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PROPELLANT AND PROCESS FOR MANUFACTURING

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The invention described herein may be manufactured and used by or for the Government for governmental purposes, without the payment to me of any royalty thereon.

This invention relates to a propellant and to a process of manufacturing the same.

In the development of propellent powders for use in high velocity small arms ammunition, it has been found necessary to employ compositions of high potential or energy content and to coat such powders with some slow burning material to retard the rate of burning of the powder in the initial stages of its combustion. Double base powders or powders containing nitroglycerin are commonly used to provide the high potential required but up to the present time the attempts to coat such powders to obtain the highest possible velocities within practicable pressure limits have not been altogether successful. The difficulty has existed that when nitroglycerin powders are provided with a coating to give the desired velocities and pressures, a marked increase in the rate of burning of the powders occurs after they are stored for a brief time at slightly elevated temperatures, this resulting in extremely high pressures in a relatively short time after the ammunition is loaded.

The possible causes of this difficulty are believed to be one or both of the following factors. The coating agent gradually dissolves in the liquid nitroglycerin contained in the powder and thus its effect in retarding the rate of burning is eliminated; the higher the temperature of storage the faster the solution occurs and the sooner the powder increases in quickness of burning; or if the coating applied to the powder is relatively insoluble in nitrogylcerin the solution of the coating can occur only to a limited extent but the tendency of nitroglycerin to volatilize is always present and causes the nitroglycerin to gradually diffuse into the coating, thus increasing the speed of burning of the coating so that the original effectiveness of the coating is lost.

With the above considerations as a basis, experiments have been conducted in an effort to work out a method of preparing or formulating coated nitroglycerin powders which will not change in ballistics upon exposure to elevated temperatures such as may be encountered in storage. It has been found that if the nitroglycerin is first saturated with the material which is to be used as coating agent, the nitroglycerin powder can then be coated with this particular agent and retain its effectiveness even when subjected to a temperature of 120° F. for several months; and

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further the volatility of the nitroglycerin can be materially reduced either by dissolving in it the material to be used as coating agent or a high potential explosive which functions ballistically similar to nitroglycerin. Obviously both procedures may be used in one and the same powder. Specific examples of powders formulated in accordance with the above procedures are as follows:

a

	Per cent
Nitrocellulose	77.8
Nitroglycerin	20
Dinitrotoluene	1.2
Diphenylamine	1

b

	Per cent
Nitrocellulose	71.2
Nitroglycerin	20
Dinitrotoluene	1.2
Trinitrotoluene	6.6
Diphenylamine	1

To each of these powders, after it was made of the proper grain dimensions, was added as a coating an amount of dinitrotoluene, actually 2 to 10%, such as is required to meet the ballistic requirements of the particular weapon.

It is noted that in each of the above powders 1.2% dinitrotoluene was used. This represents complete saturation of the nitroglycerin in the powder with dinitrotoluene as it was found by experiment that the latter is soluble in nitroglycerin to the extent of 6%. The second powder listed contains 6.6% of trinitrotoluene which represents saturation of the nitroglycerin with trinitrotoluene, the solubility of the latter in nitroglycerin having been found by experiment to be 33%. Powders made in accordance with the method described were loaded in caliber .30 ammunition and fired immediately after loading and then periodically during storage at 50° C. (122° F.) over a period of seven months. The measured velocities and pressures at the end of the storage period agreed closely with the values given by the ammunition before storage. In fact the differences were within the limits of experimental error, thus indicating that for all practical purposes the method of formulating the coated powders eliminated the difficulty of change in rate of burning which has existed in the past when coated nitroglycerin powders were used.

While it is known that dinitrotrotoluene has been used for years as a coating agent for nitrocellulose propellant powders, the method above outlined of avoiding the change in ballistics that occurs when it is used on nitroglycerin powders has not been previously disclosed. It is known further that trinitrotoluene has been used extensively as an ingredient of nitroglycerin powders but the above method of using it involving saturation of the nitroglycerin and then applying a coating agent which cannot dissolve in the nitroglycerin due to saturation of the nitroglycerin with the coating agent has not been previously disclosed so far as known. The above procedure effectively reduces the change in ballistics of coated nitroglycerin powders by preventing solution of the coating agent in the nitroglycerin or diffusion of the nitroglycerin into the coating or both.

