

[54] **LASSER STIMULATED ORDNANCE
INITIATION DEVICE**

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[73] Assignee: The United States of America as
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Navy

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[58] Field of Search: 149/92; 102/70.2, 28, 70.2 A,
102/46

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[57] **ABSTRACT**

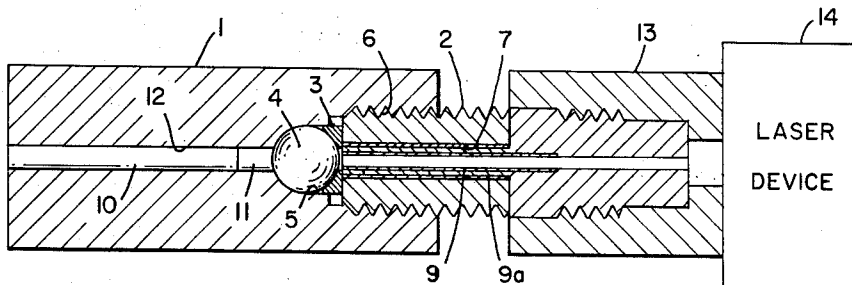
A device for generating a high order detonation by using fiber optics and a spherical glass focusing head to distribute the initiating light pulse and a low energy laser to initiate the explosive material. Potassium Hexanitro Diphenylamine (KHND), a secondary explosive, is initiated by the device to a low order detonation which in turn sets off Pentaerythritol Tetranitrate (PETN), another secondary explosive material, to give a high order detonation.

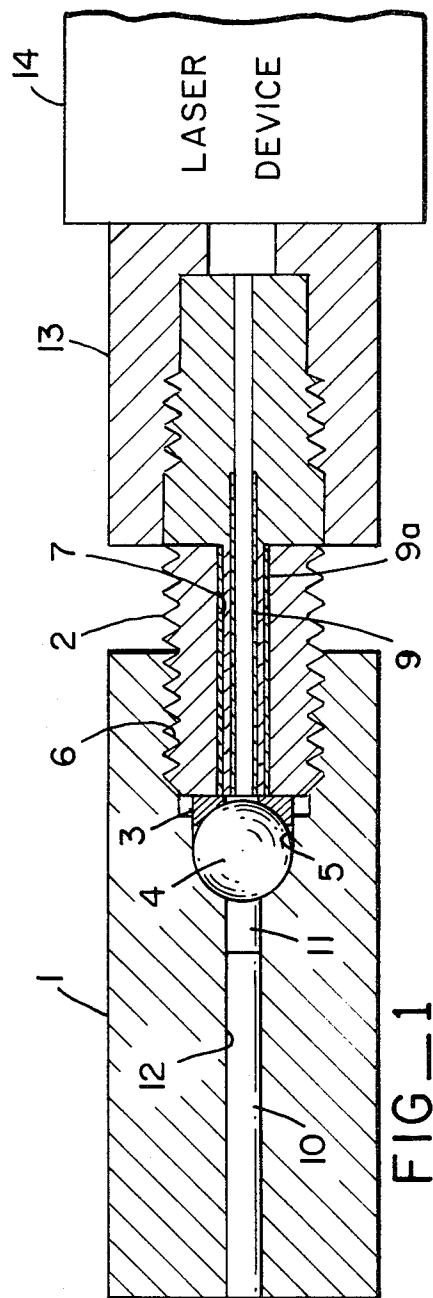
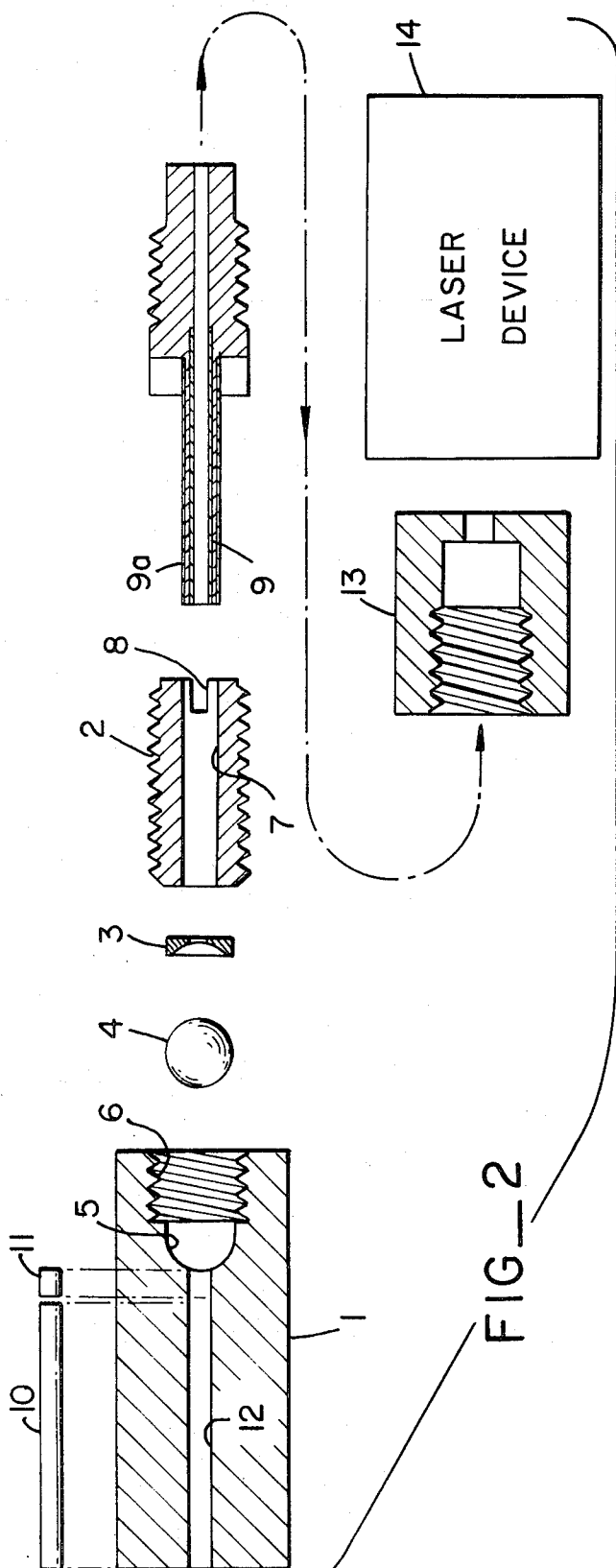
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3 Claims, 2 Drawing Figures

