33 to be ignited which, in turn, ignites transfer agent 34 and smoke-producing composition 30. The gases generated by the combustion of these burning products causes case 29 to be separated from base 22 and a smoke trail is emitted from the aft end of case 29 as it travels through the air. It should be noted that the flight of case 29 is due mainly to the impact of the bullet fired from pistol 12, rather than from any propulsion due from the burning of the smoke-producing composition 30. Devices embodying the present invention have been made and tested at the Naval Ammunition Depot, Crane, Ind., and have been observed to travel between 450 and 500 feet.

We claim:

1. A smoke signal adaptable for being launched by a projectile fired from a pistol comprising:

an adapter for receiving the barrel of a pistol,

a base separably attached to one end of said adapter and having a central cavity therein, said base being adaptable to be separated from said adapter during launch,

a percussion primer positioned in said central cavity of said base at a position opposed to the juncture of said adapter and said base and positioned to be detonated by a projectile fired through said barrel of said pistol, whereupon detonation of said primer separates said base from said adapter,

a cylindrical case separably attached to said base, said cylindrical case having a domed-shaped forward end,

a quantity of smoke-producing composition in said cylindrical case, and

fuze means for igniting said smoke composition upon detonation of said percussion primer by a projectile fired by said pistol whereby ignition of said smoke composition causes said case to be separated from said base.

2. A smoke signal as set forth in claim 1 wherein said adapter has at least one hole for venting gas generated by firing said pistol.

3. A smoke signal as set forth in claim 1 wherein said smoke-producing composition is comprised, by weight, of about 30.2 percent of red dye, about 22.6 percent of potassium chlorate, about 2 percent of potassium bicarbonate, about 11 percent of sugar and about 34.2 percent of binder.

4. A smoke signal as set forth in claim 3 wherein said binder is comprised, by weight, of about 8 percent of cellulose nitrate and about 92 percent of acetone.

* * * * *

United States Patent [19]

Abel et al.

[11] **3,712,232**

[45] **Jan. 23, 1973**

[54] **VARIABLE DELAY FUSE FOR AIRCRAFT PARACHUTE FLARE**

[75] Inventors: **Carroll Abel, Shoals; John R. Chilton, Bedford; James R. Luekiug, Bloomfield, all of Ind.**

[73] Assignee: **The United States of America as represented by the Secretary of the Navy**

[22] Filed: **Oct. 23, 1968**

[21] Appl. No.: **769,999**

[52] U.S. Cl. ..... **102/85.2, 89/1.5 D, 102/35.6, 102/85.6**

[51] Int. Cl. **F42c 9/10**

[58] Field of Search ..... **102/85.2, 85.6, 35.6; 89/1.5 D**

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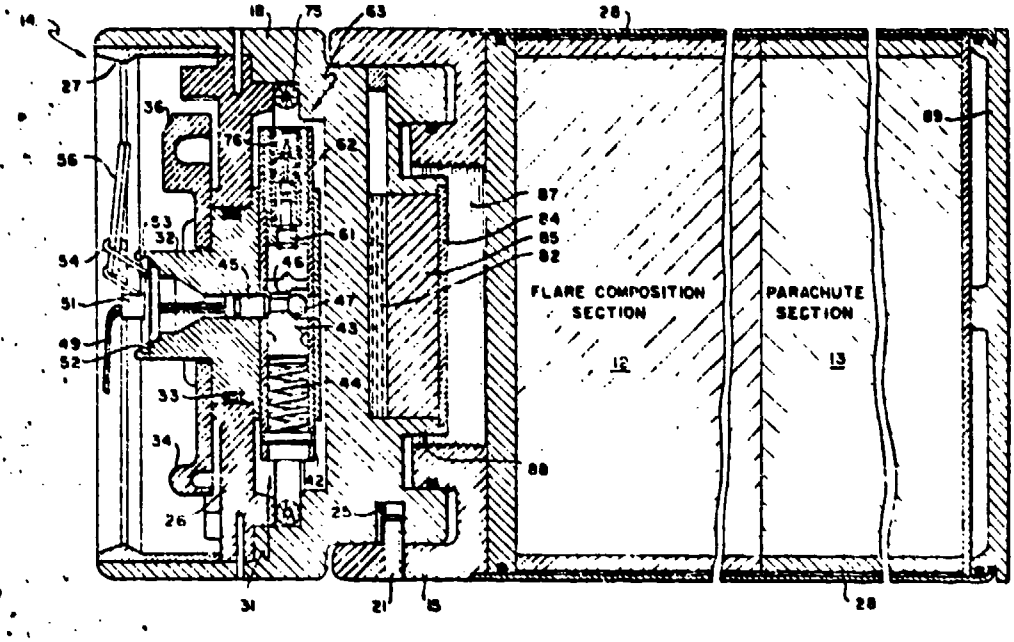
[57] ABSTRACT

A fuse and ejection device for an aircraft parachute flare having an expellant charge for separating a parachute and flare from an outer container, a stationarily mounted delay fuse for igniting the expellant charge, and a rotatable triggering device for selectively igniting different lengths of the delay fuse whereby the time of free fall of the parachute and flare within the outer container can be varied. A safety locking ring is provided to prevent accidental triggering of the expellant charge and the safety locking ring is first removed by the pull of a lanyard secured to a launching aircraft and then the lanyard pulls a disconnect pin which actuates the triggering device.

2 Claims, 9 Drawing Figures



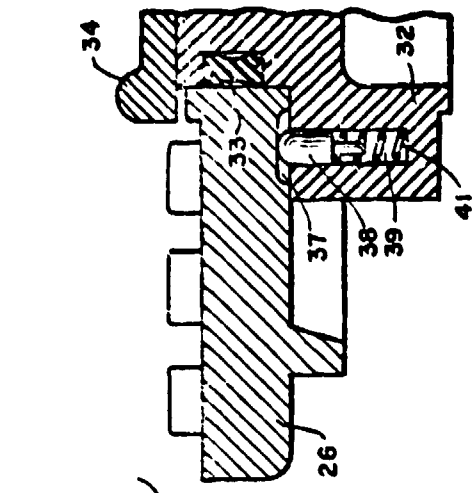


FIG. 5.

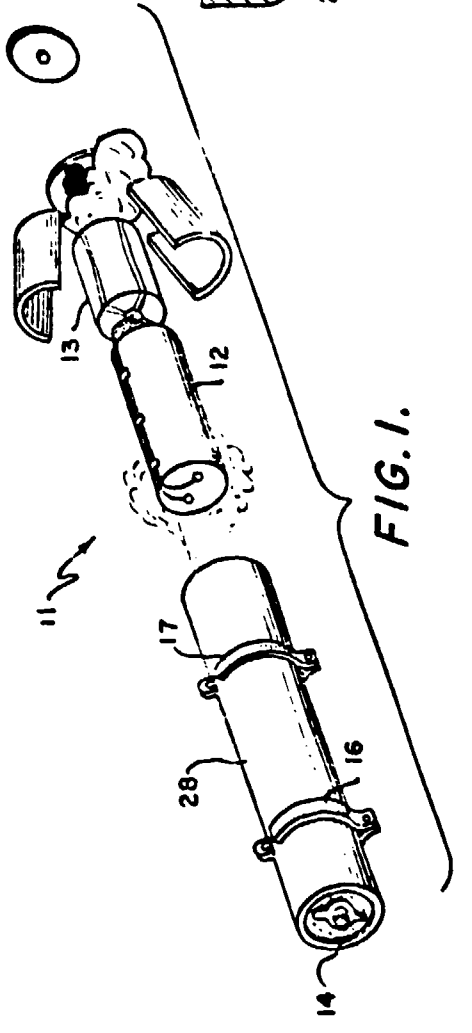


FIG. 1.

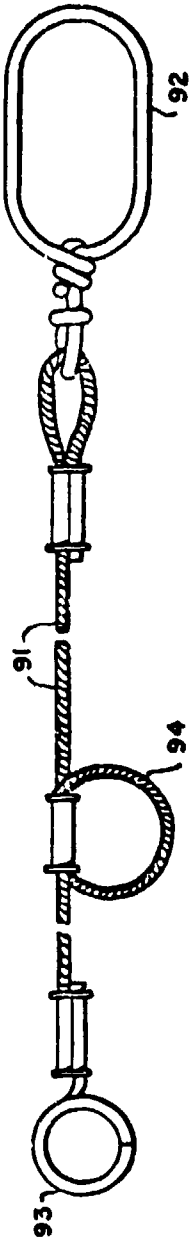


FIG. 9.

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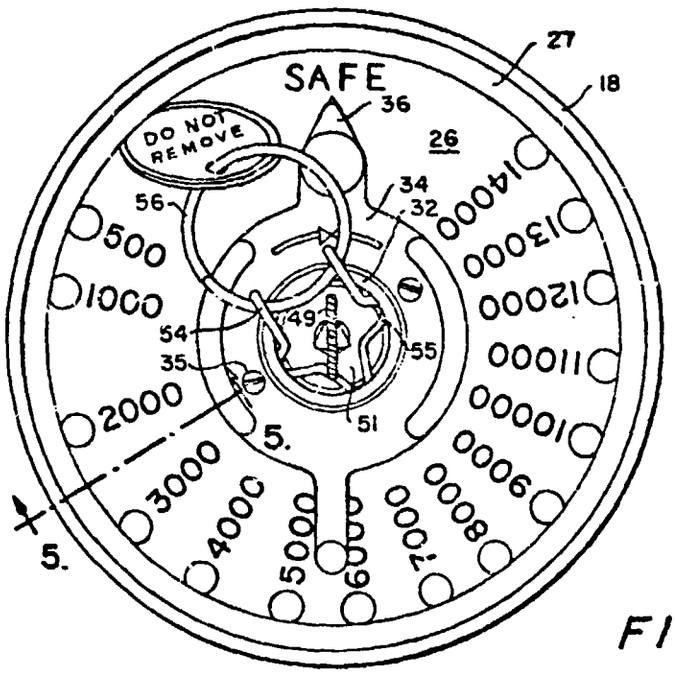

FIG. 2.

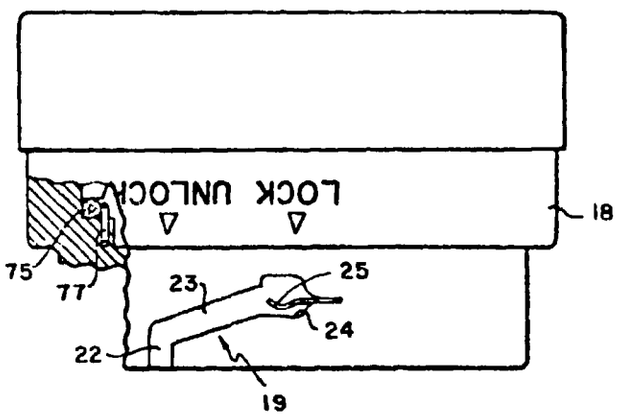

FIG. 4.

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PATENTED JAN 23 1973

3,712,232

SHEET 3 OF 4

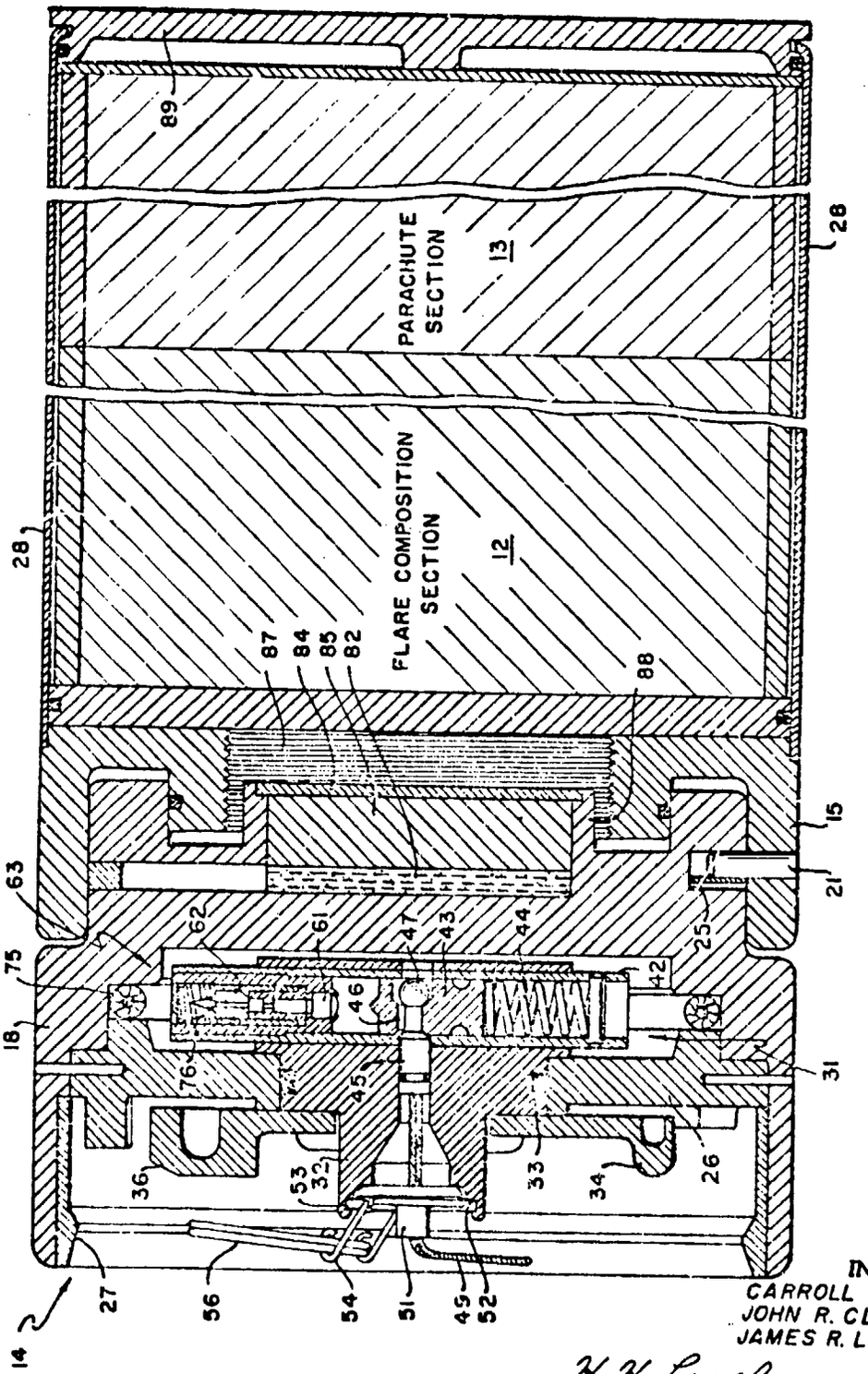

FIG. 3.

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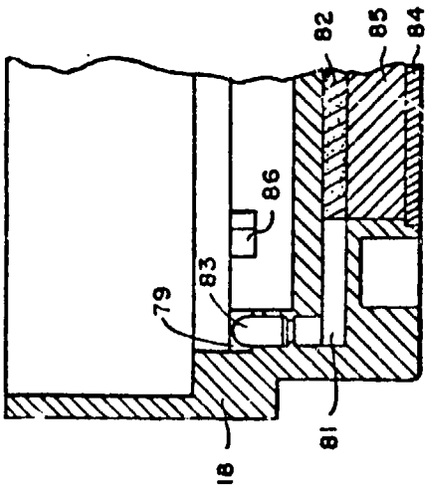

FIG. 7.

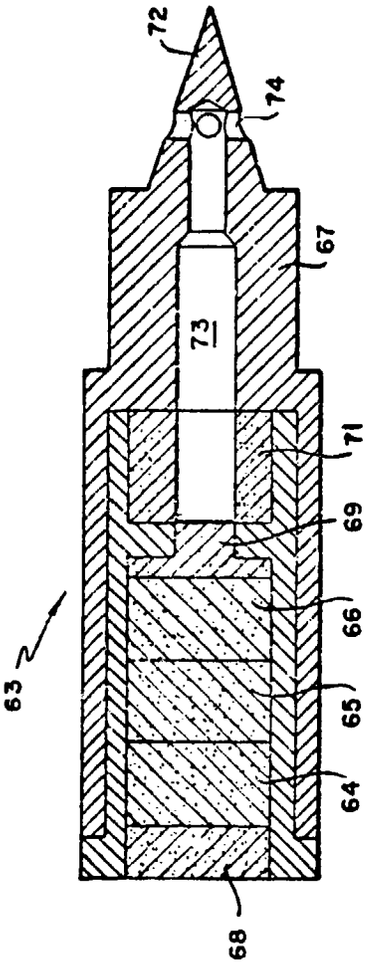

FIG. 8.

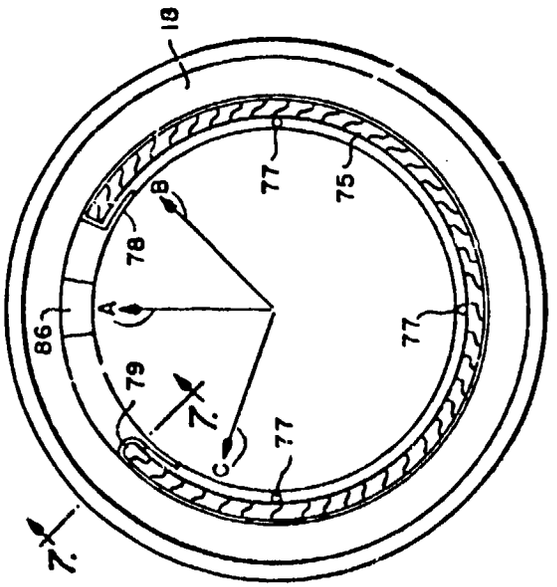

FIG. 6.

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VARIABLE DELAY FUSE FOR AIRCRAFT PARACHUTE FLARE

STATEMENT OF GOVERNMENT INTEREST

BACKGROUND OF THE INVENTION

The present invention relates to a delay fuse for an aircraft parachute flare and more particularly to a delay fuse having improved reliability and safety features.

An aircraft parachute flare is normally provided with three sections or components, namely a parachute, a section containing a pyrotechnic composition and a triggering mechanism. The triggering mechanism, in addition to igniting the pyrotechnic composition, frequently provides for a delay period so that the aircraft parachute flare can free fall a predetermined distance prior to parachute opening. This free fall feature permits the aircraft parachute flare to be launched or dropped from relatively high altitudes, but prevents ignition of the pyrotechnic composition until the parachute flare is at an altitude such that light from the flare will illuminate the ground below.

Various mechanisms and devices have heretofore been employed to provide a delay period between time of launch and ignition of the pyrotechnic composition. One mechanical device is shown in U.S. Pat. No. 2,144,056, which issued Jan. 17, 1939, to Ralph Halbach. In this patented device, a timing arrangement utilizing a standard clock mechanism is employed to actuate a locking bolt to produce an opening of the parachute casing whereupon the parachute is permitted to open and the flare is ignited.

Another type of timing mechanism is shown and described in U.S. Pat. No. 1,346,434, which issued July 13, 1920, to Harold Holt. In this timing mechanism a fuse is provided which has a fixed cap and base member with an intermediate member containing fuse material. The intermediate member is rotatable to provide different length of communication paths between an electric igniter and a quick match element which ignites the illuminating material.

As an aircraft parachute flare is an expendable item, possibly the most important features on these flares are the safety features which attempt to prevent accidental or premature ignition of the pyrotechnic composition. As the illuminating materials which are used in present day flares provide extreme heat upon burning, any accidental ignition of these flares could result in a catastrophic disaster, particularly if the flares are in storage aboard a ship. In order to provide some measure of safety, most present day flares are provided with a safety pin which is kept in position until the flare is mounted in a launching rack on an aircraft. In the event the aircraft returns with flares, the safety pins are reinserted.

SUMMARY OF THE INVENTION

The present invention relates to a variable delay fuse which is removably attached to an aircraft flare and which provides an adjustable delay period prior to initiating parachute opening and ignition of an illuminating composition. The variable delay fuse is provided with a safety locking ring which remains in position until the aircraft parachute flare is launched from an aircraft whereupon a lanyard attached to the aircraft causes the safety locking ring to be first removed and then the lanyard actuates a triggering means. The triggering means is rotatable relative to a stationarily attached fuse cord whereby different lengths of fuse cord can be ignited to provide different delay periods between time of launch and ignition of the illuminating composition. A safe position is provided for the triggering means and, when in this safe position, any accidental release of the triggering means will not ignite the fuse cord.

It is therefore a general object of the present invention to provide a fuse assembly which is removably attached to an aircraft parachute flare whereby the fuse can be stored separately from the illuminating composition and can be quickly assembled prior to use.

Other objects and advantages of the present invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a diagrammatic view showing a parachute flare being ejected from its case;

FIG. 2 is a top plan view of a preferred embodiment of the present invention;

FIG. 3 is a longitudinal sectional view of a preferred embodiment of the present invention;

FIG. 4 is a side view of a fuse housing showing locking slots;

FIG. 5 is a partial sectional view taken on line 5—5 of FIG. 2 and showing a detent arrangement;

FIG. 6 is a top plan view of a fuse housing;

FIG. 7 is a partial sectional view taken on line 7—7 of FIG. 6;

FIG. 8 is a sectional view showing an ejection plunger having delay elements; and

FIG. 9 is a plan view showing a lanyard assembly.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring first to FIG. 1 of the drawings, there is shown an aircraft parachute flare 11 which is in process of being opened. Basically, an aircraft parachute flare is comprised of a flare composition section 12 which contains an illuminating material, a parachute section 13, and a fuse section 14. The flare composition section 12 and parachute section 13 are contained in a container 28, to which the fuse section 14 is attached through adapter housing 15. Container 28 is attached to a launcher on an aircraft by means of brackets 16 and 17.

Referring now to FIGS. 3 and 4 of the drawings, it can be seen that fuse case 18 is provided with grooves 19 which engage with pins 21 in adapter housing 15 so that fuse section 14 can be removably attached to adapter housing 15. By way of example, three equally spaced grooves 19 might be provided in fuze case 18, with each groove being provided with a vertical portion 22, a slanted portion 23, and a radiused seat portion 24.

A leaf spring 25 is attached to fuse case 18 adjacent each seat portion 24 to provide a locking force against pins 21. When attaching fuse section 14 to adapter housing 15, pins 21 are first engaged in vertical portion 22 of grooves 19, and then fuse case 18 is rotated so that pins 21 are then engaged in slanted portion 23 thereby drawing together fuse case 18 with adapter housing 15. Pins 21 then become seated in radiused seat portion 24, and leaf springs 25 provide an additional holding force against pins 21. By providing a strong torque to fuse case 18, however, while holding adapter housing 15 against rotation, fuse section 14 can be removed, if desired.

As best shown in FIGS. 2 and 3 of the drawings, a dial plate 26 is provided in fuse case 18 and indicia on dial plate 26 indicates setting which provide different free fall distances before parachute opening is initiated. Dial plate 26 is maintained in position by locking ring 27 which is secured to fuse case 18 by any conventional means, such as screws or adhesive. A trigger assembly 31 is rotatably attached to dial plate 26 by means of a rotor 32 which is fitted in a hole in dial plate 26. A resilient ring 33 is provided on the outer circumference of rotor 32 to provide a seal against moisture. An indicator knob 34 is attached to rotor 32 by means of screws 35 and knob 34 is provided with a pointer 36 which points to the selected indicia on dial plate 26. As shown in FIG. 5 of the drawings, dial plate 26 is provided with a plurality of indentations 37 on the bottom side thereof, there being one indentation for each position of indicia which is shown on the top of dial plate 26. A detent 38 is provided in hole 39 in rotor 32 and spring 41 biases detent 38 against the bottom of dial plate 26 so that detent 38 can selectively engage different indentations 37.

A firing pin housing 42 is attached to rotor 32 and firing pin 43 is slidably mounted in housing 42. Helical spring 44 provided the driving force for firing pin 43. Firing pin 43 is retained in a cocked position by pull pin 45 which engages in an elongated slot 46 in firing pin 43. Pull pin 45 is provided with a spherical end 47 and it can be seen that, in order to remove pull pin 45 from elongated slot 46, spherical end 47 causes firing pin 43 to move a very short distance backwards, thereby compressing helical spring 44 an additional distance. It is this elongated slot 46 and spherical end 47 arrangement that provides an extra large pulling force to remove pull pin 45, thereby preventing accidental release of firing pin 43. A short cable 48 is attached to the upper end of pull pin 45 with cable 48 being doubled to form a loop 49 on the outer end. A toggle 51 is staked to cable 48, and a seat 52 is provided in rotor 32 for seating toggle 51. A retaining groove 53 is provided adjacent seat 52, and a safety locking ring 54 is engageable in groove 53 to secure toggle 51 to rotor 32 and, consequently, to secure pull pin 45 in slot 46 of firing pin 43. As best shown in FIG. 2 of the drawings, locking ring 54 is provided with three nodes 55 which are positioned approximately 90° apart. Nodes 55 are engageable in groove 53. The ends of locking ring 54 are attached to an annual ring 56 and, by pulling on ring 56, nod. . 55 can be removed from groove 53.

A primer 61 is positioned in a holder 62 which is mounted in housing 42, and also a fixed delay and ejection triggering mechanism 63 is provided in holder 62. As best shown in FIG. 8 of the drawings, three delay increments 64, 65, and 66 are provided within an ejection plunger 67 and are ignited when primer 61 is detonated and ignites ignition powder 68. The delay increments, in turn, ignite black powder charge 69 and an annular ring 71 of black powder. By way of example, delay increments 64, 65, and 66 might be comprised, by weight, of 61 percent of barium chromate, 13 percent of potassium perchlorate, and 26 percent of a powdered alloy consisting of 70 percent zirconium and 30 percent nickel. Ejection plunger 67 is provided with a pointed forward end 72 and a bore 73 provides a passageway so that heat and flame from annular ring of black powder 71 can pass into the forward end and exit through a plurality of holes 74 in pointed end 72 to ignite a time delay fuse 75. A very weak spring 76 is provided within holder 62 to prevent ejection plunger 67 from engaging time delay fuse 75 until firing pin 43 strikes primer 61.

As best seen in FIGS. 6 and 7 of the drawings, time delay fuse 75 is positioned in an arc around an inner peripheral edge of fuse case 18. A plurality of dowel pins 77 are provided in fuse case 18 to maintain time delay fuse 75 in a circular position. The beginning of time delay fuse 75 is positioned by a flange 78 which can be made integral with fuse case 18. The terminal end of fuse 75 passes through a hole 79, and a passageway 81 connects hole 79 with a quantity of ejection powder 82. A ferrule 83 is provided on the terminal end of fuse 75 in order to maintain fuse 75 in position in hole 79. An end cap 84 and spacer 85 are provided to enclose ejection powder 82 so that it will not be affected by moisture and the like. As shown in FIG. 6 of the drawings, arrow A indicates the direction which the pointed end 72 of ejection plunger 67 is pointing when pointer 36 shows a "safe" position. It can be seen that if the device is accidentally fired, the time fuse 75 will not be ignited. A slot 86 is provided to shield fuse 75 from any flame and heat coming through holes 74 in the event fuse section 14 is triggered while in a "safe" position. Arrow B indicates the direction which the pointed end 72 of ejection plunger 67 is pointing when the pointer 36 shows a "14,000" feet position, and it can be seen a considerable delay will be provided while a long length of time fuse 75 burns. Arrow C indicates the direction which pointed end 72 of ejection plunger 67 is pointing when pointer 36 shows a "500" feet position, and it can be seen that a very short length of fuse 75 will burn.

Housing 15 is provided with an aperture 87 and a center portion 88 of fuse case 18 extends into aperture 18. It is in this center portion 88 that ejection powder 82 and end cap 84 are contained, and the explosive force from the detonation of powder 82 will be channeled through aperture 87 to blow out end closure 89 and expel flare composition section 12 and parachute section 13 from outer container 28. Aperture 87 is threaded so that when fuse case 18 is not attached to adapter housing 15, a plug can be threaded into aperture 87 to prevent moisture and dirt from entering into flare composition section 12.

FIG. 9 of the drawings shows a lanyard cable 91 to which a swivel loop 92 is provided for fastening to an aircraft. A snap 93 is provided on the other end of cable 91 and is engegeable with loop 49 of cable 48,

and a loop 94 in lanyard cable 91 is provided to engage ring 56.

OPERATION

For maximum safety, fuse section 14 is not assembled to the aircraft parachute flare 11 until the flare is to be put into use. When it is desired to mate fuse section 14 to adapter housing 15, any plug which is threaded into aperture 87 must be removed. Also locking ring 54 should be in position and indicator knob 34 should be rotated until pointer 36 is indicating a "safe" position, as shown in FIG. 2 of the drawing. Fuse section 14 can then be mated with adapter housing 15 by engaging pins 21 in adapter housing 15 with grooves 19 in fuse case 18 and rotating fuse case 18 so that pins 21 will be seated in radiused seat portions 24.

Immediately prior to mounting the aircraft parachute flare 11 to the launcher on an aircraft, indicator knob 34 is turned so that pointer 36 will indicate the desired free fall distance. For example, with pointer 36 pointing to "4000," the aircraft parachute flare will fall approximately 4,000 feet, before the flare composition section 12 and parachute section 13 will be ejected from container 28. Upon aircraft parachute flare 11 being mounted to a launcher on an aircraft, snap 93 of the lanyard is attached to loop 49 of cable 48 and ring 56 is attached to loop 94 of the lanyard. The length of the lanyard cable 91 between loop 94 and snap 93 is such that a pull on cable 91 will first cause ring 56 to be pulled, which in turn causes locking ring 54 to be removed from retaining groove 53 and then, after locking ring 54 has been removed, the pulling force of the lanyard cable will be applied to loop 49 and pull pin 45 will be withdrawn to release firing pin 43.

With pull pin 45 having cleared firing pin 43, spring 44 will drive firing pin 43 into primer 61 which, upon detonation, drives ejection plunger outwardly, whereupon pointed end 72 of ejection plunger 67 becomes embedded in time delay fuse 75. Detonation of primer 61 causes black powder charge 68 to be ignited which, in turn, causes delay elements 64, 65, and 66 to be ignited. These delay elements cause about a 2-second delay before powder charges 69 and 71 are ignited. The heat and flame from the burning of powder charge 71 pass through bore 73 and out of holes 74 in pointed end 72 of ejection plunger 67 and cause time delay fuse 75 to be ignited. Time delay fuse 75, in turn, causes ejection powder 82 to be detonated whereupon end cap 84 and spacer 85 are forced out, and also end closure 89 is blown out, and flare composition section 12 and parachute section 13 are ejected from container 28.

It can thus be seen that the present invention provides an improved variable delay fuse for an aircraft parachute flare which has improved safety features to prevent an accidental ignition of the pyrotechnic material inside the flare. Obviously many modifications and variations of the present invention are possible in the light of the above teachings.

We claim:

1. A variable delay fuse and ejection device for ejecting a flare and parachute from an outer container having plurality of attaching pins thereon comprising,

a fuse case having a plurality of grooves which are engageable one each with the plurality of attaching pins on said outer container and said fuze case having a plurality of indentations on one surface thereof,

a rotor rotatably mounted to said fuse case and provided with a spring-biased detent which is selectively engageable with said indentations,

a charge of powder in said fuse case,

a time delay fuse positioned in an arc within said case for igniting said charge of powder,

trigger mechanism attached to said rotor and adaptable for igniting said time delay fuse at selected positions, said trigger mechanism including a firing pin, spring means for driving said firing pin, a pull pin engageable with said rotor and said firing pin for holding said firing pin in a cocked position and ignition means for igniting said time delay fuze upon triggering of said firing pin, and

means for locking said trigger mechanism.

2. A variable delay fuse and ejection device as set forth in claim 1 wherein said means for locking said trigger mechanism includes a locking ring engageable with said rotor for preventing removal of said pull pin.

* * * * *

United States Patent

Short, Jr.

[15] 3,699,890

[45] Oct. 24, 1972

[54] **FIRE RESISTANT PHOTOFLASH CARTRIDGE**

[72] Inventor: James E. Short, Jr., Switz City, Ind.

[73] Assignee: The United States of America as represented by the Secretary of the Navy

[22] Filed: May 4, 1971

[21] Appl. No.: 140,083

[52] U.S. Cl. 102/37.8, 102/37.4, 102/37.6, 102/105

[51] Int. Cl. C06d 1/10, C06d 1/04

[58] Field of Search 102/32, 35, 35.6, 37.4, 37.6, 102/37.7, 37.8, 66, 70.87, 92.2, 92.6, 102, 103, 105

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Primary Examiner—Benjamin A. Borchelt
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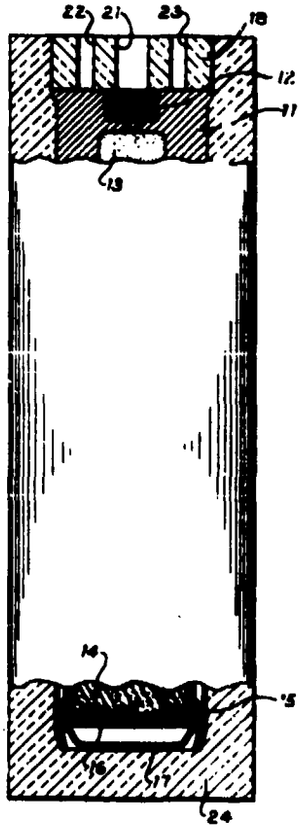
[57] ABSTRACT

A fire resistant photoflash cartridge containing a charge of photoflash composition and an electric primer for initiating ignition of said photoflash composition, the improvement comprising a disk of heating insulating material attached to said cartridge adjacent said electric primer and a heavy layer of intumescent material surrounding the remainder of the cartridge.

2 Claims, 2 Drawing Figures



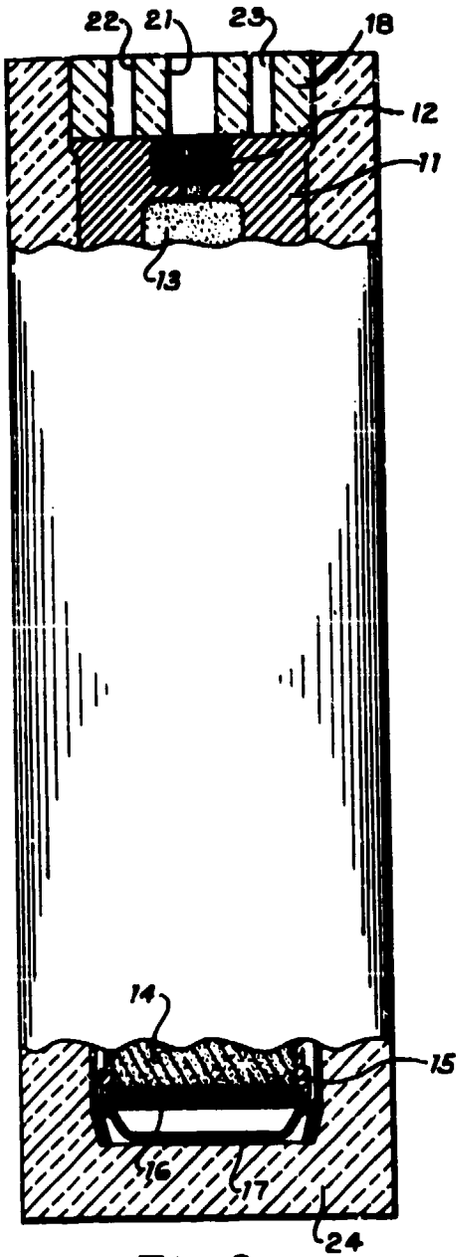


Fig. 2

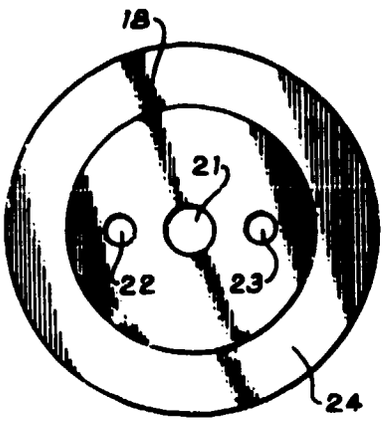


Fig. 1

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FIRE RESISTANT PHOTOFLASH CARTRIDGE

STATEMENT OF GOVERNMENT INTEREST

BACKGROUND OF THE INVENTION

The present invention relates to a flare cartridge for providing illumination in support of night aerial photography, and more particularly to a flare cartridge which is insulated to delay ignition in the event of a fire in the area where the cartridge is stored or located.

The military services are presently using a photoflash cartridge which, after a fixed delay, explodes to provide a high intensity flash. One such device is shown and described in U.S. Pat. No. 3,473,472, which issued Oct. 21, 1969, to Billy R. Bliss, Clarence W. Gilliam, and John E. Laswell. In this patent there is shown and described a photoflash cartridge which, upon ejection and after a fixed delay, explodes to provide a high intensity, short duration flash. An inner charge case is propelled or fired from a cartridge case and, after a fixed delay, a homogeneous explosive mixture is ignited that causes the inner charge case to explode and the surrounding flash composition to be rapidly ignited.

Photoflash cartridges which are presently used by the military services are reliable and provide good light output, however, these photoflash cartridges have an inherent weakness. In recent fires aboard ships it has been learned that photoflash cartridges are one of the first pyrotechnic items to be ejected or exploded by the heat of the fire. In tests conducted at the Naval Ammunition Depot, Crane, Indiana, it has been shown that in the event of a fire caused by ignition of jet fuel, photoflash cartridges mounted beneath an aircraft wing are likely to eject and explode in about 26 seconds after the jet fuel was ignited. Thus in about ½minute after a fire starts involving an aircraft carrying photoflash cartridges, a fireman is susceptible to being hit by an ejected or exploded cartridge.

SUMMARY OF THE INVENTION

The present invention relates to a photoflash cartridge which is insulated so that the cartridge will withstand a burning jet fuel environment for a minimum of 5 minutes. The photoflash cartridge is provided with a closed end that has an electric primer positioned therein and a disk of heat insulating material is attached to the closed end. The remainder of the cartridge is covered with a heavy layer of intumescent vinyl material which is applied in thin layers to build up to a thickness of about ¾ of an inch.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a top view of a preferred embodiment of the present invention; and

FIG. 2 is a side view, partially broken away, of a preferred embodiment.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawing, there is shown a photoflash cartridge of the type more fully explained in U.S. Pat. No. 3,473,472, which issued Oct. 21, 1969, to Billy R. Bliss, Clarence W. Gilliam, and John E. Laswell. A cartridge case 11 is substantially closed on one end which is provided with a threaded hole so that an electric primer 12 can be threadedly connected therein. The opposite end of cartridge case 11 is open. The closed end of cartridge case 11 is provided with a counterbore that is filled with an expelling charge 13, such as black powder. A photoflash composition 14 is contained within case 15 and a closing disk 16 is provided to close the end of case 15. Cap 17 is provided to close the outer end of cartridge case 11.

A disk 18 of heat insulating material is attached to the closed end of cartridge case 11 and is provided with holes 21,22 and 23, which are provided so that electrical contact can be made to ignite primer 12. By way of example, disk 18 might be made of grade AAA HR asbestos-filled phenolic, which is sold commercially by Raybestos-Manhattan, Inc., Bridgeport, Conn., and attached to said case by cementing. The remainder of cartridge case 11 is covered with a heavy layer of intumescent material 24. By way of example, the intumescent material 24 might be Albi–89, an intumescent vinyl material marketed by the Albi Mfg. Dept. — Cities Service Co., Rockville, Conn. The coating of Albi–89 material is applied in thin layers which are built up to provide a coating having a thickness of about ¾ of an inch. It has been observed in tests conducted at Naval Ammunition Depot, Crane, Indiana, that a photoflash cartridge having a disk 18 attached thereto and a ¾ inch layer of intumescent material will not explode or ignite for at least 7 minutes after exposure to a burning jet fuel environment.

I claim:

1. A fire resistant photoflash cartridge comprising

a cartridge case having a closed end and an open end,

a charge of photoflash composition in said cartridge case,

a cap closing the open end of said cartridge case,

an electric primer threadedly attached in said closed end of said cartridge case,

a disk of asbestos-filled phenolic material attached to the closed end of said cartridge case, said disk having at least two holes therein for providing passage for electrical conductors for carrying a current to said primer, and

a heavy layer of intumescent vinyl material covering said cap and the remainder of said cartridge case not covered by said disk of asbestos-filled phenolic material.

2. A fire resistant photoflash cartridge as set forth in claim 1 wherein said disk of asbestos-filled phenolic material is attached to said closed end of said cartridge case by cementing.

* * * * *

Case 47743

United States Patent Office

3,698,968
Patented Oct. 17, 1972

3,698,968

PYROTECHNIC COMPOSITION

Duane M. Johnson, Bicknell, and Donald R. Ravelton, Winslow, Ind., assignors to the United States of America as represented by the Secretary of the Navy

No Drawing. Filed Oct. 28, 1968, Ser. No. 772,067
Int. Cl. C06d 3/00
U.S. Cl. 149—19 3 Claims

ABSTRACT OF THE DISCLOSURE

An improved pyrotechnic composition containing potassium iodate, silver iodate, a light metal and an epoxy resin binder which upon combustion yields products which are useful in artificially modifying the weather.

GOVERNMENT INTEREST

The invention described herein may be manufactured and used by or for the government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

BACKGROUND OF THE INVENTION

Many compositions and methods are known to the art which produce upon combustion or detonation quantities of finely divided silver iodide or silver iodide complexes which have use in artificially modifying the weather by turning undercooled clouds into ice particles for the purpose of generating rain or of preventing the formation of hail. A need exists for a composition which will efficiently produce large quantities of silver-based nuclei for use in cloud seeding. The present invention provides an improved pyrotechnic composition which produces ice freezing nuclei in greater quantities than other pyrotechnic materials presently known to the art.

SUMMARY

This invention relates to an improved pyrotechnic composition.

The general purpose is to provide a composition for pyrotechnically generating silver-based nuclei for use in turning undercooled clouds into ice particles for the purpose of generating rain. Another purpose is to provide a pyrotechnic composition which is simple and inexpensive to formulate and safe to use. The composition also

provides upon combustion a smoke containing active silver-based nuclei active at temperatures up to −1° C.

Other objects, features and many attendant advantages of this invention will become readily appreciated as the same become better understood by reference to the following detailed description.

DESCRIPTION OF THE INVENTION

In accordance with the present invention an improved pyrotechnic composition is formulated which upon combustion yields smoke containing silver iodide alone and silver iodide complexes. The composition comprises silver iodate, potassium iodate, a metal selected from the group consisting of boron, aluminum, and magnesium or mixtures thereof, and an epoxy resin binder.

The following examples given in the chart below will better illustrate the invention but the invention should not be considered as limited to these examples.

All the formulations below use both silver iodate and potassium iodate except Example I wherein potassium iodate alone was used and Example XVI (the standard) potassium nitrate was used instead of potassium iodate.

Example	Mg	Al	Si	B	$AgIO_3$	KIO_3	Epoxy Binder[1]	Gilsonite[2]	Inverse burnrate, sec./in.	Nucleation efficiency
I	6.3	14.0				79.7	6.0		32	
II			14.0		51.6	55.7	5.7		30	
III	6.1	12.7			53.1	53.1	5.7		35	
IV				1.8	26.5	60.7	8.0	3.0	10.14	
V				2.8	25.8	58.4	8.0	9.0	13.2	
VI				2.8	25.6	58.7	8.0		5.8	
VII				4.0	26.5	60.7	8.0		15.9	
VIII	16.9				23.5	53.6	6.0			
IX				2.8	26.5	60.7	6.0		3.5	
X				1.8	26.5	60.7	6.0		7.8	
XI				3.0	26.5	60.7	6.0		11.2	
XII				1.5	26.5	60.7	6.0		31.0	
XIII				1.7	25.7	58.8	7.8	3.0		4.1×10^{9} at −5.5° C.
XIV	16.9				23.5	53.6	6.0		4.65	3.6×10^{9} at −5.9° C.
XV				2.8	25.6	58.7	8.0		16.0	
XVI	8.4	18.01			21.00	43.74	6.0			5.9×10^{9} at −5° C.

[1] Epoxy binder—An epoxy resin mixture made essentially which is made from the reaction product of Bisphenol A and epichlorohydrin having an epoxy equivalent weight of about 185. To this is added about 10 weight percent of butyl glycidyl ether as a reactive diluent. This product is cured with an epoxy curing agent such as diethylene triamine.

[2] Gilsonite—a bituminous material or solid mineral hydrocarbons, specific gravity 1.05-1.10 (77° F.) hardness (Abbe scale) 2, soluble in carbon disulfide.

Note: Si=silicon; Mg=magnesium, atomized about 224 Sg; Al=aluminum, about 22. ±. 8μ; B=boron about 0.65μ. $AgIO_3$=silver iodate, 1.6 3.½. KIO_3=potassium iodate.

The epoxy resin used was DER321, described in Epoxy Resins by Lee and Neville, at page 19. This resin system is liquid, has an epoxide equivalent of 187-193; average molecular weight of 350-400; and has viscosity at 25° C. of 11,000-16,000 centipoises. It cures completely at 25° C. in less than 72 hours, and exhibits a low exotherm with a reasonable pot life in the present formulations. Other suitable epoxy resins may be used.

The ingredients of the above compositions were mixed using a Cowles dissolver blade—air driven. The epoxy was blended into a small amount of acetone (about 300 ml.) and the metallic fuels added and mixed for about two or three minutes. The iodates were added along with more acetone (about 1200 ml.), as needed, to maintain a slurry. The slurry was mixed at high blade speed for about five minutes. The mix was then removed and placed in an open pan in a well ventilated area and the acetone was evaporated off by blowing air across it while continuously stirring the mix. When the mix crumbled and broke up with stirring, the material was ready to be screened through a 30 mesh screen. As soon as the composition was screened it was placed in sealed containers, and is now ready for the pressing operation which should

be complete within six hours from the end of the mixing cycle. The material was pressed at about 2600 p.s.i. It is very important to eliminate moisture in the final product because it produces an exothermic reaction. In the mixing procedure described above, it was found that one of the ways to eliminate the possibility of moisture is to pour the composition after it is thoroughly mixed into aluminum pans which are placed in a vacuum oven at 30° C. Under the aluminum pan is an aluminum block which acts as a heat sink. This sink holds the temperature of the composition to a minimum of about 20° C. through the drying, thus allowing the acetone to vaporize as rapidly as possible. After drying, the composition is allowed to come up to room temperature prior to removal from the oven, insuring no moisture condensation on removal of the composition from the oven. The composition may then be transferred to a sample powder tank for eventual pressing. No screen is necessary.

Nucleation efficiencies of Examples XIII, XIV and XVI were as follows (in nuclei/grams of theoretical silver iodide):

(XIII) 2.1×10^{12} and 4.1×10^{12} at $-5.5°$ C.

(XIV) 3.3×10^{12} at $-6.5°$ C.
3.6×10^{12} at $-5.9°$ C.

(XVI) 5.9×10^{11} at $-5.0°$ C.
1.1×10^{12} at $-6.0°$ C.

This comparison indicates that Examples XIII and XIV using potassium iodate as an oxidizer are at least four times better than Example XVI (the standard) which does not include potassium iodate but instead uses potassium nitrate.

Hazard data on Example XIII which has a pressed density of 47.7 grams/cu in is as follows:

Impact sensitivity—56 kg. cm.
Electrostatic sensitivity—no fire at 1 joule
Friction sensitivity—no fire at 220 ft. lbs.
Ignition temperature—350° C.

Example XV which has a pressed density of 44.7 grams/cu. in. shows the following hazard data:

Impact sensitivity—53 kg. cm.
Electrostatic sensitivity—no fire at 0.9 joule
Friction sensitivity—no fire at 2240 ft. lbs.
Ignition temperature—365° C.

The use of boron in the formulation makes for a more stable pyrotechnics composition which is safer to use. The use of an epoxy resin system seems to be of definite advantage both in the mixing procedure and the consolidation procedure. The epoxy resin system wets or encapsulates the compositions much better than the Laminac system used in prior art pyrotechnic compositions. The best evidence for this is seen when the friction sensitivity of the compositions are compared. For example, the present improved compositions with the epoxy system requires 3.5 times as much frictional energy before ignition occurs than the compositions using Laminac binder. This indicates good encapsulation of the solid ingredients is occurring with the epoxy system. The epoxy resin binder system also improves the shelf life of the composition.

The suitability of the pyrotechnic compositions as cloud seeding materials has been recognized by systematic research. These compositions upon combustion form atomized products such as silver iodide alone and the silver iodide-potassium iodide complex. In use undercooled clouds were turned into ice particles by the introduction of the finely distributed complex whereby in certain circumstances an increased rainfall is obtained. Often the pyrotechnic composition is carried in a pyrotechnic device built into an aircraft which is ferried directly into the clouds to be seeded. The pyrotechnic is ignited and the atomized cloud freezing nuclei which are formed are dispersed. Clouds are also seeded by loading rockets and artillery missiles with the pyrotechnic composition and firing them into preselected clouds.

What is claimed is:

1. A pyrotechnic composition comprising the following:

Ingredients:	Percent by weight
Silver iodate	23 to 30
Potassium iodate	43 to 60
Boron	1 to 8
Epoxy resin	5 to 8

said resin being a reaction product of Bisphenol A and epichlorohydrin to which is added butyl glycidyl ether as a reactive diluent and diethylene triamine which is a curing agent.

2. The composition of claim 1 to which gilsonite is added in an amount ranging from 3 to 9 percent by weight.

3. A pyrotechnic composition comprising
silver iodate;
potassium iodate;
a metal selected from the group consisting of silicon, boron, aluminum, magnesium and mixtures thereof; and
an epoxy resin,
which upon combustion yields a silver iodide-potassium iodide complex for use in weather modification.

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CARL D. QUARFORTH, Primary Examiner

E. A. MILLER, Assistant Examiner

U.S. Cl. X.R.

149—22, 44, 81, 87

United States Patent

Johnson et al.

[15] **3,668,684**

[45] **June 6, 1972**

[54] PORTABLE MORSE CODE SIGNALING DEVICE

[72] Inventors: Donald W. Johnson, Linton; Ronald J. Stovall, Crane; Larry A. Wheelock, Bloomfield, all of Ind.

[73] Assignee: The United States of America as represented by the Secretary of the Navy

[22] Filed: Dec. 28, 1970

[21] Appl. No.: 101,693

[52] U.S. Cl. ..... 340/321 R, 178/26 R, 340/345 R

[51] Int. Cl. H04f 15/04

[58] Field of Search 178/26; 340/321, 345

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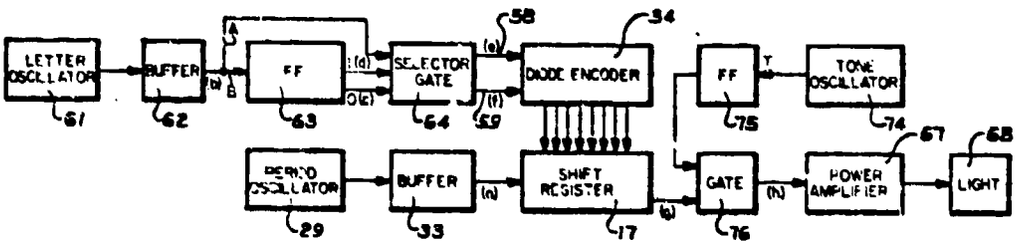
Primary Examiner—Harold I. Pitts

Attorney—R. S. Sciascia, H. H. Losche and Paul S. Collignon

[57] ABSTRACT

A signaling device for producing a light that flashes a Morse code signal. A light source is energized by a source of energy and circuit means are provided to energize the light source according to an output signal from a shift register comprised of a plurality of flip-flops. A diode encoder having a plurality of switches is provided to select flip-flops that are to be set which, upon clearing of the shift register, provides a Morse code signal. A first oscillator is provided to pulse the shift register and a second oscillator is provided to pulse the diode encoder for resetting the flip-flops.

