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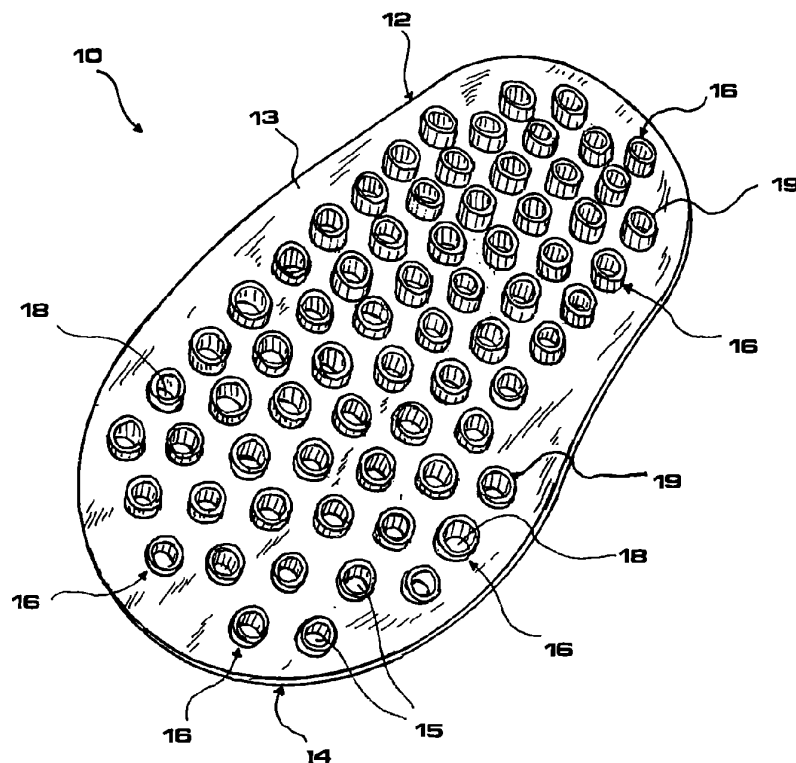
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(54) **Protection device and wearable article including said protection device**

(57) The present disclosure relates to a protection device (10, 110, 410, 510) for dynamic sports. The protection device (10, 110, 410, 510) comprises, in a single body of flexible material, a base element (12) having a first face (13) and a second face (14) opposite to the first face (13), and a plurality of tubular bodies (16, 116) projecting from the first face (13) of the base element (12).

The base element (12) has a plurality of through holes (15, 115) and each of the tubular bodies (16) is arranged at a respective hole (15, 115), to form with the hole (15, 115) a cavity (18, 118) extending from a free end (19) of the tubular body (16, 116) to the second face (14) of the base element (12).



**FIG.1**

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## Description

**[0001]** The present disclosure generally refers to a protection device for protecting the human body in the course of dynamic sports, i.e. a protection device of the type adapted to be used during sports activities for protecting a user in case of knocks, falls and impacts in general. The present disclosure also refers to a wearable article for dynamic sports practice, including said protection device.

**[0002]** It is widely known that sporting activities such as motorcycling, but also skiing, skating, cycling, and anyhow when high-speed motions are envisaged, can easily lead to falls of persons practicing the activity; in these falls, a number of the person's body zones are particularly at risk of injury.

**[0003]** Knees, wrists, elbows, shoulders, neck and back are usually the parts more subjected to be hit by falls during such activities, both as these usually are the parts first contacting the ground, and as they have no layer of muscle or fatty tissue that may sufficiently cushion knocks.

**[0004]** To mitigate consequences of falls and impacts in general, protection devices are made available which are arranged at body parts exposed to an impact while dynamic or extreme sports activities are in progress.

**[0005]** A first category of products suitable therefor envisages the use of a rigid element that is fastened, e.g. on a garment, at the zone to be protected, so as to cover said zone and shield it from impacts. Different materials and geometries of the protective element are used to improve the strength thereof and increase the capacity of dissipating impact energy.

**[0006]** These rigid protection devices, though advantageous under several standpoints, entail some drawbacks.

**[0007]** A drawback lies, e.g., in the same rigidity of the protections and in the fact that it is not always possible to perfectly adapt such protections to the shape of the user's body, above all to the anatomy of the body joints, and therefore it is difficult to make the protection adhere perfectly to the body during a fall or accident.

**[0008]** To solve said drawback it has been proposed to use protections of flexible material, like e.g. of rubber.

**[0009]** Currently available protections of flexible material, though entailing the advantage of clinging better to the shape of the human body, entail anyhow some drawbacks still unsolved.

**[0010]** In particular, e.g., a drawback lies in the fact that, in order to guarantee sufficient protection, rubber protections of relevant thickness have been proposed which are particularly heavy. Such a weight is incompatible with the practical use in a wearable article for dynamic sports.

**[0011]** Moreover, known rubber protections do not allow an adequate perspiration when worn-on.

**[0012]** The technical problem underlying the present invention is to provide a protection device adapted to

protect the human body in dynamic sports, and concomitantly allowing to obtain a high protection, an adaptability to the shape of the body part to be protected, a limited weight, and an adequate perspiration, and/or to provide further advantages.

**[0013]** Such a problem is solved by a protection device according to claim 1, and by a wearable article according to claim 13.

**[0014]** In particular, it has been found that a protection device comprising, in a single body of flexible material:

- a base element having a first face and a second face opposite to the first face and having a plurality of through holes; and
- a plurality of tubular bodies projecting from the first face of said base element, wherein each of said tubular bodies is arranged at a respective hole of the base element to form, with said hole, a cavity extending from a free end of the tubular body to the second face of the base element, concomitantly has features of satisfactory lightness of weight, flexibility, perspiration and encumbrance, making it particularly suitable for use in articles wearable for dynamic sports.

**[0015]** Moreover, it was found that this protection device is particularly suitable to guarantee sufficient protection from impact in case of falls or accidents in general in the practice of dynamic sports, such as motorcycling or skiing.

**[0016]** For instance, it was found that on the occasion of some impacts by items or bodies hitting the protection device with an energy, e.g., of the order of 50 Joules, the protection device in accordance with the present disclosure can be capable of transmitting a force of the order of about 28-30 kN, falling within lawful limits set for the protection of joints in the dynamic sports field. These results were achieved by tests conducted in compliance with current technical reference standards, e.g. EN 1621.1.

