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PROPELLANT EXPLOSIVE

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This invention relates to the production of propellant explosives of the double base solventless type, i. e., those containing nitrocellulose and nitroglycerin or the like and in the manufacture of which no volatile solvent is used.

In the manufacture of this type of propellant it is customary to employ a non-volatile substance which acts as a gelatinizer for the nitrocellulose, and also performs the function of a stabilizer for the explosive as a whole. The substance which has found widest application in this respect is symmetrical di-ethyl diphenyl urea, also known as ethyl centralite, but it has some disadvantages which render the manufacture of the propellant a somewhat difficult operation. In addition, the solubility of ethyl centralite in nitroglycerin at ordinary temperatures is rather low, with the result that the nitroglycerin present in a number of widely used propellants is insufficient to dissolve the desired amount of ethyl centralite.

It is known that symmetrical dimethyl diphenyl urea (methyl centralite) has properties which correspond generally to those of ethyl centralite, but the solubility in nitroglycerin is still lower than that of ethyl centralite and also the setting point of methyl centralite is higher than that of ethyl centralite, so that the difficulties in the manufacture of the propellant are still further increased if methyl centralite is substituted for ethyl centralite. We have now found, however, that by employing a mixture of ethyl centralite and methyl centralite the solubility of the mixture in nitroglycerin is considerably greater than that of the single substances, and also that the setting point of the mixture is definitely lower than that of either substance. Moreover, the gelatinizing power and stabilizing power of the mixture are at least equal to those of the single substances.

Our invention, therefore, consists in an improved method for the manufacture of gelatinized propellant explosives of the type containing nitrocellulose and nitroglycerin or the like nitric ester, according to which nitrocellulose is gelatinized with nitroglycerin or the like nitric ester and a mixture of ethyl centralite and methyl centralite in the absence of a volatile solvent.

We have also found that there is a eutectic mixture of ethyl centralite and methyl centralite, containing approximately 77 parts by weight of ethyl centralite to 23 parts of methyl centralite, this eutectic mixture having the lowest setting point of all the mixtures. The setting points and solubilities in nitroglycerin of ethyl centralite, methyl centralite and of the eutectic mixture are given in the following table:

Substance	Solubility in 100 gm. nitroglycerin at 20° C.	Setting point
Ethyl centralite	17 gm.	70° C.
Methyl centralite	4.5 gm.	120° C.
Eutectic mixture	50 gm.	61° C.

It will therefore be seen that the employment of the mixed centralites in the manufacture of propellant explosives of the type described offers considerable advantages over the use of either centralite by itself. We prefer to use the eutectic mixture, on account of its superior properties to other mixtures and also because it is easily prepared as a uniform product, but we may also use the mixed centralities in other proportions.

The advantages of the use of the mixed centralites become apparent during the actual process of manufacture of solventless propellants. The preliminary operation of mixing the nitroglycerin, nitrocellulose and centralites may be carried out just as in the case of ethyl centralite, or if desired, the mixed centralites may be dissolved in the nitroglycerin and the solution sprayed on to the water wet nitrocellulose, according to the methods well known in the art. The usual processes of drying and gelatinizing the paste are then carried out, and it is in these that some of the advantages of the mixed centralites become easy to observe. The paste sheets are formed with great ease on hot rolls, and final gelatinization takes place very readily. The operation of re-working faulty sheets or cords is considerably facilitated owing to the flexible nature of the colloid produced when the mixed centralites are employed. If it is desired to press the gelatinized sheets into cord form, the great flexibility and plasticity of the propellant are again in evidence.

Compositions which may be prepared according to the present invention consist in general of the following types:—

	Per cent
Nitroglycerin or the like	from 50 to 15
Nitrocellulose	from 40 to 80
Mixed centralites	from 3 to 15

Other ingredients may be introduced according to ballistic requirements, or in order to bring about flashlessness or for anti-fouling purposes. Such ingredients are: dinitrotoluene or trinitro-

toluene for ballistics; nitroguanidine for flashlessness; and tetrabutyl stannane for anti-fouling. For many purposes, however, the use of ingredients other than nitrocellulose, nitroglycerin and the mixed centralites is unnecessary. For example, excellent results are given by the application of the present invention to propellant compositions of the following proportions:

	Parts by weight
Nitroglycerin	41
Nitrocellulose	50
Mixed centralites	9
	100

The example just given represents proportions of nitroglycerin, nitrocellulose and gelatinizer, which have long been in use, with ethyl centralite being employed as gelatinizer-stabilizer. It is to be noted that the use of the mixed centralizes involves only a negligible change in the heat of combustion of the powder; also the stability of the propellant is not brought into question on account of the close similarity of the centralites in respect of stabilizing qualities. On the contrary, the increased ease of working produced by the use of the mixed centralites makes it possible to reduce the temperatures required for the rolling and pressing operations, and this reduction of temperature is a distinct benefit to the stability of the propellant.

Having now particularly described and ascertained the nature of my said invention, I declare that what I claim is:

1. The process of manufacturing gelatinized propellant explosives containing nitrocellulose and a liquid nitric ester of a polyhydric aliphatic alcohol, which comprises gelatinizing the nitrocellulose with the nitric ester and a mixture of diethyl diphenyl urea and dimethyl diphenyl urea.

2. The process of manufacturing gelatinized propellant explosives containing nitrocellulose and a liquid nitric ester of a polyhydric aliphatic alcohol, which comprises gelatinizing the nitrocellulose with the nitric ester, and approximately 77 parts di-ethyl diphenyl urea together with approximately 23 parts di-methyl diphenyl urea in each 100 parts of the mixture.

3. A propellant explosive containing nitrocellulose and a liquid nitric ester of a polyhydric aliphatic alcohol, which comprises a gelatinized nitrocellulose, and a mixture of diethyl diphenyl urea and dimethyl diphenyl urea.

4. A propellant explosive containing nitrocellulose and a liquid nitric ester of a polyhydric aliphatic alcohol, which comprises a gelatinized nitrocellulose and a eutectic mixture of diethyl diphenyl urea and dimethyl diphenyl urea.

5. The process of manufacturing gelatinized propellant explosives containing nitrocellulose and nitroglycerin, which comprises gelatinizing the nitrocellulose with the nitroglycerin and a mixture of diethyl diphenyl urea and dimethyl diphenyl urea.

6. The process of manufacturing gelatinized propellant explosives containing nitrocellulose and nitroglycerin, which comprises gelatinizing the nitrocellulose with the nitroglycerin, and approximately 77 parts of ethyl diphenyl urea together with approximately 23 parts of methyl diphenyl urea in each 100 parts of the mixture.

7. A propellant explosive containing nitrocellulose and nitroglycerin, which comprises a gelatinized nitrocellulose, and a mixture of diethyl diphenyl urea and dimethyl diphenyl urea.

8. A propellant explosive containing nitrocellulose and nitroglycerin, which comprises a gelatinized nitrocellulose, and eutectic mixture of diethyl diphenyl urea and dimethyl diphenyl urea.

EDWARD WHITWORTH.