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(54) **PROTECTION DEVICE AND PROCESS FOR MANUFACTURING SUCH PROTECTION DEVICE**

(57) The present disclosure relates to a protection device (10) for protecting a user, which is designed to assume at least an inflated active configuration and a deflated rest configuration. The inflatable element (12) comprises a first mesh portion (18) and a second mesh portion (19), wherein said first mesh portion (18) and said second mesh portion (19) are situated opposite each other and connected together by means of a plurality of tie members (5). The inflatable element (12) comprises a first operative protective region (20) and a second operative protective region (21), wherein said second operative protective region (21) is arranged more adjacent to a free edge region (25) of the inflatable element (12) than said first operative protective region (20), and wherein said second operative protective region (21) comprises a concentration of tie members (5), or a number of tie members (5), per unit area greater than the concentration of tie members (5), or number of tie members (5), per unit area of the first operative protective region (20) of the inflatable element (12).

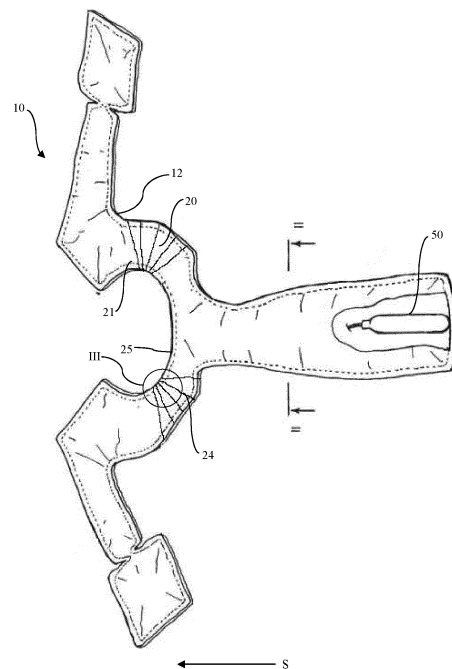


Fig. 1

Description

[0001] The present disclosure relates in general to a protection device for protecting a user. The protection device includes an inflatable element which, in the inflated condition, is designed to protect from impacts and/or falls a motorcycle rider or passenger or similar user, during a sporting and/or working activity and/or any other activity.

[0002] A known protection device is for example that described in the European patent EP3291697B1. Such a device includes an inflatable element designed to assume an inflated active condition and a deflated rest condition. The inflatable element includes a knitted body, namely a body made by means of a knitting process. Said knitted body is a closed or at least tubular structure defining an inner region or area or chamber. This inner chamber is occupied at least partially by a plurality of joining threads which connect together opposite portions of the knitted body. The fact of providing a single knitted body has the advantage of limiting the manufacturing waste and minimizing the production time; in fact, the joining threads and meshes may be worked using a single knitting machine. The joining threads form part of single thread connected to the opposite portions of the knitted body. In particular, the thread passes along alternate sections and continuously between a first portion and a second portion of the knitted body.

[0003] Preferably, the inflatable element also includes sealing walls which allow the inflation fluid to be contained for a given period of time. The walls consist, for example, of a first sheet, or first wall, and of a second sheet, or second wall, which are fixed together along respective perimetral edges. Said first and second sheets cover and line the knitted body on an outer side or outer surface.

[0004] The authors of the present disclosure have noted that in a known protection device, when the inflatable element is in an inflated condition, a knitted body with joining threads has an "elastic" behavior. In other words, the knitted body has a certain yielding capacity which makes it impossible to predict beforehand a behavior of the knitted body upon inflation. To this end it is necessary to use covering walls which are more rigid or have a pre-defined consistency in order to counteract the behavior of the knitted body upon inflation.

[0005] One technical problem underlying the present disclosure is that of providing a protection device for protecting a user, which is able to overcome the drawbacks of the prior art or reduce the yielding capacity of the knitted body and/or achieve further advantages, and provide a garment including said personal protection device.

[0006] This problem is solved by a protection device for protecting a user, by a protective garment and by a production process for manufacturing a protection device according to the respective independent claims.

[0007] Secondary characteristic features forming the subject of the present disclosure are defined in the respective dependent claims.

