

The present invention relates to the field of munitions, notably military munitions, with reduced risks. It relates to a low-vulnerability explosive munition element consisting of a casing, generally metal, containing an explosive charge. Such munitions are notably useful for generating a blast effect in mid-air or a bubble effect in an underwater environment. The charge and its casing generally have axial symmetry (a surface formed by rotation) so as to generate symmetrical effects. Explosive munitions, notably during the storage or transportation thereof, may be subjected to attacks such as fire, impact and penetration from shrapnel or bullets, or the nearby detonation of adjacent munitions.

Though the problems of fire and shrapnel can be practically resolved by means of conventional composite explosives, the problem of detonation by influence, or more precisely of vulnerability to the nearby detonation of adjacent munitions, has not yet been satisfactorily resolved.

It is well known that composite explosives, particularly of low sensitivity, can be used, loaded for example with 5-oxo 3-nitro 1,2,4-triazole (ONTA), triaminotrinitrobenzene (TATB) or nitroguanidine. This solution has however two major drawbacks.

The first is that the vulnerability of the munition to the nearby detonation of adjacent munitions is then related to the vulnerability of the detonating system. These relatively insensitive composite explosives generally have a large critical diameter which may exceed 10 cm and can conventionally be detonated only by means of a powerful relay of large size and therefore particularly sensitive and vulnerable.

The second major drawback is that even a highly insensitive explosive such as the ones mentioned above may detonate by influence as from a certain calibre.

As is conventional, the term composite explosive is intended to mean a functionally detonatable pyrotechnic composition, consisting of a solid polymer matrix, generally polyurethane or polyester, which is loaded, the said load being in powder form and containing for the most part an organic nitrate explosive load, for example hexogen, octogen, ONTA, or a mixture of at least two of these compounds.

The composite explosives and the method of obtaining them are for example described by J. QUINCHON, Powders, Propellants and Explosives, Vol 1, Explosives, Technology and Documentation, 1982, p 190-192.

French patent FR 2 365 774 describes an approximately cylindrical explosive munition element consisting of a casing containing a multicomposition charge which may be a composite explosive. This multicomposition charge has a plurality of adjacent coaxial annular layers, the peripheral layer having a powerful heavy explosive content (hexogen, octogen) greater than that of the layer immediately adjacent to it, and so on as far as the central axial layer, which is a solid cylinder and includes the lowest content of powerful heavy explosive. Such an explosive munition element is therefore particularly vulnerable.

In addition, the article "Insensitive Munitions - A fire safety plus?", which appeared in May 1989 in the journal "Military Fire Fighter" pages 74 to 81, discloses that the vulnerability of a munition element loaded with vulnerable composite explosive can be reduced by cladding this explosive in a less vulnerable composite explosive. However, as indicated above, composite explosives of low sensitivity are not free of all risk.

Experts are therefore in search of a solution which is more satisfactory than the above-mentioned known ones, enabling the vulnerability of the charge, and better still the vulnerability of the munition element consisting of the said charge and its detonating relay, to be reduced still further, whilst keeping the necessary performance with regard to the required blast and/or bubble effect.

The present invention proposes such a solution. The Applicant discovered that, unexpectedly, the vulnerability of an explosive munition element consisting of a casing which is in general and preferably metallic containing a composite explosive consisting of a polyurethane or polyester polymer matrix loaded on the one hand with an organic nitrate explosive in powder form and on the other hand with a powder load free of organic nitrate explosive but comprising at least one mineral oxidant was reduced by distributing the organic nitrate explosive and the load free of organic nitrate explosive in the polyurethane or polyester polymer matrix so as to produce a multicomposition charge, preferably a dual-composition charge, in which the innermost layer is a composite explosive whose load contains more than 40% by weight of organic nitrate explosive, this percentage being expressed with respect to the composite explosive, and whose peripheral layer is a pyrotechnic composition consisting of a loaded polyurethane or polyester polymer matrix, the said load containing at least one mineral oxidant and less than 10% by weight of organic nitrate explosive, this percentage being expressed with respect to the pyrotechnic composition, whilst keeping practically the same performance level, namely the same blast and/or bubble effect.