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LASSER STIMULATED ORDNANCE INITIATION DEVICE

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 generally to a device for initiating a high order explosion by utilizing a laser device and fiber optic transmission system and more particularly to the use of Potassium Hexanitro Diphenylamine (KHND), a low order detonation material adjacent to a glass focusing bead and a low energy laser device to initiate the Potassium Hexanitro Diphenylamine (KHND), which in turn initiates another secondary explosive material thereby causing a high order detonation.

The present day ordnance systems may be grouped roughly into three categories:

a. a low voltage explosive device that has as its initiating charge a primary explosive, which reacts to a hot wire which in turn is stimulated by a low voltage distributor system. The primary charge initiates the secondary explosive charge.

b. An exploding bridgewire--device that initiates a secondary explosive directly, thus eliminating the need for a primary explosive. The objections to the sensitivity of the low voltage system using primary explosives in a low voltage systems led to the development of the exploding bridgewire systems.

c. A confined detonating cord that replaced the electrical initiation distributor used in the low voltage system and the exploding bridgewire device. The confined detonating cord system uses an explosive cord shielded with a fiberglass braid to distribute the initiating event.

It has been found that the laser with its unique optical characteristics is a very safe and reliable method for initiating explosive charges in that none of the usual hazards such as electromagnetic radiation, X-ray, and the like, would provide the proper stimulus for initiator. The primary advantage of this new device is the unique method of initiating the explosive. The distribution system is extremely simple and presents none of the problems or hazards caused by the use of electrical or explosive distribution systems.

The major object of the invention is to provide an explosive system initiated by the output of a low energy laser device.

A more particular object of the invention is to provide a high order detonation by using a secondary explosive charge.

Another object of the invention is to provide a safe and reliable method of explosive initiation.

Other objects and features will be apparent from the following description of the invention and from the accompanying drawings of the preferred embodiment of the present invention wherein:

FIG. 1 is a sectional view of the assembled detonator; and

FIG. 2 is an exploded view, partially in section, of the detonator assembly.

Explosive material and explosive train. The explosive device or detonator is shown in both of FIGS. 1 and 2. The success or failure of the overall detonation system

lies in the design of the detonator assembly and the explosive train. It has been found that the choice of explosive upon which the laser beam impinges is a critical factor in success or failure of the system. None of the commonly used secondary explosives performed satisfactorily, apparently having a too low melting point as well as other more subtle characteristics relating to the manner of energy absorption.

A potassium salt of Hexanitro Diphenylamine, hereafter referred to as KHND, for various technological reasons was found to react in the desired manner under laser stimulation. Although KHND is a high-energy, temperature-insensitive high explosive, it did not itself give a high order event herein, but when the KHND was followed by a column of Pentaerythritol Tetranitrate, hereafter referred to as PETN, a high order detonation was obtained.

Several alternative explosive materials have been found equally successful; namely, salts of Hexanitro Diphenylamine, either sodium or Strontium and pyrotechnic compounds such as Hafnium/Copper Oxide and Zirconium/Copper Oxide. All of these explosive materials were tested in laser fired devices and yielded adequate output evidence of detonation in steel end plates.

Detonator device. Referring to FIG. 1, where the detonator assembly consists of body 1, spherical washer 3, spherical shaped glass focusing bead 4, and threaded collet 2.

