



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
24.10.2007 Bulletin 2007/43

(51) Int Cl.:
F41H 5/04 (2006.01) B32B 3/20 (2006.01)

(21) Application number: **06113983.8**

(22) Date of filing: **16.05.2006**

(84) Designated Contracting States:
**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI
SK TR**
Designated Extension States:
AL BA HR MK YU

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(30) Priority: **20.04.2006 AR 0601566 U**

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(54) **A stratum to be used in ballistic elements and a ballistic element containing it**

(57) A stratum to make a ballistic panel to be used in ballistic elements such as bullet proof vests, shields, helmets and the similar, and a ballistic element containing it. The ballistic panel defined by the stratum remark-

ably increases the ballistic limit (V50), considerably reducing the trauma level, and at the same time reduces the weight and thickness of the ballistic panel made with said stratum.

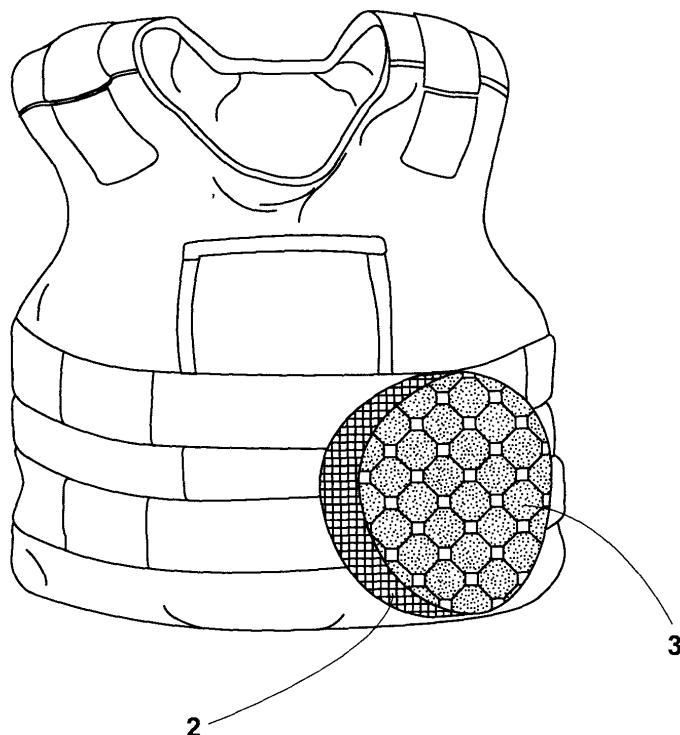


Fig. 3

Description

[0001] The present invention refers to a stratum to be used in ballistic elements such as bullet proof vests, shields, helmets and the like, and a ballistic element containing it.

[0002] As it is known, the frequency of violent acts is increasing over the years in different parts of the world. Thus, the industry is in constant evolution manufacturing products for protecting those people who must face and resolve different violent attacks, namely: policemen, firemen, bodyguards, military and any other authority that takes part in different kind of confrontations.

[0003] One of the most important points in relation to protective gear is to preserve the physical integrity of the people wearing them, such as bullet proof vests, helmets and many other protecting gears. It is known that bullet proof vests have been used for a long time and have been subject to changes since the classic bullet proof vest with lead plates, to vests relatively more comfortable to use, and with a greater grade of protection and lighter.

[0004] One of the main reasons of the evolution of said bullet proof vests was the invention of poliamides. The aramides belong to a nylon family, including Nomex and Kevlar. Kevlar® is an organic fiber belonging to the family of the aromatic poliamides (aramides), in which great resistance, light weight, comfortableness and protection are combined. This material is five times stronger than steel and offers reliable performance and solid resistance. This equilibrium of extraordinary properties makes possible to use this product in a wide range of applications from bullet proof vests to cut proof gloves, to explosion and flame barriers.

