

# PATENT SPECIFICATION

(11) 1 575 170

1 575 170

- (21) Application No. 13037/78 / (22) Filed 4 April 1978 /  
 (31) Convention Application No. 4404/77  
 (32) Filed 7 April 1977/in  
 (33) Switzerland (CH)  
 (44) Complete Specification published 17 Sept. 1980  
 (51) INT CL<sup>3</sup> C06B 43/00 C06C 7/00  
 (52) Index at acceptance

CID 6A1B 6A1D 6A1F 6A2C 6A2N 6B3



## (54) PUNCTURE-SENSITIVE PRIMER COMPOSITION

(71) We, WERKZEUGMASCHINEN-FABRIK 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:—

The invention relates to a puncture-sensitive primer composition for initiating a secondary charge of one or more of tetryl, nitropenta, hexogen and octagen.

A known puncture-sensitive primer composition of this type contains lead azide together with a content of 2%—8% of tetrazene. Such a primer composition has the advantage that it has an initiating effect on a secondary explosive, such as tetryl, nitropenta, hexogen or octagen. A disadvantage of such a tetrazene-containing primer composition is the low deflagration temperature of about 140°C, corresponding to the deflagration point of tetrazene. Detonators having a primer composition of this type do not meet the so-called cook-off safety regulations.

Detonators for rifled ammunition must meet the following stringent safety regulations:

- In the safe state of the fuse, the detonators must be separated by a mechanical barrier from the direct initiation line of the effective charge of the projectile;
- Detonators must have a high responsiveness;
- Detonators must be safe against cook-off, that is to say, in the case of functional failure of the weapon when a cartridge remains in a barrel which has become hot by firing, must not explode before the propellant charge has been ignited by heat transfer. Thus, they must withstand a temperature of over 200°C for at least 30 minutes;
- In the safe fuse setting, detonators must not effect any destruction of the

fuse housing, visible from the outside, when they fire inadvertently.

A primer composition which meets these safety regulations comprises, according to the invention, 2%—8% by weight of tetrazene, at least the major proportion of which has a particle size greater than 10 microns and smaller than 40 microns, whereby the deflagration temperature is at least 200°C, and 98% to 92% by weight of lead azide or a mixture of a friction agent with one or more of lead trinitroresorcinol, potassium chlorate, lead nitrate, barium nitrate, and antimony sulphide. Preferably the said major proportion is about 80% by weight.

A primer composition of this type, in which the particle size of the tetrazene is >10<40 μm, can be manufactured by various processes, for example by grinding, sieving or precipitating. The process according to the invention for manufacturing the primer mixture is characterised by the precipitation of tetrazene crystals in a particle size >10<40 μm.

A known detonator possesses a cap body comprising in the first place a puncture-sensitive primer mixture which is covered by a small puncture plate, as well as secondly an initiating charge and thirdly a charge of secondary explosive. Preferably, a small cover plate of light metal or steel is placed on the charge of secondary explosive, and this is then fixed by beading and sealed with a covering lacquer.

Caps of this type having three components, namely a puncture-sensitive primer composition, an initiating charge and a charge of secondary explosive, are expensive to manufacture.

For this reason, detonators have also been suggested in the past, which contain only a puncture-sensitive primer composition and a charge of secondary explosive and do not contain any initiating charge. Detonators of this type use a primer composition which contains lead azide and 2%—8% of tetrazene, which composition

10

has the advantages and disadvantages already mentioned, namely that it is able, on the one hand, to ignite the secondary explosive but that it is not, on the other hand, safe against cook-off. Detonators of this type have the advantage in production that only two metering steps and only two compression steps are required, which substantially cheapens and simplifies the manufacture, as compared with three-substance detonators.

The use of the primer composition according to the invention for a detonator is characterised in that the detonator contains in a priming cap 20%—50% of the puncture-sensitive primer composition, and a secondary charge, the primer composition containing, by weight, 2% to 8% of tetrazene and 98% to 92% of lead azide, the tetrazene having a particle size greater than 10 microns and smaller than 40 microns, and the secondary charge containing one or more of the materials tetryl, nitropenta, hexogen and octogen. Preferably, the cap body has at most a diameter of 4—5 mm and a length of 5—6 mm.

The invention will be explained in yet greater detail by reference to a number of illustrative embodiments. Examples 1, 2, 5 and 6 are given by way of comparison only.

