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(54) Title: A BRA FOR MEASURING A PHYSIOLOGICAL SIGNAL

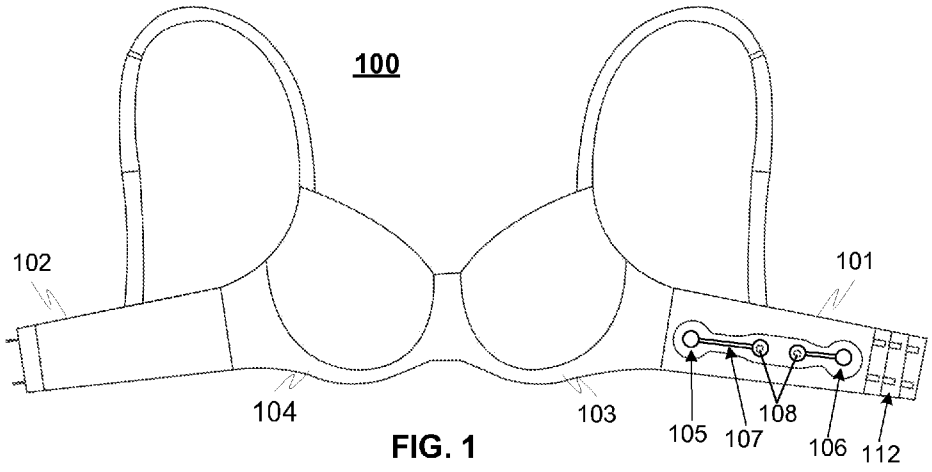

FIG. 1

(57) Abstract: A bra (100) for measuring a physiological signal from a body of a user wearing the bra comprises first (103) and second (104) front portions, or bra cups portions. The bra also comprises first (101) and second (102) side wings, wherein the first side wing (101) is coupled with the first front portion (103) and the second side wing (102) is coupled with the second front portion (104). In addition the bra comprises a measuring device and/or at least two electrodes (105, 106), where the measuring device or at least one electrode (105, 106) is arranged to a module, and the module forms at least a basis of the first (101) side wing of the bra or even the first (101) side wing of the bra as its entirety.

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A BRA FOR MEASURING A PHYSIOLOGICAL SIGNAL

TECHNICAL FIELD OF THE INVENTION

The invention relates to a bra for measuring a physiological signal, advantageously an electrical signal from a body of a user wearing the bra. In addition the invention relates to a method for manufacturing the bra.

BACKGROUND OF THE INVENTION

A measuring of physiological signals, such as ECG for heart rate detection, is commonly known by using e.g. dry (i.e. water moistened) electrodes integrated into sports bra. In the sports bra the mids of the electrodes are typically located about 10 cm from the body midline on the left and right side of the body just under the bra cups. In addition the physiological signals can also be measured using e.g. the dry electrodes integrated into women's daily worn bra.

There are however some disadvantages relating to the known prior art, such as that majority of the current daily worn bra or leisure bra models have little or no fabric under the cups that could incorporate the measurement electrodes to similar positions as in the sports bra. In the sports bra there is often an elastic underband which has space for sensors and measuring electronics. However, this approach cannot be used in the daily worn bra, because daily worn bra should typically be skin-tight and comfortable for worn whole day so in other words there is no space for additional sensor package or the like under the cups.

Furthermore additional disadvantages are also related to the known prior art, where the electric components are integrated into or onto the structure of the garment, such as the bra, at a manufacturing stage of the garment. Very often the garment manufacturer needs to manufacture and install one electric component to a certain location, another electric component to another location and provide suitable power and signal lines between the components. Thus the garment manufacturer needs to have also knowledge also about the field of electronics. Other possibility is that the manufacturer

sends a semi-finished garment, such as the bra, to an electronic component manufacturer, who manufactures the components and installs them into or onto the semi-finished garment and again sends the semi-finished garment with the installed electronic components to the garment manufacturer for the finishing stage.

In addition designing of the electronic components raises often numbers of special issues which are not always very clear for the manufacturers of the garments, such as the bra manufacturer. Furthermore there is a disadvantage relating to recycling of the garments after their lifetime, because they includes electronic components with materials, like metals and especially heavy metals used in electronic components and batteries, which should be recycled separately from the garment material, like textile or fabric. For example the components integrated into the structure of the bra might be very difficult to find and remove.