[0005] However, the exclusive use of multiple layers of Kevlar or the similar for manufacturing bullet proof vests causes other problems. For example, although this compound stops the projectile, the impact is absorbed by the body of the person wearing said vest. Thus, after two or more impacts, the person suffers several traumatisms - from bruises to rib breakage or more severe trauma depending on the caliber of the projectile impacting the vest.

[0006] In order to find a solution to this problem, bullet proof vests have been manufactured including impact absorbing material layers such as rubber layers, layers of foam rubber and the like being these layers added behind the Kevlar layer. Although this solution reduced considerably the traumatism caused by the projectile impacts, the thickness of the vest is considerably increased and, as a consequence, it becomes an uncomfortable garment.

[0007] Although the comfortableness of the vest was important, reducing the traumatism caused by an impact was much more important. As a consequence, different test were carried out with different engineering materials until the use of a material called hollow thermoplastic microspheres was discovered. These microspheres have been incorporated to polymers in order to create cellular matrices and achieve light weight in the finished products. The use of these microspheres further improves the elastic resistance and impact absorption. Therefore, the new bullet proof vests were equipped with layers of a non-woven material incorporating said microspheres. The result of said combination was surprising since not only the impact trauma caused by the projectile was remarkably reduced but the rigidity and weight of the vest was also reduced.

[0008] However, although the addition of layers of non-woven material with microspheres reduced the trauma, the useful life of the bullet proof vest was not the best since the ballistic limit (V50) remained the same. The V50 or the ballistic limit is the average speed in which a determined projectile perforator of armors flies in order to consistently and completely penetrate in an armed plate of a given thickness and physics conditions of specific obliquity angle.

[0009] Thus, there is no ballistic panel in the market capable of remarkably reducing the impact trauma of the projectile and with an improved ballistic limit V50.

[0010] It is therefore an object of this invention to provide a stratum to be used in ballistic elements such as bullet proof vests, shields, helmets and the like, remarkably improving the ballistic limit and remarkably reducing the trauma.

[0011] It is a further object of this invention to provide a stratum to be used in ballistic elements such as bullet proof vests, shields, helmets and the like, which comprises at least a layer of poliamides in which in at least one of the faces of said layer a plurality of hollow thermoplastic microspheres is disposed.

[0012] For a better understanding of the object of this invention, the same has been illustrated in many drawings in which the preferred embodiments have been represented, wherein:

Fig. 1 is a top view of the object of this invention.

Fig. 2 is a side view that shows the structure of the stratum of Fig. 1; and

Fig. 3 is a side view of a bullet proof vest in which the application of the stratum object of this invention is observed.

[0013] Making reference to the figures, it is observed that the stratum **1** object of this invention comprises at least a layer of poliamides **2**, which in this embodiment, is a Kevlar layer. It is important to point out that although the description of the invention has been made using the Kevlar material, it is evident to those skilled in the art that the use of any other material sharing the same properties than Kevlar's material, such as for example other poliamides commercially known

as Twaron® or including those materials with ballistic or mechanical resistance made of polyethylene commercially known as Spectra® or Dyneema® or also other materials combining poliamides with polyethylene commercially known as Goldflex®, does not limit the scope of the invention.

[0014] In at least one of the faces of said layer 2, a plurality of hollow thermoplastic microspheres **3** is disposed. It is important to point out that said microspheres **3** are adhered to one or both faces of the aramide layer by means of a binding element. Said binding element can be any other element having the resistance and durability characteristics desired so that said microspheres are not modified during its application.

[0015] The application of the microspheres over the Kevlar layer is carried out in a conventional manner, i.e., by means of specially designed machines for the application of microspheres over layers of non-woven material such as those used by EXPANCEL. However, in this embodiment it was used the conventional method in which it is generated a layer of microspheres in a binding material and then the Kevlar layer is applied so that later the set can be introduced in an in-line oven in which the microspheres begin to expand.

[0016] The following ballistic examples show the properties granted to Kevlar, as well as to any other aramide woven, by the addition of microspheres with a binding media in at least one of the walls.

TEST I

[0017] This test was performed using a ballistic pack made of 22 layers of Kevlar Style 720 without the addition of microspheres.

