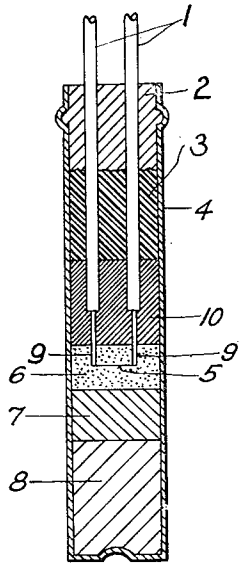
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BLASTING CAP

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BLASTING CAP

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This invention relates generally to initiators and more particularly to electric blasting caps containing a novel igniter.

Primary explosives such as, for example, normal lead styphnate, mercury fulminate, diazodinitrophenol and the like are usually utilized for the igniting charge in electric blasting caps. Explosives of this type have been selected for this purpose because they are easily ignited by means of a heated resistance wire. Such explosives are not entirely satisfactory for igniters in electric blasting caps, however, as in addition to being easily ignited by a heated wire they are also easily initiated by impact. Dry mercury fulminate, for example, can be fired by the impact of a two kilogram weight falling from a height of about two centimeters and blasting caps containing charges of such sensitive explosives are potentially hazardous and must be handled with extreme care in order to prevent premature firing of the cap. On the other hand, the explosives heretofore available which are less sensitive to impact such as trinitrotoluene, ethylenedinitramine, tetryl, cyclotrimethylenetrinitramine and the like are not satisfactory for ignition charges because they cannot be easily ignited by heated resistance wires.

It is an object of this invention to provide electric blasting caps devoid of the foregoing disadvantages. It is another object of this invention to provide improved electric initiators. A further object of this invention is to provide novel ignition compositions for electric blasting caps which are less susceptible to firing from impact than ignition compositions containing primary explosives.

In accordance with the present invention, the foregoing objects as well as others which will become apparent from the following description are accomplished by providing electrically ignitable devices containing novel ignition compositions. More specifically, this invention contemplates ignition compositions for electric blasting caps which contain the lead salt of ethylenedinitramine.

The lead salt of ethylenedinitramine (also referred to herein as lead ethylenedinitramine) to be utilized in the ignition compositions of this invention can be prepared by forming an alkali metal salt of ethylenedinitramine and subsequently reacting this material with lead nitrate or other lead salt. As an example, about 15 parts ethylenedinitramine are suspended in about 500 parts water at room temperature and containing about 16.5 parts sodium hydroxide. The slurry is agitated until substantially all of the ethylenedinitramine has dissolved to form a water soluble sodium salt. The resulting sodium salt is then converted to the lead salt of ethylenedinitramine by adding to the solution about 66 parts lead nitrate dissolved in about 400 parts water at room temperature. The lead salt is insoluble in the solution and is rapidly formed but agitation is continued for a few minutes to insure complete mixing of the two solutions. The suspension is then filtered and the precipitate air dried at room temperature for about sixteen hours.

Ignition compositions containing the lead salt of ethylenedinitramine as the explosive therein have been found

to have several characteristics which are advantageous over prior ignition compositions. One of the most important characteristics is the low impact sensitivity of this explosive. A drop of about 30 centimeters is required with a 5 kilogram weight to initiate dry lead ethylenedinitramine. This figure of insensitiveness is about 49 percent of that of picric acid and the importance of this characteristic from a safety standpoint can be appreciated when compared with the impact sensitivity of mercury fulminate which fires upon the impact of a two kilogram weight falling two centimeters.

Another important characteristic of an igniter composition containing lead ethylenedinitramine is that caps containing the same are particularly well suited for series firing. In some blasting operations it is desirable to ignite several explosive charges substantially simultaneously. In such an operation, an electric blasting cap is placed in each explosive charge and the caps electrically connected together in series. In order to function satisfactorily the ignition composition in each cap must be heated to the point where it has ignited before any one of the other caps electrically connected thereto has fired and thus broken the electrical circuit. The suitability of electric blasting caps for series firing can be determined by a test in which the "pulse time" and the "total explosion time" are measured. In this test, the total number of milliseconds required for ignition or the "pulse time" is determined by subjecting a cap to a known current (usually one ampere) for successively longer intervals of current flow until ignition thereof. The "total explosion time" is determined by providing an electrical circuit connected between the wall of the caps and a chronograph and the total time between the application of current and breaking of this latter circuit is measured as the "total explosion time." The "lag time" or duration of time between ignition of the ingiter composition and explosion of the cap is determined by subtracting the "pulse time" from the "total explosive time" and is an indication of the suitability of the caps for series firing. In a test of this type, conducted with electric blasting caps containing a loose igniter consisting of the lead salt of ethylenedinitramine and more fully described in the embodiment hereinbelow, the following results were obtained which illustrate that such caps function to advantage in series firing:

