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(54)

**non-deflagrating reactive armor.**

(57)

The present invention relates to a non-deflagrating detonation limiting reactive composition in a armor configuration which composition comprises oxidizer compound and binder compound components in which the binder comprises a plasticizer and binder mixture.

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## BACKGROUND OF THE INVENTION

The present invention relates to reactive armor for military vehicles such as tanks and armored personnel carriers. In particular, this invention relates to an improved means for protecting the surface area of the vehicle from attack and penetration of its armor by various types of anti-armor projectiles.

In a military combat environment it is essential for the occupants of military vehicles exposed to hostile fire such as modern anti-armor projectiles to be afforded protection from the deleterious effects of such projectiles when same impact the vehicle. In general there are three types of anti-armor projectiles: kinetic energy projectiles, projectiles with shaped charge warheads, and projectiles with high explosive warheads.

The kinetic energy projectile consists of a small caliber projectile of high density material launched from a gun tube and accelerated to supersonic velocity. This type of projectile does not have an explosive warhead but due to its high density and speed can easily penetrate unprotected armor and cause considerable damage to the vehicle by ricocheting off interior walls. In the shaped charge warhead, the projectile strikes the exterior armor causing a high explosive charge to collapse a metallic liner and form a high speed jet which then penetrates even very thick armor. In high explosive warheads, a high explosive charge detonates upon impact with the exterior armor causing damage by concussion or blast fragmentation.

The most effective armor available to defeat shaped charge warheads is reactive armor. Reactive armors are armors which contain explosives which react in response to the impact of the shaped charge jet, causing the jet to dissipate its energy prior to penetration of the hull armor. Reactive armor can also be very effective for defeating penetration by kinetic energy impact. In this case, the activated armor will throw a steel plate or some other similar structure, which will deflect or bend the penetration rod on impact, and severely degrade its penetration performance. The principal type of reactive armor currently available is an explosive sandwiched between two plates of inert material. The principal drawback of current explosive armor designs is that without using elaborate mechanical segmentation barrier installation approaches, a single projectile hit anywhere on a vehicle has the potential to deplete a large fraction of the active armor protection of that vehicle. This depletion can be by either detonation or deflagration reaction of the material to completion, subsequent to impact by an anti-armor projectile. This invention solves this problem, by use of a reactive

material with a self limiting detonative response, and the characteristic that it will not burn subsequent to impact.

## OBJECTS AND SUMMARY OF THE INVENTION

A primary object of the invention is to reduce or eliminate ignition and deflagration to reaction completion by combustion of the reactive armor when same is struck by an explosive or penetrator type projectile.

Another object of the invention is to preclude the depletion of contiguous explosive armor by detonative reaction, once a portion of the reactive armor is impacted by a anti-armor projectile.

The objects stated above are accomplished by providing a non-deflagrating detonation limiting reactive composition in a armor configuration which composition comprises oxidizer compound and binder compound components in which the binder comprises a plasticizer and binder mixture. The reactive composition may optionally contain a flame retardant compound component. This explosive limiting reactive composition may be sandwiched between armor plates or affixed to a vehicle's armor configuration as known by one skilled in the art.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

As previously noted the essence of the present invention resides in a explosive self-limiting, non-deflagrating reactive composition in a armor configuration comprising an oxidizer and binder in which the binder comprises a plasticizer and binder mixture and optionally a flame retardant compound. Of the reactive composition, the oxidizer comprises from about 70 percent to about 80 percent of the composition and the binder component comprises from about 20 percent to about 30 percent of the composition. With respect to the binder component of the reactive composition, same comprises a plasticizer and binder mixture which may vary, but in one embodiment was formulated in a ratio of three parts plasticizer to two parts binder (1.50).

The plasticizer portion of the binder may be selected from dibromopropyl bromo acetate, or other inert or active flame retardant material. As to the flame retardant compound component of the reactive composition, it makes up about 5 percent of the composition. Suitable oxidizers which may be used in formulating the reaction composition are potassium perchlorate and ammonium perchlorate. The binder portion of the binder compound component may be polyepibromohydrin or polyepichlorohydrin. With respect to the flame retardant compound component, same may be selected

from ammonium sulfate, oxamide ( $\text{H}_4\text{C}_2\text{N}_2\text{O}_2$ ), alumina, and ammonium bicarbonate.

