United States Patent

Heinemann

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[54] EXPLOSIVE INITIATING DEVICES

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[52] **U.S. Cl.** .....**102/28 R,** 102/70

[51] **Int. Cl.**.....**F42b 3/12,** F42b 3/18

[58] **Field of Search** 102/22–24, 27, 102/28, 70, 90

[56] **References Cited**

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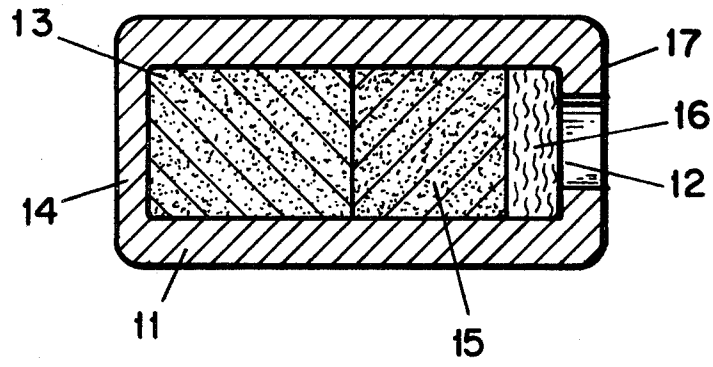
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Primary Examiner—Verlin R. Pendegrass

[57] **ABSTRACT**

Explosive initiating devices constructed to permit a volatile liquid to penetrate into the housing, thereby saturating the explosive to prevent inadvertent initiation of the devices. Subsequent evaporation of the liquid from the explosive, over a predetermined interval of time, arms the devices.

2 Claims, 9 Drawing Figures



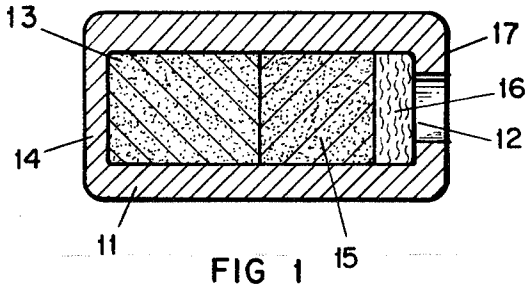


FIG 1

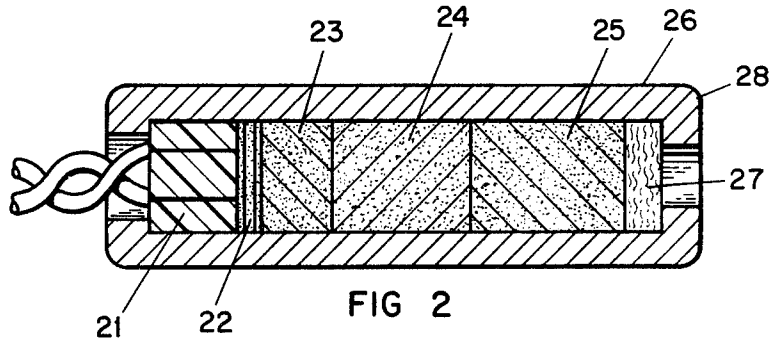


FIG 2

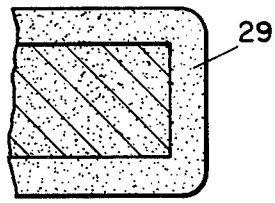


FIG 2A

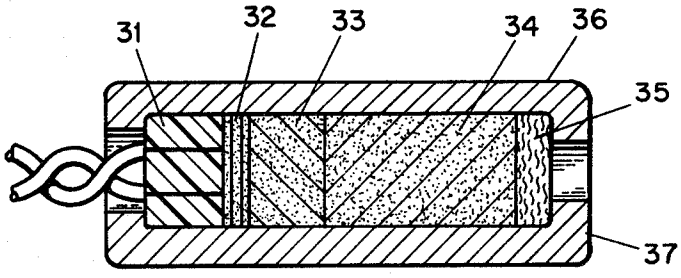


FIG 3

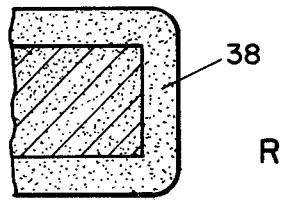


FIG 3A

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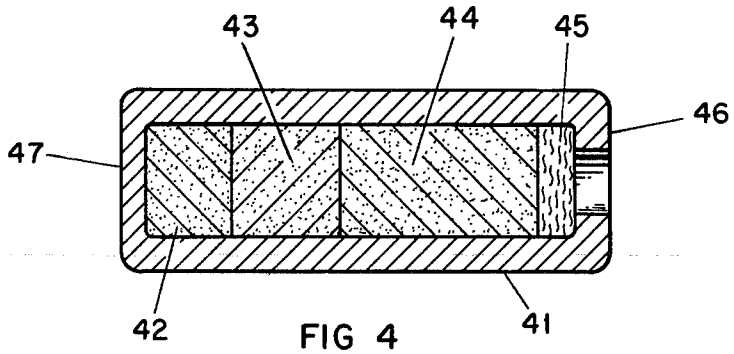