SUMMARY OF THE INVENTION

An object of the invention is to alleviate and eliminate the problems relating to the known prior art. Especially the object of the invention is to provide a bra for measuring a physiological signal from a body of a user wearing the bra so that electronics, especially electrodes and conductive leads as well as also connectors can be integrated to the bra structure easily and so that also the manufacturer without any knowledge about the measuring technology can manufacture the bra so that the measuring of the physiological signals is possible and in addition so that there is no need for example to send the semi-finished product to the expert of the measuring technology field.

The object of the invention can be achieved by the features of independent claims.

The invention relates to a bra for measuring a physiological signal from a body of a user wearing the bra according to claim 1. In addition the invention relates to a manufacturing method of the bra according to claim 12.

According to an embodiment of the invention a bra for measuring a physiological signal comprises first (left) and second (right) front portions, such as bra cups (or at least imaginary portions), and first (left) and second (right) side wings. The first end of the left side wing is advantageously coupled with the first front portion and the first end of the second side wing with the second front portion. The second ends of the side wings are extended so that they can be connected to each other in the back side of the used during the use.

According to an embodiment the bra additionally comprises a measuring device for measuring the physiological signal from a body of a user wearing the bra. The measuring device may comprise e.g. at least two electrodes, where at least one electrode is arranged to the first side wing of the bra. Advantageously also another electrode is arranged to the first side wing. The measuring device may also comprise an optical, temperature, or strain gauge integrated to the first side wing. The physiological signal to be measured is e.g. ECG signal for heart rate detection, but can also be bioimpedance, or EDA (electro dermal activity) (also known as GSR (Galvanic Skin Response)) signal, for example.

According to an embodiment, the measuring device or at least one electrode is arranged to a module, where the module forms at least a basis of the first side wing of the bra. The basis means according to an embodiment at least a major portion of the side wing structure, whereupon for example only a trim or stitching ribbon or other minor portion can still be added for example to support and fasten the module to the structure of the bra. Advantageously the major portion is at least 60%, more advantageously at least 70% and most advantageously more than 80% of the whole side wing structure. In particularly the module is configured to form at least a bearing structure or portion of the first side wing of the bra. According to another embodiment the module may form the first side wing of the bra as its entirety.

As an example the electrodes are as positive and negative electrodes, and they are advantageously suitable for measuring electric signal from the body of said used as the physiological signal. According to an embodiment the first electrode is a positive electrode and the second electrode is a negative electrode and they are arranged to the first side wing so that said first electrode is arranged between the second electrode and the first front

portion of the bra. In other words the positive electrode is arranged into the left side wing next and close fabric just left to the left side cup and negative electrode is integrated into the fabric that extends over the left side of the body towards the back.

The bra advantageously comprises also conductive lead material integrated to the first side wing material. The lead material may be e.g. conductive fabric, which is laminated to the first side wing. Advantageously the conductive lead fabric does not bind the bra fabric and thereby allows both materials to stretch and thus user comfort is retained. The bra advantageously comprises also connectors and leads, where the leads couple the electrodes and connectors electrically together. According to the invention the connectors and leads are both arranged to the first side wing. In addition the bra comprises also a data measuring and/or processing unit, transmitter and/or power source, which are also advantageously arranged to the first side wing.

It is to be noted that the connectors, leads, measuring, processing unit, transmitter and/or power source can be arranged to a module. Also at least one electrode can be arranged to the module. Advantageously the module is then integrated to the bra as the first side wing or as a portion of the first side wing. The module can be e.g. sewn or laminated to the first side wing, but also other fixing method can be applied.

The electrode used can naturally be any suitable electrode, but according to an advantageous embodiment the electrode used is a dry electrode. The using of the dry electrode offers advantages namely there is no need to use any conductive gel or even moisturising the sensor area for enabling good electrical contact between the skin and the electrode. Furthermore the dry electrode garment can be washed. In addition it is to be noted that the invention is very suitable also for a daily worn bra, where there is very limited space for measuring devices and electrodes under the cups area that could incorporate the measurement electrodes to similar positions as in the sports bra.

