# United States Patent [19]

**Ceyrat**

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[54] **ELECTRICALLY ACTUATED PRIMING DEVICE**


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[30] **Foreign Application Priority Data**

Nov. 12, 1971 France ..... 71.4568

[52] **U.S. Cl.** .. **102/28 R,** 102/70.2 R, 102/70.2 GA, 102/46, 219/10.49, 317/80, 317/92

[51] **Int. Cl.** ..... **C06c 5/06**

[58] **Field of Search** ..... 317/80, 81, 92, 93, 98; 219/10.47, 10.49, 10.57; 89/1.5 R, 1.814; 102/28 R, 28 M, 70.2 GA; 60/35.6 RS; 13/27; 336/84



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[57] **ABSTRACT**

A priming device actuated by electrical induction and comprising a primer containing a pyrotechnical substance, an armature placed in contact with or proximate to the pyrotechnical substance and an inductor for producing an alternating magnetic field which causes electrical heating of the armature by induction. The armature can be separate from or formed of all or part of a casing containing the pyrotechnical substance.


**2 Claims, 7 Drawing Figures**

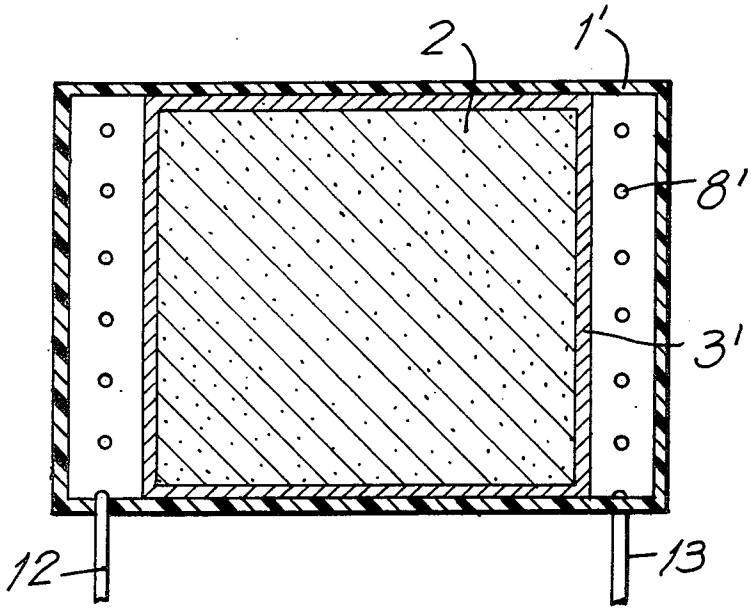


FIG. 1

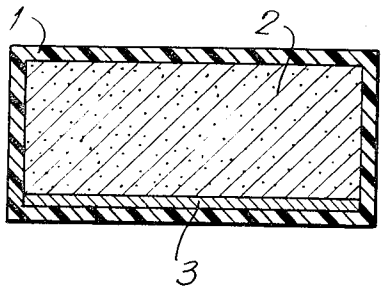
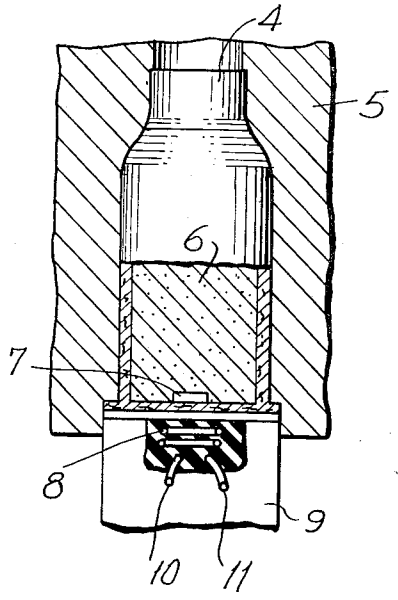



