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NONDETONATING BLASTING EXPLOSIVE

Alexander Thomson Tyre, Ardrossan, Ayrshire, Scotland, assignor to Imperial Chemical Industries Limited, a corporation of Great Britain

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5 Claims. (Cl. 52—14)

The present invention relates to non-detonating blasting explosives. Such explosives are suitable for use when a slow heaving action rather than a ripping action is required, and hence find extensive use in coal mining.

In the class of detonating explosives, compositions of quite a variety of types have hitherto found application; for instance, gelatinous and non-gelatinous nitroglycerine explosives, chlorate and other Sprengel explosives, ammonium nitrate and nitrobody explosives and liquid oxygen explosives. On the other hand, however, in the class of non-detonating explosives, with which the present invention is concerned, practical application has been confined hitherto almost entirely to blackpowder or modifications of blackpowder. Within more recent years pressure-venting blasting devices charged with liquid carbon dioxide and a heater have found some application in coal mining; and a composition based on a mixture of sodium nitrite and ammonium chloride has recently been proposed for use in such devices. The present invention, however, is concerned only with explosives adapted to blast after being loaded direct into a borehole and tamped in the usual manner.

An objection to the use of unmodified blackpowder in coal mines is that its explosion is accompanied by a flame that will ignite a dangerous mine atmosphere. On this account, blackpowder is excluded from an important field, in which its characteristic properties would otherwise ensure its extensive use, in favour of certain detonating explosives and other blasting devices that are safe in gas.

The present invention is concerned with the production of non-detonating explosives having the heaving action characteristic of gunpowder, and having in some cases the additional advantage that their combustion is flameless and does not ignite a dangerous mine atmosphere.

It is already known that the salts of hypophosphorous acid have explosive properties; and it has been proposed to employe the hypophosphites, particularly of sodium potassium and ammonium, in conjunction with a fulminate or fulminate-chlorate detonator, as detonating explosives for military or commercial purposes. It has also been proposed to employ such hypophosphites in admixture with oxidizing agents such as nitrates, chlorates or dioxides, the amount of such oxidizing agent varying from 10 to 50%.

The decomposition of the hypophosphites, or of the known compositions containing them, is accompanied by flame. For example, mixtures of ammonium hypophosphite and ammonium or potassium nitrate in all proportions that form self-combustible mixtures burn with flame; and the addition of a cooling salt with a view to the reduction of the flame either hinders the propagation of combustion without producing the desired effect, or renders the composition incapable of self-combustion. Mixtures of other hypophosphites with oxidizing salts give compositions of comparatively poor combustibility which, if they burn at all, burn with flame. Further, many of such explosive mixtures have to be very carefully protected from moist atmospheres.

This invention has as an object to produce new non-detonating blasting explosives. A further object is to produce non-detonating blasting explosives which will explode without flame. A further object is to produce non-detonating blasting explosives which will not be easily damaged by moist atmosphere. A further object of this invention is to provide methods of manufacturing such explosives. Further objects will appear hereinafter.

These objects are achieved by the following invention. I have found that if, in a mixture of ammonium nitrate, with or without cooling salt, and an alkali metal hypophosphite, the ammonium nitrate is replaced by a salt pair forming ammonium nitrate and a cooling salt by metathesis, compositions are formed which are self-combustible when locally ignited, closely resemble blackpowder in their rate of pressure-development under confinement, and in some cases present the additional advantageous feature that their combustion is flameless, thereby rendering the compositions suitable for use as non-detonating explosives in fiery and dusty mines. A further advantage of these compositions is that they do not require to be protected from moist atmospheres as do ammonium nitrate compositions.

According to the present invention, a non-detonating blasting explosive composition comprises an alkali metal or preferably ammonium hypophosphite, and a mixture of an ammonium salt and an alkali metal nitrate; the said mixture being adapted to form by metathesis a mixture of ammonium nitrate and a cooling salt such as a sulphate, carbonate, bicarbonate, or chloride of the alkali or alkaline earth metals, and containing if desired an initial proportion of either or both of the latter salts in the free state.

