Aug. 3, 1943.

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2,326,008

USE OF LEAD SALTS OF NITROAMINO GUANIDINE
AS INITIATING CHARGE FOR FIRING DEVICES

Filed Nov. 1, 1940

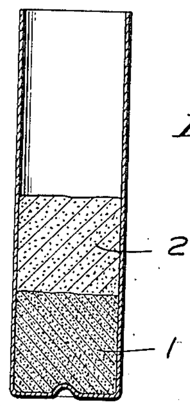

Fig. 1.

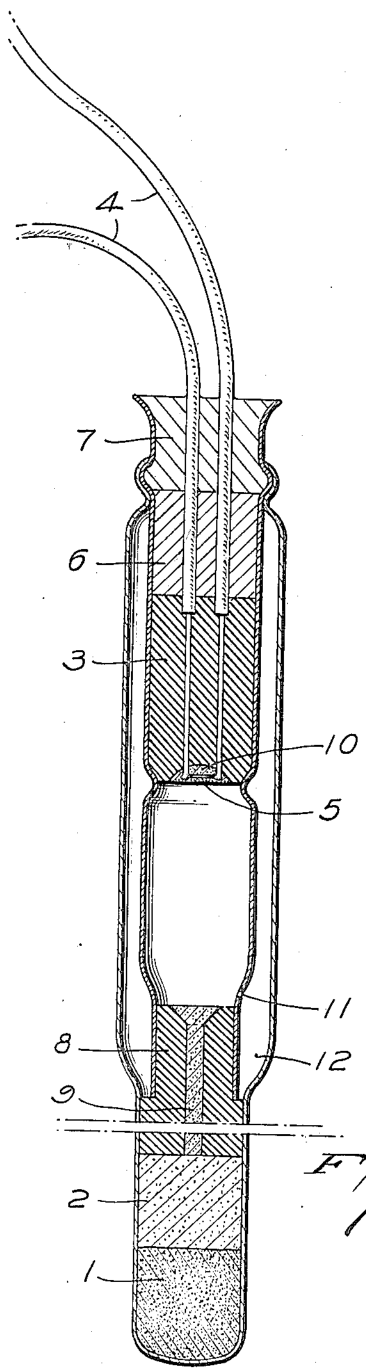

Fig. 3.

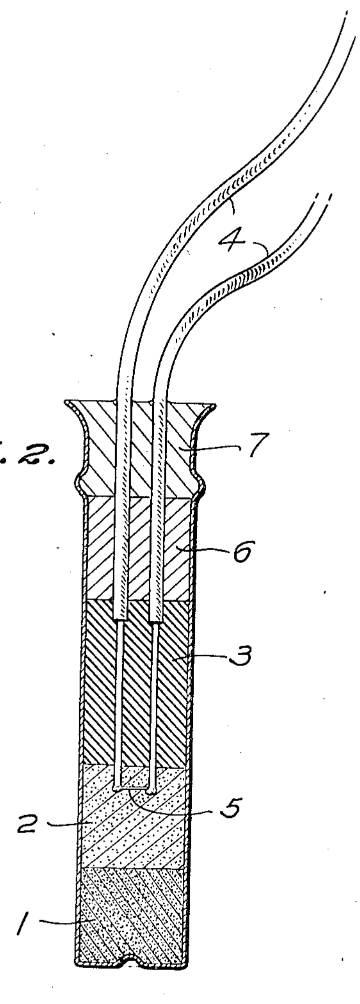

Fig. 2.

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Patented Aug. 3, 1943 2,326,008

UNITED STATES PATENT OFFICE

2,326,008

USE OF LEAD SALTS OF NITROAMINO GUANIDINE AS INITIATING CHARGE IN FIRING DEVICES

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Application November 1, 1940, Serial No. 363,815

12 Claims. (Cl. 52—4)

This invention relates to an improved firing device and more particularly to an improved blasting cap of the type containing a base charge and an initiating charge.

It is well known that the commercial firing devices used by the art may be either closed shell electric blasting caps of either the delay or instantaneous type or open shell fuse blasting caps. The base charge-initiating charge combination of the present invention may be used with any or all of the above types of caps with equal success.

The primary object of the invention is to provide an improved base charge-initiating charge combination for such firing devices. A further object is to provide a blasting cap with a base charge and having an initiating charge which is less sensitive to friction and impact than the previous initiating charges used by the art. A still further object of the invention is to provide a firing device of the above type in which a lead salt of nitroaminoguanidine is included in the initiating charge.

