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(54) DETONATOR FOR PROJECTILES

(71) We, WERKZEUGMASCHINENFABRIK OERLIKON-BUHRLE AG a company organised and existing under the laws of Switzerland, of Birchstrasse 155, CH-8050 Zurich, Switzerland do hereby declare the invention for which we pray that a patent may be granted to us and the method by which it is to be performed to be particularly described in and by the following statement:

This invention relates to a detonator containing octogen crystals for initiating or propagating detonation of projectiles.

It has been observed that well-known detonators of this type are not all reliably capable of explosion.

It is an object of this invention to improve the explosive capacity of these detonators and reduce their susceptibility to trouble.

It has now been found that the explosive capacity of the octogen depends on the shape and size of the crystals, which should as far as possible be undamaged.

A detonator in accordance with this invention contains an explosive charge of octogen crystals, of which 30% by weight have a size in the range 75 μ to 150 μ, a length-diameter ratio of about 3:1 and substantially undamaged edges.

At one end of the detonator the octogen will preferably have a greater density than at the other end, the density will gradually reduce and at the said other end be sufficiently low for the crystals to remain substantially whole.

The invention also relates to a method of manufacturing a detonator, comprising wet-screening octogen crystals to obtain screened crystals having a size in the range 75 μ to 150 μ, a length-diameter ratio of about 3:1 and substantially undamaged edges, adding sufficient of the screened crystals to a mixture of different sizes of octogen crystals to obtain a mixture containing at least 30% by weight of crystals having a size in the range 75 μ to 150 μ, a length-diameter ratio of about 3:1 and substantially undamaged edges, and providing the detonator with an explosive charge of the mixture so obtained.

An embodiment of the detonator according to this invention is described below in detail with reference to the accompanying drawings, in which:

Figures 1 and *2* show octogen crystals in diagrammatic form;

Figures 3 to *6* show various steps in the method of manufacturing the detonators; and

Figure 7 is a diagram of the explosive capacity.

The crystal shown in Figure 1 is greater than 75 μ and less than 150 μ and its length-diameter ratio is about 3:1.

The crystal shown on the same scale in Figure 2 is greater than 150 μ, and in addition it does not have the required length-diameter ratio of about 3:1, nor does it therefore have the necessary explosive capacity.

The fundamental factor for good explosive capacity is that the crystals should not be damaged. By screening, particularly wet screening, those crystals which are too large and those which are too small can be separated out. It is more difficult to grade the crystals according to their shape. However as an observation of the crystals through a microscope shows, the elongated crystals are smaller than the rather more ball-shaped crystals, so that by using a screening method it is possible to enrich the elongated crystals. The crystals are basically damaged by great pressures. If as many of the crystals as possible are to remain undamaged, then the pressures when the capsules are loaded must not exceed certain values.

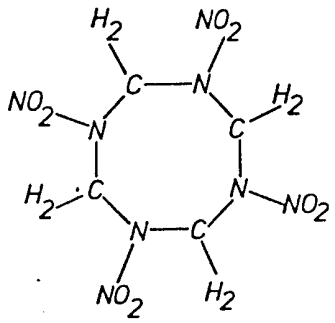
In the manufacturing stage shown in Figure 3, a quantity of about 140 mg octogen is pressed at a pressure of about 12 atmospheres absolute pressure into a sleeve 10 with bottom 11 using a ram 12.

In the stage shown in Figure 4, a further quantity of about 140 mg octogen is then pressed at a lower pressure of about 6 atmospheres absolute pressure into the same sleeve 10.

Finally, in the stage shown in Figure 5, a last quantity of again about 140 mg of the octogen is pressed at an even lower pressure of about 2 atmospheres pressure into the sleeve 10.

Figure 6 shows the sleeve 10 closed with a cover 13 and the top edge of the sleeve 10 beaded over, for which a pressure of about 20 atmospheres absolute pressure is necessary.

Octogen is known alternatively as Homocyclonite, Tetramethylentetranitramine, HMX, and Cyclotetramethylenetetramine, and has the following formula



There are four forms (α, β, γ, δ - forms)
Melting point 280°C
Explosion heat 1228 cal/g (H_2O in the form of steam)
Speed of detonation 9100 m/s
Detonation temperature 287°C.

The β - form is used for the detonator according to a preferred embodiment of this invention.