[0008] A protection device according to the present disclosure for protecting a user comprises an inflatable element, which is designed to assume an inflated active configuration and a deflated rest configuration. The inflatable element comprises a first mesh portion and a second mesh portion, wherein the first mesh portion and the second mesh portion are arranged opposite each other and connected together by means of a plurality of tie members. Moreover, the inflatable element comprises a first and second operative protective region, wherein the second operative protective region is arranged more adjacent to a free edge region of the inflatable element than the first operative protective region. The second operative protective region comprises a concentration of tie members, or a number of tie members, per unit area greater than the concentration of tie members, or number of tie members, per unit area of the first operative protective region.

[0009] As a result, advantageously, for the same surface area of the inflatable element, the second operative protective region comprises a number of tie members greater than that of the first operative protective region. Consequently, the yielding capacity of the mesh portions in the second operative protective region is counteracted by the greater density of tie members compared to the first operative protective region. In fact, it should be noted that a condition of at least partial tension of the tie members corresponds to the inflated active configuration of the inflatable element, and a condition of at least partial slackening of the tie members corresponds to the deflated rest configuration of the inflatable element. In this way, when the inflatable element is tensioned, the presence of a greater number of tie members may counteract the greater yielding capacity of the mesh portion, in particular along the edge.

[0010] This allows the expansion of the inflatable element along the edge of the said inflatable element to be controlled.

[0011] According to a preferred aspect of the present disclosure, the tie members are arranged between said first mesh portion and said second mesh portion, aligned in a plurality of rows of tie members. Preferably, each row of tie members of the plurality of rows of tie members comprises a plurality of tie members.

[0012] According to a preferred aspect of the present disclosure, each row of tie members extends from the second operative protective region to the first operative protective region of the inflatable element.

[0013] Preferably, according to a further preferred aspect of the present disclosure, the row of tie members are at least partially arranged with a radial pattern in the inflatable element. More preferably, the rows of said radial tie members are arranged along lines which depart from a point on the outside of the free edge and extend towards the first operative protective region of the inflatable element.

[0014] Basically, the rows of tie members converge towards the free edge.

[0015] According to a preferred aspect of the present disclosure, in the condition of at least partial tension, the tie members extend along a direction of development substantially perpendicular to the direction of extension of the rows of tie members.

[0016] In one embodiment of the present disclosure, the inflatable element is made using the technology described in the patent application WO2017163196A1. Namely it consists preferably of an inflatable element with threads, which is formed by meshes and walls as described in this patent application, and even more preferably with a curved configuration due to a varying expansion capacity of an inner side facing the user and an outer side. In particular the outer side of the inflatable elements gives way or extends more than the inner side facing the user. As a result of this feature, it is possible to obtain a general curvature of the bag in every direction, namely a non-varying curvature. In other words, the inflatable element inflates in a non-varying manner.

[0017] By organizing the threads with a varying density in an edge zone or peripheral zone of the inflatable element and a more central zone it is possible to adjust in an optimum manner the curvature of the bag and vary the curvature of the bag compared to the curvature determined by the different yielding capacity. In other words, by varying the density of the threads, such that it is greater in the edge zone than in the central zone, it is possible to offset the varied yielding response of the outer side of the inflatable element. This advantage is particularly useful when the edge extends in a sagittal direction S of the human body from the front to the rear and vice versa.

[0018] For example, in a neck region or around the shoulders, the bag has an anatomical curvature, namely has an anatomical curved profile so as to surround the neck and the respective shoulders. Since the edge has a greater concentration of tie threads, it is possible to control the curvature along this edge. This advantage is increased even further by the radial arrangement of the threads. In fact, by arranging the radial pattern so that an ideal starting point of the radial pattern is situated at the centre of the curve of the edge, for example the curve which surrounds the neck, it is possible to obtain a controlled curvature of the bag in the direction of curvature of the neck. In fact, the radial pattern extends from the centre of the neck with rows of tie members which extend radially towards the respective shoulder. Similarly, it is possible to obtain this effect in the curved zone of the shoulders, by arranging a radial pattern of threads which ideally departs from an outer point of the bag on the outside of the shoulder, with rows of threads which extend radially towards the neck.

[0019] The radial patterns are symmetrical with respect a sagittal mid-plane of the user's body.

[0020] As a result, therefore, the tie members are arranged so as to follow the form of the user's neck and, at the same time, reduce the effect of the yielding response of the mesh portions in this region of the inflatable

element.

