

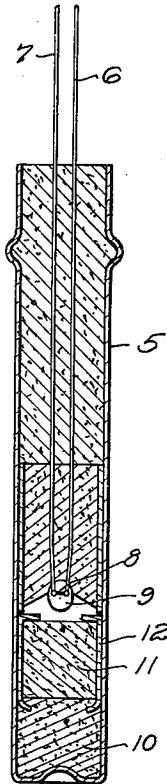
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DETONATOR AND COMPOSITION FOR THE SAME

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DETONATOR AND COMPOSITION FOR
THE SAMESylvester B. Large, Tamaqua, Pa., assignor to
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This invention relates to improvements in detonators which are used for initiating charges of explosives.

Its object is to provide blasting caps which are marked, by greater economy and by decreased hazard in manufacture and use, but with no sacrifice of efficiency. A further object is the adaptation of an improved type of composition either as the entire cap charge or as the initiating charge in compound caps.

Solid explosive organic nitrates of the general formula $C_nH_{n+2}(NO_3)_n$, as instanced by hexanitromannite and tetranitroerythrite, may be used as primary detonating agents in blasting caps when suitably confined and initiated. Such compounds may be used individually or in admixture. They function efficiently as primary detonants for base charges of compound detonators, such as tetryl, as disclosed in my copending application No. 502,559, as well as when used as entire primary charges in simple detonators.

In accordance with my present invention, I have discovered a novel means of initiating primary detonator charges of solid organic nitrates of the class described that is more practical and efficient than any heretofore known or used. My novel means for initiating a primary detonator charge of the class described consists of a semi-explosive burst of hot flame directed against the said primary detonator charge. While I have found electric fuse heads to be highly efficient and convenient, it is also true that efficient results are had by the use of any type of fuse head or equivalent element constructed to deliver a semi-explosive burst of flame forcibly upon the said primary charge whether the ignition of such element be brought about electrically or otherwise. By employing a flame producing agency in the form of a fuse head, as for example an electric match of the character herein described, I bring about the generation of a kinetic or semi-explosive hot flash, the flame of which is more or less forcibly impelled toward and against the said primary charge. In this manner, the heat produced by the said flash composition is directed and concentrated against the said type of primary charge and thereby permits relatively cool as well as relatively small amounts of flash compositions to be effectively and practically used. Thus, I am able to employ the difficultly ignitable but very safe solid explosive organic nitrates described, without, at the same time, having to use such hot flash compositions as would tend to melt or otherwise destroy or injure the detonator shells. Further, I have found that the said flame producing agency functions in

a very effective manner when disposed either in spaced relation or in direct contact with the said type of primary detonator charge.

There are, in current use, two general means for providing the heat and flame which initiate the primary detonating charge in electric blasting caps. One type involves placing an unpressed flash composition on top of the primary detonating charge and imbedding therein the bridge wire which is usually fastened to the ends of the leading wires by soldering, crimping or welding. The other type involves a preformed fuse head in which the flash composition is pressed, molded or otherwise formed around the bridge wire prior to insertion of same into the cap. Examples of this second type are the well known electric match head consisting of two metal plates, separated by electrical insulation, but joined at one end by the bridge wire and fastened to the leading wires at the other end, or the bridge wire fastened to the leading wires and ending in a cup or pocket, as in a sulphur plug, which cup or pocket may be packed with flash composition. The preformed fuse head type has several advantages among which are:

1. The expense and hazard of charging a loose flash composition upon the primary detonating charge and imbedding the bridge wire therein are avoided.

2. The bridge wire is surrounded by a fixed and rigid mass which protects it against breakage or other damage.

3. The fuse head is electrically insulated from the shell and also from the detonator charge so that a somewhat conductive detonator charge cannot transmit accidental electric currents to the bridge wire as by contact of shell and a leading wire with a source of current.

4. Flash compositions which would be chemically reactive with the detonator charge may be used, because they are not in contact.

5. The flash composition is more effective in its action because of closer contact with the bridge wire and because it is in a more concentrated or compacted form.

Examples of flash compositions for the preformed fuse head type are:

1. Cuprous acetylide around the bridge wire and in turn surrounded by a mixture of charcoal and potassium chlorate.

2. A mixture of mercury fulminate, nitrostarch and potassium chlorate.

3. Lead picrate.

4. Fulminate of mercury around the bridge wire and in turn surrounded by a mixture of a

nitro-compound, as tetryl, and an oxidizing agent, as potassium chlorate.

It is with items 4 and 5 of preformed fuse head advantages that this invention is especially concerned.

The following examples will make clear the scope of the possibilities, characteristics and distinctive qualities of my invention, but it is to be understood that these examples are not limiting.

1. A charge of 0.3 gram hexanitromannite pressed in an electric blasting cap and confined under an inner capsule gives an excellent lead plate and a sand test of about 37 grams in the U. S. Bureau of Mines sand test, the flash initiator being merely an ordinary electric match head of cuprous acetylide, charcoal and potassium chlorate. Even when the match head was completely covered and surrounded by sulphur similar results were obtained.