3 Claims, 4 Drawing Figures



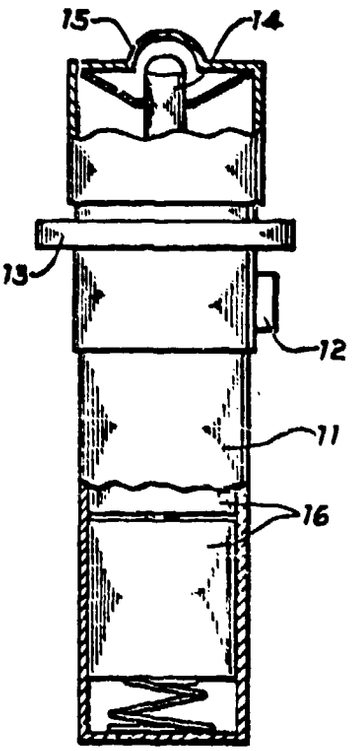


Fig. 1

CLOSED SWITCH	LETTER	CODE	FLIP-FLOP SETTINGS 21 22 23 24 25 26 27 28
41	R	• — •	▯ ▨ ▯ ▨ ▨ ▨ ▯ ▨
42	D	— • •	▯ ▨ ▨ ▨ ▯ ▨ ▯ ▨
43	M	— —	▯ ▨ ▨ ▨ ▯ ▨ ▨ ▨
44	U	• • —	▯ ▨ ▯ ▨ ▯ ▨ ▨ ▨
45	M	— —	▯ ▨ ▨ ▨ ▯ ▨ ▨ ▨
46	H	• • • •	▯ ▨ ▯ ▨ ▯ ▨ ▯ ▨
47	D	— • •	▯ ▨ ▨ ▨ ▯ ▨ ▯ ▨
48	H	• • • •	▯ ▨ ▯ ▨ ▯ ▨ ▯ ▨

Fig. 5

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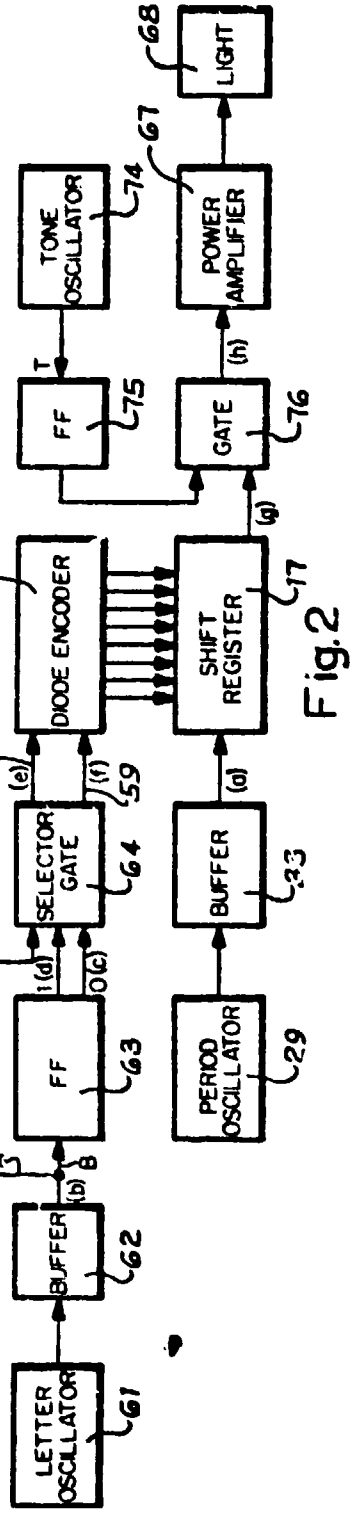

Fig. 2

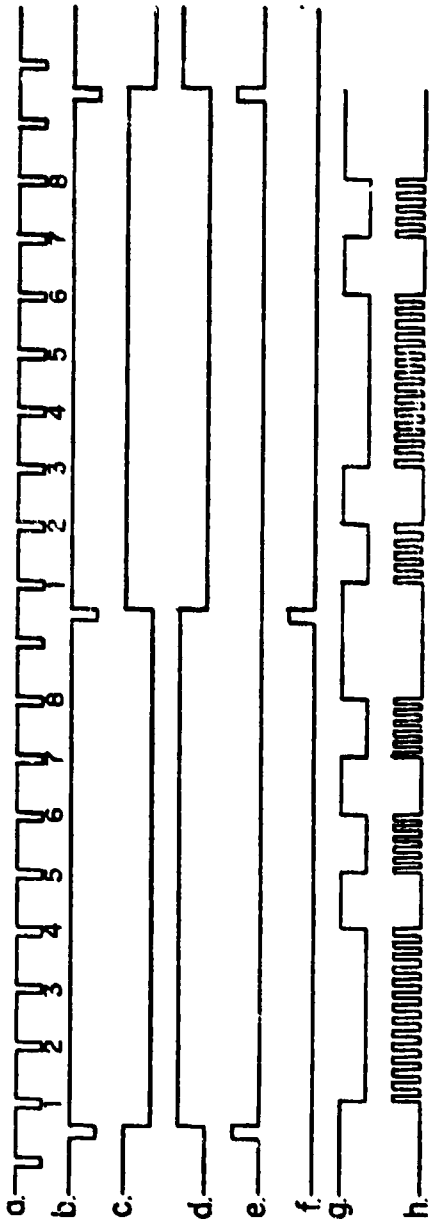

Fig. 4

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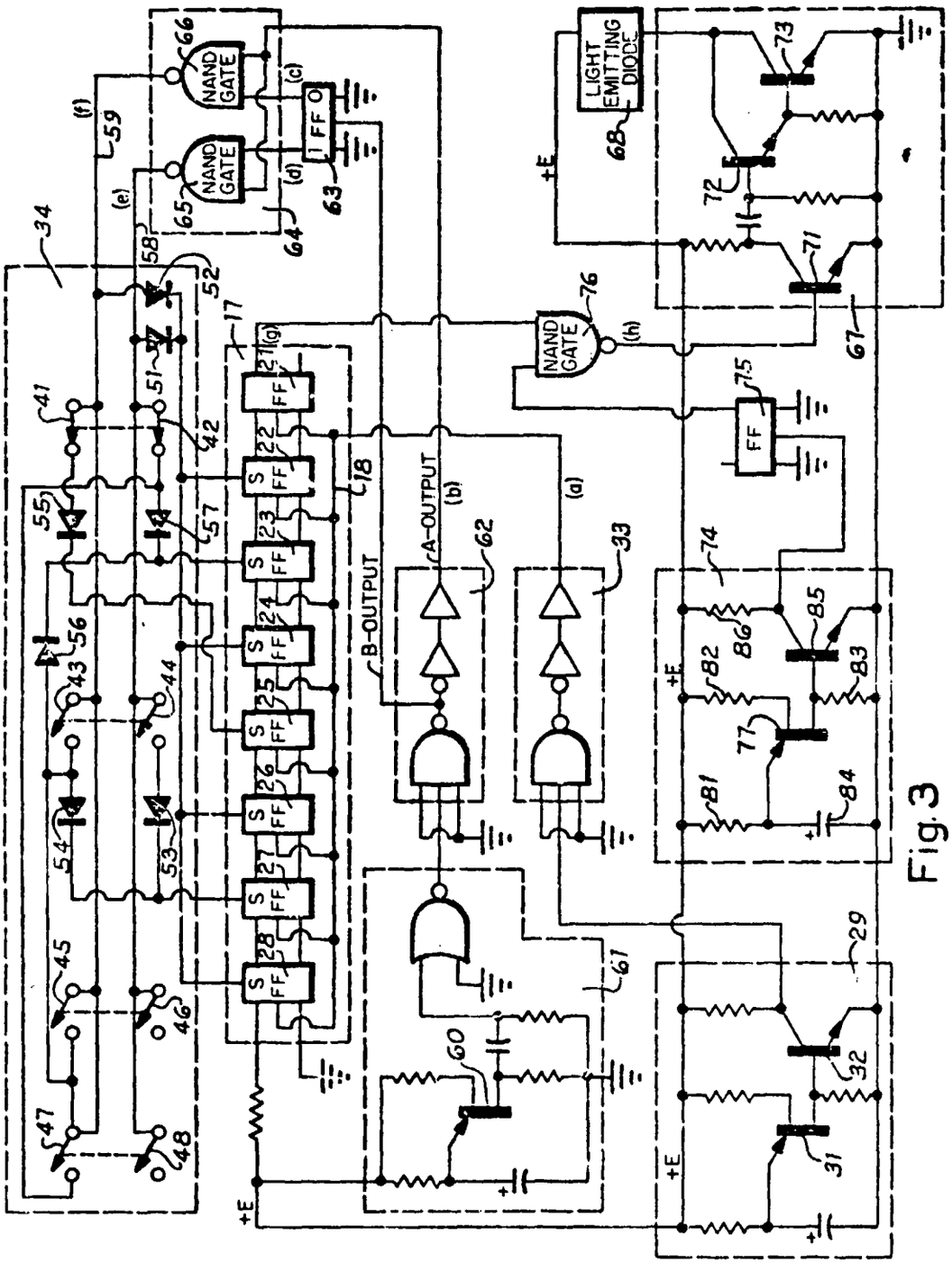

Fig. 3

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PORTABLE MORSE CODE SIGNALING DEVICE

STATEMENT OF GOVERNMENT INTEREST

BACKGROUND OF THE INVENTION

The present invention relates to a hand-held signaling device and more particularly to a signaling device which will flash an infrared Morse code signal.

Various hand-held signaling devices are available for flashing Morse coded signals. For example, in U. S. Pat. No. 3,001,185, which issued Sept. 19, 1961, to Charles L. Cleek, there is shown a hand-held signaling device which has a shutter that is mechanically actuated by depressing a trigger. The depression of the trigger also closes a normally open circuit and energizes a light source.

Another signaling device is shown in U. S. Pat. No. 3,142,052, which issued July 21, 1964, to N. E. Tambert. A spring wound motor is provided for driving an electric generator and a rotatable contact member. The generator energizes a light source and the rotatable contact member engages a plurality of spaced contacts to open and close a circuit thereby de-energizing and energizing the light source.

SUMMARY OF THE INVENTION

The present invention relates to a signaling device which flashes a coded signal which is electronically generated. A selector ring is provided for selecting one pair of a plurality of pairs of letters which can be generated. A shift register having a plurality of flip-flops is provided and a first oscillator is provided for pulsing the shift register which, upon clearing, provides a coded output which causes a light emitting diode to be energized and de-energized. A second oscillator is provided to pulse an encoder which selects different letters which are to be transmitted and resets the flip-flops in the shift register. A tone oscillator is also provided so that an audio signal can be received by a viewer.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a plan view, partially broken away, showing a preferred embodiment of the present invention;

FIG. 2 is a block diagram of a preferred embodiment of the present invention;

FIG. 3 is a circuit schematic diagram of a preferred embodiment of the present invention;

FIG. 4 is a series of waveforms illustrating the functioning of a preferred embodiment of the present invention, and

FIG. 5 is a chart showing switch settings to generate various Morse code signals.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring first to FIG. 1 of the drawing there is shown a hand-held signaling device having a case 11, off-on switch 12, code selector ring 13, light source 14 and lens 15. By way of example, in order to make the case 11 more water-tight, off-on switch 12 and a plurality of switches which are operated by code selector ring 13, might be of the reed type which are pivotable by magnetic means. Batteries 16 are provided for energizing light source 14.

Referring now to FIGS. 2, 3, and 5 of the drawings, formation of Morse code letters is accomplished by presetting specific flip-flops in a shift register 17 and then clearing shift register 17 by pulsing the common shift line 18. Shift register 17 is made up of eight flip-flops 21–28 and the common shift line 18 is supplied with pulses from period oscillator 29 which is comprised of transistors 31 and 32. A non-inverting buffer 33 provides the necessary current to drive shift line 18. Shift line 18 is continuously pulsed which results in a continuous clearing of the flip-flops in shift register 17.

A diode encoder 34 is provided to select a particular pair of letters that are to be generated from the output of shift register 17. Switches 41–48 are provided in diode encoder 34, along with diodes 51–57, and a particular pair of switches are selected and closed by operating code selector ring 13. As shown in FIG. 3 of the drawings switches 41 and 42 are paired, 43 and 44 are paired, 45 and 46 are paired, and 47 and 48 are paired.

A pair of input lines 58 and 59 are provided for encoder 34 and the set terminals of flip-flops 22, 24, 26, and 28 are connected to lines 58 and 59. Isolation diode 51 is placed between line 58 and the set terminals of flip-flops 22, 24, 26, and 28, and likewise, isolation diode 52 is placed between line 59 and the set terminals of flip-flops 22, 24, 26, and 28. It can thus be seen that flip-flops 22, 24, 26, and 28 are set when either line 58 or line 59 is pulsed. The set terminal of flip-flop 23 is connected to line 58 through switch 42 and isolation diode 57 and also the set terminal of flip-flop 23 is connected to line 59 through switch 45 and isolation diode 56. Additionally, the set terminal of flip-flop 23 is connected to line 59 through switch 47 and diode 57. The set terminal of flip-flop 25 is connected to line 59 through switch 41 and isolation diode 55. The set terminal of flip-flop 27 is connected to line 58 through switch 44 and isolation diode 53 and also to line 59 through switch 43 and isolation diode 54. Letter oscillator 61 is provided for pulsing encoder 34 and non-inverting buffer 62 provides the necessary current. Lines 58 and 59 are alternately pulsed to achieve the two letter Morse code combinations which result from a particular switch setting. As shown in FIG. 5 of the drawings, when switches 41 and 42 are closed, the letters R and D are formed, when switches 43 and 44 are closed, the letters M and U are formed, when switches 45 and 46 are closed, the letters M and H are formed, and when switches 47 and 48 are closed, the letters D and H are formed.

Alternate pulses on lines 58 and 59 result from the NAND logic between flip-flop 63 and selector gate 64, which includes two NAND gates 65 and 66. Flip-flop 63 is toggled by the buffered output of letter oscillator 61 and the output of NAND gate 65 is high when the 1 output of flip-flop 63 is low and the A output of buffer 62 goes low. This logical condition is satisfied with every other pulse from letter oscillator 61. The output of NAND gate 66 goes high when the 0 output of flip-flop 63 goes low at the same time the A output of buffer 62 is low.

The output voltage taken from flip-flop 21, which is represented as waveform *g* in FIG. 4 of the drawings, provides one source of the driving voltage for current amplifier 67 which drives light emitting diode 68. In order to provide an audio signal as well as a visual one, the coded driving voltage is interrupted at an audio rate. The actual driving voltage applied to current amplifier 67, which includes transistors 71, 72, and 73, is a composite voltage logically generated from the output of shift register 17 and a tone oscillator 74. Voltage is applied to the input of transistor 71 only when the outputs from flip-flop 21 and flip-flop 75 are in their low states. As shown in FIGS. 2 and 3 of the drawings, the output of flip-flop 21 and the output of flip-flop 75 are combined in NAND gate 76.

Tone oscillator 74 is comprised of a unijunction transistor 77 utilized in a relaxation circuit comprised of resistors 81, 82, and 83 and capacitor 84. The output across resistor 83 is used to overdrive a voltage amplifier circuit comprised of transistor 85 and resistor 86. This arrangement serves to square the output waveform and make it compatible with the toggle input of flip-flop 75. Flip-flop 75 serves to generate a square wave voltage used for one logic input to NAND gate 76, with the other logic input being supplied from flip-flop 21 in shift register 17.

In operation, assuming the letters D and R are to be transmitted in Morse code, selector ring 13 is turned to a marked position and switches 41 and 42 are closed. The other switches in encoder 34 remain open. The buffered output from letter oscillator 61 alternately pulses input lines 58 and 59. (See waveform *b* of FIG. 4). Assuming that line 58 is first pulse,

(see waveform *e*) flip-flops 22, 23, 24, 26 and 28 are set, as shown in FIGS. 3 and 5 of the drawings, due to switch 42 being closed. Next the period oscillator 29 will provide pulses, to the common shift line 18 of shift register 17. (See waveform *a* of FIG. 4). The output from flip-flop 21 will represent, in Morse code, the letter D (— · ·) (see waveform *g*) and this output is supplied as one input to gate 76. Tone oscillator 74 also supplies an output to gate 76 and the output from gate 76, which is illustrated as waveform *h* in FIG. 4, is supplied to amplifier 76 and light emitting diode 68. By way of example, diode 68 might be of the type PEX 1206 manufactured by Texas Instruments, Inc., Dallas, Texas, and which is designed to emit near-infrared light when forward biased. It should be noted that the device shown in FIG. 3 does not transmit any sound, but rather is designed so that the infrared light can be detected and then converted into sound by an appropriate receiver.

As shown by waveforms *c* and *d* of FIG. 4, the outputs of flip-flop 63 alternately go high and low, which alternately pulses lines 58 and 59. When line 59 is pulsed, (see waveform *f*) flip-flops 22, 24, 25, 26, and 28 are set, as shown in FIGS. 3 and 5 of the drawings, due to switch 41 being close . Pulses from period oscillator 29, which are applied to common shift line 18, will clear shift register 17 and the output from flip-flop 21 will represent, in Morse code, the letter R (· — ·). As long as switches 41 and 42 remain closed, and with lines 58 and 59 being alternately pulsed, the letters D and R will be alternately transmitted in Morse code. As illustrated in FIG. 5 of the drawings, other switch settings will cause other letter combinations to be flashed by diode 68.

We claim:

1. A hand-held signaling device for flashing light in Morse Code comprising,

a light source,

normally open circuit means for energizing said light source including a source of energy,

a shift register having a plurality of flip-flops for intermittently closing said normally open circuit means and energizing said light source,

an encoder having a plurality of switches arranged in first and second circuit paths and connected to selected flip-flops in said shift register,

a first oscillator connected to said shift register for pulsing and clearing said flip-flops in said shift register,

a second oscillator, and

a selector gate connected between said second oscillator and said encoder for alternately switching the output of said second oscillator to said first and second circuit paths whereby a first arrangement of flip-flop settings is made in said shift register when said first circuit path is connected between said encoder and said shift register thereby intermittently energizing said light source to flash in Morse Code a first alphabetical letter when said shift register is pulsed and cleared, and whereby a second arrangement of flip-flop settings is made in said shift register when said second circuit path is connected between said encoder and said shift register thereby intermittently energizing said light source to flash in Morse Code a second alphabetical letter different from said first alphabetical letter when said shift register is pulsed and cleared.

2. A hand-held signaling device as set forth in claim 1 wherein said light source is a light emitting diode.

3. A hand-held signaling device as set forth in claim 1 having a tone oscillator and a NAND gate for combining the output of said shift register and the output of said tone oscillator whereby the output of said shift register is interrupted at an audio rate.

* * * * *

United States Patent

Lohkamp et al.

[15] **3,635,162**

[45] **Jan. 18, 1972**

[54] PRACTICE BOMB

[72] Inventors: **Carl W. Lohkamp, Scotland; James E. Short, Jr., Switz City, both of Ind.**

[73] Assignee: **The United States of America as represented by the Secretary of the Navy**

[22] Filed: **July 9, 1970**

[21] Appl. No.: **53,609**

[52] U.S. Cl. ..... **102/7.6, 89/1.5 D, 102/4**

[51] Int. Cl. **F42b 25/18**

[58] Field of Search ..... 244/327, 329; 89/1.5 D; 102/4, 102/7.6

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3,343,486	9/1967	Patrick	102/7.6

Primary Examiner—Samuel W. Engle

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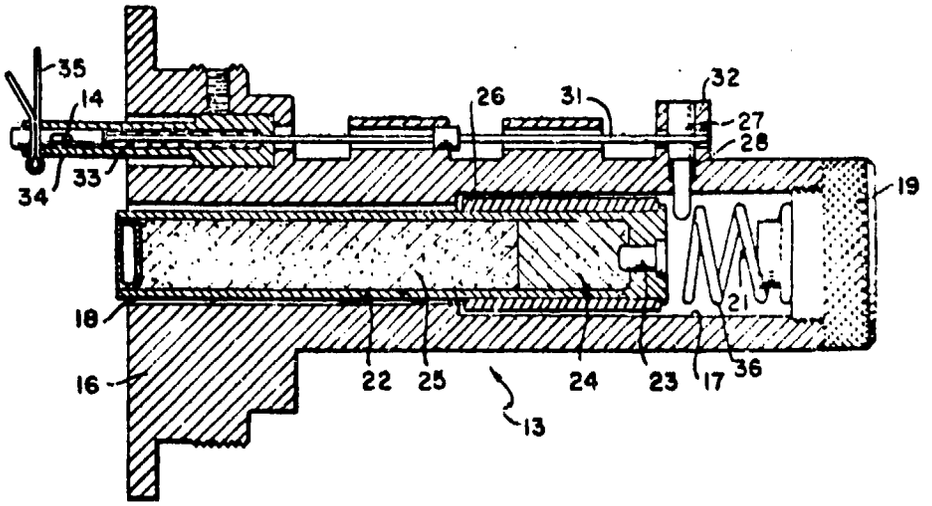
[57] **ABSTRACT**

A practice bomb having a signal cartridge for locating the point of impact of said practice bomb after an airdrop and having means for arming the practice bomb during flight of said practice bomb by actuation of an arming pin connected to foldable fins which open upon high velocity of said practice bomb.

4 Claims, 4 Drawing Figures



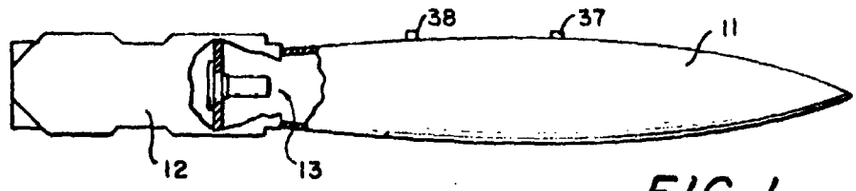


FIG. 1.

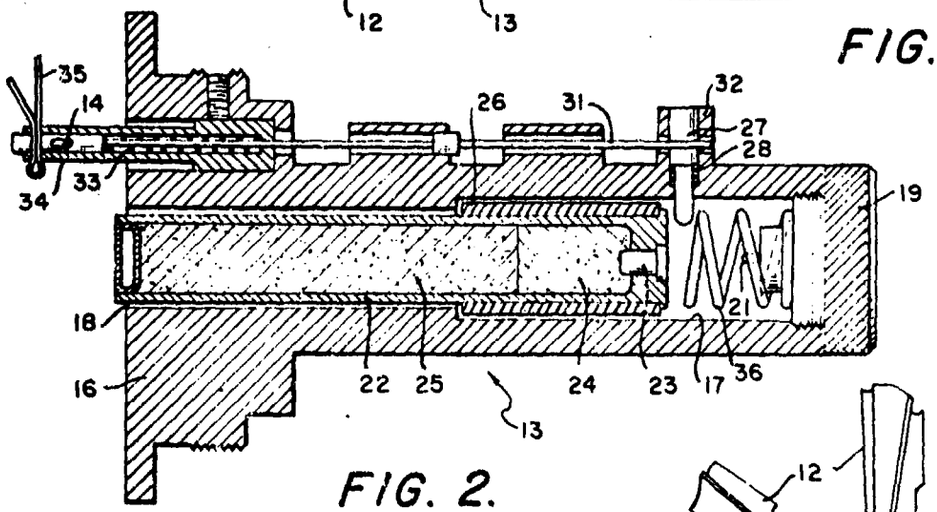


FIG. 2.

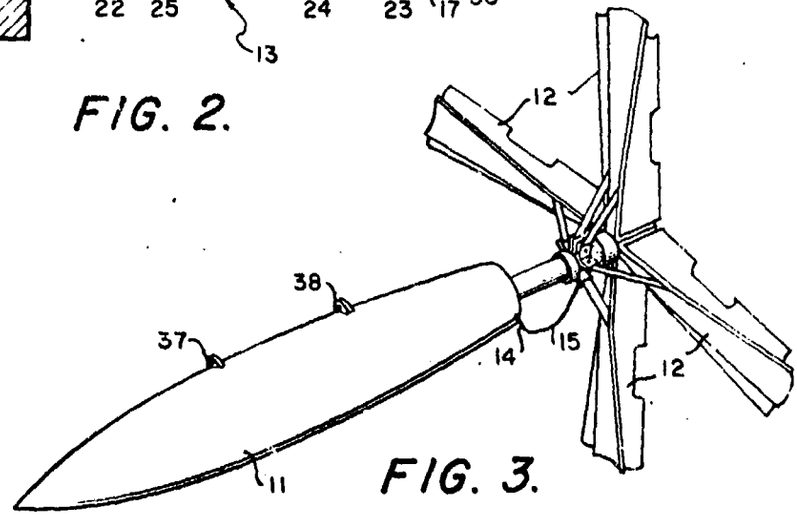


FIG. 3.

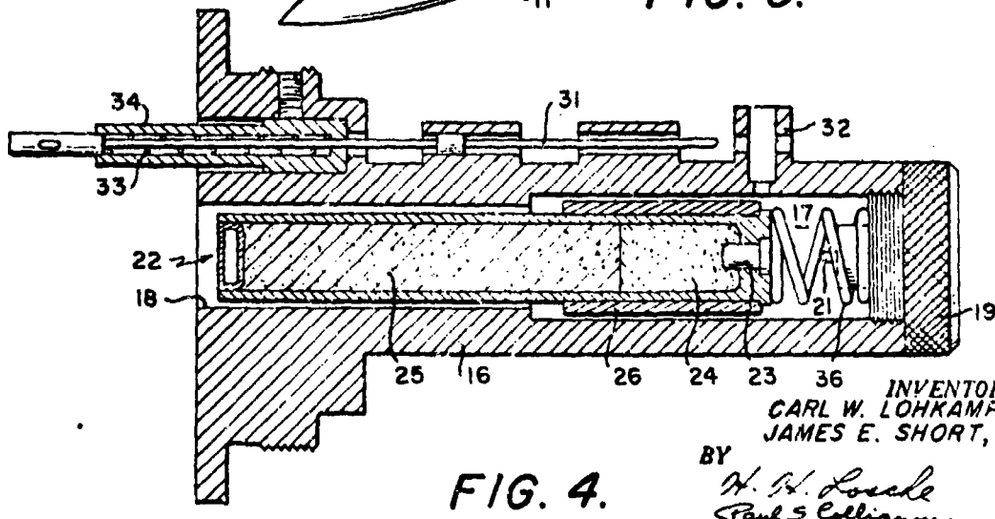


FIG. 4.

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PRACTICE BOMB

STATEMENT OF GOVERNMENT INTEREST

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

BACKGROUND OF THE INVENTION

The present invention relates to a practice bomb which will provide a visual indication of the point of impact after an air-drop, and more particularly to a practice bomb which becomes armed during flight to provide maximum safety prior to launch from an aircraft.

Practice bombs which do not contain a large quantity of high explosives are in general training use by the various military departments. Practice bombs are relatively inexpensive, as compared to high-explosives bombs, and these bombs usually carry a small explosive charge to mark the point of impact of the practice bomb. Although the explosive charge in most practice bombs is not sufficiently large, various safety precautions must be taken to prevent accidental discharge of these bombs. A premature detonation of a practice bomb on shipboard, for example, could cause fuels or high explosives to ignite and create a large peril to the ship and to those aboard. In order to prevent such an occurrence, most practice bombs are maintained in a safe or unarmed condition until the practice bomb separates from the launching aircraft.

By way of example, in U S. Pat. No. 2,108,818, which issued Feb. 22, 1938, to Sargent P. Huff and Arthur Adelman, there is shown a practice bomb which remains in an unarmed condition until the practice bomb separates from the aircraft. A wire, which has one end attached to the aircraft, prevents movement of a bolt that extends between a firing pin and a cartridge Upon launch of the practice bomb, the wire remains with the aircraft, and the bolt moves to permit arming of the practice bomb.

The main objection to arming devices which arm weapons upon separation of the weapon from the carrying vehicle is that inadvertent launchings always drop armed weapons. For example, should either a high explosive or practice bomb fall from an aircraft while taxiing across the deck of an aircraft carrier, a highly dangerous condition arises if the bomb becomes armed due to the mere separation of the bomb from the aircraft. As many practice bombs detonate on impact, it is highly probable that practice bombs of the type shown in the aforesaid patent, would detonate if they were inadvertently dropped while an aircraft were taxiing.

SUMMARY OF THE INVENTION

The present invention relates to a practice bomb which has foldable fins which unfold due to the high velocity of the bomb during a drop. A signal cartridge is provided in the bomb and is designed to be detonated upon impact of the bomb. The signal cartridge is maintained in a safe or unarmed condition, however, until the fins are unfolded. Thus a short fall, such as might occur during taxiing of an aircraft, will not be sufficient to arm the practice bomb of the present invention.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a side view, partially broken away, showing a preferred embodiment of the present invention;

FIG. 2 is a sectional view showing a signal cartridge and arming mechanism in a safe condition;

FIG. 3 is a view showing a practice bomb in a descent stage; and

FIG. 4 is a sectional view similar to FIG. 2 of the drawings only showing an armed condition

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawing, there is shown a practice bomb having a bomb case 11, foldable fins 12 and an impact-marking section 13. As best shown in FIG. 3 of the drawing, fins 12 are designed to be opened by action of the airstream as the practice bomb free falls from a launching aircraft. An arming pin 14 is provided to maintain the impact-marking section 13 in a "safe" or unarmed condition. A cable 15 connects arming pin 14 with fins 12 so that when fins 12 are unfolded pin 14 is withdrawn from section 13.

Referring now to FIGS. 2 and 4 of the drawing the impact-marking section 13 has a body 16 having central bores 17 and 18 therein. A firing pin device 19 threadedly engages and closes one end of bore 17 and has a firing pin tang 21 on the inner end thereof. A signal cartridge 22 having a primer 23, a quantity of pistol powder 24, and a quantity of phosphorus composition 25 is provided in signal cartridge 22. An inertia sleeve 26 is positioned around the outside of signal cartridge 22 and provides additional momentum for signal cartridge 22 on impact of the practice bomb. An arming stop pin 27 is slidably mounted through the wall of body 16 and, as shown in FIG. 2 of the drawing, protrudes into bore 17 between the forward end of signal cartridge 22 and the end of firing pin tang 21. It can readily be seen that, when in position as shown in FIG. 2 of the drawing, arming stop pin 27 prevents primer 23 in signal cartridge 22 from engaging firing pin tang 21. A spring 28 is provided for biasing arming stop pin 27 outwardly, however, movement of arming stop pin 27 is prevented until rod 31 is withdrawn from engagement with arming stop pin 27 and boss 32 on body 16. A spring 33 in sleeve 34 is provided for withdrawing rod 31 from engagement with arming stop pin 27, however, movement of rod 31 is constrained by cotter pin 35 and arming pin 14 As best shown in FIG. 4 of the drawing, a spring 36 is provided around firing pin tang 21 to separate signal cartridge 22 from firing pin tang 21 until the time of impact of the practice bomb.

OPERATION

During storage and prior to loading onto a launching aircraft, cotter pin 35 is kept in position and keeps the practice bomb in a "safe" condition. The practice bomb is attached to the aircraft by means of lugs 37 and 38 with fins 12 being in a closed position, as shown in FIG. 1 of the drawing. After loading into the bomb shackles, cotter pin 35 is removed, however, the practice bomb is still in a "safe" condition, as arming stop pin 27 prevents contact between primer 23 in signal cartridge 22 and arming stop pin 27, is, in turn, retained in position by rod 31.

Upon release of the practice bomb by the launching aircraft, the airstream causes fins 12 to open and arming pin 14 is withdrawn by cable 15 which is attached to fins 12. Upon removal of arming pin 14, spring 33 actuates rod 31 and rod 31 is withdrawn from engagement with arming stop pin 27. Spring 28 then moves arming stop pin 27 outwardly thereby clearing the path of signal cartridge 22. As signal cartridge 22 is preferably loosely fitted in bores 17 and 18 of body 16, signal cartridge 22 moves forward and contacts spring 36, which prevents primer 23 from engaging firing pin tang 21.

Upon impact of the practice bomb with the ground, or some target, the momentum of signal cartridge 22 causes primer 23 to strike firing pin tang 21 and detonation of primer 23 causes ignition of pistol powder 24 which, in turn, ignites phosphorus composition 25 to provide a visual indication of the point of impact of the practice bomb.

We claim:

1. A practice bomb comprising,

a bomb case,

fins pivotally attached to said bomb case and adaptable for opening upon launching of said practice bomb,

a firing pin stationarily mounted in said bomb case,

marking means slidably mounted within said bomb case and engageable with said firing pin for indicating the point of impact of said bomb case, and

arming means connected to said fins for arming said practice bomb upon opening of said fins.

2. A practice bomb as set forth in claim 1 wherein said marking means comprises a signal cartridge having a primer, a quantity of smokeless powder and a quantity of phosphorus composition whereupon impact of said practice bomb said primer strikes said firing pin thereby igniting said smokeless powder which in turn ignites and expels said phosphorus composition.

3. A practice bomb as set forth in claim 2 wherein said arming means includes an arming stop pin positioned between said firing pin and said signal cartridge for preventing ignition of said signal cartridge until said fin is open.

4. A practice bomb as set forth in claim 2 wherein an inertia sleeve is attached to said signal cartridge to facilitate movement of said signal cartridge upon impact of said practice bomb.

* * * * *

United States Patent

[11] 3,630,413

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[21] Appl. No. 24,574
[22] Filed Apr. 1, 1970
[45] Patented Dec. 28, 1971

[73] Assignee The United States of America as represented by the Secretary of the Navy

[54] DEVICE FOR MANUALLY OR AUTOMATICALLY INFLATING A LIFE PRESERVER
4 Claims, 4 Drawing Figs.

[52] U.S. Cl. 222/5, 9/318
[51] Int. Cl. B67b 7/24
[50] Field of Search 222/5, 3; 9/318

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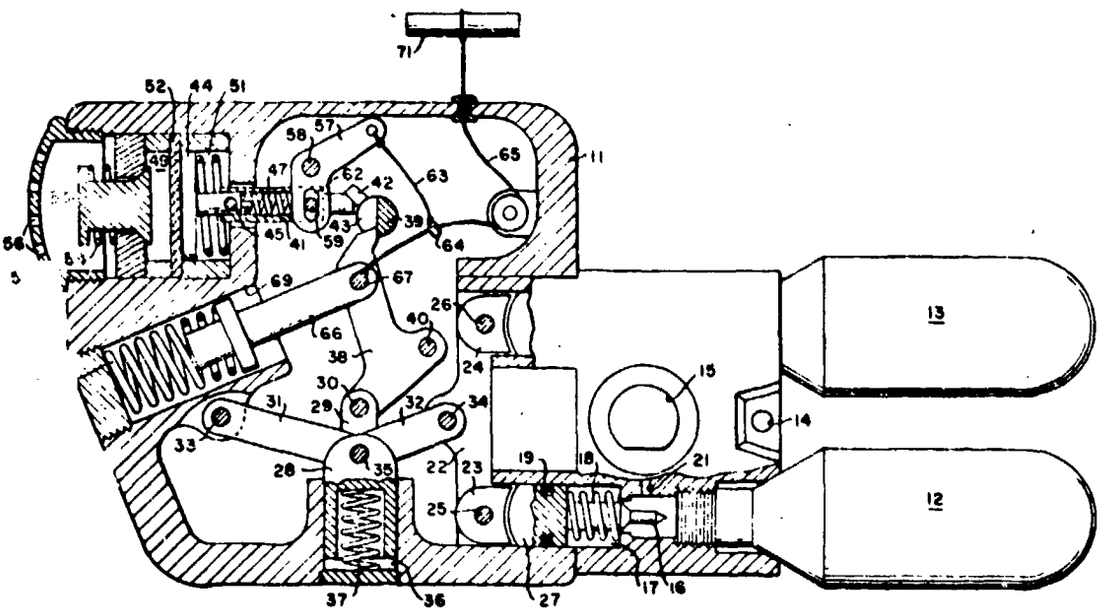
ABSTRACT: A device for manually or automatically puncturing one or more carbon dioxide cartridges for use in inflating a life preserver. A water-soluble disk is used to prevent movement of a spring-biased piston, and upon dissolving of this water-soluble disk, the spring-biased cylinder moves to withdraw a stop thereby permitting actuation of toggle linkage to drive one or more plungers which puncture one or more carbon dioxide cartridges. A one-way valve which is actuated by water pressure is provided to prevent high humidity or water spray from dissolving the water-soluble disk. A cable is also provided which can be used to actuate the toggle linkage to puncture the carbon dioxide cartridges.



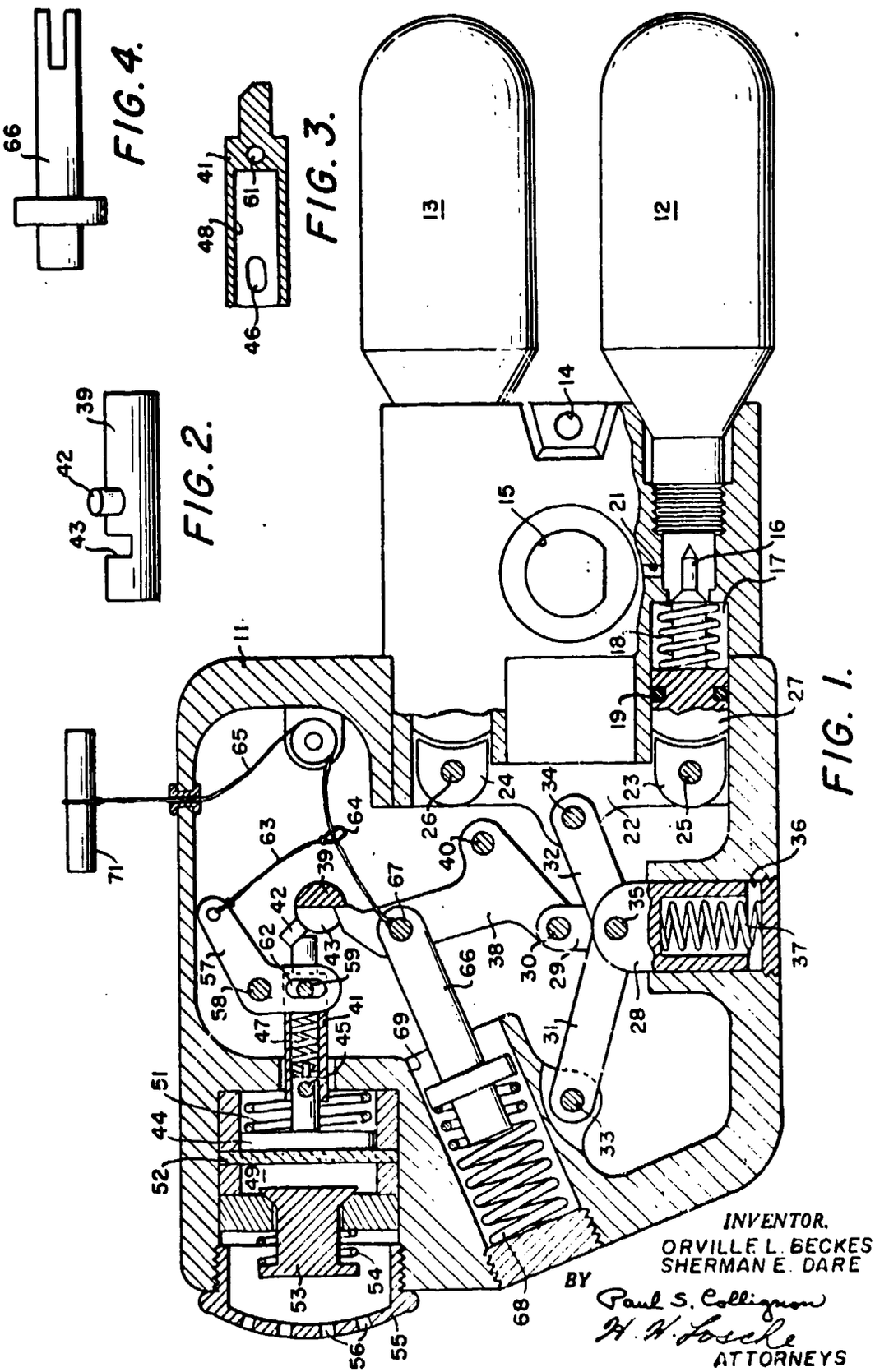


FIG. 1.

FIG. 2.

FIG. 3.

FIG. 4.

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DEVICE FOR MANUALLY OR AUTOMATICALLY INFLATING A LIFE PRESERVER

STATEMENT OF GOVERNMENT INTEREST

BACKGROUND OF THE INVENTION

The present invention relates to a device for actuating a life preserver, such as a jacket, and more particularly to a device which can be operated manually and which will also operate automatically upon being immersed in water.

Life jackets which are inflatable by gas are well known and are used by both civilian and military personnel. These well-known devices are generally provided with a carbon dioxide cartridge which, upon puncturing by manual operation, releases carbon dioxide to inflate the jacket. The only disadvantage to these presently available devices is that, if the wearer of the life preserver is a small child, the child may not be able to actuate the device particularly if the child suddenly falls into the water and is frightened, and also adults, such as military personnel, may be injured or unconscious, and may not be capable of operating a manual device.

Various devices have been provided to permit automatic inflation of a life preserver upon entering water. In U.S. Pat. No. 2,964,050, which issued Dec. 13, 1960, to Joseph F. Novak, a container of compressed air is provided with a spring loaded valve which, when depressed, permits flow of the gas from the container to an inflatable body. A plunger which is loaded by a coiled spring is provided to depress the valve, but is prevented from movement by a liquid disintegrable body composed of aspirin or the like. Upon entering the water, the disintegrable body dissolves, and the plunger is driven by a spring against the valve to permit passage of compressed air from the container into the inflatable body.

Another automatically inflatable life preserver is shown and described in U.S. Pat. No. 3,127,624, which issued Apr. 7, 1964, to Ted J. Kubit and William S. Stanton. In this patented device, a puncturing needle is stationarily mounted in a housing, and a carbon dioxide cartridge is positioned so that it can be moved against the puncturing needle by a cam attached to a pivotal element. A spring mechanism is provided to move the pivotal element but is restrained by a stop mechanism which includes a sugar cube. Upon entering water, the sugar cube dissolves and the spring mechanism moves the cartridge against the puncturing needle. A cable is provided so that the pivotal element can also be manually actuated.

The main disadvantage to most heretofore available actuating devices is that there is no protection from water spray or high humidity and the device can be triggered without entering water.

SUMMARY OF THE INVENTION

The present invention relates to an inflatable device for life preservers which can be manually actuated by pulling a cable and which will automatically actuate when a wearer of the life preserver enters water. A pair of gas cartridges are threadedly attached to a housing and first and second puncturing elements are provided for puncturing these gas cartridges. A toggle mechanism, which is spring drivable, is provided to actuate the first and second puncturing elements, but a latch is provided to retain the toggle mechanism in a cocked position. A spring-drivable piston is provided as a release mechanism for the latch, but movement of the piston is prevented by a soluble disk positioned in a cylinder containing the piston. A one way valve is provided to prevent water spray from entering into the cylinder containing the soluble disk. A cable is provided to actuate the toggle mechanism by pulling.

It is therefore a general object of the present invention to provide a device which will automatically inflate a life preserver when immersed in water.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a plan view, partially in section and partially broken away, showing a preferred embodiment of the present invention;

FIG. 2 is a plan view of a latching bar;

FIG. 3 is a sectional view of slidable stop; and

FIG. 4 is a plan view of a bifurcated plunger.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawing, there is shown a housing 11 to which first and second gas cartridges 12 and 13 are threadedly attached. Although a pair of cartridges are shown, it should be understood that a single cartridge could be utilized when the item to be inflated is of small capacity. A fastening hole 14 and an inflation hole 15 are provided to facilitate the securing of the present invention to a life preserver (not shown). A plunger 16 is provided for each gas cartridge and each plunger is slidable in a bore 17 and biased away from the end of the gas cartridge by a spring 18. A sealing ring 19 is provided around the periphery of plunger 16 to prevent excessive loss of gas when the gas cartridges are punctured. Upon puncturing of the gas cartridges, gas passes through hole 21 and then through inflation hole 15 to which an inflatable device is attached.

A pressure bar 22 is provided to move plungers 16 and pushing pads 23 and 24 are pivotally attached to driving bar 22 by means of pins 25 and 26, respectively. Pushing pads 23 and 24 are curved to fit the curvature of the heads 27 of plungers 16. A toggle mechanism, comprised of yoke 28 and links 31 and 32 is provided to actuate pressure bar 22. One end of link 31 is pivotally attached to housing 11 by means of pin 33 while one end of link 32 is pivotally attached to pressure bar 22 by means of pin 34. The other ends of links 31 and 32 are attached to yoke 28 by means of pin 35. Yoke 28 is slidably mounted in bore 36 in housing 11 and a spring 37 is provided which furnishes the driving force for movement of the toggle mechanism.

A latch 38 is pivotally attached to housing 11 by means of pin 40 and the toggle mechanism is connected to latch 38 by link 29 which has one end attached to latch 38 by means of pin 30 and the other end connected to pin 35. One end of latch 38 is engageable with latching bar 39 which is rotatably mounted to housing 11, and is normally prevented from rotation by slidable stop 41. As shown in FIGS. 1 and 2 of the drawing, a tang 42 and a slot 43 are provided on latching bar 39. Tang 42 is engageable with slidable stop 41 and latch 38 is engageable in slot 43. Slidable stop 41 is connected to piston 44 by means of pin 45 which passes through an elongated hole 46 in slidable stop 41. As will be more fully hereinafter explained, elongated hole 46 permits movement of slidable stop 41 while piston 44 remains stationary, thereby permitting manual operation of the device of the present invention. A spring 47 is provided in a bore 48 in slidable stop 41 and spring 47 biases piston 44 and slidable stop 41 as far apart as elongated hole 46 permits.

Piston 44 is slidably mounted in cylinder 49 and a piston spring 51 is provided to move piston 44. A soluble disk 52 of suitable material is provided to prevent movement of piston 44 until the mechanism is immersed in water, such as occasioned by a person falling off a boat. A valve mechanism 53, which is kept closed with a very weak spring 54 is provided to prevent water spray or rain from affecting soluble disk 52. A threaded cap 55 closes cylinder 49 and cap 55 is provided with a plurality of holes 56 that permit water to enter cylinder 49 when the water pressure is sufficient to depress spring 54 and open valve 53.

A release lever 57 is pivotally attached to housing 11 by pin 58, and release lever 47 is connected to slidable stop 41 by means of pin 59 which passes through hole 61 in slidable stop 41 and elongated slot 62 in release lever 57. One end of cable 63 is attached to release lever 57 and the other end of cable 63 is attached to a small ring 64 through which cable 65 passes. A bifurcated plunger 66 is attached to latch 38 by pin 67 and a

spring 68 in a bore 69 in housing 11 is provided for moving plunger 66 and rotating latch 38 about pin 39. A handle 71 is connected to one end of cable 65 to facilitate pulling of cable 65 and the other end of cable 65 is attached to bifurcated plunger 66.

OPERATION

Assuming the inflation device is in a cocked position, as shown in FIG. 1 of the drawing, upon entering water by a person wearing the device, water enters through holes 56 in cap 55 and water pressure opens valve 53 to permit entry of water into cylinder 49. Soluble disk 52 is dissolved by the water in cylinder 49 whereupon spring 51 moves piston 44 which, in turn, pulls slidable stop 41 a sufficient distance to be clear of tang 42 on latching bar 39. Latch 38 applies a pushing force on latching bar 39 due to the force applied by spring 68 to bifurcated plunger 66. Upon tang 42 being clear from slidable stop 41, latch 38 is rotated about pin 40 and latching bar 39 is rotated to free latch 38. As latch 38 rotates, pin 30 is raised which, in turn, raises link 29 thereby permitting spring 37 to operate the toggle mechanism comprised of links 31 and 32 and yoke 28. The toggle mechanism moves pressure bar 22 thereby causing pushing pads 23 and 24 to move plungers 16 thereby puncturing gas cartridges 12 and 13. Gas from the punctured cartridges passes through hole 21 and into inflation hole 15 to which an inflatable device is attached.

Assuming again that the inflation device is in a cocked position as shown in FIG. 1 of the drawing, and a manual release is desired, pulling of handle 71 causes cable 63 to pivot release lever 57 about pin 58 and this pivoting causes pin 59 to move slidable stop 41 to the rear a sufficient distance to permit tang 42 on latching bar 39 to clear slidable stop 41. When tang 42 becomes free to rotate, the mechanism operates in the same manner as that described for automatic operation, with the difference between automatic and manual operation being in the manner in which slidable stop 41 is withdrawn from contact with tang 42.

We claim:

1. A device for automatically inflating a life preserver comprising,

a housing adaptable for attaching an inflatable life preserver and at least one gas cartridge thereto,

at least one puncturing element slidably mounted in said housing and adaptable for engaging the end of a gas cartridge attached to said housing,

a toggle mechanism pivotally attached to said housing for actuating said at least one puncturing element,

a latch pivotally attached to said housing and connected to said toggle mechanism,

a latching bar rotatably mounted to said housing and engageable with said latch to lock said latch in a cocked position,

a slidable stop,

means including a water soluble disk for biasing said slidable stop in engagement with said latching bar,

a release lever pivotally attached to said housing for disengaging said slidable stop from said latching bar,

and a spring connected to said toggle mechanism for actuating said toggle mechanism upon disengagement of said latch from aid latching bar.

2. A device for automatically inflating a life preserver as set forth in claim 1 having a spring biasing said latch into engagement with said latching bar whereupon disengagement of said slidable stop from said latching bar said latch rotates said latching bar thereby causing disengagement between said latch and said latching bar.

3. A device for automatically inflating a life preserver as set forth in claim 1 wherein said means including a water soluble disk for biasing said slidable stop in engagement with said latching bar comprises a cylinder in said housing, a piston slidably mounted in said cylinder and a spring biasing said cylinder against said soluble disk, said piston being connected to said slidable stop whereby water entering said cylinder dissolves said soluble disk whereupon said spring moves said piston to disengage said slidable stop from said latching bar.

4. A device for automatically inflating a life preserver as set forth in claim 3 wherein said cylinder has an opening for the entrance of water and a spring-biased valve closing said entrance.

* * * * *

United States Patent

[11] 3,625,855

[72] Inventor **Bernard E. Douda**
Bloomfield, Ind.

[21] Appl. No. 873,687
[22] Filed Nov. 3, 1969
[45] Patented Dec. 7, 1971

[73] Assignee **The United States of America as represented by the Secretary of the Navy**

[54] WHITE SMOKE COMPOSITION

2 Claims, No Drawings

[52] U.S. Cl. 252/305, 149/44, 149/37

[51] Int. Cl. C06d 3/00, C09k 3/30

[50] Field of Search 252/305; 149/44, 37

[56] **References Cited**

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2,939,779	6/1960	Brock	149/76

Primary Examiner—John D. Welsh
Attorneys—R. S. Sciascia, H. H. Losche and Paul S. Collignon

ABSTRACT: A composition having long burning time and producing high volume white smoke and being comprised of between 11 and 13 percent of magnesium, between 44 and 49 percent of zinc oxide, between 25 and 26 percent of a chlorinated organic compound, and between 14 and 22 percent of a nonacid-type binder.

PO-1050
(5/69)

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

UNDER RULE 322

Patent No. 3,625,855 Dated December 7, 1971

Inventor(s) BERNARD E. DOUDA

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 2, EXAMPLE II, that portion of the formula reading

"Zinc Oxide Hexachlorobenzene"

should read

-- Zinc Oxide 47

Hexachlorobenzene 26 --

Column 4, Claim 1, Line 39

"between 23 and 326 percent of chlorinated organic com-"

should read

-- between 23 and 26 percent of chlorinated organic com- --

Column 4, Claim 1, Line 44

"the group of epoxy resin and epoxy-polyglycol resin."

should read

-- the group consisting of epoxy resin and epoxy-polyglycol resin. --

Signed and sealed this 30th day of May 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER, JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents

WHITE SMOKE COMPOSITION

STATEMENT OF GOVERNMENT INTEREST

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

BACKGROUND OF THE INVENTION

The present invention relates to a pyrotechnic composition which, upon burning, provides a large volume of white smoke.

Chemicals in the category of screening smokes are those which, when dispersed in air, produce a cloud of finely divided particles of solid, liquid, or both. These are used to shield tactical operations or disrupt the movements of the enemy. Outstanding examples of such materials are: fuel oil used in "artificial fog" generators, white phosphorus, sulfur trioxide, titanium tetrachloride, and so-called zinc chloride smokes. Each of the above-listed smoke-generating compositions is characterized by certain advantages and disadvantages in military operations, depending upon the importance of such factors as mobility of the smoke-producing apparatus, toxicity, logistical considerations, and the total obscuring power of the composition employed.

For military use, volatile hygroscopic chloride (HC) smokes are the most important, other than oil mixtures, which are utilized for large-scale operations. The most widely used HC types of smokes are those resulting in the production of zinc chloride smokes.

The original mixture employed to produce a zinc chloride smoke was the Berger mixture, developed by the French Army during World War I. The original Berger mixture consisted of zinc dust and carbon tetrachloride with zinc oxide and diatomite. Upon ignition, a vigorous reaction takes place, resulting in the formation of zinc chloride, which is volatilized by the heat of the reaction and solidifies to form smoke. However, since this mixture employed a liquid organic chloride, it was difficult to transport and store. By the beginning of World War II, the United States Government had developed a mixture designated "HC smoke mixture" which contained zinc, a perchlorate as an oxidizing agent, hexachloroethane as the organic chloride compound, and a retarder, ammonium chloride. Subsequently, a mixture was found which was better in many ways than the original; it was a combination of hexachloroethane, aluminum and zinc oxide. This mixture required no stabilizer against moisture absorption, and changing the percentage of aluminum varied the burning time, as desired. However, these compositions are corrosive and will interfere with firing mechanisms, thereby materially limiting the storage life of the smoke-generating composition.

SUMMARY OF THE INVENTION

The present invention relates to a pyrotechnic composition which is suitable for making smoke candles by a tamp-cast technique. While most smoke compositions contain aluminum, magnesium is used in the present invention in order to increase the combustibility of the composition. The composition contains zinc oxide, a chlorinated organic compound and a nonacid-type binder. The binder can range from about 5 percent when the composition is to be pressed into a candle and up to about 30 percent when a pour-cast technique is employed. A preferred range of about 13 to 18 percent of binder is employed so that smoke candles can be made by a tamp-cast technique

DESCRIPTION OF THE PREFERRED EMBODIMENT

In accordance with the present invention, a white smoke composition is provided which contains magnesium, zinc oxide, a chlorinated organic compound and a nonacid-type binder. By way of example, the chlorinated organic compound might be hexachlorobenzene, polyvinyl chloride, perchloropentacyclodecane, or a chlorinated rubber compound. The binder mixture must be a nonacid type for binder systems which are even only slightly acid react with the chlorinated ingredients and cause a gassing reaction to occur. Thus during polymerization, an undesirable swelling takes place. By way of example, suitable binders might be amine cured epoxy systems and epoxy-polyglycol compositions.

The following are examples of compositions according to the present invention.

EXAMPLE I

	PERCENT (By Weight)
Magnesium (granulation 15)	11
Zinc Oxide	46
Perchloropentacyclodecane	25
Polyglycol Resin (QX 3812)	11.16
Epoxy Resin (D. E. R. - 732)	6.84

The magnesium particles were of granulation 15, as defined in Mil-Spec JAN-M-382, entitled, "Magnesium Powder For Use In Ammunition." The polygycol and epoxy resins were obtained from The Dow Chemical Company, Midland, Mich. The epoxy resin used is marketed by The Dow Chemical Company under the trademark D. E. R. 732 and is flexible epoxy resin. The polyglycol resin is a perchlorate-modified amine-terminated long chain polyglycol and The Dow Chemical Company designates the resin as QX-3812. The polyglycol resin is an amber liquid having a specific gravity of 1.05 at 25° C. and has the following analysis:

	PERCENT (By Weight)
Carbon	59.10
Hydrogen	10.20
Oxygen	28.05
Chlorine	1.36
Nitrogen	1.29

After the ingredients were mixed and blended, the composition was poured and tamped to form a smoke candle about 2.66 inches in diameter and about 11.2 inches long.

The smoke candle weight 1,810 grams and had a density of 1.77 g./cm.^{3}. After curing, the smoke candle was ignited and burned for 540 seconds. A dense, white smoke was produced.

EXAMPLE II

	PERCENT (By Weight)
Magnesium (granulation 15)	11
Zinc Oxide	Hexachlorobenzene 8.68
Polyglycol Resin (QX-3812)	5.32
Epoxy Resin (D. E. R. - 732)	

The ingredients were blended as in example I and then tamped to form a smoke candle about 8 inches in diameter and about 5.3 inches long. The smoke candle weighed 7,700 grams and had a density of 1.83 g./cm.^{3}. After curing, the smoke candle was ignited and burned for 407 seconds. A dense, white smoke was produced.

EXAMPLE III

	PERCENT (By Weight)
Magnesium (granulation 15)	11.2

Zinc Oxide	46.5
Polyvinyl chloride	24.5
Polyglycol Resin (QX-3812)	11.04
Epoxy Resin (D. E. R.-732)	6.76

The ingredients were blended as in example I and then tamped to form a smoke candle about 4.25 inches in diameter and about 12.88 inches long. The smoke candle weighed 5,690 grams and had a density of 1.90 g./cm.^{3}. After curing, the smoke candle was ignited and burned for 905 seconds. A dense, white smoke was produced.

EXAMPLE IV

	PERCENT (By Weight)
Magnesium (granulation 15)	10.7
Zinc Oxide	44.0
Chlorinated Rubber	23.0
Polyglycol Resin (QX-3812)	13.83
Epoxy Resin (D. E. R.-732)	8.47

The chlorinated rubber compound which was used is marketed under the trade name Parlon and is a product of Hercules Powder Co., Wilmington, Del. The ingredients were blended as in example I and then tamped to form a smoke candle about 4.25 inches in diameter and about 13.75 inches long. The smoke candle weighed 5,040 grams and had a density of 1.57 g./cm^3. After curing, the smoke candle was ignited and burned for 1,245 seconds. A dense, white smoke was produced.