	Pulse Time, Milliseconds	Lag Time, Milliseconds	Total Explosion Time, Milliseconds
Ave.	7.2	3.9	11.1
Max.	7.5	6.4	13.9
Min.	7.0	2.7	10.2

Still another characteristic of lead ethylenedinitramine ignition compositions is their stability at elevated temperatures. Although they are easily ignited by a heated resistance wire, they have been found to possess a relatively high flash point. The lead salt of ethylenedinitramine will ordinarily flash after about one second exposure to a temperature of about 310° C. The significance of this can be more readily appreciated by comparing it with the flash point of mercury fulminate and the parent compound ethylenedinitramine both of which flash at about 180° C. The ability to withstand high temperatures is a characteristic required of blasting caps for initiating explosives utilized in perforating oil well bore hole casings so lead ethylenedinitramine ignition compositions are particularly desirable in blasting caps intended for utilization in operations of this type.

In order to more fully describe and to further clarify this invention, the following is a description of one embodiment thereof:

Referring now to the accompanying drawing, the electric blasting cap shown comprises a metallic case or cup **4** containing sulfur plug **10**, pitch seal **3** and sulfur plug **2** which form a water-proof closure for the mouth of the cup **4**. The bared terminals **9** of lead wires **1** which extend through plugs **2**, **3** and **10** are bridged with a rhodium-platinum-iridium alloy resistance wire **5** embedded in the igniting charge **6** consisting of the lead salt of ethylenedinitramine. The cup **4** also contains an initiating charge **7** of lead azide adjacent the igniting charge **6** and above a base charge **8** of cyclotrimethylenetrinitramine.

While in the foregoing preferred embodiment an igniter consisting of lead ethylenedinitramine is described, other igniting compositions containing lead ethylenedinitramine in mixtures with other materials frequently used to modify the characteristics of such compositions can be employed. For instance, in some electric blasting caps, igniters comprising an oxidizing agent such as barium nitrate, potassium chlorate, potassium nitrate or co-precipitated potassium nitrate and barium nitrate can be utilized in the igniter with lead ethylenedinitramine to advantage. The "lag time" and other important characteristics can be modified, if desired, by including nitrocellulose such as pyro cotton or smokeless powder in an igniter composition containing lead ethylenedinitramine, the "lag time" being increased by such additions. Likewise, the usual explosives other than lead azide and cyclotrimethylenetrinitramine can be utilized for the initiating and base charges if desired, such as trinitrotoluene, ethylenedinitramine, picric acid and tetryl and the like. Variations can also be made in the other components. For instance, a suitable plastic case can be used and rubber type closures and other suitable resistance wires can be substituted for those in the foregoing embodiment, if desired.

As pointed out hereinbefore, lead ethylenedinitramine when utilized with other explosive materials, electrical components, cases, and mouth closures for the case which

are relatively heat stable can be utilized in blasting operations conducted at elevated temperatures.

It should be apparent from the foregoing description that this invention accomplishes its objects and provides ignition compositions having improved characteristics and provides electric blasting caps which are relatively unsusceptible to inadvertent firing from impact and also possess other worthwhile advantages over the blasting caps heretofore proposed.

Although the present invention has been described in detail with respect to electric blasting caps and some modifications have been suggested, it is not limited to such details and can be followed to advantage in manufacturing other types of electrical initiators such as electric squibs, fuses and the like. Numerous modifications will become evident to those skilled in the art from the foregoing description and may be made without departing from the spirit and scope of this invention.

Having thus described the invention, what is claimed and desired to secure by Letters Patent is:

An electric blasting cap having an ignition composition comprising lead ethylenedinitramine, a lead azide initiator charge, and a base charge selected from the group of explosives consisting of cyclotrimethylenetrinitramine, trinitrotoluene, ethylenedinitramine, picric acid and tetryl.

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