



US 20140305295A1

(19) **United States**

(12) **Patent Application Publication**
Sobczak et al.

(10) **Pub. No.: US 2014/0305295 A1**

(43) **Pub. Date: Oct. 16, 2014**

(54) **COMPOSITE PASSIVE ARMOR PROTECTION**

Publication Classification

(71) Applicant: **INSTYTUT ODLEWNICTWA,**
Kraków (PL)

(51) **Int. Cl.**
F41H 5/02 (2006.01)

(72) Inventors: **Jerzy Sobczak,** Wieliczka (PL); **Pawel Darlak,** Krakow (PL); **Piotr Dlugosz,** Krakow (PL)

(52) **U.S. Cl.**
CPC **F41H 5/02** (2013.01)
USPC **89/36.02**

(21) Appl. No.: **14/355,215**

(57) **ABSTRACT**

(22) PCT Filed: **Oct. 25, 2012**

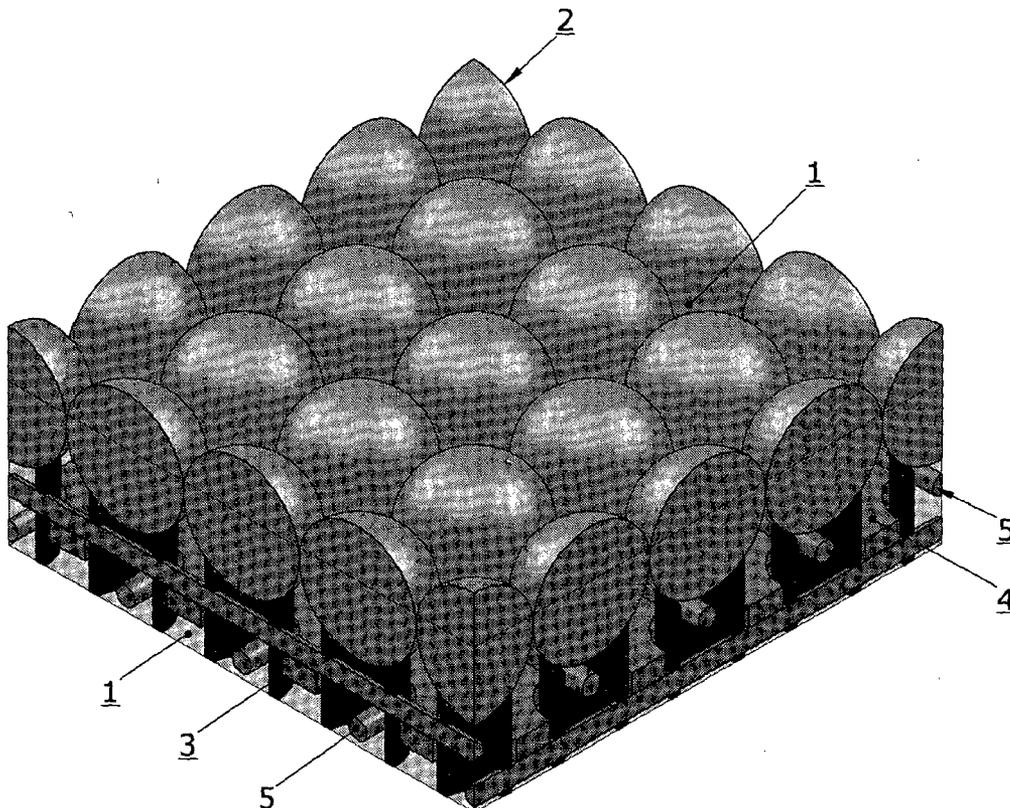
A composite passive armor protection comprises a structure, embedded in the light alloy matrix (1), wherein said structure is made of geometric solids (2), resting on brackets (3), passing through the holes in plate (4), wherein said brackets (3) have through-holes located at a height above and below the plate (4), wherein in said through-holes are secured rods (5) in such a way that they form a grid, wherein the geometric solids (2) are embedded in the light alloy matrix (1), preferably to a level above one half of their diameter, and wherein the rods (5) are preferably fixed in such a way that their longitudinal axes coincide with the axes of the geometric solids (2).