The pyrotechnic composition of the peripheral layer is from the class of composite solid propellants.

As is conventional, the term composition solid propellant is intended to mean a pyrotechnic composition used in an

identical manner to a composite explosive, and consisting of a solid polymer matrix, in general polyurethane or polyester, and loaded, the said load being in powder form and consisting essentially of a mineral oxidant and in general a reducing metal. The load may also sometimes contain an organic nitrate explosive. Being intended for propulsion, composite solid propellants are functionally combustible and comprise various additives for controlling the propulsion. Composite solid propellants and the method of obtaining them are for example described by A. DAVENAS, Solid Propellant Technology, Masson, 1989.

According to the present invention, the propulsion function being neither sought nor used, the Applicant does not wish to refer to the peripheral layer as a "Propellant" although the composition of this layer differs from that of composite solid propellants only through the absence of the additives related to the propulsion function of the propellants (ballistic additives, combustion accelerators, etc), and prefers to use the expression "Pyrotechnic composition from the class of composite solid propellants".

In addition, given that aliphatic nitrate derivatives have not yet given rise to any major industrial application as an explosive, the term "organic nitrate explosive" is, in a conventional manner, intended to mean an explosive chosen from the group consisting of aromatic nitrate explosives (including at least one C-NO₂ group, the carbon atom forming part of an aromatic ring), nitric ester explosives (including at least one C-O-NO₂ group) and nitramine explosives (including at least one C-N-NO₂ group).

The Applicant also discovered, in a more general sense, that the above-mentioned surprising result is also obtained when the polymer matrix of the composite explosive is different from that of the pyrotechnic composition from the class of composite solid propellants.

It must be stated that, though functionally a composite explosive detonates, a composite solid propellant burns without detonating. The phenomena of combustion and detonation are well defined by, differentiated by and known to experts. Reference may for example be made to the above-mentioned work by J. QUINCHON, pages 12 and 13.

Experts are therefore quite surprised to find that practically the same blast and/or bubble effect level are maintained in comparison with the composite explosive equivalent in weight which completely detonates, whilst the peripheral layer of the charge reacts without detonating, even when explosive loads such as octogen and ammonium perchlorate are in this peripheral layer.

In addition, this multicomposition configuration with a peripheral layer of pyrotechnic composition from the class of composite solid propellants in which the load contains at least one mineral oxidant and less than 10% by weight of organic nitrate explosive, and preferably 0%, makes the munition element almost invulnerable to the nearby detonation of adjacent munitions.

In addition, the element according to the invention is easier to detonate, by means of a relay in contact with the innermost layer of the multicomposition charge, than according to the configuration equivalent in weight known in the prior art. Because of this, the element according to the invention can be initiated by a relay of smaller size, which on the one hand reduces the vulnerability of the casing/charge/relay assembly still further, and on the other hand allows the use of composite explosives which are very difficult to detonate, which up till now were prohibited because of the size of the detonating relays necessary and the consequent risks.

The configuration according to the invention therefore makes it possible simultaneously to reduce the vulnerability of the

charge vis-a-vis detonation waves, in general lateral, caused by the nearby detonation of adjacent munitions, and to increase its susceptibility to frontal detonation because of a detonating relay situated on the axis of the charge in contact with the innermost layer. Such a result, namely reducing the vulnerability of a charge whilst increasing its susceptibility to detonation, is surprising for an expert and makes it possible to obtain almost non-vulnerable casing/charge/relay munition elements and/or to obtain low-vulnerability casing/charge/relay munition elements, the production of which, up till now, could not have been envisaged because of the low susceptibility to detonation of the charge.