The present invention offers advantages over the known prior art, such as allowing elastic and comfort measuring platform also for daily worn bra models, which typically have little or no fabric under the cups that could incorporate the measurement electrodes to similar positions as in the sports

bra. In addition the manufacturing is easy and fast and reliable process even if the garment manufacturer have no or minimal knowledge about the field of electronics. Neither there is need for sending a half-finished garment, such as the bra, to an electronic component manufacturer for installing the electronic components and sending the half-finished garment with the installed electronic components back to the garment manufacturer for the finishing stage. Moreover the recycling of the garments after their lifetime is very easy, thanks for the current invention, namely the electronics is very easy and fast to remove e.g. just cutting the left side wing away, and in particularly in the embodiment where the garment or bar does have the electronic components in the module. In addition the manufacturing of the seams is very easy, because all the measuring techniques and the electronics can be built in a one textile module or piece.

The exemplary embodiments presented in this text are not to be interpreted to pose limitations to the applicability of the appended claims. The verb "to comprise" is used in this text as an open limitation that does not exclude the existence of also unrecited features. The features recited in depending claims are mutually freely combinable unless otherwise explicitly stated.

The novel features which are considered as characteristic of the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific example embodiments when read in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Next the invention will be described in greater detail with reference to exemplary embodiments in accordance with the accompanying drawings, in which:

Figure 1 illustrates a principle of an exemplary bra for measuring a physiological signal according to an advantageous embodiment of the invention,

Figure 2 illustrates an exemplary bra for measuring a physiological signal with a module wing structure according to an advantageous embodiment of the invention,

Figure 3 illustrates an exemplary module wing structure for a bra for measuring a physiological signal according to an advantageous embodiment of the invention, and

Figure 4 illustrates another example of the bra for measuring a physiological signal with a module wing structure according to an advantageous embodiment of the invention.

DETAILED DESCRIPTION

Figures 1 and 2 and 4 illustrate a principle of an exemplary bra 100 for measuring a physiological signal according to an advantageous embodiment of the invention, where the bra 100 comprises first (left) 103 and second (right) 104 front portions, where the bra cups locate. In addition the bra comprises also first (left) 101 and second (right) 102 side wings. As can be seen in the Figures the first end of the left side wing 101 is coupled with the first front portion 103 and the first end of the second side wing 102 with the second front portion 104. The second ends of the side wings 101, 102 are extended so that they can be connected to each other in the back side of the used during the use.

The measuring device and/or the electrodes 105, 106 is/are arranged to the first 101 side wing of the bra. The electrodes 105, 106 can be located such that a positive electrode 105 is integrated into the fabric just left to the left side cup 103. The negative electrode 106 is integrated into the fabric that extends over the left side of the body towards the back. The electrode location is next to the bra back hook-loop mechanism 112. This electrode setup measures nearly the same amplitude ECG as from the usual front electrode positions, and can be used to detect heart rate reliably. In order for the daily worn bra to be comfortable, the side fabrics joining the cups and encircling the body need to allow equal stretch. The conductive lead fabric can be attached to the fabric using non-continuous heat bonding membranes, which can be for example perforated material or having through holes or punctures through the material and/or attached only via

spot-like locations (i.e. not attached uniformly and continuously in every points).

The bra comprises also conductive lead material 107 integrated to the first side wing 101 material. The bra comprises also connectors 108 and leads 107 for electrically coupling the electrodes 105, 106 and connectors 108. The connectors and leads are both arranged to the first side wing 101, as can be seen in Figures 1, 2 and 3. In addition the bra may also comprise a data measuring or processing unit 109, transmitter 109 and/or power source 110, which are also advantageously arranged to the first side wing 101.

Figure 2 and 3 illustrate an exemplary module wing structure 111 for a bra 100 for measuring a physiological signal according to an advantageous embodiment of the invention, where it can be seen that the measuring devices or electrodes 105, 106, connectors 108, leads 107 as well as measuring and processing unit 109, transmitter 109 and/or power source 110 can be arranged to the module 111. The module 111 can form said first side wing 101 as such or a portion of the first side wing 101, which can then be integrated to the bra 100 as the first side wing 101 as such or as a portion of the first side wing 101. The module 111 can be integrated e.g. by sewing or laminating, and it can comprise a suitable area, such as peripheral band or strip for integration process.

Figure 4 illustrates very similar bra construction for measuring a physiological signal with a module wing structure according to an advantageous embodiment of the invention as is depicted in Figure 2. In Figure 4 it is still emphasized that the module forms the bearing structure or major portion of the first side wing of the bra, but still there might be a trim or stitching ribbon 113 or other minor portion added for example to support and fasten the module to the other structure of the bra.

