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PROPELLANT POWDER AND PROCESS OF MAKING THE SAME

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This invention relates to propellant powders and process of making the same, and more particularly to powders composed of nitro-cellulose, and nitro-glycerin, adapted particularly for shot shells.

In the manufacture of nitro-cellulose-nitro-glycerin powders as heretofore produced, the procedure generally stated has been to finely divide the nitro-cellulose, add thereto and mix therewith the desired amount of nitro-glycerin and then subject the same to pressure so that the nitro-cellulose will become gelatinized by the nitro-glycerin. In accordance with one of the processes, the nitro-cellulose is pulped with water, the nitro-glycerin added in a fine stream of spray, the whole agitated to secure an emulsion of the nitro-glycerin and the attachment of the nitro-glycerin globules to the nitro-cellulose particles; the water is then strained off, the mixture subjected to pressure or rolling, dried and cut into grains. The pressing or rolling causes a low nitration nitro-cellulose to become gelatinized, but a high nitration nitro-cellulose may be only partly gelatinized. It has, therefore, been the practice to add a nitro-cellulose solvent such as acetone, to enhance the gelatinization. These methods however contemplate the gelatinization of the nitro-cellulose with nitro-glycerin by mixing and pressing, which increases the density and reduces the burning rate and results in a powder having a uniform density and burning rate throughout its mass; and the center of the grains will burn at the same rate as the exterior.

If, now, nitro-glycerin is added to ungelatinized nitro-cellulose, which has already been made up into sheets or cut up in grains, and if no pressure is used to break down the fiber structure, the surfaces only of the fibers will be gelatinized. This gelatinizing of the surface of the fibers will achieve a degree of waterproofing which is superior to an equal amount of nitro-glycerin equally distributed by pressure throughout the entire body of the nitro-cellulose. Surface gelatinization only reduces the burning rate of the exterior of the fibers, leaving the interior unchanged. The nitro-glycerin as it gelatinizes the nitro-cellulose will penetrate deeper and deeper, depending on the viscosity of the solution and the time of treatment, temperature and other conditions being the same. Furthermore, the gelatinization and the percentage of nitro-glycerin will decrease gradually from the outside towards the center, resulting in a powder having a progressive burning rate of a definite relation to the degree of penetration of the nitro-glycerin.

One of the objects of this invention, therefore, is to provide a process for producing powder, and a resultant powder grain, in which the nitro-cellulose is so surface-treated, i. e. coated or impregnated with nitro-glycerin as to secure a substantially water-proof grain having the desired ballistic properties.

Another object is to provide a process obviating the initial fine division of the nitro-cellulose but permitting the grain structure to be maintained throughout the process.

Another object is to provide a process obviating the preliminary stage in which the nitro-cellulose exists as discrete fibers by permitting the grain structure to be maintained throughout the process.

Further objects will appear from the detail description, in which will be described an illustrative embodiment of this invention; it will be understood, however, that this invention is susceptible of various embodiments other than those described.

Generally stated, in accordance with this invention, the nitro-cellulose grains, and more particularly ungelatinized grains, are treated with a solution of nitro-glycerin in a non-solvent for nitro-cellulose. The solvent for nitro-glycerin, which is a non-solvent for nitro-cellulose, is in accordance with one embodiment of this invention, volatile, so that this solvent can be, and is, subsequently evaporated. The resultant nitro-cellulose powder grain is, therefore, coated or impregnated with nitro-glycerin which partially fills the pores of the powder grain and is so deposited and in such a condition as to provide a tough and coherent coating substantially free from cracks, which will effectively reduce the hygroscopicity of the grain, while enhancing its ballistic properties.

While the nitro-glycerin has a gelatinizing action on the nitro-cellulose, the grain fibers are rather surface-gelatinized. It will, however, be understood that this invention is susceptible of variations within the scope of the appended claims.

The vehicle employed to deposit the nitro-glycerin on the nitro-cellulose powder grain in order to coat or impregnate the same and partially fill the pores, may be any suitable solvent for nitro-glycerin which is, however, a non-solvent for nitro-cellulose; examples are benzol, methanol, ethylalcohol, etc.

As an example of one illustrative embodiment of this invention, 100 parts of ungelatinized nitro-cellulose grains are treated with 115 parts of a solution containing 28.75 parts of nitro-glycerin. The nitro-cellulose grains can be dipped in the solution and drained to retain 115 percent of the solution, or the ingredients can be mixed directly in a receptacle in these proportions. The wet grains are then allowed to dry, preferably in a vacuum with means for recovery of the volatile vehicle. The resultant powder grain will, therefore, contain 77.6 percent nitro-cellulose and 22.4 percent nitro-glycerin. In the same way any other predetermined percentage of nitro-glycerin may be incorporated with the nitro-cellulose.