Test No. 35

[0018]

Date: April 6, 2006

Material: Kevlar Style 720

Quantity: 22 layers without seam

Measures: 40cm x 40cm

Back: box of 60cm x 60cm of 10cm of depth with modeling clay roma style at 28°C.

Kind of weapon: gun Smith & Wesson cannon 4"

Caliber: 357 Magnum

Charge: Magtech of 158 Grains (10.24g) (SJHP Semi Jacketed Hollow Point).

Results of the Test

[0019]

Shot No.	Velocity m/s	Penetration	Ballistic Deformation
1	374	no	38.5mm
2	370	no	38.0mm
3	375	no	38.2mm

TEST II

[0020] This test was performed using a ballistic pack made of 11 layers of Kevlar Style 720 with the adding of microspheres and with 11 layers of Kevlar Style 720 without microspheres.

Test No. 36

[0021]

Date: April 6, 2006

Material: Kevlar Style 720

Quantity: 11 layers Style 270

11 layers Style 270 with microspheres

Total: 22 layers without seam

Measures: 40cm x 40cm

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Back: box of 60cm x 60cm of 10cm of depth with modeling clay roma style at 28°C.

Kind of weapon: gun Smith & Wesson cannon 4"

Caliber: 357 Magnum

Charge: SJHP of 158 Grains (10.24g) (SJHP Semi Jacketed Hollow Point).

Results of the Test

[0022]

Shot No.	Velocity m/s	Penetration	Ballistic Deformation
1	373	no	23.0mm
2	376	no	23.0mm
3	373	no	21.7mm

[0023] Style 270 with the addition of microspheres and with 7 layers of Kevlar Style 720 without microspheres.

Test III

Test No. 37

[0024]

Date: April 6, 2006

Material: Kevlar Style 720

Quantity: 7 layers Style 720

11 layers Style 720 without microspheres

Total: 18 layers without seam

Measures: 40cm x 40cm

Back: box of 60cm x 60cm of 10cm of depth with modeling clay roma style at 28°C.

Kind of weapon: gun Smith & Wesson cannon 4"

Caliber: 357 Magnum

Charge: SJHP of 158 Grains (10.24g) (SJHP Semi Jacketed Hollow Point).

Results of the Test

[0025]

Shot No.	Velocity m/s	Penetration	Ballistic Deformation
1	376	no	29.3mm
2	375	no	28.5mm
3	375	no	29.0mm

[0026] As it can be observed from the tests, it is evident that the addition of a layer of microspheres to at least one of the faces of the Kevlar layers remarkably reduces the ballistic deformation. This is mainly due to the fact that since the layers are impregnated with a plurality of hollow microspheres, these microspheres that are charged with gas offer resistance when receiving the projectile impact exercising a resistance in the opposite direction to the projectile impact.

[0027] It is important to note that although these examples are made based on a particular number of layers, the optimizing result of the ballistic deformation and the reduction of the trauma is maintained uniform independently of the quantity of layers used. However, it is evident that the number of layers is given by the rules that the ballistic panels must comply with and its field of application.

Claims

1. A stratum to be used in ballistic elements such as bullet proof vests, shields, helmets and the similar, wherein said stratum comprises at least a layer of a material with ballistic and/or mechanical resistance, in which in at least one

of the faces of said layer a plurality of hollow thermoplastic microspheres is disposed.

2. The stratum of claim 1, wherein said plurality of hollow thermoplastic microspheres is adhered to at least one face of said layer of aramides.

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3. The stratum of claim 1, wherein said hollow thermoplastic microspheres are in expanded state.

4. The stratum of claim 1, wherein said hollow thermoplastic microspheres are in a non-expanded state.

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5. The stratum of claim 1, wherein said hollow thermoplastic microspheres are combined with a binding substance.

6. The stratum in accordance with any of the claims mentioned above, wherein at least one of said layers with ballistic and/or mechanical resistance is composed of poliaramides, polyethylene and the combination thereof.