[0021] According to another preferred aspect of the present disclosure, in the condition of at least partial tension, the tie members belonging to a same row of tie members are arranged substantially parallel to each other.

[0022] Further advantages, characteristic features and modes of use forming the subject of the present disclosure will become clear from the following detailed description of a number of preferred examples of embodiment thereof, provided by way of a nonlimiting example. It is nevertheless evident that each embodiment may have one or more of the advantages listed above; in any case it is nevertheless not necessary that each embodiment should have simultaneously all the advantages listed.

[0023] Reference will now be made to the figures in the attached drawings in which:

Figure 1 shows a plan view of a protection device according to an embodiment of the present disclosure;

Figure 2 shows a cross-sectional view along the line II-II of the protection device according to Figure 1, with the inflatable element inflated;

Figure 3 shows a view of a detail III of Figure 1 in a cross-sectioned form;

Figure 4 shows a view of a garment including a personal protection device.

[0024] With reference to the accompanying figures, the reference number 10 indicates a personal protection device according to the present disclosure in accordance with an embodiment of the present disclosure.

[0025] The personal protection device 10 comprises an inflatable element 12 which is designed to assume substantially a first rest condition or deflated condition, and a second active condition or inflated condition. The modes of inflating the inflatable element 12 will be described in the description below.

[0026] In one embodiment of the present disclosure the inflatable element 12 has a vest-like form and is designed to surround a top zone or chest zone of the user's body.

[0027] The inflatable element 12 may be made using the technology described in the patent application PCT/IB2009/055512 and in the patent application PCT/IT2009/000547, which are incorporated here by reference in their entirety in the present disclosure, or more preferably using the technology described in the patent application WO2016178143A1 or even more preferably in the patent application WO2017163196A1. Namely it consists preferably of an inflatable element with threads, which is formed by meshes and walls as described in these patent applications, and even more preferably with a curved configuration due to a varying expansion capacity of an inner side facing the user and an outer side.

[0028] The inflatable element 12 comprises a first

mesh portion 18 and a second mesh portion 19. The first mesh portion 18 and the second mesh portion 19 are arranged opposite each other and are connected together by a plurality of tie members 5. The inflatable element 12 also comprises a first operative protective region 20 and a second operative protective region. According to one aspect of the present disclosure the second operative protective region 21 is arranged more adjacent to a free edge region of the inflatable element 12 than said first operative protective region 20. For example, the second operative region is an edge region which surrounds the neck. Another second operative region is a shoulder region which surrounds each shoulder.

[0029] The second operative protective region 21 comprises a concentration of tie members, or a number of tie members 5, per unit area greater than the concentration of tie members 5, or number of tie members 5, per unit area of the first operative protective region 20 of the inflatable element 2. In this way in the edge region the tie members are able to contrast the expansion of the inflatable element 2 to a greater degree. Preferably, the tie members 5 are arranged between said first mesh portion 18 and said second mesh portion 19 which are aligned in a plurality of rows 24 of tie members 5. The arrangement in rows 24 allows better management of the layout of the rows and greater control of the expansion and curvature of the inflatable element.

[0030] Even more preferably, each row 24 of tie members 5 extends from said second operative protective region 21 to said first operative protective region 20 of the inflatable element 2. For example, the rows 24 of tie members 5 are at least partially arranged with a radial pattern in said inflatable element 2. In the figures, in particular Figure 1, it can be seen that a plurality of tie members 5 extends radially from the centre of the neck towards the shoulders, namely in a specular manner with respect to a sagittal mid-plane from the neck towards a shoulder, and from the neck towards the other shoulder. In other words, the rows of said radial tie members are arranged along lines which start from a point on the outside of the free edge, at the centre of the neck, and extend towards the first operative protective region 20 of the inflatable element 12.

[0031] Even more particularly, a plurality of tie threads 5 extends radially from an edge zone of the shoulder towards the neck and a plurality of tie threads extends radially from an edge zone of the other shoulder towards the neck. In Figure 1 the rows 24 of tie members 5 are represented schematically by means of lines for the purposes of comprehension of the invention.

[0032] In order to control even better the expansion of the inflatable element, in the active condition, when the inflatable element 2 is in the inflated condition, the tie members 5 are parallel to each other in the respective row 24 and substantially orthogonal to the direction of the row. The rows are preferably shorter in the edge zone, namely they gradually decrease in length towards the edge zone.