With compound detonators having tetryl base charges and match head initiation as in (1) I have found that 0.15 gram hexanitromannite pressed on the tetryl and under an inner capsule would initiate the tetryl. This was the case whether the pressure on the hexanitromannite was 50# or 200# per detonator. Without an inner capsule 0.20 gram hexanitromannite initiated the tetryl base charge. Such compound detonators give perfect lead plates and detonate insensitive explosives perfectly. With 0.10 gram tetryl and 0.25 gram hexanitromannite under an inner capsule the Bureau of Mines sand test was 39 grams. With the same conditions except that 0.60 gram tetryl was used, the sand test was 62 grams.

I have found that the solid organic nitrates of the general formula $C_nH_{n+2}(NO_3)_n$ presents far less manufacturing and handling hazards than other primary detonating compounds such as mercury fulminate, lead azide, mercurous azide and diazodinitrophenol. The consumer of blasting caps also partakes of this advantage.

Solid organic nitrates of the type proposed have a marked tendency toward instability, which may be overcome by suitable and extensive purification and by keeping them out of contact with other substances. It is often very undesirable to load a flash composition directly thereon and the preformed fuse head, such as the electric match, obviates this difficulty. Also, the preformed fuse head can be and is easily and thoroughly protected by lacquers and waxes from any products of slight decomposition of the solid organic nitrates so that the proper functioning of the assembly is assured.

The solid organic nitrates of the proposed type, when used as primary detonating substances, require for their initiation a semi-explosive burst of hot and concentrated flame. For instance, they do not respond to the spit of safety fuse as do fulminates, azides and diazodinitrophenol. The preformed fuse head or electric match, with its concentrated, compacted and directed mass, furnishes the essential qualities.

I do not make the claim that it is impossible to make the proposed primary detonating materials function with a suitable flash composition pressed thereon or with a suitable flash composition loosely loaded thereon and in which a bridge wire is imbedded. A pressed flash composition when ignited by my preformed fuse head is within the scope of my invention.

I prefer that the use of a preformed fuse head because it greatly widens the field of suitable flash compositions, is conducive to more assured

results, is more economical, is less hazardous to manufacturer and consumer, is not so affected by partial decomposition of the proposed organic nitrates and requires lesser amounts of flash composition.

It is my belief that detonators embodying my invention, as for example a detonator embodying the combination of a preformed hot flash composition, a primary charge comprising as an essential ingredient a solid nitration product having the general formula $C_nH_{n+2}(NO_3)_n$, and a base charge adapted to be exploded by such primary charge, provide greater measures of safety and economy in conjunction with high practicality and efficiency than any other type of detonator heretofore known or used.

While the construction of a detonator in accordance with the invention, insofar as its mechanical features are concerned so closely resembles known constructions as to make a drawing hardly necessary, yet in order that the invention may be clearly understood, I have illustrated one form of the invention in the accompanying drawing, wherein 5 represents the detonator shell, 6 and 7 the lead in wires, 8 the bridge wire imbedded in the described hot flash composition 9, 10 the base charge of any suitable composition, such as tetryl, for example, and 11 the primary charge of formula $C_nH_{n+2}(NO_3)_n$. An inner capsule 12 may be employed, if desired. It is also to be understood that the solid explosive substances of the general formula $C_nH_{n+2}(NO_3)_n$, specified as essential to my invention, may be the ordinary grades of impure products usually produced, for example, by the nitration of the commercial forms of the required polyhydric alcohols of the general formula $C_nH_{n+2}(OH)_n$; the said nitration products being prone to contain certain impure isomers, lower nitric ester, etc. They may, however, also be the chemically pure compounds, as obtained, for example, by recrystallization of impure forms, from a suitable solvent or solvents. Hexanitromannite or nitromannite, for example, may refer either to the chemically pure hexanitric ester or it may include proportions of the lower nitric esters, mixed therewith.

It is to be understood that the invention is not limited to the particular form illustrated but that it includes within its purview whatever changes fairly come within either the terms or the spirit of the appended claims.

Having described my invention, what I claim is:

1. In a detonator, a primary initiating charge of a solid nitration product of polyhydric alcohol having the general formula $C_nH_{n+2}(OH)_n$, and a pre-formed fuse head of a nature adapted to deliver a hot semi-explosive burst of flame upon said primary initiating charge.

2. A detonator comprising a primary initiating charge of a solid nitration product of polyhydric alcohol having the general formula $C_nH_{n+2}(OH)_n$, and an electrically initiated flame producing agency located outwardly of the polyhydric alcohol nitration product and separate therefrom.

3. An electric detonator comprising a primary initiating charge of a solid nitration product of polyhydric alcohol having the general formula $C_nH_{n+2}(OH)_n$, and a pre-formed fuse head comprising a bridge wire and a hot flash composition formed around the bridge wire prior to the insertion of the fuse head in the shell of the detonator, said hot flash composition lying in spaced relation to the initiating charge and being of a nature such as to deliver a semi-explosive

burst of flame upon said polyhydric alcohol nitrate to bring about detonation thereof.