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7. A bullet proof element that uses the stratum of claim 1, wherein said bullet proof element defines a ballistic, anti-fragment, anti-knife and anti-punch panel.

8. The element of claim 7, wherein said element is one of a group composed of bullet proof vests, bullet proof penels, helmets and ballistic protectors in general.

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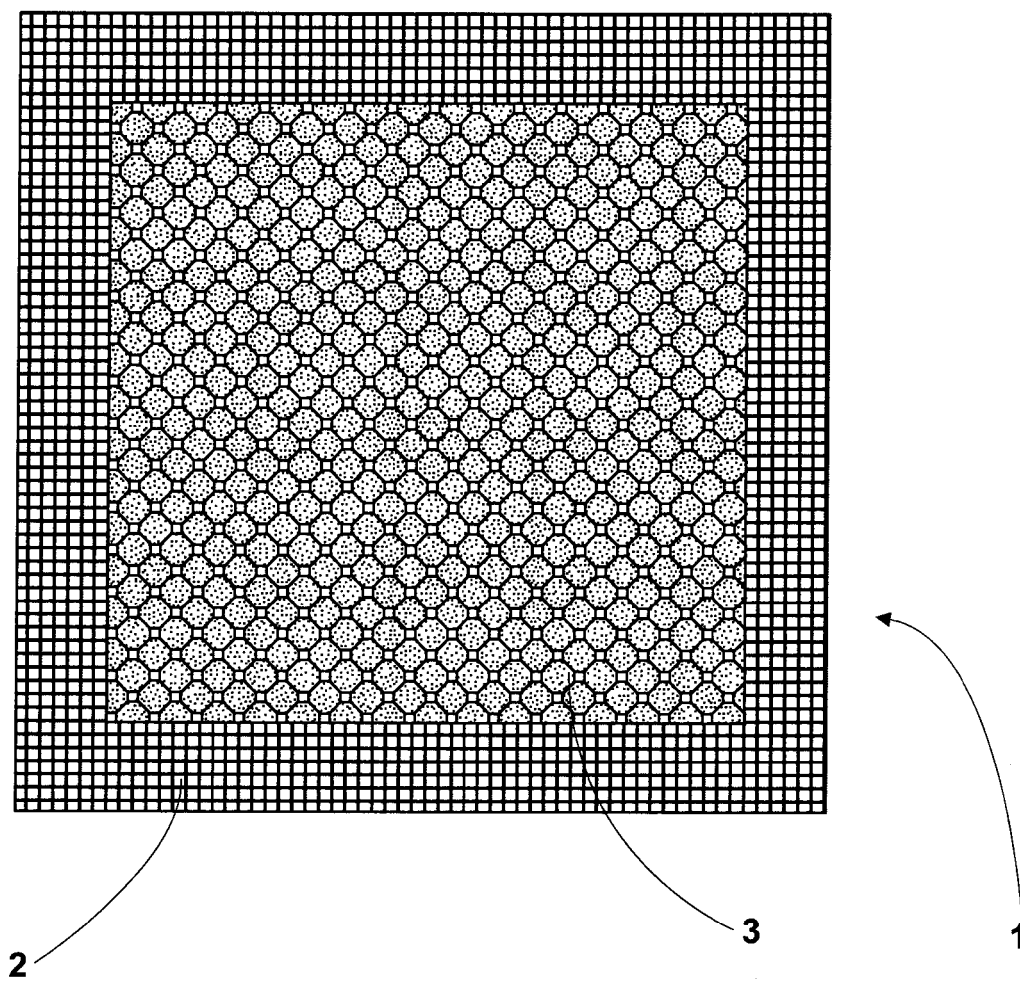