[0033] The present disclosure also relates to a protective garment 30 comprising a protection device 10 as defined above.

[0034] The present disclosure also relates to a process for manufacturing a protective device 10 for protecting a user.

[0035] The process comprises the steps of:

- providing an inflatable element 12 designed to assume an inflated active configuration and a deflated rest configuration, wherein said inflatable element 12 comprises a first mesh portion 18 and a second mesh portion 19 opposite to the first mesh portion 18, the inflatable element 12 further comprising a first operative protective region 20 and a second operative protective region 21, wherein said second operative protective region is arranged more adjacent to a free edge region of the inflatable element 2;
- connecting said first mesh portion 18 to said second mesh portion 19 with a plurality of tie members 5 so that the concentration of tie members 5, or number of tie members 5, per unit area of the second operative protective region 21 is greater than the concentration of tie members 5, or number of tie members 5, per unit area of the first operative protective region 20 of the inflatable element 12.

[0036] Preferably, the step of connecting the first mesh portion 18 to the second mesh portion 19 by means of the plurality of tie members 5 is performed by arranging the tie members 5 aligned in a plurality of rows 24 of tie members, wherein each row 24 of tie members 5 comprises a plurality of tie members 5 and extends from the second operative protective region 21 to the first operative protective region 20 of the inflatable element.

[0037] Even more preferably, the rows 24 of tie members 5 are arranged with a radial pattern in the inflatable element 2. For example the rows 24 of tie members extend radially from the neck towards the respective shoulders and/or from the shoulders towards the neck.

[0038] With regard to inflation, in order to perform inflation of the inflatable element 12, in the event of a sudden fall and/or sliding and/or an impact involving a user or a vehicle being ridden/driven, the protection device 10 is designed to cooperate with special activation means (not shown) which are operationally connected for example to a cylinder 50 containing compressed cold gas, such as helium. The cylinder may be provided with a respective shut-off valve (not shown).

[0039] Alternatively, the inflation fluid source may comprise gas generators of the pyrotechnic or other hybrid type or other types known according to the state of the art.

[0040] Opening of the shut-off valve of each inflation cylinder is preferably controlled by a control unit depending on the detection of the state of the vehicle/rider system; for example said control unit may implement a system for predicting the fall which allows early identification of the fall event and a reliable prediction of this event by

means of accelerometer sensors attached to the vehicle (or rider) and a unit for processing the signals produced by the said sensors.

[0041] Alternatively, the device according to the present disclosure may also be applied using an activation cable connected to a vehicle ridden/driven by a user, which cable activates inflation of the inflatable element following the movement of the user away from the vehicle, for example following a fall or a sudden impact. Use of the cable is employed in particular in the horse-riding sector.

[0042] In any case the aforementioned activation and inflation means may be incorporated in the protection device according to the present invention or located on the outside thereof.

[0043] It should also be noted that the activation modes, although being an aspect of particular importance for effective operation of the device, will not be further described in greater detail since they are methods which are essentially already known to a person skilled in the art of protection of an individual from sudden impacts.

[0044] The subject-matter of the present disclosure has been described hitherto with reference to embodiments thereof. It is to be 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 illustrated hereinbelow.

Claims

1. Protection device (10) for protecting a user, said protection device (10) comprising an inflatable element (12) configured to assume at least an inflated active configuration and a deflated rest configuration, said inflatable element (12) comprising a first mesh portion (18) and a second mesh portion (19), wherein said first mesh portion (18) and said second mesh portion (19) are arranged opposite each other and are connected together by a plurality of tie members (5); the inflatable element (12) comprising a first operative protective region (20) and a second operative protective region (21), wherein said second operative protective region (21) is arranged more adjacent to a free edge region (25) of the inflatable element (12) than said first operative protective region (20), and wherein said second operative protective region (21) comprises a concentration of tie members (5), or a number of tie members (5), per unit area greater than the concentration of tie members (5), or number of tie members (5), per unit area of the first operating protective region (20) of the inflatable element (12).
2. Protection device (10) according to claim 1, wherein the tie members (5) are arranged between said first mesh portion (18) and said second mesh portion (19) aligned in a plurality of rows (24) of tie members (5).

