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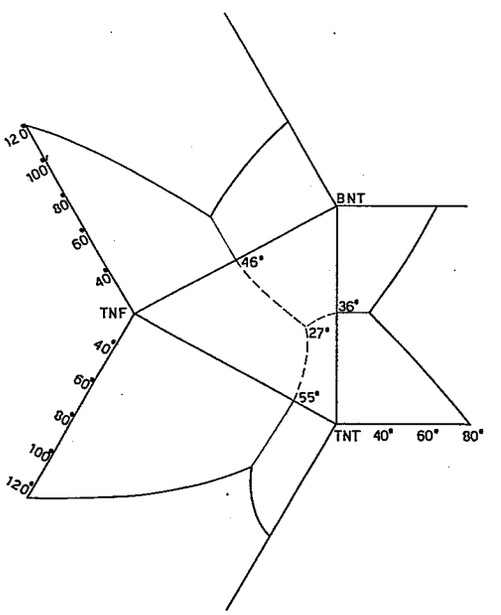
(54) **Explosive charges obtained by the cold-mixing of oxidizing salts with liquid nitro compounds, and procedure for production of the same.**

(57) This invention concerns explosive charges consisting mainly of inorganic nitrates and mixtures of aromatic nitro compounds, in which the mixture of nitro compounds is at least ternary and has a composition such as to lead to melting temperatures such that such mixtures are liquid at least at about the ambient temperature.



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"EXPLOSIVE CHARGES OBTAINED BY THE COLD-MIXING OF OXIDIZING SALTS WITH LIQUID NITRO COMPOUNDS, AND PROCEDURE FOR PRODUCTION OF THE SAME".

This invention concerns explosive charges obtained by the cold-mixing of oxidizing salts with liquid nitro compounds.

Nitro compounds here mean those organic compounds (called nitric esters) in which the NO2 groups are bonded directly to atoms of C and not through an atom of O.

The invention also concerns procedures to obtain such explosive charges.

To be more exact, the invention concerns the production of explosive charges by using at least ternary mixtures of aromatic nitro compounds, the composition of the latter being such that they are normally liquid at the ambient temperature, so that mixing with nitrates can be carried out at the ambient temperature.

The aromatic nitro compounds employed in the art of explosives are many in number: nitrobenzenes, nitrotoluenes, nitrophenols, nitronaphthalenes with one, two, three or more nitric NO2 groups in the molecule, but for various practical reasons only the nitro derivatives of toluene, in particular trinitrotoluene and dinitrotoluene, remain in use now.

The mixing of these compounds with nitrates (mainly ammonium nitrate) is normally carried out with two procedures:

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1) hot-mixing with the use of melted nitro compounds;

2) cold-mixing (at about the ambient temperature) with the use of powdered nitro compounds.

The known procedure with hot-mixing has a considerable requirement of energy to heat the components and reduces the productivity of plants owing to the long heating and cooling times. Moreover, this procedure entails difficulties in correct processing to avoid a decline in the quality of the product.

Such a decline in quality is due to hardening of the explosive mixture at temperatures close to that of crystalline conversion of the ammonium nitrate or at temperatures of solidification of nitro compounds including dinitrotoluene too.

The known procedure with cold-mixing provides a low quality product which has low sensitivity and less explosive power.

Some patents which disclose explosive charges are known and include:-

CA 1,382,222: this patent claims a liquid composition to be used to fracture underground rocks near well drillings, the composition being based on a nitric ether such as diethylene glycol dinitrate; this liquid can contain substances which vary the freezing temperature, viscosity, stability, sensitivity, etc.

Nitro components are not used in this composition and this patent is therefore outside the field of application of the present invention.

US 1,820,567: this patent discloses explosives based on chlorates alone, which therefore do not form part of the field of application of the present invention.

US 1,820,568: this patent discloses explosives consisting of an absorbent in coal powder, various chlorates and a mixture of liquid nitro compounds. This mixture contains two nitro compounds and is liquefied by heating before it is mixed with

the other components. This composition also discloses other substances outside the field of the present invention.

