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(54) **BALISTIC JACKET AND PROTECTIVE  
PANELS SYSTEM**

**Publication Classification**

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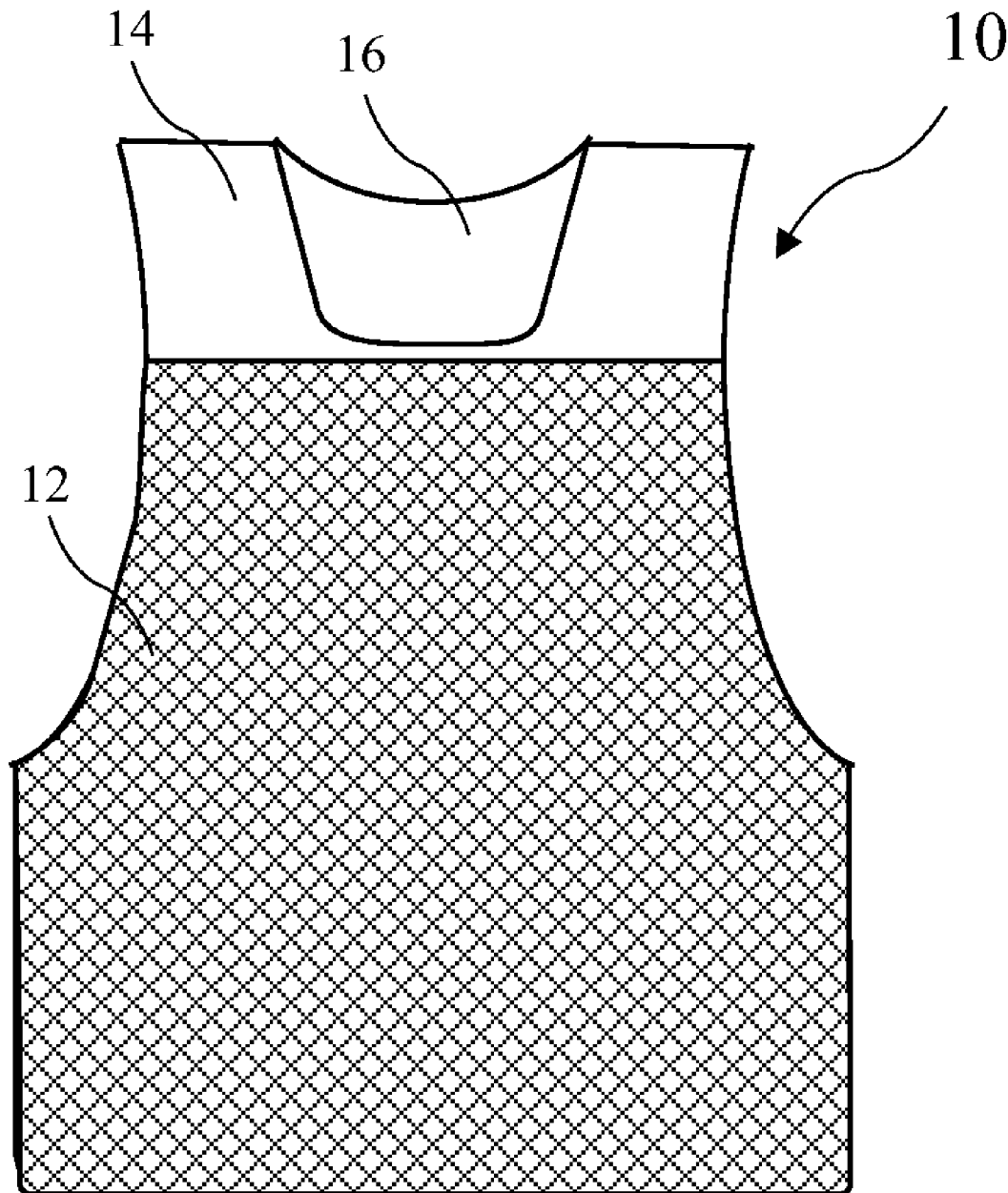
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(57) **ABSTRACT**

A light weight body armor is constructed from offset layers of mosaic like panels. The panels are formed from woven material made from volcanic black rock. The panels are light weight and strong, and the woven material is less expensive than know materials used to construct body armor.

