March 22, 1960 I. O. LEWIS 2,929,325

PACKAGES CONTAINING MATERIALS FOR USE IN BLASTING OPERATIONS

Filed Nov. 21, 1955

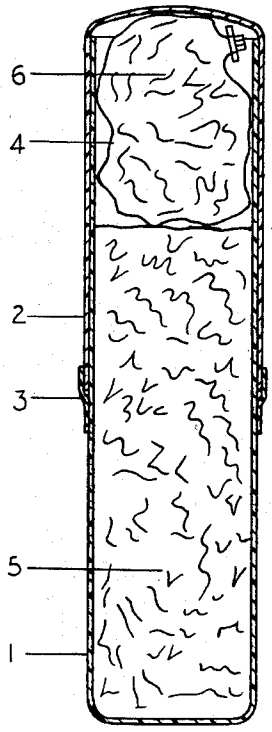

FIG. 1

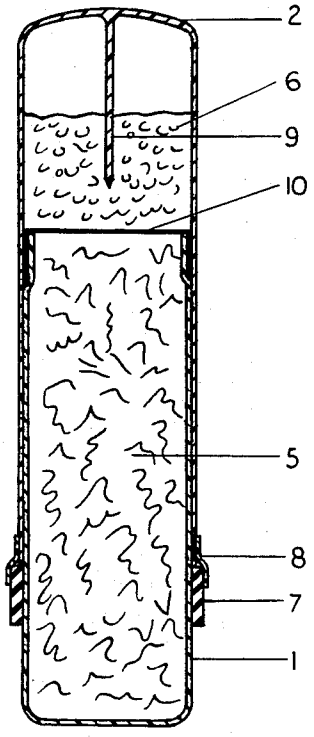

FIG. 2

INVENTOR
IDWAL OWEN LEWIS

BY Cushman, Darby & Cushman
ATTORNEYS

United States Patent Office 2,929,325
Patented Mar. 22, 1960

2,929,325

PACKAGES CONTAINING MATERIALS FOR USE IN BLASTING OPERATIONS

Idwal Owen Lewis, Ardrossan, Scotland, assignor to Imperial Chemical Industries Limited, London, England, a corporation of Great Britain

Application November 21, 1955, Serial No. 548,212

Claims priority, application Great Britain February 25, 1955

9 Claims. (Cl. 102—24)

The present invention relates to the production and application of packages of materials suitable for use in blasting operations.

The explosive compositions employed for blasting operations are conventionally produced by mixing the ingredients together and packaging the resulting mixture as such in a container which, according to the nature of the explosive mixture and the situation in which it is required to be used, may be a thin paper wrapper, which may or may not be waxed, or a more substantial waterproof structure of a pliable or rigid construction, for example a rubberised cloth bag or a tinplate canister. More than 80 years ago, however, Sprengel proposed that there should be used for blasting operations explosive mixtures made up from individually non-explosive constituents which were to be separately transported to the scene of the blasting operation and brought together into contact there for the first time. This practice would have obvious advantages as regards safety in storage and transport of the materials required and consequently in the cost of their carriage. Sprengel described three methods by which what have come to be known as Sprengel explosives could be made up.

Briefly, Sprengel's three methods consisted in mixing at the scene of the blast either a liquid non-explosive oxidising agent with a liquid non-explosive fuel or with a solid non-explosive fuel, or a liquid non-explosive fuel with a solid non-explosive oxidising agent. In certain countries the operation of bringing together non-explosive oxidising agents and non-explosive fuels at the scene of the blast is an operation that can only be carried out in accordance with conditions laid down in enactments relating to explosives, but this does not detract from the advantages to be gained in respect of the cost of storage and transport of the non-explosive ingredients to the place where this operation is to be conducted. The solid non-explosive oxidising agents specified by Sprengel were the chlorates and perchlorates of the alkali metals and alkaline earth metals and the nitrates of the alkali metals and alkaline earth metals which are not hygroscopic. The liquid fuels he suggested included carbon bisulphide, nitro-benzene, alcohols and oils, and the liquid oxidising agents suggested by him were oxy-acids, particularly nitric acid. The liquid oxygen explosives of commerce and those chlorate explosives in which a stick or the like of potassium chlorate is dipped in an oil at the scene of the blast are obviously in accordance with the principles enunciated by Sprengel. Sprengel stated that the mixing in this way of solid non-explosive oxidising agents and solid non-explosive combustible agents had been tried and abandoned as impracticable.