EXAMPLE V

	PERCENT (By Weight)
Magnesium (granulation 15)	11.60
Zinc Oxide	48.80
Perchloropentacyclodecane	25.50
Epoxy Resin	9.60
Curing Agent	4.50

The epoxy resin used was a general purpose liquid resin and was obtained from The Dow Chemical Company, Midland, Mich., under the trade name D. E. R. 321. The curing agent

was also obtained from The Dow Chemical Company, and was a low viscosity aliphatic diamine which is sold under the trade name D. E. H. 31. The ingredients were blended as in example I and then tamped to form a smoke candle about 2.66 inches in diameter and about 16.50 inches long. The smoke candle weighed 3,580 grams and had a density of 2.36 g./cm.^{3} After curing, the smoke candle was ignited and burned for 1,170 seconds. A dense, white smoke was produced.

EXAMPLE VI

	PERCENT (By Weight)
Magnesium (granulation 15)	11.70
Zinc Oxide	48.80
Perchloropentacyclodecane	25.70
Epoxy Resin	7.45
Curing Agent	6.35

The epoxy resin used was a low-viscosity liquid resin obtained from The Dow Chemical Company, Midland, Mich., under the trade name D. E. R. 732. The curing agent was also obtained from The Dow Chemical Company and was a low-viscosity aliphatic diamine which is sold under the trade name D. E. H. 33. The ingredients were blended as in example I and then tamped to form a smoke candle about 2.66 inches in diameter and about 16.75 inches long. The smoke candle weighed 3,540 grams and had a density of 2.32 g./cm.^{3}. After curing, the smoke candle was ignited and burned for 1,305 seconds. A dense, white smoke was produced.

I claim:

1. A substantially homogenous white-smoke-generating composition consisting entirely by weight, of
   between 11 and 13 percent of magnesium,
   between 46 and 49 percent of zinc oxide,
   between 23 and 326 percent of chlorinated organic compound selected from the group consisting of perchloropentacyclodecane, hexachlorobenzene and polyvinyl chloride, and
   between 14 and 22 percent of a resin binder selected from the group of epoxy resin and epoxy-polyglycol resin.

2. A white smoke-generating composition as set forth in claim 1 wherein said epoxy-polyglycol resin is comprised, by weight, of about 62 percent of polyglycol resin and about 38 percent of epoxy resin.

* * * * *

United States Patent

[11] 3,625,155

[72] Inventors **Bernard E. Douda**
Bloomfield, Ind.;
Roscoe D. Dwiggins, Derwyn Heights, Md.

[21] Appl. No. 1,500
[22] Filed Jan. 8, 1970
[45] Patented Dec. 7, 1971

[73] Assignee **The United States of America as represented by the Secretary of the Navy**

[54] **DEVICE FOR PRODUCING WHITE SMOKE BY IMPLODING RED PHOSPHORUS**
3 Claims, 2 Drawing Figs.

[52] U.S. Cl. **102/90,** 102/65, 102/66
[51] **Int. Cl.** **F42b 13/44**
[50] **Field of Search** 102/1, 6, 32, 39, 66, 98, 87, 65

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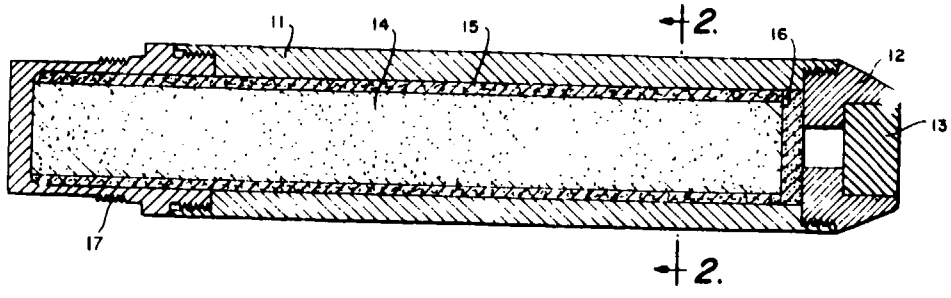
Primary Examiner—Robert F. Stahl
Attorneys—R. S. Sciascia, H. H. Losche and Paul S. Collignon

ABSTRACT: A device for producing white smoke having an inner core of red phosphorus surrounded by a flexible sheet of explosive material and having means for detonating said explosive material whereby red phosphorus is imploded to produce white smoke.



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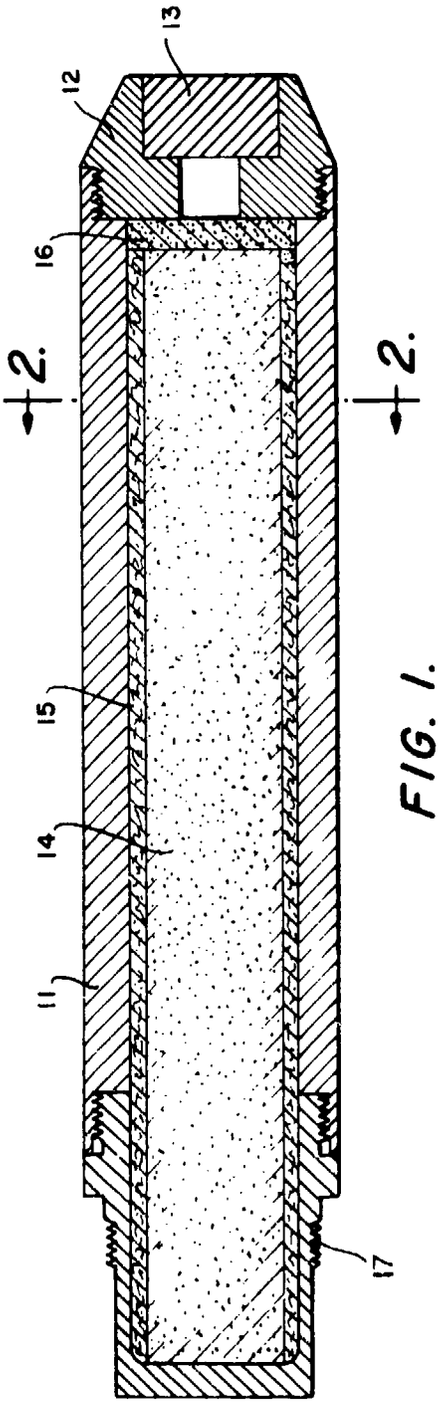

FIG. 1.

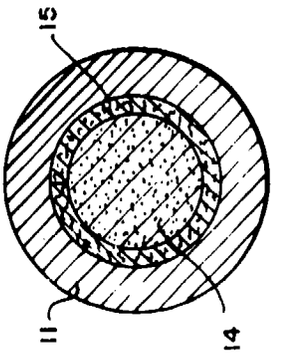

FIG. 2.

INVENTORS
BERNARD E. DOUDA
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ATTORNEYS

DEVICE FOR PRODUCING WHITE SMOKE BY IMPLODING RED PHOSPHORUS

STATEMENT OF GOVERNMENT INTEREST

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

BACKGROUND OF THE INVENTION

The present invention relates to a device for producing white smoke by imploding red phosphorus.

Chemicals in the category of screening smokes are those which, when dispersed in air, produce a cloud of finely divided particles of solid, liquid, or both. These are used to shield tactical operations or disrupt the movements of the enemy. Outstanding examples of such materials are: fuel oil used in "artificial fog" generators. white phosphorus, sulfur trioxide, titanium tetrachloride, and so-called zinc chloride smokes. Each of the above-listed smoke-generating compositions is characterized by certain advantages and disadvantages in military operations, depending upon the importance of such factors as mobility of the smoke-producing apparatus, toxicity, logistical considerations, and the total obscuring power of the composition employed.

Traditionally, the Military has used white phosphorus as the load in munitions designed to provide a white smoke mark. The method employed is to explode the white phosphorus by means of a high-explosive center core. The white-pillaring cloud produced is the product of combustion of the white phosphorus with the oxygen from the surrounding atmosphere. Since white phosphorus is spontaneously reactive with air (pyrophoric) upon dispersal into the atmosphere, the conversion of the white phosphorus to smoke approaches 100 percent

There are, however, several notable disadvantages to the use of white phosphorus in military hardware, such as increased cost to load due to the pyrophoric nature of white phosphorus, low melting point (44.3° C.), which may cause center of gravity shifts if the load melts, and danger of leakage from containers and shells. Also, presently there is only one production facility in the United States which can load white phosphorus.

It has been observed in the past that red phosphorus will produce a white smoke cloud comparable to that produced by the white form if combustion is complete. In addition, as the red phosphorus is a solid up to 597° C., and is not pyrophoric. it does not have many of the disadvantages of the white form. Additionally, about every commercial pyrotechnic company has the facilities and capability to load red phosphorus, thus insuring competitive bidding and competition.

The main reason that red phosphorus was never universally substituted for white phosphorus in smoke marking munitions is that it was extremely difficult to achieve complete combustion of the red form with existing technology. It was conventionally necessary to explode the phosphorus into the atmosphere to generate the smoke cloud. Such action would result in an ex · llent white cloud when white phosphorus was used. On the other hand, however, when the red form was used, not all of the phosphorus was ignited during the explosion. This resulted in incomplete combustion and consequently, a smoke cloud of reduced size and density was formed.

SUMMARY OF THE INVENTION

The present invention relates to a device for producing white smoke by using red phosphorus. Red phosphorus pellets are wrapped with a flexible plastic explosive and loaded into a thin-walled container or shell. Upon detonation of the flexible plastic explosive, nearly complete combustion is achieved by implosion of red phosphorus thereby producing a smoke cloud similar to that formed from explosion of an equal amount of white phosphorus.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a longitudinal sectional view of a preferred embodiment of the present invention; and

FIG. 2 is a sectional view taken on line 2—2 of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawing, there is shown a smoke bomb having a cylindrical body section 11 to which a nose section 12 is threadedly attached. A suitable fuze 13 is provided in nose section 12 and, by way of example, fuze 13 might be either a point-detonating nose fuze or a proximity fuze, both of which are well known to those skilled in the art. An inner core of red phosphorus 14 is provided in cylindrical body section 11, and this red phosphorus 14 might either be in granular form or be mixed with a suitable binder and formed in pellets. A sheathing of flexible high explosive 15 is positioned between body section 11 and the red phosphorus 14 and explosive 15 completely surrounds red phosphorus 14. By way of example, the sheathing of flexible high explosive 15 might be Detasheet, a flexible plastic-bonded form of high explosive marketed by E. I. DuPont deNemours and Co., Wilmington, Delaware. A detonating booster 16, such as tetryl pellet, is provided in the forward end of body section 11 to detonate high explosive 15.

OPERATION

Cylindrical body section 11 is provided with external threads 17 so that body section 11 can be attached to a rocket or other delivering device. Upon actuation of fuze 13, booster 16 is detonated which, in turn, detonates high explosive 15 thereby imploding red phosphorus 14.

In a test conducted at Naval Ammunition Depot, Crane, Indiana red phosphorus pellets were wrapped with Detasheet and placed in a 2.75 inch rocket head. The rocket head cavity was about 18 inches long and had an inside diameter of 2.5 inches. The rocket head was made of aluminum and had a 0.125-inch thick wall. Loaded rocket heads were statically fired while positioned horizontally on the ground and the implosion of the red phosphorus resulted in the formation of a huge smoke cloud. Inspection of the test area after firing did not reveal any significant amount of unconsumed red phosphorus and it was concluded that nearly complete combustion was achieved by imploding red phosphorus.

The smoke cloud resulting from implosion of red phosphorus is similar to that formed from explosion of an equal amount of white phosphorus. In the text, *Phosphorus And Its Compounds*, Vol. I, by John R. Van Wazer, (Interscience Publishers, Inc. 1958), at page 101, it is explained that molten red phosphorus yields white phosphorus upon rapid cooling. It is believed that the heat and pressure generated when red phosphorus is imploded causes some of the red phosphorus to melt and this liquid, upon rapid cooling, forms white phosphorus which subsequently burns upon contact with the atmosphere. This phenomenon, in combination with the pillared-dispersal of the red phosphorus, is believed to account for the superior manner of making a smoke cloud when red phosphorus is imploded.

We claim:

1. A white smoke producing device comprising,
   - a cylindrical housing,
   - an inner core consisting entirely of red phosphorus within said housing,
   - a layer of flexible plastic-bonded high explosive positioned between said inner core of red phosphorus and the inside wall surface of said cylindrical housing and surrounding said inner core of red phosphorus, and
   - means for detonating said layer of flexible plastic-bonded high explosive whereby said inner core of red phosphorus is imploded to produce white smoke.

2. A white smoke producing device as set forth in claim 1 wherein said red phosphorus is in granular form.

3. A white smoke producing device as set forth in claim 1 wherein said red phosphorus is in pellet form.

* * * * *

United States Patent

[11] 3,617,408

[72] Inventors: Roger D. Hunter; William L. Ripley, both of Bedford, Ind.

[21] Appl. No. 846,944
[22] Filed Aug. 1, 1969
[45] Patented Nov. 2, 1971

[73] Assignee The United States of America as represented by the Secretary of the Navy

[54] ZIRCONIUM SALT ANTICAKING INGREDIENT FOR NITRATES

3 Claims, No Drawings

[52] U.S. Cl. 149/46, 149/61, 149/70, 23/102, 23/103

[51] Int. Cl. C06b 1/04

[50] Field of Search 23/102, 103; 149/46, 61, 5, 70, 41

[56] References Cited

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Primary Examiner—Benjamin R. Padgett
Assistant Examiner—Stephen J. Lechert, Jr.
Attorneys—Edgar J. Brower, H. H. Losche and Paul S. Collignon

ABSTRACT: Quadrivalent zirconium is added in small proportions to nitrates, such as sodium nitrate and ammonium nitrate, to prevent caking. A solution of a soluble quadrivalent zirconium salt is added to a nitrate and the quadrivalent zirconium modifies the resultant crystal lattice of the nitrate upon drying to prevent caking of the nitrate during storage.

ZIRCONIUM SALT ANTICAKING INGREDIENT FOR NITRATES

STATEMENT OF GOVERNMENT INTEREST

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

BACKGROUND OF THE INVENTION

The present invention relates to a process and an ingredient for preventing caking of nitrates, such as sodium nitrate and ammonium nitrate, which are to be added as oxidizers for pyrotechnic devices, such as illuminating flares. Sodium nitrate which is used in pyrotechnics is purchased under a military specification which requires an average particle size between 20 and 50 microns. Sodium nitrate which is pulverized to this fineness, however, normally cakes into a hard mass before it can be used, so that it requires an additional grinding operation before being used. Heretofore no anticaking agents could be added because, in order to be effective, from 3—5 percent, by weight, of anticaking agent had to be added and this had a deleterious effect on the candlepower efficiency of illuminating flares.

Various noncaking ingredients have been used in the past, particularly with fertilizers to facilitate their capacity for being scattered. For example, in U.S. Pat. No. 1,966,947, which issued July 17, 1934, to Carl Eyer, it was disclosed that fertilizers containing ammonium nitrate had less tendency to cake when mixed with salts of aluminum or iron. Specifically, the Eyer patent disclosed that fertilizers containing between 1 and 10 percent of either aluminum sulfate or ferric sulfate would have less tendency to cake during storage.

Another anticaking ingredient for fertilizer materials is disclosed in U.S. Pat. No. 3,070,435, which issued Dec. 25, 1962, to Robert E. Reusser and Van C. Vives. This patent discloses that the addition of between 0.75 and 3 percent by weight of anhydrous magnesium sulfate will prevent fertilizers containing ammonium nitrate from caking.

SUMMARY OF THE INVENTION

The present invention relates to an improved process and ingredient for preventing the caking of nitrates, such as sodium nitrate and ammonium nitrate. A soluble salt of quadrivalent zirconium is dissolved in water and mixed with a nitrate, such as sodium nitrate and ammonium nitrate. The quadrivalent zirconium modifies the resultant crystal lattice of the nitrate upon drying and the nitrate will not cake during storage. The percentage of zirconium required to prevent caking is extremely low, being in the range of 0.16 to 0.80 percent, by weight, and thus there is only a slight reduction of candlepower efficiency in illuminating flares which use a nitrate having this anticaking ingredient.

DESCRIPTION OF THE PREFERRED EMBODIMENT

According to the present invention, it has been found that quadrivalent zirconium will modify the crystal lattice of both sodium nitrate and ammonium nitrate and, when so modified, these nitrates will no longer tend to cake while in storage. A solution is made using a soluble salt of zirconium and then the nitrate is added. Upon drying, the crystal lattice is modified.

Satisfactory end results, that is, noncaking nitrates, have been achieved using zirconium acetate, zirconium nitrate, zirconium oxychloride, zirconium sulfate and zirconium tetrachloride. When insoluble zirconium oxide was used, no anticaking effect was achieved.

Sodium nitrate has been combined with zirconium to provide a free-flowing powder after it is pulverized. For example, satisfactory results have been obtained using zirconium sulfate concentration of between 0.16 and 0.80 percent, by weight, that is, 0.20 to 1.0 percent as $Zr(SO_4)_2 \cdot 4H_2O$. The sodium nitrate is precipitated or crystallized from the zirconium sulfate solution. On drying, the sodium nitrate contaminated with zirconium sulfate formed a growth on the surface. Chemical analysis showed the presence of about 0.15 percent zirconium, and X-ray diffraction studies revealed no differences in the pattern of the zirconium-sulfate-doped sodium nitrate and a control sodium nitrate. Differential thermal analysis, however, showed a very large endotherm at 150° C. The dried and ground material had a dull, chalky appearance and formed no lumps after standing for 6 months. It remained free flowing and powdery.

Experimental illuminating flares were made using the zirconium-doped sodium nitrate and these were compared with control candles. A typical formulation for an illuminating candle might be that of about 58 percent of granulated magnesium, about 37.5 percent of sodium nitrate and about 4.5 percent of a binder. The average burning time of four control flares was about 190 seconds with an average candlepower of 1,900,000. The candlepower efficiency was 53,000 cp.-sec./g. The average burning time of four experimental candles made with zirconium-sulfate-doped sodium nitrate was 164 seconds with an average candlepower of 1,964,000. The candlepower efficiency was 49,000 cp.-sec./g. Thus, although the efficiency of a flare using the improved sodium nitrate is lower than that of a flare using untreated sodium nitrate, the reduction is so low that it will not preclude the use of treated sodium sulfate in military flares, as the advantage of having a noncaking nitrate more than compensates for the slight reduction in efficiency of an illuminating flare. Quadrivalent zirconium also has an anticaking affect when employed with ammonium nitrate.

We claim:

1. A method for reducing the caking tendency of a nitrate selected from the group consisting of sodium nitrate and ammonium nitrate comprising adding a solution of a zirconium salt selected from the group consisting of zirconium acetate, zirconium nitrate, zirconium oxychloride, zirconium sulfate, and zirconium tetrachloride to modify the resultant crystal lattice of said nitrate upon drying.

2. An oxidizing material having reduced tendency to cake comprising,

a nitrate selected from the group consisting of sodium nitrate and ammonium nitrate, and

a soluble salt of quadrivalent zirconium selected from the group consisting of zirconium acetate, zirconium nitrate, zirconium oxychloride, zirconium sulfate, and zirconium tetrachloride.

3. An oxidizing material having reduced tendency to cake as set forth in claim 3 wherein the amount of quadrivalent zirconium is in the range of 0.16 to 0.08 percent, by weight, of the oxidizing material.

* * * * *

United States Patent

[11] 3,617,403

[72] Inventor Duane M. Johnson
Bicknell, Ind.

[21] Appl. No. 819,523
[22] Filed Apr. 24, 1969
[45] Patented Nov. 2, 1971

[73] Assignee The United States of America as represented by the Secretary of the Navy

[54] IGNITION TRANSFER COMPOSITION COMPRISING FUEL, OXIDIZER AND FLUOROELASTOMER

2 Claims, No Drawings

[52] U.S. Cl. 149/19, 149/22, 149/44
[51] Int. Cl. C06d 5/00
[50] Field of Search 149/19, 22, 44

[56] References Cited

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Primary Examiner—Carl D. Quarforth
Assistant Examiner—E. A. Miller
Attorneys—Edgar J. Brower, H. H. Losche and Paul S. Collignon

ABSTRACT: A transfer composition for igniting a pyrotechnic composition comprised of a fuel such as boron, an oxidizer, such as lead dioxide, and a fluoroelastomer which serves as a binder and desensitizer.

IGNITION TRANSFER COMPOSITION COMPRISING FUEL, OXIDIZER AND FLUOROELASTOMER

STATEMENT OF GOVERNMENT INTEREST

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

BACKGROUND OF THE INVENTION

Various types of transfer or igniter compositions are used in the pyrotechnic art to transfer combustion from an initiator, such as a primer, squib, or detonator, to a pyrotechnic composition such as propelling powder, flare composition, or the like. For example, in U.S. Pat. No. 3,173,367, issued Mar. 16, 1965, to Roy L. Shinpaugh, there is disclosed an ignition composition comprised of between 65–78 percent of barium chromate, between 7–16 percent of boron, and between 10–20 percent of lead dioxide. This composition is designed to have improved dielectric resistance and to be substantially insensitive to a wide range of temperature conditions.

Previously available transfer compositions which are highly ignition-sensitive, are also highly friction sensitive and difficult to handle during manufacture. In addition, these transfer compositions are not very durable and are adversely affected by shock and vibration. Pressed columns of these compositions tend to crack or powder and then become unreliable.

SUMMARY OF THE INVENTION

The improved transfer composition of the present invention is comprised of between 3 and 12 percent of a fuel, such as boron, between 80 and 95 percent of an oxidizer, such as lead dioxide and between 2 and 12 percent of a fluoroelastomer which serves as a binder and desensitizer. The transfer composition may be used in the loose form when extreme ignition sensitivity is desired, or it may be extruded or consolidated under pressure. DESCRIPTION OF THE PREFERRED EMBODIMENT

Various transfer compositions were prepared using boron, lead dioxide, and a fluoroelastomer. The proportions, by weight, ranged between 3 to 12 percent boron, between 80 to 95 percent lead dioxide, and between 2 to 12 percent of a fluoroelastomer known as Viton A, a polymer of 32.1 percent carbon, 1.8 percent hydrogen, and 66.1 percent fluorine. Viton A, which is shown as $(-CF_2CH_2CF_2)_x$ is sold by E. I. duPont deNemours, Wilmington, Delaware.

The transfer composition is prepared by adding the fuel and oxidizer to an acetone solution of Viton A. The ingredients are mixed by agitation until a homogeneous mixture is obtained.

While agitation is in process, hexane is added in the ratio of two volumes of hexane per volume of solution. The binder precipitates out of solution onto the solid particles of fuel and oxidizer. Agitation is then stopped and the solids are allowed to settle. The hexane-acetone solution is then decanted off. Additional hexane is then added and the solids are again agitated. The hexane is decanted off and the solids allowed to flash-dry. The composition may be used in the loose form when extreme ignition sensitivity is desired, or it may be extruded or consolidated under pressure.

The following nonlimiting examples represent embodiments of the invention which were compounded and satisfactorily tested at the Naval Ammunition Depot, Crane, Ind. The percentages listed are by weight.

Example Number	Fuel (%)	Oxidizer (%)	Binder (%)
1	Boron—9.6	Red lead dioxide—86.4	Viton A—4
2.	Boron—8.6	Lead dioxide 87.1	Viton A—4 3
3.	Boron—6.6	Lead dioxide—89.1	Viton A—4.3
4	Boron—4.8	Lead dioxide—90.9	Viton A—4 3
5.	Boron—5 7	Red lead oxide—90 0	Viton A—4 3
6	Boron—19.2	Manganese dioxide—76 8	Viton A—4 0
7	Silicon—9 6	Lead dioxide—86.4	Viton A—4 0
8	Silicon—17.3	Lead dioxide—78.7	Viton A—4 0
9	(Boron—3.8) (Silicon—5 7)	(Lead dioxide—19 2) (Manganese dioxide—67 3)	Viton A—4 0

I claim:

1. An ignition transfer composition comprised, by weight, of,

between about 3 and 12 percent of a fuel selected from the group consisting of boron and silicon,

between about 80 and 95 percent of an oxidizer selected from the group consisting of lead dioxide, red lead oxide and manganese dioxide, and

between about 2 and 12 percent of a fluoroelastomer having the formula $(-CF_2CH_2CF_2)_x$, and comprised, by weight, of about 32.1 percent carbon, about 1.8 percent hydrogen and about 66.1 percent fluorine.

2. An ignition transfer composition as set forth in claim 4 wherein said fuel is boron and said oxidizer is lead dioxide.

* * * * *

United States Patent

[11] 3,612,857

[72] Inventors: Dave P. Beatty, Worthington; James O. Reinhart, Bloomfield, both of Ind.

[21] Appl. No. 19,896
[22] Filed Mar. 16, 1970
[45] Patented Oct. 12, 1971

[73] Assignee: The United States of America as represented by the Secretary of the Navy

[54] LOCATION MARKER FOR PRODUCING LUMINOUS DISPLAY

5 Claims, 7 Drawing Figs.

[52] U.S. Cl. ..... 240/2.25, 102/4, 102/35.6, 102/37.6, 102/60, 102/85, 116/124 B, 252/188.3

[51] Int. Cl. F21v 9/16

[50] Field of Search ..... 102/37.8, 37.6, 60, 87; 240/2.25; 116/124 B

[56] References Cited

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Primary Examiner—Robert F. Stahl
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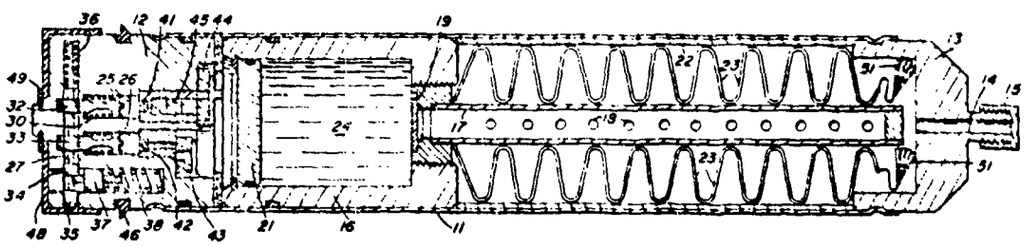
ABSTRACT: A location marker having a first compartment containing at least one cloth streamer saturated with a chemiluminescent material and having a second compartment containing an activator composition for activating the chemiluminescent material, said first and second compartments being separated by a frangible barrier. A fuze section is provided having first and second triggering means whereby said first triggering means activates a gas-generating component to cause said activator composition to rupture said frangible barrier and saturate said at least one cloth streamer, and whereby said second triggering means actuates a pyrotechnic delay train which, in turn, ignites an explosive composition to eject said at least one cloth streamer from its compartment.



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3,612,857

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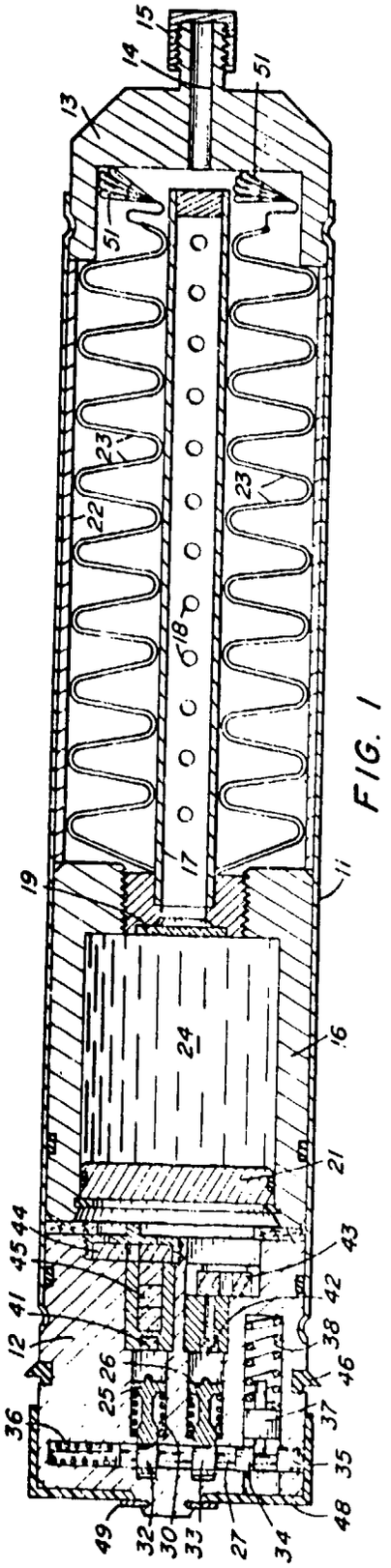

FIG. 1

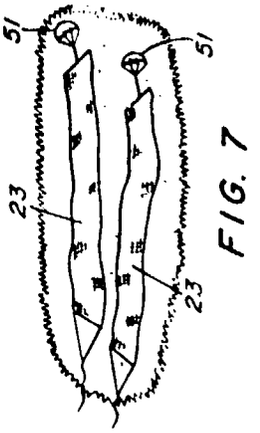

FIG. 7

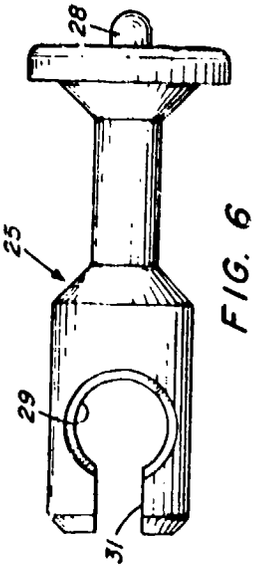

FIG. 6

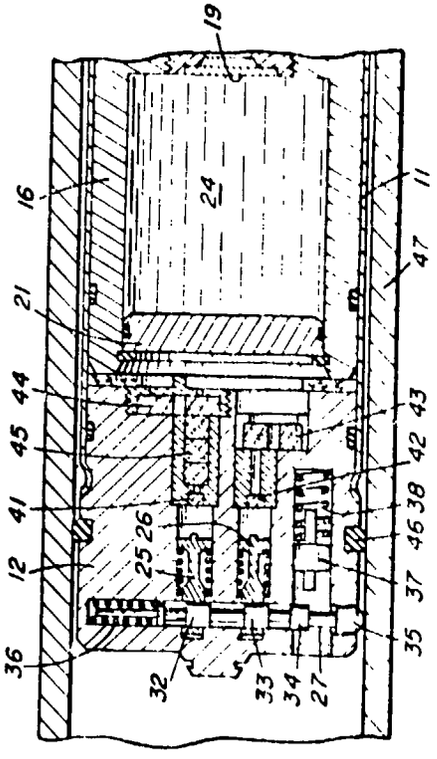

FIG. 2

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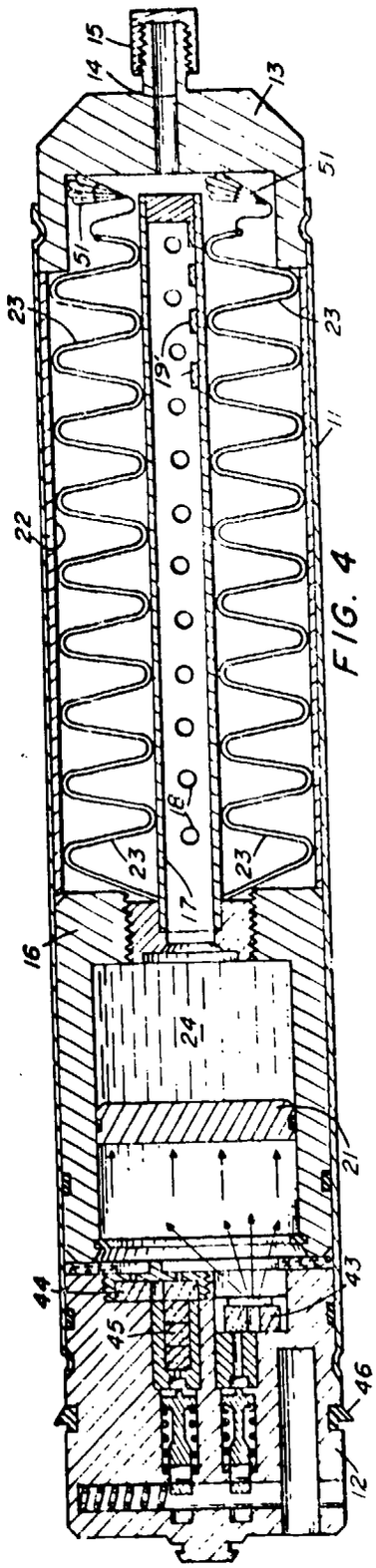

FIG. 4

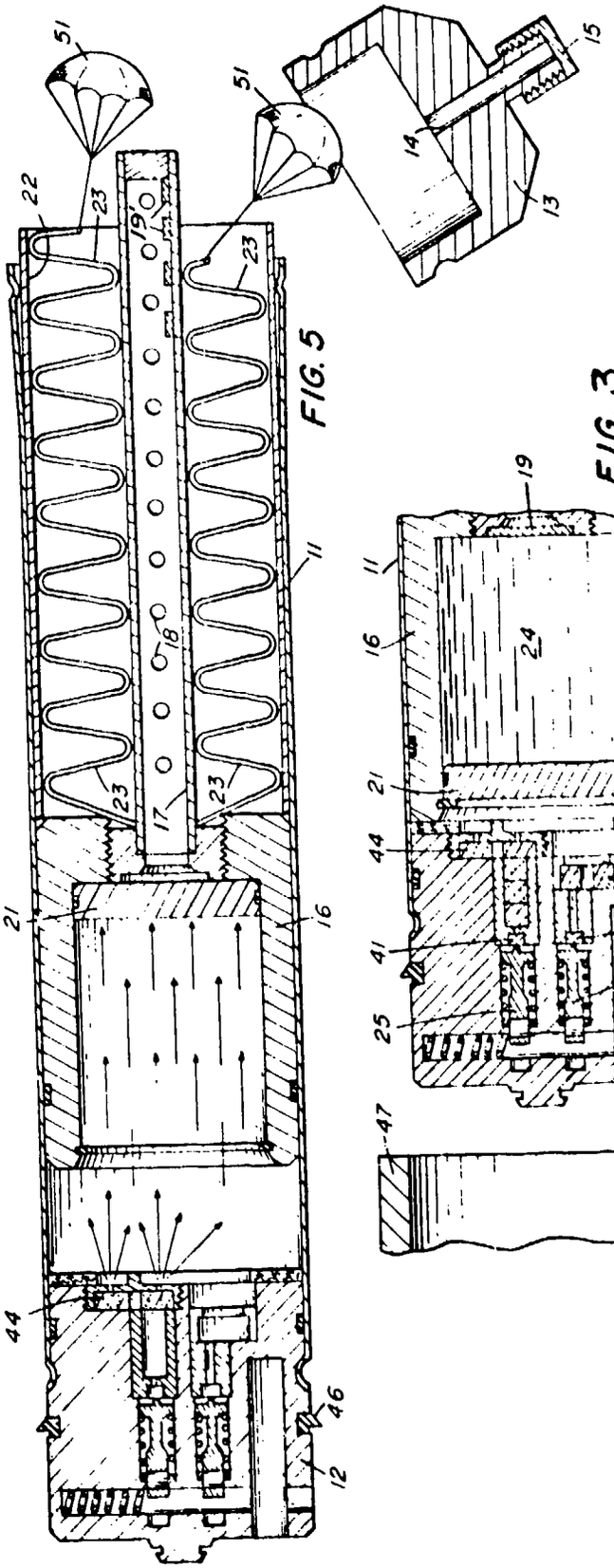

FIG. 5

FIG. 3

LOCATION MARKER FOR PRODUCING LUMINOUS DISPLAY

STATEMENT OF GOVERNMENT INTEREST

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

BACKGROUND OF THE INVENTION

The present invention relates to a location marker and more particularly to a location marker which can be launched from an aircraft and, when deployed on the ground, will emit a luminous display which can be seen at night by aircraft personnel.

Various devices are presently being employed to mark ground or sea locations by dropping, or launching, markers from aircraft. In general, these devices serve either to locate friendly personnel who might be in need of rescue or to locate enemy troop or supply location for future destruction. Frequently, a spot in the ocean is to be marked, such as for spotting submarines, and many of these locating device utilize the water environment to activate a smoke- or flame-producing composition. For example, one marine location marker employed during night operation by the U.S. Navy consists of a steel can containing a main charge of calcium carbide in its bottom inner section and a centrally located tube containing a smaller charge of calcium phosphide. The reaction of these chemicals with sea water produces acetylene and phosphine. Phosphine ignites spontaneously within 70 seconds after water enters the marker. The burning phosphine ignites the acetylene as it escapes from the can and a flame about 9 inches high is produced.

Another marine location marker which is used to produce both flame and smoke contains red phosphorous. Ignition is accomplished by electrical current supplied by a sea-water-activated battery. When sea water enters the battery cavity in the base assembly, the sea water acts as a electrolyte in the battery causing sufficient electrical current to be produced to initiate an electric squib which, in turn, ignites a starter mix and red phosphorus. Gases of combustion force a valve body out of the nose of the location marker thereby allowing yellow flame and white smoke to be emitted. A marker containing 784 grams of red phosphorus will burn between 13 and 19 minutes.

Still another type of location marker employed in a water environment is one containing a fluorescein dye which is expelled by an explosive charge to spread dye on the water. This marker is designed to be launched either from surface craft or aircraft to produce a daylight reference on the ocean's surface in the form of a dye slick which is used in antisubmarine warfare or as a distress signal in search and rescue operations. Unless the sea is extremely rough, these dye slick markers normally provide a marker which lasts substantially longer than the burning-type markers.

Smoke and flame producing markers are also employed by the military for locating and marking ground areas. Instead, of sea water being used as an initiating agent, however, various mechanical and chemical means are utilized to ignite a pyrotechnic composition which burns to produce a signal.

SUMMARY OF THE INVENTION

The present invention relates to a location marker having a first compartment for holding one or more cloth streamers which are saturated with a chemiluminescent material. A second compartment is provided for holding a liquid activator composition and the first and second compartments are separated by a frangible barrier, such as a glass disk. A fuze section is provided adjacent the second compartment and contains first and second firing pins. These firing pins are maintained in a cocked position by a bore rider pin which prevents actuation of the firing pins until the location marker has cleared its launching tube. A gas generator pellet is provided in the fuze section and, upon actuation of the firing pins, the gas generator pellet is ignited and gas therefrom moves a piston which injects the liquid activator composition into the first compartment containing one or more cloth streamers. An ejection pellet is also provided in the fuze section and, upon ignition of the ejection pellet, the cloth streamers are ejected from their compartment. The cloth streamers fall to the ground and provide a highly effective location marker which is visible from 5 miles for about 15 minutes.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a longitudinal sectional view of a preferred embodiment of the present invention;

FIG. 2 is a partial sectional view showing a location marker in a launching tube;

FIG. 3 is a partial sectional view showing a location marker leaving a launching tube;

FIG. 4 is a sectional view showing the preferred embodiment in a fired condition;

FIG. 5 is a sectional view showing cloth streamers being ejected from a compartment;

FIG. 6 is an enlarged view of a firing pin; and

FIG. 7 is a diagrammatic view showing cloth streamers after landing in a target area.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring first to FIG. 1 of the drawing, there is shown a cylindrical container 11 that has one end crimped to a fuze section 12 and the other end crimped to an end cap 13. End cap 13 is provided with an opening 14 through which fluid can pass, and opening 14 is closed by a threaded plug 15 which attaches to end cap 13. A piston housing 16 is slidably positioned inside container 11 and has a cavity for holding fluid. A distribution pipe 17, having a plurality of holes 18 therein, is attached to one end of piston housing 16 and a frangible barrier 19, such as a glass disk, is provided to retain fluid within the cavity of piston housing 16. A piston 21 is slidably positioned in the cavity of piston housing 16. An ejection cylinder 22, which is split into two halves, is positioned inside container 11 between one end of piston housing 16 and the inner end of end cap 13, and movement of piston housing 16 causes end cap 13 to be separated from container 11.

One or more cloth streamers 23 are placed within container 11 and streamers 23 are saturated with a chemiluminescent fluid which can be introduced into container 11 through opening 14 in end cap 13. By way of example, chemiluminescent fluid might be comprised of 0.2 molar bis (2, 4, 5-trichloro-6-carbobutoxyheyenyl) oxalate, 0.003 molar 9, 10-bis (phenylethynyl) anthracene, 1 percent cyanacryl terpolymer, and 2 percent bis-(2-ethylhexyl) phthalate in benzene. A suitable activator fluid 24, which is retained in the cavity of piston housing 16, might be 1.5 molar hydrogen peroxide in dimethyl phthalate.

Firing pins 25 and 26 are slidably positioned in fuze section 12 and are maintained in a cocked positioned by a bore rider pin 27. The driving force for each firing pin is supplied by a separate firing pin spring 30. As best shown in FIG. 6 of the drawings, each firing pin is provided with a tang 28, a bore 29 and a slot 31. Bore rider pin 27 is provided with three enlarged diameter sections 32, 33, and 34 and a head 35. Enlarged diameter section 32 is slidably engageable in bore 29 of firing pin 25 and enlarged diameter section 33 is slidably engageable in bore 29 of firing pin 26 and, when so engaged, firing pins 25 and 26 are held in a cocked position. Spring 36 is provided as a driving force to move bore rider pin 27 out of fuze section 12, however, during a cocked condition, pneumatic button 37 engages the end of enlarged diameter section 34 to prevent movement of bore rider pin 27 and release of firing pins 25 and 26. Spring 38 is provided to maintain pneumatic button 37 in engagement with enlarged diameter section 34.

Primers 41 and 42 are provided in fuze section 12 and are in line to be struck by firing pins 25 and 26, respectively. A gas-

generating pellet 43, which is to be ignited by primer 42, is provided to produce gas for driving piston 21 and an ejection pellet 44 is provided to produce an explosive force for driving piston housing 16 and ejecting streamers 23. By way of example, gas-generating pellet 43 might be comprised by a mixture of magnesium and Teflon that is pressed into a pellet, and ejection pellet 44 might be black powder. Delay pellets 45 are positioned between primer 41 and ejection pellet 44 to delay ejection of streamers 23 for sufficient time to permit activator component to pass through holes 18 in distribution pipe 17.

As one method of launching the marker of the present invention is by compressed air, a sealing ring 46 of resilient material is provided around the outer periphery of fuze section 12 to prevent excessive leakage of air between the outer perimeter of the marker and the inner surface of a launching tube 47. As dropping the marker could cause movement of pneumatic button 37 and accidental release of bore rider pin 27, a safety cap 48 is provided around the end of fuze section 12 and locked thereto by retaining ring 49.

OPERATION

After the location marker of the present invention is assembled as shown in FIG. 1 of the drawings with streamers 23 therein, chemiluminescent fluid is added through orifice 14 of end cap 13 to saturate cloth streamers 23. Immediately prior to launching, retaining ring 49 and safety cap 48 are removed.

Upon launching in launching tube 47, the propelling force, such as that of an explosion, or compressed air, causes pneumatic button 37 to move inwardly thereby compressing spring 38 and freeing, or releasing, bore pin 27. Spring 36 moves bore rider pin 27 against the inner bore of launcher 47, but as shown in FIG. 2 of the drawing, the movement of pin 27 is insufficient to release firing pins 25 and 26. Upon location marker clearing launching tube 47, spring 36 moves pin 27 outwardly and releases firing pins 25 and 26 and their respective firing pin springs 30 drive firing pins 25 and 26 forwardly and detonate primers 41 and 42, respectively.

As best shown in FIG. 4 of the drawings, primer 41 ignites gas generating pellet 43 and the gas pressure therefrom drives piston 21 forwardly causing fluid 24 to break frangible barrier 19. As piston 21 continues to move forwardly, fluid 24 is forced through distribution pipe 17 and holes 18 to saturate streamers 23 and activate the chemiluminescent fluid which has been absorbed by streamers 23. Primer 41 is detonated simultaneously with primer 42, and primer 41 ignites delay elements 45 which, in turn, detonate ejection pellet 44. By way of example, delay elements 45 might be designed to ignite ejection pellet 44 about 8 seconds after gas-generating pellet 43. This delay allows fluid 34 to pass through holes 18 and saturate streamers 23 and also allows a free fall of the location marker before expellent charge 44 ejects streamers 23.

Referring now to FIG. 5 of the drawings, explosive charge 44 is shown being detonated and piston housing 16 is moving outwardly from fuze section 12. Piston housing 16 moves ejection cylinder 22 against end cap 13 and end cap 13 is separated from container 11. As piston housing 16 continues to move forwardly, ejection cylinder 22 continues to separate from container 11. When the rearward end of ejection cylinder 22 clears the end of container 11, the two halves of ejection cylinder 22 separate and fall away. To facilitate separation of streamers 23, a small drogue parachute 51 may be provided to one end of each streamer 23. Also, if desired, the other end of each streamer 23 may be fastened to either container 11 or piston housing 16 to provide a weight so that streamers 23 may be more accurately deployed. Without such a weight, streamers 23 would be highly susceptible to wind and their location could not be accurately placed by dropping from an aircraft. FIG. 7 of the drawings shows a pair of streamers 23 lying on the ground and emitting a colored glow that can be seen at night from searching aircraft.

We claim:

1. A location marker comprising,

a tubular container,

at least one strip of cloth saturated with chemiluminescent material in one end of said container,

a piston housing slidably mounted in said tubular container having a fluid compartment and a piston slidably mounted in said fluid compartment,

a quantity of activator fluid in said fluid compartment,

a frangible barrier closing one end of said fluid compartment,

means for slidably moving said piston in said piston housing whereby movement of said piston causes said frangible barrier to break and saturate said at least one strip of cloth with activator fluid, and

means for slidably moving said piston housing whereby movement of said piston housing ejects said at least one strip of cloth.

2. A location marker as set forth in claim 1, wherein said at least one strip of cloth is saturated with chemiluminescent material comprised of 0.2 molar bis (2, 4, 5-trichloro-6 carbobutoxyhyenyl) oxalate, 0.003 molar 9, 10-bis (phenylethynyl) anthracene, 1 percent cyanacryl terpolymer, and 2 percent bis-(2-ethylhexyl) phthalate in benzene and wherein said activator fluid is comprised of 1.5 molar hydrogen peroxide in dimethyl phthalate.

3. A location marker as set forth in claim 1, wherein said means for slidably moving said piston includes a first firing pin, a primer, and a gas-generating pellet whereby triggering of said firing pin detonates said primer and ignites said gas-generating pellet and gas from same pellet moves said piston to rupture said frangible barrier whereby said at least one strip of cloth saturated with chemiluminescent material is activated by said activator fluid.

4. A location marker as set forth in claim 3, wherein said means for slidably moving said piston housing comprises a second firing pin, a primer, a pyrotechnic delay train, and an explosive pellet whereby detonation of said explosive pellet after said gas-generating pellet is ignited ejects said at least one strip of cloth.

5. A location marker as set forth in claim 4, wherein said first and second firing pins are maintained in a cocked position by a bore rider pin having means for preventing triggering of said firing pins while said location marker is within a launching tube.

United States Patent

[11] 3,611,935

[72] Inventors: Orville L. Becher, Washington; John L. Brown, Bedford; Benjamin F. Harkness, Odon, all of Ind.

[21] Appl. No. 872,817
[22] Filed Oct. 31, 1969
[45] Patented Oct. 12, 1971

[73] Assignee The United States of America as represented by the Secretary of the Navy

[54] SMALL CALIBER DUAL COLORED SIGNAL FLARE

6 Claims, 2 Drawing Figs.

[52] U.S. Cl. 102/37.7, 102/32
[51] Int. Cl. C06d 1/10
[50] Field of Search 102/32, 35, 35.2, 35.6, 37.6, 37.7, 37.8, 49.4, 87, 90, 65

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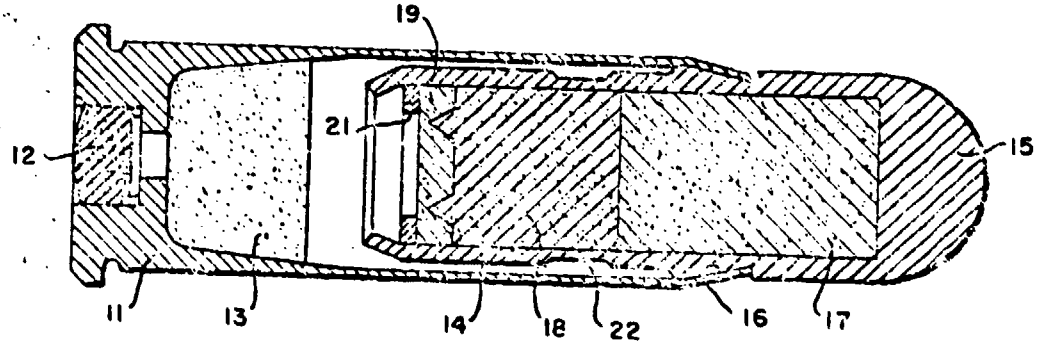
Primary Examiner—Robert F. Stahl
Attorneys—R. S. Sciascia, H. H. Losche and Paul S. Collignon

ABSTRACT: A small caliber dual colored signal flare having a cartridge case holding a primer and a charge of expelling powder, and a projectile body partially extending into and attached to said cartridge case. The projectile body contains a first pyrotechnic composition which, upon burning, provides a green colored display and also a second pyrotechnic composition which, upon burning after said first composition is consumed, provides a red colored display. The projectile body is provided with an undercut so that after the first pyrotechnic composition is consumed the projectile body will sever in order to provide better illumination of the burning of said second pyrotechnic composition.



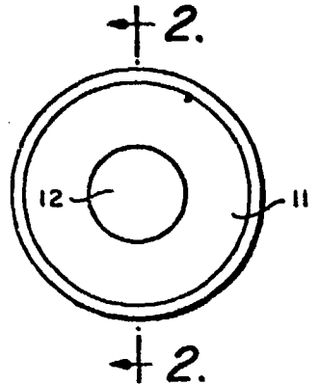


FIG. 1.

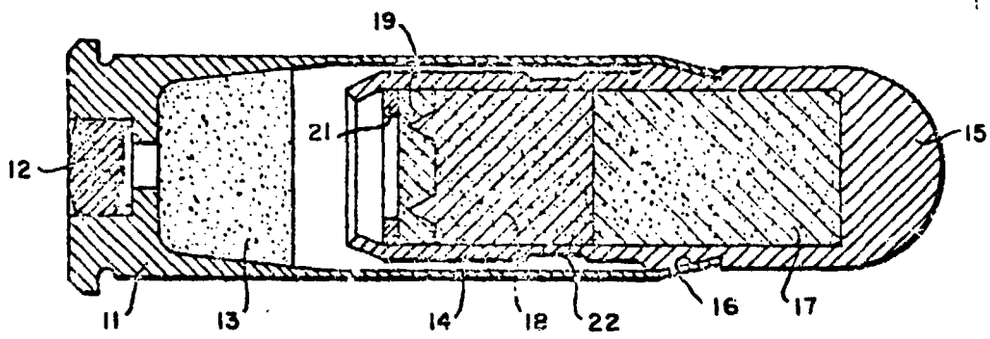


FIG. 2.

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SMALL CALIBER DUAL COLORED SIGNAL FLARE

STATEMENT OF GOVERNMENT INTEREST

BACKGROUND OF THE INVENTION

Presently, the military departments are providing certain personnel with a small caliber flare which can be fired from a hand-held weapon, such as a .38 caliber pistol. In particular, such a flare might be fired by a person in distress, such as a downed aircraft pilot. Heretofore the flares that have been used provided only a single colored display, which was usually red. This type of small flare has a disadvantage, however, as it is often mistakenly believed to be a tracer round from an enemy gun and tends to drive-off a would-be rescuer.

SUMMARY OF THE INVENTION

The present invention provides a small caliber signal flare which is designed to be fired from a hand-held weapon, such as a .38 caliber pistol. A cartridge case is provided which contains a primer and a quantity of expelling powder, and projectile body partially extends into the cartridge case. The projectile body is provided with a cavity and a forward hemispherical nose. Within the cavity there is a first pyrotechnic composition containing a barium compound and a second pyrotechnic composition containing a strontium compound. The pyrotechnic composition containing the barium compound is ignited first and a green colored display is produced. The pyrotechnic composition containing the strontium compound is ignited second and a red colored display is produced.

An ignition composition is provided adjacent the first composition and this ignition composition is ignited by the burning of the expelling powder. This ignition composition ignites the first pyrotechnic composition which provides a green colored display. The first pyrotechnic composition, in turn, ignites the second pyrotechnic composition. An undercut, or reduced wall thickness section, is provided in the projectile body adjacent the innermost end of the first pyrotechnic composition and the projectile body is separated at this section to enhance visibility of the red colored display.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is an end view of a preferred embodiment of the present invention; and

FIG. 2 is a sectional view taken on line 2—2 of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawing, there is shown a cartridge case 11 which is sized to fit a standard hand-held weapon, such as a .38 caliber pistol. A primer 12 and a quantity of expelling powder 13, are contained in a closed end of cartridge case 11 and the opposite end of cartridge case 11 is open. By way of example, expelling powder 13 might be comprised, by weight, of about 44.85 percent of nitrocellulose, about 13.25 percent of nitrogen in nitrocellulose, about 0.40 percent of graphite, about 39.00 percent of nitroglycerine, about 1.00 percent of ethyl centralite and about 1.50 percent of potassium sulfate.

A projectile body 14, having a hemispherical nose section 15, has a portion of its length extending into cartridge case 11, and projectile body is provided with a tapered surface 16 and open end of cartridge case 11 is crimped against this tapered surface 16 to secure projectile body 14 to cartridge case 11. A quantity of pyrotechnic composition 17 is provided in projectile body 14, which upon burning, gives a colored display. By way of example, pyrotechnic composition 17 might be comprised, by weight, of about 37.75 percent of strontium nitrate, about 24.50 percent of powdered magnesium, about 21.85 percent of potassium perchlorate, about 9.94 percent of polyvinyl chloride, and about 5.96 percent of a polyester resin binder, such as Laminac 4110, a produce produced and marketed by American Cyanamid Co. This composition, when burned, provides a red colored display.

Another pyrotechnic composition 18 is provided in projectile body 14 adjacent composition 17. By way of example, composition 18, when burned, will provide a green colored display and be comprised, by weight, of about 31.82 percent of barium nitrate, about 30.90 percent of powdered magnesium, about 4.55 percent of powdered copper, about 18.18 percent of potassium perchlorate, about 9.10 percent of perchloropentacyclodecane, and about 5.45 percent of polyester resin binder, such as Laminac 4110. Ignition composition 19 is provided adjacent the outer end of pyrotechnic composition 19. Ignition composition 19 is ignited by the burning of powder 13 and, in turn, ignites composition 18. By way of example, ignition composition 19 might be comprised, by weight, of about 41.66 percent of lead oxide, about 23.44 percent of silicon, about 11.46 percent of manganese and about 23.44 percent of a suitable binder solution. A retaining washer 21 is positioned adjacent ignition composition 19 and the inner end of projectile body 14 is crimped, or spun over, to retain the pyrotechnic compositions within body 14.