The invention has been explained above with reference to the aforementioned embodiments, and several advantages of the invention have been demonstrated. It is clear that the invention is not only restricted to these embodiments, but comprises all possible embodiments within the spirit and scope of the inventive thought and the following patent claims.

The features recited in dependent claims are mutually freely combinable unless otherwise explicitly stated. Especially it should be noted that the

measuring device located in the left side wing may comprise electrodes and suitable leads and connectors, as well as other measuring components.

Claims

1. A bra (100) for measuring a physiological signal from a body of a user wearing said bra, said bra comprising first (103) and second (104) front portions and first (101) and second (102) side wings, wherein the first side wing (101) is coupled with the first front portion (103) and the second side wing (102) is coupled with the second front portion (104),
characterized in that the bra comprises a measuring device and/or at least two electrodes (105, 106), where said measuring device or at least one electrode (105, 106) is arranged to a module, and wherein the module forms at least a basis of the first (101) side wing of the bra.

2. The bra of claim 1, wherein the bra comprises first and second electrodes (105, 106), where said both electrodes are arranged to the first side wing (101).

3. The bra of any previous claims, wherein the bra comprises also connectors (108) and leads (107), said lead (107) being arranged to couple said electrodes (105, 106) and connectors (108) electrically to each other, and wherein said connectors and leads are arranged into said first side wing (101).

4. The bra of any previous claims, wherein the bra comprises also a data measuring and/or processing unit (109), transmitter (109) and/or power source (110) arranged into said first side wing (101).

5. The bra of claim 3 or 4, wherein said connectors and leads of claim 3 or measuring and/or processing unit (109), transmitter (109) and/or power source (110) of claim 4 is/are arranged to the module (111), where said module (111) is integrated, such as sewn or laminated, to said bra as said first side wing (101).

6. The bra of any previous claims, wherein said at least one electrode (105,106) is arranged to the module (111), where said module is integrated, such as sewn or laminated, to said bra as said first side wing (101).

7. The bra of any previous claims, wherein said at least one electrode (105, 106) is a dry or wet moistened electrode (105, 106).

8. The bra of any previous claims, wherein said bra is a daily worn bra (100) or leisure bra (100).

9. The bra of any previous claims, wherein said bra is for measuring electric signal from a body of a user wearing said bra, and especially ECG signal for heart rate detection, bioimpedance, or EDA (electro dermal activity) signal.

10. The bra of any previous claims, wherein said measuring device comprises optical, temperature, or strain gauge integrated to the first side wing (101).

11. The bra of any previous claims, wherein said module forms major portion of the first (101) side wing of the bra, or wherein said module forms the first (101) side wing of the bra as its entirety.

12. A method for manufacturing a bra (100) of any previous claims, wherein said bra is configured for measuring a physiological signal from a body of a user wearing said bra, wherein the method comprises steps of

- providing first (103) and second (104) front portions and a first (101) and second (102) side wings, and coupling the first side wing (101) with the first front portion (103) and the second side wing (102) with the second front portion (104),
- providing a measuring device or at least two electrodes (105, 106) for measuring said physiological signal, and
- providing said measuring device or at least one electrode (105, 106) to a module, wherein the module forms at least a basis of the first side wing (101) of the bra.

13. The method of claim 12, wherein the method comprises a step of providing positive and negative electrodes (105, 106) to the first side wing (101) so that providing said positive electrode (105) between the negative electrode (106) and the first front portion (103) of the bra.

14. The method of any claims 12-13, wherein the method comprises a step of providing connectors (108) and leads (107), and coupling said electrodes (105, 106) and connectors (108) electrically by said leads (107) so that said connectors and leads are arranged into said module, said module forming said first side wing (101).

15. The method of any claims 12-14, wherein the method comprises a step of providing a data measuring and/or processing unit (109), transmitter (109) and/or power source (110) into said module, said module forming said first side wing (101).

16. The method of any claims 14 or 15, wherein the method comprises a step of providing said connectors (108) and leads (107) of claim 14 or measuring and/or processing unit (109), transmitter (109) and/or power source (110) of claim 15 to said module (111), and integrating, such as sewing or laminating, said module (111) to said bra as said first side wing (101).

17. The method of any claims 12-16, wherein the method comprises a step of providing at least one electrode (105, 106) to said module (111), and integrating, such as sewing or laminating, said module (111) to said bra as said first side wing (101).