The proportion of hypophosphite used is sufficient to render the composition self-propagating when locally ignited; but is insufficient to cause it to burn with flame. For example, an equimolar

mixture of potassium nitrate and ammonium chloride containing as little as 3.5% of ammonium hypophosphite will propagate its own combustion; but the best results with mixtures of these salts are obtained when the proportion of ammonium hypophosphite is about 20% of the total composition, i. e., about one-half molar proportion. As mixtures containing the higher proportions of hypophosphite evolve gases containing hydrogen and phosphine, and thereby may cause an objectionable fume, I may add a small proportion of an oxidising agent, preferably ammonium nitrate, for the purpose of improving the oxygen balance of the composition; also adding if necessary a small proportion of a cooling salt to offset any consequent increased tendency to combustion with flame.

The compositions of my invention may be prepared by incorporation of the dry ingredients, for instance by milling, followed by granulation if desired. In order to ignite the compositions I may use igniting devices adapted to produce a local supply of heat, for instance a safety igniter. The non-detonating composition may also be initiated by means of the heat developed by a blasting detonator; detonation of the composition does not occur.

The invention is further illustrated by the following example in which the parts are parts by weight.

Example

101 parts potassium nitrate, 53.5 parts ammonium chloride, 41.5 parts ammonium hypophosphite, and 20 parts ammonium nitrate, all in the form of crystalline powders, are ground together in a mill. The mixture is then pressed and granulated. A No. 6 fulminate chlorate 80:20 detonator, or a safety igniter, may be employed for igniting the granular mixture in the borehole. No ignition occurs in the gallery test when 12 oz. of this composition are tested by being fired from a gun into a 9% methane-in-air mixture. Exposed 4 oz. charges of the composition may be fired either by safety igniters or by blasting detonators in the same atmosphere without causing any ignition of gas.

Examples of the hypophosphites suitable for this invention are: ammonium, potassium and sodium hypophosphites, which can be used in the manufacture of safety explosives according to the invention. Other hypophosphites, e. g. iron, calcium or barium hypophosphites, may be used where the production of flame during the explosion is not undesirable.

Examples of the salt pairs which form ammonium nitrate by metathesis are: ammonium sulphate and sodium nitrate or potassium nitrate; ammonium carbonate or bicarbonate and sodium or potassium nitrate; ammonium chloride and a nitrate of sodium, potassium, calcium, strontium or barium.

This invention is a valuable advance in the art as it extends the range of known non-detonating explosives and certain of them possess a margin of safety from ignition from fiery or dusty atmospheres which is greater than that of the known safety detonating explosives of commerce.

As many apparently widely different embodiments of this invention may be made without departing from the spirit and scope thereof it is to be understood that I do not limit myself to the specific embodiments thereof except as defined in the appended claims.

I claim:

1. A non-detonating blasting explosive comprising a compound selected from the group consisting of the ammonium and alkali metal hypophosphites, and a salt mixture containing an ammonium salt selected from the group consisting of ammonium sulphate, carbonate, bicarbonate, and chloride and a second salt taken from the group consisting of the alkali and alkaline earth nitrates, said salt mixture being adapted to form by metathesis a mixture of ammonium nitrate and a cooling salt selected from the group consisting of the sulphates, carbonates, bicarbonates, and chlorides of the alkali or alkaline earth metals.

2. An explosive as claimed in claim 1 containing an additional portion of an oxidising agent.

3. An explosive as claimed in claim 1 containing an additional portion of ammonium nitrate.

4. An explosive claimed in claim 1 containing an additional portion of a cooling salt.

5. An explosive as claimed in claim 1 in which the proportion of hypophosphite in the total composition does not exceed one-half molar proportion.

ALEXANDER THOMSON TYRE.