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[54] **NH_4NO_3-NITROCELLULOSE COATED WITH NITROCELLULOSE AND AL**

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[51] **Int. Cl.** **C06b 19/02**

[58] **Field of Search** ..... 149/8, 38, 114; 264/3 E; 102/49.1

[56] **References Cited**

UNITED STATES PATENTS

3,367,805	2/1968	Clay et al.	149/114 X
3,489,593	1/1970	Cohen et al.	149/8 X

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[57] **ABSTRACT**

A novel propellant composition comprises granules of ammonium nitrate and nitrocellulose, in the ratio between 0.22 and 1, the granules being coated with at least one layer of nitrocellulose containing powdered aluminum, the aluminum being in the proportion between 1 and 5 percent by weight of the compositions. The composition exhibits improved water resistance, lower water absorbency and ignition is facilitated. According to one embodiment, nitrocellulose is replaced by polyvinyl nitrate in the proportion of up to 40 percent based on the weight of the mixture of polyvinyl nitrate and nitrocellulose.

16 Claims, No Drawings

NH_4NO_3-NITROCELLULOSE COATED WITH NITROCELLULOSE AND AL

This invention is concerned with propellant powders comprising ammonium nitrate and nitrocellulose.

We have developed a propellant powder based on ammonium nitrate and nitrocellulose, which has a number of advantages over conventional nitroglycerine-containing propellant powders.

According to the present invention, we provide a propellant powder comprising ammonium nitrate and nitrocellulose, in which the powder is in the form of granules having thereon at least one coating layer of nitrocellulose containing powdered aluminium. The nitrocellulose may be replaced in part by polyvinyl nitrate.

The ammonium nitrate used is preferably of fertiliser quality and is preferably crushed and screened so as to have a particle size in the range 0 to 350 μ. The nitrocellulose used is preferably of the type with a medium (12.8 to 13.45 percent of nitrogen) or low (less than 12.8 percent of nitrogen) nitrogen content. The weight ratio between the nitrocellulose and the ammonium nitrate in the powder is preferably from 0.22 to 1.

The quantity of nitrocellulose used for coating is preferably from 4 to 8 percent by weight of the final powder. Where more than one coating layer is present, they may contain nitrocellulose of the same nitrogen content or nitrocelluloses of different nitrogen contents. The quantity of aluminium used is preferably from 1 to 5 percent by weight of the final powder. The aluminium powder is preferably in the form of flakes having a particle size of 5 to 15 μ. The aluminium may be incorporated in one or more nitrocellulose coating layers or be deposited upon the final nitrocellulose coating layer.

The role of the aluminium is two fold: firstly, it facilitates ignition of the powder and secondly, it improves the water-resistance and reduces the water-absorbency of the powder granules.

The powder preferably contains a conventional stabilising agent, such as diphenylamine or 2-nitrodiphenylamine, in a quantity of 1 to 2 percent by weight based on the ammonium nitrate and nitrocellulose.

The advantages of the propellant powder according to the invention over conventional powders containing nitroglycerine are, as follows:

a. in addition to its higher potential and its improved resistance to penetration by water and to uptake of humidity, it has a lower erosiveness (which results in decreased dirtying of weapons and decreased smoke formation), a greater quickness and a lesser degression;
b. the granule form facilitates loading of cartridges;
c. the total absence of exuding imparts exceptional chemical stability to the powder according to the invention.

The propellant powder according to the invention is thus particularly suitable for use for the same purposes as conventional propellant powders containing nitroglycerine and, more particularly, in auxiliary propellant elements for mortars which are collectively known as mortar secondary charges.

The present invention also comprises a process for the production of the propellant powder according to the invention, which comprises coating granules of ammonium nitrate and nitrocellulose possibly which may, if desired, contain a stabilising agent, by immersion in or spraying with a collodion of nitrocellulose in ethanol containing aluminium powder and, if desired, a stabilising agent and camphor. The quantity of nitrocellulose for coating is preferably from 4 to 8 percent by weight of the final powder, and that of the aluminium is preferably from 1 to 5 percent by weight of the final powder.

In order that the invention may be more fully understood, the following example is given by way of illustration only:

EXAMPLE

A mixture of the following constituents was mixed in a Werner mixer for one-half hour:

70 parts by weight of ammonium nitrate (fertiliser quality, crushed to a particle size in the range 0 to 350 μ),
30 parts by weight of nitrocellulose of 12.80 percent nitrogen content,
18 parts of acetone,
3.5 parts of ethanol (or isopropanol)

To this were added 1.30 parts of diphenyl-amine as stabilising agent.

The mixture obtained was then formed into granules by extrusion and cutting in conventional manner.

The granules were subjected to two successive immersions:

i. a first immersion in water to reduce the ammonium nitrate content to 80% of the nitrate introduced, and
ii. a second immersion in ethanol to eliminate traces of nitrate deposited on the surface of the granules.

Volatile materials were then eliminated by draining and drying the granules.