US 1,968,158: this patent discloses the production of a very homogeneous explosive mixture to be used molten or cast and based on ammonium nitrate and nitrates of aliphatic amines. This patent is outside the field of application of the present invention as regards both its method of use and its composition.

US 3,178,325: this patent discloses explosives based on sodium, calcium, barium, strontium and potassium nitrates in association with sensitizers such as aromatic hydrocarbons. It does not deal with nitro compounds and is therefore outside the field of the present invention.

DT 1.646.307: this patent discloses explosive mixtures which are solid at 70°C and are based on tetryl or ethyl tetryl mixed with hexogen, octogen or pentaerythrite; stabilizers and polymers such as resins or nitrocellulose may also be used. However, this composition does not include any of the components employed in the present invention.

Powder-type explosive charges are manufactured by mixing nitrates (mainly ammonium nitrate, but to a lesser extent potassium, sodium or calcium nitrate) with combustible and sensitizing substances which react by using the excess oxygen made available by the nitrates as the supporter of combustion. Among combustible substances the ones which have been used for the longest time are the aromatic nitro compounds, which enable products to be made which give the best average balance as between efficiency and sensitivity. In fact the classic product nitroglycerine and like compounds (nitric esters) behave very little like combustible substances in a strict sense, since they themselves contain all or almost all the oxygen needed for the reactions and thus do not use the oxygen made available by the nitrates; on the other hand they have great

sensitivity to outside actions and therefore cannot be said to be ideal from the point of view of safety; whereas mineral oil, which is used a great deal nowadays in mixtures with ammonium nitrate, exploits very fully the oxidizing properties of that salt but does not always enable sensitive enough products to be obtained, particularly when the explosive charges are only slightly stemmed or have a small diameter.

Aromatic nitro compounds provide a compromise solution which offers the best obtainable from the various foregoing points of view. They have a satisfactory behaviour as combustible substances, enough but not excessive sensitivity after mixing and very good long term stability together with a low vapour pressure, which enables losses by evaporation, such as those experienced with Diesel oil, to be avoided.

To avoid the shortcomings of the prior art, which discloses hot-mixing and cold-mixing procedures respectively to manufacture explosives based on inorganic nitrates and nitro compounds, the present applicant has studied, experimented and obtained the present invention, which also enables many benefits to be provided, as will become clear in the description hereinafter. According to the invention mixtures of nitro compounds that remain liquid at the ambient temperature are obtained on the basis of the principle of eutectic mixtures.

It is known that, when two substances are miscible in the liquid state and not miscible or only partly miscible in the solid state, the solidification temperatures of each of the two components can be lowered. To obtain this reduction of the solidification temperature a given quantity of one of the components is added to the other component. This fall in the solidification temperature is greatest for a certain composition which is called eutectic.

The invention envisages the use of at least ternary mixtures of aromatic nitrocompounds, which have a composition

such as will be liquid at the ambient temperature.

Such at least ternary mixtures can therefore have a eutectic composition or a composition within the neighbourhood of a eutectic composition, the composition in all cases being such that the mixtures are liquid at about the ambient temperature.

The invention is therefore embodied with explosive charges consisting mainly of inorganic nitrates and mixtures of aromatic nitro compounds, the mixtures of nitro compounds being at least ternary and having a composition such as to lead to melting temperatures such that such mixtures are liquid at least at about the ambient temperature.

We shall give hereafter some non-restrictive examples of mixtures of nitro compounds suitable for obtaining explosive charges according to the invention, with the help of the attached figures.

Figs.1 and 2 give examples of binary mixtures, from which ternary mixtures can then be obtained;

Fig.3 gives an example of a ternary mixture.

The graph of Fig.1 shows the progress of the solidification temperatures for a mixture of orthonitrotoluene and paranitrotoluene in all possible proportions from 0 to 100%.