For experimental purposes, the following primer compositions, in which all percentages are by weight, were prepared and tested in the corresponding cap body:

- 1) Lead azide: 95%, tetrazene: 5%.  
Particle size: over 100  $\mu$ m  
Deflagration temperature: about 140°C
- 2) Lead azide: 97.5%, tetrazene: 2.5%.  
Particle size: over 100  $\mu$ m  
Deflagration temperature: about 140°C
- 3) Lead azide: 95%, tetrazene: 5%.  
Particle size: >10<40  $\mu$ m  
Deflagration temperature: about 320°C
- 4) Lead azide: 93%, tetrazene: 7%.  
Particle size: >10<40  $\mu$ m  
Deflagration temperature: about 320°C
- 5) Lead azide: 91%, tetrazene: 9%.  
Particle size: >10<40  $\mu$ m  
Deflagration temperature: about 150°C
- 6) Lead trinitroresorcinol, barium nitrate, antimony trisulphide, and carborundum: 95%,  
Tetrazene: 5%.  
Particle size: greater than 100  $\mu$ m  
Deflagration temperature: about 150°C
- 7) Lead trinitroresorcinol, barium nitrate, antimony trisulphide, and carborundum: 95%,  
Tetrazene: 5%.  
Particle size: >10<40  $\mu$ m  
Deflagration temperature: greater than 200°C
- 8) 23% of a puncture-sensitive primer composition, consisting of 2.5% of

tetrazene of particle size >10<40  $\mu$ m and 97.5% of lead azide, and 77% of lead azide as a separate body of material within the cap

Deflagration temperature: 200°C

9) 50% of a puncture-sensitive primer composition, consisting of 2.5% of tetrazene of >10<40  $\mu$ m and 97.5% of lead azide, and

50% of lead azide as a separate body of material within the cap

Deflagration temperature: 200°C

10) 58.5% of a puncture-sensitive primer composition, consisting of 2.5% of tetrazene of >10<40  $\mu$ m and 97.5% of lead azide, and

41.5% of lead azide as a separate body of material within the cap

Deflagration temperature: 200°C.

The experiments have thus shown that tetrazene-containing primer compositions which are safe against cook-off can be prepared if the tetrazene is used with a particle size of >10<40  $\mu$ m and in sufficient dilution.

When placed in a detonator, primer compositions of this type have a high puncture-sensitivity and are particularly suitable for initiating a secondary charge of tetryl, nitropenta, hexogen or octogen. The permissible content of tetrazene in the lead azide and the total amount of the primer composition in the detonator are, however, restricted. If, for example, detonators are prepared with a primer composition consisting of 2.5% of tetrazene and 97.5% of lead azide, the proportion of the primer composition must not amount to more than, for example, 50% of the total quantity of explosive material in the detonator; otherwise, safety against cook-off is no longer ensured. On the other hand, the primer composition must not have a higher tetrazene content than 8% since, with a higher content of tetrazene, the safety against cook-off is no longer ensured.

However, the invention also relates to other primer compositions, for example to friction compositions. Such compositions contain glass powder or quartz powder, together with one or more of lead trinitroresorcinol, potassium chlorate, lead nitrate, barium nitrate, calcium silicide, and antimony trisulphide. In the case of compositions of this type, it is also possible to add tetrazene with a particle size of 10 to 40 microns in proportions of 2—8% in order to increase the puncture-sensitivity, without the deflagration temperature falling below 200°C.

In summary, the following properties of the primer compositions have been found:

- 1) The deflagration temperature depends on the particle size. With increasing particle size, the deflagration

temperature falls and, as soon as the deflagration temperature is lower than 200°C, the safety against cook-off is no longer ensured.

- 2) In a detonator, the puncture-sensitivity depends on the proportion of primer composition and hence tetrazene in the total quantity of explosive in the detonator. The larger the proportion of tetrazene, the higher is the puncture-sensitivity. When the tetrazene content is too small, the puncture-sensitivity is insufficient.
- 3) The deflagration temperature also depends on the proportion of tetrazene. The larger the proportion of tetrazene, the lower is the deflagration temperature and, as soon as the latter is lower than 200°C, the safety against cook-off is no longer ensured.
- 4) The deflagration temperature depends on the proportion of the primer composition in the detonator. The greater the proportion of the primer composition, the lower is the deflagration temperature and, as soon as the latter is lower than 200°C, the safety against cook-off is no longer ensured.
- 5) The puncture-sensitivity likewise depends on the tetrazene content of the primer composition. The smaller the tetrazene content, the lower is the puncture-sensitivity. If the tetrazene content is too small, the puncture-sensitivity is insufficient.

#### WHAT WE CLAIM IS:—

1. A puncture-sensitive primer composition which can be used for initiating a secondary charge of an explosive which contains one or more of the materials tetryl, nitropenta, hexogen and octogen, the composition comprising 2%—8% by weight of tetrazene, at least the major proportion of which has a particle size greater than 10 microns and smaller than 40 microns, whereby the deflagration temperature is at least 200°C, and 98% to 92% by weight of lead azide or a mixture of a friction agent with one or more of lead trinitroresorcinol, potassium chlorate, lead nitrate, barium nitrate, and antimony sulphide.

2. A composition according to Claim 1, wherein about 80% by weight of the

tetrazene has a particle size greater than 10 microns and smaller than 40 microns.

3. A composition according to Claim 1 or 2, in which the friction agent is calcium silicide, glass powder or quartz powder.