(86) PCT No.: **PCT/PL2012/000114**

§ 371 (c)(1),
(2), (4) Date: **Apr. 30, 2014**

(30) **Foreign Application Priority Data**

Nov. 7, 2011 (PL) P.396893



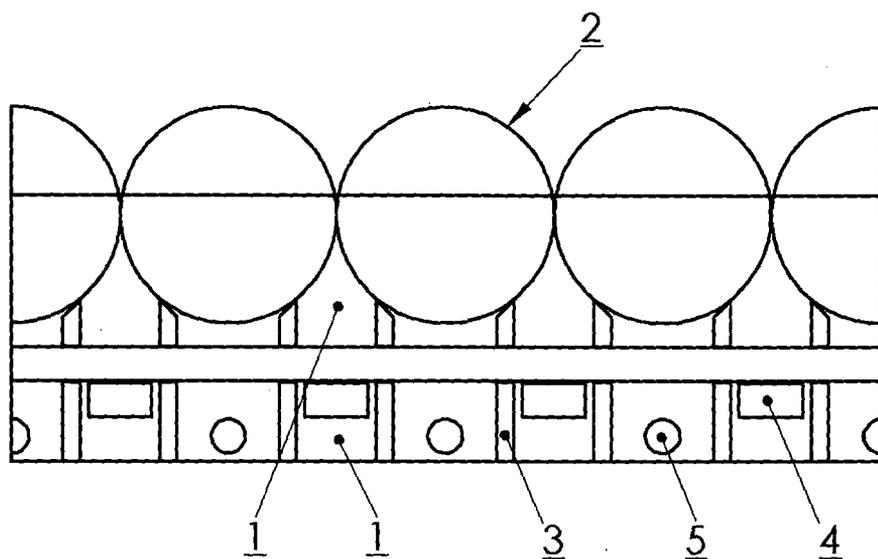


Fig.1

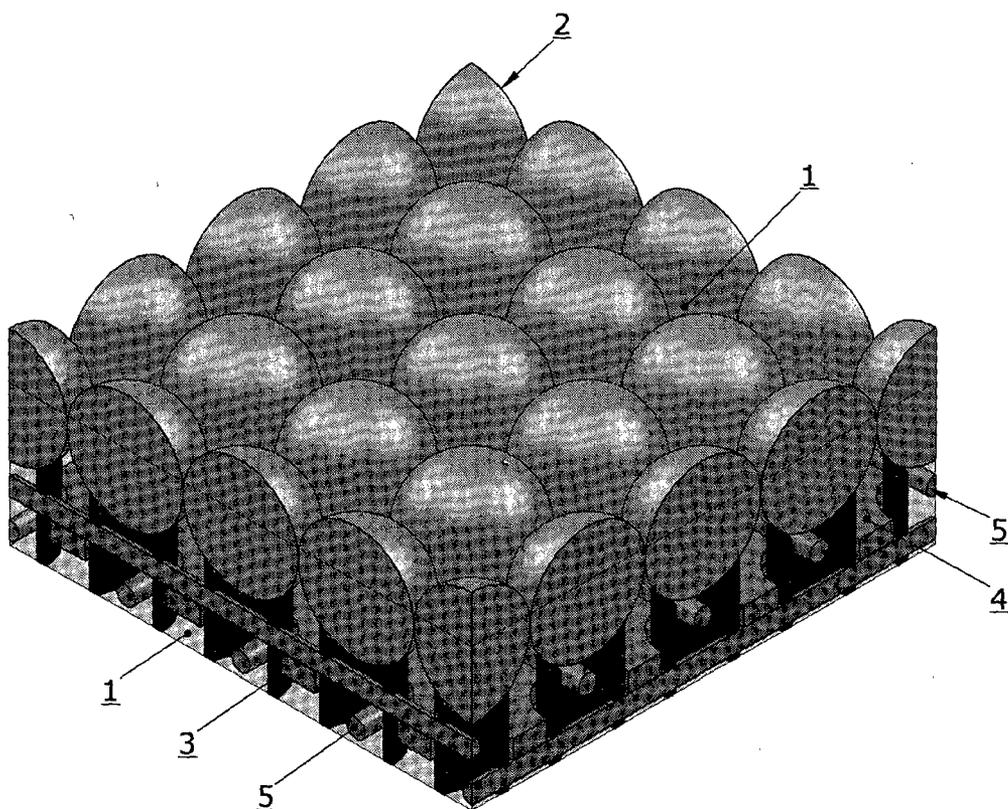


Fig. 2

COMPOSITE PASSIVE ARMOR PROTECTION

[0001] The invention relates to a composite passive armor protection to safeguard objects from the effect of projectiles and projectile fragments.

