

UNITED STATES PATENT OFFICE

2,154,416

NONDETONATING BLASTING EXPLOSIVE

Alexander Thomson Tyre, Ardrossan, Ayrshire,
Scotland, assignor to Imperial Chemical In-
dustries Limited, a corporation of Great Brit-
ain

No Drawing. Application August 4, 1937, Serial
No. 157,282. In Great Britain August 10,
1936

5 Claims. (Cl. 52—14)

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

In the class of detonating explosives, composi-
tions of quite a variety of types have hitherto
found application; for instance, gelatinous and
non-gelatinous nitroglycerine explosives, chlo-
10 rate and other Sprengel explosives, ammonium
nitrate and nitrobody explosives and liquid oxy-
gen explosives. On the other hand, however, in
the class of non-detonating explosives, with which
the present invention is concerned, practical ap-
15 plication has been confined hitherto almost en-
tirely to blackpowder or modifications of black-
powder. Within more recent years pressure-
venting blasting devices charged with liquid car-
bon dioxide and a heater have found some appli-
20 cation 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
25 after being loaded direct into a borehole and
tamped in the usual manner.

An objection to the use of unmodified black-
powder in coal mines is that its explosion is ac-
companied by a flame that will ignite a danger-
30 ous mine atmosphere. On this account, black-
powder is excluded from an important field, in
which its characteristic properties would other-
wise ensure its extensive use, in favour of cer-
tain detonating explosives and other blasting de-
35 vices 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 advan-
40 tage that their combustion is flameless and does
not ignite a dangerous mine atmosphere.

It is already known that the salts of hypophos-
phorous acid have explosive properties; and it
has been proposed to employ the hypophosphites,
45 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
50 admixture with oxidizing agents such as nitrates,
chlorates or dioxides, the amount of such oxidiz-
ing agent varying from 10 to 50%.

The decomposition of the hypophosphites, or of
the known compositions containing them, is ac-
55 companied 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
5 reduction of the flame either hinders the propaga-
tion of combustion without producing the de-
sired effect, or renders the composition incapa-
ble of self-combustion. Mixtures of other hypo-
phosphites with oxidizing salts give compositions
10 of comparatively poor combustibility which, if
they burn at all, burn with flame. Further, many
of such explosive mixtures have to be very care-
fully protected from moist atmospheres.

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

These objects are achieved by the following in-
25 vention. I have found that if, in a mixture of
ammonium nitrate, with or without cooling salt,
and an alkali metal hypophosphite, the am-
monium nitrate is replaced by a salt pair forming
ammonium nitrate and a cooling salt by metathe-
30 sis, compositions are formed which are self-com-
bustible when locally ignited, closely resemble
blackpowder in their rate of pressure-devel-
opment under confinement, and in some cases pre-
sent the additional advantageous feature that
35 their combustion is flameless, thereby rendering
the compositions suitable for use as non-detonat-
ing explosives in fiery and dusty mines. A further
advantage of these compositions is that they do
not require to be protected from moist atmos-
40 pheres as do ammonium nitrate compositions.

According to the present invention, a non-det-
onating blasting explosive composition comprises
an alkali metal or preferably ammonium hypo-
phosphite, and a mixture of an ammonium salt
45 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 contain-
50 ing if desired an initial proportion of either or
both of the latter salts in the free state.

The proportion of hypophosphite used is suf-
ficient to render the composition self-propagating
when locally ignited; but is insufficient to cause
55 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. 50