As best shown in FIG. 2 of the drawing, projectile body 14 is provided with an undercut 22, or reduced diameter portion, which is positioned near the inner end of pyrotechnic composition 18. When the burning of composition 18 reaches undercut 22, this reduced wall section burns away and the trailing edge of projectile body 14 breaks away to provide better visibility of the display produced by the burning of pyrotechnic composition 17.

In operation, assuming the signal flare is to fit and be fired by a hand-held weapon, such as a .38 caliber pistol, upon triggering the weapon, the firing pin will strike and explode primer 12 which will ignite powder 13. The exploding of powder 13 will, in turn, ignite ignition composition 19 and the explosion force from powder 13 will eject and propel projectile body 14. Ignition composition 19 will ignite pyrotechnic composition 18 causing a green colored display to be produced from the rear of projectile body 14. When pyrotechnic composition 18 is nearly consumed, the burning will be taking place opposite undercut 22 causing this thin-walled section to burn through and sever the projectile body 14. Pyrotechnic composition 17 will be ignited from the burning of composition 18 and will produce a red colored display. As the rear portion of projectile body 14 will drop away, this portion of body 14 will not be present to act as a shield, and better visibility of the red colored display will be provided. About 1.5 grams each of pyrotechnic composition 17 and 18 will produce about a 3 second green colored display followed by about a 3 second red colored display.

We claim:

1. A small caliber dual colored signal flare comprising:
   - a cartridge case having a closed end and an open end,
   - a primer and a charge of expelling powder within said cartridge case adjacent said closed end,
   - a single projectile body having a closed end and an opened end with said opened end extending inwardly into said cartridge case,
   - a first pyrotechnic composition in said projectile body for producing a first tracer color,
   - a second pyrotechnic composition in said projectile body for producing a second tracer color, and
   - an undercut in said single projectile body for severing said projectile body by the burning of said first pyrotechnic composition thereby enhancing the visibility of the burning of said second pyrotechnic composition.

2. A small caliber dual colored signal flare as set forth in claim 1 wherein said first pyrotechnic composition contains barium nitrate and upon burning of said first pyrotechnic composition a green colored display is provided.

3. A small caliber dual colored signal flare as set forth in claim 1 wherein said second pyrotechnic composition con-

tains strontium nitrate and upon burning of said second pyrotechnic composition a red colored display is provided.

4. A small caliber dual colored signal flare as set forth in claim 1 wherein said first pyrotechnic composition contains barium nitrate and said second pyrotechnic composition contains strontium nitrate and upon ignition of said signal flare a green colored display is first produced followed by a red colored display.

5. A small caliber dual colored signal flare as set forth in claim 1 wherein said first pyrotechnic composition is comprised, by weight, of about 31.82 percent of barium nitrate, about 30.90 percent of powdered magnesium, about 4.55 percent of powdered copper, about 18.18 percent of potassium perchlorate, about 9.10 percent of perchloropentacyclodecane, and about 5.45 percent of a polyester resin binder.

6. A small caliber dual colored signal flare as set forth in claim 1 wherein said second pyrotechnic composition is comprised, by weight, of about 37.75 percent of strontium nitrate, about 24.50 percent of powdered magnesium, about 21.85 percent of potassium perchlorate, about 9.94 percent of polyvinyl chloride, and about 5.96 percent of a polyester resin binder.

United States Patent

[11] **3,607,472**

[72] Inventor **Bernard E. Douda**
Bloomfield, Ind.

[21] Appl. No. **876,118**
[22] Filed **Nov. 12, 1969**
[45] Patented **Sept. 21, 1971**

[73] Assignee **The United States of America as represented by the Secretary of the Navy**

[54] **WHITE SMOKE COMPOSITION CONTAINING RED PHOSPHOROUS**
5 Claims, No Drawings

[52] U.S. Cl. 149/19, 149/29, 149/30, 252/305
[51] Int. Cl. C06d 3/00
[50] Field of Search 149/19, 29, 30; 252/305

[56] **References Cited**

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FOREIGN PATENTS

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Primary Examiner—Leland A. Sebastian
Attorneys—R. S. Sciascia, H. H. Losche and Paul S. Collignon

ABSTRACT: A white smoke producing composition comprised of between 8 and 12 percent of magnesium, between 30 and 34 percent of magnesium dioxide, between 0 manganese 3 percent of zinc oxide, between 0 and 4 percent of lead dioxide, between 38 and 45 percent of red phosphorus and between 10 and 18 percent of a resinuous binder.

WHITE SMOKE COMPOSITION CONTAINING RED PHOSPHOROUS

STATEMENT OF GOVERNMENT INTEREST

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

BACKGROUND OF THE INVENTION

The present invention relates to a pyrotechnic composition which, when burned, will produce a dense white smoke particularly adapted for military purposes, such as signalling or camouflage, and more particularly the composition contains red phosphorus.

Chemicals in the category of screening smokes are those which, when dispersed in air, produce a cloud of finely divided particles of solid, liquid, or both. These are used to shield tactical operations or disrupt the movements of the enemy. Outstanding examples of such materials are: fuel oil used in "artificial fog" generators, white phosphorus, sulfur trioxide, titanium tetrachloride, and so called zinc chloride smokes. Each of the above-listed smoke-generating compositions is characterized by certain advantages and disadvantages in military operations, depending upon the importance of such factors as mobility of the smoke producing apparatus, toxicity, logistical considerations, and the total obscuring power of the composition employed.

For military use, volatile hygroscopic chloride (HC) smokes are the most important, other than oil mixtures, which are utilized for large scale operations. The most widely used HC types of smokes are those resulting in the production of zinc chloride smokes.

The original mixture employed to produce a zinc chloride smoke was the Berger mixture, developed by the French Army during World War I. The original Berger mixture consisted of zinc dust and carbon tetrachloride with zinc oxide and diatomite. Upon ignition, a vigorous reaction takes place, resulting in the formation of zinc chloride, which is volatilized by the heat of the reaction and solidifies to form smoke. However, since this mixture employed a liquid organic chloride, it was difficult to transport and store. By the beginning of World War II, the United States Government had developed a mixture designated "HC smoke mixture" which contained zinc, a perchlorate as an oxidizing agent, hexachloroethane as the organic chloride compound, with a retarder, ammonium chloride. Subsequently, a mixture was found which was better in many ways than the original; it was a combination of hexachloroethane, aluminum and zinc oxide. This mixture required no stabilizer against moisture absorption, and changing the percentage of aluminum varied the burning time, as desired. However, these compositions are corrosive and will interfere with firing mechanisms, thereby materially limiting the storage life of the smoke-generating composition.

SUMMARY OF THE INVENTION

The present invention relates to a smoke-producing composition which can be made into smoke candles and more particularly to a pyrotechnic composition for making smoke candles by a tamp-cast method. The composition is comprised of a fuel, such as magnesium, red phosphorus, oxidizing materials, and from about 12 to 14 percent of a resinous binder such as epoxy or an epoxy-polyglycol system.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The present invention relates to a pyrotechnic composition for producing candles which, when burned, produce a dense white smoke, and the composition is suitable for making smoke candles by a tamp-cast method, as opposed to a pressed method which has heretofore been used to make all red phosphorus smoke candles used by the various military departments. Magnesium is used as a fuel and the composition

contains from about 38 to 45 percent of red phosphorus. While it is desirable to get as much red phosphorus as possible into a smoke candle, presently there is available in the United States only one form of red phosphorus and this is a very finely ground material, that is, it has a very small average particle size. Accordingly, available red phosphorus has a high surface area per weight of material and a large amount of binder is normally needed to wet the red phosphorus. If smoke candles are to be made by a pressed method, as little as 3 or 4 percent of binder might be employed. On the other hand, if candles are to be made by a pure cast method, it is necessary, because of the fine red phosphorus available, to go to a very high percentage of binder, such as between 25 and 30 percent. Such a high percentage of binder however, reduces the amount of red phosphorus in the system and is undesirable. In the present invention, a tamp-cast method is employed in making smoke candles and the resinous binder is in the range of from 10 to 18 percent.

The following examples are provided in order to illustrate the present invention.

EXAMPLE I

	PERCENT (By Weight)
Magnesium (granulation 12)	11
Manganese dioxide	34
Zinc Oxide	3
Red phosphorus	38
Polyglycol Resin (QX-3812)	8.68
Epoxy Resin (D. E. R. 732)	5.32

The magnesium particles were of granulation 12, as defined in Mil-Spec JAN-M-382, entitled, "Magnesium Powder For Use In Ammunition." The polyglycol and epoxy resins were obtained from The Dow Chemical Company, Midland, Michigan. The epoxy resin used is marketed by The Dow Chemical Company under the trademark D. E. R. 732 and is a flexible epoxy resin. The polyglycol resin is a perchlorate-modified amine-terminated long chain polyglycol and The Dow Chemical Company designates the resin as QX-3812. This polyglycol resin is an amber liquid having a specific gravity of 1.05 at 25° C. and has the following analysis:

	PERCENT (By Weight)
Carbon	39.10
Hydrogen	10.20
Oxygen	48.05
Chlorine	1.36
Nitrogen	1.29

After the ingredients were mixed and blended the composition was pouted and tamped to form a smoke candle about 1.76 inches in diameter and about 2.75 inches long. The smoke candle weighed 190 grams and had a density of 1.74 g./cm³. After curing, the smoke candle was ignited and burned for 180 seconds. A dense, white smoke was produced.

EXAMPLE II

	PERCENT (By Weight)
Magnesium (granulation 12)	11
Manganese dioxide	30
Zinc oxide	3
Lead dioxide	4
Red phosphorus	38
Polyglycol resin (QX-3812)	8.68
Epoxy resin (D. E. R. 732)	5.32

The addition of lead dioxide provides an increase in the burning rate of the composition. As spontaneous ignition can occur when mixing lead dioxide with red phosphorus, special precaution must be taken when mixing these two ingredients. The red phosphorus was first mixed with the binder and thoroughly wetted before the lead dioxide and other ingredients were added. Also the percentage of lead dioxide must be kept low.

After the ingredients were mixed, the composition was poured and tamped to form a smoke candle about 1.76 inches in diameter and about 2.81 inches long. The smoke candle weighed 190 grams and had a density of 1.72 grams/cm³. After curing, the smoke candle was ignited and burned for 185 seconds. A dense, white smoke was produced.

EXAMPLE III

	PERCENT (By Weight)
Magnesium (granulation 12)	10
Manganese dioxide	34
Red phosphorus	42
Polyglycol resin (QX-3812)	8.68
Epoxy Resin (D. E. R. 732)	5.32

The ingredients were blended as in EXAMPLE I and then poured and tamped to form a smoke candle about 1.76 inches in diameter and about 2.38 inches long. The smoke candle weighed 195 grams and had a density of 2.03 grams/cm³. After curing, the smoke candle was ignited and burned for 250 seconds. A dense, white smoke was produced.

EXAMPLE IV

	PERCENT (By Weight)
Magnesium (granulation 12)	10
Manganese dioxide	30
Lead dioxide	4
Red phosphorus	42
Polyglycol resin (QX-3812)	8.68
Epoxy resin (D. E. R. 732)	5.32

The ingredients were mixed as in example II and then poured and tamped to form a smoke candle about 1.76 inches in diameter and about 2.25 inches long. The smoke candle weighed 182 grams and had a density of 2.02 grams/cm³. After curing, the smoke candle was ignited and burned for 223 seconds. A dense, white smoke was produced.

EXAMPLE V

	PERCENT (By Weight)
Magnesium (granulation 12)	12
Manganese dioxide	30
Lead dioxide	4
Red phosphorus	40
Epoxy resin	9.52
Curing agent	4.48

The epoxy resin used was a general purpose liquid resin and was obtained from The Dow Chemical Company, Midland, Michigan, under the trade name D. E. R. 321. The curing agent was also obtained from The Dow Chemical Company and was a low-viscosity aliphatic diamine which is sold under the trade name D. E. H. 31. The ingredients were blended as in example I and then tamped to form a smoke candle about 20 inches in diameter and about 17.5 inches long. The smoke candle weighed 147,550 grams and had a density of 1.92 grams/cm³. After curing, the smoke candle was ignited and burned for 120 seconds. In order to facilitate the rapid burning of the candle, 19 holes each about 1 ⅛ inches in diameter were made in the candle. Upon burning, a dense, white smoke was produced.

I claim:

1. A white smoke-generating composition comprised, by weight, of
between 8 and 12 percent of magnesium,
between 30 and 34 percent of manganese dioxide,
between 0 and 3 percent of zinc oxide,
between 0 and 4 percent of lead dioxide,
between 38 and 45 percent of red phosphorus, and
between 10 and 18 percent of a resinous binder.

2. A white smoke-generating composition as set forth in claim 1 wherein said resinous binder is selected from the group consisting of epoxy resin and epoxy-polyglycol resin.

3. A white smoke-generating composition as set forth in claim 1 wherein said resinous binder is epoxy resin.

4. A white smoke-generating composition as set forth in claim 1 wherein said resinous binder is epoxy-polyglycol resin.

5. A white smoke-generating composition as set forth in claim 4 wherein said resinous binder is comprised, by weight, of about 62 percent of polyglycol resin and about 38 percent of epoxy resin.

United States Patent

[11] 3,598,058

[72] Inventor Alvin Smith
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[21] Appl. No. 819,058
[22] Filed Apr. 24, 1969
[45] Patented Aug. 10, 1971

[73] Assignee The United States of America as represented by the Secretary of the Navy

[54] CARTRIDGE CASE PLUG FOR SEMIFIXED GUN AMMUNITION

2 Claims, 3 Drawing Figs.

[52] U.S. Cl. 102/95, 102/41

[51] Int. Cl. F42b 9/18, F42b 9/28

[50] Field of Search ..... 102/39, 43 C, 95

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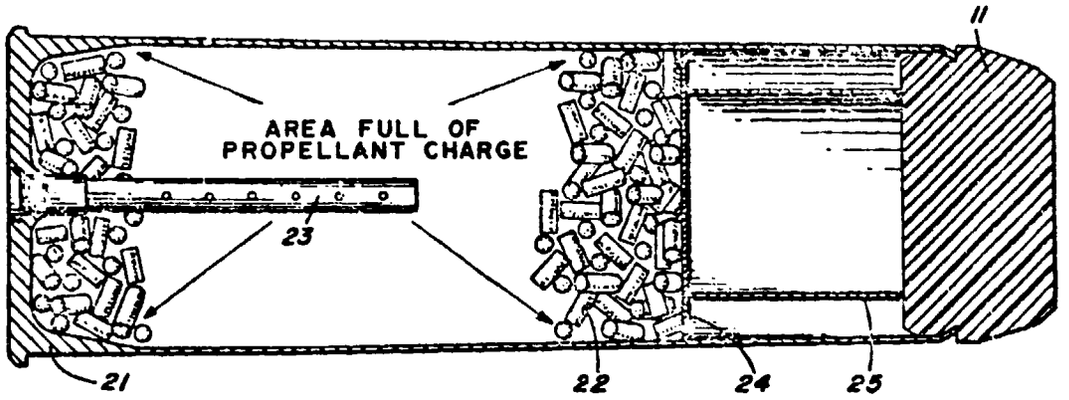
Primary Examiner—Robert F. Stahl
Attorneys—Edgar J. Brower, H. H. Losche and Paul S. Collignon

ABSTRACT: A cartridge case plug for semifixed gun ammunition having a skirt portion adaptable for fitting into a mouth of a cartridge case and having a tapered crown portion adjacent to said skirt portion, said plug being made of a rigid polyurethane foam having a density range of between 12 and 14.5 pounds per cubic foot after molding.



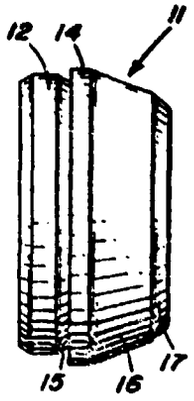


FIG. 2

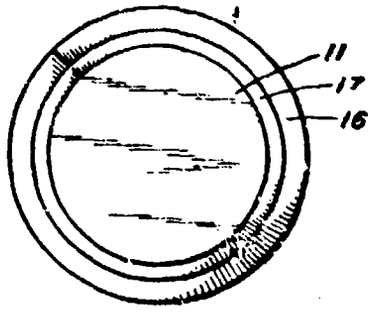


FIG. 1

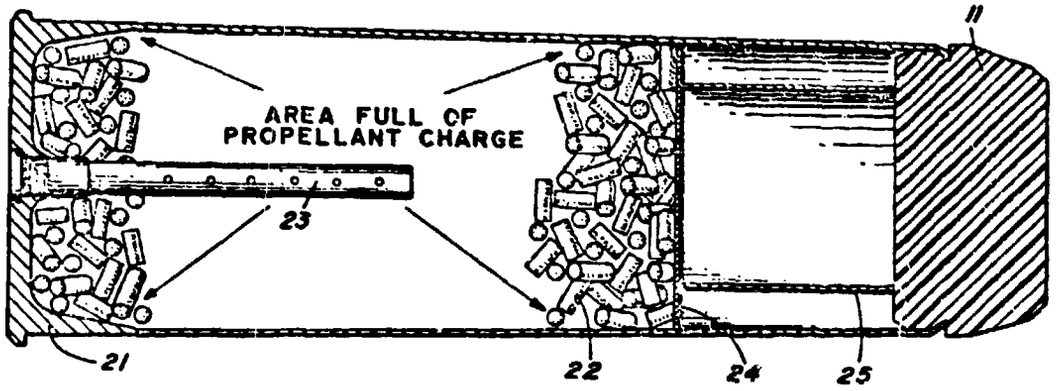


FIG. 3

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Paul S. Colligmon
ATTORNEYS

CARTRIDGE-CASE PLUG FOR SEMIFIXED GUN AMMUNITION

STATEMENT OF GOVERNMENT INTEREST

BACKGROUND OF THE INVENTION

Semifixed gun ammunition cartridges are widely used by the military department. The U.S. Navy, for example, uses gun ammunition cartridges for its 5-, 6-, and 8-inch guns. These semifixed gun ammunition cartridges are comprised of a cartridge case, a primer, a charge of propellant, and a plug for retaining the propellant within the cartridge case. The projectile is not attached to the cartridge case and is loaded separately into a gun chamber.

Heretofore, the majority of cartridge case plugs have been made of cork which is an imported material and excessively expensive. Additionally, cork is dimensionally unstable and frequently fails to maintain case closure during handling and gun loading. As these cartridge case plugs break up when a gun is fired, it is most important that the pieces be sufficiently small so as not to cause a safety hazard to personnel. By way of example, a cork plug for a 5inch/38 gun should disintegrate so that no fragment will exceed a weight of one-half ounce. Frequently, however, cork pieces are observed which exceed this weight and consequently are a hazard to shipboard personnel.

In addition to the disintegration requirement, a plug must be able to withstand and absorb extreme forces of shock when the cartridge case and accompanying projectile are rammed into a gun chamber. These plugs must perform a buffering action so that the cartridge cases will not be deformed, as any deformation could prevent proper chambering of the cartridge case in the gun chamber.

SUMMARY OF THE INVENTION

The present invention relates to a cartridge case plug which is made from polyurethane foam which has a critical density of between 12 and 14.5 pounds per cubic foot. This density is critical in order to assure satisfactory fragmentation of the plug when the ammunition is fired, and yet be able to withstand loading and ramming into a gun chamber.

The plug is cylindrical in shape and has a skirt portion which is adaptable to be secured in a cartridge case. A forward crown portion is tapered to facilitate loading of the cartridge case into the gun chamber.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a front view showing a preferred embodiment of a cartridge case plug;

FIG. 2 is a side view of the cartridge case plug shown in FIG 1 of the drawing; and

FIG. 3 is a sectional view of a cartridge case showing a plug closing one end of the case.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawing, there is shown a cartridge case plug 11 having a skirt portion 12 which fits with a cartridge case 13 and a crown portion 14. Skirt portion 12 has a tapered section 15 which facilitates the crimping of cartridge case 13 around plug 11. Crown 14 has a tapered section 16 which terminates with a bevel 17 to facilitate the loading of the cartridge case assembly into the chamber of a gun.

Cartridge case plug 11 is composed of a polyester based carbon dioxide expanded type of rigid polyurethane foam with a density between 12 and 14.5 pounds per cubic foot. The material and density is critical in order to meet the military requirement that for a cartridge case plug used in a 5inches/38 gun, no fragment of the plug should exceed one-half ounce (14.18 gm). The material and density is also critical in order that the molded plug be capable of withstanding hoisting and ramming of the cartridge assembly into the chamber of the gun. The rammer strikes the base of the cartridge assembly and pushes it and the projectile into the gun chamber. Plug 11 must act as a buffer between the cartridge case and the projectile. The shock on the plug is greatest when seating of the cartridge in the gun chamber occurs and might be as high as 50,000 g's.

Referring now to FIG. 3 of the drawing, there is shown a cartridge case 21 having inside a propellant charge 22 and a primer 23. Cartridge case 21 is closed by a sheet 24 of nitrocellulose, spacer 25, and plug 11. By way of example, spacer 25 might be made of cardboard or chipboard. Cartridge case 21 is crimped onto tapered section 15 of skirt portion 12 thereby firmly attaching plug 11 to cartridge case 21.

In addition to the selection of the material for plug 11 being critical with respect to fragmentation and severe shock, there are other requirements that must be met. For example, the material should not be adversely affected by alcohol-ether vapor. The common propellants used in semifixed gun ammunition are processed using a mixture of alcohol and ether as process solvents. After extrusion or forming, some alcohol and ether remain as residual constituents, which generally evaporate out. Since an assembled cartridge represents a closed situation, these vapors should not have a deleterious affect on plug 11.

A test was conducted at the Naval Ammunition Depot, Crane, Ind., to determine the affect of alcohol-ether vapors on plugs 11 which were made of polyurethane foam having a density of between 12 and 14.5 pounds per cubic foot. The test was set up by placing equal volumes of ethanol and diethyl ether in a carrier of dibutyl phthalate (inert, very low vapor pressure solvent). The solution consisted of six parts alcohol, six parts ether, and 100 parts dibutyl phthalate. The solution was placed in a sealed container in which a plug was supported in a stand such that no contact was made with the liquid. After 37 days, the plug was removed from the sealed container and any dimensions and weight changes in the plug were considered insignificant with regard to suitability of the material.

It is a requirement that when fired as a component of a service round, plug 11 must disintegrate into small fragments. For a 5inch/38 plug, the largest fragment may not exceed one-half ounce (14.18 gm.) Ten rounds were fired and the largest fragment from each was recovered and weighed. The largest fragments range from 0.5030 grams to 3.0900 grams. The largest fragment recovered from the 10 rounds was 3.0900 grams, which is only about 22 percent of the allowed value of 14.18 grams.

It can thus be seen that the present invention provides an improved plug for a cartridge case which is economical to make, and is strong and steady, yet will disintegrate into very small fragments upon firing the round to which the plug is attached.

I claim:

1. A cartridge case plug for semifixed gun ammunition comprising,

a cylindrical body having a skirt portion adaptable for fitting into a cartridge case and having a tapered crown portion extending forward of said skirt portion, said plug being made of a rigid polyurethane foam material having a density of between 12 and 14.5 pounds per cubic foot whereby said plug disintegrates into very small fragments of firing said ammunition.

2. A cartridge case plug for semifixed gun ammunition as set forth in claim 1 wherein said foam material is a polyester based carbon dioxide expanded type of rigid polyurethane foam having a density of between 12 and 14.5 pounds per cubic foot.

United States Patent

[11] 3,587,468

[72] Inventor **Billy R. Bliss**
Bedford, Ind.

[21] Appl. No **742,972**
[22] Filed **July 2, 1968**
[45] Patented **June 28, 1971**
[73] Assignee **The United States of America as represented by the Secretary of the Navy**

[54] **PHOTOFLASH CARTRIDGE HAVING DUAL FLASHES**
3 Claims, 4 Drawing Figs.

[52] U.S. Cl. 102/32
[51] Int. Cl. F42b 5/16
[50] Field of Search 102/32, 39, 87, 90

[56] **References Cited**

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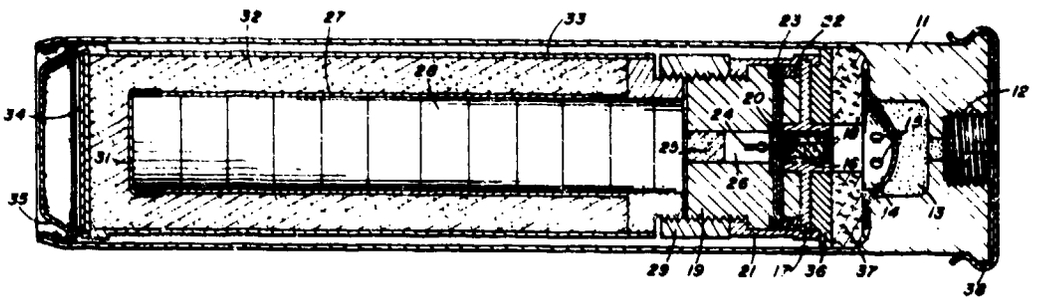
Primary Examiner—Robert F. Stahl
Attorneys—George J. Rubens, H. H. Losche and Paul S. Collignon

ABSTRACT: A photoflash cartridge having first and second inner containers coupled together and slidably positioned within a cartridge case, said first inner container containing a key flash composition which is first ignited and utilized as a signal for opening a camera shutter and said second inner container having a charge of photoflash composition which is ignited after said key flash composition is ignited to provide illumination for night aerial photography.



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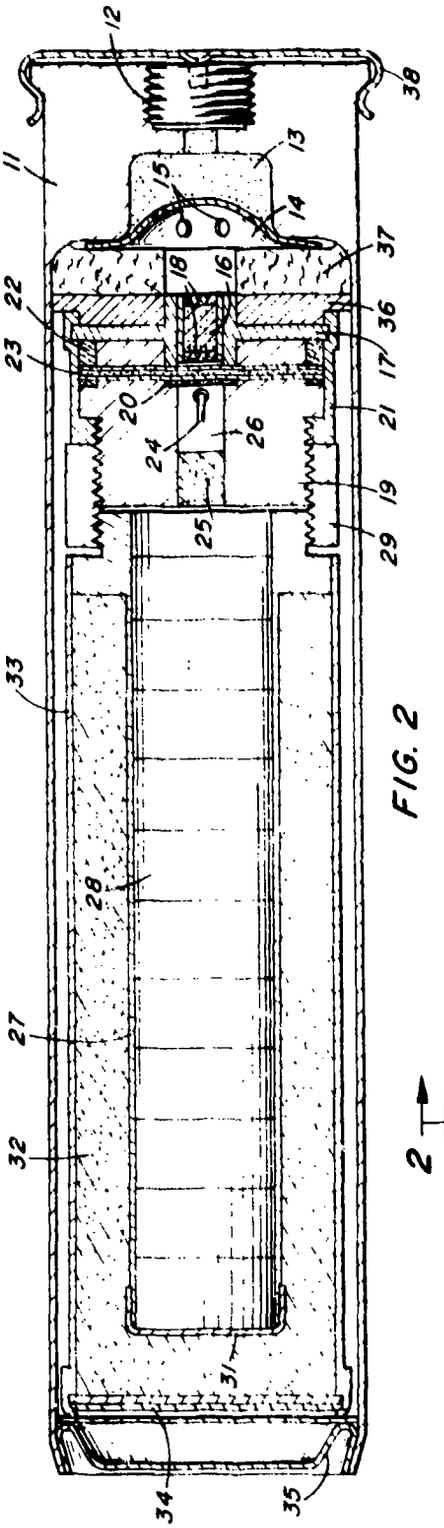

FIG. 2

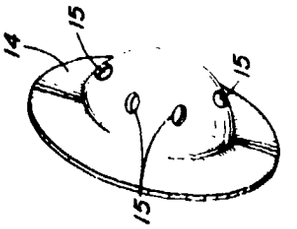

FIG. 4

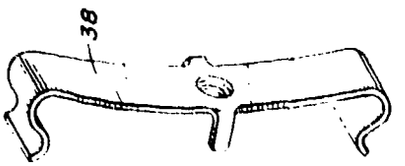

FIG. 3

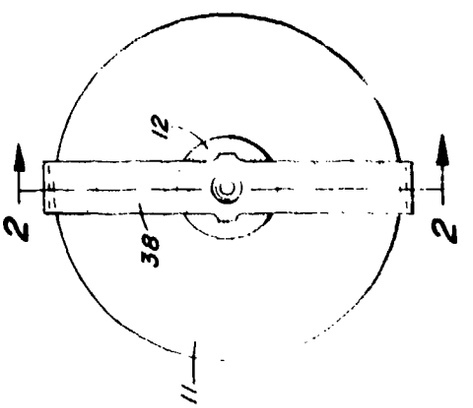

FIG. 1

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BILLY R. BLISS

BY Paul S. Collignon

ATTORNEY

PHOTOFLASH CARTRIDGE HAVING DUAL FLASHES

CROSS-REFERENCES TO RELATED APPLICATIONS

Application of Billy R. Bliss, Clarence W. Gilliam, and John E. Laswell, entitled, PHOTOFLASH CARTRIDGE, Ser. No. 390,266, filed Aug. 13, 1964, which issued Oct. 21, 1969, as U.S. Pat. No. 3,473,472

BACKGROUND OF THE INVENTION

The present invention relates to a photoflash cartridge for providing illumination in support of night aerial photography and more particularly to a photoflash cartridge having an auxiliary flash composition which ignites prior to a main flash to operate as a detectable signal for opening a camera shutter.

Prior to the invention disclosed in the above-mentioned application for a "Photoflash Cartridge," most photoflash devices provided high-intensity flash, however, the flash duration was relatively long which affected the quality of a picture being taken. In the invention disclosed in the referenced application, an explosive mixture is provided within the flash composition and upon ignition, the explosive mixture causes the surrounding flash composition to be rapidly ignited. The first 4.5 milliseconds of light energy is used only for opening a camera shutter and this period includes the peak intensity, thus losing this light energy for film exposure.

SUMMARY OF THE INVENTION

The present invention has first and second containers coupled together and slidably contained in a cartridge case. One container has a key flash composition and the second container carries the main flash composition. The cartridge case contains an electric primer and a propellant charge and, upon ignition of the primer, the propellant charge expels the first and second containers from the cartridge case and ignites an ejection delay fuze of 1-second duration. The ejection delay fuze allows the two containers to travel a safe distance from the aircraft before the key flash composition is ignited. The ejection-delay fuze ignites another fuze which transfers ignition to the key flash composition and, upon ignition, the key flash composition produces a low-intensity flash of short duration which is utilized to open a camera shutter. After the camera shutter is opened, the main flash composition is ignited to illuminate a target.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is an end view of a preferred embodiment of the present invention;

FIG. 2 is a sectional view taken on line 2-2 of FIG. 1;

FIG. 3 is a perspective view of a shunting clip; and

FIG. 4 is a perspective view of a primer shield.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawing which shows a preferred embodiment of the present invention, a cartridge case **11** is provided that is adaptable for fitting into a military-type ejector. Cartridge case **11** is substantially closed on one end which is provided with a threaded hole so that an electric primer **12** can be threadedly connected therein. The opposite end of cartridge case **11** is open. The closed end of cartridge case **11** is provided with a counterbore that is filled with an expelling charge **13**, such as black powder. Expelling charge **13** is adjacent primer **12** and is retained in position by means of a primer shield **14**. As shown in FIG. **4** of the drawing, primer shield **14** is provided with a plurality of small holes **15** that, upon ignition of the black powder, permits a flame to pass through the primer shield to ignite a delay composition **16** that is compressed into a delay holder **17**

By way of example, the delay composition might be comprised of about 82.2 percent, by weight, of barium chromate, about 7.8 percent, by weight, of boron, and about 10 percent, by weight, of diatomaceous earth (99 percent SiO_2). By filling a ¼-inch diameter bore with about a 1-inch length of the foregoing described delay composition, a delay of approximately 1 second is achieved. By increasing the percent of barium chromate and reducing the percent of boron, the delay period can be increased. An ignition mixture **18** is pressed on each end of delay composition **16** and, by way of example, ignition mixture **18** might be comprised of about 90 percent, by weight, of barium chromate and about 10 percent, by weight, of boron.

A key flash housing **19** is provided with a reduced-diameter portion and charge case **21** surrounds housing **19** to provide a cavity which contains a key flash composition **22**. By way of example, key flash composition might be comprised, by weight, of 40 percent aluminum powder (average particle size about 16.3 microns), 30 percent potassium perchlorate (average particle size about 8,5 microns) and 30 percent granulated barium nitrate). A fuze **23** which, by way of example, might be of lead azide core material in a lead sheath, and manufactured by E. I. Du Pont de Nemours & Co., Inc., Wilmington, Delaware, under the trade name Pyrocore, is inserted in a hole in housing **19** to ignite key flash composition **22**. Fuze **23** is ignited from the heat and flame from delay composition **16**.

Another fuze **24** and a delay detonator **25** are provided in a bore **26** in housing **19**. By way of example, fuze **24** might be similar to fuze **23** and delay detonator **25** might consist of a delay composition, such as a 90 percent barium chromate and a 10 percent boron composition, which is pressed on an explosive material. Fuze **24** is ignited from the heat and flame of key flash composition **22** and, in order to facilitate ignition, a transfer ignition composition **20** is provided and, by way of example, might be A1A composition, (By weight, 65 percent zironcium powder, 25 percent Iron oxide, Ferric (Fe_2O_3) and 10 percent diatomaceous earth), as defined in Military Specification MIL-P-22264. The A1A composition **20** can be attached to the forward end of housing **19** by making a slurry comprised, by weight, of four parts A1A composition and one part of nitrocellulose camphor acetone solution.

A pellet tube **27**, containing a plurality of explosive pellets **28**, is provided with a threaded end, and coupling **29** threadedly connects pellet tube **27** and housing **19** together. By way of example, explosive pellets **28** might be RDX Composition CH-6, which is described in Military Specification MIL-R-21723. RDX Composition CH-6 is a homogeneous explosive mixture of about 97.5 percent RDX (Type B, Class A, as outlined in MIL—398C), about 1.5 percent calcium stearate, about 0.5 percent graphite, and about 0.5 percent polyisobutylene. A pellet tube cap **31** is provided to close the outer end of pellet tube **27**.

A photoflash composition **32** is contained within charge case **33** and, by way of example, might be comprised of about 60 percent potassium perchlorate and about 40 percent atomized aluminum powder. A closing disc **34** is provided to close the end of charge case **33** which is then crimped or spun-over at its outer end, and likewise, cap **35** is provided to close the outer end of cartridge case **11**. Gas checks **36** and **37** are provided in the forward end of cartridge case **11**. A shunting clip **38** is removable attached to cartridge case **11** and engages and shorts primer **12** to prevent accidental ignition of primer **12**.

OPERATION

In operation, shunting clip **38** is retained in the position shown in FIGS. **1** and **2** of the drawing until just prior to placing cartridge case **11** in an ejector, at which time clip **38** is removed. Upon the application of an electric current to primer **12**, primer **12** will ignite and, in turn, ignite expelling charge **13** which will expel charge cases **21** and **33** out of the

outer end of cartridge case 11. Expelling charge 13 ignites ejection delay composition 16 which, in turn ignites key flash composition 22 through fuze 23. The ejection-delay composition 16 allows charge cases 21 and 33, which are coupled together, to travel a safe distance from the aircraft from which launch takes place before ignition of key flash composition 22. Ignition of key flash composition 22 causes case 21 to burst, and a low-intensity flash of a few milliseconds duration is produced. This low-intensity flash is observed by a flash detector in the camera system and initiates mechanical action to open a camera shutter.

The heat and flame produced by key flash composition 22 ignites, in order, transfer ignition composition 20 and fuze 24. Fuze 24, in turn, ignites delay detonator 25 which causes explosive pellets 28 to be detonated. Delay detonator 25 functions to delay the detonation of explosive pellets 28 until the camera shutter is fully open. The explosion of pellets 28 detonates photoflash composition 32 to provide a high-intensity flash of short duration.

It can thus be seen that the present invention provides an improved photoflash cartridge which provides a first flash which can be utilized for opening a camera shutter and a second flash of high intensity and short duration.

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.

I claim:

1. A photoflash cartridge comprising:

a cartridge case having a closed end and an open end,

an expelling powder charge within said cartridge case adjacent said closed end,

a first container of photoflash composition within said cartridge case,

first fuze means including a delay element for igniting the photoflash composition in said first container from the heat and flame produced by the combustion of said expelling powder,

a second container of photoflash composition within said cartridge case, said second container being coupled to said first container, and

second fuze means including a delay element for igniting the photoflash composition in said second container from the heat and flame produced by the combustion of said photoflash composition in said first container.

2. A photoflash cartridge as set forth in claim 1 wherein an electric primer is threadedly attached in said closed end of said cartridge case.

3. A photoflash cartridge as set forth in claim 1 wherein said photoflash composition in said first container is comprised of about 40 percent atomized aluminum powder, about 30 percent potassium perchlorate, and about 30 percent barium nitrate, and wherein said photoflash composition in said second container is comprised of about 60 percent potassium perchlorate and about 40 percent atomized aluminum powder.

United States Patent

[11] 3,575,111

[72] Inventor **Raymond L. Richardson**
Bloomfield, Ind.

[21] Appl No **819,597**
[22] Filed **Apr. 28, 1969**
[45] Patented **Apr. 13, 1971**

[73] Assignee **The United States of America as represented by the Secretary of the Navy**

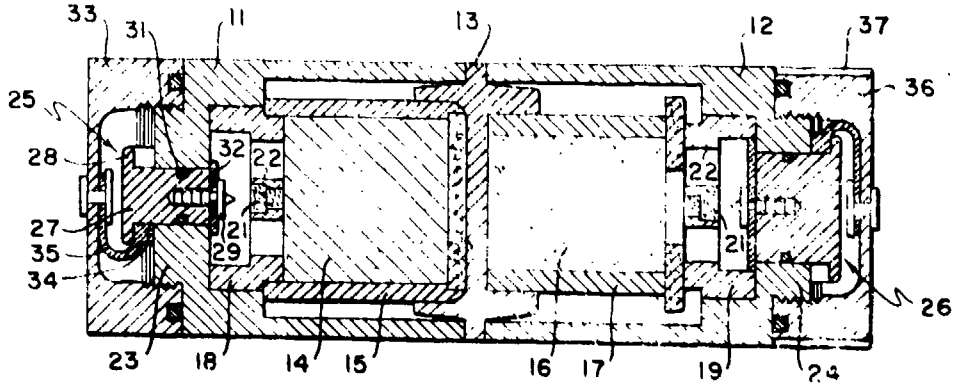
[54] **SIGNALING DEVICE HAVING MANUAL FIRING MEANS**
5 Claims, 3 Drawing Figs.

[52] **U.S. Cl.** **102/37.8,** 102/70, 102/90, 102/65
[51] **Int. Cl.** **F42b 13/44**
[50] **Field of Search** 102/37.8, 65, 90, 70

[56] **References Cited**
FOREIGN PATENTS
... 1942 Germany 102/37.8

Primary Examiner—Robert F. Stahl
Attorneys—Edgar J. Brower, H. H. Losche and Paul S. Collignon

ABSTRACT: A pyrotechnic signal having a housing containing a quantity of pyrotechnic material and a primer for igniting said pyrotechnic material, a manually actuated striker assembly suitably attached to said housing having a firing pin on the inner end thereof, a protective cap threadedly attached to said housing and having a safety clip attached thereto and engaging said striker assembly for preventing accidental ignition of said primer.



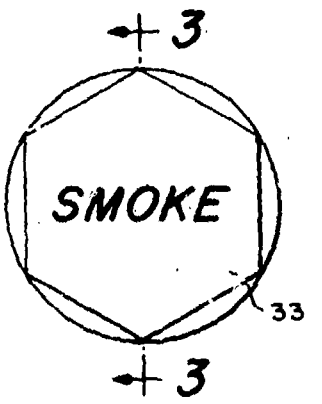


FIG. 1.

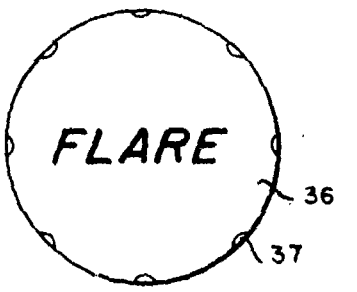


FIG. 2.

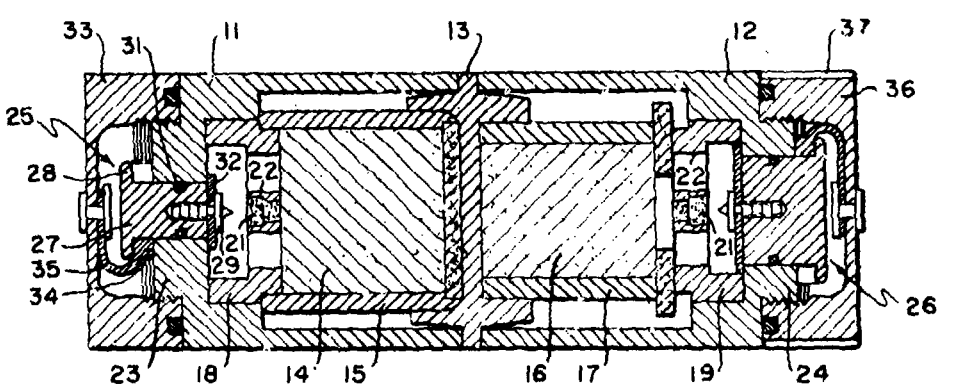


FIG. 3.

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SIGNALING DEVICE HAVING MANUAL FIRING MEANS

STATEMENT OF GOVERNMENT INTEREST

BACKGROUND OF THE INVENTION

The present invention relates to a pyrotechnic device and more particularly to an improved device for igniting a pyrotechnic device, such as a hand-held flare.

Various types of hand-held pyrotechnic devices are used by the military departments primarily for signaling purposes. In one type of Navy flare, which is sometimes referred to as a Railroad Warning flare, ignition is made by a friction igniter. One end of the flare is closed by a cover which has an exterior coating of the same abrasive material found on the side of a safety-match box. Beneath the cover is a small cotton wad that protects the friction igniter which is impregnated in a cloth substance covering the pyrotechnic composition. This friction igniter is the same material as is used in the head of a safety match. The signal is ignited by scraping the inverted cover across the friction igniter.

In another type of friction ignition device, a pull wire is provided to ignite a primer. A sharp, quick pull on a ring moves a friction wire through igniter material and causes ignition thereof, and this igniter material, in turn, ignites either a smoke mixture, for day use, or a pyrotechnic candle, for night use.

While the above-described hand-held ignition devices are still being used by the military departments, reliability is not as good as desired and also ignition of these devices normally require the use of both hands. Accordingly, in the event a person might be in the water and holding onto a raft, or in the event a person might be injured, ignition devices which require the use of both hands are undesirable.

A third, and more sophisticated triggering device, utilizes a spring actuated striker assembly. One such device is shown in U.S. Pat. No. 3,167,050, which issued Jan. 26, 1965, to Glenn C. Johnson. In this patented device, a striker assembly is maintained in a cocked position by a cover that is slidably attached to the container. The cover can be removed by pushing sideways, and as the cover becomes disengaged, the striker assembly is actuated to ignite a primer which, in turn, ignites the signal producing composition. This device is constructed so that it can be operated by using only one hand.

SUMMARY OF THE INVENTION

The present invention provides a container having a smoke-producing composition in one end and a flare composition in the other end. A circular-shaped screw cap is threadedly attached to the flare end, and a hexagon-shaped screw cap is threadedly attached to the smoke end. These different shaped screw caps readily identify each end so that the desired end can be ignited in the dark. A plunger is slidably attached to each end, and each inner end of these plungers are provided with a firing pin which is engageable with a primer. Each plunger is locked to the container by a thin, frangible disc of plastic material. Movement of each plunger is prevented by a safety clip which is connected to one of the end caps. Upon removal of one end cap and its accompanying safety clip, the plunger can be struck a sharp blow, which causes the firing pin to strike the primer which, in turn, ignites the pyrotechnic composition. The frangible disc prevents the immediate ejection of the plunger until sufficient heat and pressure are available to melt and/or break the frangible disc. This built-in delay, which can be controlled by the choice of material and thickness of the disc, provides time for the operator to orient the pyrotechnic device so he will not be burned and, additionally, optimum burning of the pyrotechnic composition can be accomplished by having sufficient pressure and temperature within the container.

It is therefore a general object of the present invention to provide an improved firing device for a handheld pyrotechnic signal.

Other objects and advantages of the present invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawing

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is an end view showing one shape of container cap,

FIG. 2 is an end view showing another shape of container cap; and

FIG. 3 is a sectional view taken on line 3–3 of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawing, there is shown a pyrotechnic device for providing both smoke and light. The smoke producing section has an outer housing 11, and the light producing section has an outer housing 12, with the two containers being connected together by a coupling 13. A smoke mixture 14 is provided in container 15 and a flare composition 16 is provided in container 17. By way of example, smoke mixture 14 and flare composition 16 might be formulated as described in U.S. Pat. No. 3,167,050, which issued Jan. 26, 1965, to G. C. Johnson.

A primer holder 18 is provided in housing 11 and, likewise, a primer holder 19 is provided in housing 12. Holders 18 and 19 each hold a primer 21. Each holder is provided with a plurality of holes 22 which serve as orifices when the pyrotechnic material in containers 15 and 17 is burned. Housings 11 and 12 are provided with closed ends 23 and 24, respectively, and each closed end is provided with a central aperture in which striker assemblies 25 and 26 are positioned. Striker assemblies 25 and 26 are similar in design, with the only difference being in size due to the orifice in closed end 24 being larger than the orifice in closed end 23, as a different size orifice is usually needed for smoke than for flare. As the two striker assemblies 25 and 26 are similar, only assembly 25 will be described.

Striker assembly 25 is comprised of a blowout plug 27 having an enlarged head 28 on the outer end and a firing pin 29 on the inner end. A sealing ring 31 is positioned around the periphery of plug 27 to provide a gastight seal. A frangible disc 32, which might be made of a plastic material, is attached to the inner end of plug 27 to provide a delay period after the pyrotechnic material is ignited. A protective cap 33, having a hexagon design, is threadedly attached to housing 11 to protect blowout plug 27. A safety clip 34, which might be U-shaped, is provided between head 28 and end 23 to prevent inner movement of striker assembly 25 in the event that the unit is dropped or subjected to a severe shock. A connecting lead 35 has one end attached to safety clip 34 and the other end to protective cap 33. The shape of protective cap 36 which is threadedly attached to the flare end is cylindrical in shape and has a plurality of flutes 37 to facilitate turning of cap 36. The different shapes of the protective caps permits ready identification of the smoke and flare units in the dark.

OPERATION

Assuming it is desired to ignite the smoke mixture 14 in container 15, cap 33 is first unscrewed from housing 11 and safety clip 34 is removed. A sharp blow on enlarged head 28 of blowout plug 27, as by striking with the palm of the hand, forces plug 27 inwardly and firing pin 29 detonates primer 21. Primer 21, in turn, ignites smoke mixture 14 which, upon combustion, generates heat and pressure to drive blowout plug 27 outwardly, but removable is prevented by frangible disc 32. The heat and pressure within housing 11 continues to build up, however, until they are sufficient to melt and rupture disc 32, and plug 27 is then ejected. The orifice in which plug 27 was blocking is now free and serves as the orifice for smoke which is generated by the burning of smoke composition 14.

The amount of delay between the time that firing pin 29 detonates primer 21 and the time that plug 27 is ejected can be varied by the choice of material for disc 32 and the thickness thereof.

I claim.

1. A signaling device comprising:

an enclosed housing having an orifice in at least one end;

at least one container within said housing, said container having an opened end and containing pyrotechnic composition,

at least one primer positioned near the opened end of said container;

a blowout plug slidably mounted in each side orifice, said blowout plug having one portion extending inwardly into said housing and having another portion extending outwardly beyond said housing;

a firing pin attached to said portion of said blowout plug extending inwardly into said housing and adaptable for engaging said at least one primer;

a frangible disc attached to said end portion of said blowout plug extending inwardly into said housing for delaying ejection of said blowout plug upon ignition of said pyrotechnic composition;

a removable safety clip engaging each said blowout plug for preventing inward movement of said blowout plug; and

at least one protective cap attached to said housing for enclosing the outer end of said blowout plug.

2. A signaling device as set forth in claim 1 wherein said safety clip is connected to said protective cap.

3. A signaling device as set forth in claim 1 wherein said pyrotechnic composition is a smoke composition.

4. A signaling device as set forth in claim 1 wherein said pyrotechnic composition is a flare composition.

5. A signaling device as set forth in claim 1 having one container of smoke composition and one container of flare composition.

United States Patent

[11] 3,566,791

[72] Inventor **Carl W. Lohkamp**
Scotland, Ind.

[21] Appl. No. **808,734**
[22] Filed **Mar. 20, 1969**
[45] Patented **Mar. 2, 1971**
[73] Assignee **the United States of America as represented by the Secretary of the Navy**

[54] **SIGNAL CARTRIDGE FOR PROVIDING LONG DURATION DISPLAY**
3 Claims, 3 Drawing Figs.

[52] **U.S. Cl.** **102/32,** 102/37.6, 102/37.7, 102/92.7
[51] **Int. Cl.** **C06d 1/10**
[50] **Field of Search** 102/32, 37.6, 37.8, 39, 1M, 49.1, 92.7, 90

[56] **References Cited**
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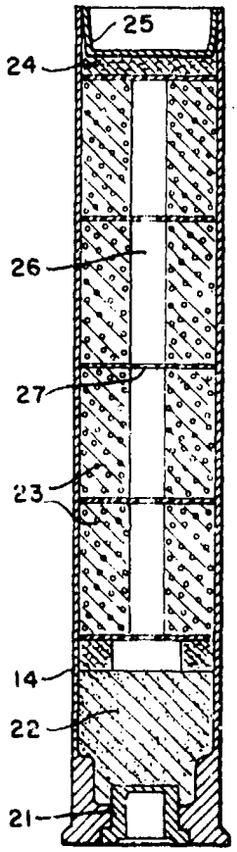
1,947,834	2/1934	Driggs, Jr. et al.	102/32
3,257,801	6/1966	Martinez et al.	149/37X
3,298,311	1/1967	Catlin	102/37.8X
3,473,472	10/1969	Bliss et al.	102/32

Primary Examiner—Robert F. Stahl
Attorneys—Edgar J. Brower, H. H. Losche and Paul S. Collignon

ABSTRACT: A signal cartridge for providing a night display of relatively long duration having a plurality of flare pellets within a cartridge case and having means for expelling and igniting the flare pellets to produce a shower display of burning chaff which has been mixed into the flare pellets.



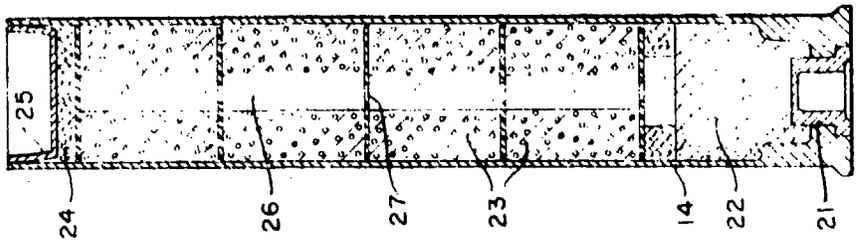


FIG. 3.

FIG. 2.

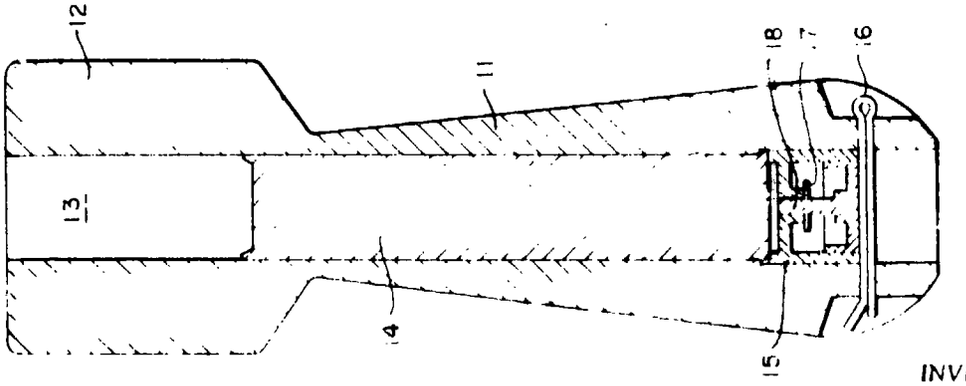


FIG. 1.

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BY

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SIGNAL CARTRIDGE FOR PROVIDING LONG DURATION DISPLAY

STATE OF GOVERNMENT INTEREST

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

BACKGROUND OF THE INVENTION

The present invention relates to a signalling device and more particularly to a signalling device which can be installed in a practice bomb to provide an indication of bombing accuracy.

Various pyrotechnic devices are used in practice bombs which are launched from aircraft to indicate the point of bomb impact. These pyrotechnic devices provide a flash of light and a puff of smoke to show the point of bomb impact. One widely used device is fitted into a signal cavity of a practice bomb and, when dropped, impact forces a firing pin into a primer to ignite a charge of red phosphorus. The burning of this red phosphorus produces a flash of light and provides a puff of white smoke.

The above-described device having red phosphorus is a reliable device but has a disadvantage of producing a flash of very short duration, with the total duration being only about 0.08 second. This extremely short duration does not allow sufficient time for ground observers to triangulate on the impact point. Airborne observers frequently miss the impact display unless they are looking directly at the correct spot at the time of impact.

SUMMARY OF THE INVENTION

The present invention relates to a signal cartridge which, when ignited, provides a visual display of between 2 and 3 seconds in duration, which is over 25 times as long as the red phosphorus devices heretofore used by the military.

A cartridge case is provided with a plurality of pyrotechnic pellets along with a quantity of pistol powder for expelling these pellets from the case upon ignition. Metallic chaff is dispersed within the pyrotechnic pellets and, upon ignition, these pellets first break up into chunks and these burning chunks then further break up and disperse burning chaff which provide a glowing cloud effect. The duration of the display is about two seconds and as the pieces of burning chaff are relatively heavy the display remains near the bomb impact point.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a sectional view of a practice bomb having a signal cartridge therein;

FIG. 2 is a side view showing a practice bomb emitting a shower of burning chaff to provide a visual display; and

FIG. 3 is a sectional view of a preferred embodiment of a signal cartridge.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring first to FIG. 1 of the drawing, there is shown a practice bomb **11** having fins **12** on its aft end, and having a central bore **13** in which a signal cartridge **14** is positioned. A firing pin mechanism **15** is positioned in the forward end of practice bomb **11** and is retained by cotter pin **16**. A shear pin **17** prevents firing pin **18** from engaging signal cartridge **14**, however, upon impact of the bomb with the ground, pin **17** is sheared and firing pin **18** rams into a primer in signal cartridge **14**. FIG. **2** of the drawing shows a shower display **19** which results when signal cartridge **14** is detonated.