To this end the invention contemplates a blasting cap having a base charge and an initiating charge of lead nitroaminoguanidine (hereinafter referred to for convenience as LNAG) alone or in admixture with an oxidizing agent such as potassium chlorate. The invention further contemplates the use with the initiating charge as above of pentaerythritol tetranitrate (hereinafter referred to for convenience as PETN) as a base charge. It is to be understood that the invention contemplates the use of such combinations in any type of firing devices.

The invention further contemplates the novel combinations hereinafter described and shown in the accompanying drawing, in which—

Fig. 1 is a sectional view of a fuse blasting cap;

Fig. 2 is a similar view of an electric blasting cap; and

Fig. 3 is a similar view of a delay electric blasting cap.

All of the above caps embody the present invention.

Referring now to the simplest form of the invention which is that with relation to a fuse cap of the .22 calibre open shell type shown in Figure 1, a base charge is shown at 1 of any suitable material. This may be tetranitromethyl analine, nitro starch, trinitrotoluene, picric acid or any of the usual non-initiating substances commonly used in the art. While we prefer to use PETN, yet the invention is not to be limited thereto. The initiating charge shown at 2 comprises LNAG either alone or in admixture with oxidizing salts. This charge is subjected to any convenient pressure and may or may not be topped by an ignition composition as desired.

Figure 2 shows an electric blasting cap in which the base charge comprises 0.25 gram of PETN pressed at 3,000 pounds pressure per square inch, and in which a loose initiating charge 2 comprises 0.40 gram of a mixture of LNAG and potassium chlorate in substantially proportions of 80 to 20. As is usual these caps are provided with a cast plug 3 carrying a pair of lead wires the ends of which are bridged as at 5. A waterproof compound 6 may then be poured into the shell on top of the plug 3, and the combination topped off with a sealing compound 7. When the above combination is contained within a .25 calibre shell, this cap contains sufficient explosive material to be classed as a No. 6 cap according to the United States Bureau of Mines' Standard.

Similarly the base charge LNAG combination may be used in the delay electric blasting cap of Fig. 3. Here a delay element 8 is superimposed upon the initiating charge 2 and contains the usual delay powder train. In this case, the plug 3, which carries the lead wires 4, is provided with a paste type ignition composition 10 in which the bridge wire 5 is embedded. The inner casing is provided with a vent 11 communicating with a gas chamber 12. This permits escape of generated or expanding gas within the casing during burning of the fuse and prevents premature rupture. The waterproof fill 6 and sealing material 7 are used here as is true in the ordinary electric blasting cap.

The caps prepared in accordance with the above examples were tested by the standard sand test and lead plate tests used by the art and were found to be equivalent to the various No. 6 caps now available on the market in performance. As a matter of fact, they gave a better sand test than a fulminate-tetryl No. 6 cap and a better lead plate test than a diazodinitrophenol-tetryl combination or a fulminate-tetryl combination cap.

In accordance with this invetnion, the initiating charges of the specific examples given hereinbefore were composed of a mixture of LNAG 80% and potassium chlorate 20% but such a mixture is not essential for an efficient initiating charge. Therefore, it is to be understood that LNAG may be used alone as the initiating charge for a PETN or other base charge or it may be used in suitable admixture with an oxidizing agent.

It will also be understood that by varying the weight of the base charge dependent upon the specific material used, the caps described can be manufactured to conform to any of the standard strengths that may be desired. Further as will be obvious to those skilled in the art, the quantities of explosives used as the base charge and initiating charge for the specific examples given compare very favorably to the quantities of explosives used in most of the commercial caps of the art. As a matter of fact, the quantities here used are less.

In the preparation of the above examples there were definite advantages derived from the use of LNAG as the initiating charge for the base charge over the use of mercury fulminate or lead azide. This relative insensitiveness is shown by the following table:

TABLE I

Sensitivity to friction [1]

Explosive	Height of fall of pendulum	Maximum added weight for no explosions
	Cms.	Grams
Lead nitroaminoguanidine	50	More than 5,000
Lead azide	50	1,000
Mercury fulminate	50	25

[1] Using the United States Bureau of Mines Friction Pendulum Type B.

Another very important advantage in the use of LNAG is due to its lack of sensitivity to impact as is shown in the following table:

TABLE II

Sensitivity to impact [1]

Explosive	Maximum height of drop of 500 gm. weight for no explosion
	Cms.
Lead nitroaminoguanidine	27.0
Diazodinitrophenol	22.5
Lead azide	17.5
Mercury fulminate	15.0

[1] Using United States Bureau of Mines Small Impact Machine.