**[0017]** Preferably, in order to limit weight to the utmost, the base element has a height comprised between 0.1 and 2.5 mm, and the tubular bodies have a height comprised between 0.1 and 25 mm.

**[0018]** Even more preferably, in an embodiment the tubular bodies have a circular section. In this case, further improvements were found in energy absorption, therefore in protection effectiveness.

**[0019]** Preferably, for the specific application in the dynamic sports field the flexible material is a rubber, even more particularly polynorbornene-based, and has a Shore hardness (measured according to modes known to a person skilled in the art) comprised between 30 and 40 Shore A and an elasticity comprised between 0 and 10% of elastic return.

**[0020]** Another advantage of the protection device according to the present disclosure lies in the fact that, for

its application, it suffices to cut following a pattern, along a desired contour, the base element, and arrange such device at the body part to be protected. In other words, the protection device is easily mouldable into the desired shape.

**[0021]** Preferably, the protection device is produced in one piece by moulding, so as to easily obtain a single body comprising the base element, the tubular bodies and the respective holes.

**[0022]** To include the protection device in a wearable article, such as, e.g., a garment (like a motorcyclist's jacket or suit) or in an independent protection accessory like a back protector or an elbow protector, it is preferable to at least partially cover the protection device with an external barrier (e.g., a fabric or a soft layer), so that the protection device be hidden to the view, and concomitantly having the external barrier in turn protecting it from external agents.

**[0023]** To this end, it is possible e.g. to arrange the device in a pocket, in a casing or below an external layer of the garment or of the protection accessory.

**[0024]** In an alternative embodiment, the device is placed on an external side of the garment to be visible or on sight. In this embodiment, the device may act as distinctive element for the garment, as it allows to immediately recognize that it is a garment capable of offering an adequate protection.

**[0025]** Other advantages, features and operation steps of the subject of the present disclosure will be made evident in the following detailed description of preferred embodiments thereof, given by way of example and not for limitative purposes. However, it is evident how each embodiment could have one or more of the advantages listed above; anyhow, it is not required for each embodiment to concurrently have all of the advantages listed.

**[0026]** It is also to be understood that all possible combinations of the aforeindicated embodiments, and of those described with reference to the following detailed description, fall within the scope of the present disclosure.

**[0027]** Reference will be made to the figures of the annexed drawings, wherein:

- Figure 1 illustrates a top perspective view of a protection device according to the present disclosure;
- Figure 2 shows a plan view of the protection device of Figure 1;
- Figure 3 shows a sectional view along section line III-III of Figure 2;
- Figure 4 shows a top perspective view of a protection device according to the present disclosure in accordance with a variant embodiment;
- Figure 5 illustrates a front view of a motorcyclist's suit including a plurality of protection devices according to the present disclosure;
- Figure 5a illustrates a sectional view along section line V-V of Figure 5;
- Figure 6 illustrates a front view of a back protector

including a protection device according to the present disclosure;

- Figure 6a illustrates a sectional view along section line VI-VI of Figure 6;
- Figure 7 illustrates a view with detached parts of a back protector including a protection device according to the present disclosure;
- Figure 8 illustrates a top perspective view of a protection device according to the present disclosure, for the protection of a shoulder;
- Figure 9 illustrates a top perspective view of a protection device according to the present disclosure, for the protection of a knee or of an elbow.

**[0028]** Referring to the annexed drawings, by reference numbers 10, 110, 410, 510 some embodiments of a protection device according to the present disclosure for dynamic sports are denoted, in which said device is adapted to effectively protect from knocks or impacts during the practice of dynamic sports, or of extreme sports in general. By "protection device for dynamic sports" it is meant in particular that the device is adapted to be worn on (directly or applied to a garment) by a user who is practicing a dynamic sport, in order to protect the user's body from the possible knocks or impacts that may occur in the course of such a sporting activity. In particular, referring initially to Figures 1 to 3, the protection device 10 is made of a flexible material and comprises, in a single body, a base element 12 having a first face 13 and a second face 14 opposite to the first face 13. The base element 12 in the example is a layer or sheet of flexible material.

**[0029]** The base element 12 has a plurality of through holes 15, visible in Figure 3 in a sectional view. In the example, these are holes 15 having a circular shape. Essentially, the holes 15 extend through the thickness of the base element 12 between the first face 13 and the second face 14.

**[0030]** The protection device 10 further comprises a plurality of tubular bodies 16 projecting from the first face 13 of said base element 12. Each of the tubular bodies 16 is arranged at a respective hole 15 of the base element 12 to form, with the hole 15, a cavity 18 extending through from a free end 19 of the respective tubular body 16 to the second face 14 of the base element 12. More precisely, the tubular body 16 (and its cavity 18) is aligned and coaxial with the respective hole 15, i.e. they have the same longitudinal central axis 150.

**[0031]** With this arrangement of parts, a protection device 10 is obtained having high flexibility and reduced encumbrance, satisfactory perspiration and lightness of weight thanks to the through cavities 18, satisfactory protection capability thanks to the presence of the tubular bodies 16 fixed in a single body with the base element 12.

**[0032]** The lightness of weight is obtained also thanks to the interspaces between the tubular bodies 16 and to their distribution, allowing to obtain a structure having a

certain overall thickness (equal to the sum of the height H1 of the base element 12 and of the height H2 of the tubular bodies 16) with a reduced use of material. Essentially, in the region between the first face 13 and the free ends 19, the empty portions are far more than the solid portions (the latter corresponding to the walls 20 of the tubular bodies 16); compared to a solid-layer protection of equal thickness, the weight is markedly reduced.

**[0033]** For instance, the protection device 10 is produced by moulding, so as to easily obtain a single body comprising the base element 12, the tubular bodies 16 and the respective holes 15.

**[0034]** More precisely, in the example the flexible material with which the protection device was made is a rubber, even more preferably it is polynorbornene, e.g. commercially available under the name of Norsorex®, and having a Shore hardness comprised between 30 and 40 Shore A and an elasticity comprised between 0 and 10% of elastic return.

**[0035]** The base element 12 is a sheet of substantially plane shape, preferably having a height H1 comprised between 0.1 mm and 2.5 mm, in the example of 1 mm. Preferably, in the example illustrated in Figures 1 to 3, the tubular bodies 16 have a height H2 comprised between 0.1 mm and 25 mm, in the example of 6 mm, and have walls 20 of circular cross section.

