

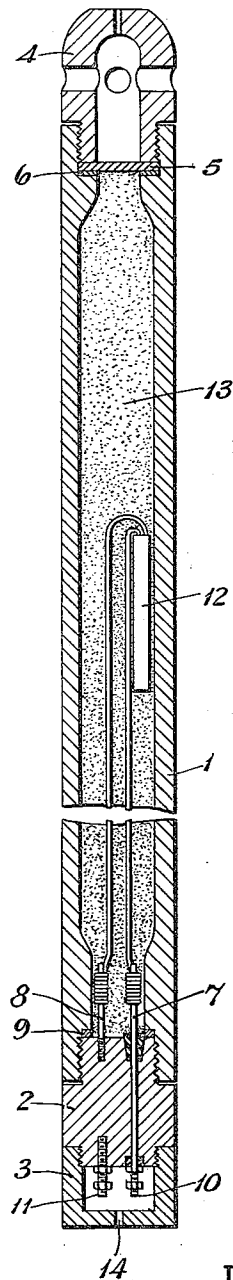
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J. TAYLOR

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BLASTING CHARGE

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James Taylor INVENTOR

BY *Thos. Q. Wilson*
ATTORNEY

UNITED STATES PATENT OFFICE

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BLASTING CHARGE

James Taylor, Saltcoats, Scotland, assignor to
Imperial Chemical Industries Limited, a corporation of Great Britain

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The present invention relates to blasting charges of the kind suitable for use in conjunction with a closed container adapted to vent at a predetermined and considerable pressure, comprising mixtures of an alkali metal nitrite and ammonium salt which undergo a self-sustained gas producing decomposition even when locally initiated under ordinary pressure and which produce a blasting effect when ignited in the containers described. A blasting device making use of these compositions is described in U. S. Patent No. 2,038,772 and also in Patent No. 2,048,827, according to which latter patent they are used in conjunction with another material capable of being decomposed exothermically with evolution of gas when heated.

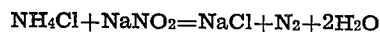
The following is a description of such a blasting device, a view in cross-section of which is shown in the appended drawing.

Into one threaded end of a shouldered strong steel container 1 there is screwed a firing head 2 separated from the container 1 by a sealing washer 9 of fibre or other suitable material such that a seal which is gas-tight even at high pressures is ensured. The firing head 2 is provided with electrodes 7 and 8 of which one, 8, is in metallic connection with the firing head 2, while the other, 7, is insulated from the firing head. The mounting of the insulated electrode 7 is such as to allow no gas leakage at pressures up to about 25 tons per sq. in. Terminals 10 and 11 are provided for the electrodes, which are used in initiating the cartridge electrically. A protective steel cap 3 having an aperture 14 for the leads to the terminals from the cable of the exploder or other suitable source of electrical energy is screwed on the firing head 2. The blasting charge 13 is introduced loosely into the tube in the requisite amount. On the shoulder of the container, remote from the firing head 2, there is placed a fibre or like sealing washer 6, the steel bursting disc 5 adapted to be ruptured at a predetermined pressure being held in position between the said washer and the hollow screwed-in cap 4, which is pierced with suitable channels for the venting of the gases and the direction and distribution of the blast. An electric powder fuse or safety igniter 12 containing, for example, 30 grains black powder is used for ignition and provided with long leads from the electrodes and positioned as shown in the drawing so that the flash is directed towards the firing head and initiation occurs near the end of the charge adjacent to the cap 4. By so positioning the cap, the tendency of the charge to be forced into a

plug at the end nearest the cap 4 is overcome. In blasting, the assembly is placed in the bore-hole with the cap 4 as far in as possible, and the device may, if desired, be tamped. It is then fired electrically.

For convenience, the device has been shown in the upright position, but it will be understood that the charge 13 would only assume the position shown if the device were horizontal. In practice, the device can be used in any position, so long as there is effective contact between the fuse 12 and the charge 13.

The said mixtures of alkali metal nitrite and ammonium salts decompose, when initiated, with the evolution of nitrogen gas and water vapour according to the equation:



These mixtures of alkali metal nitrite and ammonium salts are not inherently stable, and in course of time they react slowly with evolution of nitrogen gas even at ordinary temperatures, so that the amount of gas obtainable from a given weight of the mixture gradually decreases. During the decomposition water is liberated, and when sufficient water has been accumulated the mixture becomes insensitive to initiation by the usual means. The temperature of storage, however, may considerably influence the actual course of the changes which take place during storage.