It is apparent from the results in the above tables that blasting caps containing LNAG as an initiating charge superimposed upon a base charge and particularly one containing PETN, are much safer to manufacture and handle than the initiating charge-base charge combination caps known to the art. Such an increase of safety in operation constitutes a major improvement in the explosive art.

The fuse blasting caps prepared show further advantages and improvements over the blasting caps of the art in that when LNAG is used as the initiator, a confining capsule is not required. Where mercury fulminate is used as an initiating charge, it must be confined with a capsule as otherwise there is not sufficient explosive force to properly detonate the base charge, particularly where the latter is PETN. It is also to be noted that the use of lead azide in open copper shells is not recommended because copper azides will be formed which are very sensitive and dangerous to handle. Lead azide is further relatively difficult to ignite by the spit of a safety fuse and for this reason, if this substance is used in blasting caps, it is customary to place an ignition charge over the initiating charge in order to insure ignition. This is objectionable from the standpoint of economy and efficiency.

While it is possible to use mercury fulminate in open shell caps having a PETN base charge, it is necessary to reinforce the fulminate with a capsule to insure positive detonation of the base charge and whenever a capsule is thus used, it is advisable to place an ignition or wafer charge above the capsule to insure ignition of the initiating charge by the spit of the fuse. Here again such a device shows disadvantages from the standpoint of economy and efficiency when compared to the devices of this invention using LNAG as an initiating charge.

The use of LNAG is, therefore, highly advantageous and provides the art with an improved firing device from the standpoint of safety, economy and efficiency of manufacture, positiveness of detonation and simplicity of construction.

A lead salt of nitroaminoguanidine may be conveniently prepared as follows:

9 parts by weight of nitroaminoguanidine are dissolved in 300 parts of water at 83° C. 9 parts of pure precipitated lead hydroxide are then added to the solution and rapidly agitated for 15 minutes at from 70 to 80° C. Upon cooling to 15° C., yellow prismatic crystals form which may be filtered, washed with alcohol and dried at 35° C.

While the invention has been shown and described with particular reference to specific embodiments, it is to be understood that it is not to be limited thereto but is to be construed broadly and restricted solely by the scope of the appended claims.

I claim:

1. A firing device containing a base charge of pentaerythritol tetranitrate and an initiating charge of lead nitroaminoguanidine superimposed thereon.

2. A firing device containing a base charge of pentaerythritol tetranitrate, and an initiating charge superimposed thereon which comprises an admixture of lead nitroaminoguanidine, and an oxidizing agent.

3. An electric blasting cap containing a base charge of pentaerythritol tetranitrate, and an initiating charge of lead nitroaminoguanidine superimposed thereon.

4. An electric blasting cap containing a base charge of pentaerythritol tetranitrate, and an initiating charge superimposed thereon which comprises an admixture of lead nitroaminoguanidine and an oxidizing agent.

5. A fuse blasting cap containing a base charge of pentaerythritol tetranitrate and an initiating charge of lead nitroaminoguanidine superimposed thereon.

6. A fuse blasting cap containing a base charge of pentaerythritol tetranitrate, and an initiating charge superimposed thereon which comprises an admixture of lead nitroaminoguanidine, and an oxidizing agent.

7. A firing device including a base charge of pentaerythritol tetranitrate and an unconfined initiating charge of lead nitroaminoguanidine superimposed thereon.

8. A firing device containing a base charge of pentaerythritol tetranitrate and an initiating charge superimposed thereon which comprises an admixture of lead nitroaminoguanidine and potassium chlorate.

9. A firing device including a base charge of pentaerythritol tetranitrate and an unconfined

initiating charge superimposed thereon which comprises an admixture of lead nitroaminoguanidine and an oxidizing agent.

10. An electric blasting cap containing a base charge of pentaerythritol tetranitrate and an initiating charge superimposed thereon which comprises an admixture of lead nitroaminoguanidine about 80% and potassium chlorate about 20%.

11. A fuse blasting cap containing a base charge of pentaerythritol tetranitrate and an initiating charge superimposed thereon which comprises an admixture of lead nitroaminoguanidine about 80% and potassium chlorate, about 20%.

12. A firing device containing a base charge of pentaerythritol tetranitrate and an unconfined initiating charge superimposed thereon which comprises an admixture of lead nitroaminoguanidine and potassium chlorate.

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