It will, therefore, be seen that the invention accomplishes its objects. A propellant powder grain is produced which is not only coated or impregnated and surface-gelatinized with nitro-glycerin, but the pores of the powder grain are partially filled with nitro-glycerin. The following hydroscopic tests show the advantageous features of the powder grains:

Percentage of moisture

	Initial	After remaining in 90% relative humidity box for:			
		1 day	2 days	3 days	4 days
Untreated nitro-cellulose	.74	1.07	2.86	2.97	3.03
Treated with 25% solution of nitro-glycerin in alcohol	.50	1.08	1.15	1.16	1.16
Treated with 40% solution of nitro-glycerin in alcohol	.32	.74	.81	.78	.81

It will be noted that on account of the employment of a solvent for nitro-glycerin, which is a non-solvent for nitro-cellulose, without mixing and pressing, the surfaces only of the nitro-cellulose fibers are gelatinized. The coating or impregnation is such that the surfaces of the fibers are gelatinized and form a protective coating of such a nature over the body of the fiber that the hygroscopicity is substantially reduced. The ballistics of powder made from ungelatinized nitro-cellulose by this process can be altered to suit the type of gun and the character of the load by variation of the grain size and variation in the percentage of nitro-glycerin contained in the grain, and by the choice of the non-solvent for nitro-cellulose used, which by its viscosity will control the penetration of the nitro-glycerin.

While this invention is applicable to the treatment of nitro-cellulose before being cut up into grains, such as in the form of sheets of any desired thickness, it is particularly applicable to the treatment of ungelatinized nitro-cellulose grains of fibrous structure. The grain may be of any suitable nitrated cellulose, regardless of the source of cellulose; e. g., from cotton, wood, straw, etc. While nitro-glycerin is particularly applicable for water-proofing and impregnating or coating the grains, nitrates of polyglycerin or ethylene-glycol; or other suitable nitrates of glycerin may be employed. It will, therefore, be understood that the terms "nitro-cellulose" and "nitro-glycerin" are used descriptively and not limitatively. It will furthermore be understood that certain features and sub-combinations are of utility and may be employed without reference to other features and sub-combinations; that is contemplated by and is within the scope of the appended claims. It is furthermore to be understood that various changes may be made in details and operations within the scope of the appended claims without departing from the spirit of this invention. It is, therefore, to be understood that this invention is not to be limited to the specific details and operations described.

Having thus described the invention what is claimed is:

1. In the art of making propellant powders, the process comprising, treating nitro-cellulose grains with a solution of nitro-glycerine in a non-solvent for nitro-cellulose.

2. In the art of making propellant powders, the process comprising, treating nitro-cellulose grains with a solution of nitro-glycerine in a volatile non-solvent for nitro-cellulose and evaporating the non-solvent.

3. In the art of making propellant powders, the process comprising, surface treating nitro-cellulose grains with a solution of nitro-glycerine in a non-solvent for nitro-cellulose.

4. In the art of making propellant powders, the process comprising, surface treating nitro-cellulose grains with a solution of nitro-glycerine in a volatile non-solvent for nitro-cellulose and evaporatitng the non-solvent.

5. In the art of making propellant powders, the process comprising, mixing nitro-glycerine with a solvent therefor but which is a non-solvent for nitro-cellulose and treating nitro-cellulose grains with the mixture.

6. In the art of making propellant powders, the process comprising, mixing nitro-glycerine with a volatile solvent therefor but which is a non-solvent for nitro-cellulose,

treating nitro-cellulose grains with the mixture and evaporating the solvent.

7. A propellant powder grain of nitro-cellulose having a substantially ungelatinized core and surface gelatinized with nitro-glycerin.

8. A propellant powder grain of nitro-cellulose, surface treated with nitro-glycerin.

9. A propellant powder grain of nitro-cellulose surface-treated with a solution of glycerin in a non-solvent for nitro-cellulose.

10. A propellant grain of ungelatinized nitro-cellulose, having a substantially ungelatinized core and surface-treated with nitro-glycerin.

11. A propellant powder grain of nitro-cellulose the fibers of which are surface-colloided with nitro-glycerin.

In testimony whereof I affix my signature this 12th day of April, 1929.

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