**[0036]** Even more specifically, in the example the walls 20 have an external diameter  $D_e$  constant along height H2, to form substantially a cylinder, whereas they have an internal diameter progressively decreasing from the free end 19 of the tubular body 16 to the hole 15 of the base element 12.

**[0037]** Essentially, the internal surface 16a of the tubular body 16 is frustocone-shaped, with a taper toward the base element 12.

**[0038]** In the example, the internal diameter  $D_i$  of the tubular body 16 at the free end 19 is, in the example, of 6 mm, whereas the diameter  $D_f$  of the hole 15 of the base element 12 is of 5 mm. The thickness  $S$  of the walls 20 is of about 1 mm at the free end 19 and progressively increases toward the base element 12.

**[0039]** The taper of the cavity 18 is, e.g., advantageous in the production stage, to allow an easier drawing of the device 10 from the mould.

**[0040]** Preferably, the tubular bodies 16 are evenly distributed on the first face 13, in the example they are preferably distributed at a respective interaxis distance  $l$  (i.e., the distance between the central axes 150 of two tubular bodies 16 close to each other) which is constant, and in particular is equal to about 1 cm. In the example, the tubular bodies 16 are distributed on the first face 13 according to an equilateral triangular lattice having side equal to the interaxis  $l$ .

**[0041]** With the aforescribed protection device 10 it was found that on occasion of some impacts (comparable to those of a fall during a dynamic sport) by impacting bodies hitting the structure with an energy, e.g., of the order of 50 Joule, the protection device 10 can be capable

of transmitting a force of the order of about 28-30 kN and therefore is adapted to be used as protector in dynamic sports. These results were obtained by tests conducted in compliance with current reference technical standards EN 1621.1, arranging the protection device 10 with the base element 12 facing the impacting body (in other words, with the base element 12 having the second face 14 facing the impacting body, the base element 12 being therefore interposed between the tubular bodies 16 and the impacting body).

**[0042]** Referring to Figure 4, a protection device 110 in accordance to a variant embodiment is illustrated.

**[0043]** In this variant embodiment, elements having the same structure and function keep the same reference number of the aforescribed embodiment 10, and are not described again.

**[0044]** In particular, in this case, the protection device 110 is made of a flexible material and comprises, in a single body, a base element 12 having a first face 13 and a second face 14 opposite to the first face 13.

**[0045]** The base element 12 has a plurality of through holes 115 (only partially visible in the drawing) and a plurality of tubular bodies 116 projecting from the first face 13 of said base element 12. Each of the tubular bodies 116 is arranged at a respective hole 115 of the base element 12 to form, with the hole, a cavity 118 extending through from a free end 119 of the respective tubular body 116 to the second face 14 of the base element 12.

**[0046]** In this example as well, the flexible material with which the protection device 110 has been made is a rubber, even more preferably it is polynorbornene, e.g. commercially available under the name Norsorex®, and having Shore hardness comprised between 30 and 40 Shore A and an elasticity comprised between 0 and 10% of elastic return.

**[0047]** Preferably, in the example illustrated in Figure 4, the tubular bodies 116 have walls 120 of polygonal section, in the example hexagonal. Even more preferably, the holes 115 have the same polygonal shape (in the example hexagonal) of the tubular bodies 116, so that the cavity 118 has an internal wall continuous and free from projections or recesses.

**[0048]** In this embodiment as well, the walls 120 have an internal surface flared or tapered toward the respective holes 115 of the base element 12, analogously to the embodiment of Figures 1 to 3, such that the cavity 118 is progressively reduced from the free end 119 to the respective hole 115 of the base element 12. In other words, the cavity 118 is shaped like a frustum of pyramid, with a taper toward the base element 12.

**[0049]** Referring to Figures 5, 5a, 6, 6a and 7, there are illustrated some applications of a protection device according to the present disclosure in an article wearable by a user or utilizer for protection from impacts in dynamic sports.

**[0050]** In the examples illustrated, it is used the protection device 10 according to the first example reported above. However, nothing prevents that other protection

devices according to the present disclosure may be used.

**[0051]** In all said applications, the protection device is arranged so that the tubular bodies 16 be facing the user and the base element 12 be facing outwards, therefore on the opposite side of the user. In other words, the tubular bodies 16 are interposed between the base body 12 and the user's body.

**[0052]** Moreover, to the ends of the application, the protection device 10 is cut following a pattern with a contour adapted to the position for which it is intended, e.g. with a near-oval shape like that illustrated in Figure 1.

**[0053]** Referring to Figure 5 and to the respective section of Figure 5a, a garment 200, more precisely a motorcyclist's suit is illustrated.

**[0054]** The garment 200 of Figure 5 includes a plurality of protection devices 10, each intended to be arranged at a respective joint of the body of the user wearing on the garment 200, like the joints of shoulders, hips, elbows and knees.

**[0055]** In the example illustrated, the protection device 10 is perimetrically fixed to the garment 200 by glue or seam and is covered, e.g., by an external barrier, like an external layer generally denoted by reference number 201, e.g. a soft comfort layer or a leather portion. Therefore, the protection device 10 is interposed between the user and the external barrier 201. Essentially, the protection device 10 is held in the garment 200 by the external barrier 201.

**[0056]** The protection device 10 might also be inserted in a pocket of the garment 200.

**[0057]** Referring to Figures 6, 6a and 7, a back protector 300 adapted to be inserted in a motorcyclist's jacket or alike garment for protecting a user's back is illustrated. It is therefore an independent protection accessory, which, like an insert, is adapted to be inserted in a dynamic sports garment, preferably in association to other energy-absorbing structures, for a more effective back protection.

**[0058]** The protection device 10 in this instance has a shape corresponding to a back to be protected and is included in a case 301.

**[0059]** More specifically, the protection device 10 is sandwiched between an external layer 302 serving as a cover barrier, and an internal layer 303, both said layers 302, 303 being adapted to give satisfactory comfort to a user. Preferably, the layers 302, 303 are made of a suitably foraminated soft fabric, preferably a so-called double-knit fabric, allowing to maintain a desired perspiration of the back protector 300.

**[0060]** A layer of fixing glue, not illustrated in the figures, is interposed between the external layer 302 and the protection device 10 (base element 12 side) and between the internal layer 303 and the protection device 10 (tubular bodies 16 side). The fixing glue is distributed at intervals (i.e., it does not form a layer having a continuous surface) in order to maintain the desired perspiration.