The object of the present invention is therefore an explosive munition element consisting of a casing, preferably of metal, containing a multicomposition explosive charge including a plurality of adjacent coaxial layers. The casing and each layer of the charge may have any shape generated by rotation, for example cylindrical, ovoid, ellipsoid, spherical, conical or bobbin shaped. All these shapes may be only approximate. The surfaces formed by rotation may notably have irregularities, for example teeth or other recesses. The layers may be not strictly coaxial. In addition, the innermost layer is preferably solid, but it could also have one or more recesses, for example a recess for housing the detonating system. The invention is characterised in that the innermost layer is a composite explosive consisting of a loaded polyurethane or polyester polymer matrix, preferably polyurethane, whose load, which is in powder form, contains an organic nitrate explosive whose content is more than 40% by weight with respect to the composite explosive, and preferably between 40% and 90%, and in that the peripheral layer is a pyrotechnic composition from the class of composite solid propellants consisting of a loaded polyurethane or polyester polymer matrix, preferably polyurethane, whose load, which is in powder form, contains at least one mineral oxidant and less than 10% by weight of organic nitrate explosive, this

percentage being expressed with respect to the pyrotechnic composition from the class of composite solid propellants. "Less than 10%" should normally be taken to mean that the content is either between 0 and 10%, or nil, that is to say, in the latter case, which is moreover preferred, the loading contains no organic nitrate explosive.

The explosive charge is preferably a dual-composition charge, the inner layer being covered with an adjacent peripheral coaxial layer. In other cases, that is to say when the charge comprises more than two layers, the intermediate layer or layers preferably consist of a composite explosive, but some layers, notably those close to the peripheral layer, may be made from a pyrotechnic composition from the class of composite solid propellants.

The polymer matrix of the composite explosive constituting the innermost layer and the polymer matrix of the pyrotechnic composition constituting the peripheral layer of the charge are preferably identical, and preferably a polyurethane matrix. According to this variant, when the charge contains more than two layers, the intermediate layers of composite explosive and/or pyrotechnic composition from the class of composite solid propellants also have the same polymer matrix as the innermost layer and peripheral layer. The polymer matrices may optionally comprise a plasticiser, such as those normally used in the production of composite explosives and composite solid propellants.

In general, within the scope of the present invention, the polyurethane polymer matrix is obtained by the reaction of a prepolymer having hydroxyl terminations with a polyisocyanate.

Examples of prepolymers with hydroxyl terminations would be those in which the skeleton is a polyisobutylene, a polybutadiene, a polyether, a polyester or a polysiloxane. A

polybutadiene with hydroxyl terminations is used for preference.

Examples of polyisocyanates would include isophorone diisocyanate (IPDI), toluene diisocyanate (TDI), dicyclohexylmethylenediisocyanate (Hylene W), hexamethylenediisocyanate (HMDI), biuret trihexane isocyanate (BTHI), and mixtures thereof.

When the polymer matrix is a polyester matrix, it is generally obtained by the reaction of a prepolymer having carboxyl terminations, preferably a polybutadiene having carboxyl terminations (PBCT) or a polyester having carboxyl terminations, with a polyepoxide, for example a condensate of epichlorhydrine and glycerol, or a polyaziridine, for example trimethylaziridinyl phosphine oxide (MAPO).

According to a variant of the invention, the load of the pyrotechnic composition from the class of composite solid propellants constituting the peripheral layer contains a mineral oxidant chosen from the group composed of ammonium perchlorate, potassium perchlorate, ammonium nitrate, sodium nitrate and mixtures thereof, that is to say all the mixtures of at least two of the aforesaid products.

According to another variant, the load of the pyrotechnic composition from the class of composite solid propellants constituting the peripheral layer contains a reducing metal, preferably chosen from the group composed of aluminium, zirconium, magnesium, boron and mixtures thereof, that is to say all the mixtures of at least two of the aforementioned four metals. In a particularly preferred manner, the reducing metal is aluminium.

As has already been mentioned, according to a preferred variant, the load of the pyrotechnic composition from the class of composite solid propellants forming the peripheral

layer is free from organic nitrate explosive. According to this preferred variant, two particularly interesting sub-variants should be mentioned.

According to the first, the load of the pyrotechnic composition forming the peripheral layer is a mineral load, preferably chosen from the group consisting of ammonium perchlorate, potassium perchlorate, ammonium nitrate, sodium nitrate and mixtures thereof. The load does not, therefore, contain any other compound.