According to U. S. Patent No. 2,038,772 it is recommended that alkaline materials such as sodium carbonate or ammonium carbonate should be employed as stabilisers for the mixture of alkali metal nitrite and ammonium salt employed. Sodium carbonate, although it is nonvolatile and in the anhydrous state is capable of forming a stable hydrate, confers only a limited immunity from decomposition on the mixture, and when incorporated into the mixture a vapour smelling of ammonia is liberated. The appearance of this vapour may be attributed to metathesis between the ammonium chloride and the sodium carbonate, forming sodium chloride and ammonium carbonate. During this metathesis any water previously fixed by the anhydrous sodium carbonate as water of hydration is liberated. Ammonium carbonate satisfactorily stabilises the mixture while it remains present but tends to disappear by evaporation and diffusion. In the said U. S. Patent No. 2,038,772 it is accordingly further suggested that in addition to the introduction of the sodium carbonate or ammonium carbonate into the mixture, the charge may be

packed with a quantity of ammonium carbonate adapted to prevent loss by volatilisation.

According to the present invention a blasting device of the kind described and containing a charge of an alkali metal nitrite and an ammonium salt as claimed in U. S. Patent No. 2,038,772 includes, as stabiliser for the said charge, a proportion of a solid inorganic material of low solubility which undergoes only slow metathesis with the ammonium salt. The material may be of a basic nature e. g. an oxide of an alkaline earth metal or an earth metal e. g. magnesium or zinc, or it may be a salt of such metal with a weak acid e. g. a carbonate, or it may be a compound of such metal capable of reacting with water vapour e. g. a carbide. It is generally preferred to employ materials which have a dehydrating action e. g. calcium oxide or carbide.

Calcium hydroxide undergoes comparatively rapid metathesis with ammonium salts in presence of moisture and is not suitable for the purposes of the invention, but when quicklime or calcium carbide is used it is not essential in any way that the material should be completely free from calcium hydroxide, the improved stabilisation, however, depending essentially upon the presence of calcium oxide or carbide. Generally, the oxides, carbonates or carbides of the alkaline earth metals or the oxides, hydroxides, carbonates and basic carbonates of magnesium and zinc are suitable for the purposes of the invention. For storage at ordinary temperatures, I prefer to employ magnesium oxide, but for storage at higher temperatures I prefer to employ a stabiliser, such as calcium carbide, having a marked dehydrating action at the storage temperature. It will be understood that the stabilisers used according to the present invention do not prevent the decomposition of the mixtures at the elevated temperatures at which they are intended to decompose, although they may have some effect upon the minimum temperature to which the material must be raised.

In putting my invention into effect, the proportion of the stabiliser may be quite small, and in general it will never be necessary to use more than 5% reckoned on the weight of the alkali metal nitrite and the ammonium salt mixture, but as a rule, it is desirable to use more than 0.5% The stabiliser is conveniently first admixed with the alkali metal nitrite in powder form before introducing the ammonium salt, but it may also be introduced during or after the admixture of these ingredients. If desired, more than one stabiliser may be employed. Some of the stabilisers, especially those of a light powdery nature such as magnesium oxide, light magnesium carbonate and calcium carbonate, when lightly mixed in have a specially useful effect in causing the material to assume an easy running granular form facilitating loading. In the case of these materials, accordingly, the mixture should not be subjected to severe mechanical action, such as milling which would break up the granules.

The stabilising effect of the materials may be determined in several ways. Thus for instance the loss in weight after storage at various temperatures may be ascertained for test samples. Alternatively small quantities of the material may be subjected to a temperature higher than that which will be encountered on storage, but lower than that at which the material commences decomposing immediately, and the times after which the mixture begins to fume off may be observed. The figures obtained in the storage test may

depend to a considerable extent on such factors as the relative humidity of the atmosphere, the nature of the container and the method of exposing the charge to the atmosphere.

In the tables which are quoted below showing the efficiency of various stabilisers, the figures for the different stabilised mixtures in each table were obtained under comparable conditions, but these conditions were not necessarily comparable with those in the examples or other tables.

Table 1

Stabiliser	Loss in weight after storage—	
	At ordinary temperature	At 35° C.
1% magnesium oxide.....	Nil in 289 days..	1.7% in 84 days 5.0% in 183 days
1.5% magnesium oxide.....	Nil in 197 days..	
2.0% magnesium oxide.....	Nil in 289 days..	2.0% in 130 days 5.3% in 200 days
2% basic magnesium carbonate.	0.1% in 270 days..	5.6% in 36 days
1% magnesium oxide.....	Nil in 270 days..	1.2% in 64 days
1% basic magnesium carbonate.		7.0% in 155 days
2% barium carbonate.....	0.1% in 333 days.	5.6% in 70 days
1% basic magnesium carbonate.		
2% calcium carbonate.....	0.14% in 336 days	

In the tests set out in Table 1 finely divided sodium nitrite and ammonium chloride were both dried separately at 60–70° C., and were admixed at room temperature in stoichiometrical proportions, the sodium nitrite being first mixed for a short time with the stabiliser whereupon the ammonium chloride was added and thoroughly mixed in. The finished composition was wrapped in 200 gm. cartridges and these were dipped in wax. The dipped cartridges were stored at ordinary temperature and in hot storage at 35° C. The figure "nil" indicates that the loss in weight was below the experimental error. The corresponding figure for 2% sodium carbonate at ordinary temperature was 2.1% in 224 days.