Referring now to FIG. **3** of the drawing, there is shown a signal cartridge **14** having a closed end and an open end. A primer **21** is positioned in the closed end of signal cartridge **14** and is provided to ignite a quantity of pistol powder **22**. A plurality of pellets **23** of pyrotechnic composition are positioned within cartridge **14**, and cartridge **14** is closed by felt packing **24** and cover **25**. Pellets **23** are provided with a central aperture **26** which facilitates the disintegration of pellets **23** upon expulsion from cartridge case **14**. Pellets **23** are separated by a thin film of polyester film **27** which prevents flame from passing through apertures **26**.

Pellets **23** are comprised of granulated magnesium, aluminum or magnesium chaff, Teflon, and a fluorocarbon rubber. Experiments and tests have shown that pellets which provide a relatively long duration of display can be made using the following range of ingredients:

Magnesium (Granulated)	32—40 percent
Chaff (Aluminum or Magnesium)	15—25 percent
Teflon	20—35 percent
Fluorocarbon Rubber	10—15 percent

The following examples are illustrative of the range of ingredients and the mixing procedure for pellets **23**.

EXAMPLE I

A 5 pound mix was made using the following parts, by weight, of ingredients:

Magnesium (Gran 16)	36
Aluminum Chaff (.002 × .008 × .25)	18
Teflon	31
Fluorocarbon Rubber (Viton A)	15

Three-fourths of a pound of fluorocarbon rubber, was mixed with 3.95 pounds of acetone. The mixture was agitated for sufficient time to insure that the fluorocarbon was completely dissolved. This solution was then put into a mixer and 1.8 pounds of magnesium (gran 16) and 0.90 pounds of aluminum chaff were added and mixed for 10 minutes. Next the Teflon was added and the mixture was again mixed for 10 minutes. Hexane was then added to drive out acetone from the composition and was mixed for 10 minutes. When mixing was finished, the liquid was removed from the mix and discarded. Hexane was again added to the mix in sufficient quantity so that the hexane covered the mixture and the ingredients were mixed for 10 minutes. The hexane was then removed and the composition was placed in drying trays. The mixture was hand worked every 15 minutes for a period of 3 hours to insure a uniform composition. The mixture was then pressed into pellets at 800 pounds dead load.

The pellets were put into a signal cartridge, as shown in FIG. 3 of the drawing, and upon firing, a showering display was produced which lasted approximately 3 seconds.

EXAMPLE II

A 5 pound mix was made using the following parts, by weight, of ingredients:

Magnesium (Gran 16)	42
Chaff (Magnesium turnings)	12
Teflon	30
Fluorocarbon rubber (Viton A)	16

The ingredients were mixed and pressed into pellets as described in EXAMPLE I and then placed into a signal cartridge. Upon firing, a showering display was produced which lasted approximately 2 seconds.

EXAMPLE III

A 5 pound mix was made using the following parts, by weight, of ingredients:

Magnesium (Gran 16)	45
Aluminum Chaff (.002 × .008 × .25)	9
Teflon	30
Fluorocarbon Rubber (Viton A)	16

The ingredients were mixed and pressed into pellets as described in EXAMPLE I and then placed into a signal cartridge. Upon firing, a showering display was produced which lasted approximately 2.5 seconds.

The fluorocarbon rubber which was used in the above listed examples was procured from E. I. DuPont de Nemours Com-

pany under the trade name Viton A. Viton A has the formula ($C_3 H_2 F_4$), and is comprised of about 32.1 percent of carbon, about 1.8 percent of hydrogen, and about 66.1 percent of florine. Viton A is used as a binder and a source of Florine. Teflon, which has the chemical name of polytetrafluoroethylene, was procured under the designation of Teflon 01 and is a needle-shaped powder which was used as a source of florine.

OPERATION

Assuming the signal cartridge shown in FIG. 3 of the drawing is to be used in a practice bomb for help in locating the point of bomb impact, the cartridge is loaded into practice bomb **11**, as shown in FIG. 1 of the drawing. Upon dropping practice bomb **11**, dirt, water, or debris will enter into the central bore **13** and move firing pin mechanism **15** in an aft direction thereby causing pin **17** to shear. Firing pin **18** will then engage and detonate primer **21**, which in turn will ignite pistol powder **22**. The force created by the ignition of pistol powder **22** causes packing **24** and cover **25** to be ejected. Pellets **23** are ignited and ejected and the combination of the pressure on the interior of the pellets produced by the pistol powder and by the gaseous by-products of the flare, causes the flare to break into multiple chunks. These burning chunks then further break up and disperse burning chaff which gives a glowing cloud effect. The effect of this multiple breakup is to keep the visual display in the near vicinity of the bomb impact point

While the operation of cartridge is described in conjunction with a practice bomb, it should be understood that other devices could be used to detonate the signal cartridge of the present invention. For example, a hand-held pyrotechnic pistol might be used to fire the signal cartridge.

I claim:

1. A signal cartridge comprising:
a cartridge case having a closed end and an open end;
an expelling powder charge within said cartridge case adjacent said closed end;
a plurality of flare pellets within said cartridge case consisting, by weight, of between 32 and 40 percent of granulated magnesium, between 15 and 25 percent of a metallic chaff selected from the group consisting of aluminum and magnesium, between 10 and 15 percent of fluorocarbon rubber and between 20 and 35 percent of polytetrafluoroethylene; and
a cover closing the open end of said cartridge case.

2. A signal cartridge as set forth in claim 1 wherein said expelling powder charge is pistol powder and wherein a primer is positioned in said closed end for igniting said pistol powder.

3. A signal cartridge as set forth in claim 1 wherein said metallic chaff is aluminum.

United States Patent

[11] 3,537,397

[72] Inventors: William L. Ripley and Lloyd A. Smith, Bedford, Indiana

[21] Appl. No. 783,890
[22] Filed Aug. 14, 1968
[45] Patented Nov. 3, 1970
[73] Assignee The United States of America, as represented by the Secretary of the Navy

[54] PYROTECHNIC SIGNALING DEVICE HAVING WATER REACTIVE IGNITER

4 Claims, 1 Drawing Fig.

[52] U.S. Cl. 102/37.8, 102/6, 102/16

[51] Int. Cl. F42b 15/22, F42b 22/28, F42c 3/00

[50] Field of Search 9/8.3; 102/6, 16, 37.8, 86.5, 70; 149/37

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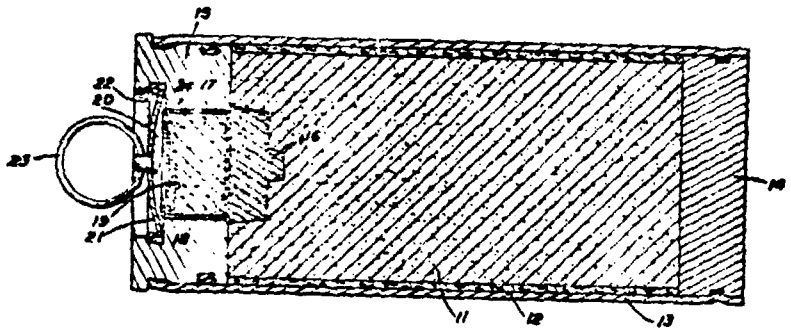
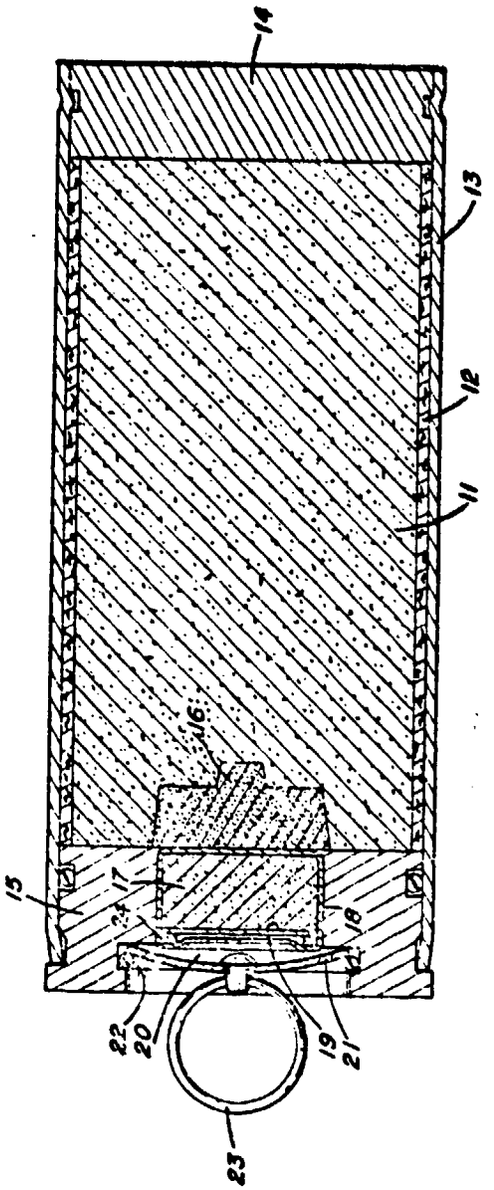
ABSTRACT: A pyrotechnic signaling device having a quantity of pyrotechnic composition for producing smoke or flame and a water reactive material for igniting said pyrotechnic composition. The water reactive material is comprised of, by weight, of between 35 and 55 percent of sodium peroxide, between 20 and 50 percent of ferrosilicon and between 10 and 25 percent of powdered aluminum.





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PYROTECHNIC SIGNALING DEVICE HAVING WATER REACTIVE IGNITER

BACKGROUND OF THE INVENTION

The present invention relates to a signaling device and more particularly to a signaling device containing a pyrotechnic composition and which has intended use in a water environment, such as on a submarine or other naval vessel.

Many types of signaling and marking devices are presently being used for marine purposes. For example, submarines frequently use pyrotechnic signals as a means of providing a mark on the ocean surface in order to show the relative position of the submarines to surface ships.

Various devices and means have heretofore been used to ignite the smoke or flame composition which is used for signaling. For example, in U.S. Pat. No. 3,196,789, issued July 27, 1965, to Stanley M. Fasig and Glenn C. Johnson, there is shown and described a sea water battery which is energized by water, and power from the battery is used to ignite or explode squibs which, in turn, ignite a pyrotechnic composition.

The use of water activated batteries for activating pyrotechnic compositions has a shortcoming in that these batteries are normally designed for operation in sea water and must be modified for use in fresh water. Once a modification is performed, the devices utilizing the batteries cannot be stored for more than 24 hours.

SUMMARY OF THE INVENTION

In the present invention, a quantity of pyrotechnic composition which, when ignited, will produce either smoke or flame is packed in a container and a starter composition is provided adjacent one end of the pyrotechnic composition. A water reactive composition is provided which is comprised of sodium peroxide, which acts as a heat generator and oxidizer; aluminum, which acts as a fuel; and ferrosilicon, which acts as a fuel, a reaction rate regulator and a clinker which holds heat during and just after the reaction. The water reactive composition is preferably placed in a hermetically sealed container to prevent deterioration from humidity.

BRIEF DESCRIPTION OF THE DRAWING

The figure of the drawing is a longitudinal sectional view of a preferred embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawing, a quantity of pyrotechnic composition 11 is packed in a cardboard container 12 and enclosed in an outer metallic container 13, which has a bottom portion 14 and a top portion 15.

By way of example, one pyrotechnic composition widely used by the military departments for producing smoke and flames is comprised, by weight, of 51 percent of phosphorus, 36 percent of manganese dioxide, 7 percent of magnesium, 3 percent of zinc oxide, and 3 percent of linseed oil. A starter composition 16 is provided in the top end of the pyrotechnic composition 11 to facilitate the ignition of pyrotechnic composition 11. By way of example, starter composition 16 might be comprised, by weight, of six parts of lead peroxide, eight parts of silicon powder, and six parts of cupric oxide.

Water reactive material 17 is provided to ignite starter composition 16 and in order to facilitate assembly and prevent moisture from affecting the water reactive material 17, it is preferably placed in a thin-walled aluminum container 18 which is closed at the top by a piece of asbestos paper 19. A cavity 20 is provided in top portion 15 and container 18 is positioned within the cavity so that the bottom of container 18 is adjacent to, and in contact with, starter composition 16. A closure top 21 and sealing ring 22 are provided to close cavity 20 in order to prevent any water from prematurely igniting pyrotechnic composition 11. A pull-ring 23 is attached to closure top 21 to facilitate removal of top 21.

Water reactive material 17 has been mixed using between 35 and 55 percent, by weight of sodium peroxide, between 20 and 50 percent, by weight, of ferrosilicon (Fe Si) and between 10 and 25 percent, by weight of powdered aluminum.

For optimum results, the aluminum should have an average particle size of 60 microns and the ferrosilicon and sodium peroxide should be of a granulation which will pass through a No. 20 U. S. Sieve. Variation of particle size, however, can be tolerated and still have an operable device. In compounding and testing various formula of water reactive material, it has been determined that if the combined weights of the sodium peroxide and powdered aluminum is less than fifty (50) percent of the total weight the material will drown-out. The sodium peroxide serves as an oxidizer, while the aluminum and ferrosilicon serve as fuels. The ferrosilicon moderates the reaction and forms a dense solid clinker which holds heat. When the combined weights of the powdered aluminum and sodium peroxide exceed eighty (80) percent of the total weight, a clinker does not form. It has been determined by experimentation at the U.S. Naval Ammunition Depot, Crane, Indiana, that an optimum formula is comprised, by weight, of 51.6 percent of sodium peroxide, 32.3 percent of ferrosilicon, and 16.1 percent of aluminum.

In preparing the water reactive material, the sodium peroxide, ferrosilicon, and powdered aluminum are first separately sieved and then combined in a dry box having an atmosphere from which substantially all moisture has been removed. A quantity of the mixture is then placed in container 18 which is closed by asbestos paper 19 which is held in position by a ring 24 and the crimping of the top edge of container 18. The weight of the water reactive material which is used is determined by the amount of energy demanded by the application. The heat output of the composition is approximately 950 calories per gram.

The water-reactive igniter of the present invention operates in both fresh water and sea water, as well as under the surface of the water. Safety and compatibility of the water-reactive igniter were shown to be satisfactory by tests conducted at the Naval Ammunition Depot, Crane, Indiana, with the following results.

Drop sensitivity—No fires at 150 kg.-cm.
Friction sensitivity—No fires at 7,500 ft.-lbs.
Electrostatic sensitivity—No fires at 0.18 joules.
Autoignition temperature—Ignited after 5 seconds at 324 degrees C.

The water-reactive composition was exposed to 80 percent relative humidity, and after four hours of exposure, the composition would not ignite. This test indicated that if container 13 were ruptured while in storage in a humid area, the composition would not ignite spontaneously but would degrade rapidly to a point where the pyrotechnic signaling device would not function. Accordingly, sealing of container 13 is important to maintain reliability of the device, but not to maintain safety.

OPERATION

By way of example, container 13 might be dimensioned and proportional so that it will float, with bottom portion 14 being submerged. When it is desired to ignite pyrotechnic composition 11, pull-ring 23 is first pulled thereby removing closure top 21. Container 13 is then tossed or mechanically ejected into the water, and water seeps or passes through the asbestos paper 19 to ignite water reactive material 17. Asbestos paper 19 tends to keep the heat from material 17 concentrated at the bottom, and aluminum container 18, which is thin-walled, is quickly melted or burned away, and starter composition 16 is ignited. Starter composition 16, in turn, ignites the pyrotechnic composition 11, which provides the desired smoke or flame.

It can thus be seen that the present invention provides a small, rather inexpensive, device for igniting pyrotechnic compositions and that no mechanically moving parts or electrical circuits are required. Also the igniter works equally well in either fresh water or sea water. Reliability of the device has been demonstrated at the Naval Ammunition Depot, Crane, Indiana, where test trials were conducted on 21 units and ignition of the pyrotechnic composition occurred every time.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. For example, instead of closure top 21, a "tear top" such as those commonly used on metal beer and soft drink cans, can be utilized to seal top portion 15 of container 13 and, upon pulling the "tear top" an aperture or opening is provided for the entry of water. It is therefore to be understood, that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described.

We claim:

1. A pyrotechnic signaling device comprising:

a container;

a quantity of pyrotechnic composition in said container;

a first fire composition adjacent one end of said pyrotechnic composition;

a water reactive material for igniting said first fire composition, said water reactive material consisting of between 35 and 55 percent, by weight, of sodium peroxide, between 20 and 50 percent, by weight, of ferrosilicon, and between 10 and 25 percent, by weight, of powdered aluminum; and

means for hermetically sealing said container.

2. A pyrotechnic signaling device as set forth in claim 1 wherein said container has a closed bottom portion and a top portion having an aperture therein and wherein said means for hermetically sealing said container are removably attached to said top portion for closing said aperture.

3. A pyrotechnic signaling device as set forth in claim 1 wherein said water reactive material consists of about 51.6 percent, by weight, of sodium peroxide, about 32.3 percent, by weight, of ferrosilicon, and about 16.1 percent, by weight, of powdered aluminum.

4. A pyrotechnic signaling device as set forth in claim 1 wherein said pyrotechnic composition consists of about 51 percent, by weight, of phosphorous, about 36 percent, by weight, of manganese dioxide, about 7 percent, by weight, of magnesium, about 3 percent, by weight, of zinc oxide, and about 3 percent, by weight, of linseed oil, and wherein said first fire composition consists, by weight, of about six parts of lead peroxide, eight parts of silicon powder, and six parts of cupric oxide.

June 2, 1970 R. L. RICHARDSON ET AL 3,515,362

PARACHUTE COLLAPSING MECHANISM

Filed Nov. 14, 1968 3 Sheets-Sheet 1

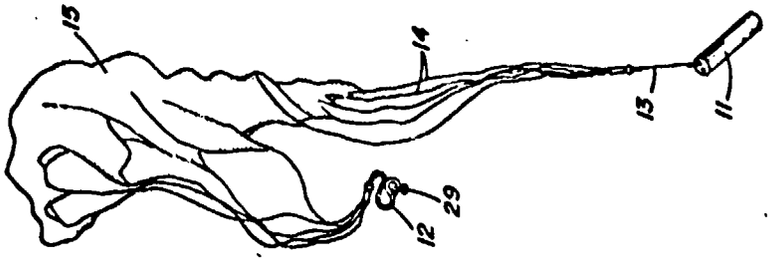

FIG. 2

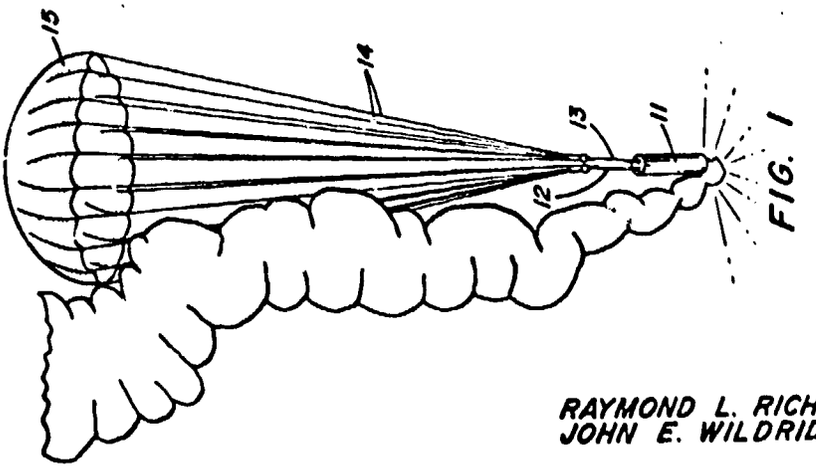

FIG. 1

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PARACHUTE COLLAPSING MECHANISM

Filed Nov. 14, 1968 3 Sheets-Sheet 2

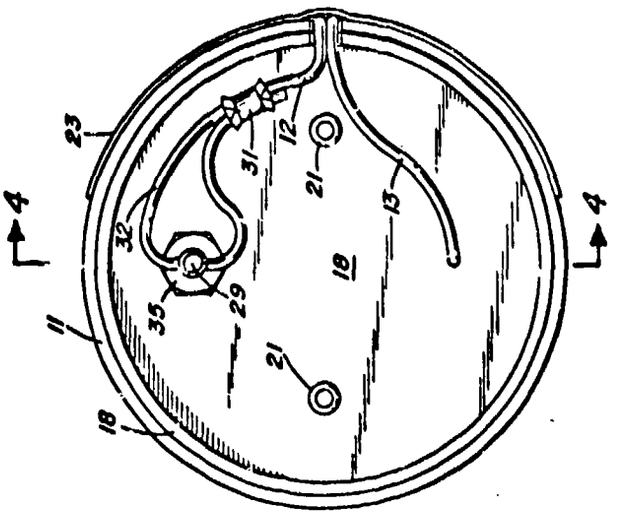

FIG. 3

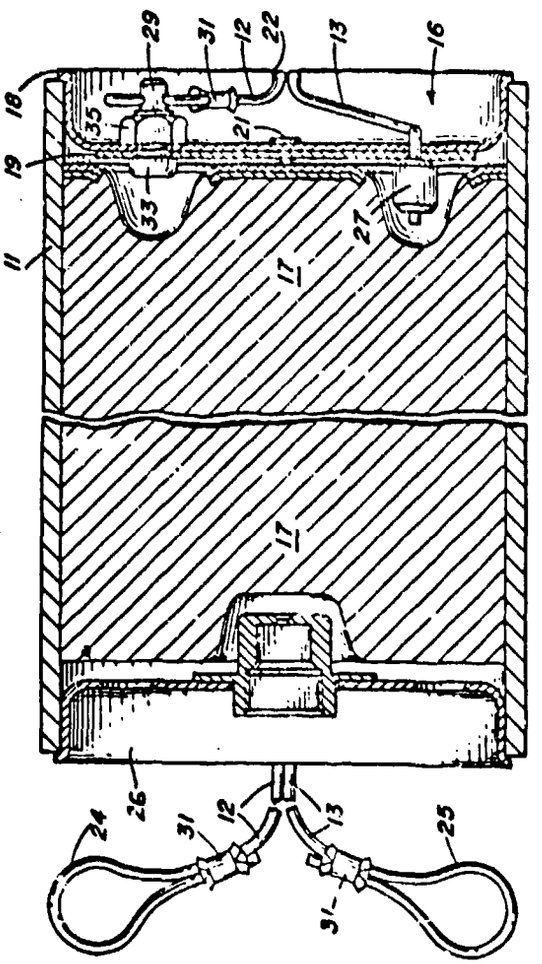

FIG. 4

June 2, 1970 R. L. RICHARDSON ET AL 3,515,362

PARACHUTE COLLAPSING MECHANISM

Filed Nov. 14, 1968 3 Sheets-Sheet 3

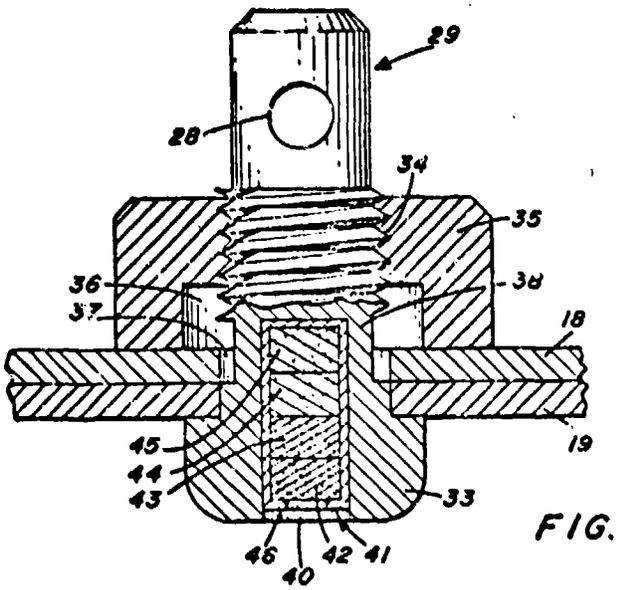

FIG. 5

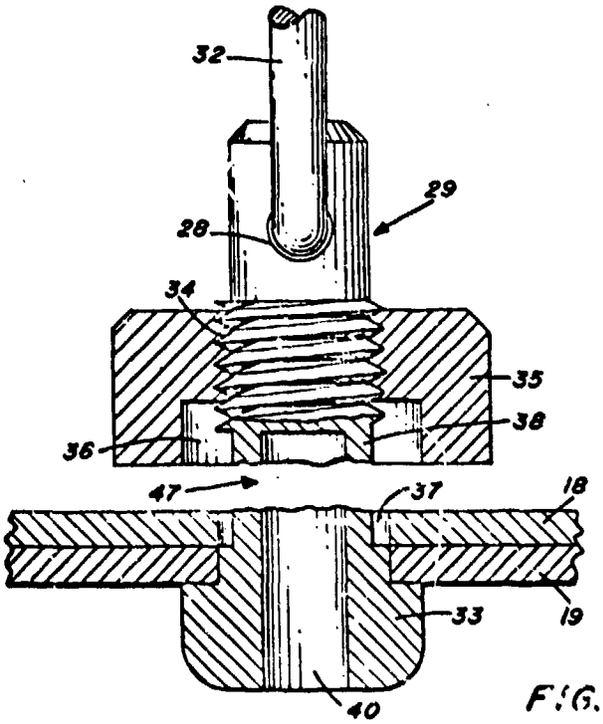

FIG. 6

United States Patent Office

3,515,362
Patented June 2, 1970

3,515,362

PARACHUTE COLLAPSING MECHANISM

Raymond L. Richardson, Bloomfield, and John E. Willridge, Washington, Ind., assignors to the United States of America as represented by the Secretary of the Navy

Filed Nov. 14, 1968, Ser. No. 775,836
Int. Cl. B64d 17/38
U.S. Cl. 244—142 3 Claims

ABSTRACT OF THE DISCLOSURE

A device for collapsing a parachute which is retarding the descent of an aircraft parachute flare, said device having first and second suspension cables which are attached to a suspension plate attached to a container of illuminating composition. The first suspension cable connects one-half the parachute shroud lines directly to the suspension plate and the second suspension cable connects the other half of the parachute shroud lines to the suspension plate through an explosive bolt which is detonated by heat from the burning of the illuminating composition. Upon detonation of the explosive bolt, one-half the parachute shroud lines are separated from the suspension plate which results in collapse of the parachute.

STATEMENT OF GOVERNMENT INTEREST

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

BACKGROUND OF THE INVENTION

The present invention relates to a device for collapsing a parachute upon the completion of the burning of an illuminating composition so that the parachute will not become a hazard to air traffic. Heretofore, aircraft parachute flares which are employed by the military departments for night illumination purposes have been permitted to float to the ground after parachute opening and after the illuminating composition has been consumed. As the illuminating candle burns out, the weight suspended by the parachute is very low and the parachute tends to remain in the air a relatively long period of time, particularly when strong updrafts or thermals are present. These drifting parachutes constitute a flight hazard to other low flying aircraft, and particularly to jet aircraft that could draw a parachute into an engine.

Various devices have been employed to separate a parachute from a load by severing a part of the shroud lines. For example, in U.S. Pat. 3,023,498, entitled, "Parachute Harness Strap Cutter," which issued Mar. 6, 1962, to Robert Temple et al., there is shown a device for use in cutting parachute harness straps in emergency situations. In this patented device, a cutting blade is attached to a piston which can be driven by an explosive force applied when a spring-actuated firing pin detonates a cartridge. The cutting blade is used to sever a parachute harness strap so that a parachute can be separated from a parachutist after landing. The device is initiated by manual means which are operated by the parachutists.

Another explosive cutter for parachute lines is shown in U.S. Pat. 2,897,709, which issued Aug. 4, 1959, to Joe A. Stupian. This device is used for releasing a main parachute after a desired period of free fall by severing a reefing line. A knife blade is provided for cutting the reefing line and the knife blade is actuated by an explosive force. The device is actuated by a pilot chute which discharges a striking pin against a primer which initiates the burning of a delay train which, in turn, ignites a black powder explosive propellant.

Another parachute releasing means is shown in U.S. Pat. 2,715,872, which issued Aug. 23, 1955, to Harold W. Klas. This releasing means was adapted for use with aircraft planted marine mines so that after the mine was in the water, the parachute became separated from the mine. The parachute shroud lines are connected to a releasable support having a downwardly projecting member adapted to be engaged and releasably locked by a pin. The pin is forcibly ejected from locking engagement with the support by the explosion of an electro-responsive detonating device which is adapted to be fired by electrical power received from a sea cell which is activated by sea water.

SUMMARY OF THE INVENTION

The present invention relates to a device for collapsing a parachute during descent by disconnecting one-half of the parachute shroud line from an attached load, such as an illuminating candle. One-half of the shroud lines are connected directly to a suspension plate which is attached to the candle container and the other half of the shroud lines are attached through an explosive bolt to the suspension plate. A detonator is provided within a chamber in the explosive bolt and upon detonation, the explosive bolt is severed and becomes unattached from the suspension plate.

The illuminating candle is ignited at the end opposite to which the suspension plate is attached, and the unburned composition serves as a heat insulator for the detonator. Upon consumption of most of the illuminating composition, however, heat from the burning of the composition causes a lead azide end of the detonator to ignite and the lead azide, in turn, explodes a tetryl pellet and causes the explosive bolt body to separate.

It is therefore a general object of the present invention to provide an aircraft parachute collapsing device which does not have any moving parts which might cause a malfunction.

Other objects and advantages of the present invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a diagrammatic view showing an illuminating device in descent while suspended to a parachute by shroud lines;

FIG. 2 is a diagrammatic view showing the parachute of FIG. 1 in a collapsed condition;

FIG. 3 is an end view of an illuminating candle showing a preferred embodiment of the present invention;

FIG. 4 is a sectional view taken on line 4—4 of FIG. 3;

FIG. 5 is a sectional view showing an explosive bolt; and

FIG. 6 is a sectional view showing an explosive bolt in a severed position.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring first to FIG. 1 of the drawings, there is shown an illuminating flare container 11 that has a pair of suspension cables 12 and 13 attached to one end. One-half of the shroud lines 14 of parachute 15 are attached to cable 12 and the other half of shroud lines 14 are attached to cable 13.

As best seen in FIGS. 3, 4, and 5 of the drawings, a suspension plate 16 is attached to one end of container 11 and a quantity of illuminating composition 17 is contained within container 11. By way of example, illuminating composition 17 might be comprised, by weight, of about 58 percent of granulated magnesium, about 37.5 percent of sodium nitrate, and about 4.5 percent of a resin

binder. Suspension plate 16 is cup-shaped with the outside diameter of cup 18 being of a dimension such that cup 18 will slip fit the inside diameter of container 11. Cup 18 is attached to container 11 by any conventional manner, such as rivets, screws, welding, or the like. A reinforcing plate 19 is attached, as by rivets 21, to the bottom of cup 18 to provide additional strength. FIGS. 3 and 4 of the drawings show the position of suspension cables 12 and 13 prior to parachute opening. Cables 12 and 13 are passed through notch 22 in cup 18 and are brought around to the other end of container 11 for attaching to a parachute. Strips of tape 23 are provided to hold cables 12 and 13 to the side of container 11, and cables 12 and 13 are terminated in loops 24 and 25, respectively, to facilitate fastening to parachute shroud lines. As best shown in FIG. 4 of the drawings, a second cup 26 is attached to container 11 to hold ignition means (not shown) for igniting illuminating composition 17. The ignition means and manner of igniting illuminating composition 17 are more fully described in applicants' copending patent application entitled, "Ignition Device For Aircraft Parachute Flare," Ser. No. 775,878, filed Nov. 14, 1968.

One end of suspension cable 13 is passed through holes in the bottom of cup 18 and reinforcing plate 19, and a hub 27 is secured to the end of cable 13 to prevent the end of cable 13 to pass back through the holes. One end of cable 12 is passed through hole 28 in explosive bolt 29, and clamp 31 is attached to provide a loop 32 in the end of cable 12. Explosive bolt 29 is provided with a head 33 and a threaded portion 34. Clearance holes are provided in cup 18 and plate 19 and explosive bolt 29 is passed therethrough and secured by nut 35. As best shown in FIG. 5 of the drawings, nut 35 is provided with a counterbore 36 and also clearance hole 37 in cup 18 is larger than the undercut portion 38 of bolt 29 thereby facilitating rupture of bolt 29, as the undercut portion 38 is free to expand. The head 33 of bolt 29 is provided with a bore 40 and a heat sensitive detonator 41 is inserted therein and secured, as by staking. By way of example, heat sensitive detonator 41 might be Detonator Mark 59, which is fully described in military specification MIL-D-18665. Detonator Mark 59 is comprised of lead azide elements 42 and 43 and tetryl (trinitrophenylmethylnitramine) elements 44 and 45, which are housed in container 46.

FIG. 6 of the drawings show a fracture 47 which typically occurs upon the detonation of detonator 41. Normally the fracture will occur at the undercut portion 38 of explosive bolt 29. As shown in FIG. 2 of the drawings, upon severing of explosive bolt 29, suspension cable 12 becomes unattached from flare container 11 and causes a collapse of parachute 15, whereupon container 11 and the collapsed parachute make a rapid descent to the ground.

OPERATION

As shown in FIGS. 1 and 4 of the drawings upon parachute opening and ignition of illuminating composition 17, the burning takes place from the bottom of container 11. When most of the illuminating composition 17 has been consumed, the heat from the burning of composition 17 causes the lead azide elements 42 and 43 to ignite which, in turn, causes tetryl elements 44 and 45 to explode and fracture and separate bolt 29. As one-half of shroud lines 14 of parachute 15 are connected through suspension cable 12 and bolt 29 to container 11, the breaking of bolt 29 causes one-half of shroud lines 14 to be disconnected from container 11 and parachute 15 collapses. Upon collapse of parachute 15, container 11, along with trailing parachute 15 makes a very rapid descent to the ground.

It can thus be seen that the present invention provides a relatively simple and inexpensive device for causing collapse of a parachute attached to an illuminating flare, after the flare has consumed the major portion of its illuminating composition. It should be understood, of course, that the foregoing disclosure relates to only a preferred embodiment of the invention and that numerous modifications or alterations may be made therein without departing from the spirit and scope of the invention.

We claim:

1. A device for collapsing during descent a parachute having a plurality of shroud lines attached to an illuminating flare container comprising,

a suspension plate attached to and closing one end of a container having illuminating flare composition therein,

an explosive bolt attached to said suspension plate and having a head extending on one side of said suspension plate into said container and having a threaded portion extending outwardly from the other side of said suspension plate,

heat sensitive detonating means positioned in a bore in said head of said explosive bolt, and

first and second suspension cables, said first suspension cable being attached between a first one-half of said shroud lines of said parachute and said suspension plate and said second suspension cable being attached between a second one-half of said shroud lines and said threaded portion of said explosive bolt whereby detonation of said heat sensitive detonator by the heat produced by burning said illuminating flare composition severs said threaded portion of said explosive bolt from said head and disconnects said second one-half of said shroud lines from said suspension plate thereby causing a collapse of said parachute.

2. A device for collapsing during descent a parachute having a plurality of shroud lines attached to an illuminating flare container as set forth in claim 1 wherein said threaded portion of said explosive bolt has a hole through the diameter thereof and wherein said second suspension cable is passed through said hole.

3. A device for collapsing during descent a parachute having a plurality of shroud lines attached to an illuminating flare container as set forth in claim 1 wherein said threaded portion of said explosive bolt is provided with an undercut to facilitate fracture of said bolt upon detonation of said heat sensitive detonator.

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MILTON BUCHLER, Primary Examiner

J. E. PITTENGER, Assistant Examiner

U.S. Cl. X.R.

102—35, 37.1

March 10, 1970 B. E. DOUDA 3,499,385

AIRCRAFT PARACHUTE FLARE

Filed Feb. 12, 1968

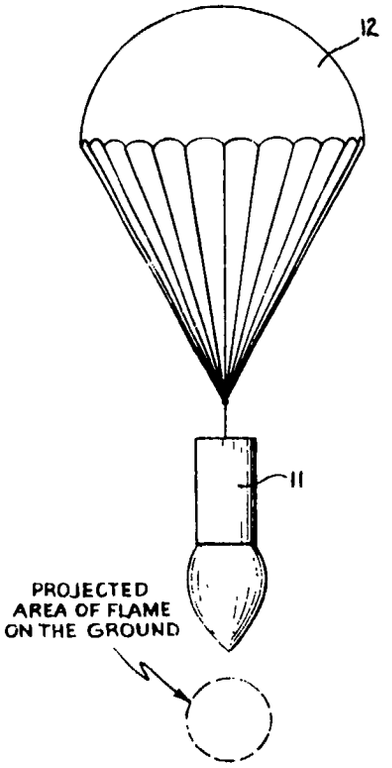

Fig. 1. (Prior Art)

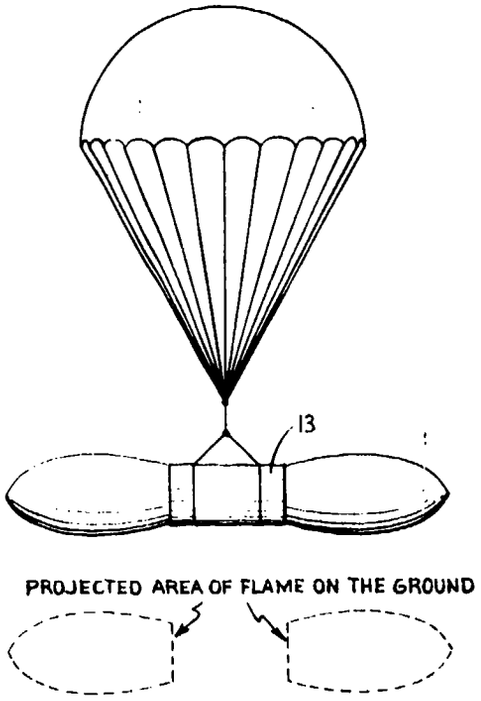

Fig. 2.

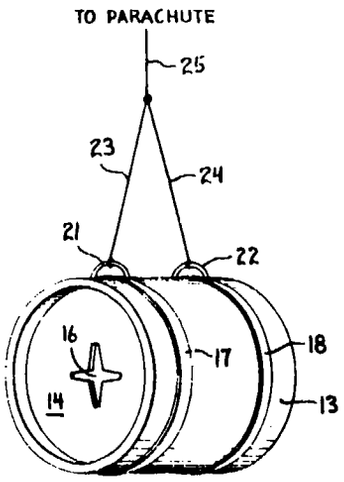

Fig. 5.

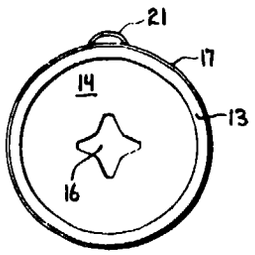

Fig. 3.

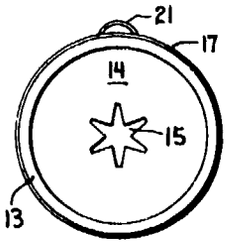

Fig. 4.

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United States Patent Office 3,499,385 Patented Mar. 10, 1970

3,499,385

AIRCRAFT PARACHUTE FLARE

Bernard E. Douda, Bloomfield, Ind., assignor to the United States of America as represented by the Secretary of the Navy

Filed Feb. 12, 1968, Ser. No. 704,745
The portion of the term of the patent subsequent to Nov. 18, 1985, has been disclaimed
Int. Cl. F42b 25/04; C06d 1/10
U.S. Cl. 102—35 1 Claim

ABSTRACT OF THE DISCLOSURE

An aircraft parachute flare comprising a cylindrical casing having pyrotechnic material with a central cavity therethrough and having at least two supporting bands around said cylindrical casing for attaching said flare to a parachute whereby upon descent of said parachute the longitudinal axis of said central cavity is disposed parallel to the ground.

Cross-references to related applications

(a) Application of Bernard E. Douda, Ser. No. 657,726, filed July 31, 1967, entitled "Illuminating Flare Composition," now issued as U.S. Patent 3,411,963.

(b) Application of Bernard E. Douda, Ser. No. 657,727, filed July 31, 1967, entitled "Illuminating Flare Composition," now issued as U.S. Patent 3,411,964.

Background of the invention

The present invention relates to a pyrotechnic flare and more particularly to a flare that is to be dropped by parachute from an aircraft for the purpose of illuminating targets or areas.

Various pyrotechnic devices have heretofore been used, particularly by the military forces for illuminating devices. These devices are designed to be launched or dropped from aircraft and many are provided with time fuzes which control their functioning at a predetermined distance from the launching aircraft.

One widely used military flare, aircraft parachute flare, Mk 24, is an aluminum encased, parachute-suspended device which is equipped with variable-delay fuzes. Each flare is capped at its fuze end with a plastic weather cap under which are two fuze dials and a flexible stainless steel lanyard. One fuze dial is used for selecting ejection delays and the other dial is used for selecting ignition delays. After the fuzes are set and a safety pin has been removed, a 12-pound pull on the lanyard initiates flare function thereby permitting a spring-loaded striker to come into contact with a precussion primer in the base of the plunger housing. The primer ignites black powder in the plunger, which is pointed on the end opposite the primer. Holes around the point permit emission of flame from the black powder. The plunger point is driven into the ejection time delay fuze at a position determined by the ejection dial setting. At the end of the preset delay, the ejection time fuze ignites the ejection disc which ejects the parachute assembly, the candle, and the ignition fuze assembly. The ejection disc also ignites the ignition

powder which, in turn ignites the black powder in the ignition plunger, forcing the plunger into the ignition time delay fuze at a position determined by the ignition dial setting. Upon ejection, the parachute opens to suspend the candle and the ignition fuze assembly. At the end of the preset ignition delay, the ignition fuze ignites the ignition disc which ignites the first-fire composition. The first-fire composition finally ignites the candle to produce the desired illumination during suspension.

All heretofore known aircraft parachute flares which are used by military forces, burn with their ignited end pointing downward. In this burning position, the flame does not ignite the parachute and also the flare points in the direction of the ground or sea to illuminate targets or areas.

Summary of the invention

The present invention relates to a pyrotechnic candle that is cylindrical in shape and has an internal cavity which extends the entire length of the candle. By way of example, the cavity might be in the shape of a cross of a six-pointed star. The pyrotechnic candle is ignited inside the cavity and, upon burning, a pressure cavity is formed and this pressure causes flames to spew out both ends of the candle a great distance. The candle is supported from the parachute so that its longitudinal axis is parallel to the ground and thus the distance that the flame extends from the end of the candle determines the size of the area which is illuminated below.

Brief description of the drawing

FIGURE 1 is a diagrammatic view showing the prior art method of dropping a flare by parachute;

FIGURE 2 is a diagrammatic view showing a pyrotechnic candle burning at both ends and being suspended from a parachute;

FIGURE 3 is a end view of a pyrotechnic candle having a cross-shaped cavity;

FIGURE 4 is an end view of a pyrotechnic candle having a star-shaped cavity; and

FIGURE 5 is a perspective view of a pyrotechnic candle having a suspension harness.

Description of the preferred embodiment

Referring first to FIGURE 1 of the drawing, there is shown a pyrotechnic candle **11** which is suspended in a customary manner from a parachute **12** such that the candle end which is burning is directed toward the ground. It can be seen that the area of illumination on the ground is determined by the diameter of the flame area rather than the distance which the flame spews out from the candle.

Referring now to FIGURES 2 through 5 of the drawing, there is shown a cylindrical container **13** in which a quantity of pyrotechnic composition **14** is packed with a central cavity extending completely through the pyrotechnic composition. FIGURE 4 shows the cavity to be of a star-configuration **15**, and FIGURES 3 and 5 of the drawing show a cross-shaped configuration **16**. By way of example, pyrotechnic composition **14** might be of the type described in either U.S. Patent No. 3,411,963 or 3,411,964, both of which issued Nov. 19, 1968, to Bernard E. Douda.

In U.S. Patent No. 3,411,963, there is described an illuminating flare composition comprised essentially of a

mixture of between 42 and 62 percent magnesium, between 28 and 40 percent sodium nitrate, and between 2 and 18 percent of a binder mix comprised of an epoxy resin and perchlorate-modified amine-terminated long chain polyglycol. The preferred binder mixture is 38 percent epoxy resin and 62 percent polyglycol resin.

In U.S. Patent No. 3,411,964, there is described an illuminating flare composition comprised of magnesium, sodium nitrate and a silicone resin binder which is a complex mixture of organo-polysiloxanes having the organic groups of menthyl, phenyl and vinyl radicals attached to the silicon atoms. The silicon resin can be obtained from the Dow Corning Corporation, Midland, Mich., under the trade name Sylgard 182. The silicone resin binder is compatible with magnesium and sodium nitrate and after polymerization the resin is durable, tough and relatively insensitive to drop, friction, and electrostatic energy.

Referring particularly to FIGURES 3, 4, and 5, of the drawing, a pair of suspension straps **17** and **18** encompass cylindrical container **13**, and rings **21** and **22** are attached, respectively, to straps **17** and **18**. A pair of suspension lines **23** and **24**, which might be rope, cable, chain, or the like, have one end attached to rings **21** and **22**, respectively, with the other ends being connected to line **25** which attach to the lines of a parachute.

The following are examples of candles made and used according to the principles of the present invention.

EXAMPLE 1

	Percent
Magnesium (granulation 17)	58.4
Sodium nitrate (150 microns)	28.8
Resin mix (Sylgard 182 and catalyst)	12.8

The magnesium particles were of granulation 17, as defined in the Mil-Spec JAN–M–382, entitled. "Magnesium Powder for use in Ammunition." The silicone resin and catalyst were first preblended and then mixed with the magnesium. This mixture was then blended and finally the sodium nitrate was added, and then the mixture was blended until a homogeneous mix was obtained. The mixture was then cast to form a solid candle 16 inches in diameter and 13.5 inches in height. The weight of the candle was 56,750 g. The candle was burned with the following results:

Burning time	65.65 secs.
Burning rate	864.4 g./secs.
Candlepower	2.31×10^6.

EXAMPLE 2

	Percent
Magnesium (granulation 15)	58.4
Sodium nitrate (150 microns)	28.8
Resin mix (Sylgard 182 and catalyst)	12.8

The ingredients were mixed as in Example 1 and then case to form a candle 16 inches in diameter and 11.75 inches in height. A six-inch star cavity was formed in one end at a depth of 4.5 inches. The weight of the candle was 56,750 g. The candle was burned with the following results:

Burning time	47 secs.
Burning rate	1207 g./secs.
Candlepower	14.9×10^6.

In comparing the burning rates of Examples 1 and 2, it can be seen that the cavity design in the candle permits a large mass of pyrotechnic composition to be burned very fast, and it is this fast burning rate that produces the high candlepower output. When the flare is ignited in the cavity, the flare burns from the inside to the outside and a large surface area of composition is burned rapidly. The cavity in the flare forms a pressure cavity and, as the flare burns internally, there is a build-up of pressure which causes the flame to spew out for a great distance from the flare.

EXAMPLE 3

	Percent
Magnesium (granulation 15)	54.4
Sodium nitrate (150 microns)	31.2
Resin mix (Sylgard 182 and catalyst)	14.4

The ingredients were mixed as in Example 1 and then cast to form a solid candle 16 inches in diameter and 12 inches in height. The weight of the candle was 56,750 g. The candle was burned with the following results:

Burning time	81 secs.
Burning rate	700 g./secs.
Candlepower	8.3×10^6.

EXAMPLE 4

	Percent
Magnesium (granulation 15)	56.8
Sodium nitrate (150 microns)	28.8
Resin mix (Sylgard 182 and catalyst)	14.4

The ingredients were mixed as in Example 1 and then cast to form a candle having a six-inch cavity as shown in FIGURE 3 of the drawing. The candle was 16 inches in diameter, 18 inches in length, and the cavity extended through the entire length of the candle. The weight of the candle was 56,750 g. and the candle was burned with the following results:

Burning time	36.14 secs.
Burning rate	2260 g./secs.
Candlepower	25.7×10^6.

In comparing the burning rates of the candles of EXAMPLES 3 and 4, it can be seen that the burning rate of the candle having the through cavity is more than three times greater than the burning rate of the solid candle. The solid candle produced a flame length of 12.3 feet while the cavity candle of Example 4 produced two flames of 22.5 feet and 17.25 feet in length. The projected flame surface area of the candle of Example 3 was 73 square feet and the total projected flame area of the candle of Example 4 was 168.6 square feet. Comparison of the candles of Examples 3 and 4 show that the luminous intensity varies directly with the length of flame.

A pyrotechnic candle having a cavity extending the entire length will, when ignited, burn at both ends, and the thrust resulting from each of two horizontally opposed flames will tend to counterbalance one another. On the other hand, a pyrotechnic candle burning at only one end will provide a thrust which will tend to propel the candle in an opposite direction.

In operation, the flare and parachute are launched from an aircraft in a conventional manner, however, after the parachute is deployed, the longitudinal axis of the cylindrical container **13** is positioned parallel with the ground. As the flare burns internally, there is a build-up of pressure in the cavity which causes the flame to spew out for a great distance from the flare and a large surface area of the flame is projected on the ground.

I claim:

1. An aircraft parachute flare comprising:

a parachute,

a container,

a quantity of illuminating flare composition comprised of between 54 and 64 percent of magnesium, between 28 and 38 percent of sodium nitrate, and between 3 and 15 percent of a resin binder selected from the group consisting of silicone resin, and a resin binder comprised of an epoxy resin and a perchlorate-modified amine-terminated long chain polyglycol resin said flare composition being cast within said container and having a central cavity therethrough whereby upon ignition a flame is expelled from both ends of said container,

at least two supporting straps encompassing said container, and

suspension means connecting said supporting straps to said parachute whereupon deployment of said para-

chute said container is supported with its longitudinal axis parallel to the ground.

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ROBERT F. STAHL, Primary Examiner

Oct. 21, 1969

B. R. BLISS ET AL

3,473,472

PHOTOFLASH CARTRIDGE

Filed Aug. 13, 1964

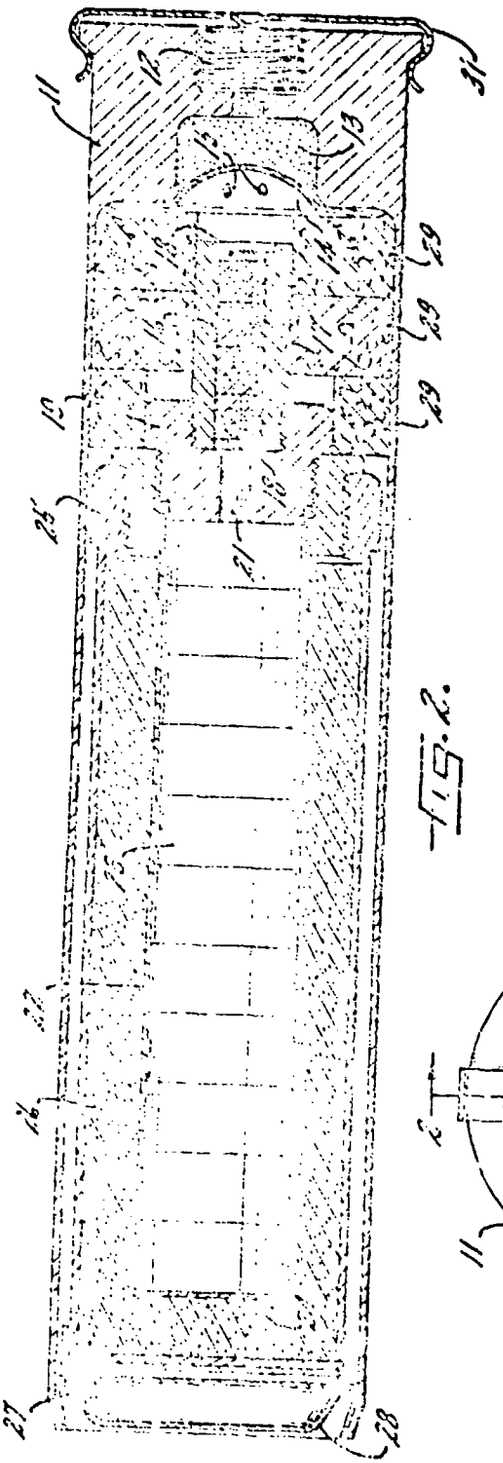

FIG. 2.

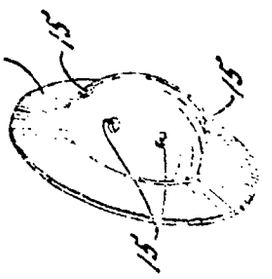

FIG. 4.

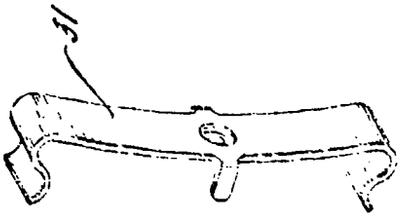

FIG. 3.

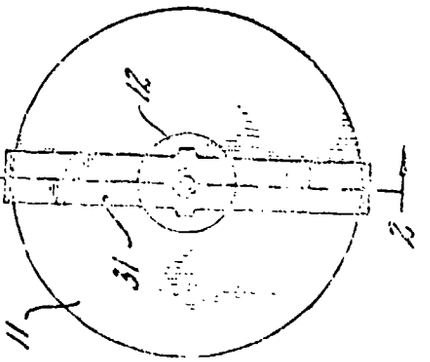

FIG. 1.

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United States Patent Office

3,473,472
Patented Oct. 21, 1969

1

3,473,472
PHOTOFLASH CARTRIDGE

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Filed Aug. 13, 1964, Ser. No. 390,266
Int. Cl. F42b 13/40
U.S. Cl. 102—32 6 Claims

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

The present invention relates to a flare cartridge and more particularly to a photoflash cartridge for providing illumination in support of night aerial photography.

The military services are presently using a photoflash unit that is ejected from an aircraft and, after a short delay, [illegible] provide a high intensity flash. While heretofore known flash units are widely used the flash duration is relatively long and thus the quality of a picture being taken is affected.

The present invention relates to a photoflash cartridge that is compatible with existing ejectors and which, after a fixed delay, explodes to provide a high intensity short duration [illegible]. An inner charge case is propelled [illegible] from a cartridge case and after a fixed delay a homogeneous explosive mixture is ignited that causes the inner charge case to explode and the surrounding flash composition to be rapidly ignited.

It is therefore a general object of the present invention to provide a photoflash cartridge which, upon ignition, will provide a high intensity, short duration flash.

Other objects and advantages of the present invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawing wherein:

FIGURE 1 is an end view of a preferred embodiment of the present invention;

FIGURE 2 is a sectional view taken on line 2—2 of FIGURE 1;

FIGURE 3 is a perspective view of a shunting clip; and

FIGURE 4 is a perspective view of a primer shield.