According to the second, the load of the pyrotechnic composition forming the peripheral layer consists, and solely consists, of a mixture of a reducing metal, preferably chosen from the group consisting of aluminium, zirconium, magnesium, boron and mixtures thereof, and of a mineral oxidant preferably chosen from the group consisting of ammonium perchlorate, potassium perchlorate, ammonium nitrate, sodium nitrate and mixtures thereof. Preferably, the load is a mixture of ammonium perchlorate and aluminium. In this case the peripheral layer preferably consists of:

- 10% to 40% by weight of a polyurethane polymer matrix
- 5% to 40% by weight of aluminium
- 20% to 85% by weight of ammonium perchlorate,

the sum of the percentages being equal to 100.

According to another variant of the invention, the organic nitrate explosive contained in the composite explosive load forming the innermost layer of the charge is chosen from the group consisting of hexogen, octogen, pentrite, 5-oxo 3-nitro 1,2,4-triazole, triaminotrinitrobenzene, nitroguanidine and mixtures thereof, in other words all the mixtures of at least two of the aforementioned compounds. This organic nitrate explosive load is preferably chosen from the group consisting

of hexogen, octogen, 5-oxo 3-nitro 1,2,4-triazole and mixtures thereof.

According to a preferred variant, the composite explosive load forming the innermost layer of the charge consists solely of the organic nitrate explosive.

In the other cases, that is to say when the composite explosive load contains other constituents, this load preferably consists, and consists solely, of organic nitrate explosive in a mixture with a load chosen from the group consisting of ammonium perchlorate, potassium perchlorate, ammonium nitrate, sodium nitrate, reducing metals and mixtures thereof, that is to say all mixtures of at least two of the aforementioned compounds. In a particularly preferred manner, the composite explosive load consists solely of the organic nitrate explosive in a mixture with a load chosen from the group consisting of ammonium perchlorate, aluminium and mixtures thereof.

The innermost layer of composite explosive preferably consists of:

- 10% to 25% by weight of a polyurethane polymer matrix
- 40% to 90% by weight of an organic nitrate explosive chosen from the group consisting of hexogen, octogen, 5-oxo 3-nitro 1,2,4-triazole and mixtures thereof.
- 0% to 35% by weight of aluminium
- 0% to 45% by weight of ammonium perchlorate,

the sum of the percentages being equal to 100.

When the percentage of aluminium differs from 0, it is preferably between 5% and 35% by weight.

When the percentage of ammonium perchlorate differs from 0, it is preferably between 10% and 40% by weight.

When the percentage of aluminium and of ammonium perchlorate is nil, the percentage of organic nitrate explosive is between 75% and 90% by weight.

Another object of the invention is a process for obtaining a blast and/or bubble effect through the release of gas, in a very short period of time, in the casing, preferably metal, of an explosive munition element consisting of the said casing containing an explosive charge, and then the rupture of the casing due to the pressure of gas formed. According to the invention, this process is characterised in that:

- the explosive munition element is an aforementioned element according to the present invention, namely an element whose explosive charge includes a plurality of adjacent coaxial layers, preferably two layers, the innermost layer, which is preferably solid, being made of composite explosive consisting of a loaded polyurethane or polyester polymer matrix whose load contains more than 40% by weight of organic nitrate explosive, this percentage being expressed with respect to the composite explosive, the peripheral layer being a pyrotechnic composition from the class of solid composite propellants consisting of a loaded polyurethane or polyester matrix whose load contains at least one mineral oxidant and less than 10% by weight of organic nitrate explosive, this percentage being expressed with respect to the pyrotechnic composition. This percentage is preferably nil, that is to say the load is free from organic nitrate explosive.
- the release of gas is obtained by the detonation of the composite explosive forming the innermost layer of the charge, and then the reaction without detonation of the pyrotechnic composition from the class of composite solid

propellants forming the peripheral layer, the said reaction being initiated by the detonation wave resulting from the detonation of the composite explosive.

The following non-limitative examples illustrate the invention and the advantages that it provides.

Example 1 Reducing the vulnerability of an explosive munition element whose explosive charge is a polyurethane composite explosive loaded with hexogen, ammonium perchlorate and aluminium.

The composition of the composite explosive charge whose vulnerability is to be reduced is as follows:

- Polyurethane polymer matrix obtained by reacting a polybutadiene having hydroxyl terminating with IPDI: 12%
- Hexogen: 20%
- Ammonium perchlorate: 43%
- Aluminium: 25%

Such a charge is used notably in mines and underwater torpedoes.