By means of a careful screening method every effort will be made to keep the preferred crystal shapes in the greatest possible purity. Through the fairly low pressures used in compacting the second and third quantities as described above with reference to Figure 4 and 5, the crystals are not damaged as much as in the first quantity, and the explosive capacity is therefore greater. This explosive capacity can be tested by means of a special test method. From the diagram in Figure 7 it can been seen that the explosive capacity depends on the grain size. With this test method one, two or three small aluminium plates, each of 1 mm thickness, are located between a priming cap and the detonator to be tested. If the explosive capacity is good the detonator can still be ignited with three plates but if the explosive capacity is bad even one plate prevents ignition of the detonator charge.

With a wet screening method it is possible to enrich the quantity of crystals of a size between 75-150 μ, which have a length-diameter ratio of 3:1, in a mix of varied octogen crystals to at least 30% by weight.

WHAT WE CLAIM IS:

1. A detonator for initiating or propagating detonation of an explosive projectile, the detonator comprising an explosive charge of octogen crystals at least 30% by weight of which have a size in the range 75 μ to 150 μ, a length-diameter ratio of about 3:1 and substantially undamaged edges.

2. A detonator according to Claim 1, wherein the density of the octogen reduces along the length of the detonator from one end to the other, the density at the said other end being sufficiently low for the crystals to remain substantially whole.

3. A detonator according to Claim 1 or 2, wherein the octogen crystals are substantially all of the β- form.

4. A detonator containing octogen crystals, substantially as hereinbefore described with reference to Figures 3 to 6 of the accompanying drawing.

5. A detonator containing octogen crystals for intiating or propagating detonation of an explosive projectile, wherein at least 30% by weight of the crystals is of the type hereinbefore described with reference to Figure 1 of the accompanying drawing.

6. A method of manufacturing a detonator, comprising wet-screening octogen crystals to obtain screened crystals having a size in the range 75 μ to 150 μ, a length-diameter ratio of about 3:1 and substantially undamaged edges, adding sufficient of the screened crystals

to a mixture of different sizes of octogen crystals to obtain a mixture containing at least 30% by weight of crystals having a size in the range 75 μ to 150 μ, a length-diameter ratio of about 3:1 and substantially undamaged edges, and providing the detonator with an explosive charge of the mixture so obtained.

7. A method of manufacturing a detonator as defined in any of Claims 1 to 5, substantially as hereinbefore described with reference to Figures 3 to 6 of the accompanying drawing.

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1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

Fig. 1

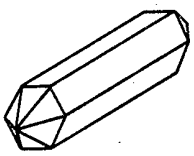
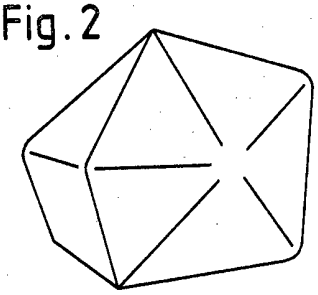


Fig. 2



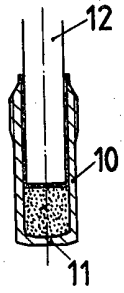


Fig. 3

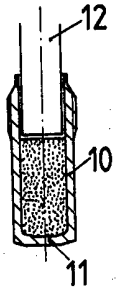


Fig. 4

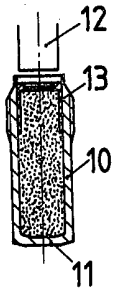


Fig. 5

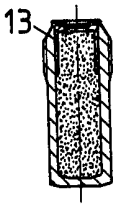


Fig. 6

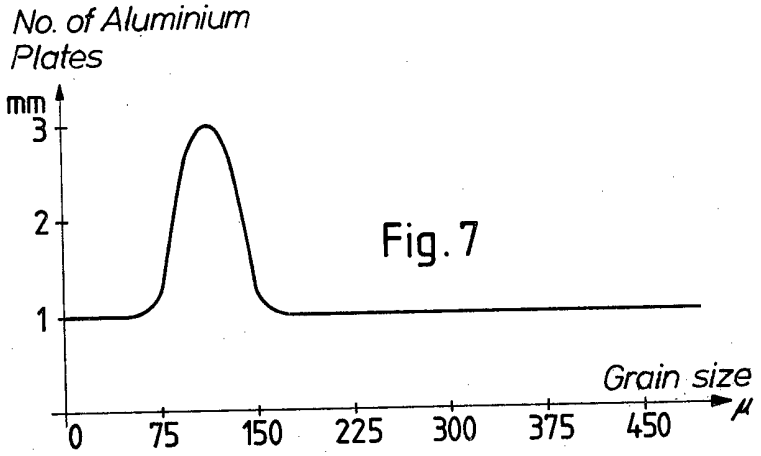


Fig. 7