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(54) Title: 3D NON-WOVEN BRA AND MANUFACTURING METHOD

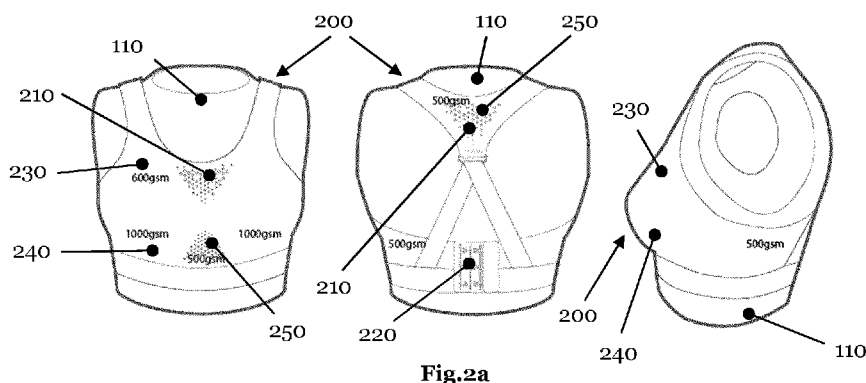


Fig. 2a

(57) Abstract: The present invention provides a bra (200), in particular a sports bra (200), comprising a fabric of a non-woven material (100), wherein the fabric (100) is obtained by depositing fibers (510) onto a three-dimensional substrate having a contour similar to a portion of a body, so that a shape of the fabric of the bra (200) is at least partly determined by the deposition of the fibers (510).



Description

3D Non-Woven Bra and manufacturing method

1. Technical Field

5 The present invention relates to a bra, in particular to a sports-bra, as well as to a method for manufacturing such a bra.

2. Technical background

10 Bra construction is typically based on the insertion of molded foam cups between several layers of a fabric. Further components of the bra are then either sewn or bonded to the fabric.

For instance, prior art document US 2011/0068507 A1 discloses molding cups via a thermo-forming process. The process starts from a flat sheet of non-woven material and provides a 3D shape of the cup as part of an additional post-production process. To finalize the bra, said cups may be further processed like a traditional cut-and-sew garment. Further, KR 101 183 200 discloses a bra, wherein the supporting part consists of non-woven material pressed into a U-shape. Furthermore, EP 3 419 450 discloses an engineered bra having preconfigured lockout and stretch zones, wherein the stretch properties may be adjusted by one or more knitting or weaving techniques and/or materials throughout the bra. The knit or woven bra may comprise zones with different elasticities through specific knit and stitch orientations or woven techniques.

25 However, the conventional manufacturing techniques of bras and the bras known from the prior art have various disadvantages. For instance, starting with a flat sheet and only achieving a 3D shape as part of a post-production process is cumbersome as it requires additional manufacturing steps. Finalizing such bras may take multiple different process steps of manual assembly and is therefore inefficient and costly. Furthermore, such assembled bras with molded cups or knitted/woven features may need multiple seams or bonds to combine different parts of the bra, which causes
30 wearer discomfort.

It is therefore the problem underlying the present invention to improve bras and their manufacture so that the above outlined disadvantages of the prior art are at least partly overcome.

5 **3. Summary of the Invention**

The above-mentioned problem is at least partly solved by the subject matter of the independent claims of the present application. Exemplary embodiments of the invention are defined in the depended claims.

10 In an embodiment, the present invention provides a bra, in particular a sports bra, comprising a fabric of a non-woven material, wherein the fabric is obtained by depositing fibers onto a three-dimensional substrate having a contour similar to a portion of a body, so that a shape of the fabric of the bra is at least partly determined by the deposition of the fibers.

15 The claimed invention therefore provides a bra, wherein the three-dimensional shape of the bra may at least partly be formed already during the deposition process of the fibers onto a contoured substrate. Therefore, the necessity of having one or more additional shaping and forming steps in a post-production phase may be reduced or
20 even fully omitted.

In some embodiments of the present invention, the substrate is at least a front part of a woman's torso. Moreover, the substrate may be a complete woman's torso and the fibers of the fabric of the bra may have been deposited onto all sides of the torso.