The detonator body 1 has a long drilled cavity 12 extending back and opening into ball end mill section 5. Cavity 12 acts as a storage chamber for the explosive material. The ball end mill section 5 extends to the bottom tap 6. The bottom tap section is threaded to accept the threaded detonator screw or collet 2. The threaded collet 2 has a hollow portion 7 with slot 8 at one end. The hollow threaded collet 2 holds the fiber optics transmission line or bundle 9 in close proximity to the glass bead 4. Referring to FIG. 2, fiber optics capsule 9 is inserted into the hollow chamber 7 of the collet 2. Glass focusing bead 4 is inserted in the ball end mill opening 5 and is in turn held back by the spherical washer 3 and threaded collet 2. There is an aperture between cavity 12 containing explosive materials 10 and 11 and ball end mill section 5, to allow spherical glass bead 4 to come in contact with explosive material 11. The function of the focusing bead 4 is twofold; first to provide optimum containment of the explosive event; second to provide optical focusing and to concentrate instant energy of the laser beam, thus encouraging hot spot initiation of the KHND charge 11 as hereinafter explained.

Detonator and detonator screw. Referring to FIG. 1, body 1 is made of stainless steel or equivalent. The detonator washer 3 is made from annealed brass and has a curved interior surface and a 0.045 inch diameter opening. The detonator glass sphere lens 4 is of the proper diameter to fit the open ball end mill 5 of the detonator body 1 and washer 3.

Fiber optics assembly and laser pulse supply. Referring to FIG. 2, fiber optics bundle 9 is enclosed in a hollow jacket assembly 9a. Outer jacket 9a is then inserted into the opening 7 of the threaded collet 2. Threaded collet 2 holds the fiber optics transmission line 9 in close proximity to the glass bead 4. A stainless steel cap

nut 13 is placed on the threaded portion of the fiber optic assembly.

Neodymium laser device 14 is used as the source of initiated energy. The energy levels used were 0.3 and 0.5 Joules. It should be noted that both the fiber optics and the laser device are standard apparatus used in the art.

Method of loading the detonator device. Referring again to FIG. 1, KHND charge 11, having a weight of about 5 milligrams, is pressed against the spherical shaped glass focusing bead 4 which in turn is held in the ball mill section 5 by the spherical washer 3 and the threaded collet 2. The explosive charge PETN 10 is then loaded into the long cavity 12. The PETN is loaded in a gradient of increasing density from right to left, filling the major portion of the cavity. The final increment of PETN is compressed to about 40,000 psi whereas the initial increment is compressed to 4,000 psi. Laser 14 is attached to the open end of the fiber optics cap nut 13 and the explosive event is as follows: The laser pulse from the supply passes through the fiber optic bundle 9, focusing bead 4, and impinges upon the KHND charge 11. The KHND charge is set into low order detonation, thereby setting the adjacent PETN into low order detonation. As this event progresses from right to left, the pressure and temperature increases rapidly because the density of the gradient loaded PETN column increases from right to left. In this manner the velocity of the reaction front increases very rapidly, reaching a detonation velocity of 7,000 to 8,000 meters per second. Thus the result is a high order explosion.

In summary, the primary advantage of this new system is the unique method and apparatus of initiation of the explosive. The usual dangers which cause accidental initiation are not present in the present invention. For example, only secondary explosives are used. In addition, it has been found that the loaded laser detonator did not result in initiation when it was subjected to the spark of a 100 KV Tesla coil generator.

A single laser source may be used to provide stimulus

to many devices, either simultaneously or in programmed sequence. The distribution system is extremely simple and presents none of the inherent problems of high voltage EBW or CDR explosives distribution systems.

What is claimed is:

1. A device for initiating an explosive charge including an optical transmission means and laser means, said device comprising in combination:

- a. a hollow detonator assembly;
- b. said detonator comprising a first interior chamber, a second interior ball chamber and an explosive storage chamber;
- c. said second ball chamber having first and second openings, said first opening communicating with said first interior chamber and said second opening communicating with said explosive storage chamber;
- d. said explosive storage chamber containing a first explosive material located adjacent a second explosive material wherein said second explosive material is compressed in a gradient of increasing density away from said first material to form an explosive train;
- e. a spherical shaped bead focusing means positioned inside said second ball chamber and in direct contact with said first explosive material;
- f. a hollow collet positioned inside said first chamber;
- g. said optical transmission means positioned inside the hollow portion of said hollow collet; and
- h. said laser means operatively connected to said optical transmission means and adjacent said collet.

2. The device recited in claim 1 wherein the major portion of said storage chamber contains said second explosive material.

3. The device recited in claim 1 wherein said first explosive material is Potassium Hexanitro Diphenylamine (KHND) and said second explosive material is Pentaerythritol Tetranitrate (PETN) to be initiated by said laser device.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,724,383 Dated April 3, 1973

Inventor(s) John A. Gallagher et al.

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Title of invention should read -- LASER STIMULATED
ORDNANCE INITIATION DEVICE --.

Signed and sealed this 19th day of March 1974.

(SEAL)
Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

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