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PROPELLANT POWDERS CONTAINING
PELARGONIC ESTERSGeorge Barsky, New York, N. Y., assignor to E. F.
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9 Claims. (CL 52-5)

The present invention is directed to propellant powders having nitrocellulose of explosive grade as a principal ingredient. More particularly, the invention relates to a composition containing an esterified material as a plasticizer or modifying agent for the propellant.

In converting nitrocellulose into powder grains it is customary to add certain substances, usually organic in nature, and sometimes having explosive properties in order to plasticize the nitrocellulose and render it more easily extruded or molded to the desired size and shape. It is also highly desirable in propellant powders to avoid a flash which normally occurs in a gun barrel when the gun is fired.

Various substances have been added to the powder in an attempt to overcome these defects. However, various disadvantages are inherent in the substances previously used. Generally, a substance which reduces the flash of the powder is likely to produce a considerable amount of smoke. Among such substances are the dialkylphthalates which, while having the property of reducing the flash, give an excessive amount of black smoke when used in sufficient quantities to eliminate the flash. Also, other substances previously proposed for the purpose have the disadvantage that they are more or less water soluble and therefore increase the tendency of the powder to absorb moisture from the air.

The present invention is intended and adapted to provide a composition which will obviate the disadvantages of previous plasticizers, it being among the objects thereof to provide a propellant powder of reduced flash during the firing thereof.

It is also among the objects of the present invention to provide a composition containing a plasticizer having a substantial solvent power for the nitrocellulose in order to render the extrusion of the composition to form powder grains, rapidly and readily accomplished.

In practicing the present invention I provide a nitrated cellulose as the principal explosive material and add thereto esters of certain acids which have the desired modifying characteristics. The present invention is based upon the discovery that an open-chain monobasic carboxylic acid having 9 carbon atoms, when esterified with a polyalkylene glycol to form a substantially neutral ester, provides a substance which when added to nitrocellulose materials, reduces the flash of the composition, gives plasticity thereto and allows the detonation of the composition without producing any substantial amount of smoke. The addition of the ester has

the further advantage of reducing the tendency of the nitrocellulose to absorb water, and thereby renders the composition substantially non-hygroscopic.

Other acids closely related to the acid having 9 carbon atoms may be used, and it has been found that the open-chain acid having 7 carbon atoms is also suitable for the purpose. Not only are the normal pelargonic and the normal heptonic acids suitable for the purpose, but various isomers thereof are equally adaptable.

The polyalkylene glycol used for esterification is a lower glycol, namely, the ethylene and propylene glycols, and particularly the di- and triethylene glycols. Said glycols may be used either singly or in admixture of each other and the esterification may be with a single acid or a mixture of acids.

The following is an example of a composition embodying the present invention:

	Parts by weight
Nitrocellulose	86
Dinitrotoluol	10
Triethylene glycol dipelargonate.....	4

A mixture is first made of the nitrocellulose and nitrotoluol and the plasticizer, dissolved in a suitable solvent, is incorporated therein by ordinary working methods. This composition is then extruded through suitable dies and the solvent allowed to evaporate. The extrusion process is quite simple and the lubricating effect of the plasticizer enables a quick and complete operation to be conducted thereon without the expenditure of any undue amount of power in the operation.

Another composition embodying the present invention is the following:

	Parts by weight
Nitrocellulose	82
Trinitrotoluol	15
Diethylene glycol diheptate.....	3

Still another composition coming within the scope of the present invention is the following:

	Parts by weight
Nitrocellulose.....	96
Mixed di- and triethylene glycol pelargonate and caprylate.....	4

All these compositions have the advantage that they have excellent plasticity to render the extrusion process readily accomplished. None of the compositions gives off any substantial amount of smoke when burnt and therefore the smokeless characteristic of the explosive is retained. The

plasticizer also makes the composition flashless.

The new esters may be obtained by a simple esterification process. In order to produce the triethylene glycol pelargonate there is provided 320 parts by weight of pelargonic acid with 100 parts of triethylene glycol. The mixture is placed in a suitable container, heat is applied, and a gentle stream of carbon dioxide is passed through the same. Heating is continued for two to three hours while gradually raising the temperature to about 270 to 275° C. to cause the esterification reaction to take place. This temperature is maintained for a sufficient length of time, up to several hours, to complete the esterification and to distill off any excess fatty acid which may be present.

