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(54) **STAB-PROOF PROTECTION ELEMENTARY COMPONENT AND CORRESPONDING STAB-PROOF PROTECTION STRUCTURE, IN PARTICULAR IN THE FORM OF A STAB-PROOF VEST**

(57) A stab-proof protection elementary component (20) is herein described, having a plate-like structure of the tile or card type and comprising at least one first face (F1) that is substantially plane, a second and opposite face (F2) that is substantially plane and parallel to the first face (F1) and a profile portion (20S) substantially orthogonal to said first and second faces (F1, F2), said

profile portion (20S) having a multi-lobed shape and the elementary component (20) being made of cut resistant material. Moreover, a stab-proof protection structure (10) comprising a plurality of said elementary components (20) associated with a flexible base (12), in particular in the form of a stab-proof vest, is described.

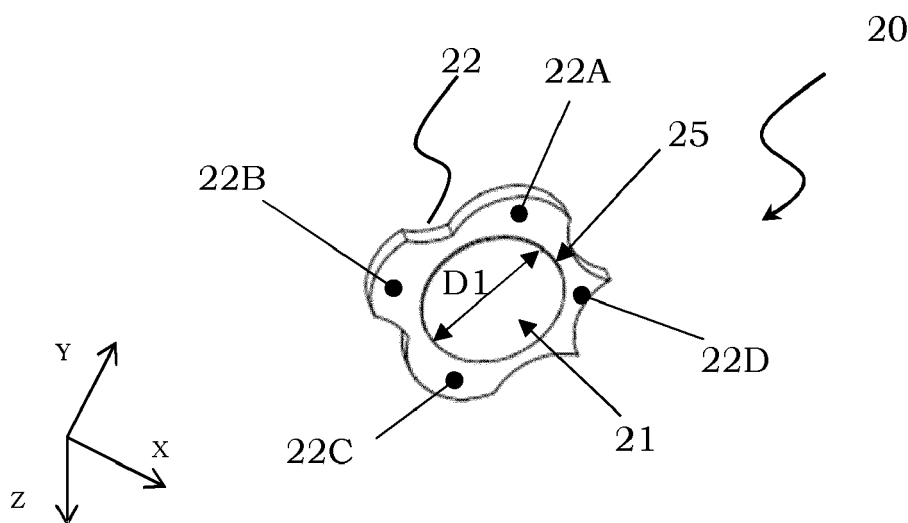


FIG. 2B

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Description

Field of application

[0001] The present invention relates to a stab-proof protection elementary component.

[0002] More specifically, the invention relates to a component adapted to form a stab-proof protection structure comprising at least one flexible base, in particular made of cut resistant fabric, and a reinforcement structure made by means of a plurality of stab-proof protection elementary components.

[0003] The invention relates in particular, but not exclusively, to a protection structure adapted to make stab-proof vests able to ensure high levels of protection, in particular against the penetration of pointed and bladed weapons such as knives, scalpels or nails, and the following description is made with reference to this field of application with the sole aim of simplifying the description thereof.

Prior art

[0004] In the field of personal protection against armed attacks, protective vests against pointed and bladed weapons are increasingly required, generically also referred to as blades, such as knives, scalpels nails, etc.; in particular, said stab-proof protection vests are usually in the form of a vest to be worn under clothing.

[0005] More particularly, the stab-proof vests are configured so as to limit the penetration of a pointed or bladed weapon within few millimeters from an exposed surface, so that the weapon cannot come into contact, if not superficially, and preferably in any way, with the body of the vest wearer.

[0006] While the bulletproof structures are configured so as to distribute and thereby reduce the impact energy of the bullets, in particular by causing said bullets to break into several pieces when impacting the structure, the penetration-resistant structures of the blades are configured so as to capture and entangle said blades in order to prevent them from continuing on their way towards the wearer.

[0007] In its more general form, a stab-proof vest is a reinforced garment, worn both under and over clothing, aimed to protect the wearer's chest, back and hips, offering protection against the penetration of sharp objects, said penetration being limited to few millimeters from an exposed surface onto which sharp objects, generally blades, impact, so as to avoid serious injury to the wearer; said stab-proof vests may also offer protection against small-caliber firearms.

[0008] It should be noted that no stab-proof vest offers total protection against assault with a pointed or bladed weapon and that is why they are usually referred to as "resistant" to penetration rather than "penetration proof". The level of protection is regulated by nationally established standards, such as the American NIJ standard,

the German VPAM standard and the English HOSDB standard.

[0009] All these standards establish the tests to be carried out, in terms of the weapon to be used and energy to be applied to establish the level of protection conferred by each material or stab-proof protection structure at issue.

[0010] It should be noted that stab-proof vests are used not only by police officers, usually under bulletproof vests, but also as single items by paramedics, security guards and bodyguards, just to name a few, the blade penetration trauma injury being statistically the most likely type of assault a public or private security professional could suffer.

[0011] Stab-blade vests of the known type are made by means of a high performance aramid fiber composite, such as, for instance, Kevlar®, Twaron® or PARAX® by Prosystems, which are para-aramid synthetic fibers capable of making strong and light products, in particular with a very high tensile strength; even polyester may be used to make said vests. Such synthetic fibers are usually tightly woven to create stab-proof vests, the level of protection increasing thanks to the tightly woven fibers that make it extremely difficult for a bladed weapon to penetrate the material, entangling the blade in the fabric and sliding through the woven material.

[0012] More particularly, fabrics made by means of tightly woven fibers are usually coated by or coupled with thermoplastic films of polyethylene or polyurethane nature, these films having the function of blocking the fibers so that a blade cannot penetrate between the fibers, moving them with respect to each other and proceed into the fabric, the final weight of the structure obtained being usually 200 to 400 g m².

[0013] To increase the degree of protection, it is common to overlap several layers, usually 15 to 30, left free to move with respect to each other, obviously obtaining a more resistant and protective final structure. However, said multilayer final structure is more rigid, heavy and with a considerable thickness, which may vary from 6mm to 12mm with density usually ranging from 3.5 kg m² to 7 kg m². Structures of this type, in addition to being very uncomfortable for a possible wearer, do not usually allow realizing stab-proof vests that can be worn under clothing.