Fig. 1

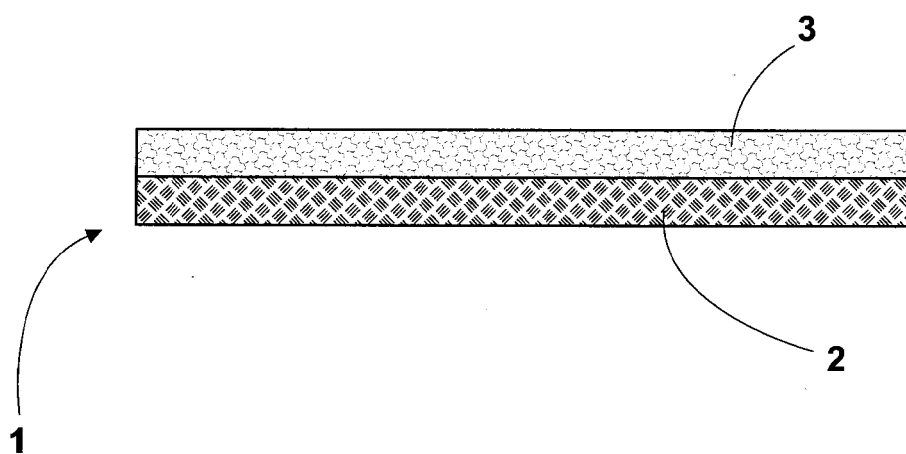


Fig. 2

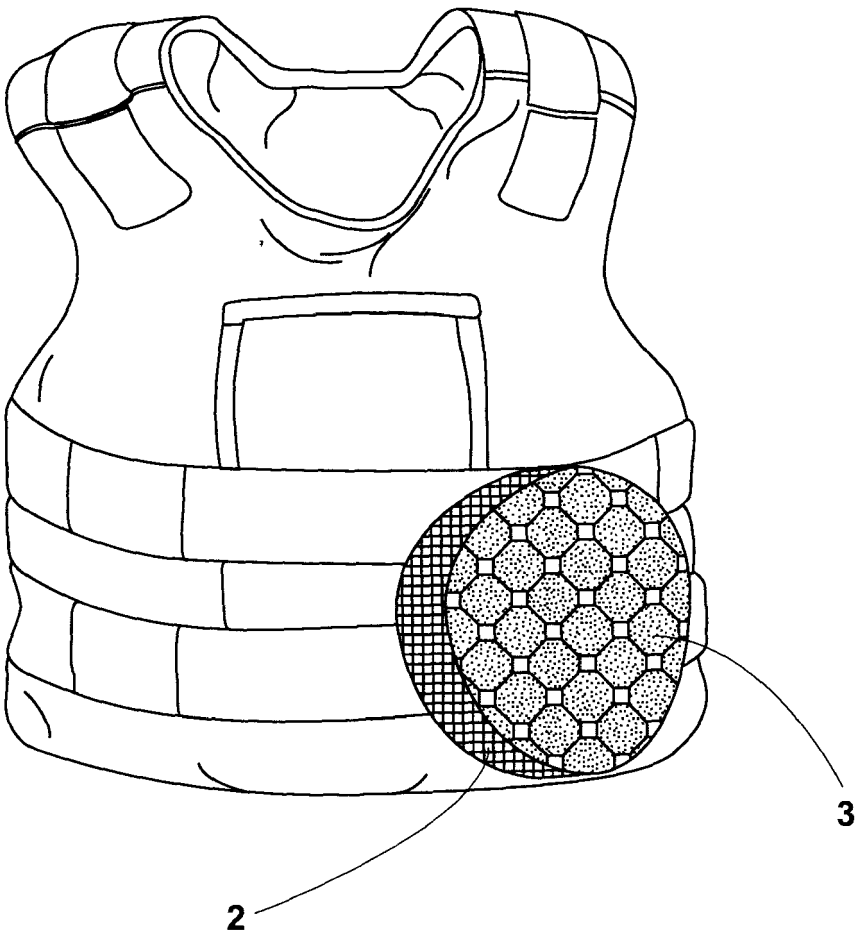


Fig. 3



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 06 11 3983

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The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
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Place of search		Date of completion of the search	Examiner
The Hague		30 June 2006	Van der Plas, J
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 06 11 3983

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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