The graph of Fig.2 shows the solidification temperatures for mixtures of trinitrotoluene 2-4-6 (TNT) and dinitrotoluene 2-4 (BNT) in all possible proportions.

In both these above graphs the solidification temperature is lowest for a given composition which is called eutectic.

The addition of a third component produces a further drop in the solidification temperature of the mixture to which the third component is added; likewise there can be a ternary eutectic, and Fig.3 shows this possibility with a three-dimensional graph.

In this figure, TNT indicates trinitrotoluene 2-4-6, while BNT is dinitrotoluene 2-6 and TNF is trinitrophenol.

The same effect can be obtained with a fourth component, and thus it is possible to form a quaternary eutectic; graphic representation of this is not possible since it would require a four-dimensional graph.

A well known and typical example of a quaternary eutectic composition is Wood's Alloy, which solidifies at 60.5°C and is made with the following mixture:

- 50% Bismuth (solidification point 271°C): 25% Lead (327°C): 12.5% Tin (231°C): 12.5% Cadmium (321°C).

In the invention at least ternary mixtures are used which consist of trinitrotoluenes and dinitrotoluenes to which may be added very small quantities of nitrotoluene and nitrobenzenes, which lower the solidification temperature even further when so required.

The following components have the solidification temperatures indicated:

trinitrotoluene 2-4-6 which solidifies at 80°C
trinitrotoluene 2-3-5 which solidifies at 104°C
dinitrotoluene 2-4 which solidifies at 70°C
dinitrotoluene 2-6 which solidifies at 65°C
orthonitrotoluene which solidifies at -3°C
metanitrotoluene which solidifies at 16°C
paranitrotoluene which solidifies at 52°C
trinitrobenzene 1-3-5 which solidifies at 122°C
nitrobenzene which solidifies at 5°C.

The mixtures obtained with the above components according to the invention have solidification temperatures considerably lower than those of the individual components.

For instance, a mixture consisting of 60% trinitrotoluene 2-4-6, 25% trinitrotoluene 2-3-5 and 15% dinitrotoluene 2-4 has a solidification temperature of about 55°C.

A mixture consisting of 50% trinitrotoluene 2-4-6, 20% trinitrotoluene 2-3-5 and 2-4-5, 20% dinitrotoluene 2-4, 7%

dinitrotoluene 2-3 and 3-5, 2% technical nitrotoluene and 1% trinitrobenzene has a solidification temperature of about 40°C.

A mixture consisting of 35% trinitrotoluene 2-4-6, 15% trinitrotoluene 2-3-4 and 2-4-5, 35% dinitrotoluene 2-4, 10% dinitrotoluene 2-3 and 3-5, 3% technical nitrotoluene and 2% trinitrobenzene has a solidification temperature of about 20°C.

In general it will be found that the addition of 1% of a second, third or fourth component to a substance already consisting of one, two or three components of the foregoing kind lowers the solidification temperature by 0.8 to 1.2°C.

Preparation of the mixtures according to the invention is easy and fast; after the desired quantity of ammonium nitrate or of other accessory components has been introduced into the mixer, the liquid mixture of the nitro compounds in a desired quantity is poured onto the powder mixture and mixing is carried on until homogenization is obtained. The liquid penetrates into the porosity of the powdery particles and the mixing is very intimate and homogeneous; there is no danger of the formation of hard crusts due to solidification, for the nitro compounds are liquid at the ambient temperature and remain such even during storage; precisely because of their liquid state they maintain a given plasticity in the explosive so produced and obviate the formation of annoying dust even if the working environment is very dry; this plasticity assists the operations of packaging and also of stemming and loading the explosive charges.

CLAIMS

1 - Explosive charges consisting mainly of inorganic nitrates and mixtures of aromatic nitro compounds, in which the mixture of nitro compounds is at least ternary and has a composition such as to lead to melting temperatures such that mixtures are liquid at least at about the ambient temperature.