3. Protection device (10) according to claim 2, wherein each row (24) of tie members (5) of the plurality of rows of tie members (5) comprises a plurality of tie members (5).
4. Protection device (10) according to claim 2 or 3, wherein each row (24) of tie members (5) extends from said second operative protective region (21) to said first operative protective region (20) of the inflatable element (12).
5. Protection device (10) according to claim 4, wherein the rows (24) of tie members (5) are arranged at least partially with a radial pattern in said inflatable element (12) starting from said second operative protective region (21), or wherein the rows (24) converge towards the second operative protective region.
6. Protection device (10) according to claim 4 or 5, wherein in said condition of at least partial tension, the tie members (5) belonging to a same row (24) of tie members (5) are arranged substantially parallel to each other.
7. Protection device (10) according to any one of claims 4 to 6, wherein in said condition of at least partial tension, the tie members (5) extend along a direction of development substantially perpendicular to a direction of extension of the rows (24) of tie members (5).
8. Protection device (10) according to any one of claims 4 to 7, wherein the tie members (5) extend in rows starting from a neck region towards a respective shoulder region of the inflatable element (12).
9. Protection device (10) according to any one of claims 4 to 8, wherein the tie members (5) extend in rows starting from a shoulder region towards a respective neck region of the inflatable element (12).
10. Protection device (10) according to any one of the preceding claims, wherein the second operative protective region is an edge region which follows a curved profile, for example around the neck and/or around the shoulder of a user.
11. Protection device (10) according to any one of the preceding claims, wherein the inflatable element (12) has a greater yielding capacity on an outer side facing away from the user compared to the lower yielding capacity of an inner side facing the user.
12. Protection device (10) according to any one of the preceding claims in combination with claim 5, wherein said rows of said tie members (5) arranged with a radial pattern are arranged along lines which depart

from a point on the outside of the free edge and extend towards the first operative protective region (20) of the inflatable element (12).

13. Protection device (10) according to claim 12, wherein said outer point corresponds to a central zone of the user's neck. 5

14. Protective garment (30) comprising a protection device (10) according to any one of the preceding claims. 10

15. Process for manufacturing a protection device (10) for the protection of a user, said process comprising the steps of: 15
 - providing an inflatable element (12) configured to assume an inflated active configuration and a deflated rest configuration, wherein said inflatable element (12) comprises a first mesh portion (18) and a second mesh portion (19), opposite to the first mesh portion (18), the inflatable element (12) further comprising a first operative protective region (20) and a second operative protective region (21) wherein said second operative protective region (21) is arranged more adjacent to a free edge region of the inflatable element (12); 20
 - connecting said first mesh portion (18) to said second mesh portion (19) with a plurality of tie members (5) so that the concentration of tie members (5), or number of tie members (5), per area unit of the second operative protective region (21) is greater than the concentration of tie members (5), or number of tie members (5), per area unit of the first operative protective region (20) of the inflatable element (12). 25

16. Process according to the preceding claim, wherein the step of connecting the first mesh portion (18) to the second mesh portion (19) by means of the plurality of tie members (5) is carried out by arranging the tie members (5) aligned in a plurality of rows (24) of tie members, wherein each row (24) of tie members (5) comprises a plurality of tie members (5) and extends from the second operative protective region (21) to the first operative protective region (20) of the inflatable element. 30

17. Process according to the preceding claim, wherein the rows (24) of tie members (5) are arranged with a radial pattern in the inflatable element (12) starting from said second operative protection region (21). 35