Referring now to the drawing which shows a preferred embodiment of the present invention, [illegible] case 11 [illegible] a military type [illegible] case 11 is [illegible] closed on one end [illegible] provided with a [illegible] hole so that an electric primer 12 can be [illegible] therein. The opposite end of cartridge case 11 is open. The closed end of [illegible] case 11 is [illegible] with a counterbore that is [illegible] with an expelling charge 13, such as black powder. [illegible] charge 13 [illegible] the primer 12 and is [illegible] in position by means of a primer shield 14. As [illegible] FIGURE 4 of the drawing, primer shield 14 is provided with a plurality of small holes 15 that upon ignition [illegible] black powder, permits a flame to pass through [illegible] shield to ignite a delay composition 16 that [illegible] into a delay holder 17.

By way of example, the delay composition 16 might be comprised of about 82.2 percent, by weight, of barium chromate, about 7.8 percent, by weight, of boron, and about [illegible] percent, by weight, of diatomaceous earth (95% SiO_2). By [illegible] one-quarter inch diameter bore delay holder 17 [illegible] about a one inch length of the foregoing described delay composition, a delay of approximately one second is achieved. By increasing the percent of barium chromate and reducing the percent of boron, the delay period can be increased. As shown in the drawing, the delay composition is divided into 4 increments and an ignition mixture 18 is pressed on each end. By way of example, the ignition mixture 18 might be comprised of about 90 percent, by weight, of barium chromate and about 10 percent, by weight, of boron.

2

Delay holder 17 has an end portion of its outside diameter threaded and this threaded portion engages with a detonator holder 19 which is provided with a bore that holds a detonator 21. One end of detonator 21 is contiguous with the end of ignition mixture 18. Detonator holder 19 also has a portion of its outside diameter threaded and a pellet tube 22 is threadedly attached to holder 19.

Pellet tube 22 contains a plurality of explosive pellets 23 which, by way of example, might be RDX Composition CH-6, which is described in Military Specification MIL-R-21723. RDX Composition CH-6 is a homogeneous explosive mixture of about 97.5 percent RDX (Type B, Class A, as outlined in MIL-R-398C), about 1.5 percent calcium stearate, about 0.5 percent graphite, and about 0.5 percent polyisobutylene. A pellet tube cap 24 is provided to close the outer end of pellet tube 22.

Pellet tube 22 has its inner end threaded and a charge case 25 is threadedly attached thereto. A photoflash composition 26 is contained within case 25 which, by way of example, might be comprised of about 60 percent potassium perchlorate and about 40 percent atomized aluminum powder. A closing disc 27 is provided to close the end of charge case 25 which is then crimped or spun over at its outer end, and likewise, cap 28 is provided to close the outer end of cartridge case 11. Gas checks 29 are provided in the forward end of cartridge case 11.

In operation, shunting clip 31 is [illegible]ed in the position shown in FIGURES 1 and 2 of the drawing until just prior to placing the photoflash cartridge in an ejector, at which time clip 31 is removed. Shunting clip 31 is provided for safety reasons and prevents primer 12 from being accidentally fired. Upon the application of current to primer 12, primer 12 will ignite and, in turn, ignite the expelling charge 13 which will expel charge case 25 out of the outer end of cartridge case 11. At the same time, delay composition 16 is ignited and after a delay of about 1 or 2 seconds the delay composition [illegible] detonator 21 to ignite which detonates the explosive pellets 23. The explosion of pellets 23 detonates the photoflash composition 26 to [illegible] high intensity flash of short duration.

It can thus be seen that the present invention provides [illegible] photoflash cartridge which [illegible] and which, upon detonation, [illegible] improved illumination for use in aerial photography.

What is claimed is:

1. A [illegible] comprising:

a cartridge case having a closed end and an open end,

an expelling powder charge within said cartridge case adjacent said closed end,

a delay fuze within said cartridge case adjacent said expelling powder charge,

a first inner container within said cartridge case containing an explosive charge,

a detonator positioned between said delay fuze and said explosive charge,

a second container within said cartridge case encircling said first container and containing a charge of photoflash composition, and

a cap closing the open end of said cartridge case.

2. A photoflash cartridge as set forth in claim 1 wherein a metallic shield is disposed between said expelling powder charge and said delay fuze, said shield having a plurality of holes therein for permitting passage of flame.

3. A photoflash cartridge as set forth in claim 1 wherein one end of said second container is threadedly attached to one end of said first container.

4. A photoflash cartridge as set forth in claim 1 wherein said explosive charge is comprised of about 97.5 percent RDX (Type B, Class A), about 1.5 percent calcium stearate, about 0.5 percent graphite and about 0.5 percent polyisobutylene.

5. A photoflash cartridge as set forth in claim 1 wherein said photoflash composition is comprised of about 60 percent potassium perchlorate and about 40 percent atomized aluminum powder.

6. A photoflash cartridge as set forth in claim 1 wherein an electric primer is threadedly attached in said closed end of said cartridge case.

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BENJAMIN A. BORCHELT, Primary Examiner

JAMES FOX, Assistant Examiner

U.S. Cl. X.R.

102—87

United States Patent Office

3,462,325

Patented Aug. 19, 1969

3,462,325

FLARE COMPOSITION COMPRISING MAGNESIUM, SODIUM PERCHLORATE, AND A TERNARY ORGANIC BINDER

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No Drawing. Filed Oct. 24, 1968, Ser. No. 770,380
Int. Cl. C06d 1/10; C06b 11/00
U.S. Cl. 149—19 3 Claims

ABSTRACT OF THE DISCLOSURE

A castable illuminating flare composition producing high luminous efficiencies comprised, by weight, of between 40 and 48 percent of magnesium, between 40 and 44 percent of sodium perchlorate, and between 12 and 16 percent of a binder which is a mixture of a methacrylate monomer and a polyester resin.

BACKGROUND OF THE INVENTION

Pyrotechnic devices that are designed for military applications generally are comprised of a metal fuel, an oxidizer, and a binder. One method of manufacturing such pyrotechnic devices consisted of mixing the ingredients and then subjecting the mixture to a very high pressure. The resulting product has a density depending upon various conditions, such as the type of ingredients in the mixture, and the amount and duration of the pressure applied. Different densities result in wide variations in the rates of combustion of the pyrotechnic devices, which results in unpredictable functioning of the product.

In order to overcome the disadvantages of compacted pyrotechnic articles, recent developments in the pyrotechnic art has produced various plastic type compounds that can be cast or molded. One such plastic compound is described in U.S. Patent 2,984,558, which issued May 16, 1961, to Edward Rolle and John Q. Tabor. This patented compound is essentially a mixture of unsaturated polyester resins to which is added a stabilizing ingredient, oxidizers, and a fuel.

Another pyrotechnic composition designed for pour casting is described in U.S. Patent 3,258,373, entitled, "Plastic Pyrotechnic Compositions Containing Strontium Perchlorate and Acrylic Polymer," which issued June 28, 1966, to Bernard E. Douda. In this patented composition, strontium perchlorate is added to an acrylic monomer with a portion of the strontium perchlorate being dissolved in the acrylic monomer and with the undissolved strontium perchlorate remaining suspended in solid form until complete polymerization takes place.

Although a number of commercial polyester resin formulations are available and appear to have utility as a binder, they are generally formulated to contain styrene (vinyl benzene) monomer which contains no oxygen and have a high carbon content. One of the desirable characteristics of a binder would be to contain a high percentage of oxygen or other oxidizing elements to enhance combustion of the flare grain. Another desirable characteristic for a binder is having a minimum of carbon molecules thereby reducing formation of elemented carbon in the flare plume during combustion.

SUMMARY OF THE INVENTION

The present invention provides an improved casting composition for use as an illuminating composition having high luminous efficiency. A metal fuel, such as magnesium, and an oxidizer, such as sodium perchlorate are mixed with a monomer and an unsaturated polyester resin and then cast and polymerized. Castable visual flare formulations producing luminous efficiencies up to 51,000 candle-seconds/gram and having a high binder percentage have been developed. The use of liquid polyester resins greatly facilitate the fabrication of the flares. Optimum results were obtained when the oxidizer to fuel ratio was maintained near the 1 to 1 range.

It is therefore a general object of the present invention to provide an improved flare composition which can be cast and which will provide high luminous efficiency.

Other objects and advantages of the present invention will be readily appreciated as the same becomes better understood by reference to the following detailed description.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The present invention resulted from a program to develop a binder system not containing styrene monomer. The oxidizer sodium perchlorate was selected largely because of its solubility in certain organic solvents. Sodium nitrate, which is used extensively in standard pressed grains, is practically insoluble in solvents other than water and offers little utility in formulating grains which contain a high percentage of oxygen. It appeared advantageous to dissolve the oxidizer salt to allow higher solids loading and more uniform oxidizer-fuel distribution.

The basic monomer used in the present invention is glycidyl methacrylate which can be predictably polymerized and which contains 33.8 percent oxygen in its basic molecule. Also sodium perchlorate is somewhat soluble in glycidyl methacrylate. Suitable basic polyester resins are added to improve polymerization characteristics and also to improve particle wetting of the solids to facilitate casting. Two liquid basic polyester resins which showed compatibility with glycidyl methacrylate monomer were obtained from the Commercial Resins Division of Interplastic Corporation, Minneapolis, Minn., under the trade names "CoRezyn 3" and "CoRezyn 10." "CoRezyn 3" is a viscous liquid resin (viscosity, over 100,000 cps.) which, when diluted with monomer gives a very flexible resin. "CoRezyn 3" is a straw-colored liquid having a specific gravity of 1.23. "CoRezyn 10" is a monomer free unsaturated polyester resin having a light straw color and a relatively low viscosity of between 600 and 650 cps.

Various formulations were tried using either "CoRezyn 3" or "CoRezyn 10." As a starting point, slurries were made using 4 percent of basic polyester resin and 12 percent of monomer, with the balance being oxidizer and fuel. To improve particle wetting, the percentages of liquid polyester resins were raised from 4 percent to 7.75 percent of the total composition, with a resultant increase in viscosity. The formulation containing 7.75 percent of "CoRezyn 10" gave the highest luminous efficiency (50,500 and 51,200 candle-seconds/gram for two samples tested). In this optimum formula, the ratio of oxidizer to fuel was 1:1, that is, 42 percent of sodium perchlorate and 42 percent of magnesium.

In order to evaluate ease of blending and casting, as well as luminous efficiency, alterations were made in the oxidizer to fuel ratio. When the amount of oxidizer was increased, the slurry was not as castable as the 1:1 formulation, and the luminous efficiency was less. Also upon lowering the percentage of oxidizer, the casting slurry became more fluid but again the luminous efficiency decreased.

The following examples are illustrative of the invention, wherein each of the percentages given is in terms of weight percent.

Example I

	Percent
Glycidyl methacrylate	7.75
Ethylene dimethacrylate	0.50
Liquid basic polyester resin (CoRezyn 3)	7.75
Sodium perchlorate	42.00
Magnesium (granulated)	42.00

A blend batch of 1500 grams was prepared with the liquid basic polyester resin being dissolved in the monomers, glycidyl methacrylate and ethylene dimethacrylate, with the latter monomer being added for cross-linking purposes. To this binder syrup, about 1.2 grams of benzoyl peroxide was added as a catalyst and stirred until completely dissolved. Approximately 30 ml. of this binder was then put aside for further use. Sodium peroxide was then added to the remaining binder syrup and blended using a planetary mixer until a homogeneous blend was added. Next the granulated magnesium was added and blending was continued. Ten drops of N,N-dimethyl-p-toluidine, a room-temperature curing agent, was added to the 30 ml. of binder syrup which was previously set aside, and stirred in completely and immediately added to the slurry. The slurry was again blended for about 5 minutes and cast into flare molds. A mild polymerization exotherm was noticed in about 20 minutes after casting. The cast flares were allowed to polymerize at room temperature and were given a post cure at 150 degrees F. in order to insure complete polymerization.

The cast candle was burned and a radiometer system was used to detect flare intensity. The testing and measuring was performed in the open air at ambient conditions. Test results indicated that the cast candle had a luminous efficiency of 47,000 candle-seconds per gram.

Example II

	Percent
Glycidyl methacrylate	7.75
Ethylene dimethacrylate	0.50
Liquid basic polyester resin (CoRezyn 10)	7.75
Sodium perchlorate	42.00
Magnesium (granulated)	42.00

The ingredients were blended and cast as in Example I. The only difference between the formulation of this example and the formulation of Example I is the "CoRezyn." "CoRezyn 10" has a viscosity of between 600–650 cps., while CoRezyn 3 has a viscosity of over 100,000 cps.

The candle of this Example II was burned and tested as in Example I. Test results indicated that the cast candle had a luminous efficiency of 50,500 candle-seconds per gram.

Example III

	Percent
Glycidyl methacrylate	7.75
Ethylene dimethacrylate	0.50
Liquid basic polyester resin (CoRezyn 10)	7.75
Sodium perchlorate	40.00
Magnesium (granulated)	44.00

The ingredients were blended and cast as in Example I. Upon burning, the candle had a luminous efficiency of 49,800 candle-seconds per gram.

Example IV

	Percent
Glycidyl methacrylate	7.75
Ethylene dimethacrylate	0.50
Liquid basic polyester resin (CoRezyn 10)	7.75

	Percent
Sodium perchlorate	36.00
Magnesium (granulated)	48.00

The ingredients were blended and cast as in Example I. Upon burning, the candle had a luminous efficiency of 44,300 candle-seconds per gram.

Example V

	Percent
Glycidyl methacrylate	7.75
Ethylene dimethacrylate	0.50
Liquid basic polyester resin (CoRezyn 10)	7.75
Sodium perchlorate	44.00
Magnesium (granulated)	40.00

The ingredients were blended and cast as in Example I. Upon burning, the candle had a luminous efficiency of 43,700 candle-seconds per gram.

Example VI

	Percent
Glycidyl methacrylate	6.20
Ethylene dimethacrylate	0.50
Liquid basic polyester resin (CoRezyn 10)	6.20
Sodium perchlorate	41.40
Magnesium (granulated)	45.70

The ingredients were blended and cast as in Example I. Upon burning, the candle had a luminous efficiency of 46,800 candle-seconds per gram.

From the foregoing examples, it can be seen that castable visual flare formulations producing very high luminous efficiencies have been developed while using relatively high binder percentages. Optimum results were obtained when the oxidizer to fuel ratio was maintained close to 1:1. Obviously many modifications and variations of the present invention are possible in the light of the above teachings.

We claim:

1. A castable illuminating composition comprising, by weight,

between 40 and 48 percent of magnesium,

between 40 and 44 percent of sodium perchlorate, and

the balance of a binder comprising by weight, between 48 and [illegible] percent of glycidyl methacrylate, between 2 and 4 percent of ethylene dimethacrylate, and between 25 and 50 percent of a monomer free unsaturated polyester resin.

2. A castable illuminating composition as set forth in claim 1 wherein the ratio of magnesium to sodium perchlorate is approximately 1 to 1.

3. A castable illuminating composition as set forth in claim 1 wherein said binder is 16 percent of the total weight of the composition and the ratio of magnesium to sodium perchlorate is approximately 1 to 1.

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BENJAMIN R. PADGETT, Primary Examiner

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U.S. Cl. X.R.

149—42, 44, 85

Dec. 17, 1968 W. L. RIPLEY 3,416,872

CONTROLLED ENERGY RELEASE SYSTEM FOR USE IN SIGNALS, FLARES, AND OTHER HIGH ENERGY LIGHTING DEVICES

Filed July 14, 1967

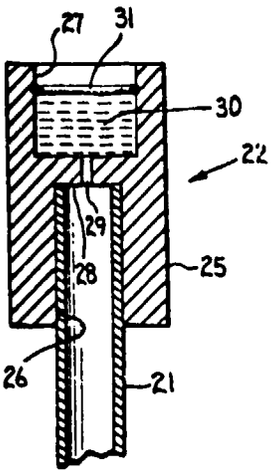

Fig. 2.

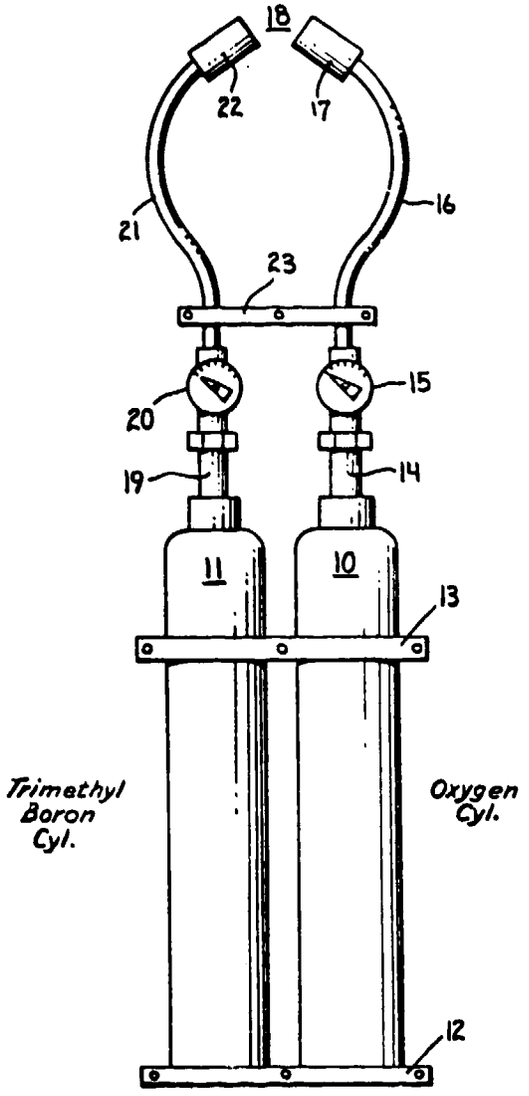

Fig. 1.

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United States Patent Office — 3,416,872 Patented Dec. 17, 1968

3,416,872

CONTROLLED ENERGY RELEASE SYSTEM FOR USE IN SIGNALS, FLARES, AND OTHER HIGH ENERGY LIGHTING DEVICES

William L. Ripley, Bedford, Ind., assignor to the United States of America as represented by the Secretary of the Navy

Filed July 14, 1967, Ser. No. 654,035
3 Claims. (Cl. 431—344)

ABSTRACT OF THE DISCLOSURE

A signal, flare, or other high energy lighting device having a container of trimethyl boron gas and a container of oxygen each conducted through metered valves to a common combustion area to ignite spontaneously and be controlled "on," "off," and in light intensity.

Background of the invention

This invention relates to light signals, such as flares or other high energy lighting devices, and more particularly to such devices that are self-igniting, that can be turned "off," "on," or to varying light intensities, and that can be reused repeatedly.

Many types of signals, flares, and illuminants exist which are conventionally solid compositions composed of an oxidizer, a fuel, a color emitter, a binder, and sometimes other additives such as color intensifiers. The performance of these devices is limited and controlled by their design and the user has little control except to ignite the device. Once burning it cannot be extinguished, and if the ignition system fails, the round is lost. Each different type of performance (duration of burning time, light or energy output, color, etc.) requires a different flare, signal, or illuminant design. While pyrophoric elements are known to self-ignite when exposed to the atmosphere or oxygen, these elements used to produce flames or burning go uncontrolled as hereinabove stated for signals, flares, and illuminants.

Summary of the invention

In the present invention the pyrophoric properties of such spontaneously inflammable gases, as trimethyl boron [$B(CH_3)_3$], are used along with an oxidizer to produce a light signal, flare, or illuminant of a brilliant pale-green light. The energy of the trimethyl boron gas is controlled through a metering valve from the gas container to an orifice or nozzle where it ignites spontaneously by virtue of its reaction to air. A container of oxygen is also controlled through a metering valve to an orifice or nozzle in the combustion area of the gas nozzle. By proportioning the gases with these metering valves the flame color can be modified. As in other flares the device of this invention is not destroyed and may be used again and again by refilling the containers with the gases. The device also is under the control of the operator to turn "on" and "off" or to control in brilliance and volume. Accordingly, it is a general object to provide a self-igniting illuminant device using a pyrophoric gas and oxygen in controlled proportions to adjust brilliance and energy expended, or to turn "on" and "off" at will.

Brief description of the drawing

These and other objects and the attendant advantages, features, and uses will become more apparent as a more detailed description proceeds when considered along with the accompanying drawing, in which:

FIGURE 1 is an elevational view of the light signal, flare, or illuminant device of this invention; and

FIGURE 2 is a cross-sectional view of the orifice or nozzle connected to the trimethyl boron gas cylinder in FIGURE 1.

Description of the preferred embodiment

Referring more particularly to FIGURE 1 an oxygen cylinder 10 and a cylinder 11 of trimethyl boron, $B(CH_3)_3$, or other suitable pyrophoric gas, are held together by clamps 12 and 13. While the invention is illustrated as using two separate cylinders clamped as a unit, it is to be understood that a single container with two compartments therein would avoid the use of clamps and probably be more feasible in mass production. Accordingly, the invention is not limited to the specific type of cylinders or containers. The oxygen cylinder 10 is piped by a conduit 14 to a metering valve 15, the outlet side of which is piped by the conduit 16 to a nozzle 17 in the combustion area 18. In like manner the gas cylinder 11 is connected by conduit 19 to a metering valve 20, the outlet of which is connected by conduit or pipe 21 to the nozzle 22. A clamp 23 gives rigidity to the pipes and nozzles although it may be understood that in production the pipes and nozzles may be made as a unit conserving space and weight over the illustrated embodiment.

Refering more particularly to FIGURE 2, the nozzle 22 consists of a body member 25 with a lower bore 26 to receive the pipe or conduit 21. The upper end of the body 25 has a bore 27 separated from the lower bore 26 by a wall portion 28 through which is an orifice 29. The upper bore 27 has a plurality of screens 30 retained by a ring 31. A screen mesh of 14 was found to be suitable although other meshes may be used. The screens provide a large surface area over which the gas passes to produce self-ignition. The nozzle 17 for oxygen may be of the generally known and used type for oxygen and will not be further explained herein.

Operation

When it is desired to produce a flare, light signal, or illuminant of pale green color, the metering valve 20 is opened to release the trimethyl boron gas, $B(CH_3)_3$, or other suitable pyrophoric gas, from the cylinder 11 to the atmosphere through the nozzle 22. Oxygen gas is then released from the cylinder 10 by opening the metering valve 15 to complete the combustion spontaneously in the combustion area 18. The rate of producing illuminant energy is controlled by the valves 15 and 20. The paleness and green brilliance of the light can be controlled by the ratio of oxygen to the pyrophoric gas. When it is desirable to extinguish the flame, the valves 15 and 20 are turned to shut-off position. Reignition can be readily obtained by re-opening valves 15 and 20, and this procedure of ignition and extinguishment can be repeated for signaling purposes. The cylinders 10 and 11 can be reused by refilling, as required.

While many modifications and changes may be made in the constructional details and features of this invention by rearrangement of parts or practicing the invention with uses other than disclosed herein I desire to be limited in the spirit of my invention only by the scope of the appended claims.

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

I claim:

1. A controlled energy illuminant self-contained flare device comprising:

a pyrophoric gas confining means;

an oxygen gas confining means attached to said pyrophoric gas confining means;

a pair of nozzles directed common combustion area with one nozzle each connected by a conduit to said pyrophoric gas confining means and to said oxygen gas confining means, respectively; and

a metering valve in each conduit to control the flow of said gases through said nozzles to said combustion area whereby the illuminant can be turned "on" without flame ignition and "off" repeatedly, controlled in intensity, and controlled in color content for signaling and flare illumination.

2. A controlled energy illuminant device as set forth in claim 1 wherein:

said nozzle connected to said pyrophoric gas has a plurality of screens therein over which said pyrophoric gas passes to the atmosphere.

3. A controlled en illuminant device as set forth in claim 2 wherein:

said pyrophoric gas is trimethyl boron.

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JAMES W. WESTHAVER, *Primary Examiner.*

U.S. Cl. X.R.

431—96, 126

United States Patent Office

3,411,964

Patented Nov. 19, 1968

3,411,964

ILLUMINATING FLARE COMPOSITION COMPOSED OF MAGNESIUM, SODIUM NITRATE, AND A VINYL TERMINATED POLYSILOXANE BINDER

Bernard E. Douda, Bloomfield, Ind., assignor to the United States of America as represented by the Secretary of the Navy

No Drawing. Filed July 31, 1967, Ser. No. 657,727

1 Claim. (Cl. 149—19)

ABSTRACT OF THE DISCLOSURE

An illuminating flare composition comprised of a fuel, such as magnesium, an oxidizing agent, such as sodium nitrate, and a silicone resin binder which is a complex mixture of organo-polysiloxanes having the organic groups of methyl, phenyl, and vinyl radicals attached to the silicon atoms.

BACKGROUND OF THE INVENTION

The present invention relates to a consumable pyrotechnic device, that is, an illuminating flare, and particularly to a flare which is to have military application, such as one to be dropped from an aircraft by parachute.

Various binders are known in the art for use in illuminating flares with the binders serving as a cohering agent for the oxidizing and light or color producing ingredients. For example, U.S. Patent 2,841,481, which issued July 1, 1958, to Ronald G. Hall, discloses pyrotechnic compositions utilizing phenol-formaldehyde resin, a urea-formaldehyde resin, or a melamine-formaldehyde resin as a binding agent.

In U.S. Patent 2,984,558, which issued May 16, 1961, to Edward Rolle, there is disclosed a binder which is a mixture of two unsaturated polyester resins having styrene as a reactive monomer. Presently, many flare compositions which are used by the military have a polyester resin for a binder, however these resins have some disadvantages, particularly during processing. For example, many polyester resins have a very short pot life and also are very tacky which makes it difficult to clean the mixing equipment.

SUMMARY OF THE INVENTION

The present invention relates to an illuminating flare which is comprised of magnesium, sodium nitrate and a silicone resin binder which is a complex mixture of organo-polysiloxanes having the organic groups of methyl, phenyl, and vinyl radicals attached to the silicon atoms.

One particular advantage of using a silicone resin as a binder for flares is that there is no exotherm during polymerization. This feature reduces the possibility of accidental ignition. Another safety advantage is provided in that the silicone resin is all solids, and since there is very little vapor pressure there is almost no odor. Consequently, the possibility of becoming obnoxious in the mixing or working area is greatly reduced. This characteristic is contrasted to the condition where polyester resins containing styrene are used. The styrene solvent evaporates during the mixing and handling process and not only is it odorous, but the vapors can become an explosion hazard. Still another safety feature associated with silicone resins is the ability to clean the mixing equipment with isopropyl alcohol which is reasonably non-toxic. The

polyester resins, on the other hand, are generally cleaned from the mixing equipment by using acetone.

The silicone resin binder used in the illuminating flares disclosed herein is compatible with magnesium and sodium nitrate and after polymerization the resin is durable and tough. After polymerization, the flares are relatively insensitive to drop, friction, and electrostatic energy.

It is therefore a general object of the present invention to provide an improved illuminating flare composition which is relatively safe to mix and handle.

Other objects and advantages of the present invention will be readily appreciated as the same becomes better understood by reference to the following detailed description.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The illuminating flares of the present invention are comprised essentially of a mixture of between 54 and 62 percent magnesium, between 28 and 38 percent sodium nitrate, and between 3 and 15 percent of a silicone resin which is a complex mixture of organo-polysiloxanes having the organic groups of methyl, phenyl, and vinyl radicals attached to the silicon atoms.

The following are examples of compositions according to the present invention.

Example 1

	Percent
Magnesium (granulation 18)	62
Sodium nitrate (20 microns)	35
Silicone resin (Sylgard 182)	2.7
Curing agent (182 catalyst)	0.3

The magnesium particles were of granulation 18, as defined in Mil-Spec JAN-M-382, entitled, "Magnesium Powder for Use in Ammunition." The silicone resin and catalyst were obtained from the Dow Corning Corporation, Midland, Mich., under the trade name Sylgard 182, and 182 curing agent, which is a metal catalyst. The following is a chemical analysis of the silicone resin:

	Percent
Silicon	37.7
Oxygen	21.5
Carbon	32.7
Hydrogen	8.1

The silicone resin and catalyst were first preblended and then mixed with the magnesium. This mixture was then blended and finally the sodium nitrate was added, and then the mixture was blended until a homogeneous mix was obtained. The mixture was then put into a container and pressed at 8450 p.s.i. to form a candle 4.25 inches in diameter. The weight of the candle was 6800 g. The candle was burned with the following results:

Burning time, secs.	205
Burning rate, g./sec.	33.1
Candlepower	1.16×10^6

Example 2

	Percent
Magnesium (granulation 18)	58
Sodium nitrate (20 microns)	37.5
Silicone resin (Sylgard 182)	4.05
Curing agent (182 catalyst)	0.45

The ingredients were mixed as in Example 1 and pressed at 8450 p.s.i. to form a candle 4.25 inches in diameter. The weight of the candle was 6800 g. The candle was burned with the following results:

Burning time, secs.	207
Burning rate, g./sec.	33.0
Candlepower	0.90×10^6

Example 3

	Percent
Magnesium (granulation 15)	58.4
Sodium nitrate (150 microns)	28.8
Silicone resin (Sylgard 182)	11.52
Curing agent (182 catalyst)	1.28

The ingredients were mixed as in Example 1 and then poured into a container to cast a candle 16 inches in diameter. The weight of the candle was 56,750 g. The candle was burned with the following results:

Burning time, secs.	81.5
Burning rate, g./sec.	696.3
Candlepower	4.21×10^6

Example 4

	Percent
Magnesium (granulation 17)	57
Sodium nitrate (150 microns)	29.2
Silicone resin (Sylgard 182)	12.42
Curing agent (182 catalyst)	1.38

The ingredients were mixed as in Example 1 and then poured into a container to cast a candle 16 inches in diameter. The weight of the candle was 56,750 g. The candle was burned with the following results:

Burning time, secs.	160.8
Burning rate, g./sec.	352.9
Candlepower	3.73×10^6

Example 5

	Percent
Magnesium (granulation 15)	54.4
Sodium nitrate (150 microns)	31.2
Silicone resin (Sylgard 182)	12.96
Curing agent (182 catalyst)	1.44

The ingredients were mixed as in Example 1 and then poured into a container to cast a candle 16 inches in diameter. The weight of the candle was 56,750 g. The candle was burned with the following results:

Burning time, secs.	81
Burning rate g./sec.	700.6
Candlepower	8.3×10^6

Example 6

	Percent
Magnesium (granulation 17)	60.0
Sodium nitrate (20 microns)	25.0
Silicone resin (Sylgard 182)	13.5
Curing agent (182 catalyst)	1.5

The ingredients were mixed as in Example 1 and then poured into a container to cast a candle 16 inches in diameter. The weight of the candle was 56,750 g. The candle was burned with the following results:

Burning time, secs.	123.3
Burning rate, g./sec.	460.2
Candlepower	4.75×10^6

The pot life of Sylgard 182 is about eight hours and polymerization is a function of temperature. At room temperature, the resin will cure in about twenty-four hours, and at a temperature of 65 degrees C., the cure time is about four hours.

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 claim, the invention may be practiced otherwise than as specifically described.

I claim:

1. An illuminating flare composition composed, by weight, of between 54 and 62 percent of magnesium; between 28 and 38 percent sodium nitrate; between 3 and 15 percent of a vinyl terminated polysiloxane composed of about 37.7 percent silicon, about 32.7 percent carbon, about 21.5 percent oxygen, and about 8.1 percent hydrogen; and between 0.3 and 1.5 percent of a metal catalyst for curing said vinyl terminated polysiloxane.

References Cited

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3,257,801	6/1966	Martinez et al.	149—43 X

CARL D. QUARFORTH, *Primary Examiner.*

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United States Patent Office 3,411,963 Patented Nov. 19, 1968

3,411,963

ILLUMINATING FLARE COMPOSITION COMPOSED OF MAGNESIUM, SODIUM NITRATE, AND AN EPOXY RESIN-POLYGLYCOL RESIN BINDER

Bernard E. Douda, Bloomfield, Ind., assignor to the United States of America as represented by the Secretary of the Navy

No Drawing. Filed July 31, 1967, Ser. No. 657,726
1 Claim. (Cl. 149—19)

ABSTRACT OF THE DISCLOSURE

An illuminating flare composition comprised of a fuel, such as magnesium, an oxidizing agent, such as sodium nitrate, and a binder comprised of an epoxy resin and a polyglycol resin.

BACKGROUND OF THE INVENTION

The present invention relates to a consumable pyrotechnic device, that is, an illuminating flare, and particularly to a flare which is to have military application, such as one to be dropped from an aircraft by parachute.

Various binders are known in the art for use in illuminating flares with the binders serving as a cohering agent for the oxidizing and light or color producing ingredients. For example, U.S. Patent 2,841,481, which issued July 1, 1958, to Ronald G. Hall, discloses a pyrotechnic composition utilizing phenol-formaldehyde resin, a ureaformaldehyde resin, or a melamine-formaldehyde resin as a binding agent.

In U.S. Patent 2,984,558, which issued May 16, 1961, to Edward Rolle, there is disclosed a binder which is a mixture of two unsaturated polyester resins having styrene as a reactive monomer. Presently, many flare compositions which are used by the military have a polyester resin for a binder, however these resins have some disadvantages, particularly during processing. For example, many polyester resins have a very short pot life which makes the processing time very critical.

SUMMARY OF THE INVENTION

The present invention relates to an illuminating flare which is comprised of magnesium, sodium nitrate and a binder which is a mixture of an epoxy resin and a perchlorate-modified amine-terminated long chain polyglycol. The preferred binder mixture is 38 percent epoxy resin and 62 percent polyglycol resin.

Illuminating flares can be made according to the teachings of the present invention by either a mix and press process, a molding process, or by a casting process. In the former process the binder ingredients are pre-blended and then this mixture is added to the magnesium fuel. After again mixing, sodium nitrate is added and the mixture is blended until a relatively homogeneous mix is obtained. In this process, about two to eight percent of binder mix is combined with 92–98 percent of magnesium-sodium nitrate. The mixture is then added in increments to a candle container and consolidated by pressing.

In the molding or casting process the ingredients are blended the same as in the mix and press process except that the percentage of binder mix is much greater. As the binder mix is a liquid before polymerization takes place, a larger amount of binder mix will make the mixture

rather fluid so that it can be readily poured in a mold or container.

It is therefore a general object of the present invention to provide an improved binder for an illuminating flare.

Other objects and advantages of the present invention will be readily appreciated as the same becomes better understood by reference to the following detailed description.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The illuminating flares of the present invention are comprised essentially of a mixture of between 42 and 62 percent magnesium, between 28 and 40 percent sodium nitrate, and between 2 and 18 percent of a binder mix comprised of an epoxy resin and perchlorate-modified amine-terminated long chain polyglycol. The preferred binder mixture is 38 percent epoxy resin and 62 percent polyglycol resin.

After the illuminating flares are formed, the epoxy-polyglycol resin binder requires heat and time to polymerize. As the polymerization takes place, the binder mixture forms a tough, rubbery mass which holds the solid ingredients together. By way of example, polymerization, or curing, is accomplished by placing the candles in an oven for 24 hours at a temperature of 160 degrees F. A higher temperature will shorten the curing time and a lower temperature will lengthen the time for curing. After polymerization, the resulting candle is a firm, rigid mass.

The following are examples of compositions according to the present invention.

Example 1

	Percent
Magnesium (granulation 18)	62.0
Sodium nitrate (20 microns)	35.0
Polyglycol resin (QX-3812)	1.86
Epoxy resin (D.E.R.-732)	1.14

The magnesium particles were of granulation 18, as defined in Mil-Spec JAN-M-382, entitled, "Magnesium Powder for Use in Ammunition." The polyglycol and epoxy resins were obtained from The Dow Chemical Company, Midland, Mich. The epoxy resin used is marketed by The Dow Chemical Company under the trademark D.E.R. 732 and is a flexible epoxy resin. The polyglycol resin is a perchlorate-modified amine-terminated long chain polyglycol and The Dow Chemical Company designates the resin as QX-3812. This polyglycol resin is an amber liquid having a specific gravity of 1.05 at 25° C. and has the following analysis:

Carbon	59.10
Hydrogen	10.20
Oxygen	28.05
Chlorine	1.36
Nitrogen	1.29

The epoxy and polyglycol resins were first pre-blended and then mixed with the magnesium. This mixture was then blended and then the sodium nitrate was added and the mixture was blended until a homogeneous mix was obtained. The mixture was then put into a container and pressed at 5520 p.s.i. to form a candle 4.25 inches in diameter. The weight of the candle was 6624 g. The candle was cured for 24 hours at a temperature of 70 degrees C., and after curing the candle was burned with the following results:

Burning time, secs	169
Burning rate, g/sec	39.2
Candlepower	1.60×10^6

Example 2

	Percent
Magnesium (granulation 18)	62.0
Sodium nitrate (20 microns)	34.0
Polyglycol resin (QX–3812)	2.48
Epoxy resin (D.E.R.–732)	1.52

The ingredients were blended as in Example 1 and then pressed at 8450 p.s.i. to form a candle 4.25 inches in diameter. The weight of the candle was 7258 g. The candle was cured for 72 hours at a temperature of 80 degrees C., and after curing the candle was burned with the following results:

Burning time, secs.	195
Burning rate, g./sec.	33.0
Candlepower	1.74×10^6

Example 3

	Percent
Magnesium (granulation 18)	58.0
Sodium nitrate (20 microns)	37.5
Polyglycol resin (QX–3812)	2.79
Epoxy resin (D.E.R.–732)	1.71

The ingredients were blended as in Example 1 and then pressed at 8450 p.s.i. to form a candle 4.25 inches in diameter. The weight of the candle was 6800 g. The candle was cured for 72 hours at 80 degrees C., and after curing the candle was burned with the following results:

Burning time, secs.	267
Burning rate, g./sec.	25.4
Candlepower	1.17×10^6

Example 4

	Percent
Magnesium (granulation 18)	60.0
Sodium nitrate (20 microns)	34.0
Polyglycol resin (QX–3812)	3.72
Epoxy resin (D.E.R.–732)	2.28

The ingredients were blended as in Example 1 and then pressed at 3000 p.s.i. to form a candle 4.25 inches in diameter. The weight of the candle was 6443 g. The candle was cured for 72 hours at a temperature of 80 degrees C., and after curing the candle was burned with the following results:

Burning time, secs.	282
Burning rate, g./sec.	22.7
Candlepower	0.94×10^6

Example 5

	Percent
Magnesium (granulation 18)	57.0
Sodium nitrate (20 microns)	37.0
Polyglycol resin (QX–3812)	3.72
Epoxy resin (D.E.R.–732)	2.28

The ingredients were blended as in Example 1 and then pressed at 5220 p.s.i. to form a candle 4.25 inches in diameter. The weight of the candle was 6624 g. The candle was cured for 72 hours at a temperature of 80 degrees C., and after curing the candle was burned with the following results:

Burning time, secs.	293
Burning rate, g./sec.	22.6
Candlepower	0.91×10^6

Example 6

	Percent
Magnesium (granulation 15)	56.0
Sodium nitrate (150 microns)	31.2
Polyglycol resin (QX–3812)	7.54
Epoxy resin (D.E.R.–732)	4.86

The ingredients were blended as in Example 1 and then poured into a container to cast a candle 16 inches in diameter. The weight of the candle was 56,750 g. The candle was cured for 72 hours at a temperature of 80 degrees C., and after curing the candle was burned with the following results:

Burning time, secs.	242
Burning rate, g./sec.	234
Candlepower	0.99×10^6

The epoxy-polyglycol resin binder of the present invention have several important advantages over heretofore used polyester binders which are used in many military type flares. Candles having epoxy-polyglycol resin binder need not be subject to high pressures, as do candles having polyester type binders. For example, during tests made at the U.S. Naval Ammunition Depot, Crane, Ind., on flares having polyester binders, it was determined that by reducing the pressing pressure from 8450 p.s.i. to 5220 p.s.i., there was a corresponding reduction of efficiency from 40,000 cd.-sec./g. to about 32,000 cd.-sec./g. This degradation is sufficiently large that the reduced pressing pressures could not be used. Tests, however, on candles utilizing an epoxy-polyglycol resin binder showed that pressing pressures of 2200 p.s.i., 3000 p.s.i., 5220 p.s.i., and 8450 p.s.i., resulted in candles all of which had an efficiency of over 40,000 cd.-sec./g.

Another feature of an epoxy-polyglycol resin binder is its slow burning property. In tests conducted at the U.S. Naval Ammunition Depot, Crane, Ind., candles having an epoxy-polyglycol binder had a consumption rate of about 25 grams per second whereas the same size candles having a polyester binder had a consumption rate of about 38 grams per second. The overall efficiency of the two types of candles was the same. This slow burning property of candles having an epoxy-polyglycol binder is unique and is of considerable advantage for designing long burning flares.

Candles made with the epoxy-polyglycol binder require an elevated temperature cure which has some advantages. For one thing, polymerization takes place after all the ingredients have been added and better bonding results. Also the binder has a long pot life at room temperature which makes it easier to process the candles as there is no danger of setting up in the mixer or during handling.

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 claim, the invention may be practiced otherwise than as specifically described.

I claim:

1. An illuminating flare composition comprised of between 42 and 62 percent by weight, of magnesium, between 28 and 40 percent, by weight, of sodium nitrate, and between 2 and 18 percent, by weight, of a binder composed of about 38 percent, by weight, of epoxy resin and about 62 percent, by weight, of polyglycol resin said polyglycol resin being composed, by weight, of about 59.10 percent carbon, about 28.05 percent oxygen, about 10.20 percent hydrogen, about 1.36 percent chlorine, and about 1.29 percent nitrogen.

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March 12, 1968 C. E. ARMOUR ETAL 3,372,574

FRICTIONAL SENSITIVITY TESTING APPARATUS

Filed Jan. 12, 1966 3 Sheets-Sheet 1

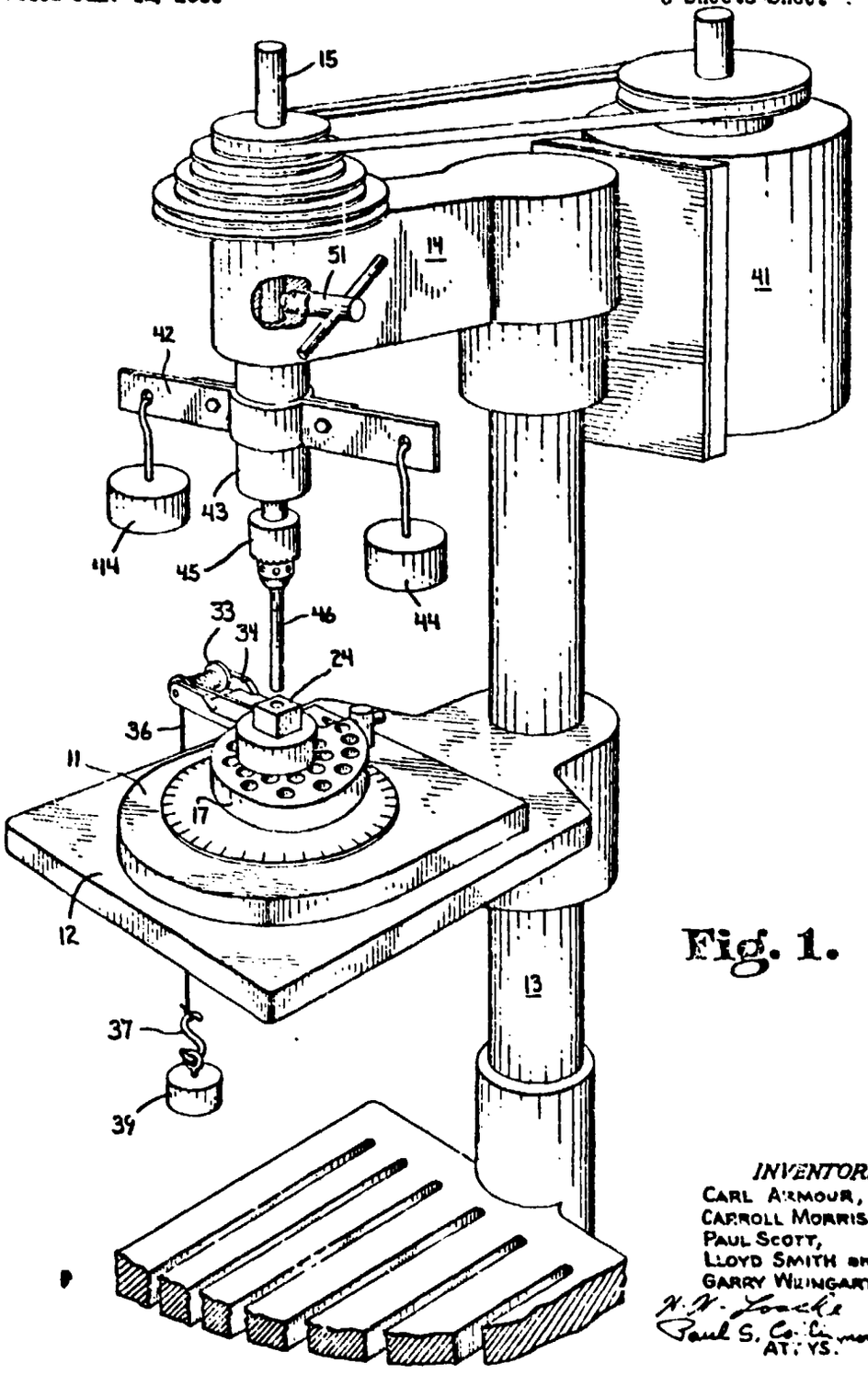

Fig. 1.

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FRICTIONAL SENSITIVITY TESTING APPARATUS

Filed Jan. 12, 1966 3 Sheets-Sheet 2

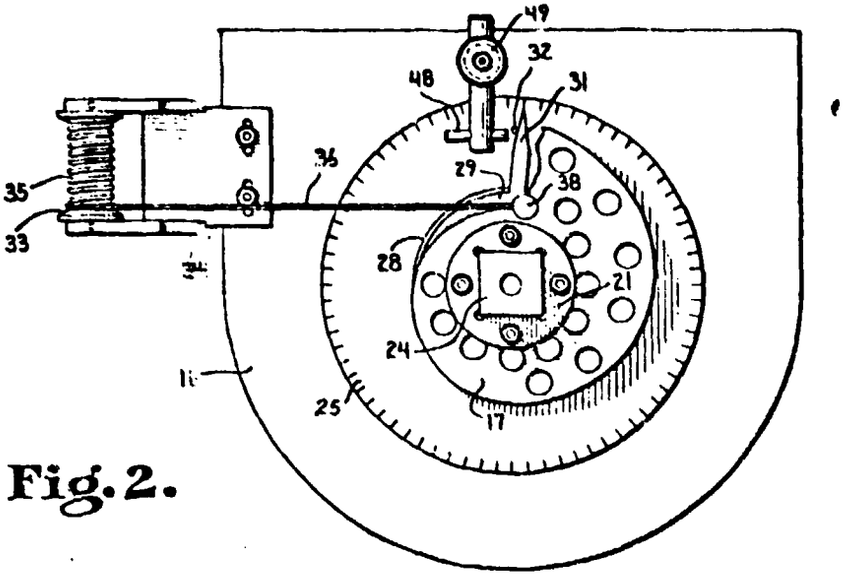

Fig. 2.

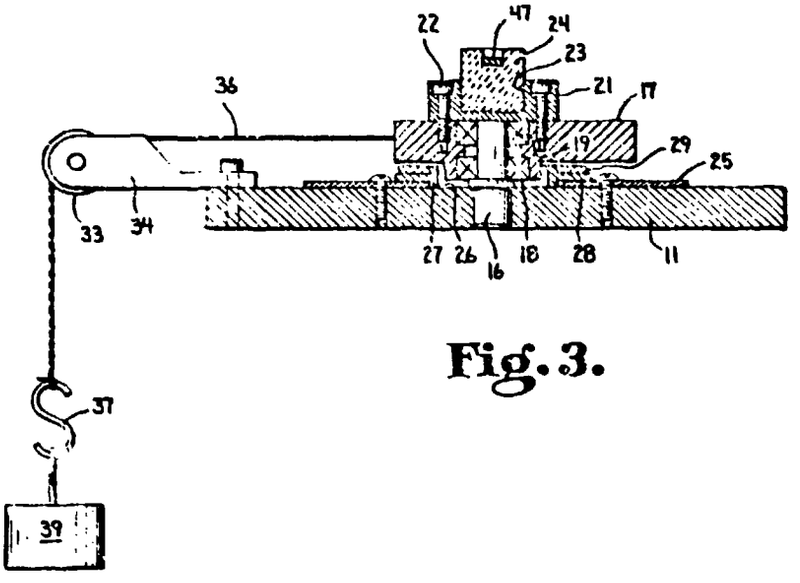

Fig. 3.

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March 12, 1968 C. E. ARMOUR ETAL 3,372,574

FRICTIONAL SENSITIVITY TESTING APPARATUS

Filed Jan. 12, 1966 3 Sheets-Sheet 3

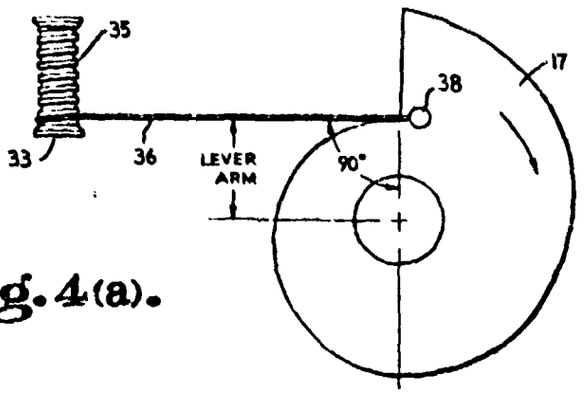

Fig. 4(a).

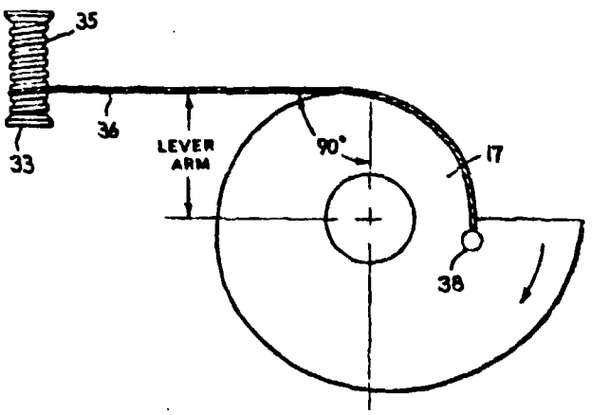

Fig. 4(b).

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United States Patent Office 3,372,574 Patented Mar. 12, 1968

3,372,574

FRICTIONAL SENSITIVITY TESTING APPARATUS

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Filed Jan. 12, 1956, Ser. No. 520,193
3 Claims. (Cl. 73—35)

ABSTRACT OF THE DISCLOSURE

A device for determining the relative frictional sensitivity of a pyrotechnic material by counter-balancing, with a weight, a rotational force applied by a rotating shaft to a quantity of pyrotechnic material held in a container which is mounted on a cam, said weight being attached to one end of a cord with the other end of said cord being attached to said cam whereby a variable torque arm is provided and whereby the amount of rotation of said cam and the time required for ignition of said pyrotechnic material determines the relative frictional sensitivity of said pyrotechnic material.

The present invention relates to a device for testing and evaluating the frictional property of materials, and more particularly to a test apparatus for determining the frictional sensitivity of pyrotechnic materials.

There is an inherent danger in the manufacture, packaging, and shipping of pyrotechnic materials, and it is often desirable to know the degree of sensitivity that a particular pyrotechnic material will have to friction. Heretofore, a standard testing apparatus used for determining friction sensitivity of pyrotechnic materials consisted of a swinging pendulum that was fitted with a shoe which is adapted to swing across a test sample that is placed on a friction anvil. This pendulum type testing apparatus has two shortcomings, one being that the test data was not reproducible on different machines, and another disadvantage being that an impact factor was included in the test result.

The present invention provides an improved method and device for evaluating the frictional sensitivity of pyrotechnic materials by engaging a spinning shaft with a quantity of pyrotechnic material held in a refractory container. The refractory container is mounted on a rotatable cam and a force is transmitted to the cam due to the friction between the spinning shaft and the pyrotechnic material. This force rotates the cam, which is weighted, and a variable lever arm is provided by the cam to provide a variable torque. The time required to ignite the quantity of pyrotechnic material is recorded, along with the angle of rotation of the cam, and a factor for frictional sensitivity can be determined.

It is therefore a general object of the present invention to provide an improved method and device for determining the relative frictional sensitivity of pyrotechnic material.

Another object of the present invention is to provide a novel device for determining the amount of frictional force being applied to a pyrotechnic material.

Other objects and advantages of the present invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

FIGURE 1 is a perspective view of a preferred embodiment of the present invention;

FIGURE 2 is a top plan view of a cam device for providing torque;

FIGURE 3 is a sectional view taken on line 3—3 of FIGURE 2; and

FIGURE 4(*a*) and FIGURE 4(*b*) are diagrammatic views illustrating the variable torque arm of a cam.

Referring now to the drawings there is shown a base plate 11 that is supported on a table 12 which is slidably attached to column 13. Column 13 also holds head 14 that supports the necessary mechanism to turn a spindle 15. A shaft 16 is attached perpendicular to base plate 11, and a cam 17 is rotatably mounted onto shaft 16 by means of bearings 18 and 19. By way of example, the profile of cam 17 is cut so that it will provide uniform motion, that is, the radius increases at a uniform rate. A container 21 is attached to the top cam 17 by means of screws 22, and a hole 23 is provided for holding a sample holder 24 which is made of a refractory material.

A dial plate 25, having a center hole 26 therein, is attached to base plate 11, and lines and numbers representing degrees are provided on the top surface of dial plate 25. A bushing 27 is positioned in center hole 26 and a flange 28 thereon, and a dial 29, having a pointer 31, is rotatably positioned on flange 28. A pin 32 is provided on cam 17 and extends downwardly so that it engages the edge of pointer 31. It can thus be seen that when cam 17 is rotated, pin 32 moves pointer 31 relative to dial plate 25 and the amount of rotation of cam 17 will be indicated.

A pulley 33 is rotatably mounted on a bracket 34 which is attached to base plate 11. Pulley 33 is provided with a spiral groove 35 and a cord 36 is passed over pulley 33 and seats in groove 35. A hook 37 is attached to one end of cord 36 and the other end of cord 36 is attached to cam 17 by means of pin 38. A weight 39 is attached to hook 37 to apply a force on cam 17.

Referring specifically to FIGURE 1 of the drawings, spindle 15 is slidable in a vertical direction in head 14 and is rotatable in a clockwise direction by motor 41 through a belt and pulley drive system. A yoke 42 is attached to the enlarged diameter portion 43 surrounding spindle 15 and weights 44 are selectively hooked to yoke 42. A standard chucking device 45 is provided on the end of spindle 15 and rod 46 is secured by chucking device 45 with the end of rod 46 being engageable with pyrotechnic material 47 which is held by sample holder 24. The desired force between the end of rod 46 and the pyrotechnic material 47 is determined by the amount of weights that are attached to yoke 42.