18. The method of any claims 12-16, wherein said module forms major portion of the first (101) side wing of the bra, or wherein said module forms the first (101) side wing of the bra as its entirety.

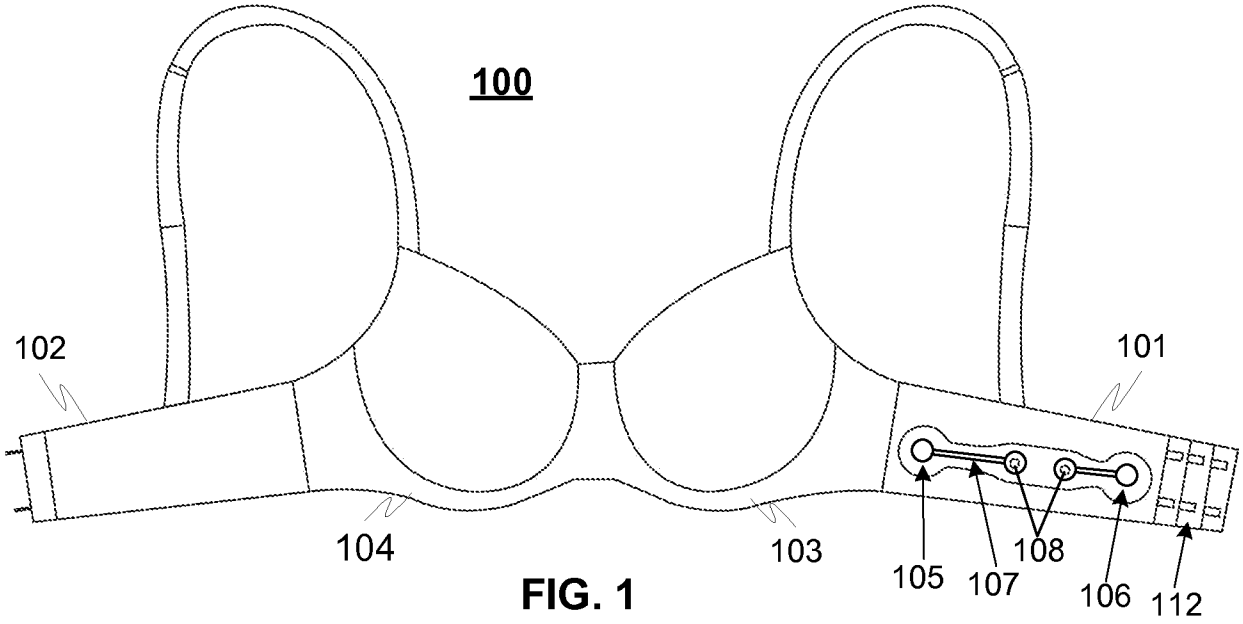
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FIG. 1

