

## UNITED STATES PATENT OFFICE

2,615,800

COATED GRANULAR EXPLOSIVE  
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Serial No. 23,622

2 Claims. (Cl. 52—11)

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This invention relates to explosive compositions containing water-soluble or hygroscopic compounds. More particularly, it relates to ammonium nitrate compositions of reduced hygroscopicity and water solubility, and to processes of producing same.

One of the most essential properties of an explosive is that it remain relatively stable during storage. Hence, if any particular degree of decomposition takes place over even a relatively long period of time, it becomes exceedingly difficult to use the explosive with the greatest degree of effectiveness because of the impossibility of knowing its exact explosive power at the time it is used.

Deterioration of explosives may be due to a number of different causes. One of these is the effect of moisture which becomes of particular importance in case the explosive or one of its ingredients is either water soluble or hygroscopic as is the case with ammonium nitrate, explosives of the dynamite type, black powder, etc. Ammonium nitrate in particular is a very extensively used ingredient in present day high explosives of the dynamite type where it has replaced nitroglycerine in increasingly large proportions for a variety of reasons, particularly because it possesses high explosive strength, has outstanding safety properties, and is economically attractive. While ammonium nitrate explosives have been used with great success, one disadvantage of this ingredient has always been evident, namely, that it has great affinity for water. Because of this fact, there is a tendency for explosive compositions high in ammonium nitrate to become hard and set on storage in the presence of even small amounts of moisture. This results in decreased sensitivity of the explosive and a lesser degree of uniformity in performance. The water resistance of ammonium nitrate explosives is generally low because of the presence of this very soluble salt.

Numerous attempts have been made in the past to reduce the effects of moisture on explosives affected thereby. Altho many attempts which have been made in the past to reduce the effect of moisture on explosives of the above type the efforts have most commonly been directed towards coating the individual particles of the explosive with some waterproofing or water-repellent material such as waxes, cellulose esters, resins, oils, soaps, sodium silicate, and the like. None of these materials has been entirely successful for various reasons. In some cases complete coverage of the particles has not been ob-

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tained, in others the coating material is affected by some other constituent of the explosive, and in still others the coating material has had an undesirable effect upon the explosives by either slowing up or reducing the power of the explosive.

I have now discovered that water-soluble or hygroscopic explosives can be satisfactorily protected from the effect of moisture without the disadvantages of the materials previously tried for this purpose by coating the particles of the explosives or the constituents thereof which are affected by water with the compound 2,2-dinitropropane. This material, in addition to being highly effective in protecting the ammonium nitrate, or other explosives, or ingredients of the explosives, from the effects of moisture possesses the highly important property of not materially affecting the explosive characteristics of the materials which have been treated with it. It has a sensitivity comparable with that of trinitrotoluene and does not explode in five seconds at a temperature of 360° C. and in 300 minutes at 135° C. The ballistic power of 2,2-dinitropropane is 123 (T. N. T.=100), and while it can be detonated it is relatively stable. When ignited, it burns with a moderately vigorous flame. These properties, therefore, make 2,2-dinitropropane ideally suited for treating ammonium nitrate or other water-soluble or hygroscopic explosives, making it resistant to the action of moisture.

The 2,2-dinitropropane can be applied to the ammonium nitrate, or other explosives, or ingredients of explosives, in a number of ways with equally satisfactory results and it is understood that I am limited to no particular procedure. Suitable methods which may be mentioned include coating the material to be protected with molten 2,2-dinitropropane (M. P. 50–53° C.), or with a suitable solution thereof, the latter procedure being, in general, both more economical and more easily effected.

The 2,2-dinitropropane is readily soluble in such solvents as methanol, ethanol, acetone, methyl ethyl ketone, ethyl acetate, ethyl ether, dioxane, methyl ether of ethylene glycol, nitromethane, 2-nitropropane, benzene, ethylene chloride, acetic acid, and the like, and is somewhat soluble in cyclohexane, ethanol amine, and ethylene glycol, but only very slightly soluble in water, caustic solution, petroleum ether, and n-heptane.