In order to facilitate the holding of spindle 15 in an upward extending position when a test is not being run, a locking arm 51 is threadedly attached to head 14 and engageable with spindle 15 to lock spindle 15 against vertical movement.

In operation, a small quantity of pyrotechnic material 47, for example 20 milligrams, is placed in holder 24 and an appropriate weight 39 is attached to cord 36. Weight 39 causes cam 17 to be rotated against stop 48 which is attached to base plate 11 by means of post 49. Pointer 31 is manually rotated in a counterclockwise direction until it engages pin 32. The torque converter is now ready for operation. A predetermined amount of weights 44 are added to yoke 42 and then motor 41 is energized to rotatably drive spindle 15 and, consequently rod 46, in a clockwise direction. When spindle 15 and rod 46 are rotating at the desired speed, they are lowered so that the end of rod 46 engages the pyrotechnic material 47 in sample holder 24. At the moment that rod 46 engages the pyrotechnic material, a timer is started, and then stopped when the pyrotechnic material is ignited.

The amount of force applied to the pyrotechnic material 47 by rod 46 is proportional to the amount of weights 44 that are attached to yoke 42.

The frictional force between the end of rod 46 and the pyrotechnic material 47 will cause cam 17 to be rotated in a clockwise direction and cord 36 will wind onto the outer periphery of cam 17 thereby raising weight 39. As cam 17 is rotated, the lever arm through which weight 39 is acting is increased, as the lever arm is equal to the distance from the center of cam 17 to the largest radius on the cam touching cord 36. As illustrated in FIGURE 4 of the drawings, as the lever arm is increased, the groove 35 in pulley 33 causes cord 36 to move an amount equal to the change in radius so that cord 36 will always be perpendicular to the same line passing through the center of cam 17. It can be seen that as cam 17 is rotated, an ever increasing torque force is being applied to counterbalance the frictional force between rod 46 and pyrotechnic material 47. When the torque force applied by weight 39 acting through its lever arm equals or counterbalances the frictional force between rod 46 and pyrotechnic material 47, cam 17 will stop rotating.

As pin 32 is attached to cam 17, pin 32 will be rotated with cam 17 and will cause dial 29 to be rotated. Thus pointer 31 will indicate on dial plate 25 the amount of rotation of cam 17. By knowing the amount of rotation of cam 17, the lever arm can then be readily ascertained and by multiplying the weight of weight 39 by the lever arm the torque force needed to counterbalance the frictional force can be determined. By knowing this value and the time required to ignite the pyrotechnic material 47, a factor can be determined for the relative frictional sensitivity of a particular pyrotechnic material.

It can thus be seen that the present invention provides an improved device for determining the relative frictional sensitivity of a pyrotechnic material.

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 device for determining the relative frictional sensitivity of a pyrotechnic material by counterbalancing a rotational force applied to a quantity of said pyrotechnic material until ignition, said device comprising:

a base plate,

a cam rotatably attached to said base plate,

means on said cam for holding a quantity of pyrotechnic material,

a shaft rotatably fixed relative to said base plate and rotatably engagable with said pyrotechnic material whereby friction between said shaft when rotating and said pyrotechnic material causes said cam to be rotated,

means for applying a selected force to said shaft during rotational engagement of said shaft with said pyrotechnic material, and

means for applying a force of known value to the periphery of said cam tending to oppose rotation thereof whereby said force acting through a changing lever arm counterbalances the frictional force that rotates said cam thereby stopping rotation of said cam whereby the amount of rotation of said cam and the time required for ignition of said pyrotechnic material determines the relative frictional sensitivity of said pyrotechnic material.

2. A device for determining the relative frictional sensitivity of a pyrotechnic material as set forth in claim 1 wherein said means for applying a force of known value to said cam comprises:

a pulley attached to said base plate,

a cord engaging said pulley and having one end attached to said cam, and

a weight of known value attached to the other end of said cord.

3. A device for determining the relative frictional sensitivity of a pyrotechnic material as set forth in claim 2 wherein said pulley is provided with a helical groove for seating said cord.

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JEFFERY NOLTON, *Assistant Examiner.*

United States Patent Office

3,369,946
Patented Feb. 20, 1968

3,369,946

PROCESS FOR POLYMERIZING ACRYLIC MONOMERS WITH STRONTIUM PERCHLORATE FOR PYROTECHNICS AND PROPELLANTS

Bernard E. Douda, Bloomfield, Ind., assignor to the United States of America as represented by the Secretary of the Navy

No Drawing. Filed June 22, 1964, Ser. No. 377,140
4 Claims. (Cl. 149—43)

ABSTRACT OF THE DISCLOSURE

A process for preparing a polymer from a monomer selected from the class consisting of acrylic acid, methacrylic acid and esters of acrylic acid and methacrylic acid comprising dissolving water moistened strontium perchlorate in said monomer and then catalyzing the solution of moistened strontium perchlorate and monomer.

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

The present invention relates to a process for polymerizing monomers and more particularly to a process for polymerizing acrylic monomers for use in pyrotechnic compositions.

Various processes are known in the prior art for polymerizing acrylic monomers. It is well-known that peroxides may be employed as catalysts. One of the most commonly used peroxide catalysts is benzoyl peroxide which yields high peak exothermic temperatures. However, if the process is not controlled, vaporous bubbles are evolved which remain as blobs in the polymerized substance when used with monomers such as methyl methacrylate. In U.S. Patent 2,616,878, which issued on Nov. 4, 1952, to Maurice Mention, 2-methyltetrahydrofurane is used to polymerize methyl methacrylate to give a clear limpid polymer free from bubbles. However, the disadvantage of the use of 2-methyltetrahydrofurane is that about a thirteen hours curing cycle is required.

Various tertiary amines, such as N,N-dimethylaniline, N,N-dimethyl-p-toluidine, and trihexylamine are also used with benzoyl peroxide to promote the polymerization of methyl methacrylate. However, these tertiary amines are not oxidizing agents and therefore do not impart combustibility to the polymer. While noncombustibility is often desirable in commercial applications, it is not desirable in some military applications such as pyrotechnics and propellants.

In the present invention, strontium perchlorate containing up to about 4 percent of water is used to prepolymerize the acrylic monomer with complete polymerization being effected at a later time by the addition of a catalyst. The strontium perchlorate will dissolve in the acrylic monomer with the degree of solubility being related to the amount of moisture added to the strontium perchlorate. As increasing amounts of strontium perchlorate are dissolved in the acrylic monomer, the solution becomes more viscous due to polymerization induced by the salt.

It is therefore a general object of the present invention to provide an improved process for polymerizing acrylic monomers.

Another object of the present invention is to provide a process for prepolymerizing an acrylic monomer whereby the polymerizable fluid will be composed of both a fuel and an oxidizing agent.

Still another object of the present invention is to provide a process for controlling the degree and rate of polymerization of an acrylic monomer.

Other objects and advantages of the present invention will be readily appreciated as the same becomes better understood by reference to the following description.

It has been found that strontium perchorlate containing up to 4 percent of water will dissolve in acrylic monomers such as the esters of acrylic and methacrylic acids. At room temperature, about 18 parts of strontium perchlorate will dissolve in 100 parts of methyl methacrylate monomer. It has been discovered, however, that the degree of solubility is related to the amount of moisture contained in the oxidant. Maximum solubility occurs when about 2.2 percent of moisture is present in the oxidant. Upon mixing the desired amount of oxidant with the acrylic monomer, a prepolymer is readily formed, accompanied by heat evolution. This results in an increase in viscosity of the mixture. This reaction occurs without the need of an organic catalyst, and if the process is not regulated as to the degree of solubility and temperature, a hard polymeric mass will be formed.

In order to obtain information concerning the effect of the amount of water in strontium perchlorate on its solubility in an acrylic monomer, a number of samples were prepared using different moisture contents. Strontium perchlorate was prepared by adding water until the desired moisture concentration was obtained. The moistened salt was then added to 25 ml. of monomer (methyl methacrylate) while a temperature of 25 degrees C. was maintained. An excess of salt was added and the temperature was raised to 30 degrees C. in order to dissolve the excess salt. The temperature was then reduced to 25 degrees C. in order to crystalize the excess salt from the solution. The results are listed in Table I. It should be noted that maximum solubility occurs when the percentage of water present is about 2.2 percent.

TABLE I

No.	Methyl Monomer (grams)	Water (grams)	Anhydrous Strontium Perchlorate Dissolved	Water (percent)
1.....	23.38	0.0	4.70	0.0
2.....	23.38	0.08	8.23	1.0
3.....	23.38	0.55	24.47	2.2
4.....	23.38	0.55	24.51	2.2
5.....	23.38	0.44	17.12	2.5
6.....	23.38	0.80	12.04	3.2
7.....	23.38	0.52	12.44	4.0

In order to show the activating effect that strontium perchlorate has on an acrylic monomer, a number of samples were prepared using different amounts of the salt. A reagent grade anhydrous strontium perchlorate was used to which water was added to provide about 2.2 percent moisture. Varying amounts of the salt were dissolved in each of 25 ml. of monomer (methyl methacrylate inhibited with 25 p.p.m. hydroquinone). After the strontium perchlorate was dissolved, ½ ml. of cumene hydroperoxide catalyst was added. The activated and catalyzed solution was then heated in an oven at 85 degrees C. and the time to effect polymerization was recorded. The results are shown in Table II. Sample number 8, containing only the ½ ml. of cumene hydroperoxide as a catalyst was prepared as a control sample. Sample number 8 did not contain any strontium perchlorate and required approximately 4 hours to polymerize. By comparison, sample number 9, which contained only about 2.5% of moistened strontium perchlorate, was polymerized in about 66 minutes. The magnitude of the polymerization time reduction caused by the relatively small amount of oxidant is one of the significant features of the present invention.

TABLE II

No.	Methyl Monomer (grams)	Anhydrous Strontium Perchlorate (grams)	Water (grams)	Moistened Strontium Perchlorate (grams)	Time to Polymerize (min.)
8. .	23.38	0.0	0.0	0.0	240
9 .	23.38	0.89	0.01	0.90	60
10 .	23.38	1.21	0.03	1.23	45
11. .	23.38	2.84	0.06	2.90	20
12. .	23.38	4.11	0.09	4.20	10
13. .	23.38	7.82	0.17	7.97	14
14. .	23.38	22.87	0.51	23.38	10

While the samples listed in Table II were catalyzed with cumene hydroperoxide, there are many more commonly known catalysts that promote polymerization of acrylic monomers. Included among the known catalysts are diacyl peroxides, ketone peroxides, alkyl hydroperoxides, aralkyl hydroperoxides, alkyl peresters, and alkyl acid peresters. Various effects can be obtained by the use of different catalysts and also combination of catalysts can produce effects not readily available with any single catalyst.

While Tables I and II each show the relationship of various samples of methyl methacrylate and strontium perchlorate, strontium perchlorate also exhibits similar characteristics as shown in Tables I and II, when mixed in solution with acrylic acid, methacrylic acid, and esters of acrylic acid and methacrylic acid, such as methyl acrylate and ethyl acrylate. Samples were prepared in which about 21 gms. of strontium perchlorate, moistened with about ½ gm. of water, was added to each of 25 ml. of acrylic acid monomer, methacrylic acid monomer, and various esters of acrylic and methacrylic acid. To each of the mixtures about ½ ml. of cumene hydroperoxide catalyst was added, and with each sample the polymerization time was reduced from an excess of 5 hours to less than 10 minutes. As in the samples using methyl methacrylate, the moisture content in the strontium perchlorate affects the solubility in the monomer.

It can thus be seen that strontium perchlorate acts both as an activator and a catalyst, that is, small amounts of strontium perchlorate, when added to an acrylic monomer, will shorten the induction time normally required to polymerize the monomer, and also the temperature required to polymerize the monomer is less. When the strontium perchlorate dissolves in the monomer, there is provided a fluid which serves both as a fuel and an oxidizing agent. This fluid, when polymerized, serves as an excellent binder for use in pyrotechnics and rocket propellants.

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 process for preparing a polymer from at least one monomer from the class consisting of acrylic acid, methacrylic acid, and esters of acrylic acid and methacrylic acid comprising:

first dissolving water moistened strontium perchlorate with a said monomer in the ratio of between .025 to .23 part, by weight, of strontium perchlorate per one part of monomer, and

then catalyzing the solution of moistened strontium perchlorate and monomer whereby said monomer is polymerized in a relatively short time.

2. A process for preparing a polymer as set forth in claim 1 wherein said solution is catalyzed with a polymerization catalyst selected from the group consisting of diacyl peroxides, ketone peroxides, alkyl hydroperoxides, aralkyl hydroperoxides, and alkyl peresters.

3. A process for preparing a polymer as set forth in claim 1 wherein said solution is catalyzed with cumene hydroperoxide.

4. A process for preparing a polymer as set forth in claim 1 wherein said strontium perchlorate is moistened with between 0.1 and 4 parts, by weight, of water per one hundred parts of strontium perchlorate.

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April 25, 1967 C. W. GILLIAM ET AL 3,315,397

FLARE GUN HAVING QUICK DISCONNECT COUPLING

Filed Nov. 29, 1965 2 Sheets-Sheet 1

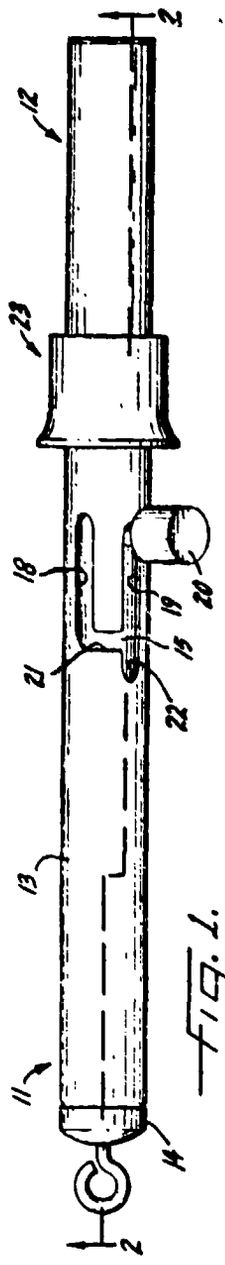

FIG. 1.

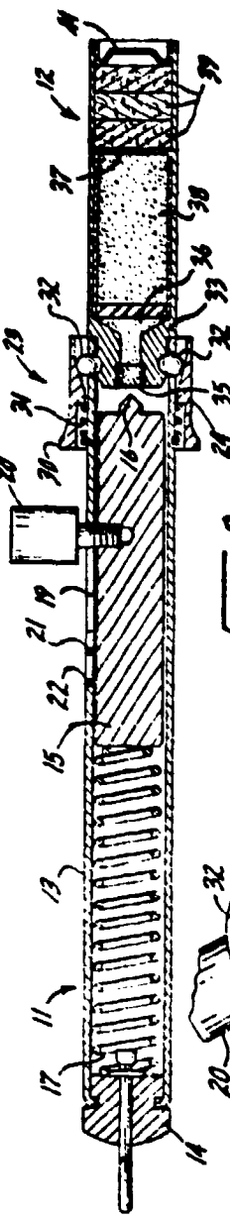

FIG. 2.

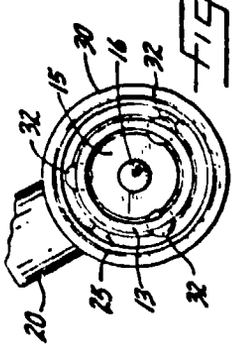

FIG. 3.

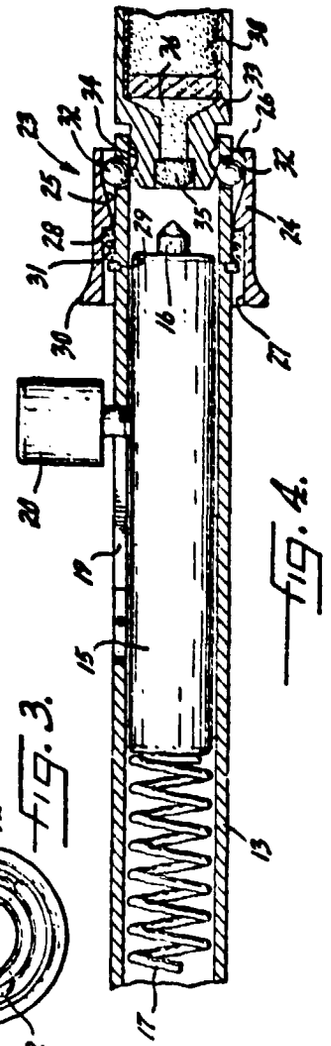

FIG. 4.

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FLARE GUN HAVING QUICK DISCONNECT COUPLING

Filed Nov. 29, 1965 2 Sheets-Sheet 2

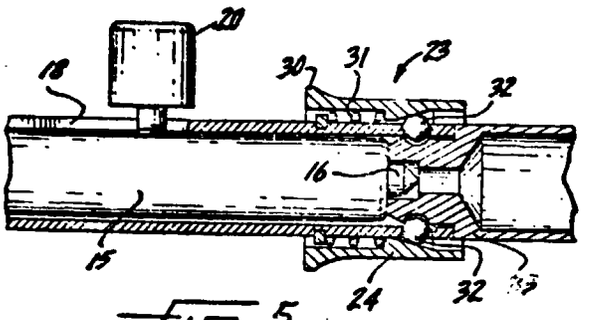

Fig. 5.

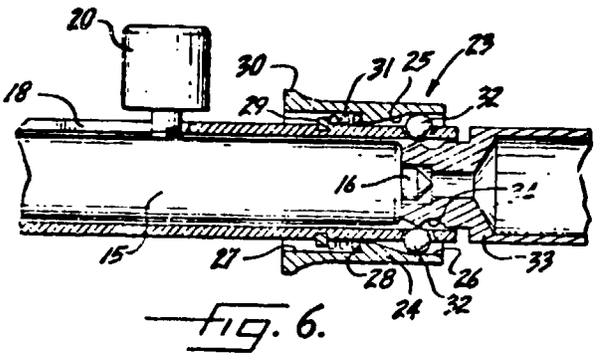

Fig. 6.

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3,315,397
Patented Apr. 25, 1967

1

3,315,397

FLARE GUN HAVING QUICK DISCONNECT COUPLING

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Filed Nov. 29, 1965, Ser. No. 510,478
3 Claims. (Cl. 42—1)

The present invention relates to a gun for launching pyrotechnic devices, such as smoke and colored flares, and more particularly, the invention relates to a flare gun having a quick disconnect coupling for quickly connecting and disconnecting a flare cartridge to a gun.

Various devices have been employed in the past to launch a pyrotechnic flare by a hand-held device. One relatively small device for launching flares is shown in U.S. Patent 3,044,360, which issued July 17, 1962, to Russell O. Stefan and Anton G. Lang. A guide tube having a bore therein is provided with a cylindrical firing pin that is spring biased by an expansive coil spring. The lower end of the tube is closed by a threaded plug and the opposite, or upper end, is threaded. A flare cartridge is provided with an externally threaded nipple which is threadedly engageable in the upper end of the tube.

In U.S. Patent 3,102,477, which issued Sept. 3, 1963, to Russell O. Stefan and Anton G. Lang, there is shown a device similar to that shown in U.S. Patent 3,044,360, except there is shown an improved flare cartridge. In this patented device, the fuse charge is ignited in a manner to delay its burning and thus assure that a substantial portion of the mass of the fuse will remain unconsumed during a considerable portion of the upward flight of the projectile, thereby contributing to the momentum aiding in the ascent of the projectile and deferring the ignition of the signal charge until the projectile has reached an altitude where it will be an effective signal. The device of U.S. Patent 3,102,477, like that of U.S. Patent 3,044,360, threadedly connects the projectile to the launcher.

While the devices of the above-mentioned patents perform adequately, they have a disadvantage in that the operator needs both hands to assemble the projectile to the launcher and also to disassemble the projectile after firing. Also, the time required to threadedly attach and disconnect the projectile to the launcher is relatively long and flares or signals cannot be rapidly launched.

The present invention consists of a projector tube that has a cylindrical firing pin and a spring is provided to forcibly drive the firing pin against a projectile case. The projectile case is provided with a circumferential groove on one end that engages with a quick disconnect device that is provided on the outer end of the projector tube. The quick disconnect consists of a plurality of balls that are separately retained in tapered holes that are of such dimensions that a portion of the balls extend into the inner diameter of the tube. A spring-biased sleeve is provided on the outer diameter of the tube and the inner bore of this sleeve is provided with a tapered portion that is engageable with the balls. Lateral movement of the sleeve causes the balls to move inwardly or outwardly, depending upon the direction of travel of the sleeve. The balls are engageable with the circumferential groove to lock the projectile case to the projector tube.

It is therefore a general object of the present invention to provide an improved projector for launching pyrotechnic signals.

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Another object of the present invention is to provide means on a projector for quickly attaching a projectile to a projector case.

Still another object of the present invention is to provide a release mechanism on a projector that is easily operated with one hand.

Other objects and advantages of the present invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

FIGURE 1 is a top plan view of a preferred embodiment of the present invention;

FIGURE 2 is a sectional view taken on line 2—2 of FIGURE 1;

FIGURE 3 is an end view of the embodiment shown in FIGURE 1, showing, however, the cartridge removed;

FIGURE 4 is a partial sectional view showing a sleeve retracted in order to facilitate coupling of a projectile case to a projector tube;

FIGURE 5 is a partial sectional view showing a cartridge after firing; and

FIGURE 6 is a partial sectional view similar to FIGURE 5 of the drawing only showing a sleeve retracted in order to uncouple a cartridge from a projector tube.

Referring now to the drawings, wherein like reference characters designate like or corresponding parts throughout the several views, there is shown a projectile launcher 11 to which a projectile case 12 is attached. The launcher is comprised of a cylindrical tube 13 which is closed at one end by a plug 14. A firing pin 15 is freely slidable within the bore of tube 13 and a pointed striker 16 is provided on the forward end of firing pin 15. A coiled spring 17 is provided between the rear end of firing pin 15 and plug 14.

Referring particularly to FIGURE 1 of the drawings, a firing slot 18 is cut through the wall of tube 13, and likewise a cocking slot 19 is cut through the wall of tube 13. Cocking slot 19 is parallel to firing slot 18, but shorter in length, and the two slots are connected by a cross slot 21. The end of cocking slot 19 is provided with a safety notch 22 that prevents the firing of the launcher in case the launcher is accidentally dropped. A cocking pin 20 is threadedly attached to firing pin 15, and cocking pin 20 has a reduced diameter portion that passes through the slots in tube 13.

On the forward end of a launcher 11, a quick disconnect coupling 23 is provided. Coupling 23 is comprised of a sleeve 24 that has an internal tapered portion 25 that adjoins an enlarged counterbore section 26 that opens in a forward direction. A second enlarged counterbore section 27 is provided in sleeve 24 and opens in a rearward facing direction. Counterbore section 27 terminates to form a shoulder 28. A retaining groove is provided on the outer periphery of tube 13 and a retaining ring 29 is provideo therein. A coiled spring 31 is positioned between shoulder 28 and retaining ring 29. Tube 13 is also provided with three tapered holes that are equally spaced and positioned near the end of tube 13. A ball 32 is provided in each tapered hole and the dimensions of the balls and the tapered holes are such that a portion of the balls protrude within the bore of tube 13. By way of example, the tapered holes might have a diameter at the outer edge of 0.135 inch and a diameter at the inner edge of 0.120 inch, and the diameter of the ball might be 0.125 inch.

Sleeve 24 is provided with a large diameter portion 30 that provides a gripping surface for actuating coupling 23. After coupling 23 is assembled, retaining ring 29 and shoulder 28 prevent coupling 23 from becoming unattached from the tube 13 when coupling 23 is moved in a rearward direction, and balls 32 and tapered portion

25 prevent coupling 23 from becoming unattached when coupling 23 is moved in a forward direction.

Referring particularly to FIGURE 2 of the drawings, projectile case 12 is comprised of a metallic cartridge 33 that is provided with a ball groove 34 on one end. Groove 34 is engageable with the three balls 32. A primer 35 is provided within cartridge 33 adjacent the end that engages launcher 11, and a quantity of black powder 36 is adjacent the primer 35. A flare cup assembly is provided adjacent the black powder and is comprised of a cup 37 that contains a quantity of pyrotechnic composition 38 which, upon burning, provides a pyrotechnic display. Spacers 39, as required, are provided and the open end of cartridge 33 is closed by an end cap 41.

In operation, prior to coupling projectile case 12 to launcher 11, cocking pin 20 is moved so that the reduced diameter portion of cocking pin 20 passes through slot 19. As best shown in FIGURE 2 of the drawings, the pointed striker 16 is spaced back so that it will not come into contact with primer 35. To facilitate coupling of projectile case 12 to launcher 11, sleeve 24 is retracted, thus compressing spring 31 and moving the tapered portion 25 away from balls 32. Balls 32 are now no longer wedged in their respective tapered holes and are free to be moved outwardly from tube 13. Cartridge 33 is then inserted into the bore of tube 13 until it shoulders against the front surface of tube 13. Sleeve 24 is then released and spring 31 drives sleeve 24 forward and tapered portion 25 causes balls 32 to become wedged in their respective holes. Balls 32 protrude into groove 34 of cartridge 33 and lock the cartridge to tube 13.

When it is desired to fire polytechnic device, cocking pin 20 is stroked backward in cocking slot 19, thus compressing spring 17. Cocking pin 20 is then moved through cross slot 21 and into firing slot 18. The cocking pin 20 is then released and spring 17 drives firing pin 15 forwardly and striker 16 strikes primer 35 causing it to fire. Primer 35, in turn, ignites the black powder 36 which propels flare cup 37 outwardly and, at the same time, causes the pyrotechnic composition 38 to ignite.

Referring particularly to FIGURE 5 of the drawings, it can be seen that after flare cup 37 has been propelled outwardly, the spent cartridge 33 is still coupled to launcher 11 by means of coupling 23. The forward end of firing pin 15 is in contact with the end of cartridge 33 and spring 17 is applying pressure to the opposite end of firing pin 15, and this pressure is tending to eject cartridge 33. The balls 32, however, are still retaining the spent cartridge 33.

Referring now to FIGURE 6 of the drawings, coupling 23 is shown retracted, whereupon the pressure being applied by spring 17 moves firing pin 15 forward thereby causing the firing pin 15 to eject spent cartridge 33. Firing pin 15 moves forward until cocking pin 20 reaches the forward end of firing slot 18.

It can thus be seen that the present invention provides a relatively simple means for coupling a projectile case to a launcher so that very rapid firing can be accomplished.

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 gun for launching a pyrotechnic signal in a cartridge having a circumferential groove around the outer periphery thereof, said gun comprising:

a cylindrical tube having a closed end and an open end,

a cylindrical firing pin slidably positioned within said cylindrical tube and having a pointed striker on the forward end thereof,

a coiled spring within said cylindrical tube between said closed end and the rear end of said firing pin,

a longitudinally extending firing slot through the wall of said cylindrical tube,

a longitudinally extending cocking slot through the wall of said cylindrical tube, said cocking slot being parallel to and shorter than said firing slot,

a cross slot connecting the rearward ends of said firing slot and said cocking slot,

a cocking pin connected to said firing pin and passing through and being movable in said firing and cocking slots,

a plurality of equally spaced tapered holes near said open end of said cylindrical tube,

a plurality of spherical balls positioned one each in each said tapered hole, said balls being engageable with said circumferential groove in said cartridge,

a sleeve slidably positioned on the outer periphery of said cylindrical tube, said sleeve having an inner tapered surface engageable with said plurality of spherical balls, and

spring means for biasing said tapered surface against said balls.

2. A gun for launching a pyrotechnic signal as set forth in claim 1 wherein a safety notch is provided at the rear end of said cocking slot.

3. A gun for launching a pyrotechnic signal as set forth in claim 1 wherein means are provided for ejecting said cartridge.

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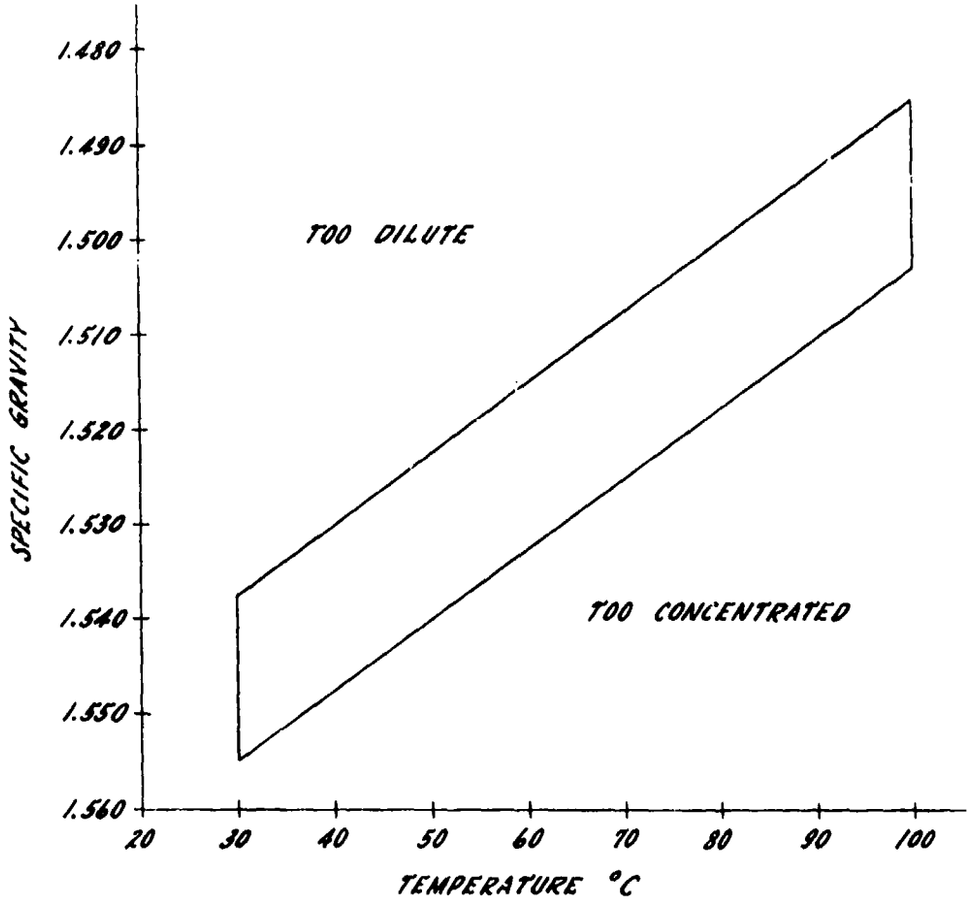
BENJAMIN A. BORCHELT, *Primary Examiner.*

Jan. 3, 1967 B. E. DOUDA 3,296,045

PYROTECHNIC COMPOUND TRIS(GLYCINE) STRONTIUM (II) PERCHLORATE AND METHOD FOR MAKING SAME

Filed Nov. 9, 1964



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United States Patent Office

3,296,045

Patented Jan. 3, 1967

3,296,045

PYROTECHNIC COMPOUND TRIS(GLYCINE) STRONTIUM (II) PERCHLORATE AND METHOD FOR MAKING SAME

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Filed Nov. 9, 1964, Ser. No. 410,037

5 Claims. (Cl. 149—75)

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

The present invention relates to a new compound and more particularly to a new compound that can be used as a pyrotechnic composition, either singularly or in combination with other ingredients.

Red pyrotechnic flares are presently formulated using conventional ingredients such as strontium nitrate, potassium perchlorate, magnesium, polyvinyl chloride and strontium oxalate. These and similar ingredients are mixed together in various proportions to make red flares. There is, however, a continuing demand, especially from military services, to provide flares with increased performance, and to meet these requirements, conventional ingredients are rearranged and reapportioned. The state of the art has now reached the point where rearranging and reapportioning will no longer provide new flares.

The present invention relates to a new compound that contains its own fuel, oxygen, and color ingredients. This compound is prepared by the reaction of glycine with strontium perchlorate in a ratio of 3 moles of glycine to one mole of strontium perchlorate. The synthesis methods consist essentially in the evaporation of water from an aqueous solution of the two ingredients. The resultant compound is a white crystalline solid; not considered as being hygroscopic; not sensitive when subjected to impact and electrostatic sensitivity tests; and, when burned, produces a red flame.

It is therefore a general object of the present invention to provide a new compound by reacting glycine and strontium perchlorate in the ratio of three moles to one mole.

Another object of the present invention is to provide a new compound suitable for use as a pyrotechnic material.

Other objects and advantages of the present invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawing wherein the figure is a graph showing the optimum relationship between temperature and specific gravity in the formation of crystals.

In the synthesis of the new compound of the present invention, one mole of strontium perchlorate is dissolved in 300 ml. of distilled water and then heated to about 80 degrees C. Any insolubles are then filtered out. Next, three moles of glycine are added to the solution and the solution is stirred until the glycine is dissolved. The solution is then adjusted for optimum crystallization condition. It has been found that crystals will most readily form when the specific gravity of the solution is maintained within a certain range for a given temperature. The figure of the drawing shows the range of specific gravity for various temperatures. For example, when the solution is maintained at a temperature of 80 degrees C., the specific gravity of the solution should be maintained between 1.500 and 1.517.

At a temperature of about 65 degrees C. the solution is seeded and crystals begin to form. During formation of the crystals, the solution is allowed to cool without stirring and by the time the temperature of the solution

reaches 25 degrees C., crystals have been formed in large quantities. The crystals are removed by filtration and then dried at about 100 degrees C. The filtrate can be used to form additional crystals by adding more strontium perchlorate and glycine in the proper proportion.

The compound formed by the reaction of strontium perchlorate and glycine is a white crystalline solid and has a solubility of 120 gms. per 100 ml. of water at 25 degrees C. It is estimated that the molecular weight is 511.75. A 3 gm. sample of the new compound gained 0.635 percent in weight after it has been subjected for 6 hours to a slowly moving stream of air containing 75 percent humidity at 25 degrees C. The compound is, therefore, not considered as being hygroscopic. The compound was considered as being not sensitive when subjected to impact and electrostatic sensitivity tests.

Pyrotechnic candles were prepared by pressing various compositions into cardboard tubes having an inside diameter of 1.437 inches. The length of the candle was about 2.5 inches.

Example I

A candle was pressed using a mixture of 100 grams of compound (tris (glycine) strontium (II) perchlorate) and 3 grams of castor oil. The candle burned with a weak red flame for about three minutes. Very little ash was formed.

Example II

A candle was pressed using a mixture of 95 grams of compound (tris (glycine) strontium (II) perchlorate), 5 grams of magnesium, and 3 grams of castor oil. The candle burned with a weak red flame for two minutes. There was a slight trace of ash formation.

Example III

A candle was pressed using a mixture of 90 grams of compound (tris (glycine) strontium (II) perchlorate), 10 grams of magnesium, and 3 grams of castor oil. The candle burned with a strong red flame for about 1.75 minutes and the ash formation was low.

Example IV

A candle was pressed using 80 grams of compound (tris (glycine) strontium (II) perchlorate), 20 grams of magnesium, and 3 grams of castor oil. The candle burned with a strong red flame about 1.33 minutes and there was medium ash formation.

The above-listed formulas are not necessarily the optimum ones for pyrotechnic candles, but rather were compounded to provide that the compound tris (glycine) strontium (II) perchlorate would support combustion without the addition of a supplementary oxygen supply, and also, to show that the compound could be mixed with other pyrotechnic ingredients to make a flare. As synthesized, the compound contains its own oxygen, fuel and coloring agent in proportions such that it will sustain combustion while producing a red flame.

As an alternate method of preparation, the compound tris (glycine) strontium (II) perchlorate can be prepared by first dissolving 1 molecular weight of strontium perchlorate in 300 ml. of distilled water. The solution is stirred while heating to 80 degrees C. Next 3 molecular weights of glycine are dissolved in the solution and then the water is evaporated by heating. The white solid that remains is dried and is the compound tris (glycine) strontium (II) perchlorate.

It can thus be seen that the present invention provides a new compound which contains its own fuel, oxygen supply and coloring agent and thus is suitable for use as a pyrotechnic substance. 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 process for preparing a pyrotechnic compound comprising:

first dissolving one mole of strontium perchlorate in water to form a solution,

next dissolving three moles of glycine in said solution, and

then removing said water.

2. A process for preparing a pyrotechnic compound comprising:

first dissolving one mole of strontium perchlorate in water to form a solution,

next dissolving three moles of glycine in said solution,

next seeding said solution containing the dissolved glycine to cause the formation of crystals, and

then removing said crystals by filtration.

3. A process for preparing a pyrotechnic compound comprising:

first dissolving one mole of strontium perchlorate in water to form a solution,

next dissolving three moles of glycine in said solution, and

then removing water by heating said solution containing the dissolved glycine.

4. A consumable pyrotechnic compound prepared by dissolving one mole of strontium perchlorate and three moles of glycine in water and then removing the water.

5. Tris (glycine) strontium (II) perchlorate.

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CARL D. QUARFORTH, *Primary Examiner.*

S. J. LECHERT, JR., *Assistant Examiner.*

United States Patent Office

3,262,824
Patented July 26, 1966

1

3,262,824

SMOKELESS ASHLESS SIGNAL FLARE COMPOSITION CONTAINING AMMONIUM PERCHLORATE

James B. McGriffin, Linton, and William L. Ripley, Bedford, Ind., assignors to the United States of America as represented by the Secretary of the Navy

No Drawing. Filed July 27, 1964, Ser. No. 385,518
4 Claims. (Cl. 149—42)

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

The present invention relates to an ashless signal flare composition and more particularly to an ashless signal flare composition which, when burned, emits a blue flame.

Various formulas have heretofore been used in compounding flares for military operations. Generally, those flares that produce a blue flame contain lead arsenate, and also may contain powdered metal, such as finely divided magnesium. While the use of magnesium in a blue flame formula may increase the candle power output of a flare, a dense white smoke is produced along with ash. This smoke tends to obscure the flame, and the ash causes the flare composition to burn unevenly. The use of lead arsenate causes the smoke and fumes to be a health hazard.

In the present invention an oxidizer-fuel system is used that is almost completely ashless and is comprised of a mixture of ammonium perchlorate and stearic acid. The ammonium perchlorate possesses the property of burning evenly, cool, and with only a small amount of smoke. As the mixture, upon burning, is practically ashless, all the heat formed is working heat, that is, as there is no residue left behind to absorb and hold heat, all the heat is dissipated out of the nozzle of the flare to increase the candlepower output and the color emission. In order to provide a blue color, a small amount of copper dust is added to the mixture of ammonium perchlorate and stearic acid.

It is therefore a general object of the present invention to provide an improved signal flare for military operations.

Another object of the present invention is to provide a signal flare composition which, when burned, is ashless and emits a blue flame.

Other objects and advantages of the present invention will be readily appreciated as the same becomes better understood by reference to the following detailed description.

In manufacturing a flare according to the teachings of the present invention, stearic acid and paraffin are melted together by heating at a temperature of about 90 degrees C. and copper dust is then added and mixed therewith. The melt is then cooled and screened and then mixed with the ammonium perchlorate. Satisfactory flares have been made by using between about 70-80 percent, by weight, of ammonium perchlorate, between about 8-12 percent, by weight, of stearic acid, between about 1-4 percent, by weight, of paraffin, and between about 8-12 percent, by weight, of copper dust. The paraffin is used to desensitize the mixture to impact.

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While the above-listed range of ingredients, when mixed, result in satisfactory flares, the following was found to be the optimum formula:

	Percent
Ammonium perchlorate	74.2
Stearic acid	11.1
Paraffin	3.6
Copper dust	11.1

Various test flares were manufactured using the above-listed optimum formula with the composition being pressed at a pressure of about 8000 p.s.i. A three-quarter inch diameter flare burned at a rate of 20 seconds per inch. The ignition temperature was found to be about 250 degrees C. and the flares were relatively insensitive to both an electrostatic charge and to impact. As to electrostatic sensitivity, a charge of 4250 volts at a capacitance of 0.2 μfd. was applied to a test flare and no fire resulted.

In order to test impact sensitivity, a 100 mg. sample was placed on an iron block and a 2 kg. weight was dropped from various heights directly onto the sample. When the weight was dropped from a height of 41 cm., or more, the sample would fire. A sample is considered to be sensitive if there is a firing upon a drop of 20 cm. or less.

Visibility tests were performed in the field during daylight and were the subjective reports of observers. At a distance of 1000 yards, upon burning, both light and the blue color from the test flares were visible. At a distance of 1500 yards, light was visible but color was not visible.

The advantages of an ashless and smokeless signal flare composition for military use becomes readily apparent. There is no smoke to obscure the light or color of the flare nor is there any ash to absorb heat, obstruct the nozzle throat, or interfere with the smooth burning rate within the flare body. Also with an ashless formulation there is a free dissipation of heat during the burning period and there is no extreme heating of the flare container.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. For example, as the color of the flare depends upon the particular molecular emitter used, it is entirely feasible that strontium or lithium compounds could be used instead of the copper dust when a red color is desired. Sodium compounds could be employed for a yellow color and barium or boron compounds could be employed for a green color. 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 consumable pyrotechnic mixture consisting of between about 70% and about 80% ammonium perchlorate,
between about 8% and about 12% stearic acid,
between about 1% and about 4% of a desensitizing ingredient and
between about 8% and about 12% of a molecular emitter for producing color.

2. A consumable pyrotechnic mixture as set forth in claim 1 wherein said desensitizing ingredient is paraffin.

3. A consumable pyrotechnic mixture as set forth in claim 1 wherein said molecular emitter is copper dust.

4. A consumable pyrotechnic mixture consisting of about 74.2% by weight, of ammonium perchlorate about 11.1% by weight, of stearic acid, about 3.6% by weight, of paraffin, and about 11.1% by weight, of copper dust.

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LEON D. ROSDOL, *Primary Examiner.*

B. R. PADGETT, *Assistant Examiner.*

United States Patent Office 3,258,373 Patented June 28, 1966

3,258,373

PLASTIC PYROTECHNIC COMPOSITIONS CONTAINING STRONTIUM PERCHLORATE AND ACRYLIC POLYMER

Bernard E. Douda, Bloomfield, Ind., assignor to the United States of America as represented by the Secretary of the Navy

No Drawing. Filed July 9, 1964, Ser. No. 381,592
6 Claims. (Cl. 149—19)

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

The present invention relates to plastic pyrotechnic compositions and more particularly to plastic pyrotechnic composition that are pour castable and upon solidification form pyrotechnics that are long burning.

Heretofore, one method of manufacturing pyrotechnic articles consisted of filling a hollow tube or container with a combustible mixture in powder form and then subjecting the mixture to a very high pressure. The resulting product has a density depending upon various conditions such as the type of mixture and the amount and duration of the pressure applied. Such pyrotechnic articles show wide variations in their rate of combustion.

In order to overcome the disadvantages of compacted pyrotechnic articles, recent developments in the pyrotechnic art has produced various plastic type compounds that can be cast or molded. One such plastic compound is described in U.S. Patent 2,984,558, which issued May 16, 1961, to Edward Rolle and John Q. Tabor. This patented compound is essentially a mixture of unsaturated polyester resins to which is added a stabilizing ingredient, oxidizers, and a fuel.

In the present invention strontium perchlorate is added to an acrylic monomer. The portion of the strontium perchlorate that dissolves in the acrylic monomer acts as an activator to prepolymerize the acrylic monomer. The undissolved strontium perchlorate remains suspended in solid form in the prepolymerized acrylic monomer. Various fuels, oxidizing agents, and coloring agents are next added to the partially polymerized monomer, and a catalyst is then added to facilitate complete polymerization.

It is therefore a general object of the present invention to provide an improved pyrotechnic material which may be readily cast or molded.

Another object of the present invention is to provide a pyrotechnic material which has an essentially constant rate of burning.

A further object of the present invention is to provide a long burning colored flare that can be readily manufactured.

Other objects and advantages of the present invention will be readily appreciated as the same becomes better understood by reference to the following description.

It has been found that strontium perchlorate will dissolve in acrylic monomers, such as the esters of acrylic and methacrylic acids. At room temperature, about 18 parts of anhydrous strontium perchlorate will dissolve in 100 parts of methyl methacrylate monomer. It has been discovered, however, that the degree of solubility is related to the amount of moisture contained in the oxidant. Maximum solubility occurs when about 2.2 percent of moisture is present in the oxidant. Upon mixing the desired amount of oxidant with the acrylic monomer, prepolymer is readily formed, accompanied by heat evolution. This results in an increase in viscosity of the mixture. This reaction occurs without the need of an organic catalyst, and if the process is not regulated as to the degree of solubility and temperature, a hard polymeric mass will be formed. From a production standpoint, this prepolymerization feature is an asset for because of the increase in density and viscosity of the monomer other insoluble ingredients will remain suspended in the viscous blended mass without appreciable settling prior to polymerization.

The strontium perchlorate acts both as an activator and a catalyst in that small amounts of strontium perchlorate when added to an acrylic monomer, will shorten the induction time normally required to polymerize the monomer, and also the temperature required to polymerize the monomer is less. When the strontium perchlorate dissolves in the monomer, there is provided a solution which serves both as a fuel and an oxidizing agent.

The following examples are illustrative of the invention. In each of the examples, the monomer used was methyl methacrylate that was inhibited with 25 p.p.m. hydroquinone, however, it should be understood, of course, that other esters of acrylic acid and methacrylic acid will work equally as well.

Example I

50 ml. of methyl methacrylate monomer
165 gms. of strontium perchlorate
3 drops of cumene hydroperoxide

The ratio, by weight, of monomer to strontium perchlorate is about 1 to 3.5. The mixture was heated in an oven for 12 hours at a temperature of 75 degrees C. A candle was prepared in a fish paper tube having an inside diameter of 1.76 inches, and a two-inch candle burned for 30 seconds. The flame was about 24 inches high and very bright red in color. A white smoke was produced and there was almost no ash.

Example II

45 ml. of methyl methacrylate monomer
35 gms. of strontium perchlorate
30 gms. of magnesium (atomized)
45 gms. of anhydrous strontium oxalate
10 gms. of anhydrous strontium chloride
¼ drop of Lupersol DDM (a solution of 60% methylethylketone peroxide in dimethylphthalate)

The ratio, by weight, of monomer to strontium perchlorate is 1 to 0.83. The mixture was heated in an oven for 24 hours at a temperature of 75 degrees C. A candle was prepared as in Example I, and the burning time was 95 seconds. The flame was about 12 inches high and very bright red in color. The magnesium was used as a fuel; the strontium chloride as a coloring agent; and the strontium oxalate as a coloring agent and burning time regulator.

Example III

50 ml. of methyl methacrylate monomer
50 gms. of strontium perchlorate
50 gms. of magnesium (atomized)
20 drops of Lupersol DDM

The ratio, by weight, of monomer to strontium perchlorate is about 1 to 1.08. The mixture was heated in an oven for 24 hours at a temperature of 75 degrees C. A candle was prepared as in Example I, and the burning time was 60 seconds. The flame was between 12 and 18 inches high and was a very bright red. A white smoke was produced.

Example IV

50 ml. of methyl methacrylate monomer
50 gms. of strontium perchlorate
50 gms. of magnesium (atomized)
30 gms. of strontium carbonate
6 drops of Lupersol DDM

The ratio, by weight, of monomer to strantium perchlorate was about 1 to 1.08. The mixture was heated in an over for 24 hours at a temperature of 75 degrees C. A candle was prepared as in Example 1 and the burning time was 35 seconds. The flame was between 12 and 18 inches high and was a very bright red. A white smoke was produced.

Example V

50 ml. of methyl methacrylate monomer
10 gms. of strontium perchlorate
50 gms. of magnesium (atomized)
40 gms. of strontium nitrate
30 drops of Lupersol DDM

The ratio, by weight, of monomer to strontium perchlorate was about 1 to 0.21. The mixture was heated in an oven for 24 hours at a temperature of 75 degrees C. A candle was prepared as in Example I, and the burning time was 22 seconds. The flame was between 12 and 18 inches high and was a very bright red. A white smoke was produced.

Example VI

47 ml. of methyl methacrylate monomer
75 gms. of strontium perchlorate
30 gms. of magnesium (atomized)
15 gms. of aluminum (atomized)
3 drops of Lupersol DDM

The ratio, by weight, of monomer to strontium perchlorate was about 1 to 1.7. The mixture was heated in an oven for 24 hours at a temperature of 55 degrees C. A candle was prepared as in Example I and the burning time was 125 seconds. The flame was about 12 inches high and was a very bright red. A white smoke was produced.

Example VII

50 ml. of methyl methacrylate monomer
83.7 gms. of strontium perchlorate
52.3 gms. of magnesium (atomized)
3 drops Lupersol DDM

The ratio, by weight, of monomer to strontium perchlorate was about 1 to 1.79. The mixture was heated in an oven for 24 hours at a temperature of 55 degrees C. A candle was prepared as in Example I and the burning time was 110 seconds. The flame was about 12 inches high and was a very bright red. A white smoke was produced.

Example VIII

28 ml. of methyl methacrylate monomer
14 ml. of styrene monomer
90 gms. of strontium perchlorate
5 gms. of magnesium (atomized)
30 gms. of glycine
3 drops of cumene hydroperoxide

The mixture was heated in an oven for 17 hours at a temperature of 75 degrees C. A candle was prepared as in Example I, and the burning time was 155 seconds. A red flame between 6 and 8 inches high was produced and white smoke was produced. The addition of the styrene monomer greatly increases the pot life of the mixture. Glycine is particularly well suited for use as a pyrotechnic fuel as glycine does not interfere with the production of the colored flame and also as only a minimum amount of oxygen is needed to oxidize the glycine.

Example IX

56 ml. of methyl methacrylate monomer
50 gms. of strontium perchlorate
25 gms. of magnesium (atomized)
45 gms. of sulfur
10 gms. of anhydrous strontium chloride
2 drops of cumene hydroperoxide

The mixture was heated in an oven for 20 hours at 75 degrees C. A candle was made as in Example I and the burning time was 7 minutes.

As can be seen from the foregoing examples, compositions with a high magnesium content burn relatively rapid and are very hot. The addition of sulfur to the mixture increases the burning time, as demonstrated by Example IX. Sulfur is best used in a range of 0.25–0.75 part of sulfur per one part of monomer.

While the foregoing examples list methyl methacrylate as the monomer which is polymerized, strontium perchlorate mixes equally as well when mixed in solution with acrylic acid, methacrylic acid and esters of acrylic acid and methacrylic acid, such as methyl acrylate and ethyl acrylate. Also, while the examples listed above were catalyzed with either cumene hydroperoxide or Lupersol DDM there are many more commonly known catalysts that promote polymerization of acrylic monomers. Included among the known catalysts are diacyl peroxides, ketone peroxides, alkyl hydroperoxides, alkyl peresters, and alkyl acid peresters. Various effects can be obtained by the use of different catalysts and also combination of catalysts can produce effects not readily available with any single catalyst.

In preparation, the acrylic monomer is normally first mixed with the strontium perchlorate and that portion of strontium perchlorate which dissolves in the monomer causes the monomer to partially polymerize. A portion of the strontium perchlorate will dissolve in the acrylic monomer and, at room temperature, about 18 parts of anhydrous strontium perchlorate will dissolve in 100 parts of acrylic monomer. The partial polymerization of the monomer causes an increase in the viscosity of the mixture and the fuel and other ingredients are then added. The increased viscosity of the mixture prevents the fuel and other undissolved ingredients from settling and consequently, a more homogenous product is produced. Pyrotechnic candles that provide adequate candlepower when burned, and also, that have a long burning time, have been prepared by maintaining a ratio of between 1 and 3.3 parts, by weight, of strontium perchlorate to one part, by weight, of acrylic monomer.

The ratio of fuel to monomer is also critical for military applications in that too small an amount of fuel will result in low average candlepower, while too large an amount of fuel will cause very rapid burning and consequently, too short a burning time. For one red flare, for example, a military specification requires a minimum average candlepower of 20,000 and a minimum burning time of 23 seconds. In order to meet both of these requirements, the ratio of fuel to monomer should be between about 0.2 and 2.0 parts of fuel to one part of acrylic monomer.

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 consumable pyrotechnic composition comprising: one part, by weight, of an acrylic polymer, and between one and 3.3 parts, by weight, of strontium perchlorate.

2. A consumable pyrotechnic composition as set forth in claim 1 having uniformly dispersed therein in a finely divided form between 0.2 and 2.0 parts, by weight, of magnesium.

3. A consumable pyrotechnic composition as set forth in claim 1 having uniformly dispersed therein in a finely divided form between 0.2 and 2.0 parts, by weight, of aluminum.

4. A consumable pyrotechnic composition as set forth in claim 1 having uniformly dispersed therein in a finely divided form between 0.2 and 2.0 parts, by weight, of magnesium and between 0.25 and 0.75 part, by weight, of sulfur.

5. A consumable pyrotechnic composition as set forth in claim 1 having uniformly dispersed therein in a finely divided form between 0.2 and 2.0 parts, by weight, of magnesium and between 0.25 and 0.75 part, by weight, of glycine.

6. A consumable pyrotechnic composition comprising:

one part, by weight, of polymer consisting of two-thirds methyl methacrylate and one-third styrene,

between one and 3.3 parts, by weight, of strontium perchlorate, and

between 0.2 and 2.0 parts, by weight, of a fuel selected from the group consisting of aluminum and magnesium.

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Aug. 10, 1965 S. M. FASIG ETAL 3,199,453

SUBMARINE SIGNAL FUZE

Filed Feb. 10, 1964 3 Sheets-Sheet 1

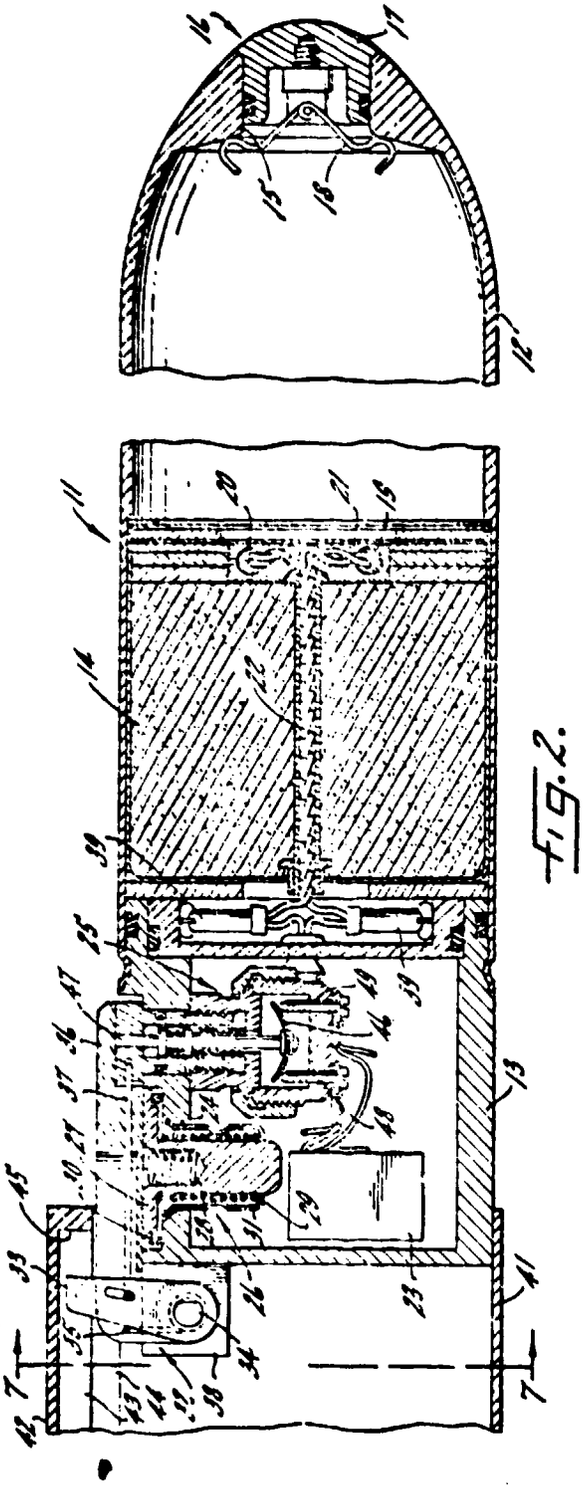

FIG. 2.