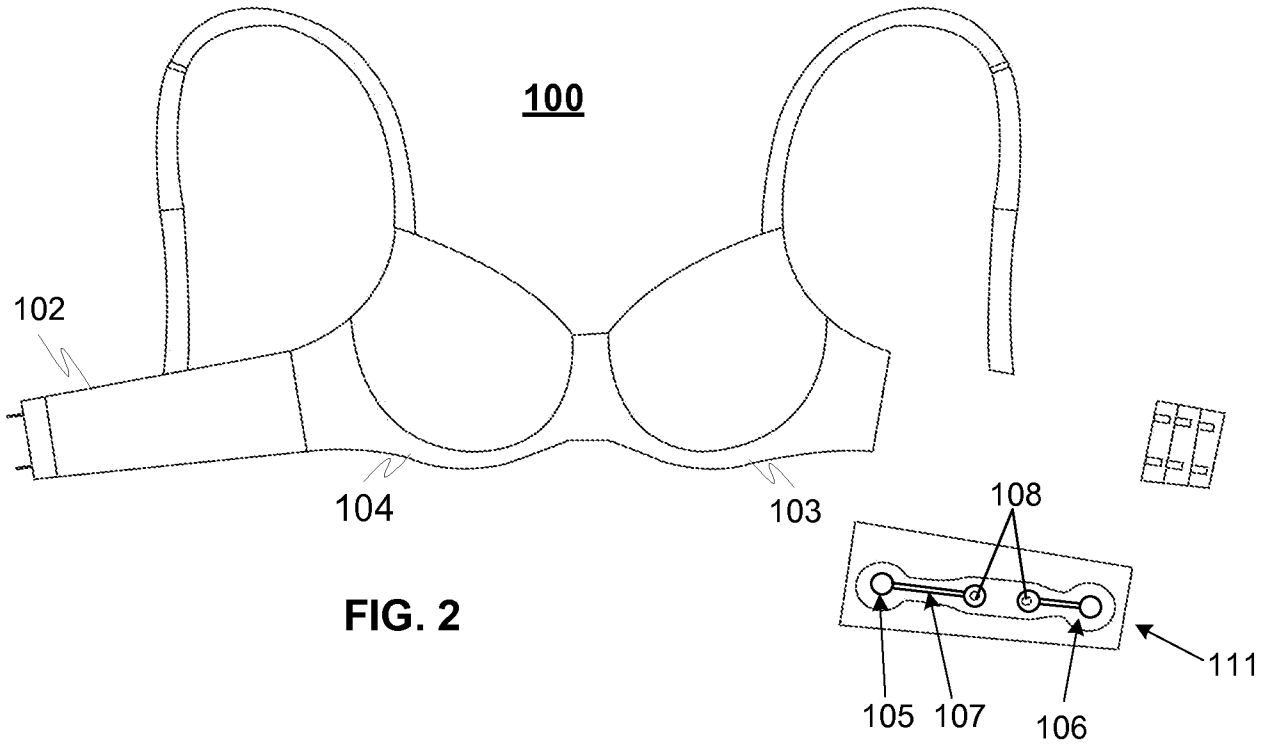
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FIG. 2

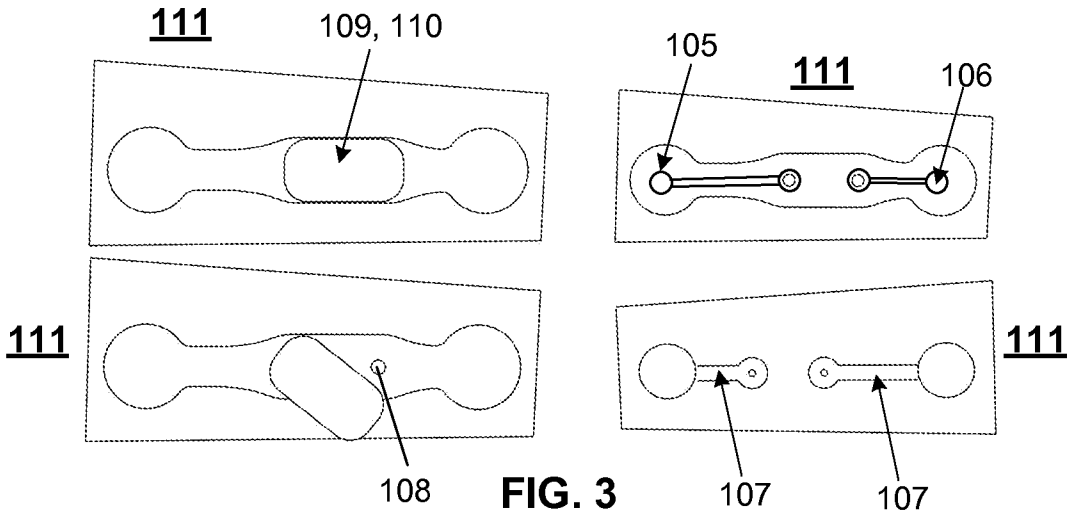
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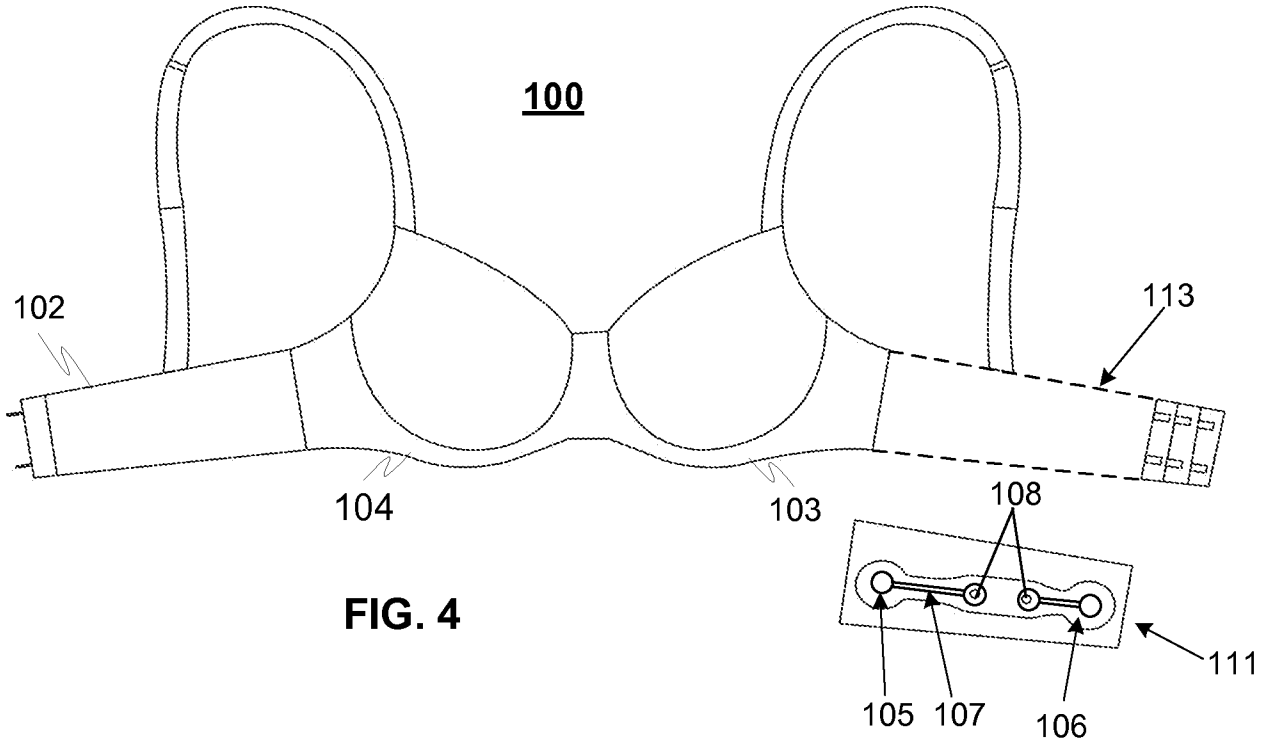
FIG. 3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106