**[0061]** Moreover, it is highlighted that the protection device 10 has a surface extension smaller than the sur-

face extension of the external layer 302 and of the internal layer 303. In particular, the external layer 302 and the internal layer 303 have perimetral edges 304, 305 projecting with respect to the protection device 10, which perimetral edges 304, 305 are sewn to each other and joined by a tape 306. Essentially, at a perimetral zone, the back protector 300 is sealed by a tape 306 having a hemming function.

**[0062]** Preferably, as mentioned, the back protector 300 is associated to other energy-absorbing layers, not visible in the drawings, to guarantee an energy absorption adequate and compliant with the existing rules.

**[0063]** The back protector 300 including the protection device 10 according to the present disclosure, or any other article thus made, is very light-weight and adapted for insertion in an article of clothing without excessively affecting the overall weight of the article of clothing itself.

**[0064]** Alike articles can be made for protecting other body parts of a user practicing dynamic sports, like e.g. an elbow protector, a knee protector, a neck protector, or a shoulder blade protector.

**[0065]** Referring to Figures 8 and 9, further embodiments of a protection device according to the present disclosure are illustrated; in particular, it is a protection device 410 adapted to be placed at a shoulder and a protection device 510 adapted to be placed at a knee or elbow.

**[0066]** In these further embodiments, elements having the same function and structure keep the same reference number of the aforescribed embodiments 10 and 110, and are not detailed again.

**[0067]** In particular, in this case, the protection device 410, 510 is made of a flexible material and comprises, in a single body, a base element 12 having a first face 13 and a second face 14 opposite to the first face 13.

**[0068]** The base element 12 has a plurality of holes not visible in the drawings, and a plurality of tubular bodies 116 projecting from the first face 13 of said base element 12. Each of the tubular bodies 116 is arranged at a respective hole of the base element 12 to form, with the hole, a cavity 118 extending through from a free end 119 of the respective tubular body 116 to the second face 14 of the base element 12.

**[0069]** In this example as well, the flexible material with which the protection device 410, 510 has been made is a rubber, even more preferably it is polynorbornene, e.g. commercially available under the name Norsorex®, and having a Shore hardness comprised between 30 and 40 Shore A and an elasticity comprised between 0 and 10% of elastic return.

**[0070]** Preferably, in the example illustrated in Figures 8 and 9, the tubular bodies 116 have walls 120 of polygonal section, in the example hexagonal. In a variant embodiment, not illustrated, the tubular bodies have a cylindrical shape or other section.

**[0071]** In these embodiments as well, the walls 120 preferably have an internal surface flared or tapered towards the holes of the base element 12, analogously to

the embodiments of Figures 1 to 3 and of Figure 4, such that the cavity 118 is progressively reduced from the free end 119 to the respective hole of the base element 12.

**[0072]** The protection device 410 and the protection device 510 have each one or more side notches 420, 421, 520, 521, in the example two notches from opposite sides, made in the base element 12.

**[0073]** Such side notches 420, 421, 520, 521 foster the folding of the respective protection device 410, 510 and the keeping of the respective protection device 410, 510 in a folded condition, in conformity with the anatomy of the shoulder and of the knee or elbow, respectively. In particular, the pair of notches 420, 421 or 520, 521 fosters a folding of the device 410, 510 with respect to a folding line 425, 525 substantially joining the two notches of the pair; this can be fostered also by providing a reduced number of tubular bodies 116 along said folding line 425, 525. It has to be noted that in the examples the protection devices 10, 110, 410, 510 have been illustrated with a lanceolate and elongate shape, with a curved and rounded profile. It is understood that protection devices having different shapes and profiles, equally adapted to be associated to a user's or utilizer's body to guarantee an adequate protection, fall within the scope of the present disclosure. The subject of the present disclosure has been described hitherto with reference to preferred embodiments thereof. It is understood that other embodiments relating to the same inventive idea may exist, all of these falling within the scope of protection of the claims which are provided hereinbelow.

## Claims

1. A protection device (10, 110, 410, 510) for dynamic sports, said protection device (10, 110, 410, 510) comprising, in a single body of flexible material,
  - a base element (12) having a first face (13) and a second face (14) opposite to the first face (13), said base element (12) having a plurality of through holes (15, 115);
  - a plurality of tubular bodies (16, 116) projecting from the first face (13) of said base element (12), wherein each of said tubular bodies (16, 116) is arranged at a respective hole (15, 115) of the base element (12) to form with said hole (15, 115) a cavity (18, 118) extending from a free end (19) of the tubular body (16, 116) to said second face (14) of the base element (12).
2. The protection device (10, 110, 410, 510) according to claim 1, wherein the flexible material is polynorbornene.
3. The protection device (10, 110, 410, 510) according to claim 1 or 2, wherein the flexible material has a

Shore hardness comprised between 30 and 40 Shore A and an elasticity comprised between 0 and 10% of elastic return.

4. The protection device (10) according to any one of the preceding claims, wherein the tubular bodies (16) have a circular section.
5. The protection device (10) according to claim 4, wherein the tubular bodies (16) have an internal diameter (Di) progressively decreasing from the free end (19) of the tubular body (16) to the hole (15) of the base element (12).
6. The protection device (10) according to claim 4 or 5, wherein the tubular bodies (16) have a substantially constant external diameter (De).
7. The protection device (110, 410, 510) according to any one of the preceding claims 1 to 3, wherein the tubular bodies (116) have a polygonal section.
8. The protection device (10, 110, 410, 510) according to any one of the preceding claims, wherein the tubular bodies (16, 116) are evenly distributed on the first face (13), said distribution being with a constant interaxis (I).
9. The protection device (10, 110, 410, 510) according to any one of the preceding claims, wherein the base element (12) has a height (H1) comprised between 0.1 and 2.5 mm.
10. The protection device (10, 110, 410, 510) according to any one of the preceding claims, wherein the tubular bodies (16, 116) have a height (H2) comprised between 0.1 and 25 mm.
11. The protection device (10, 110, 410, 510) according to any one of the preceding claims, wherein said protection device (10, 110, 410, 510) is adapted to be placed at a joint of a user's body.
12. The protection device (10, 110, 410, 510) according to any one of the preceding claims, comprising one or more side notches (420, 421, 520, 521) made in the base element (12).
13. A wearable article (200, 300) adapted for dynamic sports practice, including a protection device (10, 110, 410, 510) according to any one of the preceding claims.
14. The wearable article (200, 300) according to claim 13, wherein said protection device (10, 110, 410, 510) is arranged so that, when the article (200, 300) is worn on by a user, said tubular bodies (16, 116) be facing the user and said base element (12) be

facing outwards, to an impact-causing event.