25 Thus, the shape of the bra may be exclusively determined by the deposition of the fibers without any additional shaping step.

In this manner, the true three-dimensional shape of the bra may be solely achieved during the deposition process including the bust, the left and right sides and the back
30 part of the bra. Therefore, any kind of post-production shaping processes, which are time-consuming and costly, may be unnecessary or at least be reduced to a minimum.

Further, in some embodiments, the non-woven material comprises a first zone of a first areal density of non-woven material and a second zone of a second areal density

of non-woven material. Moreover, the second zone may have a different, in particular higher, modulus of elasticity than the first zone.

Controlling the areal density of deposited non-woven material and the modulus of elasticity enables to precisely tune the different zones to a desired amount of stiffness or flexibility simply by adjusting the deposition process.

In some embodiments of the present invention, the bra comprises at least two second zones adapted to be arranged below the breasts, when the bra is worn. Moreover, the bra may comprise at least two first zones adapted to be arranged above the breasts, when the bra is worn. The areal density of the first zone may be between 300 and 1000 grams per square meter (gsm) and / or the density of the second zone may be between 600 and 2000 gsm.

In another embodiment, the present invention comprises a third zone having a third areal density, wherein the third zone may have an areal density that is lower than the areal densities of the first and the second zone. Moreover, the third zone may comprise perforations and may furthermore be adapted to be arranged between the breasts and / or on the back, when the bra is worn.

The introduction of several zones of different areal densities, wherein the number of zones is not limited to the numbers in the above-mentioned embodiments, provides a way of precisely designed support as a more or less direct result of the deposition process.

In some embodiments of the present invention, the fabric does not comprise any seam in an area around the breast. Moreover, in another embodiment, the bra does not comprise any seam.

Thus, by having a bra, in particular a sports-bra, with no seams at all, an embodiment of the present invention offers a unique possibility of wearer comfort especially when exercising. Furthermore, the elimination of sewing threads and / or bonding with glue or the like also leads to a more cost- and time-efficient manufacturing process.

The non-woven material of the bra may consist of melt-blown fibers of a single material class of thermoplastic materials, in particular a thermoplastic polyurethane (TPU). Moreover, the bra may comprise closure means made from the same single material class of thermoplastic materials, in particular TPU. Furthermore, the bra may exclusively consist of the single material class, in particular TPU.

Thus, in an embodiment of the present invention the major parts or even the full bra is created from a single thermoplastic material class such as TPU, including closures, hooks, buckles and elastic bands. This is a key advantage to facilitate a simplified recycling of the complete product.

In another embodiment, the present invention provides a method of manufacturing a bra, comprising the steps of providing a three-dimensional substrate having a contour similar to a portion of a body and depositing fibers onto the three-dimensional substrate to provide a fabric of the bra of non-woven material, wherein a shape of the fabric may at least be partly determined by the deposition.

For instance, the method may involve the portion of a body to be at least a front portion of a woman's torso. Furthermore, the woman's torso may have a shape based on data obtained from three-dimensional scanning a plurality of women.

In this manner, by using the three-dimensional scanning of a plurality of women as a template for manufacturing a bra, the present invention may be able to define a new sizing system which may help women to find the most appropriate bra.

In another embodiment the present invention provides a method, wherein an areal density of the deposited fibers varies over the three-dimensional substrate. For instance, the variation of the areal density may be achieved by varying an exposure time and / or a distance of the three-dimensional substrate to a source of fibers for a first and a second portion of the three-dimensional substrate.

Furthermore, in some embodiments the present invention provides a method, to control the exposure time and / or the distance by moving the three-dimensional substrate relative to the stream of melt blown fibers. For instance, the three-dimensional

substrate may be attached to a robotic arm, which may move the three-dimensional substrate along a programmed path.

It is a key factor for some of the above-mentioned embodiments to control the areal density which is required for individual areas of the bra to provide different levels of support. The robotically controlled process may allow flexibility in determining placement and areal density of fibers according to performance and design needs.

A further embodiment of the present invention provides an individual three-dimensional substrate based on scanning an individual body. For instance, the individual substrate may be provided using at least partly additive manufacturing.