[0002] Known from the DE1578324 description armor consists of a non-metallic matrix, in which totally embedded are a plate and, arranged above said plate, the energy-absorbing layers, comprising elements which have the shape of plates or of cylindrical solids arranged side by side or at certain distances in the layers. On the other hand, the protective screen to defend against explosion as disclosed in the PL171251 description is made of air-permeable side layers, having the form of precut sheets of metal foil, and of a porous core, placed between these foils, containing the beads or ellipsoids made of the same material as the sheet. Preferably, the sheets of metal foil contain magnesium alloy. A passive armor known from the PL181177 description consists of the main inner protective metal layer and the outer protective layer comprising a number of rectangular, metallic cassettes containing ceramic layers. The spaces between the ceramic layers and the surfaces of the cassette walls are filled with a composition of small ceramic pieces mixed with glue and concrete. The cassettes in an outer protective layer of the armor are removably secured to the main inner protective metal layer by means of various connecting and clamping elements. A safety element used to protect the life and health of the crew of a military vehicle against the explosion of mine under this vehicle known from the PL206571 description consists of a shield having through-holes on its entire surface. The shield is connected by means of the vertical supports with a thin intermediate plate, which, through springs and connected to these springs mounting plates, is attached to the underside of the vehicle floor. Discharge ducts are running from the shield surface.

[0003] A composite passive armor protection according to the present invention comprises a structure, embedded in the light alloy matrix, wherein said structure is made of geometric solids resting on brackets passing through the holes in the plate, wherein said brackets have through-holes located at a height above and below the plate, wherein in said through-holes are secured rods in such a way that they form a grid, wherein the geometric solids are embedded in the light alloy matrix preferably to a level above one half of their total height, and wherein, the rods are preferably fixed in such a way that their longitudinal axes coincide with the axes of the geometric solids.

[0004] Preferably, the geometric solids are spheres or truncated pyramids with a square base. The geometric solids are ceramic solids or metallic solids. The rods are preferably made of high-strength stainless steel.

[0005] Owing to its specific construction, the composite passive armor protection according to the present invention is resistant to projectile impacts. The protruding part of geometric solids prevents the penetration of AP-type projectiles, projectile fragments, and small arms projectiles. The mere shape and very hard material of the geometric solids cause distortion in the projectile flight path, or ricochet and weakening of the projectile kinetic energy. Brackets and rods pass-

ing through these brackets reinforce the plate and act as a shock absorbing cushion for the geometric solids. The matrix made of a light alloy protects the armor against tearing. The composite passive armor protection according to the present invention, the matrix whereof is made of a light alloy, is highly effective in protection against the AP projectiles of up to 12.6 mm. The use of light alloy as a matrix material reduces the armor weight, thereby increasing the mobility of the protected vehicles, reducing fuel consumption and enabling the armor to be used as a means of protection for the aircraft and watercraft.

[0006] The composite passive armor protection is made by casting methods. The structure composed of geometric solids resting on brackets passing through the holes in the plate and brackets with fixed rods is placed in a specially designed foundry mould and poured with a liquid light metal alloy. The alloy solidification is carried out under the conditions of elevated pressure. As a last step, the armor is subjected to machining to the required dimensions.

[0007] The composite passive armor protection according to the present invention is shown in a sample embodiment in the accompanying drawings, where

[0008] FIG. 1 shows a vertical section of the composite passive armor protection, and

[0009] FIG. 2 its schematic representation.

[0010] The composite passive armor protection comprises a structure, embedded in the light alloy matrix 1, wherein said structure is made of ceramic balls 2, resting on brackets 3, passing through the holes in plate 4, wherein said brackets 3 have through-holes located at a height above and below the plate 4, wherein in said through-holes are secured rods 5 in such a way that they form a rectangular grid. The ceramic balls 2 are embedded in the light alloy matrix 1 to a level above one half of their diameter. The rods 5 made of high-strength stainless steel are fixed coaxially with the ceramic balls 2.

1. A composite passive armor protection having a structure comprised of the geometric solids, said structure being embedded in a matrix, characterized in that it made of a structure embedded in the light alloy matrix (1), wherein said structure is made of the geometric solids (2), resting on brackets (3), passing through the holes in plate (4), wherein said brackets (3) have through-holes located at a height above and below the plate (4), wherein in said through-holes are secured rods (5) in such a way that they form a grid, wherein said geometric solids (2) are embedded in the light alloy matrix (1), to a level above one half of their total height, and wherein the rods (5) are fixed in such a way that their longitudinal axes coincide with the axes of the geometric solids (2).

2. The composite passive armor protection of claim 1, wherein said geometric solids (2) are ceramic solids.

3. The composite passive armor protection of claim 1, wherein said geometric solids (2) are metallic solids.

4. The composite passive armor protection of claim 1, wherein said geometric solids (2) are in the shape of spheres or truncated pyramids with a square base.

5. The composite passive armor protection of claim 1, wherein said rods (5) are made of high-strength stainless steel.

* * * * *