United States Patent

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[54] **METHOD AND APPARATUS FOR ELECTROMAGNETICALLY INITIATING ORDNANCE**

4 Claims, 2 Drawing Figs.

[52] **U.S. Cl.** ..... **102/46,** 89/28, 102/70.2 R
[51] **Int. Cl.** **F42b 9/08**
[50] **Field of Search** 89/135, 28; 42/84; 102/46, 70.2

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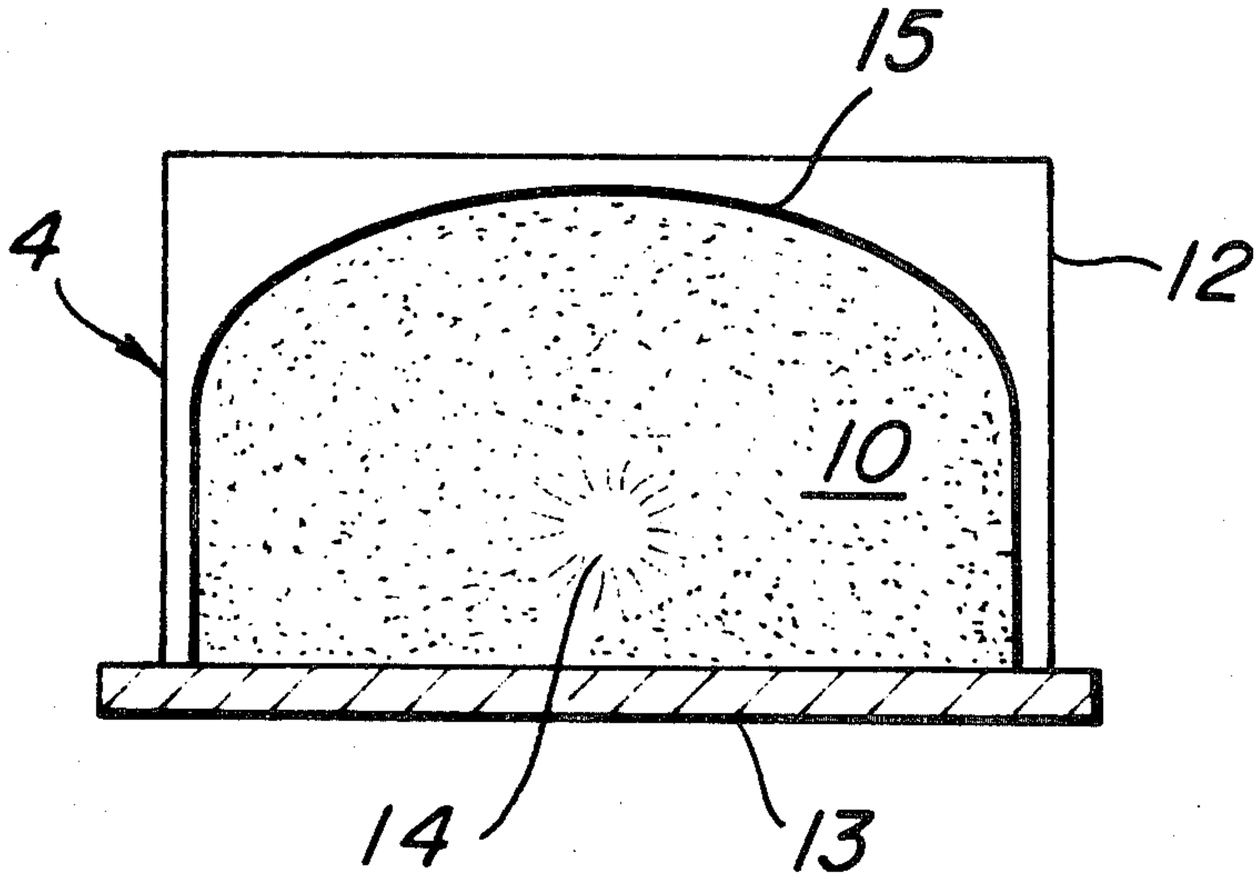
ABSTRACT: In order to obviate the necessity for using firing pins or electrical probes for initiating ammunition, a cluster of conductors are enclosed within a mass of pyroignition material, and means are provided to subject the cluster of conductors to control electromagnetic radiation such that they are heated into an incandescent state to ignite the pyroignition material.