This method may allow to produce a highly customized bra, in particular a sports-bra, in an extremely precise and fast manner, leading to a product true to shape of an individual woman's body.

In another embodiment, the present invention provides a method of trimming the fabric of non-woven material to a desired pattern, in particular using a laser beam.

For instance, the pattern and / or the deposition process may be defined to provide a predefined amount of stretch for the bra.

The described method may allow to trim the deposited non-woven fabric to a desired pattern by directly cutting selected areas using for example one or more robotically controlled laser beams, or a manual trimming process. This aspect of the invention further contributes to a highly efficient manufacture, which may again also operate in a customized manner according to data of an individual wearer.

A further embodiment of the present invention provides a method to form a loop in the fabric of non-woven material of the bra, in particular via ultrasonic welding. Such a manufacturing step obviates or reduces the need for inserting additional closure means.

Moreover, a plurality of perforations may be provided in the fabric of non-woven material of the bra, in particular via laser cutting. Thus, areas of higher air permeability can be provided by creating holes with a high amount of design freedom regarding their size, shape and distribution within the bra.

Another embodiment of the present invention provides a method of depositing the fibers onto the three-dimensional substrate, wherein the fibers comprise at least two different colors.

This aspect of the claimed method may allow to manufacture a bra with feathered color transition, wherein the method is not limited to the number of mentioned colors above but may in fact contain a wide variety of fibers with different colors

In another embodiment, the present invention provides a method to manufacture a bra according to any of the above-mentioned embodiments.

4. Short description of the figures

Aspects of the present invention are described in more detail in the following by reference to the accompanying figures. These figures show:

Fig. 1 an illustration of a three-dimensional fabric of non-woven material deposited onto a woman's torso; and

Fig. 2a an embodiment schematically illustrating a sports-bra on a woman's torso from three different viewing directions; and

Fig. 2b a schematic drawing illustrating the positions of multiple zones of different areal densities on a woman's torso; and

Fig. 3 a further embodiment illustrating different zones of a sports-bra including perforations and bonds; and

Fig. 4 a diagram illustrating the relationship between the modulus of elasticity of the non-woven fabric and the deposited amount of fibers in grams per square meter; and

Fig. 5 an illustration of a fiber depositing process to manufacture an embodiment of a bra, wherein the deposition process is controlled via a robotic arm.

5. Detailed description of some exemplary embodiments

In the following, exemplary embodiments of the present invention are described in more detail, with reference to a bra, particularly a sports-bra. While specific feature combinations are described in the following with respect to the exemplary embodiments of the present invention, it is to be understood that the disclosure is not limited to such embodiments. In particular, not all features have to be present for realizing the invention, and the embodiments may be modified by combining certain features of one embodiment with one or more features of another embodiment. Moreover, while embodiments of the present invention are illustrated in the following with respect to a sports-bra and methods adapted to provide a sports-bra, it should be appreciated that the same methods can also be used to provide different pieces of apparel for different portions of a body.

Figure 1 depicts a non-woven fabric 100 manufactured by depositing fibers 510 (cf. Fig. 5) onto a three-dimensional substrate having the shape of a woman's torso 110, wherein the fibers 510 of the fabric 100 have been deposited onto all sides of the torso. Thus, the shape of the fabric 100 is essentially determined by the deposition of the fibers 510 without any additional shaping step and also may provide a bra without any or at least a reduced number of seams. This method of producing an embodiment almost fully shaped during one manufacturing step may provide a bra with a reduced number of components, but with no compromise in performance.

Figure 2a depicts an illustration of a sports-bra 200, which was manufactured by depositing fibers 510 onto a three-dimensional substrate having the shape of a woman's torso 110. Here an additional trimming step by means of a laser or a manually process (not shown) of cutting the non-woven fabric 100 to a desired pattern has already taken place. The sports-bra 200 may comprise perforations 210 to achieve areas of higher air permeability. Again, this can be achieved by laser cutting with a high degree of design freedom regarding the size, shape and distribution of the perforations 210.