- 15.** The wearable article (200, 300) according to claim 13 or 14, wherein said protection device (10, 110, 410, 510) is arranged at a respective joint area, such as shoulder, elbow, hip or knee. 5
- 16.** The wearable article (200, 300) according to claim 13, 14 or 15, wherein said wearable article (200, 300) is a motorcyclist's jacket or suit. 10
- 17.** The wearable article (200, 300) according to claim 13, 14 or 15, wherein said article is a protection accessory, such as a back protector, a shoulder blade protector, an elbow protector, a knee protector or a neck protector. 15
- 18.** The wearable article (200, 300) according to any one of the preceding claims 13 to 17, including an external barrier (201, 302) adapted to cover at least partially said protection device (10, 110, 410, 510). 20

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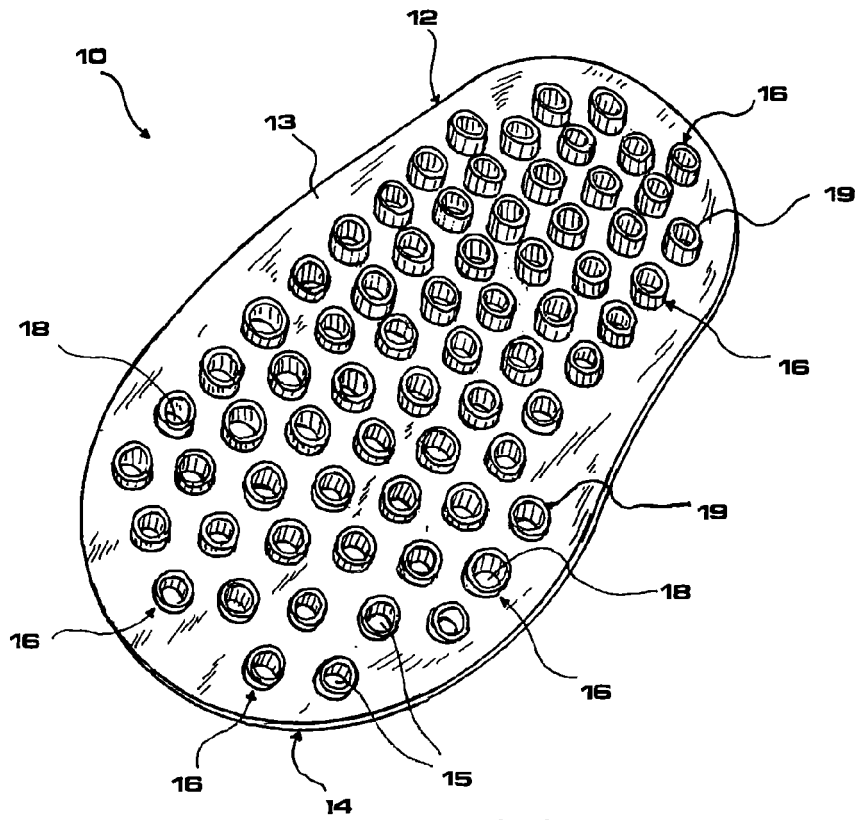