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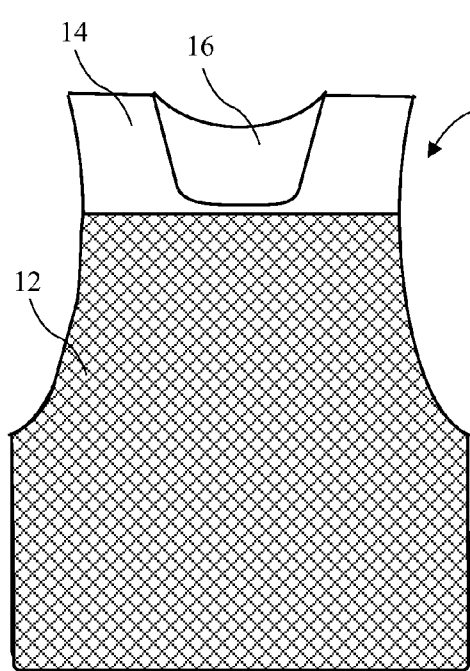


FIG. 1A

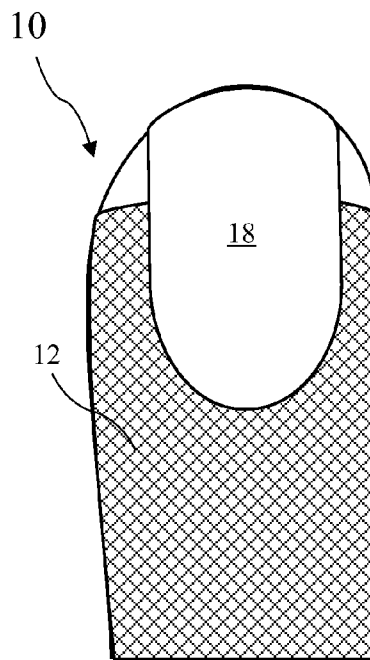


FIG. 1B

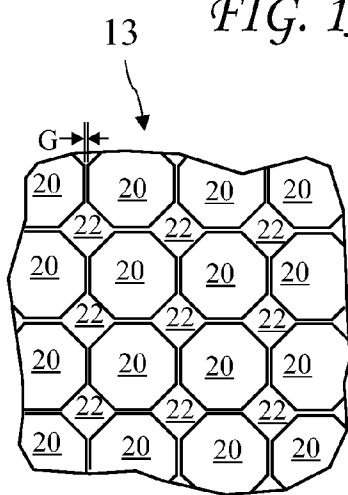


FIG. 2A

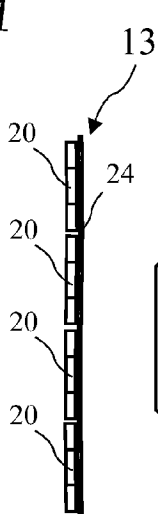


FIG. 2B

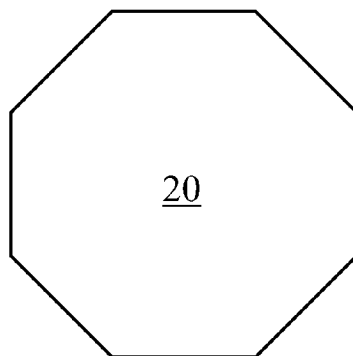


FIG. 3A

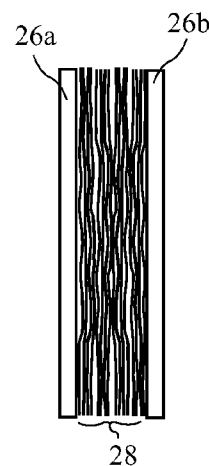


FIG. 3B

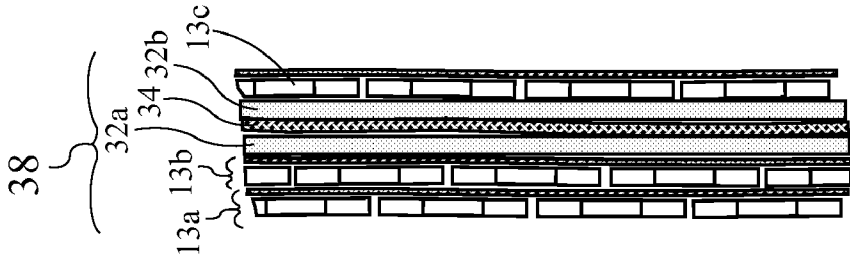


FIG. 6

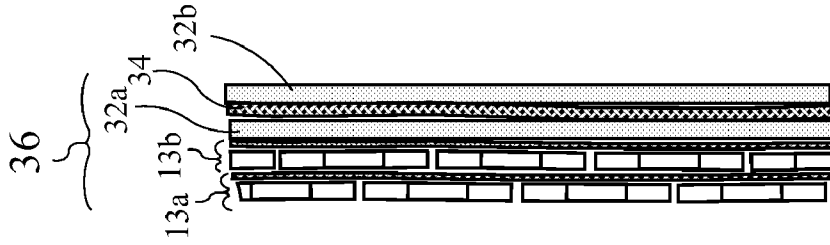


FIG. 5

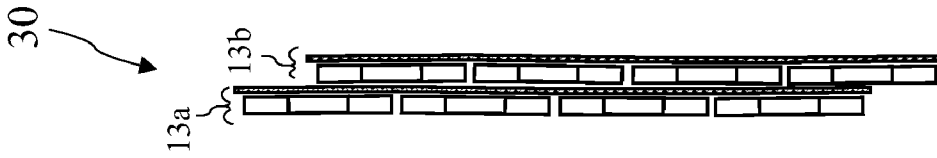


FIG. 4B

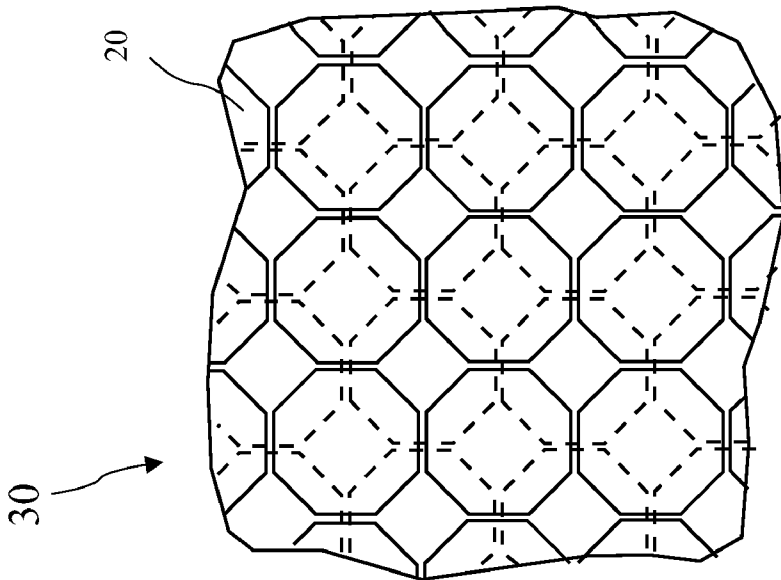


FIG. 4A

**BALISTIC JACKET AND PROTECTIVE PANELS SYSTEM**

**BACKGROUND OF THE INVENTION**

[0001] The present invention relates to body armor and in particular to body armor constructed from material made from black volcanic rock.

[0002] Military and law enforcement personnel often must place themselves in locations where hostile gun fire may be experienced. Their missions often require that they cannot maintain cover providing individual protection. Body armor is commonly worn in such situations. Three levels of body armor are commonly known. Level I body armor is suitable to protect the wearer against low velocity pistol bullets, for example, 38 special at up to 850 Feet Per Second (FPS) and 22 at up to 1,050 FPS. Level II body armor is suitable to protect the wearer against 9 mm Full Metal Jacket (FMJ) at up to about 1,090 FPS and 357 Magnum Jacketed Soft Point (JSP) bullets at up to 1,250 FPS. Level III—A body armor is suitable to protect the wearer against 9 mm FMJ at up to 1,400 FPS (this may be from 9 mm sub machine gun or +P ammunition having much higher chamber pressure than common 9 mm ammunition) and 44 Magnum Semi Wadcutter (SWC) bullets at up to 1,400 FPS. Level III body armor is suitable to protect the wearer against standard military rifle ammunition such as the NATO 7.62 by 51 mm ammunition. While known body armor has been certified up to Level III, such body armor is expensive, heavy, and bulky. Therefore, a need remains for better and less expensive body armor.