The granules were then glazed by spraying them with a coating solution containing the following ingredients:

Ingredients	% by weight
Nitrocellulose (12.8% nitrogen content)	2.30
Diphenylamine (stabilising agent)	0.05
Aluminium powder (having a particle size of 5-15μ)	3.90
Synthetic camphor	0.65
Ethanol (96°)	74.1
Acetone	19

The nitrocellulose content of the coating obtained was from 4 to 8 percent by weight of the final powder, and the aluminium content was 1.6 percent by weight of the final powder.

The powder granules were then dried to eliminate the alcohol introduced during glazing.

The powder obtained was in the form of granules having a mean diameter of 1.22 cm and a mean length of 1.32 cm, and consisting of a core of ammonium nitrate and nitrocellulose and a coating of nitrocellulose containing aluminium powder. It had the following composition:

	% by weight
Ammonium nitrate	55.8
Nitrocellulose	40.93
Diphenylamine	1.17
Aluminium powder	1.6
Camphor	0.5

Preferred embodiments of the invention can also be obtained by modifying the procedure of the above Example as follows; the ratio (nitrocellulose/ammonium nitrate) may be varied between 0.22 and 1, the acetone

and ethanol (or isopropanol) wetting proportion, that is the ratio solvent/dry materials to be wetted may be varied between 0.3 and 0.5, the diphenylamine content may be varied between 1 and 1.5 percent by weight, relative to the solids content of the mixture, or the diphenylamine may be replaced by 2-nitrodiphenylamine, at the rate of 1.5 to 2 percent by weight relative to the solids content.

Similarly, in the glazing stage, the powdered aluminium content may be varied between 1 and 5 percent based on the weight of the final powder.

In addition, a nitrocellulose may be used having a nitrogen content lower than 13.45 percent, preferably lower than 12.8 percent, or part of the nitrocellulose may be replaced by polyvinyl nitrate in the proportion up to 40 percent by weight of the mixture of nitrocellulose and polyvinyl nitrate.

With regard to resistance to water penetration, the influence of the aluminium may be illustrated by the following experiment:

An ammonium nitrate and nitrocellulose powder in the form of granules having a coating layer of nitrocellulose, but not containing aluminium, loses the whole of its ammonium nitrate by an immersion in boiling water for 10 minutes. An otherwise similar powder in which the coating layer contains aluminium, retains 30 percent of its ammonium nitrate following immersion in boiling water for 1½ hours.

The characteristics of a powder according to the invention filled into a cartridge and suitable for use as a mortar secondary charge, are compared in the following Table with the characteristics of a currently available powder known as Balistite, in the form of grains of 0.15 mm diameter, also filled into cartridges for use as a mortar secondary charge.

Total charge (Cartridge powder	Powder	Velocity (m/s)	Pressure (Bars)
9.9g	Of the invention	128.2	280
13.2g	Of the invention	145.8	360
9.9g	Balistite	129.2	270
13.2g	Balistite	149	320

What we claim is:

1. A propellant composition comprising ammonium nitrate and nitrocellulose, which is in the form of granules having thereon at least one coating layer of nitrocellulose containing powdered aluminum.

2. A composition according to claim **1**, which is a powder and in which the weight ratio of nitrocellulose : ammonium nitrate is from 0.22 to 1.

3. A composition according to claim **1**, in which the quantity of nitrocellulose in said coating layer or layers is from 4 to 8 percent by weight of the final composition.

4. A composition according to claim **1**, in which the aluminum content is from 1 to 5 percent by weight of the final composition.

5. A composition according to claim **1**, in which the aluminum powder is in the form of flakes having a particle size of from 5 to 15 μ.

6. A composition according to claim **1**, in which the aluminum powder is deposited on the final layer of the nitrocellulose coating.

7. A composition according to claim **1**, in which the nitrocellulose has a nitrogen content of up to 13.45 percent by weight.

8. A composition according to claim **1**, which additionally comprises a stabilizing agent.

9. A composition according to claim **8**, which contains from 1 to 2 percent based on the combined weights of the ammonium nitrate and the nitrocellulose, of a stabilizing agent selected from diphenylamine and 2-nitrodiphenylamine.

10. A mortar secondary charge comprising a propellant composition as claimed in claim **1**.

11. A process for the production of a propellant powder comprising ammonium nitrate and nitrocellulose, which comprises forming granules of ammonium nitrate and nitrocellulose, coating said granules with a solution of nitrocellulose in ethanol containing aluminum powder.

12. A process according to claim **11**, in which the solution additionally contains camphor.

13. A process according to claim **11**, in which coating is effected under such conditions that the nitrocellulose content of the coating is from 4 to 8 percent by weight of the final composition.

14. A process according to claim **11**, in which coating is effected under such conditions that the aluminum content of the coating is from 1 to 5 percent by weight of the final composition.

15. A process according to claim **11**, in which coating is effected by several applications using solutions of nitrocellulose of the same nitrogen content or different nitrogen contents.

16. A composition according to claim **1** which additionally comprises polyvinyl nitrate in the proportion up to 40 percent of the weight of said nitrocellulose, said polyvinyl nitrate being in partial substitution of said nitrocellulose.

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