FIG. 1

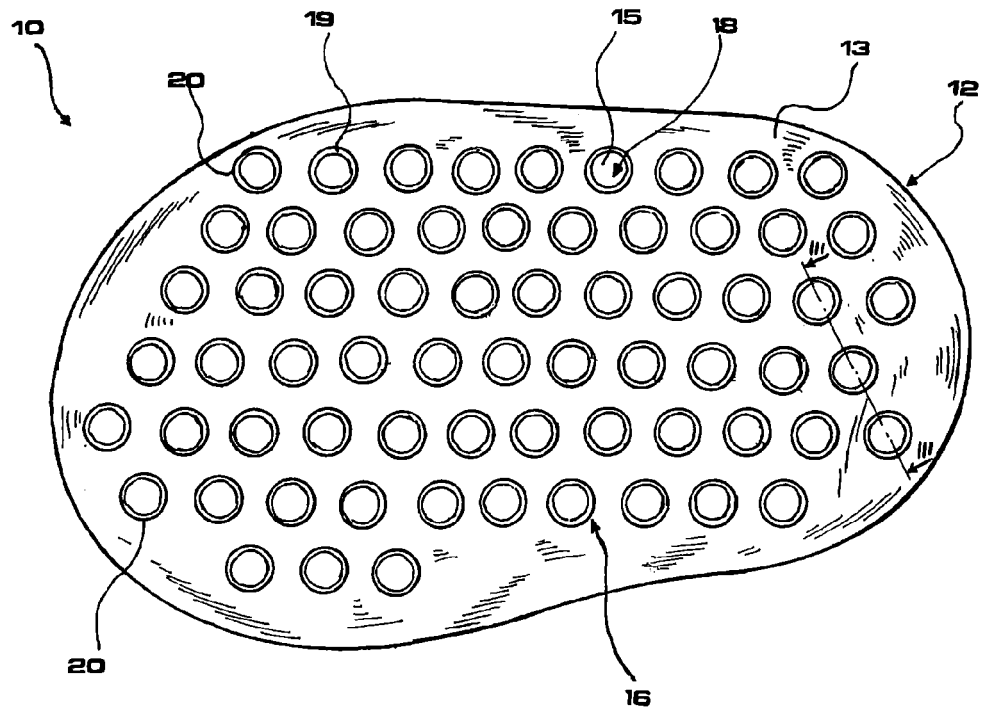


FIG. 2

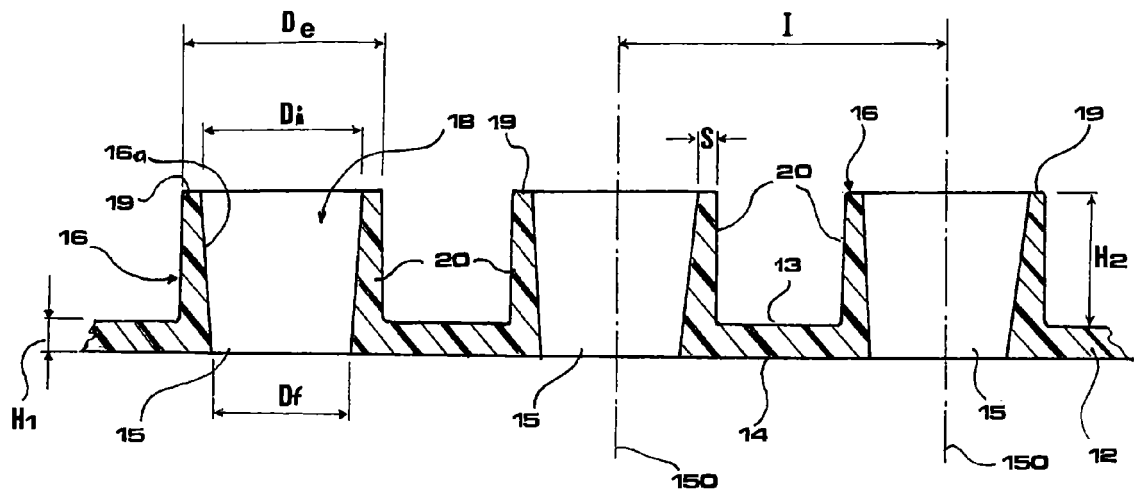


FIG. 3

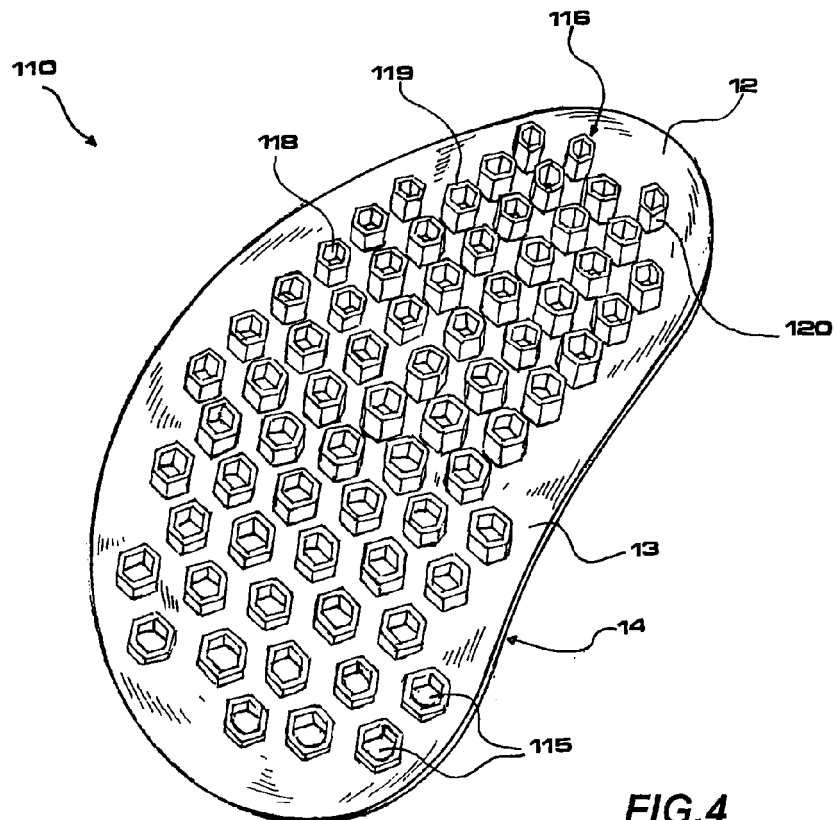
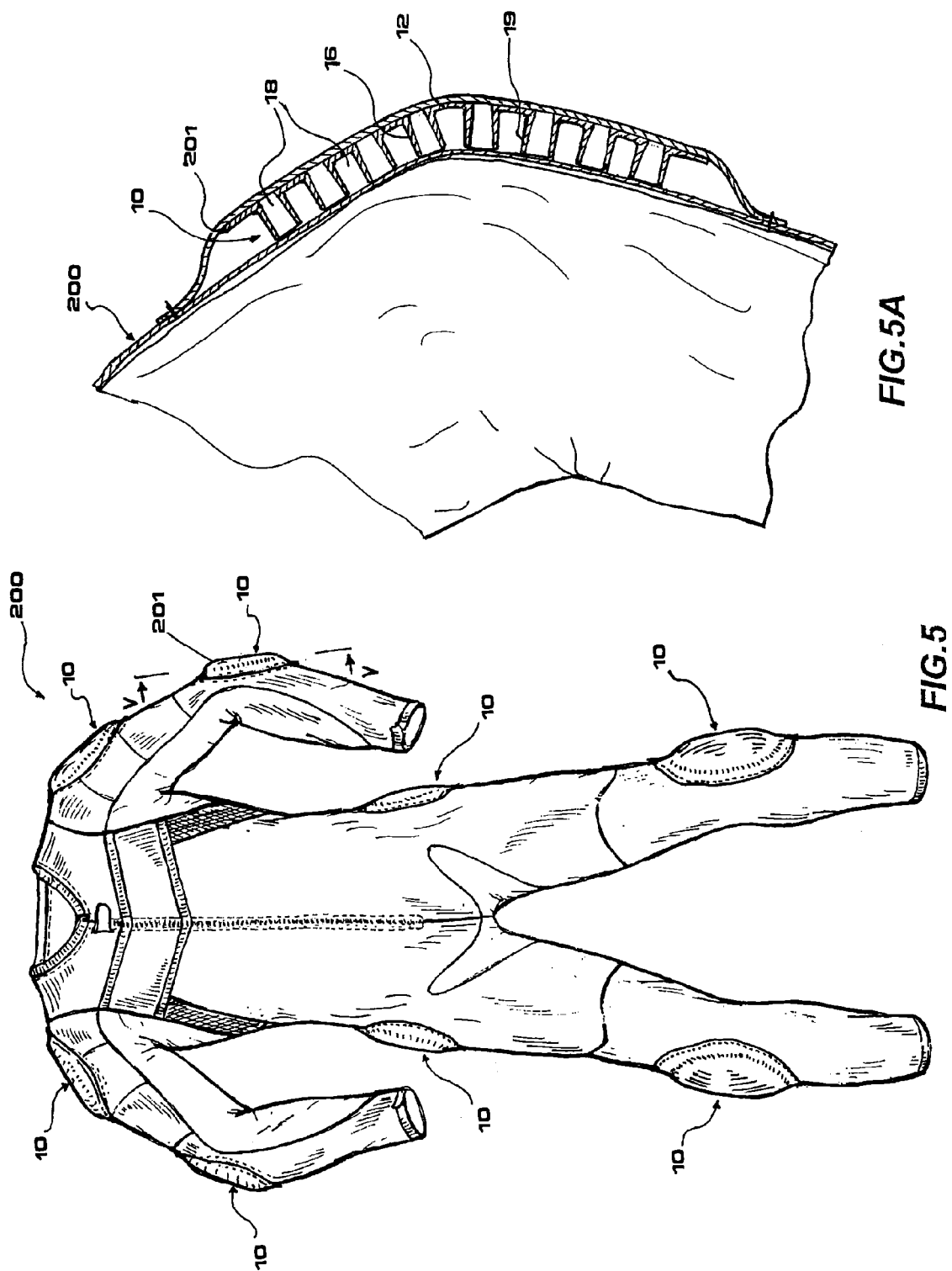


