

UNITED STATES PATENT OFFICE

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PROPELLENT POWDER

No Drawing.

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This invention relates to an improved propellant powder, and more particularly to a flashless propellant powder for small arms.

As is well known in the art powders of the progressive burning type, that is to say nitrocellulose powders, the surfaces of the grains of which are impregnated with either a deterrent explosive such as dinitrotoluol, or a deterrent material such as dimethyldiphenylurea or some other deterrent material are much superior to powders not so treated. Powders of this type give much better ballistics than powders which have not been surface impregnated. Powders of the so-called progressive burning surface impregnated type are extensively used in high powered rifles, especially military rifles, but they have all possessed, until the present invention, a serious disadvantage and that is that upon combustion under ordinary conditions of use such as in rifles, machine guns, and other types of small arms having relatively short barrels, a white luminous muzzle flash is produced.

This invention has as an object the elimination of muzzle flash in small arms and other types of arms including small caliber cannon. A further object of my invention is the production of a propellant powder of the so-called progressive burning type for this purpose. Other objects will appear as the description proceeds.

These objects are accomplished by the following invention which essentially comprises incorporating a tin salt of an organic acid into a nitrocellulose powder of the progressive burning type and impregnating the grains of the powder with a deterrent material.

As a preferred embodiment of my invention the following example is described as illustrating a composition of powder made according to my invention.

100 parts nitrocellulose of about 13.15% nitrogen content.
0.6 parts diphenylamine.
2.5 parts stannous phthalate.

The manufacture of the powder requires no special skill. Nitrocellulose of the proper

grade is dehydrated with ethyl alcohol and placed in a suitable mixer. Dry, finely and uniformly divided stannous phthalate prepared by adding the theoretical amount of stannous chloride in dilute aqueous solution to a dilute solution of sodium phthalate and washing the precipitated stannous phthalate free from chlorides, is added to the dehydrated nitrocellulose. The nitrocellulose is then colloided with the addition of ether in which has been dissolved the proper amount of diphenylamine to act as a stabilizer. The resulting colloid is then pressed and cut in tubular grains with single perforation or in the flake form of grain in suitable granulation for rifle or machine gun or small size cannon. The grains of the powder are then given thorough solvent recovery treatment before final drying, which is preferably done by steeping in hot water not in excess of 60° C., although a higher temperature may be used without injury to the chemical stability of the powder. After the water drying treatment, the powder grains are impregnated with dimethyldiphenylurea according to the process described in U. S. Patent 1,379,073 or other suitable process. The powders are finally dried, glazed with graphite and sieved.

A principal feature of the invention, therefore, is the addition of a flash suppressing agent such as a tin salt of an organic acid, for example, stannous phthalate, to nitrocellulose at some point in the manufacture of powders of this type and also the impregnation of the surfaces of the grains of the powder with a deterrent material, such as one of the dialkyldiaryllureas, for example, dimethyldiphenylurea, which itself acts as a flash suppressing agent in addition to its usual deterrent function. I have found that the material used for impregnating the surfaces of the powder grains is an important factor as regards flashlessness. For example, a nitrocellulose propellant powder surface impregnated with a deterrent explosive such as dinitrotoluene, will give rise to muzzle flash more readily in rifle barrels of reduced length than a similar powder, the surface of which has been impregnated with a

deterrent material such as dimethyldiphenylurea. In other words, the latter powder would stand greater reduction in barrel length than the former without giving rise to muzzle flash. This is due to the fact that powder surface impregnated with dimethyldiphenylurea has a slightly lower combustion temperature than powder impregnated with dinitrotoluene and also a slightly different composition of gases upon combustion.

Although the tin salt may be incorporated into the powder in various ways, I prefer to add it in a dry, finely divided condition to the dehydrated nitrocellulose before the usual colloidizing operation.

As is illustrated in the example given above, the colloidizing is usually carried out in ether-alcohol mixture or other solvent to which has been added a stabilizing agent such as diphenylamine. After the colloidizing operation is completed and the colloidized nitrocellulose is pressed and cut into grains of various sizes, according to the use to which the powder is eventually to be put, these grains are given a solvent removal treatment by steeping in hot water.