It does not appear to have occurred to Sprengel that in the production of an explosive whose ingredients were to be mixed on the spot that ammonium nitrate would present certain advantages over the chlorate, perchlorates and nitrates of the alkali and alkaline earth metals. When unmixed with self-explosive sensitisers or with

organic or inorganic fuels, ammonium nitrate is a compound that can only be caused to detonate with considerable difficulty, and in practice ammonium nitrate unmixed with other ingredients may be stored and transported otherwise than as an explosive. Although in the great majority of the ammonium nitrate explosive of commerce the composition contains a self-explosive ingredient of an oxidisable nature, or a self-explosive ingredient and an oxidisable ingredient which can be oxidised by the ammonium nitrate, it is nevertheless possible to prepare compositions made up from ammonium nitrate and solid fuels alone without introducing any self-explosive ingredient as a sensitiser for the ammonium nitrate, which will propagate their own detonation provided they are used in charges of sufficient diameter and are sufficiently primed. In producing such compositions the ammonium nitrate has usually been brought into very intimate admixture with the solid fuel, for instance by grinding them together or by a wet impregnation technique.

The present invention depends on the fact that it is possible to produce exposive charges of sufficient capacity for commercial blasting operations by simple shaking together of separate charges consisting respectively at least predominantly of dry ammonium nitrate particles and of particles of a solid fuel devoid of explosive constituents and consisting for example at least predominatingly of dried vegetable tissue carbonaceous material, which may if desired or if necessary include as a minor constituent particles of a metal oxidisable by the ammonium nitrate and known to be capable of increasing the sensitivity of ammonium nitrate explosives devoid of self-explosive constituents, the amount of said solid fuel being sufficient to provide an at least approximately oxygen balanced mixture, for instance an accurate oxygen balanced mixture or one having an oxygen deficiency or excess not exceeding 5% of that theoretically required to provide steam, carbon dioxide and nitrogen as the gaseous products of its self combustion.

Thus, the invention has for its principal object the provision of a novel package arrangement containing materials for use in blasting operations, and also the provision of a novel process for preparing an explosive composition which comprises initially preparing the novel package arrangement, referred to.

Further objects and advantages of the invention will be in part obvious and in part pointed out hereinafter.

The novel features of the invention may be best made clear from the following description and accompanying drawings in which:

Figure 1 is a longitudinal section view through a package arrangement embodying the invention; and

Figure 2 is a longitudinal sectional view through another form of package arrangement embodying the invention.

A package according to the invention consists of a substantially cylindrical waterproof container of greater length than diameter enclosing two non-explosive charges kept apart from one another by an internal separation, wherein one charge consists at least predominantly of ammonium nitrate particles and the other charge consists of particles of a solid fuel, as for instance one which comprises dried vegetable tissue carbonaceous material, sufficient in amount to provide an at least approximately oxygen balanced mixture with the first mentioned charge, wherein the volume of said container slightly exceeds that of the combined bulk of said charges, and wherein the separation continues to serve as such until it is purposely modified to act no longer in this way.

As the dried vegetable tissue carbonaceous material there may be used for instance sawdust and woodmeals of ordinary or low density woods, and barks, comminuted vegetable piths, cereal meals, comminuted cereal husks

and straws, comminuted peat and lignite, coal and anthracite dusts. The state of division of the ammonium nitrate and of the dried vegetable tissue carbonaceous material influences the sensitiveness of the resulting mixture and its capacity for propagating its own detonation, which also depend on the internal diameter of the container. Depending on the degree of sensitiveness to initiation and propagation required for the cartridge, e.g. whether it is required to be effective with a detonator alone or whether a booster explosive cartridge will be present to prime it, and on the state of division of the particles of the ammonium nitrate and the dried vegetable tissue carbonaceous material, it may be necessary to include in the fuel particles a metal powder capable of acting as a sensitiser. For this purpose aluminium is very effective especially if at least a portion of the aluminium is in the paint fine state of division.