2 - Explosive charges as claimed in Claim 1, which contain small additional quantities of mononitro compounds, thus obtaining a further reduction of the solidification temperature of the mixture of aromatic nitro compounds.

3 - Explosive charges as claimed in Claim 1 or 2, which have a composition of about that of a eutectic composition.

4 - Explosive charges as claimed in any claim hereinbefore, in which the mixture of aromatic nitro compounds consists mainly of derivatives of toluene.

5 - Explosive charges as claimed in any claim hereinbefore, in which the mixing of the inorganic nitrates with the liquid mixture of aromatic nitro compounds takes place at the ambient temperature.

6 - Explosive charges as claimed in any claim hereinbefore, in which during cold-mixing of inorganic nitrates with liquid nitro derivatives the liquid components are at least partly absorbed by the solid components.

7 - Procedure for production of explosive charges constituted according to any claim hereinbefore, which envisages the introduction of at least one powder-type inorganic nitrate and of at least ternary liquid mixtures of aromatic nitro compounds within a mixing machine for explosives at the ambient temperature according to any claim hereinbefore and the successive mixing of the same, the mixing of the inorganic nitrate with the mixtures of aromatic nitro compounds taking place at the ambient temperature.

8 - Procedure for production of explosive charges as claimed

in Claim 7, according to which the mixing is carried out without the application of heat from the outside.

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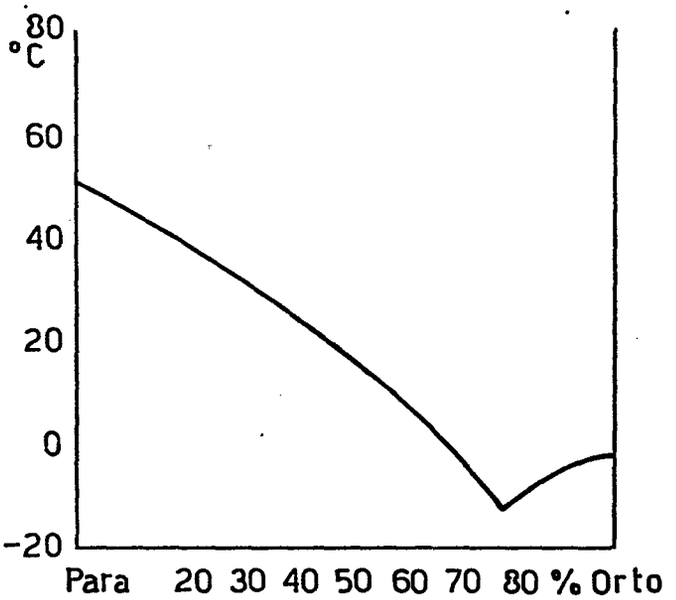