[0014] The technical problem of the present invention is to provide a stab-proof protection structure having lower thickness and weight, with equal protection, compared to the known solutions, increasing the comfort of personal protection devices realized by means of such a structure, such as the stab-proof vests, improving their overall flexibility and therefore the wearer's comfort, also allowing it to be easily hidden under clothing, always ensuring extended coverage even of irregular surfaces, which is essential in the case of a stab-proof vest to wear, so as to overcome the limitations and drawbacks which still nowadays affect the structures and vests made according to the prior art.

Summary of the invention

[0015] The solution idea underlying the present invention is to provide a stab-proof protection structure by means of a plurality of stab-proof elementary components, structurally independent with each other and shaped so as to have mutually complementary perimeter portions, associated with a flexible base of cut resistant fabric in a mosaic shape, said elementary components being able to tilt independently from each other so as to facilitate a folding of the stab-proof protection structure thus obtained.

[0016] Based on this solution idea, the technical problem is solved by a stab-proof protection elementary component having a plate-like structure of the tile or card type and comprising at least one first face that is substantially plane, one second and opposite face that is substantially plane and parallel to the first face and a profile portion that is substantially orthogonal to said first and second faces, characterized in that said profile portion the multilobed-shaped, the elementary component being made of cut resistant material.

[0017] More particularly, the invention comprises the following supplementary and optional features, taken singularly or in combination if necessary.

[0018] According to another aspect of the invention, the elementary component may comprise a peripheral section, in turn comprising a plurality of lobes adapted to define the multilobed shape of the profile portion and a central section surrounded by the peripheral section.

[0019] Said peripheral section may further comprise a plurality of junctions adapted to connect two consecutive lobes of the plurality of lobes, said junctions having a conjugate and complementary shape with respect to the lobes.

[0020] Furthermore, at least one lobe of the plurality of lobes may have inverse concavity with respect to the other lobes of the plurality of lobes.

[0021] In particular, according to this aspect of the invention, the junctions may have concavity equal to such at least one lobe of the plurality of lobes.

[0022] According to another aspect of the invention, the central section may comprise connection means and the peripheral section may be devoid of said connection means.

[0023] Still according to this aspect of the invention, the elementary component may comprise an adhesive film arranged at the central section to realize the connection means.

[0024] Furthermore, according to another aspect of the invention, the peripheral section may comprise lobes and junctions having an arc of a circle shape, the profile portion may be completely radiated since it is only formed by portions of a circle.

[0025] According to another aspect of the invention, each of said lobes and junctions may have a shape chosen from: a parabolic arc, a broken line of linear segments, a broken line of curvilinear segments.

[0026] Still according to another aspect of the invention, the elementary component may be made of a plurality of layers of a cut resistant material suitably impregnated with a hardening material adapted to join said layers of fabric.

[0027] In particular, the cut resistant material may be chosen from: an aramid or para-aramid fiber fabric, preferably Kevlar[®], Twaron[®] or PARAX[®] by Prosystems, or high molecular weight polyethylene, or PBO (i.e. poly benzoxazole).

[0028] Furthermore, the hardening material may comprise a thermosetting resin chosen from: an epoxy resin, a polyester resin, an acrylic or vinyl ester resin, a polyurethane resin, or a urea resin.

[0029] Moreover, the elementary component may comprise a number n ranging between 3 and 8 of layers of cut resistant fabric.

[0030] According to another aspect of the invention, the elementary component may have hardness ranging between 70-80 Shore and thickness ranging between 2 mm and 6 mm.

[0031] Finally, according to another aspect of the invention, the central section may be raised with respect to the peripheral section.

[0032] The technical problem is also solved by a stab-proof protection structure comprising at least one flexible base and a reinforced portion associated with the flexible base, said reinforced portion comprising a plurality of elementary components singularly associated with the flexible base, structurally independent with each other and not linked to each other at profile portions thereof, characterized in that each of said elementary components is made as above indicated.

[0033] According to another aspect of the invention, the elementary components may be associated with the flexible base only at the central section thereof.

[0034] Furthermore, according to another aspect of the invention, the flexible base may be made of a cut resistant material chosen from: an aramid or para-aramid fiber fabric, preferably Kevlar[®], Twaron[®] or PARAX[®] by Prosystems, or high molecular weight polyethylene, or PBO (i.e. poly benzoxazole).

[0035] Said stab-proof protection structure may also comprise a plurality of preferential folding lines, positioned in a plurality of free areas formed by peripheral sections of consecutive elementary components, in said free areas the elementary components not being linked to the flexible base, the structure being adapted to cover surfaces or structures having an irregular pattern by folding according to the folding lines.

[0036] Finally, the stab-proof protection structure may have the shape of a stab-proof vest.

[0037] The features and advantages of the elementary component and of the stab-proof protection structure according to the invention will become apparent from the description, made hereinafter, of embodiments thereof, given by indicative and non-limiting example, with reference to the accompanying drawings.

Brief description of the drawings

[0038] In said drawings:

Figure 1 schematically shows a stab-proof protection structure made according to the present invention;

Figures 2A-2C schematically show a stab-proof protection elementary component made according to the present invention, in respective axonometry and top views;

Figures 3A and 3B schematically show side views of the stab-proof protection structure of Figure 1, in different operating configurations.

Detailed description

[0039] With reference to said figures and in particular to Figures 1 and 2A-2C, a stab-proof protection structure 10 comprising a plurality of elementary components 20, independent with each other and contiguous, associated with a flexible base of cut resistant fabric is described.

[0040] It should be noted that the figures represent schematic views and are not drawn to scale, instead they are drawn so as to enhance the important features of the invention. Moreover, in said figures, the different components are also shown schematically, and their shape may vary according to the desired application. Finally, particular measures described in connection to one embodiment may also be used in other embodiments, in any combination.