FIG. 2



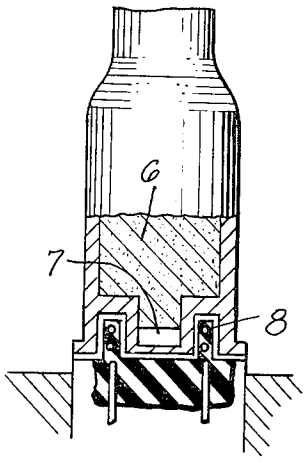




FIG. 3

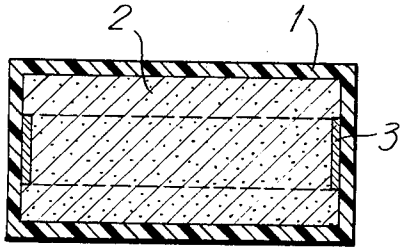



FIG. 4

FIG. 5

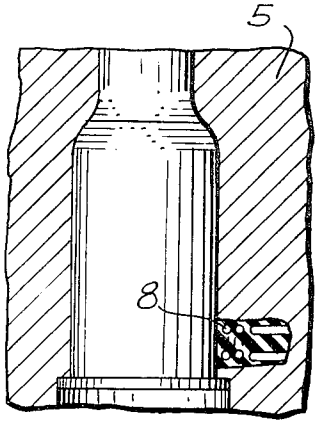



FIG. 6

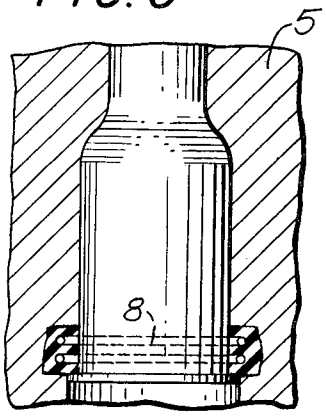
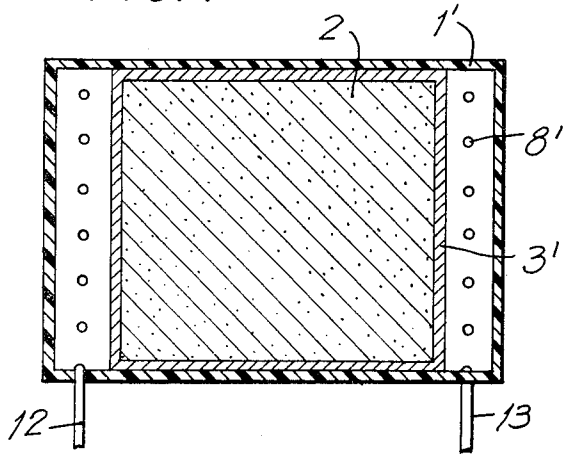



FIG. 7



# ELECTRICALLY ACTUATED PRIMING DEVICE

## BACKGROUND

1. Field of the Invention

The invention relates to the application of electric heating by induction to produce explosion of a pyrotechnical substance.

This electrical induction heating can be used for priming or explosive systems; its use is generally for converting an electrical phenomenon into a pyrotechnical effect.

2. Prior Art

The initiation of all known priming devices is obtained by either electricity or by percussion or friction.

However, the known devices whose actuation is obtained through electricity have several deficiencies in common:

a. the sensitive pyrotechnical substance is in contact with the conductive electrodes carrying electricity so that any potential difference fortuitously occurring between the electrodes can involve untimely actuation of the priming devices. A well known cause of such accidents is static electricity;

b. connection of the priming devices to an electrical generator compels accurate placing to be provided. This drawback is particularly troublesome in all uses where, current is supplied through a contact which through pressure secures contact with a contact stud integral with the priming devices;

c. the necessity of having electrically conductive parts inside the priming devices generally hinders their use in any applications where no splinters or solid residues are desired during and after the operation.

Additionally, the known priming device whose actuation is obtained by percussion or friction also necessitate the provision of extremely accurate placing; such devices are, moreover, relatively dangerous to handle because of the use of extremely shock-sensitive pyrotechnical substances.

## SUMMARY OF THE INVENTION

An object of the present invention is to provide actuation of a pyrotechnical substance by means of a device which overcomes the enumerated deficiencies of the prior art devices.

For this purpose, in accordance with a first characteristic feature of the invention, the sensitive pyrotechnical substance is placed in a casing not pierced by electrodes at whose terminals a potential difference might arise.

In accordance with a second characteristic feature of the invention, the priming operation is obtained in the absence of a physical connection between the electric generator and the device containing the pyrotechnical substance.

According to a third characteristic feature, the device can be consumed or destroyed so as not to produce splinters or solid residues.

According to a fourth characteristic feature, the device allows usage of pyrotechnical substances known to be insensitive to impact or friction.

The invention contemplates priming apparatus with electric actuation, comprising: a priming device containing a pyrotechnical substance, an armature placed in contact with or close to the pyrotechnical substance, and an inductor for creating an alternating magnetic field to cause electrical heating, by induction of said armature.



The invention further contemplates a priming device which can be used in apparatus such as the foregoing, such priming device being composed of a casing containing a heat-sensitive pyrotechnical substance and an armature distinct from the casing or composed of all or part of said casing, placed in contact with or close to the pyrotechnical substance.

## BRIEF DESCRIPTION OF THE DRAWING

The invention will be described hereafter with reference to the annexed drawings which illustrate particular embodiments:

FIG. 1 is a sectional elevation view of one embodiment of an inductive priming device according to the present invention,

FIG. 2 is a sectional view of a portion of an artillery shell provided with the inductive priming device as shown in FIG. 1,

FIG. 3 diagrammatically shows one particular means of locating the inductor in the case of priming an artillery shell,

FIG. 4 shows the inductive priming device corresponding to the arrangement in FIG. 3,

FIGS. 5 and 6 diagrammatically illustrate variants in the placement of the inductor for priming artillery shells, and

FIG. 7 diagrammatically illustrates a further embodiment of an inductive priming device, the inductor being incorporated therewith.