**BRIEF SUMMARY OF THE INVENTION**

[0003] The present invention addresses the above and other needs by providing a light weight body armor which is constructed from offset layers of mosaic like panels. The panels are formed from woven material made from volcanic black rock. The panels are light weight and strong, and the woven material is less expensive than know materials used to construct body armor.

[0004] In accordance with one aspect of the invention, there is provided body armor comprising protective layers formed from a mosaic of small panels. The body armor includes top and second protective layers, a second protective layer under the top protective layer, a top layer of impact foam under the top protective layer, a layer of woven material under the impact foam, a second layer of impact foam under the layer of woven material and a bottom protective layer including a flexible material and a mosaic of close fitting octagonal panels set to the flexible material. The top and second protective layers includes a flexible material and a mosaic of close fitting octagonal panels set to the flexible material, the panels comprising a top and a bottom plate and a lay-up of layers of inorganic material and resin, the inorganic material made from volcanic black rock. The second protective layer under the top protective layer and including two protective layers offset from each other to overlap the panels of the layers to cover voids between adjacent panels.

**BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING**

[0005] The above and other aspects, features and advantages of the present invention will be more apparent from the following more particular description thereof, presented in conjunction with the following drawings wherein:

[0006] FIG. 1A is a front view of a ballistic vest made from ballistic material according to the present invention.

[0007] FIG. 1B is a side view of the ballistic vest made from the ballistic material according to the present invention.

[0008] FIG. 2A shows a front view of a single layer of a mosaic pattern of panels according to the present invention for forming the ballistic material according to the present invention.

[0009] FIG. 2B shows a side view of the single layer of the mosaic pattern of panels according to the present invention for forming the ballistic material according to the present invention.

[0010] FIG. 3A shows a front view of one of the panels according to the present invention used for forming the ballistic material according to the present invention.

[0011] FIG. 3B shows a side view of one of the panels according to the present invention used for forming the ballistic material according to the present invention.

[0012] FIG. 4A shows a front view a protective layer of overlapped mosaic patterns of panels according to the present invention for forming the ballistic material according to the present invention.

[0013] FIG. 4B shows an edge view the protective later formed of the overlapped mosaic patterns of panels according to the present invention for forming the ballistic material according to the present invention.

[0014] FIG. 5 Shown a cross-sectional view of a level I ballistic material according to the present invention.

[0015] FIG. 6 Shown a cross-sectional view of a level III ballistic material according to the present invention.

[0016] Corresponding reference characters indicate corresponding components throughout the several views of the drawings.

**DETAILED DESCRIPTION OF THE INVENTION**

[0017] The following description is of the best mode presently contemplated for carrying out the invention. This description is not to be taken in a limiting sense, but is made merely for the purpose of describing one or more preferred embodiments of the invention. The scope of the invention should be determined with reference to the claims.

[0018] A front view of a ballistic vest **10** made from ballistic material **12** according to the present invention is shown in FIG. 1A and a side view of the ballistic vest **10** is shown in FIG. 1B. The ballistic vest **10** is designed to protect vital organs of a wearer without overly encumbering the wearer. The ballistic vest **10** includes shoulders **14** on each side of a neck opening **16**, and arm cutouts **18**. The ballistic vest **10** may be constructed using different embodiments of the ballistic material **12**, as described below, to provide different levels of protection to the wearer. The ballistic material **12** may be worn exposed to view, or may be worn inside a garment concealed from view.