The cylindrical metal casing containing the charge is made from steel, 12.5 mm thick. The diameter of the charge (the internal diameter of the metal casing) is 248 mm and its length is 450 mm.

Along a barricade, a stack of two munition elements thus constituted, separated by 25 mm, was formed, and then the detonation of the bottom element was effected by means of a relay 63 mm in diameter and 120 mm in length made from a composite explosive consisting of 40% octogen, 44% pentrite

and 16% polyurethane binder, and a DAVEY BICKFORD SA 4000 detonator.

Detonation of the top element by influence was observed, even though it had no detonating relay.

According to the invention, in an identical metal casing, the loads were distributed in the polyurethane polymer matrix of the charge so as to produce a dual-composition charge equivalent in weight to the previous one and having the same dimensions. The composition of each layer and the relative proportions by weight of the two layers for obtaining the equivalence result from simple calculations obvious to an expert. Many solutions result from these calculations. The dual-composition charge produced consists of a solid cylinder of composite explosive having as its axis the axis of the charge, 128 mm in diameter, consisting of 88% by weight of hexogen and 12% by weight of the aforesaid polymer matrix, clad in a cylindrical sleeve of a pyrotechnic composition from the class of composite solid propellants, of internal diameter 128 mm and external diameter 248 mm and therefore with a thickness of 60 mm, consisting of 55.6% by weight of ammonium perchlorate, 32.4% by weight of aluminium and 12% by weight of the aforesaid polymer matrix. Except for the additives, this composition is that of a BUTALANE propellant, (trade mark filed by the SNPE). This dual-composition charge was produced in accordance with the technology, well known to experts, for producing composite explosives and multicomposition composite solid propellants by successive castings in moulds followed by polymerisation.

The solid cylinder of composite explosive has a detonating system consisting of a flat-wave generator of large diameter 50 mm and length 70 mm, situated coaxially with respect to the charge, of dual-composition composite explosive (polyurethane binder 14% and octogen 86% for the first and polyurethane binder 11.5%, pentrite 17% and minium 71.5% for the second).

Along a barricade, a stack of three munition elements thus constituted was formed, that is to say comprising the casing, the dual-composition charge and the detonating relay. The separation distance between the elements was 25 mm.

The detonation of the relay and consequently the detonation of the composite explosive constituting the solid cylinder of the charge of the bottom element was effected, using a conventional detonator in contact with the relay.

The detonation of the composite explosive forming the solid cylinder of the charge of the bottom element brought about the reaction without detonation of the BUTALANE propellant type composition forming the adjacent annular peripheral layer in the form of a sleeve.

The non-detonation by influence of the two top receiving elements was observed, in spite of the presence in these two elements of a detonating system identical to that of the donor element, which demonstrates that this munition element is almost invulnerable vis-a-vis the detonation wave, notably during storage, and that the invention is of advantage since the single-composition charge equivalent in weight is vulnerable although it has no detonating system. This considerable reduction in vulnerability is not obtained to the detriment of the desired effects since the aforesaid dual-composition element according to the invention has blast and/or bubble effects similar to those obtained with the single-composition element equivalent in weight.

Within the framework of this example, the increase in susceptibility to detonation of the charge is difficult to measure because the single-composition charge of composite explosive whose vulnerability it is desired to reduce is already easily detonated.

Example 2 Reduction in the vulnerability and increase in susceptibility to detonation of an explosive munition element whose explosive charge is a polyurethane composite explosive loaded with ONTA, octogen, ammonium perchlorate and aluminium.

The composition of the composite explosive charge whose vulnerability it is desired to reduce and whose susceptibility to detonation it is desired to increase is as follows:

- Polyurethane polymer matrix obtained by reacting a polybutadiene having hydroxyl terminations with IPDI: 15%
- Octogen: 6%
- ONTA 31%
- Ammonium perchlorate: 38%
- Aluminium: 10%

The cylindrical metal casing containing the charge is identical to that of Example 1.