The above examples of the method of preparing nitroglycerin-nitrocellulose powders which are to be coated with dinitrotoluene are given merely to demonstrate the principle which is involved in this invention. The general method is obviously applicable to nitroglycerin-nitrocellulose powders which are to be coated with any agent to retard the initial rate of burning of the powder. For instance dimethyldiphenylurea has been found to be soluble in nitroglycerin to the extent of 5.8%; if the former is used as coating agent it is also added to the powder composition in an amount such as is sufficient at least to saturate the nitroglycerin. Thus, for a powder containing 20% nitroglycerin, at least 1.16% of dimethyl-diphenylurea should be added to the powder, while a powder containing 40% nitroglycerin would require at least 2.32% of the urea derivative; after these amounts of the latter compound are added to the powder, any amount of the same compound desired may be used as a coating since none of the coating can dissolve in the saturated nitroglycerin. On the other hand if a coating agent is used which is entirely insoluble in nitroglycerin, as for example, nitroguanidine, ethylenedinitramine, etc., it is necessary to add to the powder composition another compound which is sufficiently soluble in nitroglycerin to reduce its volatility and thereby reduce the tendency of the nitroglycerin to diffuse into and be absorbed by the coating agent. While trinitrotoluene has been found especially effective for this, due to its high solubility in nitroglycerin; viz. 33%, tetryl with a solubility of 12% and other compounds soluble in nitroglycerin may be used to fulfill the purpose, subject, of course, to the limitation that the compounds dissolved in the nitroglycerin shall not cause objectionable decomposition of the nitroglycerin under the conditions of use.

I claim:

1. A propellent powder comprising nitrocellulose 77.8%, nitroglycerin 20%, dinitrotoluene 1.2%, a stabilizer 1%, and having a coating of dinitrotoluene 2 to 10%.

2. A propellent powder comprising nitrocellulose 71.2%, nitroglycerin 20%, dinitrotoluene 1.2%, a high potential explosive 6.6%, a stabilizer 1%, and having a coating of dinitrotoluene 2 to 10%.

3. A coated high potential double-base propellent powder comprising nitrocellulose, nitroglycerin saturated with dinitrotoluene, and a coating of dinitrotoluene.

4. A coated high potential double-base propellent powder, comprising nitrocellulose, nitroglycerin saturated with dinitrotoluene and with a high potential explosive, and a coating of dinitrotoluene.

5. A coated high potential double-base propellent powder comprising nitrocellulose, nitroglycerin saturated with dinitrotoluene and with a high potential explosive, and a coating insoluble in nitroglycerin and which retards the initial burning rate of the powder.

6. A coated high potential double-base propellent powder comprising nitrocellulose, nitroglycerin saturated with dimethyl-diphenylurea, and a coating of dimethyldiphenylurea.

7. A coated high potential double-base propellent powder comprising nitrocellulose, nitroglycerin saturated with material which as a coating for the powder retards its initial burning rate, and a coating agent of said material.

8. A coated high potential double-base propellent powder comprising nitrocellulose, nitroglycerin, an agent soluble in nitroglycerin to reduce its volatility, and a coating insoluble in nitroglycerin and which retards the initial burning rate of the powder.

9. A coated high potential double-base propellent powder comprising nitrocellulose, nitroglycerin, a high potential explosive soluble in nitroglycerin, and a coating insoluble in nitroglycerin and which retards the initial burning rate of the powder.

10. The process for the manufacture of coated nitroglycerin-nitrocellulose powders which comprises saturating the nitroglycerin with a material which as a coating for the powder retards its initial burning rate, and then applying a coating agent of said material.

11. The process for the manufacture of coated nitroglycerin-nitrocellose powders which comprises saturating the nitroglycerin with a material which as a coating for the powder retards its initial burning rate, saturating the nitroglycerin with a high potential explosive, and then applying a coating of a material which retards the initial burning rate of the powder.

12. The process for the manufacture of coated nitroglycerin-nitrocellulose powders which comprises saturating the nitroglycerin with a high potential explosive, and then applying a coating which is insoluble in nitroglycerin and which retards the initial burning rate of the powder.

13. The process for the manufacture of coated nitroglycerin-nitrocellulose powders which comprises adding to the nitroglycerin an agent for reducing its volatility, and applying a coating which is insoluble in nitroglycerin and which retards the initial burning rate of the powder.

14. A coated high potential double-base propellent powder, substantially stabilized against change in ballistic characteristics during storage at elevated temperatures, said base including nitrocellulose and nitroglycerin, and a coating for said base to retard the rate of burning of the powder in the initial stages of its combustion, said nitroglycerin containing a nitroglycerin soluble compound which renders the nitroglycerin non-diffusible into said coating material and of reduced volatility, and said coating being formed of a material which is insoluble in the modified nitroglycerin of the base.

15. The coated double-base propellent powder of claim 14, the material of said coating being normally soluble in the nitroglycerin and said nitroglycerin being substantially saturated with the material of the coating to render the coating insoluble therein.

16. A coated propellent powder comprising nitroglycerin saturated with a material which when used as a coating for the powder retards its initial burning rate, another explosive material, and a coating of a material which retards the initial burning rate of the powder.

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