FIG. 1.

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SUBMARINE SIGNAL FUZE

Filed Feb. [illegible] 1964 3 Sheets-Sheet 2

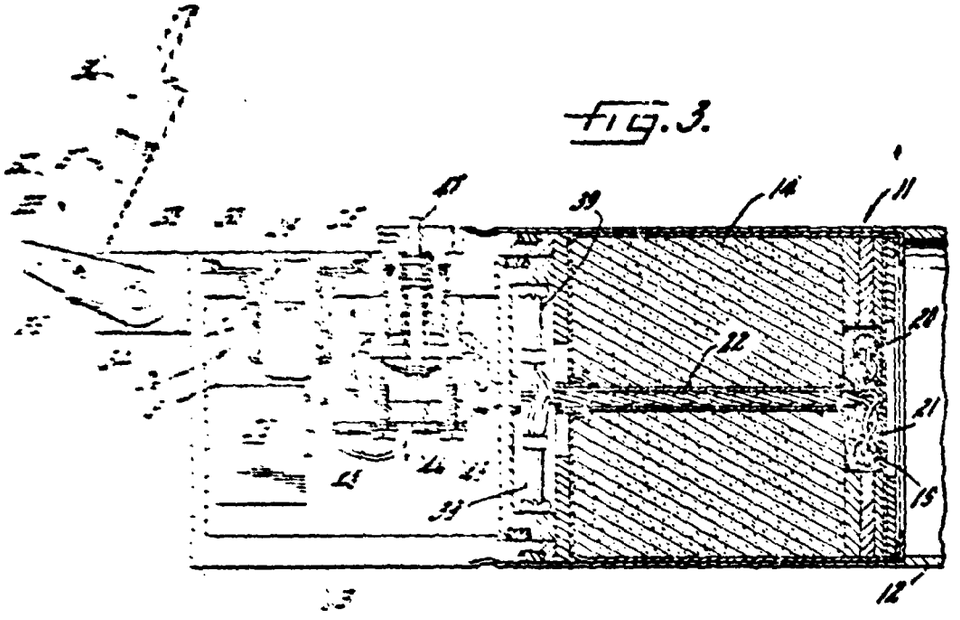

Fig. 3.

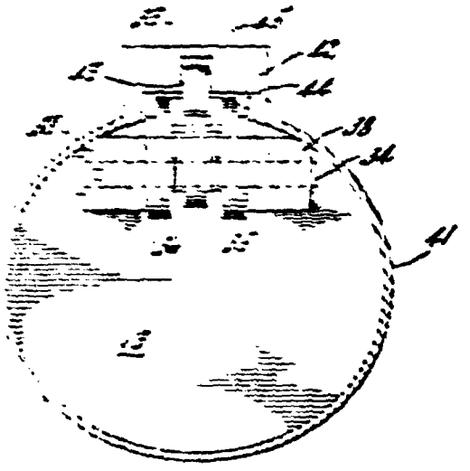

Fig. 7.

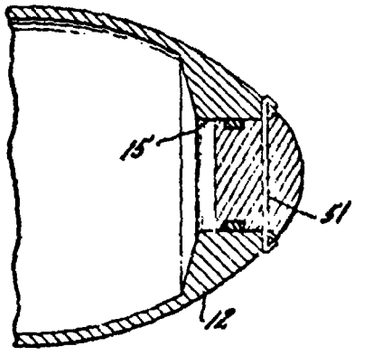

Fig. 6.

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SUBMARINE SIGNAL FUZE

Filed Feb. 10, 1964 3 Sheets-Sheet 3

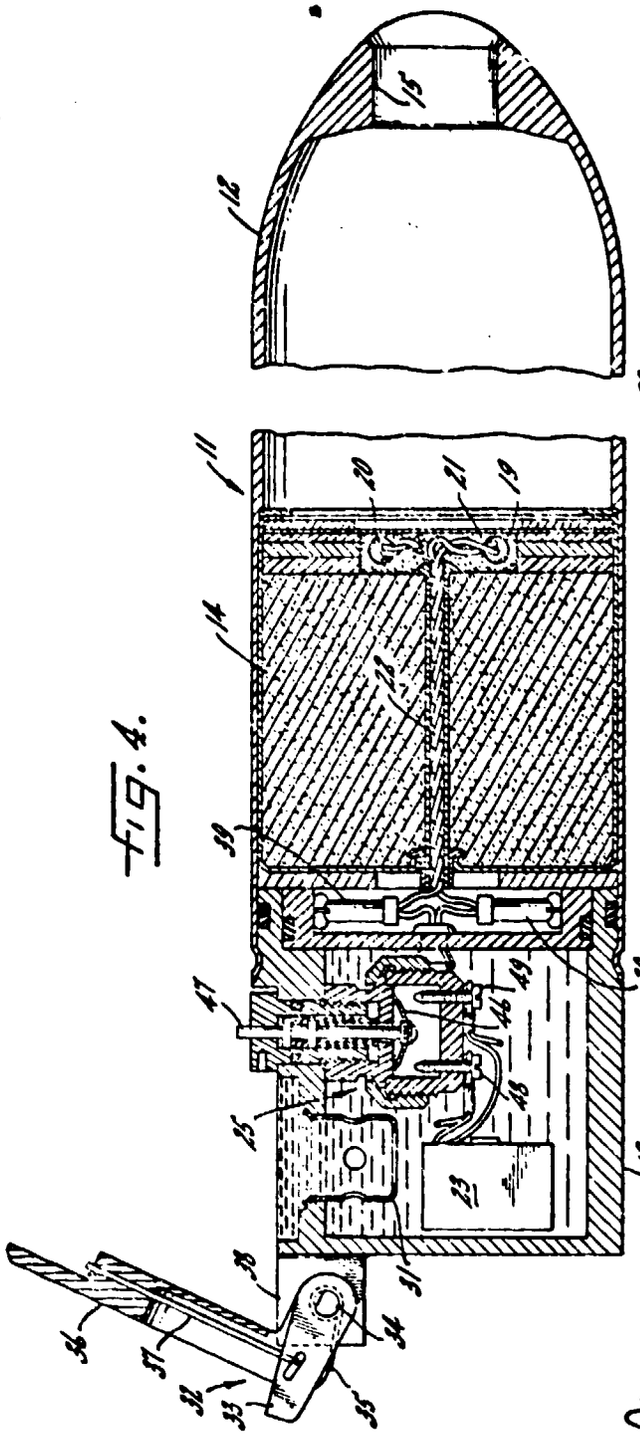

FIG. 4.

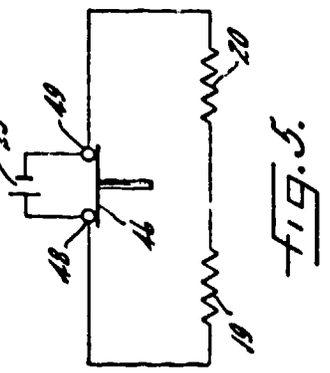

FIG. 5.

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United States Patent Office 3,199,453 Patented Aug. 10, 1965

1

3,199,453

SUBMARINE SIGNAL FUZE

Stanley M. Fasig, Bloomington, Ind., and Glenn C. Johnson, Hyattsville, Md., assignors to the United States of America, as represented by the Secretary of the Navy

Filed Feb. 10, 1954, Ser. No. 343,901
1 Claim. (Cl. 102—7)
(Granted under Title 35, U.S. Code (1952), sec. 265)

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

The present invention relates to a submarine signalling device and more particularly to a signalling device containing a pyrotechnic composition and which is launched from a submerged submarine.

Submarines have used pyrotechnic signals as a means of providing a mark on the ocean surface in order to show the relative position of the submarine to surface ships. Heretofore, most signal devices have been provided with a fixed time delay which permits the signal to rise to the surface before the pyrotechnic is ignited. However with the advent of nuclear submarines, which can operate faster and at greater depths, the fixed time delay device is no longer adequate as the submarine may travel a great distance between the time of launch and the time of ignition of the pyrotechnic device.

In order to overcome the disadvantages of the fixed time delay type device, devices have been provided that operate by pressure and are actuated upon reaching a predetermined depth. One such device is shown in United States Patent 3,048,112 which issued August 7, 1962, to Baker et al. This patent shows an arming and firing mechanism which operates through progressive steps and is actuated by changing pressure of the water medium through which it is launched. A relatively high hydraulic pressure is first used to align a portion of a firing pin and then a low pressure is used to actuate another portion of the firing pin which then strikes that portion which was placed in alignment. While this patent does provide the desired function, that is, the pyrotechnic is ignited upon the signal fuze reaching the surface, nevertheless the complicated mechanism is expensive to build and the complicated mechanism can result in malfunctioning.

The present invention functionally operates similar to the Baker et al. device in that the pyrotechnic composition is not ignited until the signal reaches the surface of the water. A sea water battery is provided and, upon the signal reaching the surface, a valve permits the battery compartment to be flooded and the sea water, acting as an electrolyte, energizes the battery plates. Various safety devices are provided to insure that the pyrotechnic composition is not ignited prior to the signal reaching the surface.

It is therefore, a general object of the present invention to provide an improved submarine signal fuze that can be launched from various depths but will not be ignited until the signal fuze reaches the surface.

Another object of the present invention is to provide a submarine signal fuze that is actuated upon a compartment being flooded whereupon sea water energizes a battery.

Other objects and advantages of the present invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

FIGURE 1 is a top plan view showing a preferred embodiment of the present invention;

FIGURE 2 is a partial sectional view of a signal fuze showing the fuze in a launching tube;

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FIGURE 3 is a partial sectional view similar to FIGURE 2 only showing the signal having left the launching tube and being in an armed condition;

FIGURE 4 is a view similar to FIGURE 3 only showing the valve removed and the battery compartment filled with sea water;

FIGURE 5 is a diagrammatic view of a wiring diagram;

FIGURE 6 is a partial sectional view of an alternate nose plug assembly; and

FIGURE 7 is a sectional view taken on line 7—7 of FIGURE 2.

Referring now to the drawings and particularly to FIGURES 1 and 2, there is shown a submarine signal fuze 11 consisting of a projectile shell 12 and a fuze body 13. Shell 12 is attached to fuze body assembly 13 as by crimping, or the two units 12 and 13 may be threadedly attached, as shown in United States Patent 3,048,111. Shell 12 contains a pyrotechnic composition 14 in the end that is attached to fuze body 13 and an aperture 15 is provided on the opposite end of shell 12 to permit the escape of the products of combustion when pyrotechnic composition 14 is ignited. By way of example, a black smoke composition might be comprised of fifteen parts by weight of magnesium, 22 parts by weight of anthracene, and 63 parts by weight of hexachloroethane. Red, yellow, green, and other colored smoke compositions, well-known in the art, might also be employed as the pyrotechnic composition 14. A nose plug assembly 16, which consists of a nose plug 17 and spring means 18, is provided to seal shell 12 during its travel through the water. A pair of electric squibs 19 and 20 are provided near the top surface of the pyrotechnic composition 14, and a first fire composition 21 is provided around these squibs to facilitate ignition. By way of example, a first fire composition might be comprised of six parts by weight of lead-peroxide, eight parts by weight of silicon powder, and six parts by weight of cupric oxide. Wires 22 connect squibs 19 and 20 to a sea water battery 23 through means of connectors 39 and a shunting switch assembly 25. By way of example, battery 23 might be of a single cell construction with the negative plate being of magnesium and the positive plate being comprised of a film of silver chloride on a silver plate. Fuze body 13 which contains the sea water battery 23 is provided with an aperture 24 which is maintained closed during travel through the water by means of a valve assembly 26.

Valve assembly 26 consists of a valve 27, an outer spring 28, an inner valve spring 29, an "O" ring 30, and a spring retainer 31. Spring retainer 31 is attached to a chamfered portion of aperture 24 and the stem of valve 27 protrudes through retainer 31. The inner valve spring 29 is retained by retainer 31 and tends to bias valve 27 outwardly so that aperture 24 will be open. However, as will be explained later, valve 27 is maintained seated at launch, and after launch, the sea pressure acting against the valve head maintains the aperture 24 closed until the force exerted by spring 29 exceeds the force of the sea. "O" ring 30 is provided to facilitate a water-tight seal between the valve head and its seat.

A guide assembly 32 is provided on the outside of the fuze body 13 and consists of a latch 33 that is rotatably supported by a shaft 34. A spring 35 is provided to keep latch 33 biased in a forward position. A guide shoe 35 is also rotatably supported on shaft 34 and when guide shoe 36 is in its down or closed position, it maintains the valve assembly 26 in a position such that no water can enter through aperture 24 into the inner chamber of the fuze body 13. A wire 37 is connected to latch 33 and passes through a hole in guide shoe 36 and into the shunt assembly 25 in order to keep guide shoe 36 in a locked position. A safety pin 40 is provided through shaft 34

and through boss 38 on fuze body 13 in order to prevent any rotation of latch 33 prior to the time that the signal fuze is placed in launching tube 41.

As best shown in FIGURES 2 and 7 of the drawings, launching tube 41 is provided with an enlarged portion 42 that has a narrow slot 43 and a broad slot 44 therein. When signal fuze 11 is placed within launching tube 41, latch 33 extends into the narrow slot 43 and guide shoe 36 extends into broad slot 44. Thus it can be seen that signal fuze 11 is guided during its travel through launching tube 41. Broad slot 44 is continuous throughout the length of launching tube 41, however the narrow slot 43 stops short of the outer end of the launching tube to provide an end portion 45. As latch 33 strikes end portion 45, the force of spring 35 will be overcome and latch 33 will be rotated about shaft 34 to armasignal fuze 11.

Shunt assembly 25 is provided to short the sea water battery 23 prior to the desired time of igniting the pyrotechnic composition 14. A shorting disc 46 is provided on the end of a spring biased shaft 47 and when guide shoe 36 is latched by wire 37 guide shoe 36 maintains the shorting disc 46 in contact with a pair of screws 48 and 49 through which battery 23 is connected and thus disc 46 shorts the battery 23 as long as guide shoe 36 remains latched by wire 37.

Operation

In operation the submarine signal fuze 11 is placed in the launching tube 41 which consists basically of a tube that extends through the hull of a submarine. Once signal fuze 11 has entered the launching tube, the safety pin 40 can be removed however launching tube 41 will prevent the guide shoe from pivoting upwardly and thus aperture 24 will remain closed by valve 27, and battery 23 will remain shorted by disc 46. By way of example, the submarine signal fuze 11 may be expelled by a compulsion firing method in which a quantity of high pressure air is released to the inside of launching tube 41 which drives the signal fuze 11 out the outer end of launching tube 41. As submarine signal fuze 11 reaches the outer end of the launching tube, latch 33 will strike end portion 45 which will cause latch 33 to be pivoted about shaft 34. As best seen in FIGURE 3 of the drawings, this rotation of latch 33 causes wire 37 to be withdrawn from the hole in shunt assembly 25 and guide shoe 36 is then free to be pivoted about shaft 34. The outer spring 28 of valve assembly 26 biases guide shoe 36 outwardly and then the shaft of the shunting assembly is free to be moved upward by its spring, and shorting disc 42 is disengaged from screws 48 and 49. Battery 23 is now no longer shorted. Also the inner spring 29 of valve assembly 26 tends to push valve 27 outwardly, however, the pressure of the sea water against valve 27 will keep valve 27 seated to close aperture 24 until the force of spring 29 exceeds the force of the sea pressure. At this time the submarine signal fuze 11 will be at or near to the surface of the water and will be in a position for ignition. As valve 27 is expelled from its seat by spring 29, sea water enters the inner compartment of the fuze body 13 and the sea water acts as an electrolyte to energize the plates of battery 23. The power from the sea water battery will then ignite or explode the squibs 19 and 20 to ignite the pyrotechnic composition 14. The products of combustion from the pyrotechnic composition 14 will increase the pressure within shell 12 until the force of spring 18 of the nose plug assembly 16 is exceeded whereupon nose plug assembly 16 will be ejected from shell 12 and the smoke from the pyrotechnic composition will then be emitted through aperture 15.

In FIGURE 6 of the drawings there is shown an alternate design for a nose plug assembly. A pin 51 is provided to maintain the nose plug 17 in position until the products of combustion from the pyrotechnic composition 14 are great enough to cause pin 51 to shear. When this happens, the nose plug assembly will then be ejected and the products of combustion can then pass through aperture 15.

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 claim, the invention may be practiced otherwise than as specifically described.

What is claimed is:

A submarine signalling device adapted to be launched in a body of sea water beneath the surface thereof comprising;

a fuze body having an inner chamber therein,

a projectile shell attached to said fuze body and containing a pyrotechnic composition therein,

a pair of electrical squibs adjacent said pyrotechnic composition for igniting said pyrotechnic composition when said squibs are energized,

a sea water battery positioned in said inner chamber of said fuze body and connected through first and second terminals to said squibs,

valve means in said fuze body normally sealing said inner chamber of said fuze body from said body of sea water,

a shaft slidably attached to said fuze body and having a shorting disc engageable with said first and second terminals,

means connected to said shaft normally biasing said shorting disc away from said first and second terminals,

a guide shoe assembly pivotally connected on the outside of said fuze body engaging said valve means and said shaft thereby locking said valve means in a closed position and maintaining said shorting disc in engagement with said first and second terminals until said signalling device is launched in a body of sea water, and

means operatively connected to said valve means for actuating said valve means when the pressure applied to said valve means by said body of water has been reduced to a predetermined value thereby permitting the entrance of sea water into said inner chamber whereby said sea water serves as an electrolyte for said battery.

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July 27, 1965 S. M. FASIG ETAL 3,196,789

SUBMARINE SIGNAL FUZE

Filed Feb. 10, 1964 3 Sheets-Sheet 1

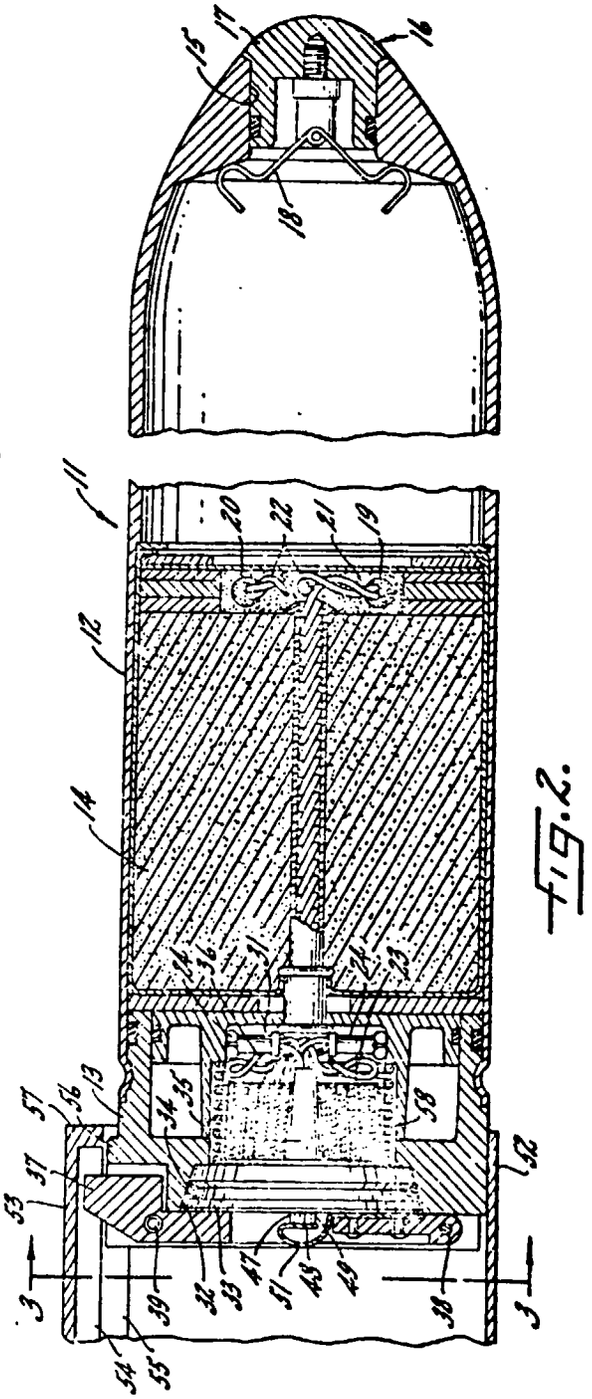

FIG. 2.

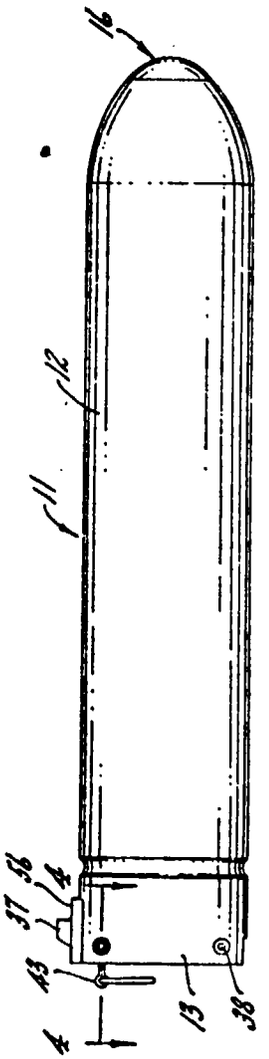

FIG. 1.

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SUBMARINE SIGNAL PULS

Filed Feb. 10, 1964

3 Sheets-Sheet 2

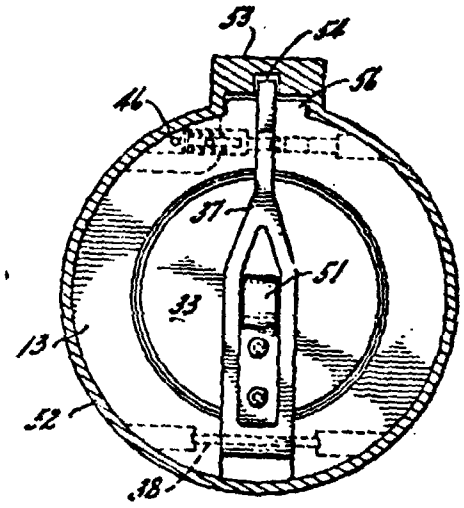

Fig. 3.

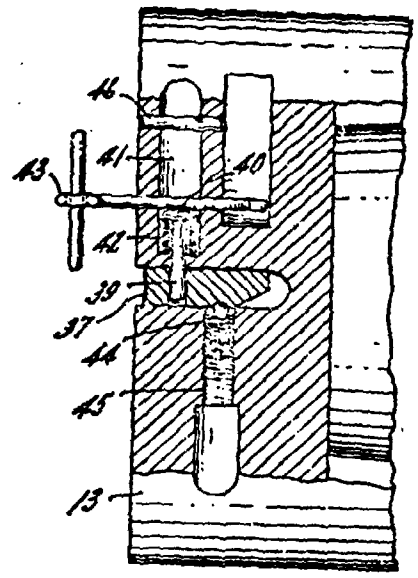

Fig. 4.

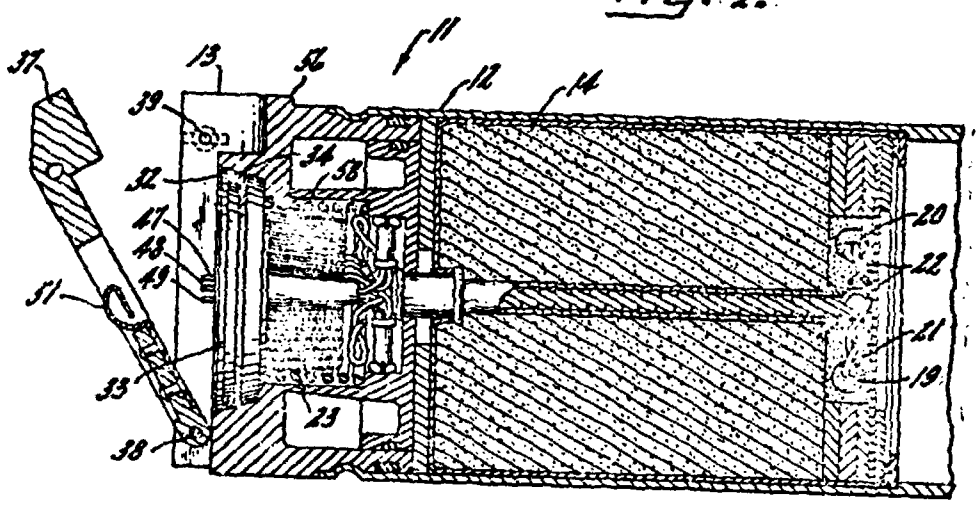

Fig. 5.

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SUBMARINE SIGNAL FUZE

Filed Feb. 10, 1964 3 Sheets-Sheet 3

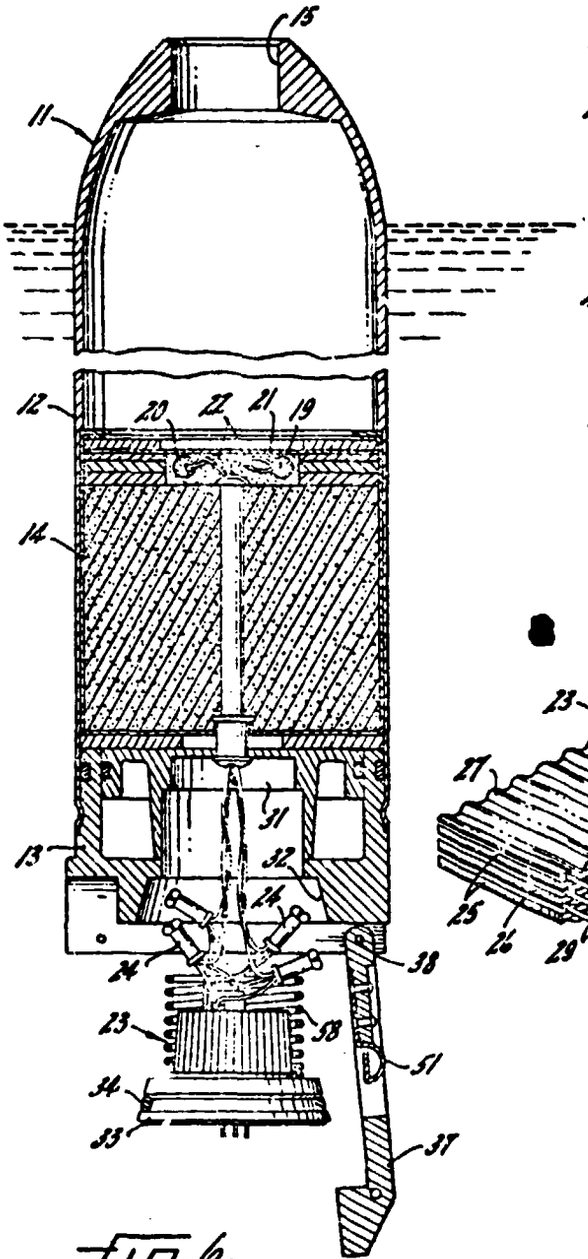

Fig. 6.

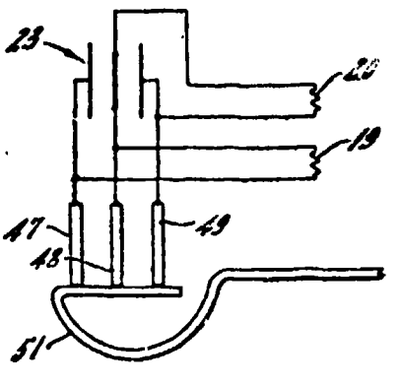

Fig. 7.

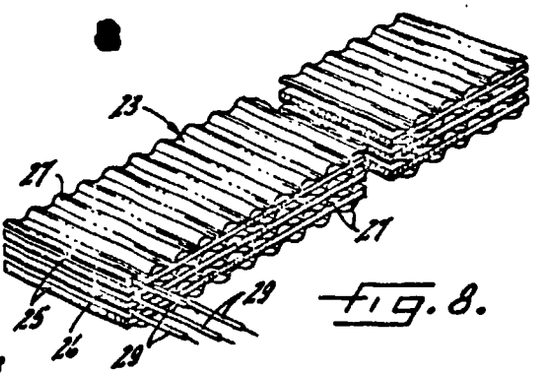

Fig. 8.

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3,196,789

SUBMARINE SIGNAL FUZE

Stanley M. Fasig, Bloomington, Ind., and Glenn C. Johnson, Hyattsville, Md., assignors to the United States of America as represented by the Secretary of the Navy

Filed Feb. 10, 1964, Ser. No. 343,903
1 Claim. (Cl. 102—7)
(Granted under Title 35, U.S. Code (1952), sec. 266)

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

The present invention relates to a submarine signalling device and more particularly to a signalling device containing a pyrotechnic composition and which is launched from a submerged submarine whereupon the pyrotechnic composition is ignited when the signalling device reaches the surface.

Submarines have used pyrotechnic signals as a means of providing a mark on the ocean surface in order to show the relative position of the submarine to surface ships. Heretofore, most signal devices have been provided with a fixed time delay which permits the signal to rise to the surface before the pyrotechnic is ignited. However with the advent of nuclear submarines, which can operate faster and at greater depths, the fixed time delay device is no longer adequate as the submarine may travel a great distance between the time of launch and the time of ignition of the pyrotechnic device.

In order to overcome the disadvantages of the fixed time delay type device, devices have been provided that operate by pressure and are actuated upon reaching a predetermined depth. One such device is shown in United States Patent 3,048,111 which issued August 7, 1962 to Baker et al. This patent shows an arming and firing mechanism which operates through progressive steps and is actuated by changing pressure of the water medium through which it is launched. A relatively high hydraulic pressure is first used to align a portion of a firing pin and then a low pressure is used to actuate another portion of the firing pin which then strikes that portion which was placed in alignment.

While this patent does provide the desired function, that is, the pyrotechnic is ignited upon the signal fuze reaching the surface, nevertheless the complicated mechanism is expensive to build and the complicated mechanism can result in malfunctioning.

The present invention functionally operates similar to the Baker et al. device in that the pyrotechnic composition is not ignited until the signal reaches the surface of the water. A sea water battery is provided and, upon the signal reaching the surface, the battery is ejected into the sea and the water, acting as an electrolyte, energizes the battery plates. Various safety devices are provided to insure that the pyrotechnic composition is not ignited prior to the signal reaching the surface.

It is therefore, a general object of the present invention to provide an improved submarine signal fuze that can be launched from various depths but will not be ignited until the signal fuze reaches the surface.

Another object of the present invention is to provide a submarine signal fuze that is actuated upon a battery being ejected into the sea whereupon sea water energizes the battery.

Other objects and advantages of the present invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

FIGURE 1 is a side view showing a preferred embodiment of the present invention;

2

FIGURE 2 is a partial sectional view of a signal fuze showing the fuze in a launching tube;

FIGURE 3 is a sectional view taken on line 3—3 of FIGURE 2;

FIGURE 4 is an enlarged sectional view taken on line 4—4 of FIGURE 1;

FIGURE 5 is a partial sectional view similiar to FIGURE 2 only showing the signal having left the launching tube and being in an armed condition;

FIGURE 6 is a partial sectional view showing the battery ejected into the sea;

FIGURE 7 is a diagrammatic view of a wiring diagram; and

FIGURE 8 is a perspective view showing a battery.

Referring now to the drawings and particularly to FIGURES 1 and 2, there is shown a submarine signal fuze 11 consisting of a projectile shell 12 and a fuze body 13. Shell 12 is attached to fuze body assembly 13 as by crimping, or the two units 12 and 13 may be threadedly attached, as shown in United States Patent 3,048,111. Shell 12 contains a pyrotechnic composition 14 in the end that is attached to fuze body 13 and an aperture 15 is provided on the opposite end of shell 12 to permit the escape of the products of combustion when pyrotechnic composition 14 is ignited. By way of example, a black smoke composition might be comprised of fifteen parts by weight of magnesium, 22 parts by weight of anthracene, and 63 parts by weight of hexachloroethane. Red, yellow, green, and other colored smoke compositions, well-known in the art, might also be employed as the pyrotechnic composition 14. A nose plug assembly 16, which consists of a nose plug 17 and spring means 18, is provided to seal shell 12 during its travel through the water. A pair of electric squibs 19 and 20 are provided near the top surface of the pyrotechnic composition 14, and a first fire composition 21 is provided around these squibs to facilitate ignition. By way of example, a first fire composition might be comprised of six parts by weight of lead peroxide, eight parts by weight of silicon powder, and six parts by weight of cupric oxide. Wires 22 connect squibs 19 and 20 to the lead wires of a sea water battery assembly 23 through connectors 24.

By way of example, battery assembly 23 might be comprised of two positive plates 25 and a negative plate 25, with the plates being separated by a spacer 27, as best shown in FIGURE 8 of the drawings. The negative plate 26 might be of magnesium, the positive plates of silver that have a film of silver chloride thereon, and the spacer might be of plastic, such as polyvinylchloride. The battery lead wires 29 are preferably spot welded to the battery plates and then the portions that are welded are covered by a heavy coat of cement, such as Pliobond which is a proprietary product of Goodyear Tire and Rubber Co., Inc., Akron, Ohio.

Fuze body 13 is provided with an inner chamber 31 and an opening 32 is provided therein. A valve 33 seats in opening 32 and an O ring 34 is positioned on valve 33 to provide a watertight seal. A stem 35 is attached to valve 33 and this stem protrudes within the inner chamber 31, and battery assembly 23 is wrapped around and secured to valve stem 35. Wires 22 that connect battery assembly 23 to squibs 19 and 20 are arranged in reverse folds 36 so that the battery assembly can be ejected into the sea. A tripping lever 37 is pivotally connected to fuze body 13 by means of pin 38 and when lever 37 is locked to fuze body 13, lever 37 will retain valve 33 tightly in opening 32 so that the inner chamber 31 is sealed.

Referring now to FIGURE 4 of the drawings, there is shown a locking pin 39 that engages lever 37 to prevent rotation of lever 37 about pin 38. Locking pin 39, which is provided with a head 40, is positioned in bore 41 and spring 42 will tend to bias locking pin 39 away from and

out of engagement with lever 37. A safety pin 43 is provided to prevent movement of locking pin 39 until it is desired to launch the signal fuze. A detent 44 is provided in bore 45 to engage lever 37 in order to retain lever 37 until it is actuated. By way of example, detent 44 might be a threaded spring plunger manufactured by Vlier Engineering Corporation, Los Angeles, California, and bore 45 would be threaded. A pin 46 is positioned transverse through bore 41 to prevent locking pin 39 from leaving bore 41 in the event that it is desired to relock lever 37 after safety pin 43 has been removed.

Valve 33, which is preferably made of an insulating material such as nylon, is provided with three shorting rods 47, 48, 49 that each extend through both ends of valve 33. A shorting spring 51 is attached, as by riveting, to lever 37 and when lever 37 is in a locked position, as shown in FIGURE 4 of the drawings, shorting spring 51 engages each of the shorting rods 47, 48, and 49. As shown in FIGURES 2 and 7 of the drawings, the leads of battery 23 are connected to squibs 19 and 20 through shorting rods 47, 48, and 49, and when spring 51 is in contact with rods 47, 48, and 49, battery 23 will be shorted.

Operation

In operation, the submarine signal fuze 11 is placed in a launching tube 52 which consists basically of a tube that extends through the hull of a submarine. Launching tube 52 is provided with an enlarged portion 53 that has a narrow slot 54 and a broad slot 55 therein. When signal fuze 11 is placed within launching tube 52, lever 37 extends into the narrow slot 54 and boss 56 on fuze body 13 extends into and is guided by broad slot 55. Broad slot 55 is continuous throughout the length of launching tube 52, but narrow slot 54 stops short of the outer end of launching tube 52 to provide an end portion 57.

Immediately prior to placing signal fuze 11 into the launching tube, safety pin 43 is removed from fuze body 13 and spring 42 moves locking pin 39 out of engagement with lever 37. However, lever 37 is maintained in a stationary position due to detent 44 which is engaged with lever 37. By way of example, signal fuze 11 may be expelled by a compulsion firing method in which a quantity of high pressure air is released to the inside of launching tube 41 which drives signal fuze 11 out the outer end of launching tube 41. As submarine signal fuze 11 reaches the outer end of the launching tube, lever 37 strikes end portion 57 which will cause lever 37 to be rotated about shaft 38. As shorting spring 51 is attached to lever 37, rotation of lever 37 causes spring 51 to pivot away from shorting rods 47, 48, and 49, and thus battery 23 is no longer shorted.

Spring 58, which surrounds battery 23, tends to push valve 33 outwardly, however, the pressure of the sea water against valve 33 will keep valve 33 seated to close opening 32 until the force of spring 58 exceeds the force of the sea pressure. At this time the submarine signal fuze 11 will be at or near to the surface of the water and will be in a position for ignition. As valve 33 is expelled from its seat by the force of spring 58 into the sea, battery 23 is also pulled into the sea, as battery 23 is attached to stem 35 of valve 33, and the sea water acts as an electrolyte to energize battery 23. The power from battery 23 will, in turn, ignite or explode squibs 19 and 20 to ignite the pyrotechnic composition 14. The products of combustion from the pyrotechnic composition 14 will increase the pressure within shell 12 until the force of spring 18 of the nose plug assembly 16 is exceeded whereupon nose plug assembly 16 will be ejected from shell 12 and the smoke from the pyrotechnic composition will then be emitted through aperture 15.

It can thus be seen that the present invention provides an improved submarine signal fuze that can be launched from various depths and upon reaching the surface of the water a battery is ejected into the water whereupon it is energized to ignite a pyrotechnic composition within the signal fuze.

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 claim, the invention may be practiced otherwise than as specifically described.

What is claimed is:

A submarine signaling device adapted to be launched in a body of sea water beneath the surface thereof comprising:

a fuze body having an inner chamber therein,

an opening in one end of said fuze body communicating with said inner chamber,

a valve of insulating material positionable in said opening for sealing said inner chamber from said body of sea water,

a plurality of rods of conducting material extending through said valve,

a projectile shell attached to said fuze body and containing a pyrotechnic composition therein,

at least one squib adjacent said pyrotechnic composition for igniting said pyrotechnic composition,

a sea water battery attached to said valve and positionable within said inner chamber and electrically connected to said squib and said plurality of rods,

a lever pivotally connected on the outside of said fuze body for maintaining said valve means in a closed position until said signaling device is launched in a body of sea water,

spring means of conducting material attached to said lever and engageable with said plurality of rods for shorting said sea water battery until said signaling device is launched,

and spring means within said inner chamber for ejecting said valve means and said battery into said body of water when the pressure applied to said valve means by said body of water has been reduced to a predetermined value.

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Jan. 26, 1965 G. C. JOHNSON 3,167,050

EMERGENCY SIGNALING DEVICE

Filed May 3, 1963 2 Sheets-Sheet 1

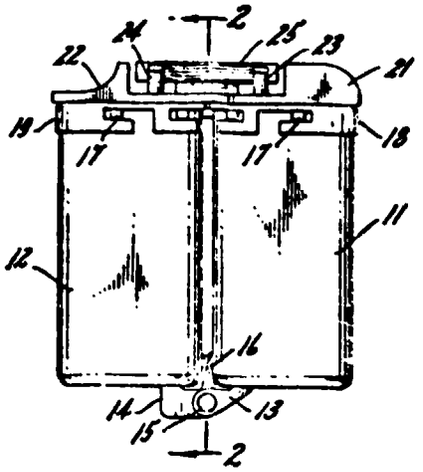

Fig. 1.

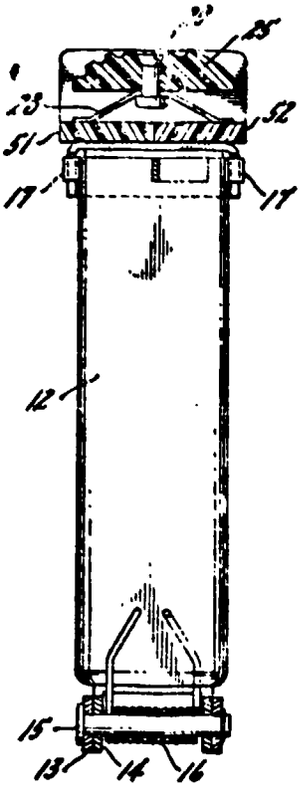

Fig. 2.

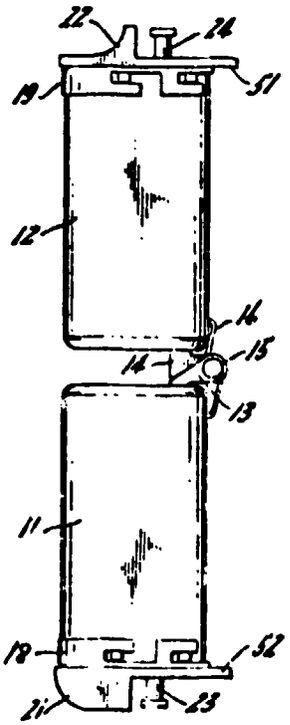

Fig. 5.

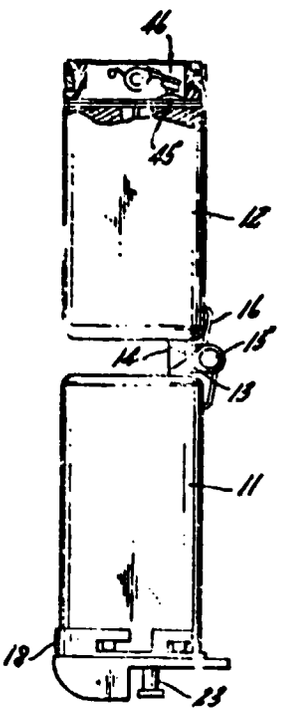

Fig. 6.

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EMERGENCY SIGNALING DEVICE

Filed May 3, 1963 2 Sheets-Sheet 2

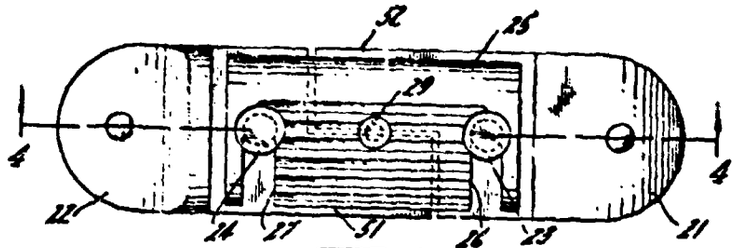

Fig. 3.

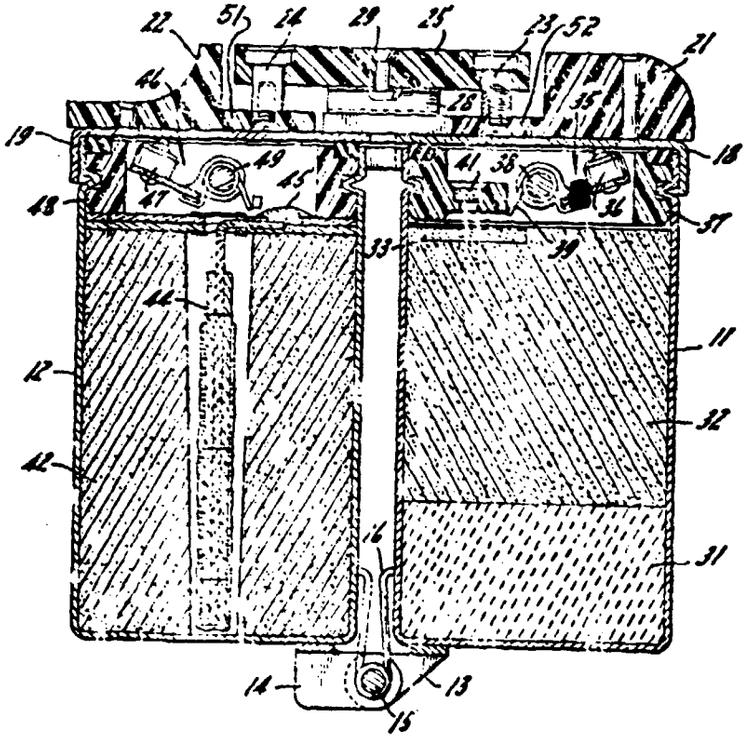

Fig. 4.

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3,167,050
EMERGENCY SIGNALING DEVICE

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3 Claims. (Cl. 116—124)
(Granted under Title 35, U.S. Code (1952), sec. 266)

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

The present invention relates to an emergency signaling device and more particularly to a smoke, signal, or illuminating flare for use by an aircraft pilot in a distress situation.

Emergency life rafts and many crewmen of aircraft are provided with signaling devices for use in emergency situations. A good emergency signal should be compact, be safe to handle and store, and also should be easily ignited as a person who has need for such a device may be injured or handicapped. In addition, it is desirable that the signal provide smoke for use in daylight and provide light for use at night.

Heretofore known signaling devices have had several inherent disadvantages. One main disadvantage is that the signals could not be easily operated, particularly by persons who may have sustained injuries in making emergency landings. Also the combination smoke and flare signals were not readily identified in darkness.

The present invention provides a small, compact, signaling device that can readily be activated by using only one hand. A pair of similar rectangular-shaped containers are pivotally connected together at one end with one container holding a smoke-producing composition and the other container holding a flare composition. A torsion spring is provided to maintain the containers in a side to side relationship. Each unit is initiated by a primer which is fired by a striker assembly similar to that used on a hand grenade. The striker assemblies are each maintained in a cocked position by a cover that is slidably attached to the container. The covers, which are of different configuration in order to identify the particular compositions, are held together by a release button that is spring-biased against a pair of locking pins.

When it is desired to ignite one of the compositions, the release button is first pushed downwardly and then outwardly to disengage the locking pins. The torsion spring will then cause a relative rotation of one hundred-eighty degrees so that the two units will then be in an end to end relationship. The unit to be activated is then identified by the configuration of the cover, and the cover is then removed by pushing the cover sideways, relative to the container. As the cover becomes disengaged, the striker assembly is actuated to ignite a primer which, in turn, ignites the signal producing composition. A short delay of the fuze permits the operator to re-position his hand to the unit that is not being actuated and this unit serves as a handle. The pyrotechnic compositions are designed to burn from 15 to 60 seconds.

It is therefore a general object of the present invention to provide an improved signaling device that can be used either during the day or night.

Another object of the present invention is to provide a combination signaling device that consists of a smoke unit and a flare unit.

Still another object of the present invention is to provide a signaling device that can be operated by using only one hand.

A further object of the present invention is to provide

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a combination signaling device having a smoke unit and a flare unit with one of said units serving as a handle while the other unit is burning.

Other objects and advantages of the present invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

FIGURE 1 is a front view of a signaling device showing a smoke container and a flare container in a locked side to side position;

FIGURE 2 is an enlarged sectional view taken on line 2—2 of FIGURE 1;

FIGURE 3 is an enlarged top view of the signaling device shown in FIGURE 1 of the drawings;

FIGURE 4 is a sectional view taken on line 4—4 of FIGURE 3;

FIGURE 5 is a front view of a signaling device showing a smoke container and a flare container in an end to end position; and

FIGURE 6 is a view similar to FIGURE 5 of the drawing only showing the smoke cover removed and the cover partially broken away to show parts in section.

Referring now to the drawings, and particularly to FIGURES 1–4, there is shown a first container 11 having a flare composition therein and a second container 12 having a smoke composition therein. Containers 11 and 12 are hinged together by means of tabs 13 and 14 and pin 15. Spring 15 is supported around pin 15 and tends to bias containers 11 and 12 in an end to end position, as shown in FIGURES 5 and 6 of the drawings. Containers 11 and 12 are each provided with a pair of lugs 17 on each side, and covers 18 and 19 are slidably engaged with the respective lugs on containers 11 and 12.

Cover 18 has a plate 52 attached thereto which has a rounded end configuration 21, that might also be painted, to indicate that it closes a container having a flare composition, and cover 19 has a plate 51 attached thereto which has a sloping portion 22 to indicate that it closes a container having a smoke composition. Cover 18 is provided with a locking pin 23 that has an enlarged diameter portion and cover 19 has a similar locking pin 24 that also has an enlarged diameter portion. A release button 25 is provided with a pair of slots 26 and 27, as best shown in FIGURE 3 of the drawings, and the ends of these slots are provided with a counterbore that will accommodate the enlarged diameter portions of the locking pins 23 and 24. A spring 28 is attached, as by rivet 29, to the underside of release button 25 to bias release button 25 against the enlarged diameter portions of locking pins 23 and 24.

Container 11 contains a lower layer of fire clay 31 and an upper layer of flare mixture 32. A starter pellet 33 is provided at the upper surface of flare mixture 32. The flare mixture 32 may, for example, be comprised of the following formulation:

	Parts by weight
Magnesium (granulation 16)	6
Strontium nitrate	60
Potassium perchlorate	10
Polyvinyl chloride	15
"Gilsonite" (asphalt) a product of Ziegler Chemical & Mining Corp., Great Neck, New York	10
Linseed oil	3

The strontium nitrate is mixed with the potassium perchlorate and the polyvinyl chloride, and this mixture is blended through a thirty mesh screen three times. The Gilsonite is then added, and the mixture is again blended through a thirty mesh screen three times. Next the linseed oil and magnesium are blended together through a

thirty mesh screen and then the two blends are added together and blended through a thirty mesh screen four times. The resulting flare mixture is then compressed into container 11.

The starter pellet, by way of example, might be comprised of the following formulation:

	Parts by weight
Lead peroxide	6
Cupric oxide	6
Silicon	8

The ingredients are mixed together and then blended four times through a thirty mesh screen. The mixture is then mixed with a suitable binder solution and then compacted into a pellet weighing about 5 grams.

A striker assembly 35 is positioned in container 11 above the flare mixture 32. A striker 36 is rotatably supported in housing 37 by means of shaft 38, and a spring 39, which is supported around shaft 38, provides a bias action to striker 36. A primer 41 is mounted in housing 37 so that it is in position to be struck by striker 36. Striker 36 is maintained in a cocked position by cover 18 which prevents striker 36 from rotating.

Container 12 contains a smoke mixture 42 which, by way of example, might be comprised of the following formulation:

	Parts by weight
Dye, Oil Scarlet 60	10
Dye, golden yellow	3.0
Potassium chlorate	4.4
Sugar	3.2
"Sil-O-Cel" (Thermal Insulation), a produce of Johns-Manville, New York, New York	0.8
Graphite	0.2
Paraffin oil (white, light, domestic)	1.0

Each ingredient is first screened through a sixty mesh screen and then the oil scarlet dye, golden yellow dye, sugar, Sil-O-Cel insulating powder, and graphite are blended three times through a thirty mesh screen. The potassium chlorate is then added and the mixture is again blended three times through a thirty mesh screen. The paraffin oil is next thoroughly blended by hand with the mixture, and the mixture is again blended three times through a thirty mesh screen.

Smoke mixture 42 is compacted in container 12, and a hollow center is provided to accommodate a firecracker fuse 44 which has one end attached to a primer 45. A striker assembly 46, which is similar to striker assembly 35, is positioned in container 12 above the smoke mixture 42. Striker 47, which is rotatably supported in housing 48 by shaft 49, is maintained in a cocked position by cover 19.

In operation, assuming that the smoke composition 42 is to be ignited, the operator first depresses release button 25 so that the enlarged diameter portions of locking pins 23 and 24 clear the top of release button 25. Release button 25 can then be moved sideways with pins 23 and 24 passing through slots 26 and 27, respectively. When release button 25 completely clears pins 23 and 24, spring 16 causes containers 11 and 12 to be relatively rotated to an end to end position, as shown in FIGURE 5 of the drawings. The sloping portion 22 on cover 19 identifies the unit containing the smoke composition 42, and cover 19 is then slidably moved by pushing on either pin 24 or plate 51. When cover 19 has cleared the lugs 17, the spring force of striker assembly 46 will cause cover 19 to flip off of container 12 and striker 47 will then rotate and strike primer 45, which will in turn ignite the fire cracker fuze 44. There will be a few seconds delay before smoke composition 42 will be ignited, and during this delay period the operator can be sliding his hand down to contain 11, which will serve as a holder while smoke composition 42 is burning.

Flare composition 32 can be ignited in a similar manner. After release button 25 has been removed and containers 11 and 12 have rotated to an end to end position, cover 18 can be slidably removed thus allowing striker 36 to be actuated and strike primer 41. Primer 41 will ignite starter pellet 33 which, in turn, will ignite flare mixture 32.

It can thus be seen that the present invention provides a complete smoke producing unit for daytime signaling and a complete light producing unit for night use. The two units are arranged in a side-to-side position for stowage and for carriage by an operator, and can be ignited by a relatively small force by an injured operator acting under adverse conditions.

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. An emergency signaling device comprising,
a first container having an open end and containing a smoke composition,
a second container having an open end and containing a flare composition, said first and second containers being pivotally connected together at the ends opposite said open ends,
a striker assembly mounted in each said container adjacent said open end,
first and second primers positioned one each near the open ends of said first and second containers, respectively, said first primer being adaptable to be ignited upon actuation of said striker assembly in said first container thereby igniting said smoke composition and said second primer being adaptable to be ignited upon actuation of said striker assembly in said second container thereby igniting said flare composition,
first and second covers slidably attached to said first and second containers, respectively, said covers closing said open end and retaining said striker assemblies in cocked position,
first and second locking pins attached, respectively, to said first and second covers,
a release button engageable with said first and second locking pins for locking said covers together, and spring means for biasing said first and second containers in an end-to-end relationship.

2. An emergency signaling device as set forth in claim 1 wherein each said locking pin is provided with an enlarged diameter portion and said release button is spring-biased against said enlarged diameter portions.

3. An emergency signaling device as set forth in claim 1 wherein said first cover is provided with a sloping portion to physically distinguish said first cover from said cover.

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