fig.1

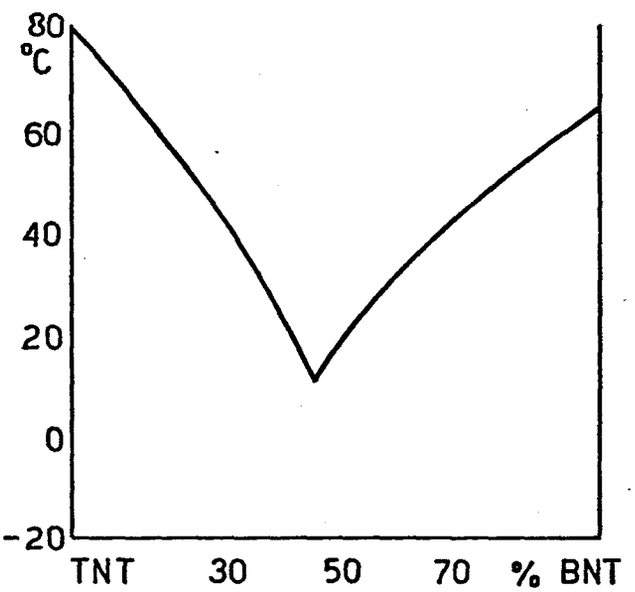

fig.2

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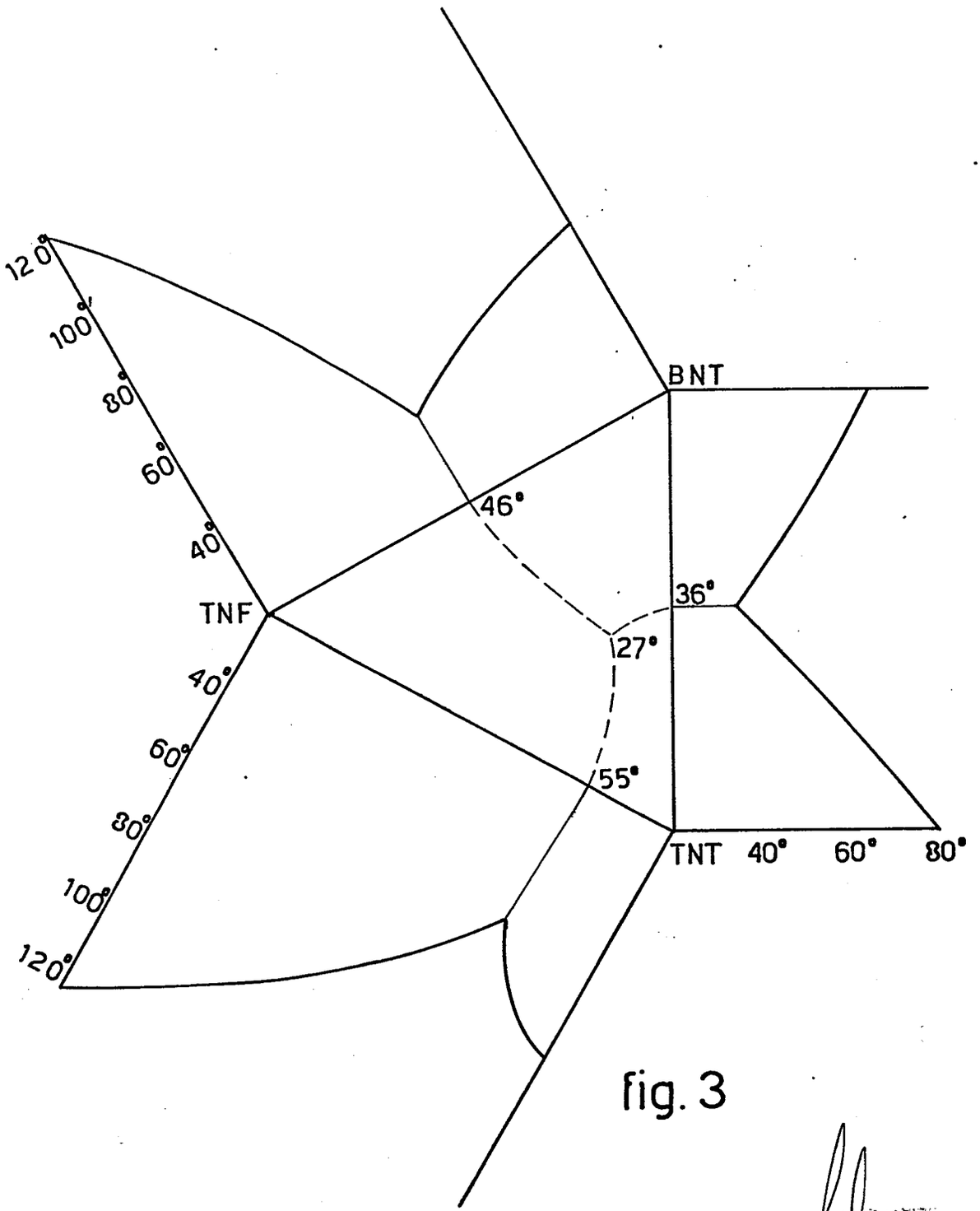

fig. 3