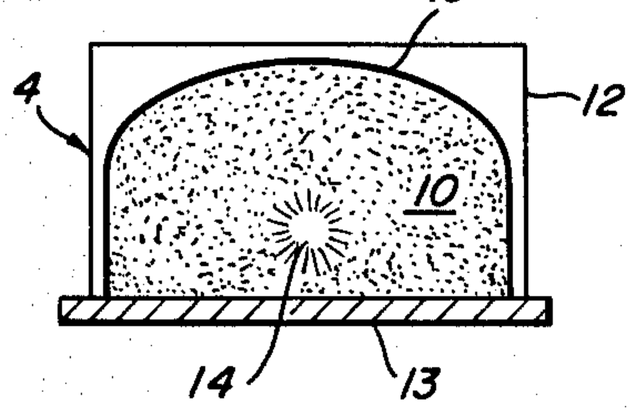
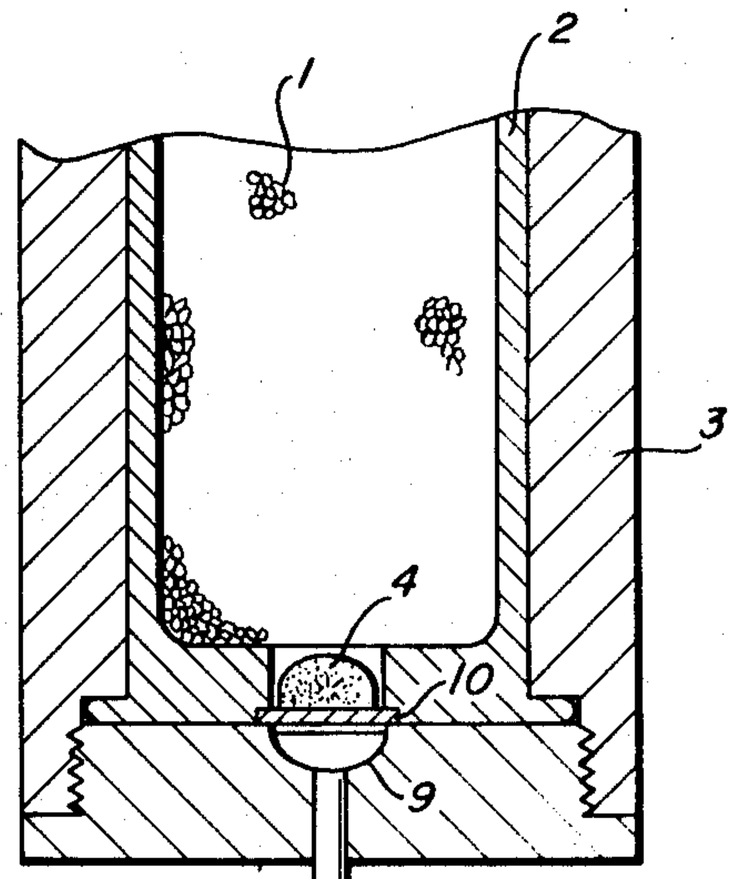
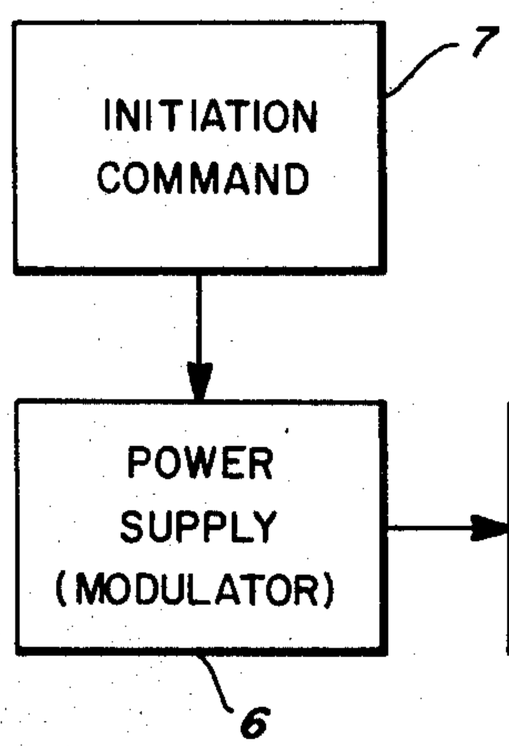


FIG. 2

FIG. 1





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METHOD AND APPARATUS FOR ELECTROMAGNETICALLY INITIATING ORDNANCE

This invention relates to ordnance and, more particularly, to a method and apparatus for initiating ammunition and the like.

The devices presently used for initiating the ammunition of the larger ordnance pieces may be classified broadly as either firing pins or electrical probes. Firing pins and electrical probes, however, continue to display a disturbing tendency to fail. In particular, when used with caseless ammunition, firing pins and electrical probes have been observed to be subject to severe and rapid deterioration such that failure occurs at a rate intolerable in modern warfare.

It is a general object of this invention to provide means for reliably initiating ammunition.

It is a further object of this invention to provide such means without the use of firing pins or electrical probes.

It is a more specific object of this invention to provide initiating means utilizing controlled electromagnetic radiation to heat a cluster of conductors to incandescence.