4. A puncture-sensitive primer composition according to Claim 1, substantially as described herein.

5. A process for improving the puncture-sensitivity of a primer composition by adding tetrazene to the composition, characterised in that a major proportion of the tetrazene has a particle size greater than 10 microns and smaller than 40 microns.

6. A process for the manufacture of a puncture-sensitive primer composition which can be used for initiating a secondary charge of an explosive which contains one or more of the materials tetryl, nitropenta, hexogen and octogen, the composition comprising 2%—8% by weight of tetrazene, and 98% to 92% by weight of lead azide, which process comprises precipitating tetrazene crystals in a particle size greater than 10 microns and smaller than 40 microns.

7. A process according to claim 6 for the manufacture of a puncture-sensitive primer composition, substantially as described herein.

8. A detonator containing in a priming cap 20%—50% by weight of a puncture-sensitive primer composition and a secondary charge, the primer composition containing, by weight, 2%—8% of tetrazene and 98%—92% of lead azide, or a mixture of a friction agent with one or more of lead trinitroresorcinol, potassium chlorate, lead nitrate, barium nitrate, and antimony sulphide, the tetrazene having a particle size greater than 10 microns and smaller than 40 microns, and the secondary charge containing one or more of the materials tetryl, nitropenta, hexogen and octogen.

9. A detonator according to Claim 8, characterised in that the cap has a maximum diameter of 4—5 mm and a length of 5—6 mm.

10. A detonator according to Claim 8, substantially as described herein.

ERIC POTTER & CLARKSON.

Chartered Patent Agents  
14 Oxford Street,  
Nottingham.

- temperature falls and, as soon as the deflagration temperature is lower than 200°C, the safety against cook-off is no longer ensured.
- 2) In a detonator, the puncture-sensitivity depends on the proportion of primer composition and hence tetrazene in the total quantity of explosive in the detonator. The larger the proportion of tetrazene, the higher is the puncture-sensitivity. When the tetrazene content is too small, the puncture-sensitivity is insufficient.
- 3) The deflagration temperature also depends on the proportion of tetrazene. The larger the proportion of tetrazene, the lower is the deflagration temperature and, as soon as the latter is lower than 200°C, the safety against cook-off is no longer ensured.
- 4) The deflagration temperature depends on the proportion of the primer composition in the detonator. The greater the proportion of the primer composition, the lower is the deflagration temperature and, as soon as the latter is lower than 200°C, the safety against cook-off is no longer ensured.
- 5) The puncture-sensitivity likewise depends on the tetrazene content of the primer composition. The smaller the tetrazene content, the lower is the puncture-sensitivity. If the tetrazene content is too small, the puncture-sensitivity is insufficient.
- tetrazene has a particle size greater than 10 microns and smaller than 40 microns.
3. A composition according to Claim 1 or 2, in which the friction agent is calcium silicide, glass powder or quartz powder.
4. A puncture-sensitive primer composition according to Claim 1, substantially as described herein.
5. A process for improving the puncture-sensitivity of a primer composition by adding tetrazene to the composition, characterised in that a major proportion of the tetrazene has a particle size greater than 10 microns and smaller than 40 microns.
6. A process for the manufacture of a puncture-sensitive primer composition which can be used for initiating a secondary charge of an explosive which contains one or more of the materials tetryl, nitropenta, hexogen and octogen, the composition comprising 2%—8% by weight of tetrazene, and 98% to 92% by weight of lead azide, which process comprises precipitating tetrazene crystals in a particle size greater than 10 microns and smaller than 40 microns.
7. A process according to claim 6 for the manufacture of a puncture-sensitive primer composition, substantially as described herein.
8. A detonator containing in a priming cap 20%—50% by weight of a puncture-sensitive primer composition and a secondary charge, the primer composition containing, by weight, 2%—8% of tetrazene and 98%—92% of lead azide, or a mixture of a friction agent with one or more of lead trinitroresorcinol, potassium chlorate, lead nitrate, barium nitrate, and antimony sulphide, the tetrazene having a particle size greater than 10 microns and smaller than 40 microns, and the secondary charge containing one or more of the materials tetryl, nitropenta, hexogen and octogen.
9. A detonator according to Claim 8, characterised in that the cap has a maximum diameter of 4—5 mm and a length of 5—6 mm.
10. A detonator according to Claim 8, substantially as described herein.

#### WHAT WE CLAIM IS:—

1. A puncture-sensitive primer composition which can be used for initiating a secondary charge of an explosive which contains one or more of the materials tetryl, nitropenta, hexogen and octogen, the composition comprising 2%—8% by weight of tetrazene, at least the major proportion of which has a particle size greater than 10 microns and smaller than 40 microns, whereby the deflagration temperature is at least 200°C, and 98% to 92% by weight of lead azide or a mixture of a friction agent with one or more of lead trinitroresorcinol, potassium chlorate, lead nitrate, barium nitrate, and antimony sulphide.
2. A composition according to Claim 1, wherein about 80% by weight of the

ERIC POTTER & CLARKSON.  
Chartered Patent Agents  
14 Oxford Street,  
Nottingham.