Further, the sports-bra 200 of Fig. 2a contains closure means 220, which may be magnetic or operate with any other suitable mechanism. In an embodiment such closure means are made from the same material class as the fibers of the sports-bra 200, preferably TPU. This material class has been found to allow the deposition of fibers leading to a flexible non-woven fabric 100 but also to manufacture stable closure means 220, for example by injection molding suitable hooks etc.

Furthermore, as shown in Fig. 2a, the sports-bra 200 may contain several zones of different areal densities 230, 240 and 250 to provide the needed amount of stretch or stiffness at the respective areas of the sports-bra 200. Therefore, zones with a medium areal density 230 may be arranged above the breasts, when the bra is worn, which may provide a sophisticated combination of stretch and support. Further zones, which may have a higher areal density 240, may be arranged below the breasts, to give the needed amount of support and compression, especially required when exercising. Fig. 2a also shows a third zone 250 arranged between the breasts and on the back of the bra, which may have the lowest areal densities combined with perforations, to provide the wearer with a pleasant degree of air permeability. Exemplary values of areal densities of an embodiment are given in Fig. 2a.

Figure 2b depicts a woman's torso 110 from two different points of view, on which exemplary multiple zones of different areal densities 230, 240, 260, 270 and 280 are denoted. Similar to the description of Fig. 2a, zones of medium (e.g. 300 – 1000 gsm) 230 and high (e.g. 600 – 2000 gsm) 240 areal densities above and below the breasts, when the bra is worn, allow for a needed amount of stretch and / or support in the respective zones. Furthermore, Fig. 2b shows a fourth zone 260 with a medium-high (e.g. 300 – 1000 gsm) areal density located at the shoulders, when the bra is worn, to provide sufficient fabric of non-woven material 100 to ensure long durability of a sports-bra 200 especially at those zones of high stress. Similar areal densities as in the fourth zone 260 may be used in areas (not shown) where other components might be attached (e.g. by sticking/bonding or ultrasonic welding) to make sure the additional components do not break the fabric of non-woven material 100 or rip it off. A further fifth zone 270 with a low areal density (e.g. 200 – 800 gsm) may be used as kind of a basic areal density to connect all existing zones of the embodiment. Furthermore, on the outside of the breasts, below the arm-pit, a sixth zone 280 is depicted in Fig. 2b,

which may provide a gradual transition of areal density (e.g. from 1000 to 500 gsm) between the second zone 240 and the basic areal density of the fifth zone 270.

Figure 3 depicts an illustration of another sports-bra 200. Again, the non-woven fabric 100 was trimmed by laser cutting and / or manually operation (not shown) to a desired pattern. The sports-bra 200 may comprise various zones with perforations 210 to achieve areas of higher air permeability by laser cutting. Further, the sports-bra 200 contains closure means 220, which may also be made of the material class of TPU, or, in another embodiment, may be magnetic or involve any other closure mechanism. Furthermore, the sports-bra 200 may contain a traditional elastic under band 300 made of TPU integrated into the garment, either with traditional manufacturing steps such as glueing or sewing or by means of a selected deposition of fibers with a higher areal density such as to provide a circumference of reduced stiffness compared to the other portions of the non-woven material. The flexibility of the band has to be adjusted such as to enable the thorax of a user to expand during a breathing cycle. Furthermore, another elastic band 310 made of deposited fibers or an additional material such as TPU may be provided, wherein this band 310 has a different elasticity than the surrounding non-woven material. The connection between the elastic band 310 and the surrounding non-woven material may be achieved with seams (not shown) glueing, or ultrasonic welding.

Figure 4 depicts a diagram illustrating the relationship between the modulus of elasticity of the non-woven fabric 100 and the deposited amount of fibers 510 in grams per square meter. This relationship may be applied in an embodiment of the present invention to create specific stiffer or more flexible zones, which provides an optimal level of breast bounce/movement reduction during medium and high impact exercise. The variation of the areal density may be achieved by varying an exposure time and / or a distance 520 of the three-dimensional substrate to a source of the fibers 530 as shown in Fig. 5.