These and other objects are achieved, according to one aspect of the invention, by disposing a cluster of conductors, each cut to a predetermined length, within a mass of pyroignition material and subjecting the cluster of conductors to electromagnetic energy preferably at the frequency at which the individual conductors are one-half wavelength. The high current coupled into the conductors quickly heat them into an incandescent state to initiate the pyroignition material surrounding them.

The subject matter of the invention is particularly pointed out and distinctly claimed in the concluding portion of the specification. The invention, however, both as to organization and method of operation, may best be understood by reference to the following description taken in connection with the accompanying drawings of which:

FIG. **1** is a schematic representation of the firing system; and

FIG. **2** is a cross-sectional detail of the ignitor.

Referring now to FIG. **1**, an ammunition round including propellant **1** packed within a case **2** is shown in cross section as disposed within a barrel **3**. The illustration of cased ammunition is merely exemplary, and it will be understood that the invention is equally applicable to ordnance pieces using caseless ammunition. An ignitor **4** is contained within a coaxial recess in the base of the case **2**.

A power oscillator **5**, such as a klystron, magnetron or the like, is modulated by selectively energizing its power supply **6** in the manner well known in the radar and high frequency engineering arts. The power supply **6** may be automatically or manually energized and deenergized by any convenient means suitable to the particular operating environment as represented by the block labeled initiation command in FIG. **1**.

Electromagnetic energy, generated when the power oscillator **5** is in operation, is coupled through a conventional wave guide **8** to an antenna horn disposed within the ordnance piece as represented in FIG. **1**. Thus, the antenna horn **9** directs the electromagnetic energy, through an electromagnetic "window" **10**, into the ignitor **4**.

The construction of the ignitor **4** is shown more clearly in FIG. **2**. A mass of pyroignition material **10** is packed within an inner casing **11** and an outer case comprising a cap **12** and a cover **13**. The cover **13** must pass electromagnetic energy without significant attenuation and, therefore, should, like the window **10** of FIG. **1**, be composed of any one of the well-known materials possessing the requisite properties.

A cluster of conductor sections **14** is generally centrally disposed within the pyroignition material **10** as best shown in FIG. **2**. Typically, the cluster comprises a plurality of metallic wires, for example, aluminum or pyrofuse wires, cut to substantially the same predetermined length. Their function will be described below. It may also be observed at this point that the upper portion **15** of the inner casing **11** is parabolic and consists of a material, such as carbon or metal, which efficiently reflects electromagnetic waves.

Referring again to FIG. **1**, as well as FIG. **2**, to initiate the pyroignition material **10**, the initiation command device **7** is activated to energize the power supply **6** thereby bringing the power oscillator **5** into operation. Electromagnetic energy from the power oscillator **5** is coupled through the wave guide **8** to the antenna horn **9** from which it is directed through the window **10** and the cover **13** to the ignitor. The electromagnetic energy passes through the pyroignition material **10** and is reflected from the parabolic surface **15** of the inner casing **11** to focus on the conductor cluster **14**. The resulting currents developed in the individual conductors of the cluster quickly heat them into an incandescent state to initiate the pyroignition material **10** which, in turn, initiates the propellant.

For maximum efficiency, it will be understood that the conductive wire cluster **14** will be centered at the focus of the parabolic reflector **15**. Further, each of the conductors in the cluster **14** will have been cut to a length which is nominally one-half wavelength at the frequency of the electromagnetic energy directed at the cluster. For example, for a frequency of **13** gigaHertz, this length is approximately 0.5 inch. Adjustment of the sensitivity of the conductor cluster can be changed by varying the wire diameter and/or the material. The dimensions of the parabolic reflector **15**, the antenna horn **9**, etc., may also depend upon the frequency, but these are matters well known in the radar engineering art and need not be treated at length here.

While the principals of the invention have now been made clear in an illustrative embodiment, there will be immediately obvious to those skilled in the art many modifications of structure, arrangement, proportions, the elements, materials, and components used in the practice of the invention which are particularly adapted for specific environments and operating requirements without departing from those principals.

I claim:

1. Apparatus for igniting pyroignition material comprising:

A. a cluster of electrical conductors disposed in heat-conducting relationship with the pyroignition material;

B. a source of electromagnetic energy;

C. means for exposing said cluster of conductors to said electromagnetic energy;

D. said electrical conductors are of predetermined substantially equal lengths; and

E. said electromagnetic energy has a frequency such that the predetermined lengths of said conductors is substantially one-half wavelength.

2. The apparatus of claim **1** which further includes means for selectively activating said course of electromagnetic energy.

3. The apparatus of claim **2** in which the pyroignition material is contained within a housing, said housing including a first side composed of a material exhibiting the properties of an electromagnetic window.

4. The apparatus of claim **3** in which said housing further includes a second side disposed opposite said first side, said second side comprising a paraboloid of electromagnetically reflective material whereby the electromagnetic energy is focused on said cluster of conductors.