[0041] In the preferred embodiment illustrated in Figure 1, the stab-proof protection structure 10 comprises a reinforced portion 11 associated with a flexible base 12, made of a cut resistant fabric.

[0042] More particularly, the flexible base 12 may be made of an aramid or para-aramid fiber fabric, for instance Kevlar®, Twaron® or PARAX® by Prosystems, or by means of high molecular weight polyethylene, or even of PBO (i.e. poly benzoxazole).

[0043] The flexible base 12 is suitably associated with the reinforced portion 11, in turn comprising a plurality of elementary components 20. It is noted that, in the context of the present invention, the term "associated" means that the reinforced portion 11 is physically connected to the flexible base 12, for instance connected in any suitable modality, and not necessarily directly connected thereto, but for instance indirectly connected through at least one further interposed layer, such as an adhesive layer.

[0044] As it will be hereinafter explained more in detail, the elementary components 20 are made with complementary and conjugated shapes adapted to interpenetrate like the pieces of a mosaic or a puzzle and to evenly cover the area of the reinforced portion 11, which in this way is finely divided into said elementary components 20. Each elementary component 20 is made of a suitable

cut resistant material, meant as a material hindering or even preventing the penetration of a pointed or bladed weapon, in particular a fabric chosen among those that may realize the flexible base 12.

[0045] Suitably, the elementary components 20 in the reinforced portion 11 are associated, preferably glued, with the flexible base 12 at a plurality of central sections thereof, side sections of said elementary components being free from being associated, preferably the gluing, with the flexible base 12. The side sections of the plurality of elementary components 20 distributed in the reinforced portion 11 thus define free areas in said reinforced portion 11.

[0046] It is clear that said free areas are distributed substantially in all directions and thus suitably allow providing respective folding lines LP1, LP2, LP3 of the stab-proof protection structure 10 where the interference between the elementary components 20 is limited and which may develop in any direction.

[0047] It is possible to compare the elementary components 20 of the reinforced portion 11 of the stab-proof protection structure 10 to tiles which are distributed so as to evenly cover an area to be protected at the reinforced portion 11 like normal building tiles would cover a floor or wall. Thanks to the particular shape of the elementary components 20 according to the present invention, as it will be clarified in greater detail hereinafter, the same are partially interpenetrated with each other, as pieces of a mosaic or puzzle. In the case of the stab-proof protection structure 10, said floor or wall actually is a flexible base 12, made of the layer of cut resistant fabric, and the elementary components 20 are capable of following any deformation thereof, for instance in case one wishes to realize stab-proof blade coatings for irregular surfaces.

[0048] In the preferred shape illustrated in Figure 1, the stab-proof protection structure 10 has the shape of a stab-proof vest, still indicated with reference number 10. The stab-proof vest illustrated in such a figure is in the shape of a vest, the reinforced portion 11 being substantially extended on the entire surface of the vest itself. It is obvious to provide for a different shape, but equally wearable by a user.

[0049] In particular, as illustrated in the figure, the reinforced portion 11 is thus realized so as to cover almost the entire chest, the side hips, and the back as well (not shown) of the user wearing the stab-proof vest, also following the shape of the axillary portions, chinstrap, and shoulders.

[0050] Said reinforced portion 11 actually realizes a total shield for the user wearing the stab-proof vest 10, which may be folded without encountering any resistance at the folding lines, for instance LP1, LP2, LP3, thus being flexible and suitable to be worn in any circumstance, also ensuring enough freedom of movement in any direction to the user wearing it.

[0051] As indicated, the stab-proof protection structure 10, in particular the reinforced portion 11 thereof, com-

prises a plurality of elementary components 20, illustrated in greater details in Figures 2A-2C. Suitably, each elementary component 20 has a flat or plate-like shape, such as a building or mosaic tile, as it will be clarified in greater detail hereinafter.

[0052] In particular, as shown in Figure 2A, each elementary component 20 has a first face F1 adapted to be associated with the flexible base 12 to realize the reinforced portion 11 and a second face F2, opposite the first face F1 and facing towards the direction of origin of possible strokes of a pointed or bladed weapon. In particular, the first face F1 faces towards a wearer and the second face F2 faces outwards when the stab-proof protection structure 10 is in the shape of a wearable stab-proof vest. The elementary component 20 further comprises a profile portion 20S, substantially orthogonal to the first face F1 and to the second face F2, adapted to face towards other elementary components 20 associated with the flexible base 12 to form the reinforced portion 11. The first face F1 and the second face F2 are substantially plane and parallel to each other.

[0053] Suitably, the profile portion 20S of each elementary component 20 is devoid of connection means, such as an adhesive layer, and is free with respect to the flexible base 12 and with respect to other elementary components surrounding it.

[0054] More particularly, as shown in Figure 2B, the elementary component 20 comprises a central section 21 intended to be associated with the flexible base 12, and a peripheral section 22 surrounding the central section 21. In a preferred embodiment, the central section 21 has a substantially circular shape.

[0055] In other words, each elementary component 20 comprises a central portion 21 provided with connection means, such as an adhesive layer, and surrounded by a multi-lobed peripheral portion 20S devoid of said connection means.

[0056] Suitably according to the present invention, the peripheral section 22 has a multi-lobed shape, said lobes having substantially corresponding profiles and two consecutive lobes being connected to each other by a junction having a profile that is complementary and conjugated to the profile of said lobes, so as to allow the elementary components 20 to be contiguously side by side to each other to form the stab-proof protection structure 10, as illustrated for instance in Figure 1.

[0057] In particular, as illustrated in Figure 2C, the peripheral section 22 is quadrilobate-shaped and comprises a first lobe 22A, a second lobe 22B, a third lobe 22C, and a fourth lobe 22D, connected to each other by a first junctions 24ab, a second junction 24bc, a third junction 24cd, and a fourth junction 24da, respectively, said lobes 22A-22D having respective profiles 23a-23d that are complementary and conjugated with the junctions 24ab-24da.