This charge has a very large critical diameter, greater than 10 cm. It is therefore very difficult to detonate. Only relays of very large size can manage to do so. However, the vulnerability of such relays in practice precludes the use of such a charge, notably in mines, underwater torpedoes and general-purpose bombs.

According to the invention, in an identical metal casing, the loads were distributed in the polyurethane polymer matrix of the charge so as to produce a dual-composition charge equivalent in weight to the previous one and having the same dimensions. This dual-composition charge consists of a solid cylinder of composite explosive having as its axis the axis of the charge, of diameter 168 mm, its composition being 12% by

weight of octogen, 72% by weight of ONTA and 16% by weight of the aforesaid polymer matrix, clad with a cylindrical sleeve made from a pyrotechnic composition from the class of composite solid propellants, of internal diameter 168 mm and external diameter 248 mm and therefore with a thickness of 40 mm, its composition being 68% by weight of ammonium perchlorate, 18% by weight of aluminium and 14% by weight of the aforesaid polymer matrix. Apart from the additives, this composition is that of a BUTALANE propellant. This dual-composition charge was produced using the same technology as that of Example 1.

The solid cylinder of composite explosive has a detonating system consisting of a flat-wave generator, with a large diameter of 90 mm and a length of 80 mm, situated coaxially with respect to the charge, of the same nature as the generator used for Example 1.

Along a barricade, a stack of three munition elements thus constituted was formed, that is to say comprising the casing, the dual-composition charge and the detonating relay. The separation distance between the elements was 25 mm.

The detonation of the relay and consequently that of the composite explosive constituting the solid cylinder of the charge of the bottom element was then effected, using a conventional detonator in contact with the relay.

The detonation of the composite explosive constituting the solid cylinder of the charge of the bottom element brought about the reaction without detonation of the BUTALANE propellant type composition constituting the adjacent annular peripheral layer.

The non-detonation by influence of the top two receiving elements was observed, in spite of the presence, in these two

elements, of a detonating system identical to that of the donor element.

This test demonstrates that the "casing/charge/relay" munition element is almost invulnerable vis-a-vis the detonation wave, notably during storage, and that the invention is of advantage since the single-composition charge equivalent in weight, which is too difficult to detonate, cannot in practice be used, for the above-mentioned reasons.

This result is not obtained to the detriment of the desired effect since the aforementioned dual-composition element according to the invention has blast and/or bubble effects similar to those obtained with the single-composition element equivalent in weight.



CLAIMS

1. Explosive munition element consisting of a casing, preferably of metal, containing a multi-composition explosive charge having a plurality of adjacent coaxial layers, characterised in that the innermost layer, which is preferably solid, is a composite explosive consisting of a loaded polyurethane or polyester polymer matrix, whose load contains more than 40% by weight of organic nitrate explosive, this percentage being expressed in relation to the composite explosive, and in that the peripheral layer is a pyrotechnic composition from the class of composite solid propellants consisting of a loaded polyurethane or polyester polymer matrix whose load contains at least one mineral oxidant and less than 10% by weight of organic nitrate explosive, this percentage being expressed with respect to the pyrotechnic composition from the class of composite solid propellants.

2. Explosive munition element according to Claim 1, characterised in that the polymer matrix of the composite explosive forming the innermost layer and the polymer matrix of the pyrotechnic composition from the class of composite solid propellants forming the peripheral layer of the charge are identical.

3. Explosive munition element according to any one of the preceding claims, characterised in that the polymer matrix of the composite explosive forming the innermost layer and the polymer matrix of the pyrotechnic composition from the class of composite solid propellants forming the peripheral layer of the charge are polyurethane matrices.

4. Explosive munition element according to any one of the preceding claims, characterised in that the polyurethane polymer matrix is obtained by reacting a polybutadiene with hydroxyl terminations with a polyisocyanate.