The particular method of applying the 2,2-dinitropropane in accordance with my invention selected will depend on a number of factors such as the character and cost of the explosive to be treated, the availability and cost of the sol-

vent, and the thickness of the coating of 2,2-dinitropropane required, the type of equipment available, and the like. Ammonium nitrate crystals, for example, may be coated by tumbling the crystals with softened 2,2-dinitropropane until a thorough coating has been secured. Or, the crystals may be sprayed with a solution of the 2,2-dinitropropane in a solvent which does not affect the ammonium nitrate, or other explosive, as for example, benzene. Alternately, the crystals may be passed counter-current to a mist of solution of 2,2-dinitropropane, or the crystals may be dipped in the solution or the solution directly poured over the crystals. In any case, after contacting the crystals in a solution of 2,2-dinitropropane it is, of course, necessary to remove the solvent by some suitable means such as evaporation, preferably in the manner so as to recover the solvent used. The removal of the solvent then leaves a coating of 2,2-dinitropropane on the crystals, the amount of 2,2-dinitropropane coating depending upon the concentration of the solution of 2,2-dinitropropane employed.

The concentration of 2,2-dinitropropane used in my process will, of course, depend upon the solubility in the particular solvent selected, the method of coating employed, and the thickness of coating desired on the crystals. While the latter may vary rather widely, it is in general desired to use a solution of sufficient concentration to give a coating amounting from about 0.1% to about 5.0% by weight of the dry ammonium nitrate or other explosives. The lower limit is determined by the degree of moisture protection desired and the effectiveness of the coating material whereas the upper limit is determined by the effect of the 2,2-dinitropropane upon the particular material being coated, and the relative costs of the 2,2-dinitropropane and the material being coated. Because of the explosive characteristics of 2,2-dinitropropane these latter factors are in general more important than in the case with materials previously used as ingredients of coatings because of the deleterious effects of these prior art materials on the explosives.

The protective action of 2,2-dinitropropane may be prolonged by using it in combination with moderate amounts of materials serving to

retard the volatility of the 2,2-dinitropropane, such as, for example, high-boiling, relatively non-volatile liquids, like butyl stearate and dibutyl phthalate or low-melting resins such as rosin and beeswax. Any volatility retarder of such types may be employed provided it is compatible with the 2,2-dinitropropane in the amount used, which is preferably within the range of 5% to 30% based on the weight of the 2,2-dinitropropane.

Now having described my invention, what I claim and desire to protect by Letters Patent is:

1. A hygroscopic, water-soluble explosive in granular form coated with a mixture comprising at least about 0.1% by weight of 2,2-dinitropropane based on the weight of said explosive and from about 5 to 30% of a high-boiling, relatively non-volatile liquid, based on the weight of said 2,2-dinitropropane, said liquid being inert to and compatible with said 2,2-dinitropropane.

2. Ammonium nitrate in granular form coated with a mixture comprising at least about 0.1% by weight of 2,2-dinitropropane based on the weight of said ammonium nitrate and from about 5 to 30% of a high-boiling, relatively non-volatile liquid, based on the weight of said 2,2-dinitropropane, said liquid being inert to and compatible with said 2,2-dinitropropane.

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#### REFERENCES CITED

The following references are of record in the file of this patent:

#### UNITED STATES PATENTS

Number	Name	Date
506,032	Blomen	Oct. 3, 1893
745,802	Edeleanu et al.	Dec. 1, 1903
987,079	Miller	May 14, 1911
1,276,537	Johnson	Aug. 20, 1918
1,627,863	O'Neil	May 10, 1927
1,648,861	O'Barr	Nov. 8, 1927
1,700,085	Scott	Jan. 22, 1929
2,325,064	Lawrence	July 27, 1943
2,338,120	Lawrence	Jan. 4, 1944

#### OTHER REFERENCES

Hass et al., "The Nitroparaffins," Chem. Reviews, vol. 32, pp. 386-388, June 1943.