[0058] Suitably, in a preferred embodiment of the present invention, the lobes 22A-22D have substantially circular-shaped profiles 23a-23d; equally, the junctions

23ab-23da have a substantially circular pattern. It is noted that, herein and hereinafter, the indication of a circular geometry, as well as the terms "plane", "parallel" and "orthogonal" are always to be intended in connection to physical elements and not geometrically abstract, and thus must always take into account the tolerances introduced by the transition from a pure mathematical/geometric world to the real world.

[0059] Advantageously according to the present invention, at least one lobe, in particular the fourth lobe 22D has inverse concavity with respect to the remaining lobes which form the peripheral section 22 of an elementary component 20. In this way, the elementary component 20 has an overall concave shape.

[0060] In particular, with reference to Figure 2C, for each elementary component 20 a longitudinal development axis XX and a transversal development axis YY, which cross in a center of symmetry W, are defined; the first lobe 22A and the third lobe 22C are arranged along the transversal development axis YY, whereas the second lobe 22B and the fourth lobe 22D are arranged along the longitudinal development axis XX. Suitably, the first lobe 22A, the second lobe 22B, and the third lobe 22C have concavity facing inwards of the elementary component 20, i.e. towards the center of symmetry W, whereas the fourth lobe 22D has concavity facing outwards of the elementary component 20, i.e. in an opposite direction with respect to the center of symmetry W.

[0061] It should be noted that the elementary component 20 in this way comprises a profile portion 20S that is completely radiated, i.e. only comprising strokes of arc of a circle, namely the profiles 23a-23d of the lobes 22A-22D and the junctions 23ab-23da, with patterns complementary and conjugated with each other and alternating concavities.

[0062] In this way it is possible to place side by side plurality of elementary components 20 which interpenetrate, thanks to the shape complementarity between the profiles 23a-23d of the lobes 22A-22D and the pattern of the junctions 23ab-23da, as well as thanks to the presence of the fourth lobe 22D having inverse concavity with respect to the others. Said elementary components 20 thus behave like building tiles or even like mosaic tiles and the stab-proof protection structure 10 thus comprises a reinforced portion 11 that is finely divided into a plurality of said elementary components 20, which are placed side by side to each other and partially interpenetrating, in particular at the fourth lobe 22D.

[0063] Moreover, it should be noted that, thanks to the presence of a lobe having inverse concavity with respect to the others, it is possible to realize elementary components 20 that are identical to each other, able to partially interpenetrate when placed side by side to each other to form the reinforced portion 11.

[0064] It is also possible to realize said elementary components 20 with more than one lobe having concavity opposite the others, said elementary components 20 adapted to form the reinforced portion 11 having different

shapes, so as to be adapted to interpenetrate, like the pieces of a puzzle.

[0065] According to an alternative embodiment not illustrated, each lobe 22A-22D may have a non-circular profile, instead realized by means of a broken line, anyway having a complementary and conjugate pattern with a broken line profile of an adjacent junction 21ab-21da, so as to allow the elementary components 20 to be contiguously placed side by side, with partial interpenetration, in order to form the stab-proof protection structure 10. It should also be noted that in this case the lobes 22A-22D are considered as provided with concavity and it is possible to provide for at least one of them an inverse concavity with respect to the others.

[0066] In its more general form, the profile portion 20S comprises lobes 22A-22D and junctions 22ab-22da, each having a shape chosen from: an arc of a circle, a parabolic arc, a broken line of linear segments, a broken line of curvilinear segments.

[0067] Suitably, the linear segments are chosen so as to have a maximum extension of 3mm, so as to properly stop a blade from penetrating between two adjacent elementary components 20.

[0068] Each elementary component 20 is realized by means of a multi-layer structure comprising a plurality of layers of cut resistant material suitably impregnated with a hardening material adapted to join said layers of fabric.

[0069] In particular, as cut resistant material an aramid or para-aramid fiber fabric, for instance Kevlar[®], Twaron[®] or PARAX[®] by Prosystems, or high molecular weight polyethylene, or PBO (i.e. poly benzoxazole), i.e. a fabric suitable for also realizing the flexible base 12, is used.

[0070] Suitably, the layers of cut resistant fabric are impregnated by means of a thermosetting resin, for instance an epoxy resin, a polyester resin, an acrylic or vinyl ester resin, a polyurethane resin, or a urea resin.

[0071] In a preferred embodiment, the elementary component 20 comprises n layers of cut resistant fabric, n ranging between 3 and 8, according to the degree of protection desired for the final stab-proof protection structure 10. Said layers of cut resistant fabric are joined by means of the thermosetting resin in a rigid final structure with hardness ranging between 70-80 Shore and thickness ranging between 2 mm and 6 mm.

[0072] It is possible to realize the elementary components 20 by overlapping the desired number of layers of cut resistant fabric, impregnated with the thermosetting resin, by subjecting the multi-layer structure thus obtained to the combined action of pressure and temperature, so as to obtain a rigid plate, which has desired hardness and thickness.

[0073] The plate thus obtained is fragmented into the plurality of elementary components 20 having the quadrilobate shape illustrated in Figures 2A-2C, i.e. with a completely radiated profile portion 20S, meaning as only formed by portions of a circle.

[0074] In this way, a blade used against a stab-proof protection structure 10 realized by means a plurality of

elementary components 20 associated with the flexible base 12 does not find any straight side and cannot penetrate through the junctions said these elementary components 20 which make up the reinforced portion 11 like a mosaic of the stab-proof protection structure 10.

[0075] Advantageously according to the present invention, the elementary components 20 are associated with the flexible base 12 just at the central section 21. In a preferred embodiment, each elementary component 20 is glued to the flexible base 12 by means of an adhesive film 25 arranged at said central section 21. More particularly, the central section 21 comprises a disc of epoxy or polyurethane adhesive.

[0076] In an alternative embodiment not illustrated, said central section 21 is raised with respect to the peripheral section 22, so as to avoid a diffusion of the adhesive film 25 in said peripheral section as much as possible.