FIG 4

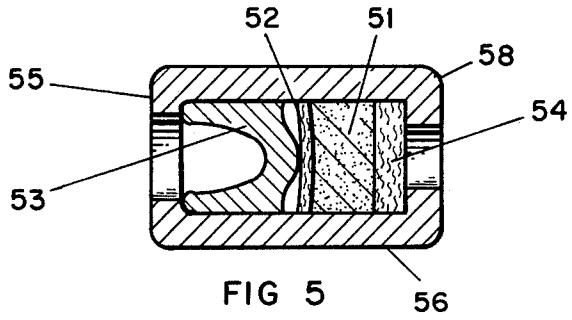


FIG 5

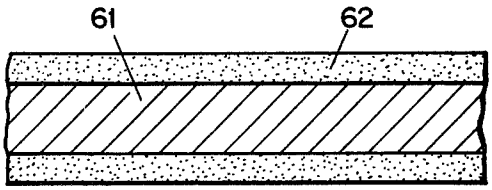


FIG 6

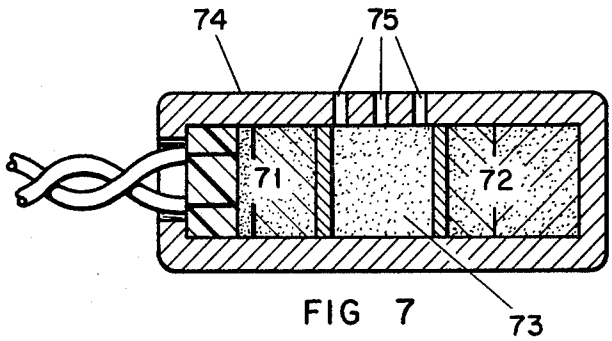


FIG 7

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EXPLOSIVE INITIATING DEVICES

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

Initiators, such as primers, detonators and blasting caps and the like, provide a convenient and reliable method for initiating or starting the reactions usually by the burning of explosives, propellant and pyrotechnic in such devices. Unfortunately, at times such devices function prematurely and cause the loss of life and property. Functioning of such premature nature may be caused by static charges, electromagnetic radiation or human or equipment failure. This is especially true where manual handling of such devices is involved. The major effort, heretofore, to correct for this problem has involved the design of highly insensitive initiators. These are costly, difficult to initiate in the field, and may still be accidentally initiated by human or equipment failure. As such, there has been considerable interest in providing initiators, which are lower in cost, easier to use and provide a greater degree of safety.

Explosive initiating devices made in accordance with this invention permit the introduction of liquids into such devices to prevent them from functioning inadvertently. A porous construction of the outer housing selectively permits the introduction of certain liquids into the initiating mix. The proper selection of the non-reacting volatile liquid permits it to initially desensitize or unarm the initiator. However, upon standing exposed to the air, the device will re-arm after a predetermined time delay, which is a function of the ambient temperature and wind conditions. Porous bulking agents may be incorporated in the chemicals of the initiating mix in order to increase the liquid content and thereby increase the degree of safety in the use of these devices as well as lengthen the arming time.

ABSTRACT OF THE INVENTION

An improved construction of explosive initiating devices, such as blasting caps, primers, detonators, igniters, leads and boosters, to insure safe handling during assembly, storage and transportation. The devices are constructed and arranged to permit a non-reacting, volatile liquid to penetrate into the explosive mix, thereby saturating the mix to prevent initiation thereof. The devices return to the normal, active state upon evaporation of the liquid.

An object of this invention is the provision of explosive initiating devices saturated with a liquid desensitizer, which devices can be handled with a high degree of safety.

An object of this invention is the provision of an initiating material which is capable of functioning a predetermined time period after assembly thereof into an explosive, propellant or pyrotechnic device.

An object of this invention is the provision of a simple, low cost, safe explosive initiating device which can be produced with existing equipment with minimum modification thereof.

