Patented Sept. 10, 1946

2,407,597

UNITED STATES PATENT OFFICE

2,407,597

EXPLOSIVE COMPOSITIONS COMPRISING LOW FREEZING LIQUID MIXTURES OF AROMATIC NITRO-COMPOUNDS

Harold R. Wright, West Kilbride, and James Taylor, Saltcoats, Scotland, assignors to Imperial Chemical Industries Limited, a corporation of Great Britain

No Drawing. Application March 2, 1944, Serial No. 524,792. In Great Britain December 12, 1942

5 Claims. (Cl. 52—13)

1

The present invention relates to new or improved low freezing explosive compositions, and in particular to the provision of improved explosive compositions comprising new liquid explosive mixtures of aromatic polynitro-compounds that are characterised by unusually low freezing points.

The invention relates more especially, but not exclusively, to the provision of new or improved low freezing explosives of plastic, gelatinous, or semi-gelatinous consistency in which nitrocellulose is gelatinised by the aforesaid new liquid explosive mixtures of aromatic polynitro-compounds. The new liquid explosive mixtures of aromatic polynitro-compounds may also be employed in admixture with other commonly used ingredients of explosive compositions, and are especially suitable for the production of low freezing explosives of relatively high power and low sensitiveness to friction and shock. The resulting low freezing composite explosive compositions may be used for blasting, military demolition, propulsive or other purposes depending on the composition of their ingredients.

In the manufacture of explosives of the kind in which there is employed, instead of a liquid nitric ester or mixture of liquid nitric esters, a liquid aromatic nitro-compound or liquid mixture of aromatic nitro-compounds, the difficulty arises that in general the freezing points of the individual nitro derivatives of an aromatic compound are the higher the greater the number of nitro groups that have been introduced into its molecule; and in order to obtain compositions that are liquid at a temperature about that of melting ice it has hitherto been necessary to employ individual nitro-aromatic compounds or mixtures of nitro-aromatic compounds having an undesirably low nitro-group content, so that the resulting explosives have been of lower power than is frequently desirable.

The crystallisation of any nitro-aromatic compound on the freezing of the explosive results in undesired changes in physical form even when the nitro-aromatic compound or mixture is present in the form of the solution or jelly obtained by dissolving nitrocellulose in it. Thus, the compositions tend to stiffen up, so that what is originally soft and gelatinous or plastic when first made up becomes hard and brittle on storage. Even slight changes of temperature are liable to result in serious alterations in consistency of this kind in the case of explosives containing trinitrotoluene

2

dissolved or partly dissolved in a liquid having a solvent action upon it. In practice explosive compositions are often exposed to temperatures somewhat below the temperature of melting ice, and the provision of explosive aromatic nitro-compounds, whether single or mixed, that are capable of withstanding such temperatures without crystallisation of solid, has hitherto been a matter of much difficulty. The lack of a suitable explosive nitro-cellulose-nitro-aromatic body jelly that will not become rigid at temperatures somewhat below that of melting ice has hitherto militated against the development of gelatine explosives in which nitro-aromatic compounds are used in place of nitro-glycerine, although from certain points of view it might be advantageous to produce such explosives. The handling of nitroglycerine, for instance, frequently induces headaches in those engaged in the manufacture of the explosives.

It is an object of the present invention to provide an explosive composition comprising a low freezing liquid mixture of aromatic nitro-compounds that contains a larger nitro-group content and hence is of higher calorific value, or that commences to crystallise at a lower temperature, than the hitherto used liquid aromatic nitro-compound mixtures. It is also an object of the invention to prepare new and useful composite explosive compositions in the preparation whereof the aforesaid new low freezing liquid aromatic nitro-compounds are used as a constituent. It is in particular an object of the invention to provide low-freezing nitro-aromatic gelatine explosives.

According to the invention, the low freezing aromatic nitro-compound mixture consists to the extent of about 70 to 85 per cent. of a mixture of isomeric dinitrotoluenes, and the remainder consists of trinitrotoluene and tetryl each in a substantial proportion, the said mixture of isomeric dinitrotoluenes being wholly liquid at temperatures approximately the melting point of ice and being obtainable, for example, by nitration of the so-called meta fraction of mononitrotoluene obtained as a by-product in the manufacture of ortho and para nitrotoluene.