[0077] Suitably, the elementary components 20 thus have the peripheral section 22 made in a quadrilobate shape not associated with the flexible base 12 made of cut resistant fabric, allowing each elementary component 20 to move, in particular to tilt and bend with respect to said flexible base.

[0078] In this way, the elementary components 20 are contiguous and independent, a number of elementary components 20 being provided so as to be enough to cover an area that must be protected. Suitably, each elementary component 20 comprises faces F1 and F2 having surface extension equal to 2-20%, preferably equal to 3-5% of the surface extension of the reinforced portion 11.

[0079] The peripheral sections 22 of a plurality of adjacent elementary components 20 define respective pluralities of free areas 13 in the reinforced portion 11 of the stab-proof protection structure 10, as indicated in Figures 3A and 3B, where a stab-proof protection structure 10 is shown in a first plane configuration (Fig. 3A) and in a second curved configuration (Fig. 3B). It is in particular noted that, at said free areas 13, it is possible to perform the bending of the stab-proof protection structure 10 without the adjacent elementary components 20 interfering with each other. In this way, the stab-proof protection structure 10 has the above indicated plurality of preferential folding lines LP1, LP2, LP3, positioned in said free areas 13, said stab-proof protection structure 10 being thus able to adapt to a non-plane surface, for instance when it realizes a stab-proof vest which has to follow the contours of a user wearing it.

[0080] It is noted that, thanks to the combination of the plurality of elementary components 20 provided with central sections 21 associated, in particular glued, with the flexible base 12 and free peripheral sections 22, in particular free to move with respect to the flexible base 12, the stab-proof protection structure 10 comprises free areas 13 which distribute substantially in all directions and thus allow providing for respective folding lines in any direction.

[0081] It is thus possible to realize a stab-proof protection structure 10 with an overall height H_p given by the sum of the height H_t of the elementary components 20 forming the reinforced portion 11 and of the thickness of the flexible base 12, with values ranging between 2.2 mm and 6.8 mm. Thanks to the so limited overall thickness, besides to the possibility of bending at the folding lines, the stab-proof protection structure 10 may be used to protect shapes with complex geometries, such as for instance the human body, thus realizing a stab-proof vest suitable for being worn even under clothing, for instance substantially in the form of a vest. It is obviously possible to provide for a different form, but equally wearable by a user.

[0082] It is immediate to verify that in this way it is possible to realize a stab-proof vest that is extremely flexible and having thickness and weight that are about half the stab-proof devices known nowadays.

[0083] In conclusion, the present invention defines stab-proof elementary components, each in the shape of a quadrilobate element comprising at least one central portion and side lobes, in particular four, at least one of said side lobes having concavity facing outwards of the component, i.e. in a direction opposite the central portion. In this way, a plurality of elementary components may be associated in a mosaic shape on a flexible base of cut resistant fabric so as not to leave portions of said fabric devoid of said elementary components, thus forming a stab-proof protection structure that may be folded to also cover irregular surfaces, such as for instance anatomic parts of a wearer should said stab-proof protection structure be used to realize a stab-proof vest.

[0084] Suitably, the innovative configuration of the elementary components according to the invention thus allows realizing a stab-proof protection structure capable of ensuring an effective protection with optimal levels such as a level KR3/SP3 (Knife/Spike resistant level) of the US NIJ 0115.00 standard in a final structure flexible enough to manage to also cover non-regular surfaces, in particular to realize a stab-proof vest.

[0085] Furthermore, it is noted that the use of the elementary components substantially in the shape of mosaic tiles to form the reinforced portion of the stab-proof protection structure allows minimizing, even eliminating, the portions of the area to be protected which are left uncovered, i.e. devoid of reinforcement elementary components, though ensuring the flexibility and thus the possibility to bend the final structure so obtained.

[0086] Moreover, thanks to the use of a reinforced portion finely divided into a plurality of elementary components, mosaic tiles-like, provided with central sections capable of suitably limiting the extension of the association, in particular the gluing, with the flexible base, it is possible to realize a stab-proof vest that remains flexible, but ensures a high protection, with limited thickness capable of being worn even under clothing.

[0087] In particular, the presence of the lobed peripheral sections of the elementary components forming the

reinforced portion comprised in the stab-proof protection structure, peripheral sections which are not associated, in particular glued, with the flexible base, allows defining free areas therein, where the adjacent elementary components do not interfere with each other and the stab-proof fabric which the flexible base is made of is not associated therewith, in particular glued, said free areas extending in any direction so as to allow realizing corresponding folding lines of the stab-proof protection structure so defined.

[0088] Suitably, the stab-proof vest according to the present invention is capable of protecting more extended surfaces (in particular different parts of the body) with respect to the known solutions, while maintaining the flexibility of the vest as a whole and thus greater comfort for the wearer, possibly even under clothing.

[0089] Finally, it is worth noticing that the use of elementary components capable of interpenetrating when placed side by side and comprising a completely radiated peripheral portion maximizes the action of blocking the penetration by pointed and bladed weapons realized by the reinforced portion comprising a plurality of said elementary components.

[0090] Obviously, a person skilled in the art, in order to satisfy contingent and specific requirements, may make numerous modifications and variations to the elementary components and to the stab-proof protection structure, in particular in the form of the stab-proof vest above described, all included in the scope of protection of the invention as defined by the following claims.

[0091] For instance, it is possible to provide for elementary components having a shape different from the illustrated ones, such as a shape with a greater number of lobes and junctions, suitably provided with conjugated and complementary profiles and to ensure a correct distribution of said components on an area to be protected.

[0092] It is also possible to realize said elementary components with more than one lobe having inverse concavity with respect to the others.

[0093] The stab-proof vest could also have different shapes from the vest-like one illustrated and could comprise more sections, distinct from each other, each divided into a plurality of elementary components possibly separated by ballistic fabric portions.

Claims

1. Stab-proof protection elementary component (20) having a plate-like structure of the tile or card type and comprising at least one first face (F1), that is substantially plane, a second and opposite face (F2) that is substantially plane and parallel to said first face (F1) and a profile portion (20S) that is substantially orthogonal to said first and second faces (F1, F2), **characterized in that** said profile portion (20S) has a multi-lobed shape, said elementary component (20) being made of cut resistant material.

