EXPLOSIVE BOMB OR WEAPON CASING

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The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

This invention relates to explosive structural material and more particularly to metal reinforced explosive material useful as a casing for explosives in weapons such as bombs, mines, and depth charges.

Commonly used explosives do not have sufficient strength without reinforcement to withstand stresses and impacts encountered prior to detonation, and heretofore inert solid casing materials such as metals and reinforced plastics have been employed as weapon casing material. The use of these inert weapon casings results in a reduced ratio of explosive weight to overall weapon weight, and thus in a corresponding reduction in net available explosive power for a given weapon weight. Therefore, if an explosive structural material having sufficient strength for use as a weapon casing replaced the commonly used inert casing, a weapon of a given weight employing a casing material capable of participating in the explosion of the weapon would have greatly increased explosive power.

The present invention describes novel explosive structural materials and processes for constructing explosive weapon casings therefrom. In accordance with this invention metal reinforced explosive weapon casings are provided which are approximately equal, for a given weight, in explosive power, blast and bubble energy to the main charge employed in the weapon, and that have sufficient strength to resist stresses and impacts encountered by the weapon during handling thereof prior to detonation. Thus a weapon of a given weight employing the novel casing of this invention has approximately the same available explosive power as the same weight of explosive.

It is an object of the present invention to provide a metalized explosive structural material which is approximately equal in explosive power per unit weight to the explosive binder employed therein.

It is another object of the present invention to provide an explosive weapon casing which is approximately equal in explosive power for a given weight as the main charge employed in the weapon.

It is a further object of the present invention to provide a process for producing explosive weapon casings from the novel structural materials described herein.

Further objects and many of the attendant advantages of the present invention will become apparent to those skilled in the art as the same becomes better understood by reference to the following detailed description, when considered in connection with the accompanying drawings which illustrate certain modifications of the invention.

Figs. 1, 3, 5, 6, 8, 9, 11 and 12 are enlarged diagramatic sections of certain preferred forms of the metal reinforced explosive structural material of this invention.

Figs. 2, 5 and 11 are plan views of Figs. 3, 6, and 12, respectively.

Referring now to the drawing, I designates a continuous sheet or screen-like reinforcing material, which may be of metal such as, for example, aluminum or magnesium, and 2 designates a suitable thermoplastic explosive binder or a binder system containing explosive, such, for example, as tri-nitrotoluene or an epoxy resin with powdered explosive dispersed therethrough.

More particularly, Figs. 1, 3, 10 and 12 illustrate preferred forms of the novel explosive structural material of this invention made in the form of a laminate comprising metal foil I and explosive binder 2. The metallic reinforcing material may be in the form of smooth continuous sheets of foil as shown in Figs. 1 and 3, or in the form of continuous corrugated sheets of metal foil as shown in Figs. 10 and 12. Either the smooth or corrugated sheets of foil may be perforated, as shown in Figs. 3 and 12. The perforations 3 in the case of foil I may be in any suitable design, Figs. 2 and 11 illustrating a preferred design. The explosive binder 2 may be of any suitable thermoplastic explosive, such as, for example, tri-nitrotoluene or a binder system containing explosive.

Figs. 4, 6, 7, 8 and 9 are illustrative of other preferred forms of the explosive structural material of this invention wherein metal foil I, such as magnesium or aluminum foil, is first assembled into a desired structure and then this structure impregnated with an explosive binder 2 such as nitrocellulose or a binder system containing explosive. The metal foil I may likewise be in any suitable configuration, such as continuous smooth or corrugated sheets, or arranged in a honeycomb-like structure as shown in Fig. 7. Smooth and corrugated layers of metal foil I may be arranged alternately, as shown in Figs. 4 and 6, to thereby space adjacent layers of foil and form voids 4 which are then impregnated with explosive binder 2. The layers of metal foil 1 may be permanently joined at abutting points 5 by any suitable method, such as by means of an adhesive, if a particularly rigid structure is desired. Figs. 8 and 9 illustrate a preferred arrangement, the metal foil I therein being composed entirely of corrugated layers 5 of metal foil 1 formed voids 4, which are then impregnated with explosive binder 2. The adjacent layers abutting at points 5 may likewise be permanently joined in any suitable manner thereby strengthening the structure. Either the smooth or corrugated layers of metal foil I may be perforated as shown in Figs. 6 and 9 to provide means for interlocking layers of explosive binder 2 through the perforations, and thus further enhance the strength of the structure.

Figs. 5 illustrates a preferred design for such perforations 3 in metal foil I.

Explosive structural material of this invention in the form of a multi-layer laminate of metal foil and explosive binder may be made in any suitable manner. A preferred procedure is to bond perforated layers of metal foil with layers of a suitable explosive binder such as nitrocellulose or trinitrotoluene about 0.003—0.004 inch thick at temperatures of approximately the melting point of the particular explosive binder employed. Sufficient pressure is applied to force the molten binder into intimate contact with the metal foil and force the explosive binder through perforations in the metal foil, thereby interlocking adjacent layers of the binder. The explosive laminate thus produced may be formed into any desired structural, such as tubular body portions for a weapon casing, by heating the laminate to the melting point of the particular explosive binder employed and rolling, or by any other suitable method to form a desired shape. Alternatively, or to produce compound shapes, the metal foil may be coated with a layer of explosive binder, the
coated metal foil cut into desired shape, sufficient layers of coated metal foil to form a desired laminate thickness assembled in a mold, sufficient pressure applied to the mold to effect bonding between metal foil and binder while heating above the melting point of the particular binder employed, and cooling the mold assembly before removing the laminate. Fig. 13 indicates a typical bomb casing constructed in the herein described manner and having a plurality of alternate laminations of metal foil reinforcement sheets and a plurality of layers of explosive binding material therebetween.