One of the features of my invention which, as indicated above, includes the use of a tin salt incorporated into the nitrocellulose, is that this steeping or water drying treatment may be carried out without removing a substantial amount of the tin salt. It is to be noted in this connection that this process includes water drying to remove solvent and that this is essential in order to obtain the best ballistic results. Another feature of my invention is in the impregnation of the powder grains with a material which I have found to be of greatest efficacy in suppressing muzzle flash, that is, one of the dialkyldiarylureas, such as dimethyldiphenylurea, for example. This impregnating operation is carried out according to a well known process.

The nitrocellulose may be a blend of nitrocellulose of the type soluble in a mixture of two parts ethyl ether to one part ethyl alcohol by volume, with nitrocellulose of the insoluble type, with a nitrogen content of about 13.15%. It should be understood that the nitrogen content may vary considerably from this and that soluble nitrocellulose alone may be used, if desired.

The amount of diphenylamine as stated in the above composition is illustrative and can be increased or decreased or substituted by another stabilizer, without departing from the spirit or scope of my invention.

The manufacture of the stannous phthalate is, as indicated above, the very simple operation of adding the theoretical amount of stannous chloride in dilute aqueous solution to a dilute solution of sodium phthalate and washing the precipitated stannous phthalate free

from chlorides. The amounts of stannous phthalate may vary widely from the amounts given in the above compositions, depending upon the type of powder and the use to which it is to be put. Instead of stannous phthalate I may use tin salts of other organic acids such as oxalic or other tin salt, selecting those which would not be appreciably extracted from the powder during the water steeping treatment, either on account of their slight solubility in water or their tenacious retention by the colloid or both.

I have found that flashless results in rifles and machine guns are more readily obtained with progressive burning powders, the surfaces of whose grains are impregnated with a material having no potential such as the dialkyldiarylureas as contrasted with dinitrotoluene. I prefer to use a combination of a dialkyldiarylurea with stannous phthalate, but I do not limit myself to this combination.

When a white luminous muzzle flash is obtained, this flash is due to the ignition of the combustible gases formed during the combustion of the powder, due to their high temperature when emerging from the muzzle of the gun and coming in contact with the oxygen of the air. The gaseous products formed by the combustion of smokeless powder are nitrogen, carbon dioxide, carbon monoxide, hydrogen, water vapor and small amounts of methane. Of these, the combustible gases are carbon monoxide, hydrogen and methane. The white luminous flash at the muzzle of the gun is due to the combustion of these gases in the presence of oxygen. This combustion can be prevented in the case of small arms by firing into an atmosphere of carbon dioxide. When the white luminous flash is eliminated in this manner or is eliminated by the use of a powder containing suitable ingredients, only a reddish glow appears at the muzzle of the gun.

The question whether or not a particular propellant powder will or will not give a luminous muzzle flash when fired in a particular rifle depends, not only on the composition and granulation of the powder, but also, to some extent, on other factors such as length of rifle barrel, weight of bullet, and ballistic requirements. Where the length of the barrel is relatively long, say twenty-nine inches, there is less muzzle flash than with rifles and other small arms having shorter barrels. When the length of the barrel is reduced, present powders tend to give muzzle flash to a greater degree and this is particularly the case when the ballistic requirements are severe. My invention is, therefore, particularly applicable to those rifles having relatively short barrel lengths and correspondingly severe ballistic requirements.

It is apparent that many changes may be made in the specific embodiments of my invention without departing from the spirit

thereof and I do not wish to be understood as limiting myself to its specific details except as defined by the appended claims.

I claim:

- 6 1. A propellent powder containing a muzzle flash preventative comprising stannous phthalate.
2. A propellent powder containing a muzzle flash preventative comprising 2.5 to 5.0%
- 10 of stannous phthalate.
3. A propellent powder containing a muzzle flash preventative taken from a group consisting of stannous oxalate and stannous phthalate.

15 In testimony whereof, I affix my signature.
RICHARD G. WOODBRIDGE.