The above-stated and other objects and advantages of the invention will become apparent from the following description when taken with the accompanying drawings. It will be understood, however, that the drawings are for purposes of illustration and are not to be construed as defining the scope or limits of the invention, reference being had for the latter purposes to the claims appended hereto.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. 1 is a longitudinal, cross-sectional view of a flash detonator made in accordance with this invention;

FIG. 2 is a similar view of an electric detonator made in accordance with this invention;

FIG. 2A is a fragmentary, cross-sectional view showing a modification of the electric detonator shown in FIG. 2;

FIG. 3 is a longitudinal, cross-sectional view of an electric primer made in accordance with this invention;

FIG. 3A is a fragmentary, cross-sectional view showing a modification of the primer shown in FIG. 3;

FIG. 4 is a longitudinal, cross-sectional view of a stab detonator made in accordance with this invention;

FIG. 5 is a similar view of a percussion primer made in accordance with this invention;

FIG. 6 is a longitudinal, cross-sectional view of a detonating cord made in accordance with this invention; and

FIG. 7 is a longitudinal, cross-sectional view showing a modification of the invention in which a porous material is interposed within the explosive, propellant or pyrotechnic initiating train of the device.

DESCRIPTION OF PREFERRED EMBODIMENTS

Referring now to the drawings, FIG. 1 shows a typical flash detonator or relay modified in accordance with the instant invention and comprising a metal container or cup **11**, which is open at one end **12**. The cup contains the typical high explosive or base charge **13** at the closed end **14** thereof. The composition adjacent to the base charge **13** is the initiating charge **15**. Preventing the initiating charge from contamination and break-up is the porous closing disc **16** held in place by the crimp **17** of the cup **11**. This construction differs from the normal design of such flash detonators or relays in that the open end **12** is usually on the high explosive side and that the closure is non-porous. A bulking agent may be incorporated into the initiating charge **15** in order to provide for additional safety and arming time as will become apparent in the subsequent discussion. This addition of bulking agents to explosives, propellant or pyrotechnic compositions will be applicable to all of the initiators discussed throughout this invention disclosure.

To practice this invention, the initiator is immersed within a specified volatile liquid for a sufficient time period to permit complete saturation of the chemical constituents (a few minutes is usually adequate). The initiator is now effectively inert and safe to handle. It can be kept in the liquid and safely transported as long as the liquid is maintained within the initiator. When required for assembly into the hazardous device or material, the initiator can be removed from the liquid and handled manually for a finite time frame without any hazard to the handler in its use. The finite time frame is a function of the vapor pressure of the liquid used to desensitize the initiator and also a function of ambient temperature conditions. The time frame, permitting safe handling, can be adjusted from a few minutes to hours based upon the liquid selected for ambient environmental conditions.

The arming time and, therefore, the safety of any device is also a function of the size of the opening or percentage of pores, the length of the device, the density of the chemicals, the presence of absorbent materials within the chemicals or between the chemicals.

It is difficult to predict the exact arming time of any initiator without complete information of its construction. The exact arming time would be the time required for the evaporation of the desensitizing volatile liquid after exposure of the wet initiator to the air. In fact, for most initiators, this arming time is best obtained analytically by weighing techniques employing time and temperature as the desired information. In lieu thereof, the arming time may be obtained by functioning attempts after various times of exposure. Since a large number of reactive chemicals may be employed within initiators, these may at times be reactive with some of the liquids which may be employed. Consequently, a check may be required to assure for any one initiator that it is compatible with the particular chemical. Compatibility tests may employ standard vacuum stability tests, or may be checked out by standard storage and subsequent functioning tests.

A list of chemical desensitizers with a temperature use point is given in the following table. The useful range may deviate by ± 20° F.:

Temp.	Chemical Compound
180	n-propanol
160	symmetrical quatrochlorodifluoroethane
120	ethanol
110	methanol
90	1,1,2 trichloro 1,2,2 trifluoroethane
80	symmetrical quatrofluorodibromoethane
50	isopentane
30	trichlorofluoromethane
10	dichlorofluoromethane
0	symmetrical quatrofluorodichloroethane
−40	methyl chloride
−60	dichlorodifluoromethane

The above teaching is directly applicable to the use of the initiators discussed subsequently and shown in FIGS. 2 through 7.

FIG. 2 shows an electric detonator or blasting cap with the plug 21, a spot charge 22, followed by the igniter charge 23, the intermediate charge 24, the base charge 25 and the porous closing disc 27 held in place by a crimp 28. An alternate construction includes the use of a porous cup or body 29, as shown in FIG. 2A, to replace the body 26. In addition, the plug 21 may be composed of a porous material or may have holes formed through the longitudinal section to permit the desensitizing liquid to enter and the vapors to exit.