Figure 5 schematically depicts an illustration of a fiber deposition process to manufacture an embodiment of the present invention. The process may contain a woman's torso 110 attached to a robotic arm 500, to adjust the areal density of the deposited fibers 510 by moving the substrate along a programmed path (not shown). Thus, by varying an exposure time and / or a distance 520 of the substrate to a source of fibers

530, different zones of areal densities 230 - 280 may be achieved. The hereby used three-dimensional substrate may be either provided by scanning of a plurality of women to allow for mass production, or by scanning an individual woman's body for producing a fully customized bra. The substrate may at least partly be produced by additive manufacturing (not shown). After the deposition process, the non-woven fabric 100 of an embodiment may be trimmed to a desired pattern with a predefined amount of stretch, using a laser beam or other cutting techniques (not shown). Additionally, perforations 210 and loops may be added, using a laser or ultrasonic welding respectively. Furthermore, some embodiments may contain different colors, wherein a feathered transition may be provided by the use of fibers with a different color (not shown).

CLAIMS

1. A bra (200), in particular a sports bra (200), comprising a fabric of a non-woven material (100), wherein the fabric (100) is obtained by depositing fibers (510) onto a
5 three-dimensional substrate having a contour similar to a portion of a body, so that a shape of the fabric of the bra (200) is at least partly determined by the deposition of the fibers (510).
2. Bra (200) according to claim 1, wherein the portion of the body is at least the front
10 part of a woman's torso (110).
3. Bra (200) according to claim 1 or 2, wherein the substrate is a complete woman's torso (110) and wherein the fibers (510) of the fabric (100) of the bra (200) have been deposited onto all sides of the torso (110).
15
4. Bra (200) according to any of the claims 1 – 3, wherein the shape of the bra (200) is exclusively determined by the deposition of the fibers (510) without any additional shaping step.
- 20 5. Bra (200) according to any of the claims 1 – 4, wherein the non-woven material comprises a first zone (230) of a first areal density of non-woven material and a second zone (240) of a second areal density of non-woven material.
6. Bra (200) according to claim 5, wherein the second zone (240) has a different, in particular higher, modulus of elasticity than the first zone (230).
25
7. Bra (200) according claim 5 or 6, comprising at least two second zones (240) adapted to be arranged below the breasts, when the bra (200) is worn.

8. Bra (200) according to any of the claims 5 – 7, comprising at least two first zones (230) adapted to be arranged above the breasts, when the bra (200) is worn.
- 5 9. Bra (200) according to any of the preceding claims 5 – 8, wherein the areal density of the first zone (230) is between 300 and 1000 grams per square meter (gsm) and / or wherein the density of the second zone (240) is between 600 and 2000 gsm.
- 10 10. Bra (200) according to any of the claims 5 – 9, further comprising a third zone (250) having a third areal density.
11. Bra (200) according to claim 10, wherein the third zone (250) has an areal density that is lower than the areal densities of the first (230) and the second zone (240).
- 15 12. Bra (200) according to claim 10 or 11, wherein the third zone (250) comprises perforations (210).
- 20 13. Bra (200) according to any of the claims 10 – 12, wherein the third zone (250) is adapted to be arranged between the breasts and / or on the back, when the bra (200) is worn.
14. Bra (200) according to any of the claims 1 – 13, wherein the fabric (100) does not comprise any seam in an area around the breast.
- 25 15. Bra (200) according to claim 14, wherein the bra (200) does not comprise any seam.
16. Bra (200) according to any of the claims 1 – 15, wherein the non-woven material consists of melt-blown fibers (510) of a single material class of thermoplastic materials, in particular a thermoplastic polyurethane, TPU.
- 30 17. Bra (200) according to claim 16, wherein the bra (200) comprises closure means (220) made from the single material class of thermoplastic materials, in particular TPU.

18. Bra (200) according to claim 16 or 17 consisting exclusively of the single material class, in particular TPU.

19. Method of manufacturing a bra (200), comprising the steps of:

- a. providing a three-dimensional substrate having the contour similar to a portion of a body;
- b. depositing fibers (510) onto the three-dimensional substrate to provide a fabric (100) of the bra (200) of non-woven material, wherein a shape of the fabric (100) is at least partly determined by the deposition.