2. Elementary component (20) according to claim 1, **characterized by** comprising a peripheral section (22) comprising a plurality of lobes (22A-22B) adapted to define said multi-lobed shape of said profile portion (20S) and a central section (21) surrounded by said peripheral section (22). 5
3. Elementary component (20) according to claim 2, **characterized in that** said peripheral section (22) further comprises a plurality of junctions (22ab-22da) adapted to connect two consecutive lobes of said plurality of lobes (22A-22D), said junctions (22ab-22da) having a conjugate and complementary shape with respect to said lobes (22A-22D) 10
4. Elementary component (20) according to claim 3, **characterized in that** at least one lobe (22D) of said plurality of lobes (22A-22D) has inverse concavity with respect to the other lobes (22A-22C) of said plurality of lobes (22A-22D). 15
5. Elementary component (20) according to claim 4, **characterized in that** said junctions (22ab-22da) have concavity equal to said at least one lobe (22D) of said plurality of lobes (22A-22D). 20
6. Elementary component (20) according to claim 2, **characterized in that** said central section (21) comprises connections means and said peripheral section (22) is devoid of said connection means. 25
7. Elementary component (20) according to claim 6, **characterized by** comprising an adhesive film (25) arranged at said central section (21) to realize said connection means. 30
8. Elementary component (20) according to claim 3, **characterized in that** said peripheral section (22) comprises lobes (22A-22D) and junctions (22ab-22da) having an arc of a circle shape, said profile portion (20S) being completely radiated being formed only by portions of a circle. 35
9. Elementary component (20) according to claim 3, **characterized in that** each of said lobes (22A-22D) and each of said junctions (22ab-22da) have a shape chosen from: a parabolic arc, a broken line of linear segments, a broken line of curvilinear segments. 40
10. Elementary component (20) according to claim 1, **characterized by** being made of a plurality of layers of a cut resistant material suitably impregnated with a hardening material adapted to join said layers of fabric, said hardening material preferably comprising a thermosetting resin chosen from: an epoxy resin, a polyester resin, an acrylic or vinyl ester resin, a polyurethane resin, or a urea resin. 45
11. Elementary component (20) according to claim 10, **characterized in that** said cut resistant material is chosen from: an aramid or para-aramid fiber fabric, preferably Kevlar®, Twaron® or PARAX® by Prosystems, or high molecular weight polyethylene or PBO (i.e. poly benzoxazole). 50
12. Elementary component (20) according to claim 2, **characterized in that** said central section (21) is raised with respect to said peripheral section (22). 55
13. Stab-proof protection structure (10) comprising at least one flexible base (12) and a reinforced portion (11) associated with said flexible base (12), said reinforced portion (11) comprising a plurality of elementary components (20) singularly associated with said flexible base (12), structurally independent with each other and not linked to each other at profile portions (20S) thereof, **characterized in that** each of said elementary components (20) is realized according to any one of the preceding claims.
14. Stab-proof protection structure (10) according to claim 13, **characterized in that** said elementary components (20) are associated with said flexible base (12) only at said central section (21), said flexible base (12) being preferably made of a cut resistant material chosen from: an aramid or para-aramid fiber fabric, preferably Kevlar®, Twaron®, or PARAX® by Prosystems, or high molecular weight polyethylene, or PBO (i.e. poly benzoxazole).
15. Stab-proof protection structure (10) according to claim 13 or 14, **characterized by** being in the form of a stab-proof vest.

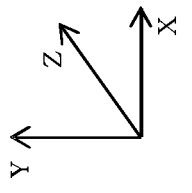
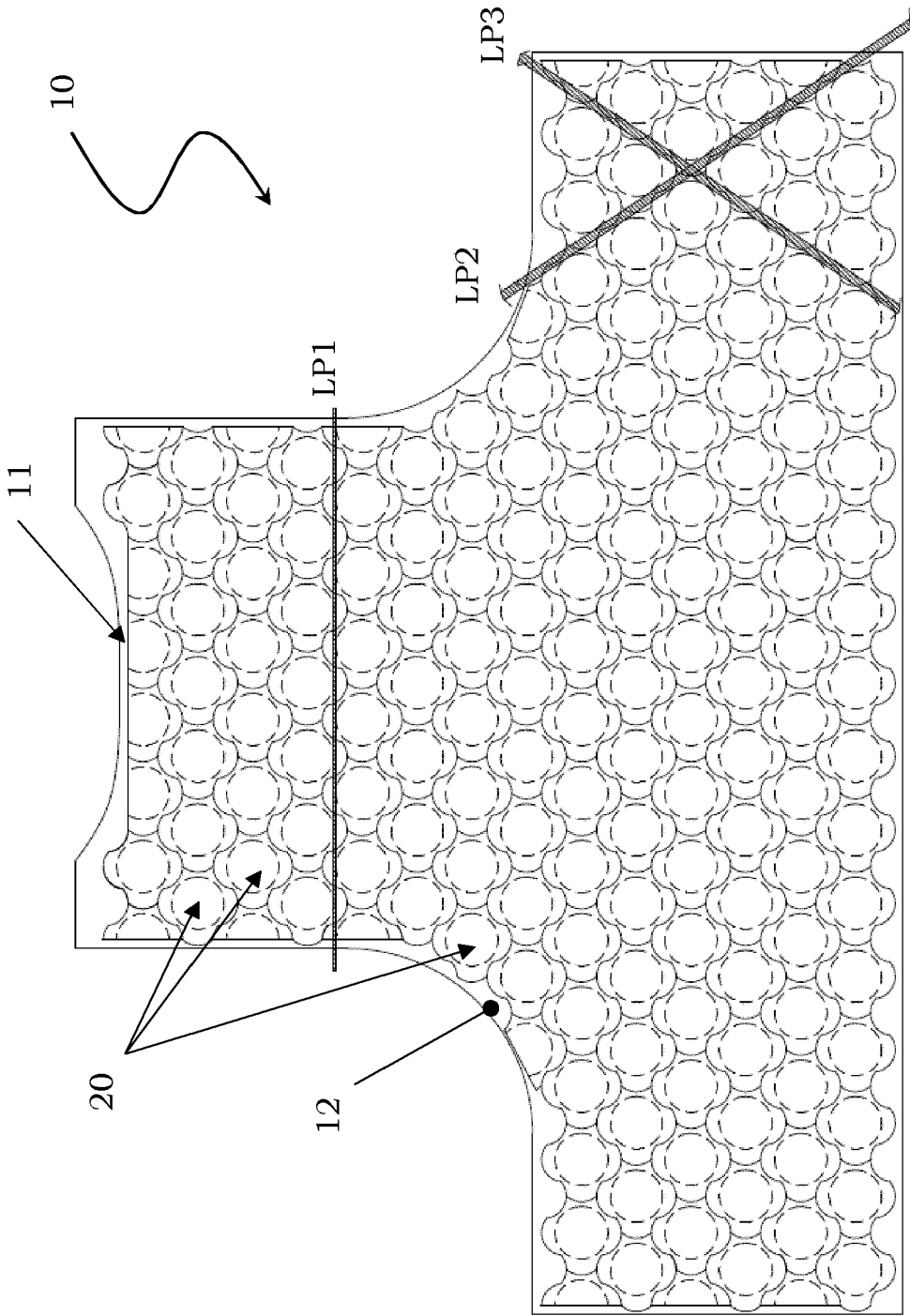