4. An electric detonator comprising a primary initiating charge of a solid nitration product of polyhydric alcohol having the general formula $C_nH_{n+2}(OH)_n$, and a pre-formed fuse head comprising a bridge wire and a hot flash composition formed around the bridge wire prior to the insertion of the fuse head in the shell of the detonator, said hot flash composition being coated with a protective substance to separate it from the primary charge, said hot flash composition being of a nature such as to deliver a semi-explosive burst of flame upon said polyhydric alcohol nitrate to bring about detonation thereof.

5. An electric detonator comprising a primary detonating charge consisting of a solid nitration product of the general formula $C_nH_{n+2}(NO_3)_n$, and an electrically initiated mass of flash composition located outwardly of the primary charge, said flash composition being provided with a protective coating and being of a nature to deliver a semi-explosive burst of flame upon said primary charge.

6. A detonator comprising a base charge, a primary initiating charge of nitromannite, and a flame producing agency in the form of a fuse head located outwardly of the nitromannite and separated therefrom by a protective coating.

7. An electric detonator comprising a shell, a primary initiating charge therein outwardly of the base charge consisting of nitromannite, and a flame producing agency outwardly of and in spaced relation to the nitromannite and comprising an electric match head, said match head being coated with a substance separating it from the nitromannite.

8. A detonator as in claim 5 wherein the said flash composition comprises a chlorate.

9. A detonator as in claim 5 wherein the said flash composition comprises potassium chlorate.

10. A detonator as in claim 5 wherein the said flash composition comprises a mixture of mercury fulminate, and potassium chlorate.

11. A detonator as in claim 5 wherein the said flash composition comprises a match of charcoal and potassium chlorate.

12. A compound detonator comprising a base charge, a primary initiating charge of a solid nitration product of polyhydric alcohol having the general formula $C_nH_{n+2}(OH)_n$, and a wholly separate pre-formed electrically initiated fuse head of a nature adapted to deliver a kinetic semi-explosive burst of hot flame upon the polyhydric alcohol nitrate.

13. A compound detonator comprising a base charge, a primary initiating charge of a solid nitration product of polyhydric alcohol, said polyhydric alcohol having the general formula $C_nH_{n+2}(OH)_n$, and an electrically initiated flame producing agency located outwardly of the primary initiating charge and separate therefrom.

14. A compound electric detonator comprising a shell, a base charge therein, a primary initiating charge outwardly of the base charge consisting of nitromannite, and a flame producing agency outwardly of and in spaced relation to the nitromannite and comprising an electric match

head, said match head being coated with a substance separating it from the nitromannite.

15. In a detonator, a primary charge of a solid nitration product of polyhydric alcohol having the general formula $C_nH_{n+2}(OH)_n$, and a wholly separate pre-formed electric fuse head of a nature adapted to deliver a hot semi-explosive burst of flame upon the polyhydric alcohol nitrate.

16. An electric detonator comprising, in combination, a shell, a base charge therein, a primary detonating charge, outwardly of the base charge, consisting of nitromannite, and a flame producing agency comprising an electric match head outwardly of and in spaced relation to the nitromannite.

17. A compound electric detonator comprising a shell, a base charge therein, a primary charge consisting of a mixture of nitroerythrite and nitromannite, and a separate pre-formed fuse head located outwardly of and in spaced relation to the said primary charge, said fuse head being of a nature to deliver a semi-explosive burst of hot flame upon the primary charge to bring about detonation of the same.

18. A detonator comprising a primary initiating charge comprising as an essential ingredient a solid nitration product having the general formula $C_nH_{n+2}(NO_3)_n$, and a flash composition in the form of a fuse head positioned to deliver a hot semi-explosive burst of flame upon said primary initiating charge.

19. A compound detonator comprising a base charge and a primary initiating charge comprising as an essential ingredient a solid nitration product having the general formula $C_nH_{n+2}(NO_3)_n$, and a flash composition in the form of a fuse head positioned to deliver a hot semi-explosive burst of flame upon said primary initiating charge.

20. A detonator comprising a primary initiating charge consisting of a mixture of solid organic nitrates having the general formula $C_nH_{n+2}(NO_3)_n$, and a fuse head positioned to deliver a hot semi-explosive burst of flame upon said primary initiating charge.

21. A detonator as recited in claim 18 wherein the primary initiating charge comprises as an essential ingredient nitromannite.

22. A detonator as recited in claim 20 wherein the primary charge consists of a mixture of nitromannite and nitroerythrite.

23. A compound detonator as recited in claim 18 wherein the base charge consists of tetryl.

24. A detonator as recited in claim 18 wherein the flash composition is in the form of a pre-formed electric fuse head.

25. A detonator as recited in claim 18 wherein the fuse head is disposed in spaced relation to the primary initiating charge.

26. A detonator as recited in claim 18 wherein the fuse head is pre-formed and is coated with a protective substance to separate it from the primary initiating charge.

27. A compound electric detonator comprising a shell, a base charge therein, a primary initiating charge of nitromannite outwardly of the base charge, and a flame producing agency in the form of a fuse head outwardly of and in spaced relation to the nitromannite.

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