20. Method according to claim 19, wherein the portion of a body is at least the front portion of a woman's torso (110).

21. Method according to claim 20, wherein the woman's torso (110) has a shape based on data obtained from three-dimensional scanning a plurality of women.

22. Method according to any of the claims 19 – 21, wherein an areal density of the deposited fibers (510) varies over the three-dimensional substrate.

23. Method according to claim 22, wherein the variation of the areal density is achieved by varying an exposure time and / or a distance (520) of the three-dimensional substrate to a source of the fibers (510) for a first and a second portion of the three-dimensional substrate.

24. Method according to claim 23, wherein the exposure time and / or the distance (520) is controlled by moving the three-dimensional substrate relative to the stream of melt blown fibers (510).

25. Method according to claim 22 or 23, wherein the three-dimensional substrate is attached to a robotic arm (500), which moves the three-dimensional substrate along a programmed path.

26. Method according to any of the claims 19 – 25, further comprising the step of providing an individual three-dimensional substrate based on scanning an individual body.

27. Method according to claim 26, wherein the individual substrate is provided using additive manufacturing.

28. Method according to any of the claims 19 – 27, further comprising the step of trimming the fabric of non-woven material to a desired pattern, in particular using a laser beam.
29. Method according to claim 28, wherein the pattern and / or the deposition process is defined to provide a predefined amount of stretch for the bra.
30. Method according to any of the claims 19 – 29, further comprising the step of forming a loop in the fabric of non-woven material, in particular via ultrasonic welding.
31. Method according to any of the claims 19 – 30, further comprising the step of providing a plurality of perforations (210) in the fabric (100) of non-woven material, in particular via laser cutting.
32. Method according to any of the claims 19 – 31, wherein step b comprises the deposition of fibers (510) having at least two different colors.
33. Method according to any of the claims 19 – 32, wherein the method is adapted to provide a bra (200) according to any of the claims 1 – 18.