FIG. 3 shows the design of an electric primer or igniter. The plug 31, spot charge 32, flash or igniter charge 33 and base igniter charge 34 is followed by a porous closure disc 35, which is held within the body or cup 36 by a crimp 37. Alternately to the closing disc, the cup may be composed of a porous material 38, as shown in FIG. 3A, and, similarly, the closing plug may be porous or contain holes through the longitudinal section to permit the desensitizing liquid to enter and the vapors to exit.

FIG. 4 shows the typical design of a stab detonator. The body or cup 41 is loaded in turn with a stab sensitive explosive mixture 42, an intermediate charge 43 and a base charge 44, closed off with a porous closing disc 45, which is secured in place by a crimp 46. In an alternate design, the coined bottom of the cup 47 at the stab sensitive end could be replaced by a thin porous closing disc. Similarly, in still another design, the body or cup 41 could be replaced by one made of porous material.

FIG. 5 shows the typical design for a percussion primer. The igniter charge 51 is contained within the primer by the liner 52 and anvil 53 on one side and the porous closing disc 54, which is secured by a crimp 55. At the opposite end of the primer the anvil 53 is secured by another crimp 58. In lieu of using the porous closing disc 54 as the opening to the atmosphere, the body 56 may be constructed of a porous material.

FIG. 6 shows the typical design of a section of a lead, booster or detonating cord. It is composed of an explosive core 61, which may contain a porous bulking agent. The core is covered by a covering material 62, which is porous to the selected liquids, but not porous to water.

FIG. 7 shows the typical design of devices in which safety is obtained by separating explosive, pyrotechnic or propellant train components by a small space containing a porous, low density bulking material. When such devices are immersed in the liquids, previously discussed, the low density bulking material absorbs such liquids and acts as a barrier, while wet, to stifle the propagation (burning) within the train. Thus FIG. 7 shows an electric primer 71, separated from a flash detonator 72 by a space, which acts as an interrupter 73. The assembly is held within a housing or sleeve 74. A space 73 is provided between the electric primer 71 and the flash detonator 72. This space 73 contains an absorbent material and in combination forms the interrupter when it is wet with the proper liquid. This space is either exposed to the atmosphere through holes 75, within the section, or through the use of porous tubing composing the housing 74.

There are circumstances where it is desired to maintain the initiators in conditions of relative inertness to permit long term safe storage, handling or transportation. The present invention permits this to be accomplished through the incorporation of non-volatile desensitizers such as mineral oil, higher molecular aliphatic hydrocarbons and molten waxes. The incorporation is accomplished by immersing the initiators in the non-volatile desensitizers. The non-volatile desensitizer permeates into the chemical constituent of the initiators and desensitizes them. Since the desensitizer is non-volatile, the initiators so treated can be safely stored, transported or handled for long time frames. The initiators will not function while they incorporate the non-volatile desensitizer. When it is desired to utilize the initiators, the latter are placed into a volatile fluid, which extracts the non-volatile desensitizer and, upon evaporation of the volatile desensitizer, arms the initiator, permitting it to perform its normal function.

Porous closure discs usable for this application may be fabricated from filter paper, microporous plastics, cloths, porous sintered metals and pressed porous materials. The microporous plastics can be made to permit the selective passage of organic liquids but not water and thereby provide for waterproofing.

The absorbent or bulking agent incorporated within the chemicals of the initiators may be of a wide variety of materials ranging from low density silicon dioxide or calcium silicates to diatomaceous earths or organic fibers. Similar materials may be used for the absorbent material within the space 73 interrupter shown in FIG. 7. In addition, a large variety of absorbent materials, such as shredded synthetic or natural fibers may be utilized.

In an alternate construction for longer term "safe" storage with a minimum of surveillance, it is possible to incorporate within the absorbent or bulking agent, any one of the available large variety of oils and waxes as examples. These can be extracted prior to use with volatile aliphatic hydrocarbons to permit proper use.

Having now described the invention, which I desire to protect by Letters Patent of the United States as set forth in the following claims.

1. In an explosive device, having chemical constituents, the improvement comprising in combination a non-reacting, non-aqueous, volatile liquid and a housing which is selectably porous to said liquid, but impervious to water, said liquid being able to migrate through said explosive device, the arrangement being such that said device is initially prevented from arming but, after a time delay, during which said liquid fully evaporates through said housing, said device is finally armed.

2. An explosive device comprising, in combination,

a. a porous housing,

b. a plurality of sealed segments within said housing, each segment containing chemicals required to properly function said explosive device, and

c. a low density absorbent material interposed between said segments said porous housing having the ability to absorb a non-reacting volatile liquid, the arrangement being such that said explosive device is disarmed until said absorbed volatile liquid evaporates over a predetermined time.

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