The crude product may then be purified as is common in the art, by first washing with caustic soda solution and with water. The ester is then heated in a vacuum to about 90° C. to distill off any water which may be present. It is then subjected to a bleaching operation with activated carbon and bleaching earth at about 110° C. and filtered.

As an example of a composition which may be used to prepare a plasticizer, the following mixture of fatty acids,

	Parts by weight
Pelargonic acid.....	80
Caprylic acid.....	15
Heptoic acid.....	5

is incorporated with a mixture of diethylene glycol and triethylene glycol in equal proportions. The mixture is then esterified as set forth above and the product purified in the usual manner.

The above compositions are intended to illustrate the nature of the invention and not to limit the same. For instance, the pelargonic acid may be mixed with one or more acids of the fatty type having 7, 8 or 10 carbon atoms, and such mixture esterified to give the desired plasticizing effect. Nitrocellulose need not be the only explosive, but various mixtures of explosives may be used in the compositions, as is well known. In the above description it has been stated that the plasticized composition is extruded to form grains. It is not necessary, in all cases, that the nitrocellulose be plasticized with the ester, but the ester may be used as a coating or water-proofing film on the surface of the propellant powder. To accomplish this, one may, if desired, omit entirely or in part from the body of the composition, the usual amount of plasticizer and, by spraying or otherwise, form a film thereof on the surface of the powder.

These and other changes in the details of the procedure and compositions may be made within the spirit of the invention, the scope of which is not to be limited except by the claims appended hereto.

What is claimed is:

1. A composition of matter comprising a nitrocellulose propellant powder containing a relatively small proportion of a polyalkylene glycol ester of an open-chain monobasic carboxylic acid taken from the class of acids having 7 and 9 carbon atoms, the amount of said ester being sufficient to plasticize said powder to render it capable of extrusion and to reduce the flash upon firing of said powder.

2. A composition of matter comprising a nitrocellulose propellant powder containing a relative-

ly small proportion of a polyethylene glycol ester of an open-chain monobasic carboxylic acid taken from the class of acids having 7 and 9 carbon atoms, the amount of said ester being sufficient to plasticize said powder to render it capable of extrusion and to reduce the flash upon firing of said powder.

3. A composition of matter comprising a nitrocellulose propellant powder containing a relatively small proportion of a polypropylene glycol ester of an open-chain monobasic carboxylic acid taken from the class of acids having 7 and 9 carbon atoms, the amount of said ester being sufficient to plasticize said powder to render it capable of extrusion and to reduce the flash upon firing of said powder.

4. A composition of matter comprising a nitrocellulose propellant powder containing a relatively small proportion of a mixed di- and triethylene glycol ester of an open-chain monobasic carboxylic acid taken from the class of acids having 7 and 9 carbon atoms, the amount of said ester being sufficient to plasticize said powder to render it capable of extrusion and to reduce the flash upon firing of said powder.

5. A composition of matter comprising a nitrocellulose propellant powder containing a relatively small proportion of the triethylene glycol ester of pelargonic acid, the amount of said ester being sufficient to plasticize said powder to render it capable of extrusion and to reduce the flash upon firing of said powder.

6. A composition of matter comprising a nitrocellulose propellant powder containing a relatively small proportion of the triethylene glycol ester of a mixture of pelargonic acid with an open-chain monocarboxylic acid taken from the class having 7, 8 and 10 carbon atoms, the amount of said ester being sufficient to plasticize said powder to render it capable of extrusion and to reduce the flash upon firing of said powder.

7. A composition of matter comprising a nitrocellulose propellant powder containing a relatively small proportion of the triethylene glycol ester of heptoic acid, the amount of said ester being sufficient to plasticize said powder to render it capable of extrusion and to reduce the flash upon firing of said powder.

8. A composition of matter comprising a nitrocellulose propellant powder containing a relatively small proportion of the triethylene glycol ester of a mixture of pelargonic acid with an open-chain monocarboxylic acid taken from the class having 7, 8 and 10 carbon atoms, said ester containing a major proportion of pelargonic acid and a minor proportion of the other acids, the amount of said ester being sufficient to plasticize said powder to render it capable of extrusion and to reduce the flash upon firing of said powder.

9. A composition of matter comprising a nitrocellulose propellant powder having a small amount of a nitroaromatic compound sufficient to modify said powder incorporated therein and containing a relatively small proportion of a polyalkylene glycol ester of an open-chain monobasic carboxylic acid taken from the class of acids having 7 and 9 carbon atoms, the amount of said ester being sufficient to plasticize said powder to render it capable of extrusion and to reduce the flash upon firing of said powder.

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