To those skilled in the art, many modifications and variations of the present invention are possible in light of the above teachings. It is therefore to be understood that the present invention can be practiced otherwise than as specifically described herein and still will be within the spirit and scope of the appended claims.

#### Claims

1. A non-deflagrating detonation limiting reactive composition in a armor configuration comprising an oxidizer component and a binder component wherein the binder further comprises a plasticizer and binder mixture. 15
2. The non-deflagrating detonation limiting reactive composition of claim 1 further comprising a flame retardant component. 20
3. The non-deflagrating detonation limiting reactive composition of claim 1 wherein the oxidizer comprises from about 70 percent to about 80 percent of the composition. 25
4. The non-deflagrating detonation limiting reactive composition of claim 1 wherein the binder comprises from about 20 percent to about 30 percent of the composition. 30
5. The non-deflagrating detonation limiting composition of claim 1 wherein the plasticizer and binder mixture of the binder component comprises a ratio of 3 parts plasticizer to 2 parts binder (1.50). 35
6. The non-deflagrating detonation limiting composition of claim 1 wherein the oxidizer is potassium perchlorate or ammonium perchlorate. 40
7. The non-deflagrating detonation limiting composition of claim 1 wherein a binder portion of the binder component is polyepibromohydrin or polyepichlorohydrin. 45
8. The non-deflagrating detonation limiting composition of claim 1 wherein a plasticizer portion of the binder component is dibromopropyl bromo acetate. 50
9. The non-deflagrating detonation limiting composition of claim 2 wherein the flame retardant compound is selected from ammonium sulfate, oxamide, alumina, and ammonium bicarbonate. 55

10. The non-deflagrating detonation limiting composition of claim 2 wherein a flame retardant component is about 5 percent of the composition.

11. A non-deflagrating detonation limiting reactive composition in a armor configuration.

12. A vehicle armor configuration incorporating a non-deflagrating detonation limiting reactive composition.



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## EUROPEAN SEARCH REPORT

Application Number  
EP 94 10 7641

| DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                        |                                                       |                                              |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|----------------------------------------------|
| Category                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Citation of document with indication, where appropriate, of relevant passages                                                                          | Relevant to claim                                     | CLASSIFICATION OF THE APPLICATION (Int.Cl.5) |
| X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | CHEMICAL ABSTRACTS, vol. 114, no. 16, 22 April 1991, Columbus, Ohio, US; abstract no. 146427p, Y. TOBE ET AL. 'Fire-resistant explosive compositions.' | 1                                                     | C06B23/00                                    |
| Y                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | page 170 ;<br>* abstract *<br>& JP-A-90 293 388 (JAPAN, DEFENSE AGENCY TECHNICAL RESEARCH DEVELOPMENT INSTITUTE)<br>---                                | 2-12                                                  |                                              |
| Y                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | US-A-4 861 397 (W.W. HILLSTROM)<br>* column 2, line 19 - line 41 *<br>---                                                                              | 2-10                                                  |                                              |
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| Y                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | DE-C-20 08 156 (MESSERSCHMITT-BÖLKOW-BLOHM GMBH)<br>* column 2, line 29 - line 63 *<br>---                                                             | 11,12                                                 | TECHNICAL FIELDS<br>SEARCHED (Int.Cl.5)      |
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| Y                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | US-A-3 725 154 (C.R. MCCULLOCH ET AL.)<br>* claim 1 *<br>---                                                                                           | 2,9                                                   |                                              |
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| A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | US-A-3 632 458 (H.E. FILTER ET AL.)<br>-----                                                                                                           |                                                       |                                              |
| The present search report has been drawn up for all claims                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                        |                                                       |                                              |
| Place of search<br>THE HAGUE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                        | Date of completion of the search<br>14 September 1994 | Examiner<br>Schut, R                         |
| <b>CATEGORY OF CITED DOCUMENTS</b><br>X : particularly relevant if taken alone<br>Y : particularly relevant if combined with another document of the same category<br>A : technological background<br>O : non-written disclosure<br>P : intermediate document<br>T : theory or principle underlying the invention<br>E : earlier patent document, but published on, or after the filing date<br>D : document cited in the application<br>L : document cited for other reasons<br>.....<br>& : member of the same patent family, corresponding document |                                                                                                                                                        |                                                       |                                              |