FIG. 1

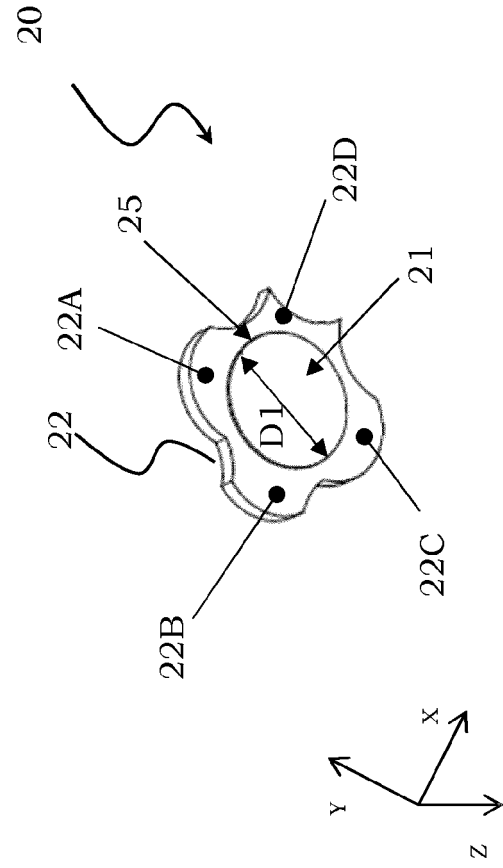


FIG. 2A

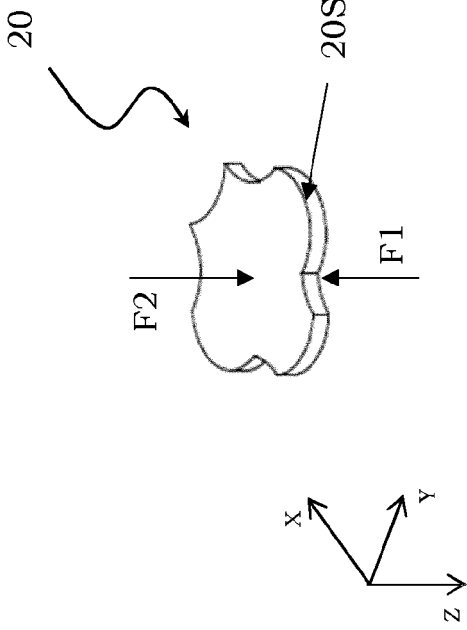


FIG. 2B

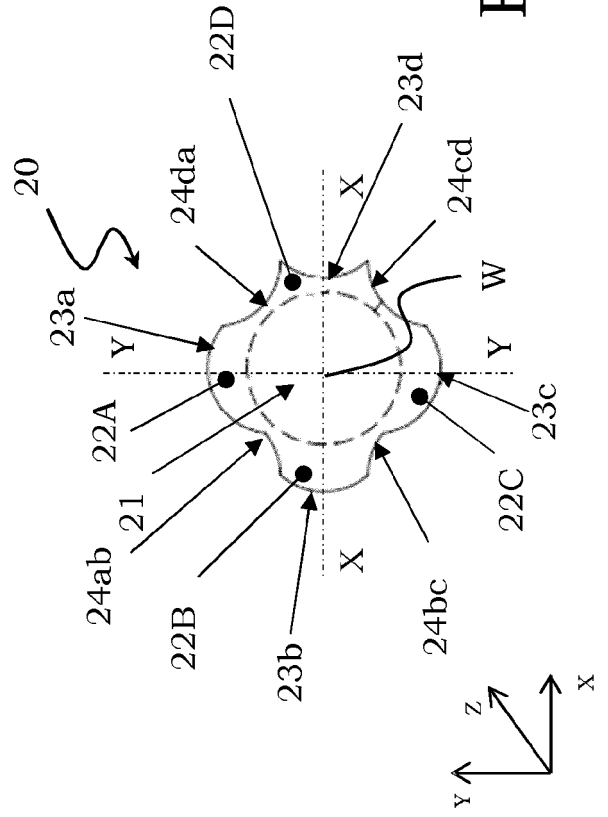
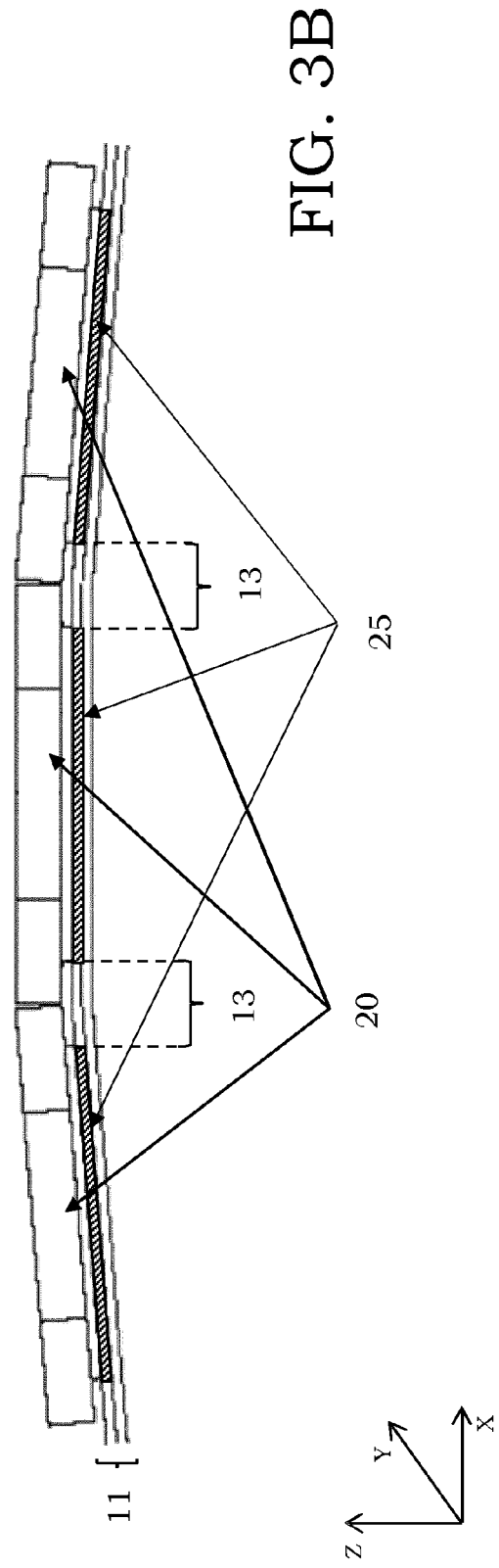
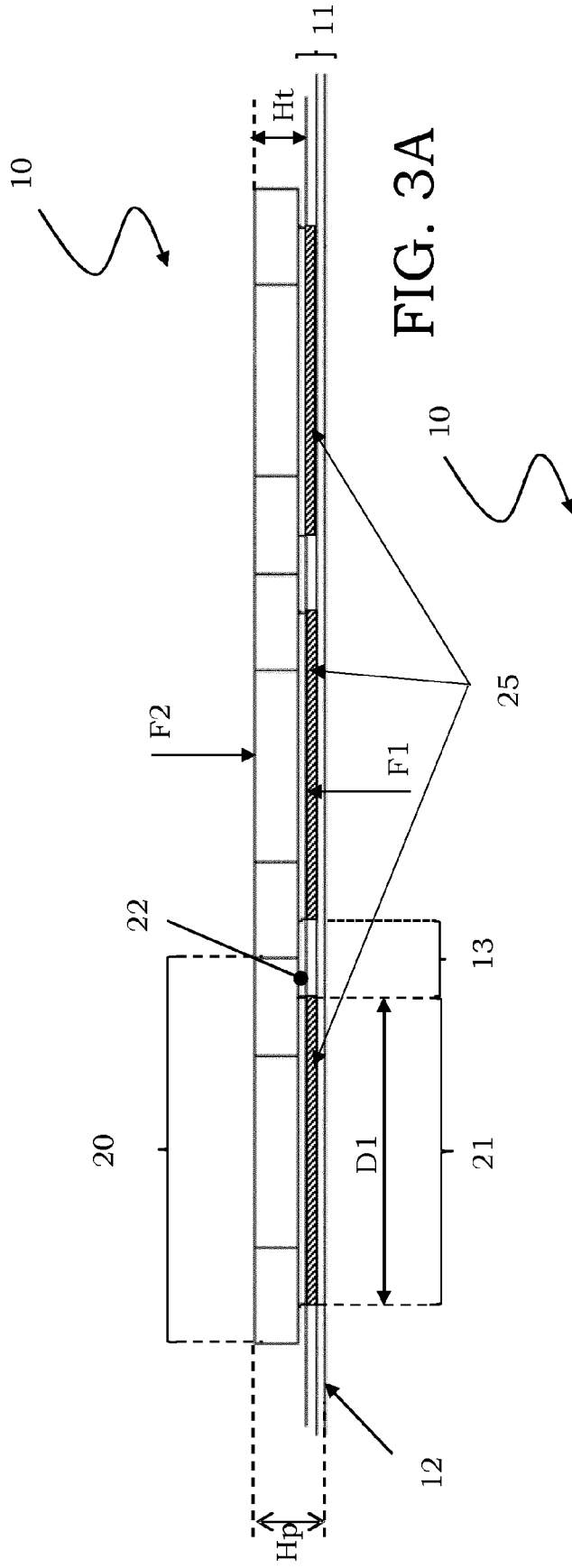


FIG. 2C





EUROPEAN SEARCH REPORT

Application Number

EP 22 20 2221

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Y	* paragraph [0024] - paragraph [0036]; claims 14,16; figure 1 *	6, 7, 12-15	F41H5/04
Y	IT 2019 0001 8038 A1 (ELET CA S R L CON SOCIO UNICO [IT]) 7 April 2021 (2021-04-07) * claims 18,19,21,23-26; figures 3A,7 *	6, 7, 12-15	
A	WO 2006/103431 A1 (SECR DEFENCE [GB]; BAXTER ANDREW GEORGE [GB] ET AL.) 5 October 2006 (2006-10-05) * the whole document *	1	
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The present search report has been drawn up for all claims

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Place of search The Hague	Date of completion of the search 8 February 2023	Examiner Beaufumé, Cédric
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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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