Figures

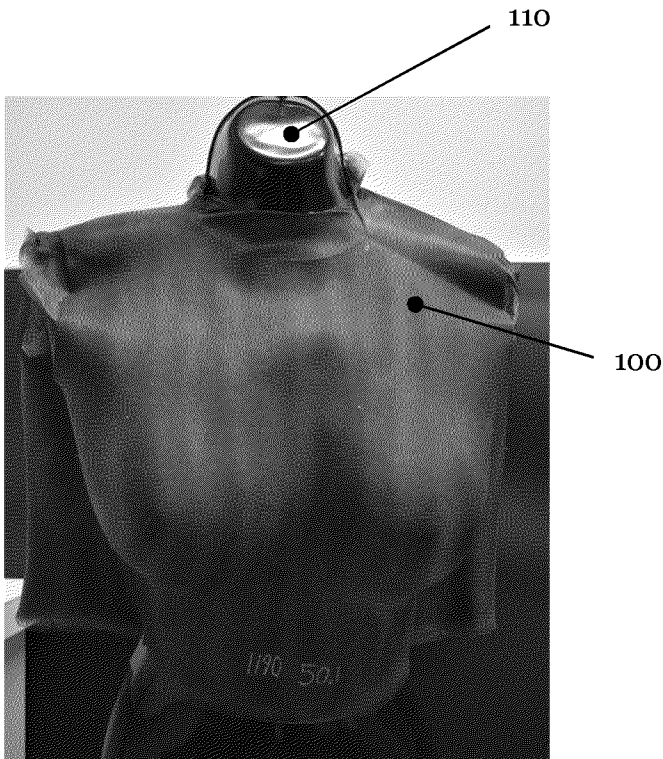


Fig. 1

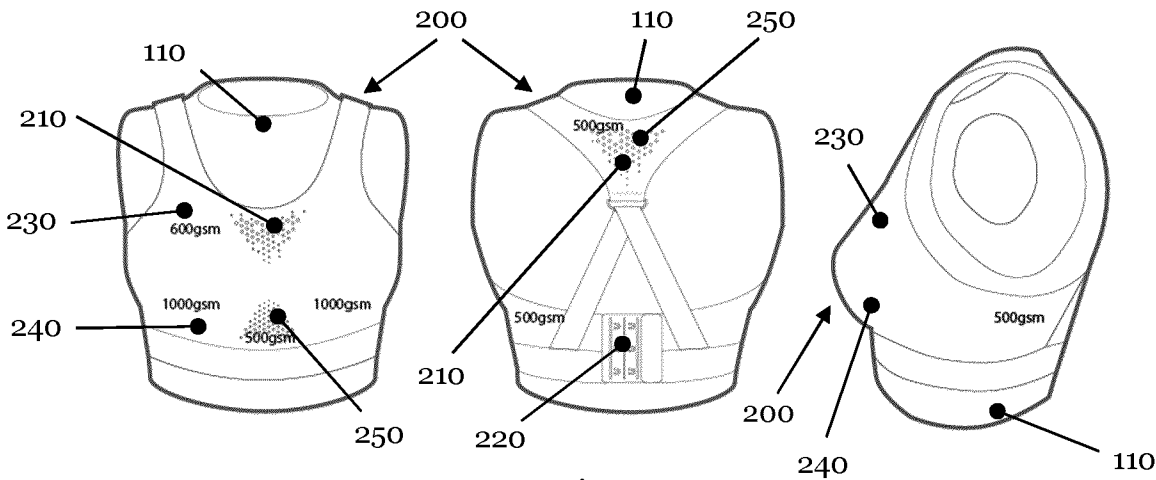


Fig.2a

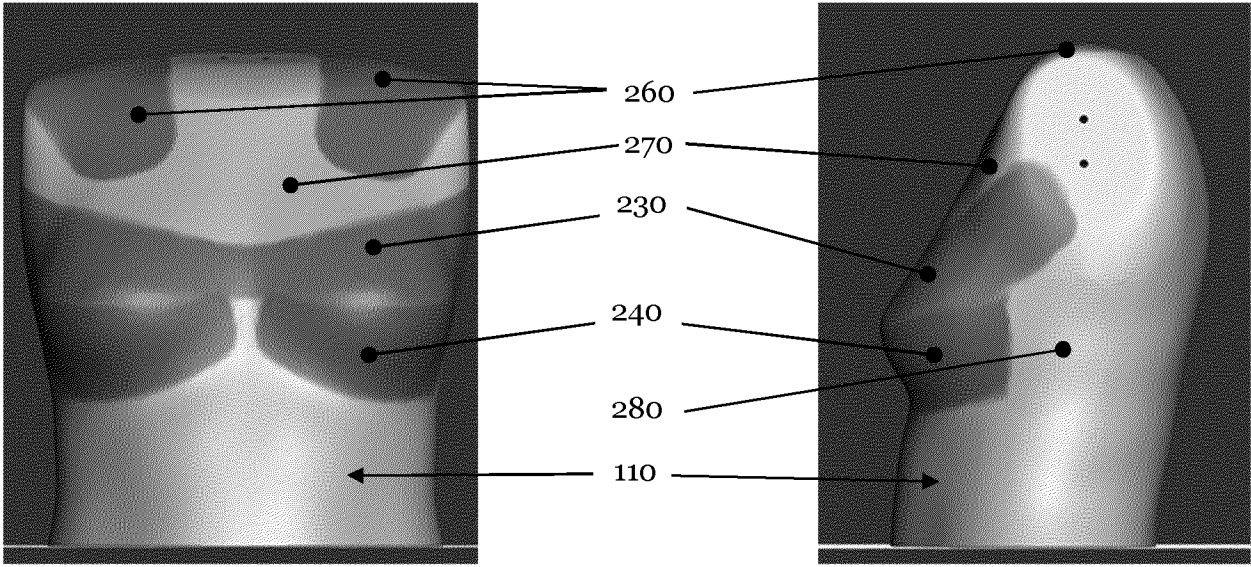


Fig. 2b

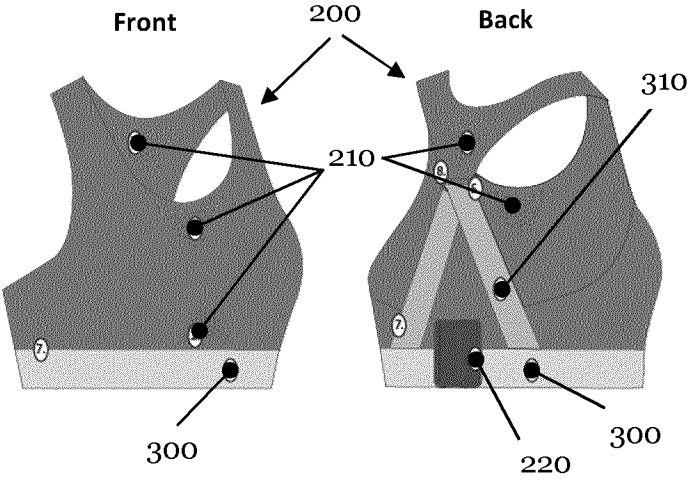


Fig. 3

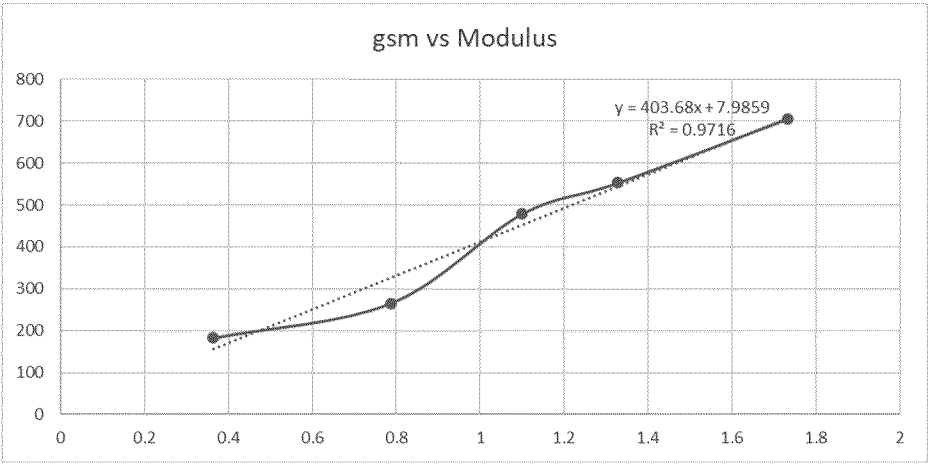


Fig. 4

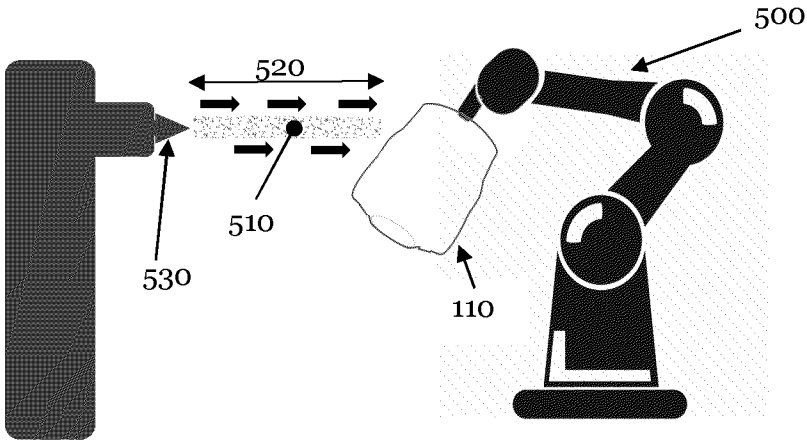


Fig. 5

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2020/053179

A. CLASSIFICATION OF SUBJECT MATTER
INV. A41C3/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A41C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2016/200875 A1 (NIKE INNOVATE CV [US]) 15 December 2016 (2016-12-15) figure 1	1-18
X	US 2013/316615 A1 (HURD REBECCA P [US]) 28 November 2013 (2013-11-28) figures 1, 4, 11	1-33



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

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Date of the actual completion of the international search

4 May 2020

Date of mailing of the international search report

14/05/2020

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2020/053179

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