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PROPELLANT POWDER

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This invention relates to propellant powders, and more particularly to powders of the double base type, such as nitrocellulose-nitroglycerin powders.

One of the objects of this invention is to provide a double base propellant powder which is so treated as to improve its ballistic characteristics.

Another object is to provide a double base powder which is so treated that the rate at which the gas is evolved will progressively increase as the powder is consumed.

Further objects will appear from the detail description, in which will be specifically described a number of illustrative embodiments of this invention; it is to be understood, however, that this invention is susceptible of various other embodiments.

Generally stated, a double base powder is treated with a suitable deterrent and in such a manner as to secure the desired ballistic properties; and in accordance with the illustrative embodiments of this invention, this deterrent is of a type which is a solvent for the powder grain. In the process of treatment, the deterrent is carried in a vehicle through the medium of which the deterrent is applied to and even carried into the grains, and the vehicle may then be extracted. The vehicle may be of a type which is a solvent for the deterrent, or a solvent for one or both of the bases of the double base powder. This vehicle may also be one which is volatile, so that the extraction of the vehicle from the treated powder grains may be secured by evaporation.

The double base powder grain may be composed of nitrocellulose and nitroglycerin, in which the nitroglycerin content is such as to secure the desired ballistic properties. For example, where powder is particularly adapted for use as a rifle powder, the nitroglycerin content may be 15%. The deterrent may be one of the usual ones employed; a deterrent which, however, has been found to be particularly useful in diamyl phthalate; a related deterrent, such as dibutyl phthalate, may also be employed. Moreover, other deterrents, such as tricresyl phosphate, ethyl lactate, dimethyl diphenylurea, diethylene glycol dinitrate, and any one of the mono nitro, dinitro and trinitro toluenes may be employed. The proportion of the deterrent may be from 2 to 8% relative the double base powder. It is desirable that the double base powder grain contain its original nitroglycerin content as distinguished from a grain in which a part of the nitroglycerin has been extracted from the grain prior to the application of the deterrent.

Such treatment with a deterrent is effective to retard the initial combustion rate of the powder substantially and thus render the same progressive burning. By the expression "retard the initial combustion rate substantially" as used herein and in the appended claims is meant that combustion of the outer layers of the powder grain is distinctly slowed by the action of the deterrent material so that the outer layers of the grain burn more slowly than the unaffected or less affected interior of the grain, and also that the outer layers burn more slowly than if they had been acted upon with a simple solvent having no definite slowing action.

As an illustrative embodiment of this invention, a double base powder containing 15% nitroglycerin, produced in any manner well known to those skilled in the art, is surface treated with 6% of diamyl phthalate. Such a powder, adapted more particularly for use in rifle cartridges of small calibre, may have grains in the form of flat discs .050–.075 mm. thick and .90 mm. in diameter.

A number of embodiments of this invention will now be described.

A double base powder of the character described is treated with a solution of diamyl phthalate in benzol, benzol being a solvent for the deterrent and also for the nitroglycerin, but a non-solvent for the nitrocellulose. For this purpose, to 100 parts by weight of powder are added 70 parts by weight of a 6.75% solution of diamyl phthalate in benzol, preferably in a rotating barrel connected with a solvent recovery system. The deterrent will be carried into the grain and as the vehicle is driven off, the deterrent will be left in the grain. After the grain is dried, it can be graphited in the usual manner.

In accordance with another embodiment of this invention, there is employed a vehicle or carrier which is a solvent only for the deterrent, while being a non-solvent for both of the bases of the double base powder grain; such a vehicle is carbon tetrachloride, which is a solvent for diamyl phthalate, but is a non-solvent for both nitrocellulose and nitroglycerin. The procedure may be generally carried out as described in the preceding embodiment, and upon volatilization of the carrier, the deterrent will be left on the powder grain. In this case, not only is the solution of either of the bases of the powder grain avoided, but since the vehicle is of the non-inflammable, although volatile, type, the fire hazard is considerably reduced.

In accordance with another embodiment of this

invention, the vehicle or carrier employed is one which is a solvent for both nitrocellulose and nitroglycerin, as well as for diamyl phthalate; an example of such a vehicle is methyl alcohol. Now, while methyl alcohol is an efficient solvent for diamyl phthalate, it is only a mild solvent for the bases of the powder grain; moreover, the process can be so carried out that not only will material solution of the grain bases be avoided, but softening of the grains can be prevented to an extent sufficient to avoid adhesion or sticking together of the grains. This may be accomplished by employing only sufficient of the vehicle to just barely wet the grain surfaces, followed by evaporation of the vehicle. By adding water to the alcohol, the vehicle may be brought to a point where very little of even the nitroglycerin base will be extracted, while the solvent action with reference to the deterrent will be still maintained. The deterrent carried by the vehicle may be applied as previously described in connection with the other embodiments, the vehicle being driven off by heat; however, the alcohol can be removed in an excess of water. Here, again, the solvent vehicle will secure penetration of the deterrent into the grain; however, by control of the process, the grains will not be softened to a point where they will adhere or stick together before the solvent is driven off.

In accordance with another embodiment of this invention, the vehicle may be composed of a mixture of a solvent and a non-solvent of nitrocellulose, such as ethyl acetate and benzol, in such proportions as to hold the deterrent in solution, but so as not to actively attack the nitrocellulose sufficiently to cause the grains to adhere one to the other. Similarly, a solution of the deterrent in the alcohol vehicle may have added thereto a small amount of ethyl acetate to secure the desired result.

Where the vehicle or carrier employed is a volatile one and of the inflammable type, the evaporation temperature may be kept down to a point required for safety. Evaporation may be accomplished at reduced temperatures under vacuum, or with large excess of air to eliminate danger of explosive mixtures.

There is thus produced a powder grain, and more particularly a double base powder grain, which not only has the desired ballistic properties, but which can be made progressive burning to the desired extent. The progressive burning characteristic imparted to the powder allows the powder charge of the cartridge to be increased without increasing the maximum pressure, resulting in much higher velocities without any increase in pressure; at the same time the nitroglycerin content imparts to the interior of the grain a fast-burning characteristic.

While this invention is particularly applicable to nitrocellulose nitroglycerin, gelatinizers for nitrocellulose other than nitroglycerin may be employed, such as nitrates of polyglycerin, or any of the glycols or polyglycols, or nitrates of any of the aromatic series. It will further be understood that various 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 will further be understood that various changes may be made in details 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 described.

Having thus described the invention, what is claimed is:

1. A double base propellant powder which is surface-treated with a dialkyl-phthalate to an extent sufficient to retard the initial combustion rate and render the grains progressive burning.

2. A double base propellant powder containing about 15% of nitroglycerin and surface-treated with a dialkyl-phthalate to an extent sufficient to retard the initial combustion rate and render the grains progressive burning.

3. A double base propellant powder which is surface-treated with diamyl phthalate to an extent sufficient to retard the initial combustion rate and render the grains progressive burning.

4. A propellant powder grain composed of nitrocellulose incorporated with a gelatinizer therefor, and containing sufficient of a dialkyl phthalate concentrated near its surface to retard the initial combustion rate and render the grain progressive burning.

5. A propellant powder grain composed of nitrocellulose incorporated with a sufficient of a gelatinizer to render the same dense and hard, and containing in addition to the said gelatinizer sufficient of a dialkyl phthalate concentrated near its surface to retard the initial combustion rate and render the grain progressive burning.

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