Preferably the trinitrotoluene and the tetryl are employed in approximately equal proportions, but as the percentage of the mixture of isomeric dinitrotoluenes in the aromatic nitrocompound mixture is increased from the lower towards the upper limit, the ratio of amounts of trinitrotol-

uene and tetryl can be varied to an increasing extent from equality without causing the mixture to deposit solid at a given low temperature.

For the manufacture of composite explosive compositions the aforesaid low freezing aromatic nitro-compound mixture may be mixed with other ingredients usual in explosive compositions, for instance nitrocellulose, oxidising salts, explosive salts such as ammonium nitrate, metal powders and other solid reducing agents, liquid nitric esters, solid nitric esters, trinitrotoluene, flame quenching ingredients, organic bases and like stabilisers, chromates and other sensitisers of thermal decomposition, and the like. These low freezing aromatic nitro-compound mixtures have the property of dissolving or gelatinising nitrocellulose, and plastic or gelatinous explosive compositions made from these two ingredients are insensitive to detonation by the impact of a 0.303 British service infantry rifle bullet fired from 40 yards against the explosive composition backed by a steel plate. If it is so desired it may be made still more insensitive by the inclusion in the composition of a non-explosive nitrocellulose plasticiser miscible with the aromatic nitro-compound mixture such as dibutyl phthalate or tricresyl phosphate, but the power of the composition is correspondingly reduced.

For instance in the manufacture of gelatine explosives of high power containing suspended highly explosive solids such as solid nitric esters or the like, it is frequently desirable to employ as the mixture of aromatic compounds one containing a proportion of the dinitrotoluene mixture approximating the upper limit, in order to minimize the sensitiveness of the resulting explosive to friction and shock. Alternatively, or in addition, a non-explosive nitrocellulose plasticiser miscible with the aromatic nitro-compound mixture may be included in the composition. On the other hand, if the solid ingredients of the gelatine explosive are of a non-explosive character, for instance organised carbonaceous ingredients and alkali metal nitrates, or include as suspended explosive ingredients only materials that are difficult to detonate by friction or shock for instance ammonium nitrate, it may be desirable that the mixture of the nitro-aromatic compounds used should contain a proportion of the dinitrotoluene mixture approximating the minimum in order that the gelatine explosive should have as high a power as possible.

The invention is illustrated by the following examples, in which the parts are parts by weight.

Example 1

The mixture of isomeric dinitrotoluenes used is one that commences to freeze at approximately −3.5° C., and was obtained by nitration of the so-called meta fraction of mononitrotoluene obtained as a by-product in the manufacture of ortho and para nitrotoluene. Into 71.6 parts of this mixture contained in a jacketed pan provided with a mechanical stirrer there are added 14.2 parts flake trinitrotoluene and 14.2 parts tetryl crystals, and the mixture is warmed to about 60° C. and stirred to hasten the solution of the solids. The resulting liquid explosive mixture can be stored indefinitely at a temperature of −10° C. or even somewhat lower without commencing to solidify even when it is seeded with a solid mixture of trinitrotoluene and tetryl.

A plastic explosive can be made from this mixture by mixing together first by hand, and then by means of a McRoberts' mixer, the following ingredients:

	Per cent.
The above described mixture of aromatic nitro-compounds	29
Blasting soluble nitrocotton	1½
Pentaerythritol tetranitrate	69½

The nitrocotton is at least to a considerable extent dissolved in the mixture of aromatic nitro-compounds at about 15° to 20° C. before the pentaerythritol tetranitrate is introduced and in the McRoberts mixer the temperature is advantageously about 30° C. The resulting explosive has a power approximately 90 per cent. of that of blasting gelatine and a velocity of detonation of approximately 8000 metres per second.

Example 2

The mixture of isomeric dinitrotoluene is the same as in Example 1. 80 parts of this mixture are incorporated with 10 parts trinitrotoluene and 10 parts tetryl by the method described in Example 1.