5. Explosive munition element according to any one of the preceding claims, characterised in that the explosive charge is a dual-composition charge, the inner layer being covered with an adjacent peripheral coaxial layer.
6. Explosive munition element according to any one of the preceding claims, characterised in that the load of the pyrotechnic composition forming the peripheral layer contains a mineral oxidant chosen from the group composed of ammonium perchlorate, potassium perchlorate, ammonium nitrate, sodium nitrate and mixtures thereof.
7. Explosive munition element according to any one of the preceding claims, characterised in that the load of the pyrotechnic composition forming the peripheral layer contains a reducing metal.
8. Explosive munition element according to Claim 7, characterised in that the reducing metal is chosen from the group composed of aluminium, zirconium, magnesium, boron and mixtures thereof, preferably aluminium.
9. Explosive munition element according to any one of the preceding claims, characterised in that the load of the pyrotechnic composition forming the peripheral layer is free of organic nitrate explosive.
10. Explosive munition element according to any one of Claims 1 to 6 and 9, characterised in that the load of the pyrotechnic composition forming the peripheral layer is a mineral oxidant chosen from the group composed of ammonium perchlorate, potassium perchlorate, ammonium nitrate, sodium nitrate and mixtures thereof.
11. Explosive munition element according to any one of Claims 1 to 9, characterised in that the load of the pyrotechnic composition forming the peripheral layer is a mixture of a



reducing metal, preferably chosen from the group composed of aluminium, zirconium, magnesium, boron and mixtures thereof, and of a mineral oxidant chosen from the group consisting of ammonium perchlorate, potassium perchlorate, ammonium nitrate, sodium nitrate and mixtures thereof.

12. Explosive munition element according to any one of Claims 1 to 9 and 11, characterised in that the load of the pyrotechnic composition forming the peripheral layer is a mixture of ammonium perchlorate and aluminium.

13. Explosive munition element according to any one of Claims 1 to 9, 11 and 12, characterised in that the peripheral layer consists of:

- 10% to 40% by weight of a polyurethane polymer matrix
- 5% to 40% by weight of aluminium
- 20% to 85% by weight of ammonium perchlorate,

the sum of the percentages being equal to 100%.

14. Explosive munition element according to any one of the preceding claims, characterised in that the organic nitrate explosive contained in the load of the composite explosive forming the innermost layer of the charge is chosen from the group composed of hexogen, octogen, pentaerythritol tetranitrate, 5-oxo 3-nitro 1,2,4-triazole, triaminotrinitrobenzene, nitroguanidine and mixtures thereof.

15. Explosive munition element according to any one of the preceding claims, characterised in that the organic nitrate explosive contained in the load of the composite explosive forming the innermost layer of the charge is chosen from the group composed of hexogen, octogen, 5-oxo 3-nitro 1,2,4-triazole and mixtures thereof.



16. Explosive munition element according to any one of the preceding claims, characterised in that the load of the composite explosive forming the innermost layer of the charge consists solely of organic nitrate explosive.

17. Explosive munition element according to any one of Claims 1 to 15, characterised in that the load of the composite explosive forming the innermost layer of the charge consists of organic nitrate explosive in a mixture with a load chosen from the group composed of ammonium perchlorate, potassium perchlorate, ammonium nitrate, sodium nitrate, reducing metals and mixtures thereof.

18. Explosive munition element according to any one of Claims 1 to 15 and 17, characterised in that the load of the composite explosive forming the innermost layer of the charge consists of organic nitrate explosive in a mixture with a load chosen from the group composed of ammonium perchlorate, aluminium and mixtures thereof.

19. Explosive munition element according to any one of the preceding claims, characterised in that the innermost layer of composite explosive consists of:

- 10% to 25% by weight of a polyurethane polymer matrix
- 40% to 90% by weight of an organic nitrate explosive chosen from the group consisting of hexogen, octogen, 5-oxo 3-nitro 1,2,4-triazole and mixtures thereof
- 0% to 35% by weight of aluminium
- 0% to 45% by weight of ammonium perchlorate,

the sum of the percentages being equal to 100.



20. Process for obtaining a blast and/or bubble effect through the release of gas in the casing of an explosive munition element consisting of a casing containing an explosive charge, and then the rupture of the casing due to the pressure of the gas, characterised in that the explosive munition element is an element according to any one of the Claims 1 to 19, and in that the release of gas is obtained by the detonation of the composite explosive forming the innermost layer of the charge, and then the reaction without detonation of the pyrotechnic composition from the class of composite solid propellants forming the peripheral layer, a reaction initiated by the detonation wave resulting from the detonation of the composite explosive.