The body of the waterproof container is advantageously somewhat rigid and it may be made of metal, plastic or stout waxed paper. One suitable form of construction of the container is in the form of a cylindrical cup with a detachable substantially cylindrical lid also in the form of a cup, the internal separation between the ammonium nitrate particles and the fuel particles being provided by enclosing either the ammonium nitrate particles or preferably the fuel particles in a closed internal container, for instance of rubber or plastic or textile coated therewith, which is removed by the operator after he has removed the lid of the outer container, and whereof the contents are spilled by him into the outer container, the lid of the outer container then replaced, and the container with its contents thereafter shaken or tumbled in order to mix the ammonium nitrate with the fuel particles. Such a form of construction of the cartridge is illustrated in Fig. 1 wherein **1** is a waxed paper cylindrical cup closed at its lower end; **2** is a lid of similar material capable of being pushed over the open end of the container for a considerable distance; **3** is a strip of adhesive serving to maintain a waterproof joint. Occupying the greater portion of the volume of the inner cup is the charge **5** of loose ammonium nitrate particles and a rubber bag **4** situated above the charge **5** and containing the charge **6** of the fuel particles, comprising the dried vegetable tissue carbonaceous material.

When the contents of the cartridge are to be mixed the waterproof tape **3** is unwound, cup **2** is removed, bag **4** is opened and its contents are poured into cup **1**. Cup **2** is replaced and the contents are shaken or tumbled together. It is arranged that there is still some free space unoccupied by the ammonium nitrate and the fuel particles during the mixing operation so as to permit this to be carried out effectively. After mixing has been completed, cup **2** is brought down over cup **1** as far as it will go so as to minimise the unoccupied space of the contents of the cartridge. If the cartridge is to be stored the tape may conveniently be replaced.

In another form of the invention the container body is in the form of a cup completely separated by a septum of a soft elastic material, for instance rubber, in a state of tension, into a compartment containing preferably the ammonium nitrate particles and a compartment containing the solid fuel particles and a cup-shaped lid which has a piercer member projecting from the interior surface of its closed end towards said septum, the container body having a stop member attached externally to it, normally in position to abut the open end of the lid to hold the piercer out of contact with said septum, said stop member being however capable of manual removal by the operator to permit the piercer to be advanced forcibly on to and through said septum. The stop member may be for example a tightly fitting rubber band or a wrapping of adhesive tape. As the septum is in a state of tension, whenever it is pierced it tends to split so as to permit it to spring back towards the cylindrical wall, and thus opens up a communication between the two compartments of the closed container wide enough to permit effective mixing of the ammonium nitrate and the fuel when the still closed container is shaken or tumbled.

An embodiment of this form of the invention is illustrated in Fig. 2, wherein the numbers **1**, **2**, **5** and **6** have the same significance as in Fig. 1. In Fig. 2, **9** is a pin attached to the cup **2** and projecting axially with its point towards a thin rubber membrane **10** stretched over the mouth of the cup **2**. A stout rubber ring **7** stretches round a portion of the cylindrical surface of the cup **1** and provides a stop for the cup **2** and thus prevents the pin **9** from puncturing the rubber cup **2** until the operator removes a rubber tape seal **8** and forcibly retracts the ring **7** towards the bottom of the cup **1**.

When this has been done the cup **2** can be forced further on to the cup **1** so as to cause the pin **9** to pierce the rubber cup **10**, which immediately tends to break up and to form an effective communication for mixing the charges when the cartridge is shaken by the operator. The joint between cups **1** and **2** is not so tight as to prevent the air at the top of cup **2** from escaping between the two cups when cup **2** is brought down.

The sensitiveness of the resulting explosive composition is improved the finer is the grist size of the ammonium nitrate and the higher is the specific surface of the solid fuel, e.g. the higher is the specific surface of the vegetable tissue carbonaceous material.

For a container having an internal diameter exceeding about 5" it will usually be possible to obtain compositions capable of propagating their detonation effectively under the influence of a booster cartridge from ammonium nitrate and the vegetable tissue carbonaceous material alone. By however including aluminium particles, whereof at least a portion is in a paint fine state of division, amongst the fuel particles there can be produced mixtures which will be sensitive to initiation by commercial detonators and will propagate their detonation satisfactorily even in diameters down to 2" or even less.