Example 3

The procedure is the same as in Example 1 except that the proportions used are:

	Parts
Liquid mixture of isomeric dinitrotoluenes	80
Trinitrotoluene	15
Tetryl	5

Example 4

The procedure is the same as in Example 1 except that the proportions used are:

	Parts
Liquid mixture of isomeric dinitrotoluenes	85
Trinitrotoluene	10
Tetryl	5

Example 5

The procedure is the same as in Example 1 except that the proportions used are:

	Parts
Liquid mixture of isomeric dinitrotoluenes	85
Trinitrotoluene	5
Tetryl	10

Example 6

The mixture of isomeric dinitrotoluenes is the same as in Example 1, and forms approximately 72 per cent. of the combined weight of the aromatic nitro-compounds, whereof the remainder consists of trinitrotoluene and tetryl in equal proportions. The mixture is made in a similar fashion to that described in Example 1. 83 parts of the nitro-aromatic compound mixture, consisting of the dinitrotoluene isomers, the trinitrotoluene and tetryl, are diluted with 17 parts dibutylphthalate. A plastic explosive is made from this mixture by mixing together, first by hand and then by means of a McRoberts mixer the following ingredients:

	Per cent.
The above mixture containing the aromatic compounds and the dibutylphthalate	29.5
½-second industrial nitrocellulose —12% nitrogen content	3.6
Blasting soluble nitrocotton	0.4
Pentaerythritol tetranitrate	66.5

The nitrocelluloses are partly dissolved in the liquid mixture at about 15 to 20° C. before the pentaerythritol tetranitrate is introduced. In the McRoberts mixer the temperature is advantageously about 30° C. The resulting explosive has

a power approximately 82 per cent. that of blasting gelatine, and is insensitive to detonation by the impact of a 0.303 British service infantry rifle bullet fired from 40 yards against the explosive composition backed by a steel plate.

The mixtures of isomeric dinitrotoluenes, trinitrotoluene and tetryl made in accordance with Examples 2 to 6 can be stored indefinitely at —10° C. without commencing to solidify, and the plastic gelatine explosives made from them remain plastic when stored indefinitely at that temperature, as does that prepared according to Example 1. These pentaerythritol plastic gelatines can be initiated by means of commercial detonators, and are well suited for demolition work.

Having now particularly described and ascertained the nature of our said invention, and in what manner the same is to be performed, we declare that what we claim is:

1. A low-freezing aromatic nitro-compound mixture whereof about 70 to 85 per cent consists of a mixture of isomeric dinitrotoluenes wholly liquid at temperatures approximating the melting point of ice, and the remainder consists of at least 5 per cent each of trinitrotoluene and tetryl.

2. A low-freezing aromatic nitro-compound mixture whereof about 70 to 85 per cent consists of a mixture of isomeric dinitrotoluenes wholly liquid at temperaures approximating the melting point of ice, and the remainder consists of trinitrotoluene and tetryl in approximately equal proportions.

3. A gelatine explosive comprising a low-freezing aromatic nitro-compound mixture whereof about 70 to 85 per cent consists of a mixture of isomeric dinitrotoluenes wholly liquid at temperatures approximating the melting point of ice, and the remainder consists of at least 5 per cent each of trinitrotoluene and tetryl, nitrocellulose gelatinised in said aromatic nitro-compound mixture, and a non-explosive nitrocellulose plasticizer miscible with said aromatic nitro-compound mixture.

4. A gelatine explosive comprising a low-freezing aromatic nitro-compound mixture whereof about 70 to 85 per cent consists of a mixture of isomeric dinitrotoluenes wholly liquid at temperatures approximating the melting point of ice, and the remainder consists of at least 5 per cent each of trinitrotoluene and tetryl, and nitrocellulose dissolved in said low-freezing aromatic nitro-compound mixture.

5. A gelatine explosive comprising a low-freezing aromatic nitro-compound mixture whereof about 70 to 85 per cent consists of a mixture of isomeric dinitrotoluenes wholly liquid at temperatures approximating the melting point of ice, and the remainder consists of at least 5 per cent each of trinitrotoluene and tetryl, and nitrocellulose dissolved in said low-freezing aromatic nitro-compound mixture, pentaerythritol tetranitrate suspended in said solution of nitrocellulose in the aromatic mixture.

HAROLD R. WRIGHT.
JAMES TAYLOR.