Table 2

Stabiliser	Loss in weight after storage	
	40°	48°
Basic magnesium carbonate.....	16% in 25 days.	18% in 8 days
Calcium carbonate.....	15% in 20 days.	18% in 3 days
Calcium carbide.....		Nil in 33 days
Magnesium oxide.....	14% in 44 days.	13% in 12 days

In the tests set out in Table 2 small samples of stabilised equimolecular mixtures of ammonium chloride and sodium nitrite were stored in unsealed bottles at 40 and 48° C., the amount of stabiliser being 2%.

Table 3

	Time for fuming off at 100° C.
	Minutes
Unstabilised.....	3
2% soda ash.....	10
2% calcium carbide.....	120
1% calcium carbide.....	30
2% magnesium oxide.....	11
2% calcium oxide.....	11

In Table 3 20 gm. samples of the stabilised equimolecular mixture of ammonium chloride and sodium nitrite were introduced into glass boiling tubes at room temperature and these were plunged into a bath of boiling water. The periods recorded are those from the introduc-

tion of the tube into the boiling water until rapid decomposition sets in.

The invention is further illustrated by the following examples of stabilised charges which are used for pressure resistant venting containers as described in U. S. Patent No. 2,038,772. The containers charged with the compositions of these examples are safe for use in methane air mixtures when used as described in the said specification.

Example 1

With a powder mixture of sodium nitrite and ammonium chloride in equimolecular proportions there was admixed 2% of magnesium oxide. The introduction of the magnesium oxide was accomplished by gentle agitation and caused the material to assume a finely granular form which facilitated loading. After 9 weeks storage at about 15° to 20° C. a cartridge of the composition lost only about 0.1% of its weight. When stored at 35° C. the loss in weight after 5 weeks was approximately 0.25%, and after 10 weeks 0.4%; the mixture still being suitable for its intended use.

Example 2

2% of calcium carbonate powder was mixed in a powder mixture of sodium nitrite and ammonium chloride in equimolecular proportions. The mixture was still sensitive to initiation after 4 weeks storage at 15° to 20° C., the loss in weight being about 0.12%. After 5 weeks at 35° C. the loss in weight was about 4%.

Example 3

A mixture of 2% witherite powder and 1% basic magnesium carbonate powder was incorporated into a powder of equimolecular proportions of sodium nitrite and ammonium chloride. The mixture was still sensitive to initiation after 4 weeks storage at 15° to 20° C., the loss in weight being about 0.1%. After 6 weeks storage at 35° the loss in weight was about 1.7%, the mixture still being sensitive.

Example 4

A mixture of 2% magnesium oxide and 1% basic magnesium carbonate was used as in Example 1 instead of magnesium oxide alone. The loss in weight after 4 weeks at 15° to 20° C. was less than 0.1%.

Example 5

The ingredients and proportions were as in Example 1, but the magnesium oxide was first mixed in with the powdered sodium nitrite by

gentle agitation, whereupon the powdered ammonium chloride was introduced while continuing the gentle agitation. The material so obtained had a finely granular form which enabled it to run freely, and rendered it suitable for loading.

Example 6

Equimolecular quantities of sodium nitrite and ammonium chloride with 2% calcium carbide, the calcium carbide being first milled with the sodium nitrite and after it had been well distributed the ammonium chloride was introduced and milling was continued for a period time. The material was then pelleted to facilitate loading.

I claim:

1. A blasting device of the non-detonating gas-generating type comprising a pressure-resisting shell, a pressure-responsive venting member disposed in said shell adapted to permit the escape of gases from said shell at a predetermined and considerable pressure, and a gas-producing agent confined within said shell comprising a non-detonating mixture of an alkali metal nitrite, an ammonium salt, and a stabilizer consisting of a solid inorganic substantially insoluble material, substantially incapable of undergoing metathesis with said ammonium salt, selected from the group consisting of the oxides, carbonates, and carbides of the alkaline earth metals, and the oxides, hydroxides, carbonates, and basic carbonates of magnesium and zinc.

2. A blasting device of the non-detonating gas-generating type comprising a pressure-resisting shell, a pressure-responsive venting member disposed in said shell adapted to permit the escape of gases from said shell at a predetermined and considerable pressure, and a gas-producing agent confined within said shell comprising a non-detonating mixture of an alkali metal nitrite, an ammonium salt, and a stabilizer selected from the group consisting of the oxides, carbonates, and carbides of the alkaline earth metals, and the oxides, hydroxides, carbonates, and basic carbonates of magnesium and zinc.

3. The blasting device of claim 1, wherein said stabilizer is a dehydrating agent.

4. The blasting device of claim 1, wherein said stabilizer is a basic oxide.

5. The blasting device of claim 1, wherein said stabilizer is the salt of a basic oxide and a weak acid.

6. The blasting device of claim 1, wherein said stabilizer is present to the extent of between .5% and 5.0% by weight of said gas-producing agent.

JAMES TAYLOR.