Thus, when there is used ammonium nitrate ground in an attrition mill until 100% passes a 100 B.S. screen, 85% passes a 170 B.S. screen and 70% passes a 240 B.S. screen in one compartment of the cartridge and fuel consisting of dry vegetable tissue carbonaceous materials and aluminium in the other compartment of the cartridge, and these are shaken together at the scene of the blasting operations the resulting mixtures are sensitive to No. 6 commercial detonators, and propagate their detonation in 4 oz. cartridges of 1¼" diameter when the propagations are such as to produce mixtures of the following compositions.

	Percent		
Attrition mill. Ammonium Nitrate	90	90	87
Paint fine aluminium (70% passing 240 BS screen)	2	1	3
Granular aluminium (25% passing 240 BS screen)	3	2	0
Bagasse	5	7	0
Woodflour	0	0	10

If a package according to the invention is 2" in diameter and 6" long and contains as one charge ammonium nitrate of such grist size that 100% passes a 36 B.S. screen, 80% passes a 30 B.S. screen and 30% passes a 100 B.S. screen and as the other charge a fuel consisting of a mixture of cork dust, ground charcoal and paint fine aluminium, wherein the relative proportions of the ammonium nitrate and the three ingredients of the fuel are such that when the two charges are mixed together by giving the package a few shakes after modifying the separation between the charges for it no longer to act in this way an explosive mixture of the following composition:

	Percent
Ammonium nitrate	91
Cork dust	2.75
Charcoal	3.50
Paint fine aluminium	2.75

is formed and thus a blasting cartridge which is sensitive to a No. 6 commercial lead azide detonator and which has a power of 80% of blasting gelatine.

What I claim is:

1. A package comprising two non-explosive charges, one of said charges consisting predominantly of ammonium nitrate particles and the other of said charges being particles of a solid fuel in an amount sufficient to provide a substantially oxygen balanced mixture with the first mentioned charge, a waterproof container of sheet material enclosing said charges, said container being of a volume which slightly exceeds the combined bulk of said charges, separating means within said container for maintaining said charges initially separate one from the other, said separating means being removable whereby mixing of said charges within the container may be accomplished by removing said separating means and shaking said container.

2. A package as claimed in claim 1 wherein said particles of a solid fuel comprise dried vegetable tissue carbonaceous material.

3. A package as claimed in claim 1 wherein said particles of a solid fuel include a metal powder capable of acting as a sensitiser.

4. A package as claimed in claim 3 wherein the metal powder is aluminium at least a portion of which is in a paint fine state of sub-division.

5. A package as claimed in claim 1 wherein the body of the waterproof container is made of metal.

6. A package as claimed in claim 1 wherein the separation between the ammonium nitrate particles and the fuel particles is provided by enclosing the fuel particles in a closed internal container.

7. A package as claimed in claim 1 wherein the internal separation is a septum of soft elastic material in a state of tension.

8. A process for preparing an explosive composition which comprises initially preparing a closed package containing two non-explosive charges separated by a removable separating member, one of said charges consisting predominantly of ammonium nitrate particles and the other charge comprising particles of solid fuel in an amount sufficient to provide a substantially oxygen balanced mixture with said first charge; maintaining said charges separated until said explosive composition is to be used and then removing said separating member and mixing said charges by shaking said package to form said explosive composition.

9. The process of claim 8 wherein said charges are kept separated until said package is positioned adjacent the point where said composition is to be used.

References Cited in the file of this patent

UNITED STATES PATENTS

1,298,500	Hardel	Mar. 25, 1919
2,214,202	Odell et al.	Sept. 10, 1940
2,324,363	Cobb	July 13, 1943
2,356,149	Davis	Aug. 22, 1944
2,426,269	Hopkins	Aug. 26, 1947
2,487,236	Greenberg	Nov. 8, 1949
2,489,610	Barker	Nov. 29, 1949
2,615,443	Sukacev	Oct. 28, 1952
2,704,706	Audrieth	Mar. 22, 1955
2,721,552	Nosik	Oct. 25, 1955
2,773,591	Jensen	Dec. 11, 1956

FOREIGN PATENTS

2,836	Great Britain	of 1882
1,027,487	France	Feb. 18, 1953