FIG. 4



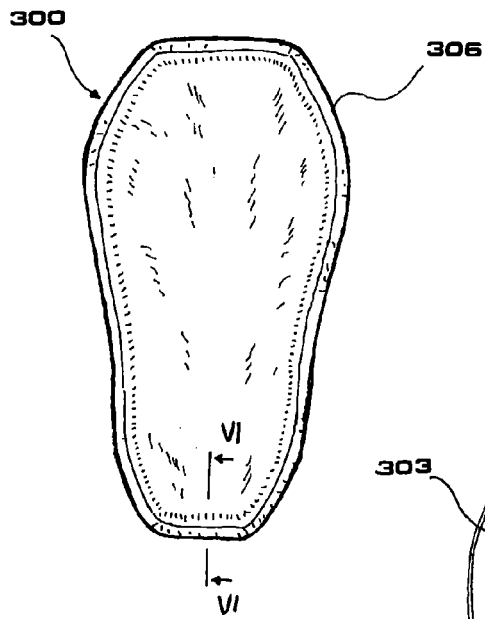


FIG. 6

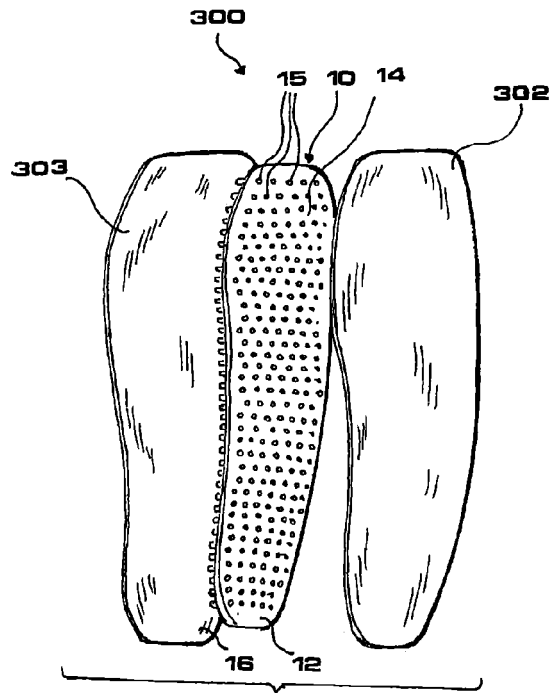


FIG. 7

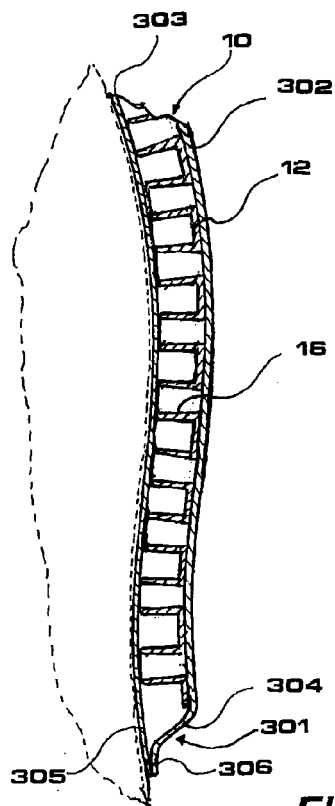


FIG. 6A

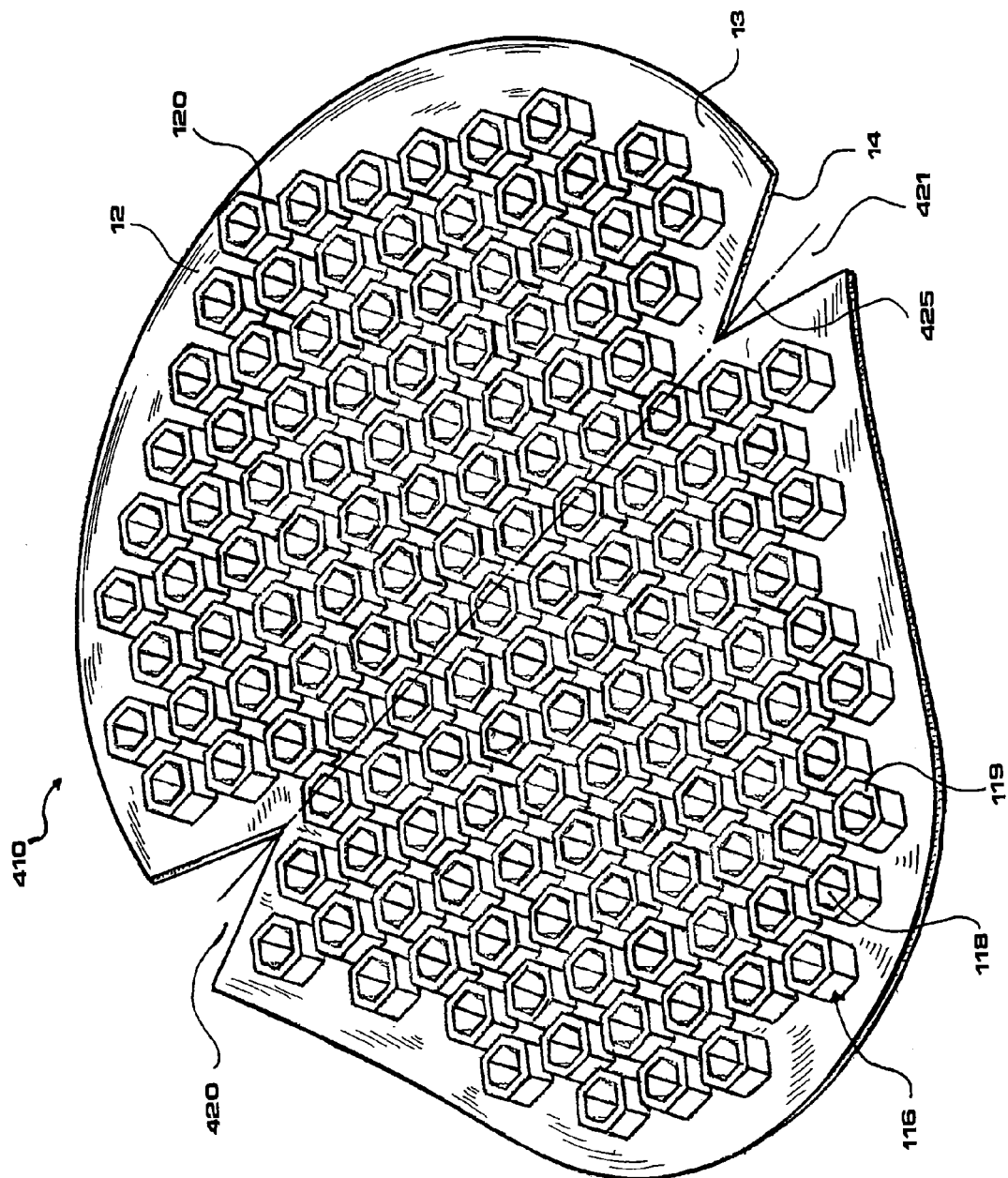


FIG. 8

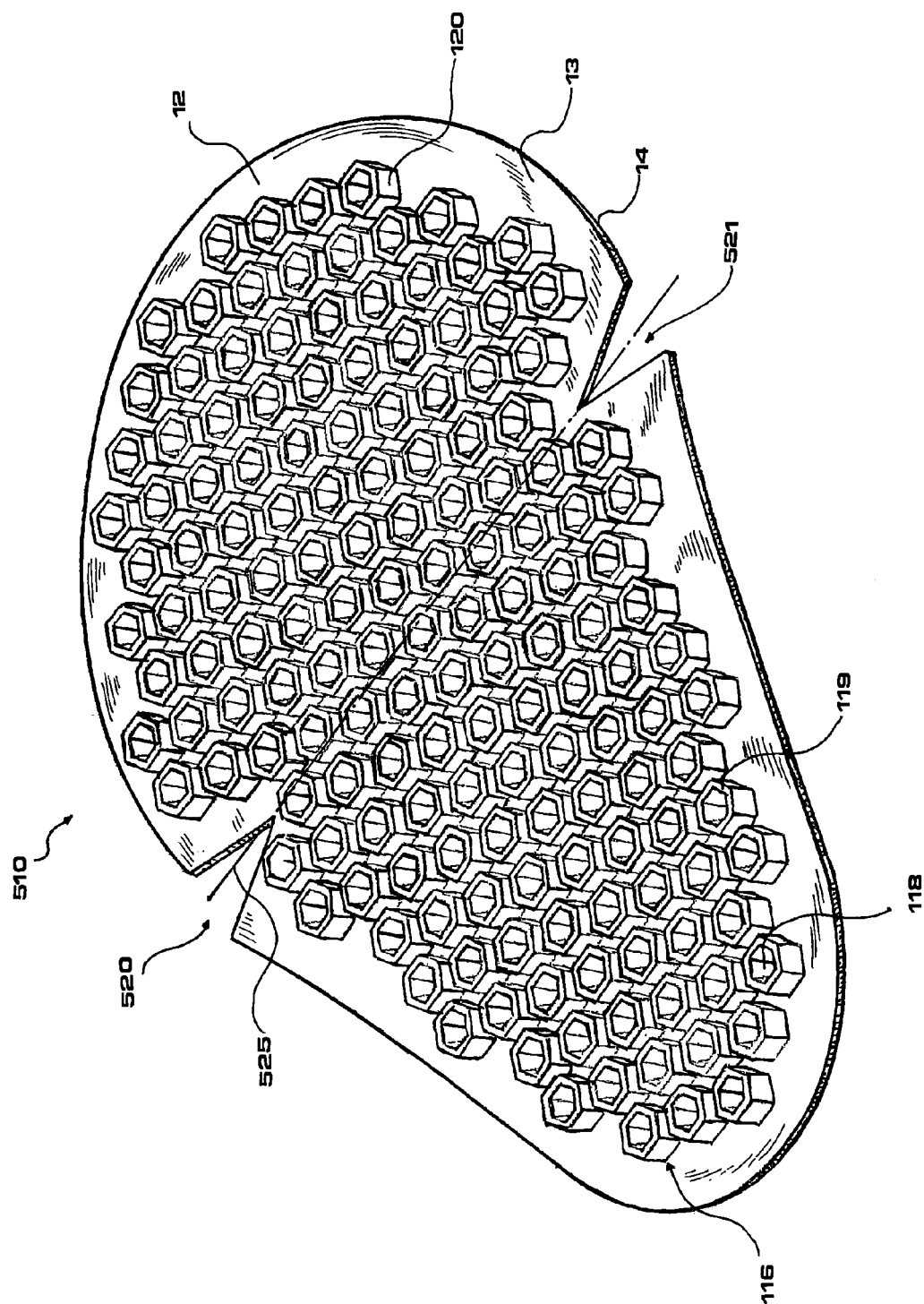


FIG. 9



## EUROPEAN SEARCH REPORT

Application Number  
EP 11 17 1492

| DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                              |                                                            |                                                 |
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| Category                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Citation of document with indication, where appropriate, of relevant passages                                                                                                                | Relevant to claim                                          | CLASSIFICATION OF THE APPLICATION (IPC)         |
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| The present search report has been drawn up for all claims                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                              |                                                            |                                                 |
| Place of search<br><b>The Hague</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                              | Date of completion of the search<br><b>3 November 2011</b> | Examiner<br><b>da Silva, José</b>               |
| <p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone<br/>Y : particularly relevant if combined with another document of the same category<br/>A : technological background<br/>O : non-written disclosure<br/>P : intermediate document</p> <p>T : theory or principle underlying the invention<br/>E : earlier patent document, but published on, or after the filing date<br/>D : document cited in the application<br/>L : document cited for other reasons<br/>.....<br/>&amp; : member of the same patent family, corresponding document</p> |                                                                                                                                                                                              |                                                            |                                                 |

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**ANNEX TO THE EUROPEAN SEARCH REPORT  
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.  
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The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

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