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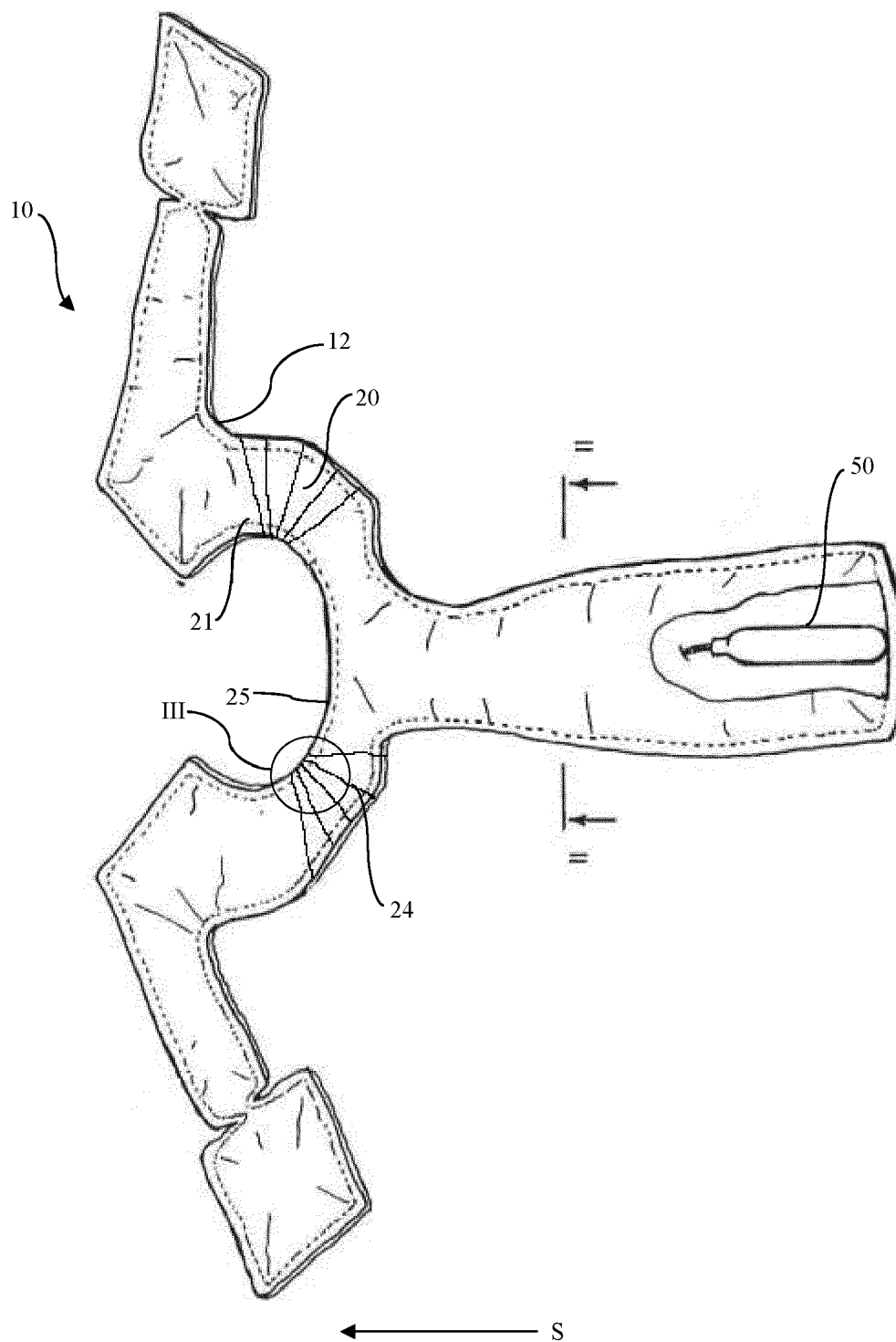