## DETAILED DESCRIPTION

Referring to FIG. 1, the inductive priming device or fuse in accordance with the invention comprises a casing 1 of plastic material containing a heat-sensitive pyrotechnical substance 2. A metal component 3 constituting an armature or inductive field-responsive element is placed inside the casing, in contact with or proximate to the substance 2. If the armature 3 is subjected to the action of an alternating magnetic field, e.g. as produced by an inductor, electrical currents are developed in armature 3 which, by Joule effect, heat said armature. This is the known principle of electrical heating by induction. If desired conditions are obtained, the produced heating will cause an explosion of the pyrotechnical substance 2. The use of a casing 1 of a plastic material or of a material suitable for taking part in the pyrotechnical reaction and an armature 3 of extremely small size as, for example, a single turn of very thin wire obviates the production of splinters or solid residues.

Referring to FIG. 2, the sheath 4 of an artillery shell, engaged in a chamber 5 of a gun, contains a propellant charge 6 and a priming device 7 described above and composed of its casing, armature and pyrotechnical substance.

An inductor 8 is placed in the breech 9 of the gun and when operation is required, carries an alternating current supplied by an electric generator connected to the inductor inputs 10 and 11, said generator either being proximate to or included inside the breech.

The magnetic field produced by the inductor 8 develops electric currents in the armature of the priming device 7 and causes it to heat. When the heating reaches a sufficient level, the pyrotechnical substance of prim-

ing device 7 explodes, causing the firing of the propellent charge 6.

If the magnetic field is sufficiently intense, the operation can be effected in a very short time, even if there is wear of the gun such that the distance between the inductor and the armature becomes considerable.

The pyrotechnical substance in the priming device can be any primary pyrotechnical substance which is heat sensitive. By way of example, for the embodiment of FIG. 2, the pyrotechnical substance can be a mixture of 60 percent by weight zirconium and 40 percent by weight of lead chromate.

The plastic material of casing 1 can be any material or synthetic resinous material which is electrically nonconductive, and by way of example, ethyl cellulose, which is very inflammable, is usable.

The parameters of voltage and frequency of the inductor are dependent of course, on the form of the inductor and the substance of the pyrotechnical substance, however, by way of example, for the embodiment of FIG. 2, the power delivered to the inductor is of the order of 100 watts at a frequency of 1 $MH_Z$. In this embodiment, the armature is constituted by a filament of gold of a diameter of 50$\mu$ wound as a spiral of a diameter of 10mm. The armature reaches a temperature of about 400°C but this obviously is related to the particular heat sensitive pyrotechnical substance which is employed.

The sheath 4 of the artillery shell is not, properly speaking, a part of the present invention, however it should be made of a material which is an electrical insulator, for example, a mixture of cardboard and nitro cellulose.

The priming device shown in FIG. 2 can operate up to a distance of 10mm from the sheath of the cartridge to the breech.

The inductor 8 can also be located within the chamber 5 as shown in FIG. 3. In this way the magnetic coupling is increased and therefore the efficiency is also increased. The induction fuse 7 can then be constructed as shown in FIG. 4 where the armature 3 is in the form of a tape in annular contact with the pyrotechnical substance 2.

Furthermore, the inductor 8 can be placed locally in the gun chamber as shown in FIG. 5 or annularly around the gun chamber as in FIG. 6, the induction fuse having a suitable configuration each time.



Referring to FIG. 7, there is shown a priming device which comprises an outer casing 1' containing inductor 8' electrically insulated from inner body 3' which is either in part or wholly metallic and forms the armature. The pyrotechnical substance 2 is placed inside the body 3'. The priming device illustrated in FIG. 7 is adapted to be connected by conductors 12 and 13 to an alternating current generator.

Clearly the scope of the invention is not exceeded by directly incorporating the armature in an explosive charge without using a priming device. This requires only a sufficiently heat-sensitive pyrotechnical substance in contact with or proximate to the armature.

The application of inductive electric heating to obtain the explosion of a pyrotechnical substance in accordance with the invention can be used in all priming problems where high safety in use and extreme simplicity of operation is sought.

One particular use can be the priming of non-metallic shell cases in various guns.

What is claimed is:

1. An electrically actuated priming device for effecting explosive priming by electrical induction, said arrangement comprising:

a priming device comprising a closed outer housing composed of a synthetic electrically nonconductive material, a pyrotechnical substance sensitive to heat in said housing and an armature, constituted as a thin metallic inner housing enclosing and in contact with said pyrotechnical substance to transmit heat thereto, placed in totality in the interior of the outer housing, and

induction means in said outer housing and being separated from said armature and physically unconnected therewith for producing an alternating magnetic field around said armature to cause heating of said armature by electrical induction, said induction means being connected to an electrical generator.

2. An arrangement according to claim 1 wherein said induction means is electrically insulated from said pyrotechnical substance.

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