FIG. 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI2018/050353

A. **CLASSIFICATION OF SUBJECT MATTER**

A41C 3/00 (2006.01) and A61B 5/024 (2006.01)

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)

IPC: A41C, A61B

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

FI, SE, NO, DK

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

EPODOC, WPIAP, EPO-Internal full-text databases, NPL, COMPDX, INSPEC, XPESP, XPIEE and XPI3E

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	ES 2238193 A1 (VIVES VIDAL VIVESA SA [ES]) 16 August 2005 (16.08.2005)	1, 7–9, 11, 12, 18
Y	abstracts (EPO & WPI); translation of description in English by TXPMTEA / EPO; figure 2	2, 4–10, 13, 15–17
Y	CN 205459740 U (DING LI) 17 August 2016 (17.08.2016) abstracts (EPO & WPI); translation of description in English by TXPCNEU / EPO; figure 1	2, 4–9, 13, 15–17
Y	WO 2016/063082 A1 (CAMBRIDGE TEMPERATURE CONCEPTS LTD [GB]) 28 April 2016 (28.04.2016)	2, 4, 5, 7–10, 13, 15, 16
A	page 1 lines 5–9 and page 10 lines 21–30; figure 5b	11
X	CN 106343623 A (HONGDOU GROUP WUXI YUANDONG CLOTHING CO LTD) 25 January 2017 (25.01.2017)	1, 4, 5, 7–9, 11, 12, 15, 16, 18
A	abstracts (EPO & WPI); translation of description in English by TXPCNEU / EPO; figure 1	3, 14

☒ 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
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"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)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
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INTERNATIONAL SEARCH REPORT

International application No.
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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2008/0287769 A1 (KURZWEIL RAYMOND C [US] et al.) 20 November 2008 (20.11.2008) paragraphs [0030]–[0044]; figures 3 and 4	1, 7, 8, 9, 10, 12

INTERNATIONAL SEARCH REPORT
Information on Patent Family Members

International application No.
PCT/FI2018/050353

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