Fig. 1

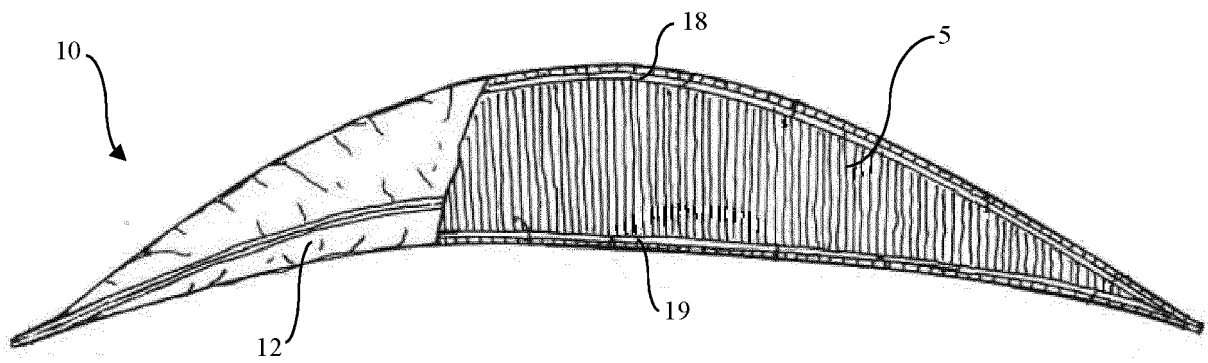


Fig. 2

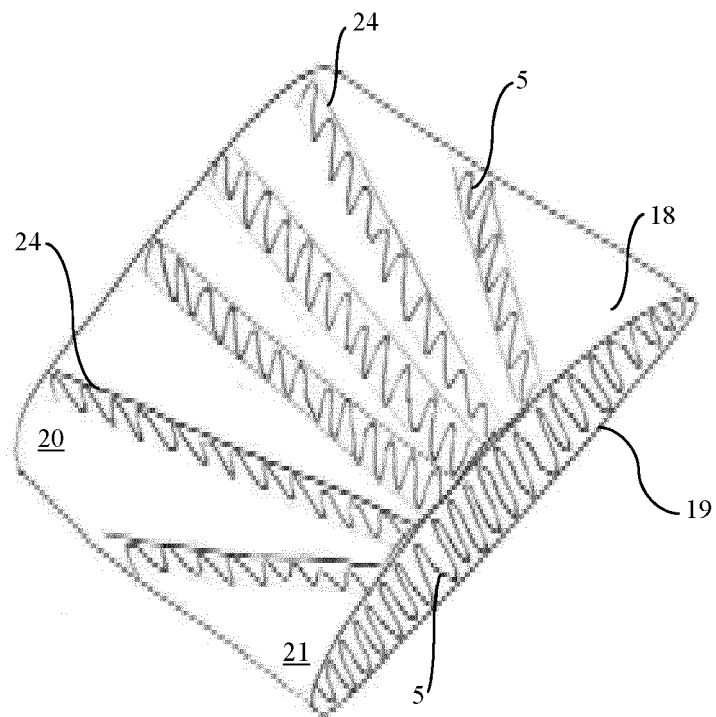


Fig. 3

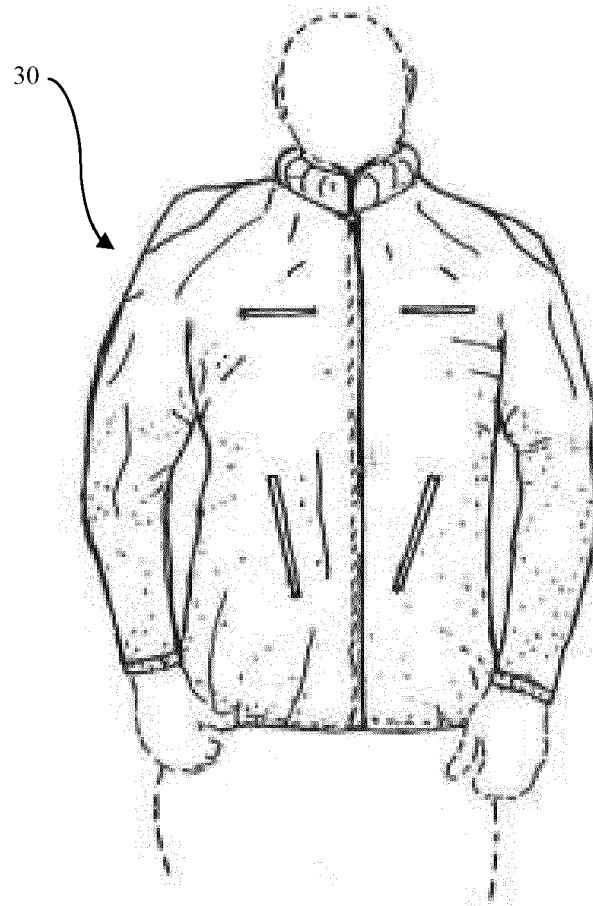


Fig. 4



EUROPEAN SEARCH REPORT

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 3 167 730 A1 (DAINESE SPA [IT]) 17 May 2017 (2017-05-17) * paragraph [0054]; figure 2 * -----	1-17	INV. A41D13/018
			TECHNICAL FIELDS SEARCHED (IPC)
			A41D
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 20 November 2020	Examiner van Voorst, Frank
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