[0019] A front view of a single layer of mosaic pattern of panels **20** bonded to a mesh backing **24** for forming a protective layer **13** according to the present invention is shown in FIG. 2A, a side view of the protective layer **13** is shown in FIG. 2B, a front view of one of the panels **20** according to the present invention used for forming the protective layer **13** is shown in FIG. 3A, and a side view of one of the panels **20** is shown in FIG. 3B. The panels **20** are octagonal, but maybe other shapes, for example, hexagonal, square, triangular, and the like, and the protective layer **13** may be formed from panels having different shapes. In the case of octangular

panels **20**, small voids **22** result between the panels **20**. The panels **20** are preferably arranged to limit vertical, horizontal, and/or diagonal gaps **G** between adjacent edges of the panels **20** to be less than 0.1 inches.

**[0020]** The panels **20** are formed from a core **28** of layers of woven inorganic material, set with epoxy resin, and sandwiched between plates made from. An example of a suitable material for the plates is aluminum or the like. The preferred woven inorganic material is sold by Barotex Technology Corporation under the trademark BAROTEX. For example, the core **28** may comprise layers of 6 ounce 3 by 1 twill unsized woven BAROTEX® material set with epoxy resin. BAROTEX® material is made from volcanic black rock and is described in U.S. Pat. No. 7,223,708 for "Inorganic Fabric" issued to the inventor of the present invention and incorporated herein in its entirety by reference. The core **28** preferably comprises between 30 and 40 layers of woven inorganic material, and more preferably between 35 and 40 layers of woven inorganic material, and the epoxy resin is preferably a high impact epoxy resin, for example, Parabond # 5130 or a similar resin made by Para-Chem Inc. in Simpsonville, S.C.

**[0021]** The core **28** is manufactured by pressing the layers of woven inorganic material together under between 300 and 400 Pound per Square Inch (PSI) and preferably under approximately 350 PSI and the core **28** is preferably between  $\frac{3}{16}$  and  $\frac{5}{16}$  inches thick and is more preferably approximately  $\frac{1}{4}$  inches thick. The core **28** is preferable post cured for approximately two hours at approximately 475 degrees Fahrenheit to obtain full strength. Plates **26a** and **26b** are attached to opposite faces of the core **28** by fasteners (e.g., bolts), by setting in an autoclave, or by pressing and curing in a pressurized oven. The panels **28** may be manufactured as large plates and then after setting and/or curing, cut to a final size, for example, hexagonal in shape and approximately two inches across, although other shapes such as squares or triangles may also be utilized.

**[0022]** The panels **20** are bonded to a thin layer of mesh to allow the protective layer **13** to fit a wearer and to move with a wearer. The mesh **24** is preferably a mesh of inorganic material and more preferably a mesh of inorganic material made from volcanic black rock, and most preferably a mesh made from BAROTEX® material. The mesh **24** is preferably approximately 0.05 inches thick to separate consecutive layers of the plates **20** to allow the resulting ballistic material to flex.

**[0023]** A front view of overlapped protective layers **30** formed by overlapped protective layer **13a** and **13b** is shown in FIG. 4A and an edge view of the overlapped protective layers **30** is shown in FIG. 4B. The protective layers **13a** and **13b** are overlapped to leave no gap greater than the gaps **G** between adjacent edges of the panels **20** (see FIG. 2A).

**[0024]** A cross-sectional view of a level I ballistic material **36** according to the present invention is shown in FIG. 5 and a cross-sectional view of a level III ballistic material **38** according to the present invention is shown in FIG. 6. The level I ballistic material **36** is formed from two overlapping protective layer **13a** and **13b**, followed by a first layer of impact foam **32a**, for example, Advantac™ syntactic foam made by Cornerstone Research Group in Dayton, Ohio or a similar product, followed by a shock and deflection layer, for example, a layer of woven material **34**, followed by a second layer of impact foam **32b**. The level III ballistic material **38** adds a third protective layer **13c** following the second layer of impact foam **32b**. Layers of impact foam **32a** and **32b** are

preferably approximately  $\frac{1}{4}$  inches thick. The layer of woven material **34** is preferably a shock resistant layer of multiple layers of woven inorganic fibers, and more preferably a layer of multiple layers of woven BAROTEX® material. The thickness of the layer of woven material **34** is dependent upon the level of protection required. For example, in the level I ballistic material **36**, the layer of woven material **34** may comprise six or more layers of woven material **34**, and in the level III ballistic material **38**, the layer of woven material **34** is preferably a lay-up of six or more layers of six ounce woven inorganic fibers, and more preferably a lay-up of six or more layers of six ounce woven BAROTEX® material. The layers of impact foam **32a** and **32b** is preferably sown through to retain the layer of woven material **34** in position between the layers of impact foam **32a** and **32b**.