A very satisfactory explosive laminate was produced as follows: A solution of commercial cellulose nitrate lacquer containing 22.9% solids (11% nitration) was diluted with sufficient acrylamide to give a solution containing about 15% solids. The solution was applied to 2 mil aluminum foil by immersing the foil therein, and was then coated with a 2 mil film of cellulose nitrate. Layers of the coated foil were assembled into a desired structure and heat (220-225° F.) and pressure (60 p.s.i.) applied to the assembly. The temperature was raised to 225° F. over a period of 10-20 minutes, maintained at 220-225° F. for about 25 minutes, and then lowered to room temperature. A pressure of 60 p.s.i. is maintained throughout the process.

The structural material for this invention may also be produced by pressure-vacuum impregnation of an assembled metal foil structure, such as shown in Figs. 4, 6, and 7 through 9, with molten explosive binder. The metal foil of these structures may be about 0.001 to 0.002 inch thick and preferably adjacent layers permanently joined at points of contact to enhance structural strength. The explosive binder selected for impregnation of the voids in the assembled structure should be sufficiently fluid at temperatures above the melting point so as to insure ease of impregnation of the structure, nitrocellulose and trinitrotoluene having been found to be satisfactory for this purpose.

The reinforcing metal employed may be any suitable malleable metal and in any suitable form, such as metal foil, wire screening, thin shredded metal, etc. However, continuous sheets of 0.001-0.004 inch aluminum or magnesium foil are preferred since it has been found that thin foil of these metals contribute to the explosion. The metal foil employed may be pretreated by either chemical or physical methods, such as by chemical etching, perforation or corruagation, to enhance the bond between metal and binder. The stiffness and strength of the completed structure may also be improved by tempering the metal foil employed therein.

The explosive binder employed in this invention may be any of a number of different types of such binders, and it is to be understood that the binder is not limited to a thermoplastic explosive material such as trinitrotoluene or nitrocellulose. By way of example only, very effective explosive binders may be produced by dispersing powdered trinitrotoluene, 2,2-dinitrobutyl acrylate, cycloheximethylene triamine, pentaerythritol tetranitrate, nitrated polyvinyl alcohol or other suitable explosive, in a suitable thermosetting resin binder such as, for example, a peroxide catalyzed polyester resin or epoxy resin with an inert curing agent such as methylamine-boron trifluoride complex. The binding resin therein may be nitrated and/or halogenated, and, if desired, finely divided aluminum or magnesium may be dispersed in the binding system for the purpose of increasing explosive power, or non-metal fibrous mechanical reinforcements added, such as asbestos or glass fibers, to increase strength. In many instances it is desirable to first coat fibrous materials with metal by some suitable method, such as by vacuum or chemical deposition. Explosive laminates may also be produced from thin sheets of halocarbon polymers, such as polytetrafluoroethylene or polychlorotrifluoroethylene and co-polymers thereof, bonded by means of an adhesive between layers of aluminum or magnesium foil, or the powdered polyhalocarbon may be dispersed in a thermosetting resin binder system. These binder systems are applied in the usual manner, and the resin then cured by processes well known in the art for the particular resin employed.

Weapon casings constructed from the metallized explosive of this invention may be made as thick as necessary without appreciably reducing the ratio of explosive weight to weapon weight, as the weapon casing is approximately equal, for a given weight, to the main explosive charge in explosive power, blast, and bubble energy. The outer surface plies of the casing may be bonded with a hard inert resin or laminate to prevent damage due to abrasion or impact during handling thereof and to reduce the likelihood of ignition by external heat, sparks, and the like. Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. A hollow laminated explosive container comprising a plurality of reinforcing aluminum foil laminations bonded together by distinct layers of an explosive binding material, each of said layers comprising a polyhalocarbon selected from the group consisting of polytetrafluoroethylene and polychlorotrifluoroethylene.

2. A casing for a weapon comprising: a hollow laminated container, said container being formed of a plurality of discrete reinforcing metal foil laminations bonded together by alternate laminations of an explosive binding material.

3. The casing of claim 2 wherein said metal foil consists of a metal capable of participating in an explosion.

4. The casing of claim 2 wherein said metal foil is aluminum.

5. The casing of claim 2 wherein said metal foil laminations are of a thickness not exceeding about four thousandths of an inch.

6. The casing of claim 2 wherein said metal foil laminations comprise corrugated sheets of metal foil having a thickness not exceeding about four thousandths of an inch.

7. A casing for a weapon comprising: a hollow laminated container, said container being formed of a plurality of discrete corrugated aluminum foil laminations not exceeding about four thousandths of an inch in thickness and bonded together by layers of thermoplastic explosive binding material.

8. A casing for a weapon comprising: a hollow laminated container, said container being formed of a plurality of discrete aluminum foil laminations bonded together by discrete layers of a thermosetting binding material, said layers having powdered explosive dispersed therethrough.

9. A casing for a weapon comprising; a hollow laminated container, said container being formed of a plurality of discrete aluminum foil laminations bonded together by a plurality of layers of explosive binding material, and non-metal fibrous reinforcing material dispersed through said layers.

10. The casing of claim 2 wherein said metal foil is magnesium.

11. The casing of claim 2 wherein said metal foil laminations comprise continuous sheets of smooth and corrugated metal foil.

12. The casing of claim 2 wherein said metal foil laminations define a plurality of cells and said explosive binding material substantially fills the cells.

13. The casing of claim 12 wherein said metal foil is magnesium.

14. The casing of claim 12 wherein said metal foil is aluminum.

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