**[0025]** A layer of polymer is applied between each of the layers of the ballistic materials **36** and **38** to bond consecutive layers and to hold the fibers together while providing flexibility. The polymer layer is very flexible and thus allows the ballistic material to easily flex. An example of a suitable polymer is Tankskin® spray-on polymer made by Armor Systems International in Chatsworth, Calif.

**[0026]** While the invention herein disclosed has been described by means of specific embodiments and applications thereof, numerous modifications and variations could be made thereto by those skilled in the art without departing from the scope of the invention set forth in the claims.

I claim:

1. Body armor comprising:
  - a top protective layer comprising:
    - a flexible material; and
    - a mosaic of close fitting panels set to the flexible material to allow the protective layer to assume the shape of a wearer, the panels comprising:
      - a top and a bottom plate; and
      - a lay-up of layers of inorganic material and resin, the inorganic material made from volcanic black rock;
  - a first layer of impact foam under the top protective layer; and
  - a layer of woven material under the impact foam.
2. The body armor of claim 1, wherein the panels are a lay-up of layers of a weave of inorganic material, and resin.
3. The body armor of claim 1, wherein the panels are octagonal.
4. The body armor of claim 1, wherein the panels are hexagonal.
5. The body armor of claim 1, further including a second layer of impact foam under the layer of woven material.
6. The body armor of claim 1, wherein the flexible material is a mesh made from an inorganic weave of fibers made from volcanic black rock.
7. The body armor of claim 1, further including a second protective layer between the top protective layer and the top layer of impact foam, the second protective layer having the same construction as the top protective layer,
  - wherein the two protective layers are offset from each other to overlap the panels of the layers to cover voids between adjacent panels.
8. The body armor of claim 7, wherein the panels are a lay-up of layers of a weave of inorganic material, and resin.
9. The body armor of claim 7, wherein the woven material comprises a shock resistant layer of multiple layers of woven inorganic fibers.

10. The body armor of claim 9, wherein the woven material comprises a shock resistant layer of multiple layers of woven inorganic fibers

11. The body armor of claim 7, further including a second layer of impact foam under the layer of woven material from volcanic black rock.

12. The body armor of claim 7, wherein the flexible material is a mesh made from an inorganic weave of fibers made from volcanic black rock.

13. Body armor comprising:  
top and second protective layers comprising:  
a flexible material; and  
a mosaic of close fitting panels set to the flexible material, the panels comprising:  
a top and a bottom plate; and  
a lay-up of layers of inorganic material and resin, the inorganic material made from volcanic black rock;  
a top layer of impact foam under the top protective layer; and  
a layer of woven material under the impact foam.

14. The body armor of claim 13, wherein the panels are a lay-up of layers of a weave of inorganic material, and resin.

15. The body armor of claim 13, wherein the panels are octagonal.

16. The body armor of claim 13, wherein the panels are hexagonal.

17. The body armor of claim 13, further including a second layer of impact foam under the layer of woven material.

18. The body armor of claim 13, wherein the flexible material is a mesh made from an inorganic weave of fibers made from volcanic black rock.

19. Body armor comprising:  
a top and second protective layer comprising:  
a flexible material comprising a mesh made from an inorganic weave of fibers made from volcanic black rock; and  
a mosaic of close fitting octagonal panels set to the flexible material, the panels comprising:  
a top and a bottom plate; and  
a lay-up of layers of inorganic material and resin, the inorganic material made from volcanic black rock;  
a second protective layer under the top protective layer having the same construction as the top protective payer, wherein the two protective layers are offset from each other to overlap the panels of the layers to cover voids between adjacent panels.  
a top layer of impact foam under the second protective layer;  
a layer of woven material under the top layer impact foam;  
a second layer of impact foam under the layer of woven material; and  
a bottom protective layer under the second layer of impact foam and having the same construction as the top protective layer.

20. The body armor of claim 19, wherein the woven material comprises a shock resistant layer of multiple layers of woven inorganic fibers.

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